Revised New Edition

Handbook for Veterinary Clinicians








Veterinarian's Oath

Being admitted to the profession of
Veterinary medicine, I solemnly
swear to use my scientific knowledge
and skill for the benefit of society
through the protection of animal
health, the relief of animal suffering,
the conservation of livestock resources,
the promotion of public health, and
the advancement of medical knowledge.

I will practise my profession
conscientiously, with dignity, and in
keeping with the principles of
Veterinary medical ethics.

I accept as lifelong obligation the
continual improvement of my
professional knowledge and competence.

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CHAPTER - 1 : BONES AND JOINTS

Osteology is the branch of science which deals with the study of bones.

Bones are the living tissues because -

1) They have blood vessels, lymphatic vessels and nerves.
2) They can grow.
3) They can repair themselves, if damaged.

STRUCTURE OF BONES :

A long bone consists of following parts :

1) ***Compact bone :*** It is hard layer of bone that covers spongy substance.
2) ***Spongy bone :*** It is composed of small bony plates arranged to form a porous or spongy structure.
3) ***Epiphysis :*** It means either extremity of long bone.
4) ***Diphysis :*** It is the cylindrical shaft of long bone.
5) ***Metaphysis :*** It is situated between epiphysis and diphysis.
6) ***Periosteum :*** It is a fibrous membrane that covers the surface of bone except at the articular surface.
7) ***Endosteum :*** It is a membrane that lines the medullary cavity and various marrow spaces
8) ***Articular Cartilage :*** It is a thin layer of cartilage which covers the articular surface of bone.
9) ***Medullary or Marrow Cavity :*** It is hollow space in the middle of the long bone fiiied with either red or yellow marrow.
10) ***Bone marrow :*** It is soft and pulpy tissue which fills marrow cavity of long bones and marrow spaces of all the bones.

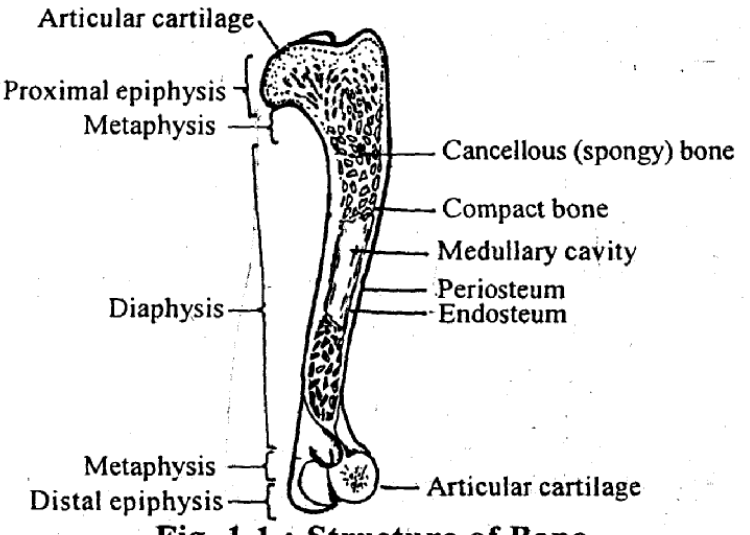


Fig. 1.1 : Structure of Bone

COMPOSITION OF BONES :

Fresh or wet bone is composed of water (25%), ash or mineral matter (45%) and organic matter (30%).

Dried bone consists of organic and inorganic matter in the ratio of 1: 2.

The ***organic matter*** mainly consists of collagen (major), mucopolysacharides, fatty acids, glyco-proteins, phospholipids (minor). The organic matter gives toughness and elasticity to bone.

The ***inorganic or mineral*** matter includes calcium, phosphorus, carbonates, citrates, sodium, potassium, magnesium, chlorides etc. The mineral matter gives hardness and rigidity to the bones.

The chemical composition of bone in ox is as follows :

Gelatin/Organic matter	: 33.30 %
Calcium phosphate	: 57.35 %
Calcium carbonate	: 3.85 %
Magnesium phosphate	: 2.05 %
Sodium chloride & carbonates	: 3.45 %

FUNCTIONS OF BONES :

1. They give definite shape to the body.
2. They offer support to the body.
3. They help in locomotion, defence and offence.
4. They protect the vital organs such as brain, lungs and heart.
5. They provide minerals like calcium and phosphorus to the body.
6. The bone marrow produces blood cells.

CLASSIFICATION OF BONES :

According to the gross appearance, the bones have been classified into six groups as long, short, flat, irregular, sesamoid and pneumatic.

1) Long bones :

1. These are greater in length than any other dimension.
2. They contain marrow/medullary cavity.
3. They are located mostly in the region of the limbs.
4. ***Functions :*** They aid in support, locomotion and prehension.
5. Examples are Humerus, Radius-ulna, Metacarpal, Femur, Tibia-fibula, Metatarsal, & Phalanges. *Femur is the largest long bone.*

Elongated bones - These are the diminutive forms of long bones. These are slender and long, but are devoid of medullary cavity. e.g. Ribs.

2) Short bones :

1. These are small bones of uniform dimensions.
2. There is no marrow cavity.
3. They are mainly found in joints between two large bones.
4. ***Function :*** They increase the mobility of the joints and distribute pressure.
5. Examples are Carpal and Tarsal bones.

3) Flat bones :

1. They are relatively thin and expanded in two dimensions.
2. ***Functions :*** They protect the vital organs and provide large area for muscle attachment.
3. Examples are Scapula and Pelvic bones.

4) Irregular bones :

1. These are irregular in shape.
2. They are generally unpaired and located on the median plane.
3. ***Functions :*** They serve for protection, support and muscle attachment.
4. Examples are Vertebrae.

5) Pneumatic bones :

1. They contain air spaces or sinuses which communicate with the exterior.
2. The bones of bird are light in weight due to presence of air sacs.
3. Examples are long bones of birds

6) Sesamoid bones :

1. These are small, sesame seed like short bones.
2. These are placed between the bones and tendons.
3. ***Function :*** They work as pully to avoid friction.
4. Example is Patella, a *largest sesamoid bone* in the animal body.

SKELETON

Skeleton : It can be defined as a hard framework of the body which supports soft structures. The skeleton (Fig. 1.2) is divided into three parts as

a) Axial Skeleton : It is made up of bones of skull , vertebral column, ribs and sternum.

b) Appendicular Skeleton : It is made up of bones of the forelimb and hind limbs.

c) Visceral Skeleton : It consist of bones developed in the substance of visceral or soft organs. e.g., Os cordis of Ox.

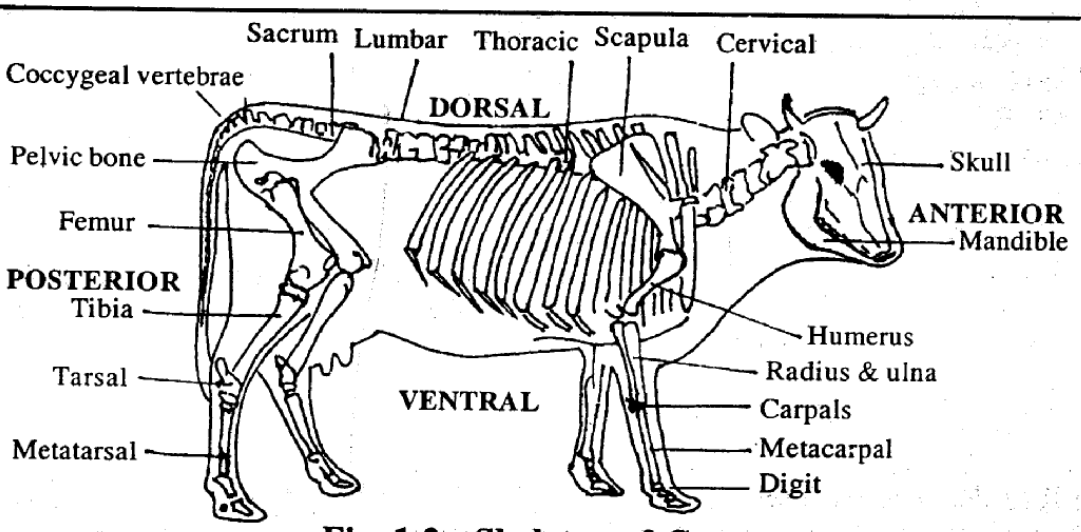


Fig. 1.2 : Skeleton of Cow

Table 1.1 Bones - their location and classification.

Bone	Location	Classification	No. in body
Appendicular Skeleton :			
A) Forelimb/Pectoral limb			
1) Scapula	Shoulder	Flat	2
2) Humerus	Arm	Long	2
3) Radius	Forearm	Long	2
4) Ulna		Long	2
5) Carpus	Knee	Short	12
6) Metacarpus		Long	4
7) Phalanges		Long	12
8) Proximal sesamoides	Manus	Sesamoid	8
9) Distal Sesamoides		Sesamoid	4
			48
B) Hind limb/Pelvic limb :			
1) Pelvic bones			
a) Ilium	Rump/Hip	Flat	2
b) Ischium			
c) Pubis			
2) Femur	Thigh	Long	2
3) Patella	Stifle	Sesamoid	2
4) Tibia - Fibula	Leg	Long	4
5) Tarsus	Hock	Short	10
6) Metatarsus		Long	4
7) Phalanges		Long	12
8) Proximal Sesamoides	Pes	Sesamoid	8
9) Distal Sesamoides		Sesamoid	4
			48
Axial Skeleton :			
1) Skull	Head	Flat	34
2) Vertebrae			
a) Cervical	Neck	Irregular	7
b) Thoracic	Chest	Irregular	13
c) Lumbar	Loin	Irregular	6
d) Sacral	Croup	Irregular	5
e) Coccygeal	Tail	Irregular	20
3) Ribs	Chest wall	Elongated	13 pairs
4) Sternum	Floor of Chest	- - - -	1
			112
Visceral Skeleton			
Os cordis	Heart	Visceral bone	2
Total Number of bones in ox			**210**

OSTEOLOGICAL TERMS :

Articular Projections :

Head	: A spherical articular projection.
Condyle	: A more or less cylindrical articular projection.
Trochlea	: A pully like articular structure.
Facet	: A flat articular surface.

Non-articular Projections :

Process	: Any prominence or projection on bone.
Tuberosity	: A large, rounded non-articular projection.
Tubercle	: A small rounded projection
Spine	: A pointed projection
Crest	: A sharp ridge
Neck	: A cylindrical part of bone to which head is attached.

Articular depressions :

Glenoid cavity	: A shallow articular concavity.
Cotyloid cavity	: A deep articular concavity.
Notch	: An articular indentation.

Non-articular depressions :

Fossa	: A large, non-articular depression.
Fovea	: A small, non-articular depression.
Foramen	: A circumscribed hole in a bone.

(A) AXIAL SKELETON

It consists of bones of skull, vertebral column, ribs, and sternum.

1) SKULL :

It includes all the bones of the head and is described into facial and cranial bones.

The ***facial bones*** form the oral and nasal cavities and gives shape to the face. The bones of face are -

1) Maxilla 2) Premaxilla
3) Palatine 4) Pterygoid
5) Nasal 6)Ventral Turbinates
7)Malar 8)Dorsal- Turbinates
9) Lacrimal 10)Vomar
11) Hyoid 12) Mandible. Out of these, last three are single while others are paired bones.

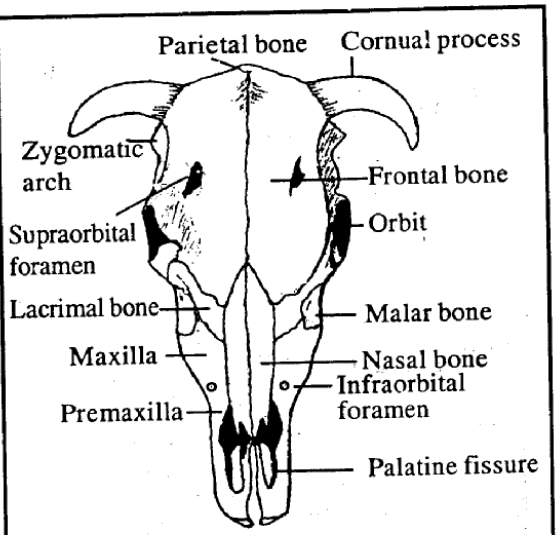


Fig. 1.3 : Skull of Ox

The ***cranial bones*** form cranium which lodges brain. Bones of cranium includes - 1) Occipital 2) Sphenoid 3) Ethmoid 4) Interparietal 5) Parietal 6) Frontal 7) Temporal bones. Out of these, first three are unpaired or single while others are paired bones.

2) VERTEBRAL COLUMN :

A series of vertebrae articulate together to form a long column of axial skeleton in the body is called as ***vertebral column.***

Vertebral column consists of five types of vertebrae -

1. Cervical vertebrae : Neck
2. Thoracic vertebrae : Withers and back
3. Lumbar vertebrae : Loin
4. Sacral vertebrae : Croup
5. Coccygeal vertebrae : Tail

The vertebral formula for ox is as - C_7 T_{13} L_6 S_5 $C_{y\ 15-25}$

Typical Vertebra :

A typical vertebra consists of a body, an arch and process.

Body : It is solid cylindrical mass which supports other structures of the bone. The anterior end is convex while posterior end is concave.

Arch : It is a bony ring situated on dorsal aspect of the body.

Processes : These are of 3 types i.e. articular, spinous and transverse. ***Articular*** processes are two on each cranial and caudal aspects. The ***spinous*** process is single and is dorsal to arch. The ***transverse*** processes are two in number and project outward from sides of the body.

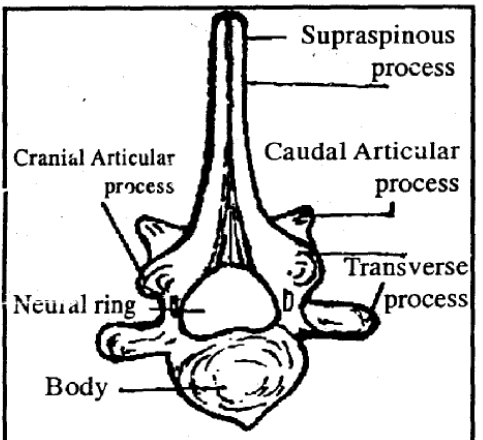


Fig. 1.4 : Typical Vertebra

1) Cervical Vertebrae :

They are seven in number as discussed below :

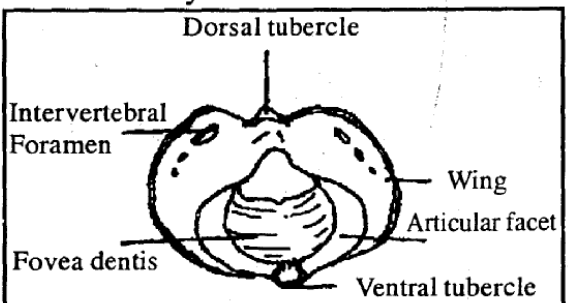


Fig. 1.5 : Atlas of Ox

i) Atlas : It is first cervical vertebra. It comprises of a larger neural ring and two wings. Cranial aspect of the body is highly concave to accomodate the occipital condyles of skull. The caudal part bears saddle shaped articular facet for axis.

ii) Axis : It is the second cervical vertebra. It is characterised by presence of odontoid process, two posterior articular processes and broad, thick spinous processes.

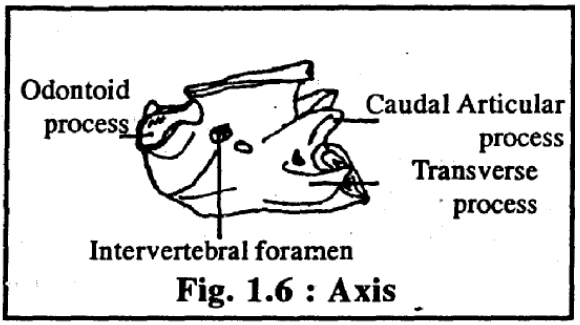


Fig. 1.6 : Axis

iii) Third, Fourth and Fifth Cervical Vertebrae : The typical cervical vertebrae i.e. iii, iv, & v have long body, well developed articular processes, short, tuberous spinous processes and a transverse process which is divided into upper and lower portions.

iv) Sixth Cervical Vertebra : In this, articular and the spinous processes are well developed.

v) Seventh Cervical Vertebra : The body bears two facets at caudal end for articulation with the heads of first pair of ribs. The spinous process is flat and well developed.

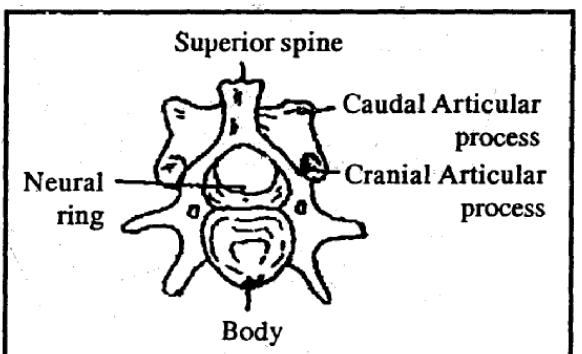


Fig. 1.7 : Typical cervical vertebra

2) Thoracic Vertebrae :

They are 13 in number. The typical thoracic vertebra has long spinous process, facet like articular process and short, thick but undivided transverse process.

3) Lumbar Vertebrae :

They are 6 in number. They are characterisied by the presence of long, transverse processes, well developed articular processes and plate like spinous processes.

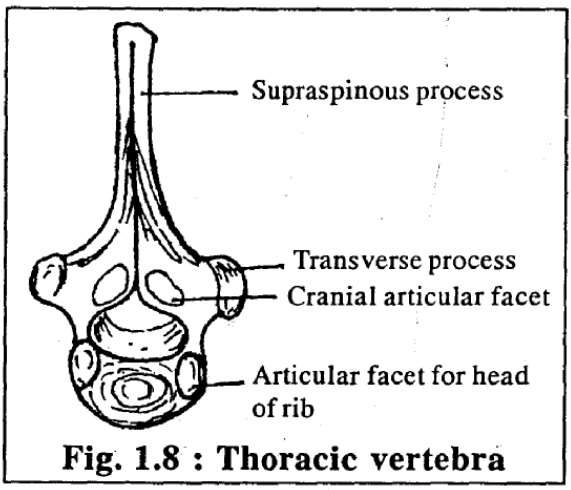


Fig. 1.8 : Thoracic vertebra

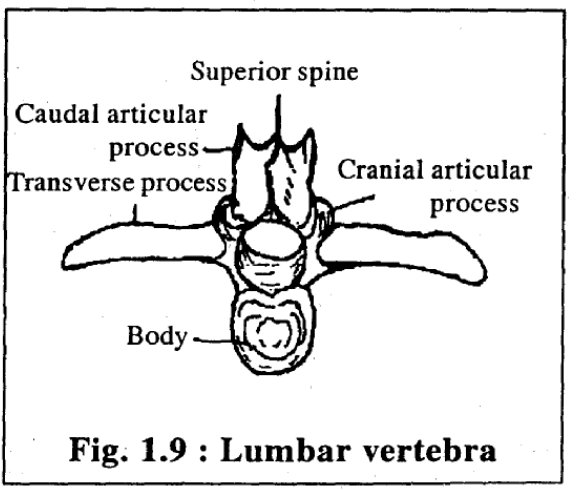


Fig. 1.9 : Lumbar vertebra

4) Sacrum :

It is formed by the fusion of five sacral vertebrae in ox. It is roughly triangular in outline and forms the roof of the pelvic cavity. The dorsal surface presents median sacral crest formed by the fusion of spinous processes. The ventral surface is concave.

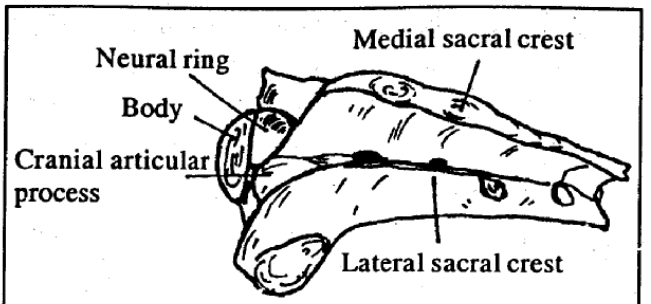


Fig. 1.10 : Sacrum of Ox

5) Coccygeal Vertebrae :

There are 15 - 25 coccygeal vertebrae in ox. First five vertebrae have neural rings, body and processes. They gradually reduce in size and last few vertebrae possess only rod shaped bodies with convex ends.

3) STERNUM :

It is centrally placed, segmented, osteo-cartilagenous structure forming the floor of the thoracic cavity. It consists of seven sternal segments called ***sternebrae.***

It is divided into 3 parts viz.

a) Presternum comprising of first sternal segment.

b) Mesosternum (body of sternum) comprising of five middle segments.

c) Xiphisternum comprising of last segment with xiphoid cartilage.

The dorsal surface of sternum is concave while the ventral surface is convex. The lateral border possess 7 pairs of facets for attachment of costal cartilage.

4) RIBS :

These are elongated bones. They form the wall of the thoracic cavity. There are 13 pairs of ribs in cattle. The first 8 pairs of ribs are sternal and rest 5 pairs are asternal. The shaft is curved and presents two surfaces and two borders. The lateral surface is convex, while medial surface is concave. The proximal extremity consists of a head, neck and tubercle. The distal extremity is either articular or is prolonged by the costal cartilage.

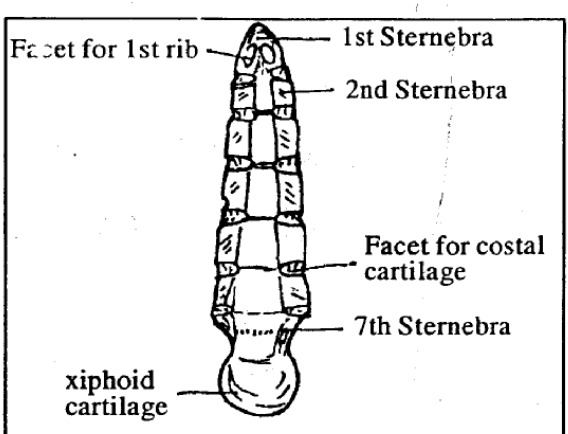


Fig. 1.11 : Sternum of Ox

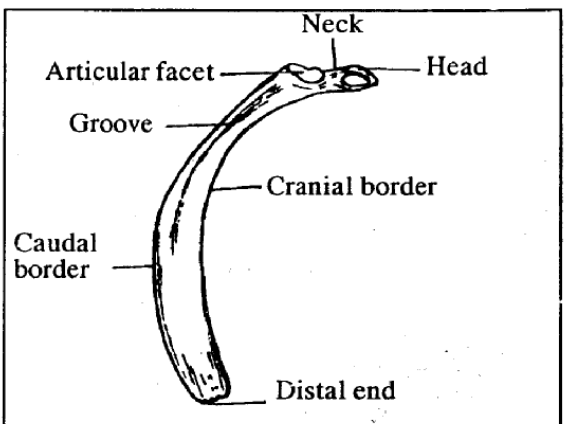


Fig. 1.12 : Rib of Ox

[B] APPENDICULAR SKELETON

It consist of the bones of forelimbs and hindlimbs.

A) BONES OF FORELIMB :

1) Scapula :

It is a flat triangular bone situated at the lateral aspect of the thorax or chest. It has two surfaces, three angles and three borders. The lateral surface is divided into two unequal halves by a ***spine.*** The anterior one is smaller and termed as ***supraspinous fossa.*** The posterior one is bigger and is called as ***infraspinous fossa.*** The spine becomes more prominent below and is prolonged by a pointed projection known as ***acromion process.*** The medial surface has a shallow depression at the middle, known as ***subscapular fossa.*** The borders are anterior, posterior and ventral. The ***glenoid cavity*** is a shallow, circular depression for the articulation with the head of humerus.

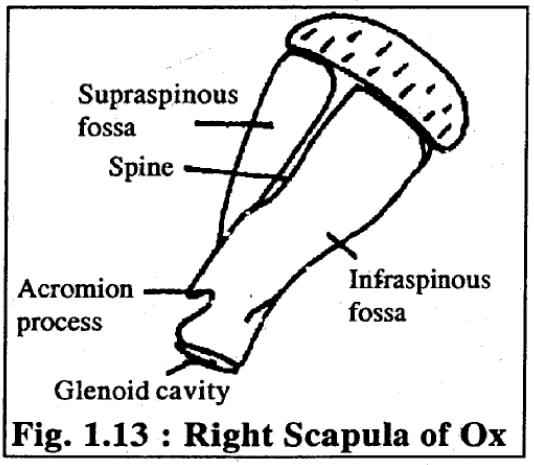


Fig. 1.13 : Right Scapula of Ox

2) Humerus :

It is long bone. It has a shaft and two extremities. The proximal extremity consists of ***head, neck*** & two ***tuberosities.*** The distal extremity consists of ***condyles, coronoid fossa*** anteriorly and an ***olecranon fossa*** posteriorly. The shaft is twisted, cylindrical and presents four surfaces viz anterior, posterior, lateral and medial. The ***deltoid tuberosity*** is a prominence present on the anterio-lateral aspect.

3) Radius :

It is a long bone. On its posterior surface, it is fused with ulna. It is shorter than ulna. It has a shaft and two extremities. The proximal extremity possess two articular surfaces separated by a ***groove***. The distal extremity articulates with the proximal row of carpal bones and presents three articular surfaces.

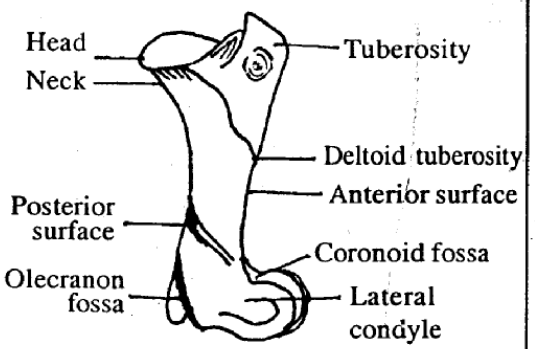


Fig. 1.14 : Right Humerus

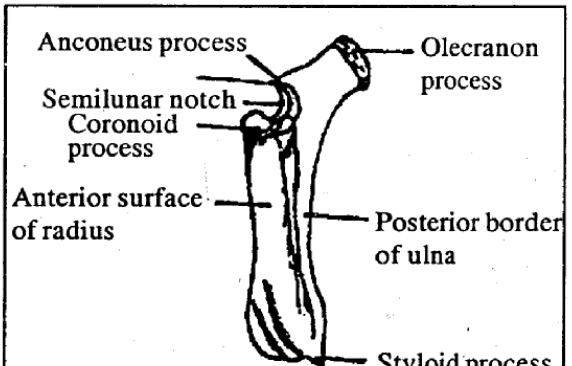


Fig. 1.15 : Right Radius & Ulna

4) Ulna :

It is a long bone fused with posterio-lateral aspect of the radius. The shaft is roughly prismatic. The proximal extremity consists of ***olecranon process*** and a semilunar notch. The distal extremity projects below the level of radius and is called ***styloid process***

5) Carpals :

These are 6 short bones arranged in two rows one above the other. The proximal row comprises of ***radial*** carpal, ***ulnar*** carpal and ***accessory*** carpal. The distal row consists of ***second and third fused*** carpal and ***fourth*** carpal.

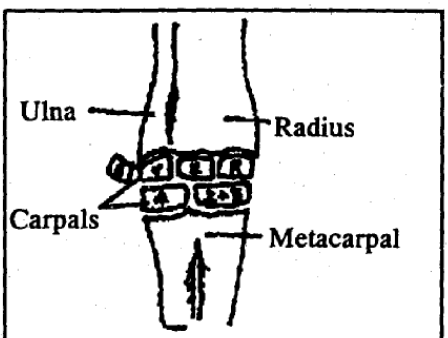


Fig. 1.16 : Carpals of Ox

6) Metacarpals :

There are two metacarpals in ox viz. the large metacarpal and the small metacarpal. The ***large metacarpal*** is a long bone placed vertically between the carpus above and the digits below. It presents shaft and two extremities. The shaft is semicylindrical and presents two surfaces. The anterior surface is rounded and has a vertical groove. The posterior surface is flat. The proximal extremity presents two articular facets. The distal extremity is divided by a cleft into medial and lateral condyles. Each condyle is divided into two parts by a ridge. The ***small metacarpal*** is a small, rod - like bone of 1-1.5" in length, It is placed on posterio-lateral surface of the large metacarpal on its proximal side.

7) Digits :

There are two fully developed digits in the ox. Each digit carries three phalanges and three sesamoids.

a) *Phalanges* :

i) *First Phalanx* : It is a long bone. The anterior surface is rounded while posterior surface is flat. The proximal end is broad and bears a concave articular surface. The distal end is divided by groove into two condyles.

ii) *Second Phalanx* : It is also a long bone. It is shorter than first phalanx. The proximal end presents two concave facets. The distal end is condyloid.

iii) *Third Phalanx* : It is triangular in shape. It is entirely enclosed in the hoof. It has four surfaces namely lateral, medial, ventral and dorsal.

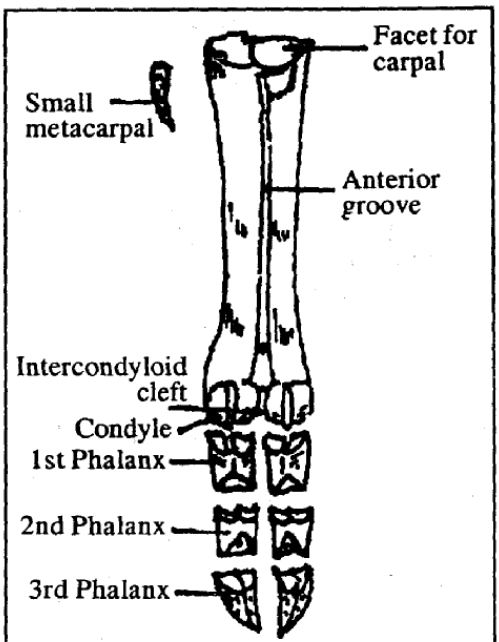


Fig. 1.17 : Metacarpals & Phalanges

b) *Sesamoids* : They are *proximal* and *distal.*

i) *Proximal sesamoids* are four in number i.e. two per each digit. They are small, oval, short bones. They are situated at metacarpo-phalangeal articulation.

ii) *Distal sesamoids* are two in number. They are located behind the distal inter-phalangeal articulation.

B) BONES OF HIND LIMB :

1) Pelvic Bone :

It is also called as ***os coxae***. It is a flat bone. It is formed by fusion of right and left hip bones. The junction of right and left hip bone is called as ***pelvic symphysis***. Each hip bone consists of three large flat bones namely ilium, ischium and pubis. These three bones unite and form a cotyloid cavity called as ***acetabulum.***

i) *Ilium :* It is the largest bone of os-coxae and is roughly triangular in shape. It is situated at anterio-lateral aspect of the pelvis. It has two surfaces namely gluteal surface and pelvic surface. It has 3 angles called as ***tuber coxae*** (external angle), ***tuber sacrale*** (internal angle) and ventral or ***cotyloid angle***.

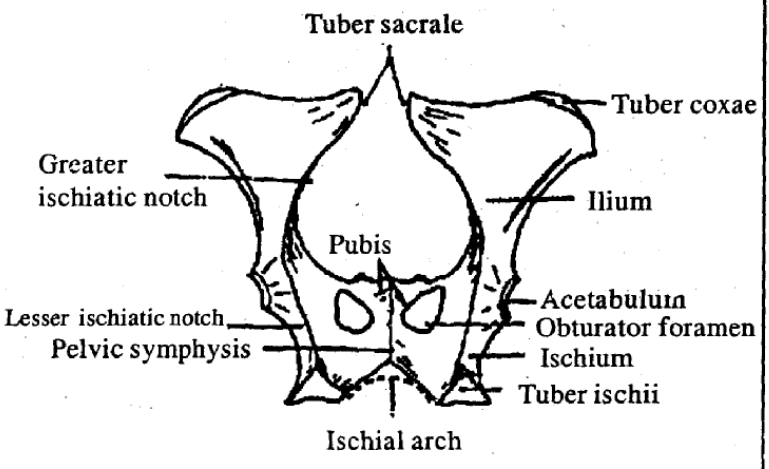


Fig. 1.18 : Pelvic bone of Ox

ii) *Ischium :* It is roughly quadrilateral in shape. It is situated behind the pubis and forms most part of the floor. It has two surfaces, four borders and four angles. The pelvic surface is concave and smooth. The ventral surface is slightly convex and rough. The anterior border forms the posterior boundary of obturator foramen. The posterior border is thick and forms ***ischial arch***. The lateral border is concave and forms the ***lesser ischiatic notch.*** The medial border forms ***ischial symphysis.*** The postero-external angle is expanded, thick and forms ***tuber ischii.***

iii) *Pubis :* It is the smallest bone of os coxae. It is triangular in shape and forms the floor of the pelvic cavity. It presents two surfaces, three angles and three borders. The pelvic surface is smooth and concave. The ventral surface is rough and convex. The medial border forms the ***pubic symphysis.*** The lateral border forms the anterior boundary of the ***obturator foramen*** which is large oval opening on the floor of pelvic cavity.

2) Femur :

It is the largest long bone. It has a shaft and two extremities. The shaft is cylindrical in the middle and three sided below. The proximal extremity consists of head, neck, trochanter major and trochanteric fossa. ***The head*** is placed medially and articulates with the acetabulum. The distal extremity comprises of ***trochlea*** infront and two ***condyles*** behind.

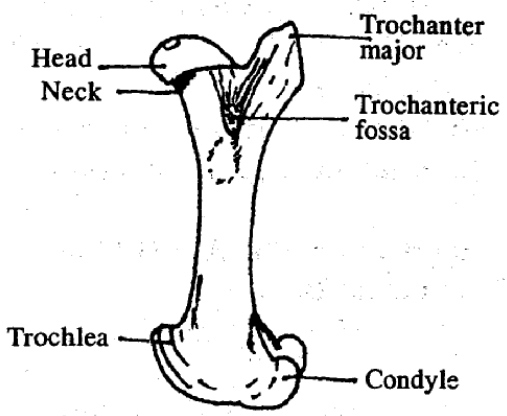


Fig. 1.19 : Femur of Ox

3) Patella :

It is the largest sesamoid bone. It is triangular in shape and is placed infront of the trochlea of femur.

4) Tibia :

It is a long bone placed between femur above and tarsus below. It presents a shaft and two extremities. The shaft is three sided (prismatic) and twisted in appearance. The proximal extremity presents two condyles and tuberosity. The distal extremity presents two grooves for articulation with the ridges of tibial tarsal bone.

5) Fibula :

It is a rudimentary bone. The head of the fibula is fused with the lateral condyle of tibia. The body and distal extremity remains as short, blunt prolongation.

6) Tarsus :

The tarsus of the ox consists of five short bones arranged in two rows. The proximal row consists of ***tibial*** tarsal (medial) and ***fibular*** tarsal (lateral). The distal row comprises of three bones namely, ***central & fourth fused*** tarsal, ***second and third fused*** tarsal (medial) and ***first*** tarsal (lateral)

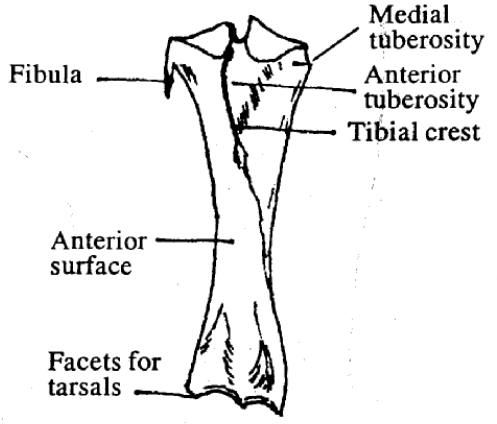


Fig. 1.20 : Tibia & Fibula of Ox

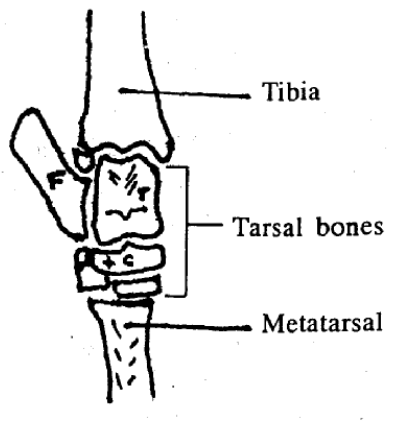


Fig. 1.21 : Tarsals of Ox

7) Metatarsal Bones :

They are two in number i.e. small metatarsal and large metatarsal. The ***small metatarsal*** is rudimentary and situated on posterio-lateral aspect of the large metatarsal. The ***large metatarsal*** is a long bone. It is distinctly quadrilateral in form. The anterior surface has wide and deep vascular groove. The proximal extremity presents medial and lateral articular areas. The distal extremity is divided by a cleft into medial & lateral condyles.

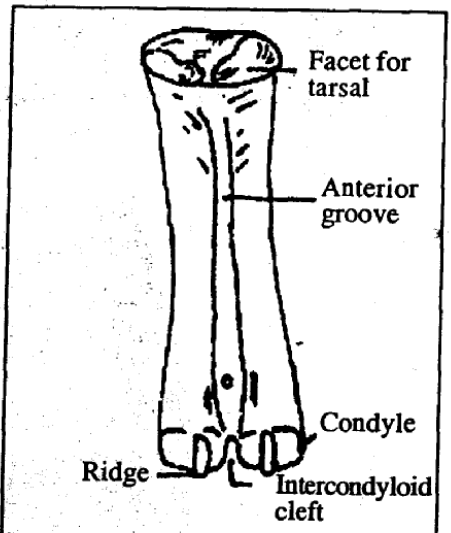


Fig. 1.22 : Metatarsal of Ox

8) Digits :

The phalanges and the sesamoids of the hindlimb are similar to those of the forelimb.

JOINTS

Syndesmology (arthrology) : It means study of joints.

Joints (articulations) - These are the structures formed by the union of two or more articular ends of the bones or cartilages.

Clssification of Joints :

Broadly joints are classified into following three groups.

1) Fibrous (Synarthrodial) joints.
2) Cartilaginous (Amphiarthrodial) joints.
3) Synovial (Diarthrodial) joints

1) *Fibrous Joints* :

1. They do not contain joint cavity.
2. These are immovable joints.
3. The bones are united by fibrous tissues.
4. Example - Skull joints.

2) *Cartilagenous Joints* :

1. They do not contain joint cavity.
2. They permit limited movements.
3. The bones are united by cartilage.
4. Example - Pelvic symphysis.

3) *Synovial Joints* :

1. These are true joints.
2. These are movable joints.
3. These contains joint cavity or articular cavity.
4. Joint cavity is surrounded by the *joint capsule* which consists of an external fibrous layer and internal synovial membrane.
5. The *synovial membrane* secretes a lubricant fluid known as *synovial fluid.*

6. The *articular cartilage* covers the surface of the bone over joint and lessens the concussion and friction.
7. Ligaments bind the bones. These are placed around the joints.
8. Examples : Knee joint, Hock joint.

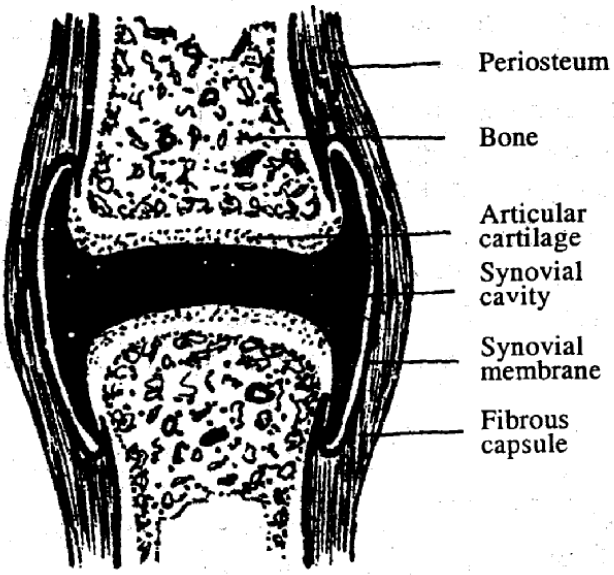


Fig. 1.23 : Typical Synovial joint

Table 1.2 : Joints of Forelimb and Hindlimb

Joint	Bones Involved
Forelimb	
1. Shoulder joint	Scapula and humerus
2. Elbow joint	Humerus and radio-ulna
3. Knee joint	Radioulna, carpals and metacarpals
4. Fetlock joint	Metacarpal & first pair of phalanges
5. Pastern joint	First and second phalanx
6. Coffin joint	Second and third phalanx
Hindlimb	
1. Hip joint	Acetabulum of pelvic bone & head of femur
2. Stifle joint	Femur and tibia
3. Hock joint	Tibia, tarsal and metatarsal bones.
4. Fetlock joint	Metatarsal & first pair of phalanges.
5. Pastern joint	First and second phalanx
6. Coffin joint	Second and third phalanx.

CHAPTER - 2 : CIRCULATORY SYSTEM

The circulatory system includes heart, blood vessels and blood.

HEART

1. It is situated in the chest cavity between 3rd and 6th rib.
2. The heart is a cone shaped, hollow, muscular organ having broad base and pointed apex.
3. It is reddish brown in colour and weighs about 5-7 lb.
4. It is enclosed in membranous sac called ***pericardium.***
5. The heart wall consists of three layers viz. ***epicardium*** (outer), ***myocardium*** (middle) and ***endocardium*** (inner).
6. The heart consists of 4 chambers i.e. two ***auricles*** (upper) and two ***ventricles*** (lower).
7. The two auricles are separated from one another by ***inter-auricular septum.***
8. The right auricle (RA) receives impure blood from the body through anterior and posterior vena cavae.
9. The right auricle communicates right ventricle (RV) through right auriculo - ventricular opening guarded by right auriculo-ventricular or ***tricuspid valve.***
10. The left auricle receives pure blood from the lungs through right and left pulmonary veins.
11. The left auricle communicates left ventricle through left auriculo-ventricular opening guarded by ***bicuspid or mitral valves.***

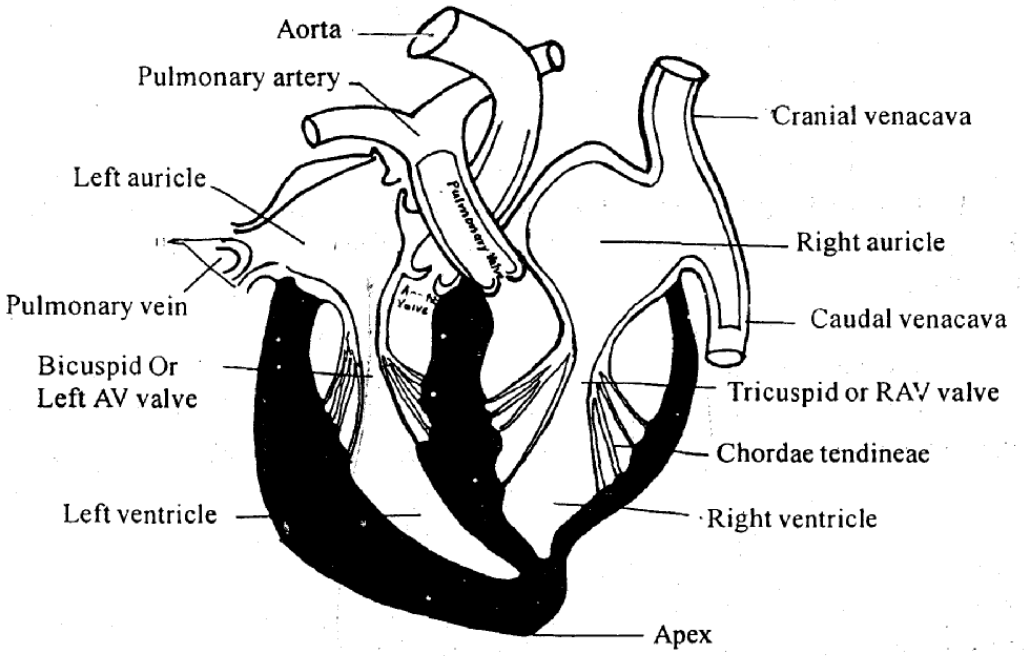


Fig. 2.1 : Structure of Heart

12. The ventricles are thick walled and muscular.
13. The two ventricles are separated from each other by ***inter-ventricular septum.***
14. The right ventricle gives off a large pulmonary artery which carries impure blood to the lungs for oxygenation.
15. The left ventricle discharges pure blood into aorta through aortic orifice guarded by ***aortic valves.***
16. The free margins of bicuspid and tricuspid valves are indirectly attached to the ventricular wall by means of a fibrous cords called as ***chordae tendineae.***
17. ***Function*** : Pumping of blood.

FUNCTIONING OF HEART

Cardiac Circulation :

1) Right auricle receives blood from anterior (head, neck and forelimbs) and posterior (abdomen, hindlimbs) portions of the body through anterior and posterior vena-cavae.
2) The blood from RA is pumped to right ventricle (RV) through Right auriculo-ventricular opening. The tricuspid or RAV valve prevent back flow of the blood.
3) The impure blood from right ventricle goes to the lungs through pulmonary arteries for purification. The pulmonary semilunar valves prevents backflow of blood from pulmonary trunk into right ventricle.
4) The purified i.e. Oxygenated blood from lungs returns to the left auricle by pulmonary veins.
5) The pure blood from left ventricle is pumped into aorta which carry pure blood to tissues through its branches.

Cardiac Cycle :

The cardiac cycle involves all the events that occurs during one complete heart beat. The cardiac cycle consists of two major phases i.e.

1) ***Diastole*** - It means the relaxation or dilatation of the heart. It may be atrial or ventricular diastole.
2) ***Systole*** - It means the contraction of the heart. It may be atrial or ventricular systole.

During atrial diastole, blood enters the right auricle from venacavae and the left auricle from the pulmonary veins. This increases auricular volume and pressure. When the auricular pressure exceeds ventricular pressure, the A - V valves open and blood flows into the relaxed ventricles. The ventricles then contract building up pressure which closes the A-V valves and opens the semilunar valves in pulmonary artery and aorta. This leads to pumping of blood into pulmonary artery and aorta.

Heart Sounds :

The following two distinct sounds are heard in each cardiac cycle.

1) ***Lub*** - A low-pitched first sound caused by the closure of the A-V valves during systole.
2) ***Dup*** - A second sharper and shorter sound produced by the closing of aortic and pulmonary valves during late systole or early diastole.

Heart Rate :

Heart rate means the number of heart beats per minute.

The ***normal heart rates*** in different animals are as follows -

Cattle and Buffalo	45-60 / min
Sheep and Goat	70 - 80 / min

The ***factors affecting heart rate*** are as follows.

1) Age - Young animals have faster heart rate than old.
2) Size - Small animals have faster heart rate than large.'
3) Body fat - Fatty animals have faster heart rates than thin.
4) Sex - Females have faster rates than males.
5) Excitement, fear & exercise - increases the heart rate.
6) The heart rate is higher in diseases characterized by fever, anemia etc.

BLOOD VESSELS

1) ***Arteries*** : These are the vessels that carry blood away from the heart
2) ***Aorta*** : It means the largest artery.
3) ***Arterioles*** : These are small arteries.
4) ***Capillaries*** : These are smallest blood vessels.
5) ***Venules*** : These are smallest veins.
6) ***Veins*** : These are the vessels that carry blood towards heart.
7) ***Venacava*** : It is the largest vein.

Table 2.1 : Difference between Arteries and Veins

Arteries	Veins
1) They carry blood away from the heart.	1) They carry blood towards the heart
2) They carry pure blood except pulmonary artery	2) They collect impure blood from various tissues except pulmonary vein.
3) The arterial blood is bright red in colour	3) The venous blood is purplish red in in colour.
4) They have thick, muscular and elastic wall	4) They have thin, less muscular and less elastic wall.
5) They donot collapse when empty.	5) They collapse when empty
6) They donot have valves.	6) They have valves.
7) They are pulsatile	7) They are non-pulsatile
8) Blood flow is rapid and under pressure	8) Blood flow is slow and under low pressure
9) They are always smaller than their respective veins	9) They are always larger than their respective arteries
10) They are deeply situated in the body i.e. well protected.	10) They are generally superficial

BLOOD

Blood : It is defined as liquid connective tissue composed of blood cells and plasma.

Plasma : It is the fluid part of unclotted blood. It contains prothrombin, fibrinogen and various clotting factors.

Serum : It is fluid part of clotted blood. It doesnot contain prothrombin, fibrinogen and various clotting factors.

PROPERTIES OF BLOOD :

1. It is red in colour.
2. It is viscous in nature.
3. The pH of blood is slightly alkaline i.e. 7.4
4. The average specific gravity is 1.043 in cattle.
5. Blood clotting time in cattle is 6.5 minutes.
6. The average blood volume in cattle is 7.7% of the total body weight.

FUNCTIONS OF BLOOD :

1. Transport of nutrients from digestive tract to the tissues.
2. Transport of waste products from tissues to the organs of excretion.
3. Transport of O_2 from lungs to tissues.
4. Transport of CO_2 from tissues to lungs.
5. Transport of hormones from the site of production to the site of action.
6. Regulation of body temperature.
7. Maintenance of body pH i.e. acid - base balance.
8. Maintenance of water balance.
9. Protection of body from disease-producing organisms.
10. Its clotting ability prevents excess loss of blood from injuries.

COMPOSITION OF BLOOD :

Blood is composed of - (a) Plasma - 66% & (b) Blood cells - 34%

(A) *PLASMA :*

It is fluid portion of the blood. It is straw coloured. It consists of 90 - 92 % water and 8 - 10 % other substances (solids). The other substances include inorganic matter and organic matter.

a) Organic constituents : They constitute about 7-9% of plasma.

1. Proteins (6-8%) : Albumin, Globulin, Fibrinogen and Prothrombin
2. Carbohydrates : Glucose, Fructose.
3. Lipids : Neutral fats, Triglycerides, Cholesterol, Phospholipids.
4. Non-Protein Nitrogenous Substances (NPN) : Urea, Uric acid, Creatinine, Ammonia.
5. Other Substances : Hormones, Enzymes, Vitamins, Pigments like bilirubin & carotene

b) Inorganic Constituents : They form about 1% of plasma.

These include calcium, phosphorus, magnesium,chlorides, bicarbonates, sulphates, phosphates, potassium, sodium, iron, iodine, copper, zinc etc.

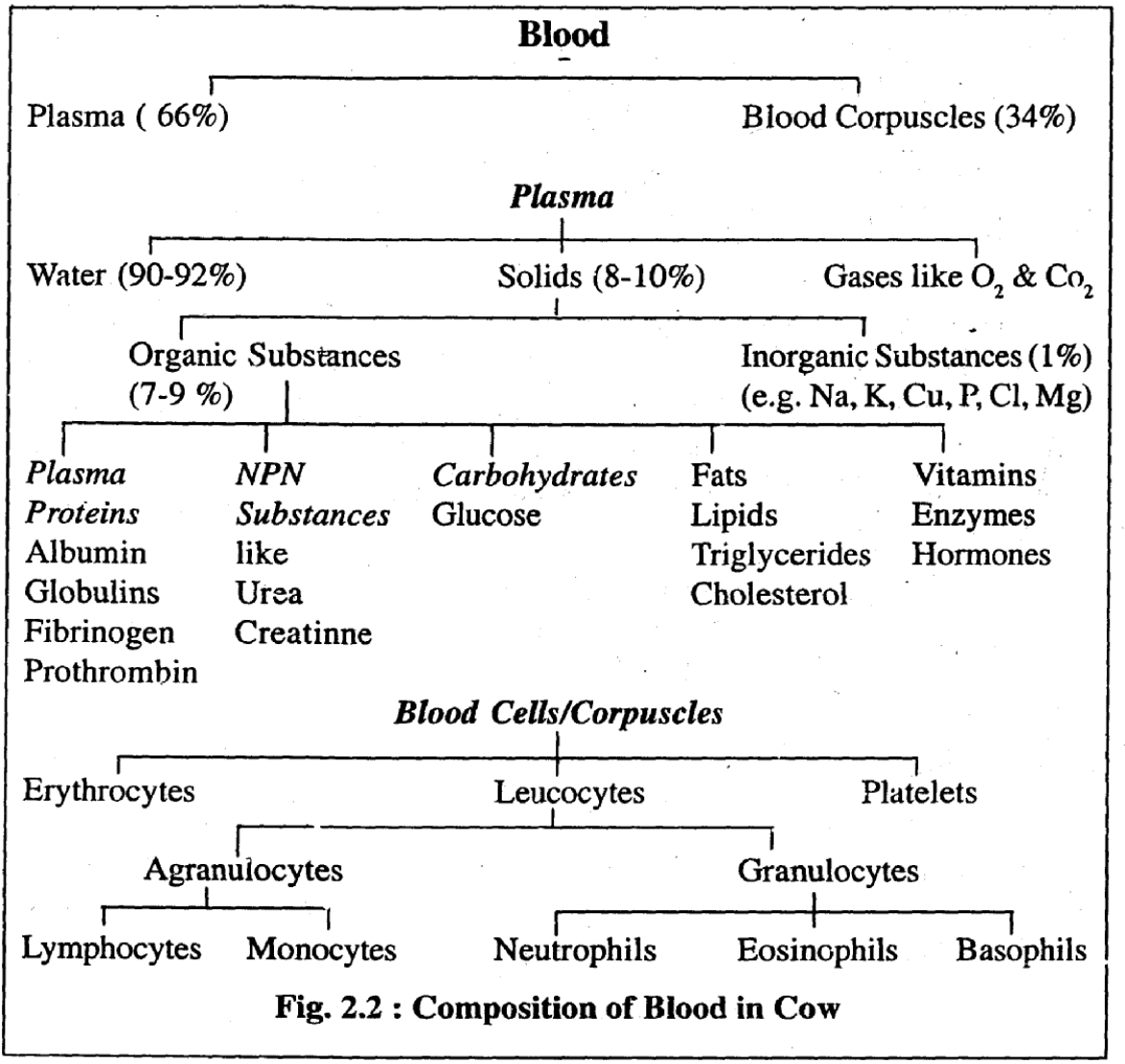


Fig. 2.2 : Composition of Blood in Cow

B) *BLOOD CELLS* : They are of three types -

1) Red blood cells 2) White blood cells 3) Platelets

1) RED BLOOD CELLS (RBC) :

1. They are also called as ***erythrocytes.***
2. They are red in colour due to ***haemoglobin.***
3. These are non-nucleated cells.
4. These are circular concave discs having thick margin and a thin centre.
5. They measure about 5 - 7 μ in diameter.
6. Their life span is 160 days in cattle.
7. The normal RBC count is 6 - 8 millions / μ *l* of blood.
8. They are formed in the red bone marrow.
9. They are composed of water (65%) and solids (35%). The solid part constitutes haemoglobin (95%) and other substances like proteins, lipids etc. (5%)
10. ***Function :*** They help in transport of respiratory gases i.e. O_2 and CO_2.

Haemoglobin :

1) It is the red pigment of blood.
2) It is the main constituent of RBC.
3) It forms approximately 33% portion of red blood cells.
4) It gives red colour to red blood cells.
5) It is composed of two parts Viz. a) Globin i.e. simple protein - 96%.
   b) Haeme i.e. iron containing pigment 4%.
6) It combines with Oxygen or Carbondioxide to form oxyhaemoglobin (HbO_2) or carbamino-haemoglobin ($HbCO_2$).
7) The molecular weight of haemoglobin is 68,000.
8) The haemoglobin content of blood is 8-12 g % in healthy animals.
9) It is synthesized inside the red cells in the bone marrow.
10) ***Function :*** Transportation of O_2 from lungs to tissues and CO_2 from tissues to lungs.

2) WHITE BLOOD CELLS (WBC) :

1. These are also called as ***leucocytes.***
2. They are white in colour.
3. These are nucleated cells.
4. These are capable of independant movement.
5. They are circular in shape.
6. They are about 8 to 25 μ in diameter.
7. The life span varies from few hours to few years.
8. There are about 9-12 thousand /μl of blood in healthy animal.
9. They are formed in bone marrow and lymphoid organs.
10. ***Function :*** These are involved in defence mechanism of body.

Table 2. 2 : Difference between RBC& WBC

Parameter	Red Blood Cells	White Blood Cells
1) Colour	Red	White
2) Shape	Biconcave disc	Circular
3) Size	Smaller	Larger
4) Nucleus	Absent	Present
5) Motility	Non-motile	Motile
6) Life span	160 days	Few hours to few years
7) Number	More	Less
8) Site of cell formation	Bone marrow	Bone marrow & Lymphoid organs.
9) Haemoglobin	Present	Absent
10) Function	Transport of O_2 & Co_2	Defence mechanism

Classification of leucocytes (WBC) :

These are classified as A) Granulocytes & B) Agranulocytes.

A) Granulocytes :

1. They contain granules within the cytoplasm.
2. The nuclei are lobulated and appear in many shapes and forms.
3. They remain functional for 10 hours to 3 days.
4. They are formed in red bone marrow.

On the basis of the shape of nuclei and staining reaction of their granules, they are classified as - i) Neutrophils ii) Eosinophils and iii) Basophils.

i) *Neutrophils :*

1. They contain very fine granules which stains faint or grayish pink.
2. They possess multilobed nucleus and hence also called as polymorphs.
3. They constitute 25-35% of total leucocytes in cattle.
4. Their number increases rapidly in acute infection.
5. They constitute first line of defence against infection.
6. They are highly phagocytic

Phagocytosis is the process of engulfing and destroying foreign material like microorganisms.

ii) *Eosinophils :*

1. They contain large red staining granules in their cytoplasm.
2. They commonly possess two or three lobed nucleus.
3. They comprise only 2 to 5% of total leucocytes.
4. Their number increases in chronic parasitic diseases and in allergic reactions.
5. They are little phagocytic & inactivate histamines & histaminic substances
6. Their primary function is detoxification of bacterial toxins & foreign proteins.

iii) *Basophils :*

1. They contain blue staining granules in the cytoplasm.
2. Their nucleus is less lobulated.
3. They are very rare in blood i.e. 0.5 to 1 %. of total W.B.C's
4. They are non-phagocytic.
5. They contain heparin which prevents clotting of blood.

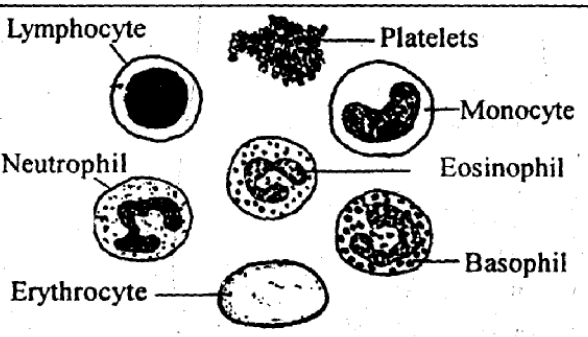


Fig. 2.3 : Blood cells

B) Agranulocytes :

1. They usually show few granules.
2. The nuclei are non-lobulated.
3. They remain functional for 100 - 300 days.
4. They are formed in lymphoid organs and bone marrow.

They are classified as i) Lymphocytes and ii) Monocytes.

i) *Lymphocytes :*

1. They are variable in size and appearance.
2. They have a relatively large spherical nucleus surrounded by a small amount of cytoplasm.
3. They constitute greatest number amongst all the WBC's i.e. 55-65%.
4. They produce antibodies and antitoxins.
5. They are non-phagocytic.

ii) *Monocytes :*

1. These are the ***largest*** leucocytes.
2. They possess kidney shaped nucleus and abundant cytoplasm.
3. They constitute 5-6% of total WBC's.
4. They are higly phagocytic.
5. Their number increases in chronic infections like tuberculosis.

Table 2.3 : Functions of Leucocytes

1) Neutrophils	They are highly phagocytic Their number rapidly increases in acute bacterial infections.
2) Eosinophils	They are mildly phagocytic Detoxification of bacterial toxins & foreign proteins Their number increases in allergic & parasitic diseases.
3) Basophils	They contain heparin which prevents clotting of blood.
4) Lymphocyte	They produce antibodies and antitoxins
5) Monocyte	They are highly phagocytic and remove foreign bodies & cellular debris produced by infection. Their number increases in chronic infections

3) PLATELETS :

1. These are also called as ***thrombocytes.***
2. These are colourless and non-nucleated cells.
3. They are oval or irregular in shape.
4. These are smallest blood cells & measure about 2-5 μ in diameter.
5. Their life span is 8 - 11 days.
6. Their number varies from 3.5 to 5 lakhs / μ *l* of blood.
7. They are formed in bone marrow.
8. ***Function :*** They help in clotting of blood.

BLOOD CLOTTING

Blood Clotting : It is a process that results in the change of blood from a fluid to a semi-solid gelatinous mass.

Importance : It prevents loss of blood through injuries. When bleeding occurs, the shed blood coagulates and the bleeding vessels become plugged off by the clot.

Mechanism

The blood clotting mechanism involves the following steps.

1) When the injury results into bleeding , the platelets and damaged tissue produce an enzyme called ***thromboplastin or thrombokinase*** that initiates clotting process.
2) Thromboplastin converts ***prothrombin*** into ***thrombin*** with the help of calcium ions.
3) Then thrombin converts ***fibrinogen*** to a gel called ***fibrin.***
4) Fibrin then forms the network in which blood cells are trapped and ***blood clot*** is formed

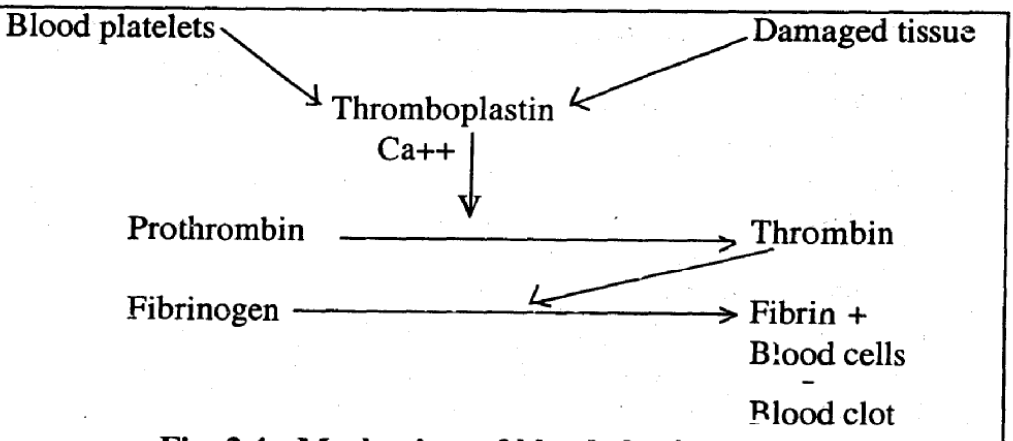


Fig. 2.4 : Mechanism of blood clotting

Factors Preventing Clotting :

1) Low temperature.
2) Anticoagulants like EDTA, Sodium citrate.
3) Addition of biological substances like Heparin, Hirudin.
4) Precipitation of fibrinogen by addition of salt solutions.
5) By avoiding contact with water-wettable surface

Factors Enhancing Clotting :

1) High temperature.
2) Vit K injections.
3) Addition of thrombin or thromboplastin.
4) Addition of calcium salts.
5) Contact with water-wettable surface

Blood Clotting time : It is the length of time from drawing a fresh blood sample until clotting occurs.

The average blood clotting times in different species are as follows.

1) Cow - 6.5 min 2) Sheep & Dog - 2.5 min 3) Human - 5 min

BLOOD CIRCULATION

The blood circulation in animals is carried out by two pathways-

A) Pulmonary Circulation (B) Systemic Circulation

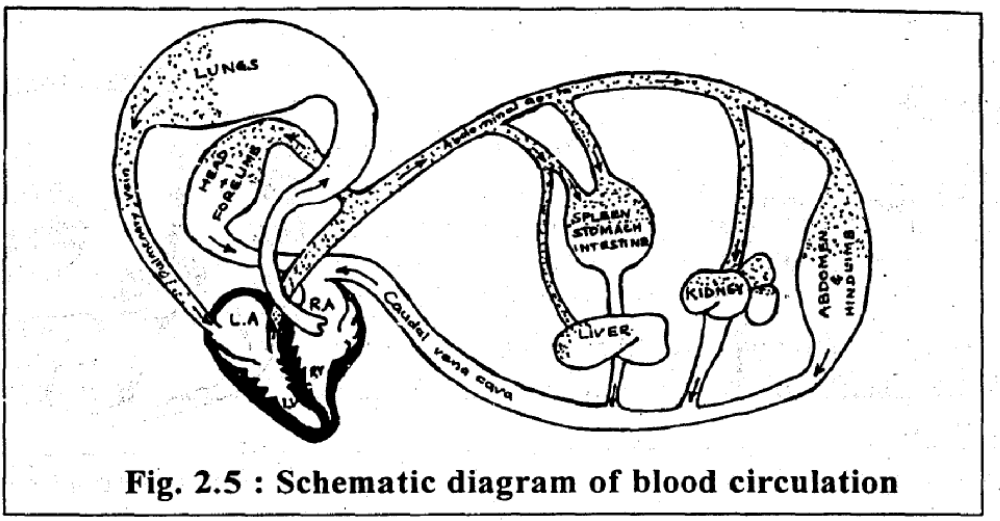


Fig. 2.5 : Schematic diagram of blood circulation

A) *Pulmonary Circulation :*

It is that part of vascular system which circulates all the blood through the lungs. The impure or deoxygenated blood from right auricle passes through the right ventricle and pulmonary arteries to the lungs for oxygenation. The pulmonary veins bring oxygenated or pure blood from lungs to the left auricle of the heart.

B) *Systemic Circulation :*

It refers to the movement of oxygenated blood to all areas of the body and the subsequent return of deoxygenated blood to the heart. The pure or oxygenated blood from the left ventricle passes to all parts of the body through the aorta and its branches. Then the deoxygenated blood from different parts of the body is brought to the right auricle by the vena cavae and their branches.

LYMPHATIC SYSTEM

It includes lymph, lymph vessels and lymphnodes.

Functions of lymphatic system :

1. It serves as system for draining tissue fluid.
2. It carries proteins and even large particulate matter away from tissue spaces.
3. It helps in absorption and transportation of fats and vit K from the small intestine to the blood.
4. It distributes the digested food to the tissues and collects metabolic waste substances.
5. It assists in the control of infection.

Lymph :

1. It is a tissue fluid which has entered lymph capillaries.
2. It is a colourless fluid.
3. It is practically blood minus the red blood cells.
4. It clots very slowly

Lymph Vessels :

1. These are the vessels which carry tissue fluid i.e. lymph to the blood stream.
2. These are small and delicate vessels.
3. They possess numerous valves.
4. They originate as blind sacs between tissue cells as capillaries and collects fluid not absorbed by venous system.
5. These vessels pass through lymphnodes and finally join cranial venacava by thoracic duct.

Lymphnodes :

1. They are spherical, oval or bean shaped.
2. They are grey rosy in colour.
3. They vary in size from very minute bodies to the size of lemon.
4. The lymphnodes are covered by a connective tissue ***capsule.***
5. The capsule sends ***septa*** or ***trabeculae*** inside the node.
6. The node is divided into ***cortex*** and ***medulla*** which contains large number of lymphocytes
7. They serve as filters for the lymph.
8. They act as one of the first body defence against infection.

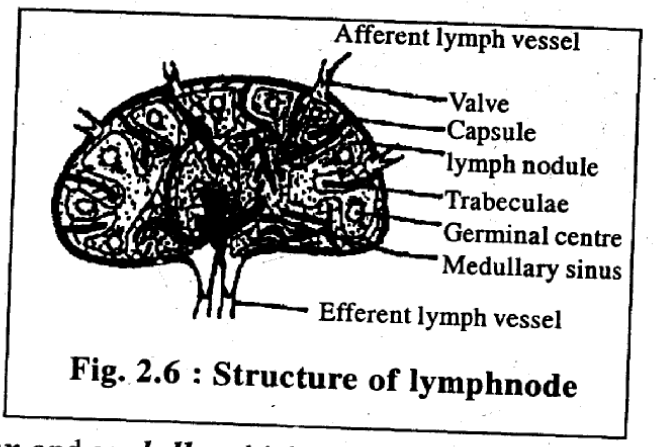


Fig. 2.6 : Structure of lymphnode

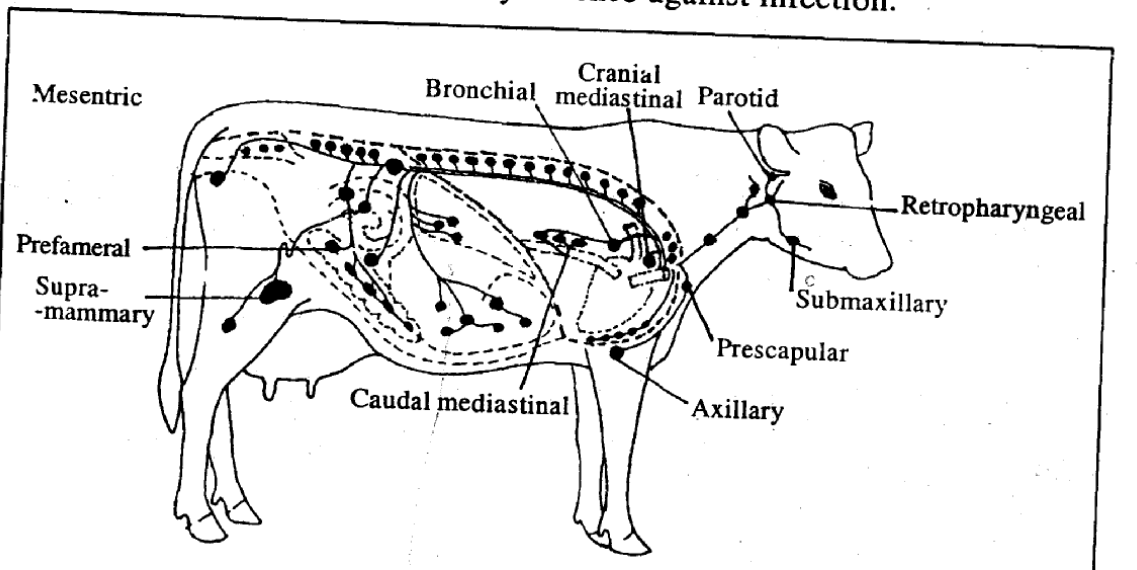


Fig. 2.7 : Lymphnodes of Cow

CHAPTER - 3 : RESPIRATORY SYSTEM

The respiratory system of bovines comprises of nasal cavity, pharynx, larynx, trachea, bronchi and lungs.

NASAL CAVITY :

1. It is the first part of the respiratory passage which extends from exterior to pharynx.
2. It is cylindrical or tubular passage enclosed by facial bones and cartilages.
3. It is separated into two compartments by ***nasal septum.***
4. It opens externally by ***nostrils*** and internally by two ***posterior nares***.
5. It is located above the mouth cavity.

Functions :

1. Passage for air.
2. Sensation of smell.

PHARYNX :

1. It is funnel shaped musculo-membranous sac common for both digestive and respiratory system.
2. There are ***seven*** openings in pharynx viz. mouth (1), posterior nares (2), eustachian tubes (2), larynx (1) and oesophagus (1).
3. It is located just behind the mouth cavity.

Function :

It is common passage for food, water and air.

LARYNX :

1. It is also known as ***'Sound Box'.***
2. It is elongated musulo-cartilaginous compartment.
3. It is made up of five cartilages namely ***epliglottis, (1) cricoid (1), thyroid (1) and arytenoids (2).***
4. There are vocal cords on internal surface of the wall of the larynx.
5. It is located between pharynx and trachea.

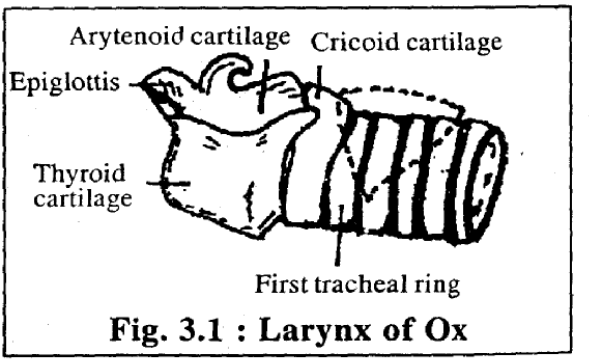


Fig. 3.1 : Larynx of Ox

Functions :

1. It regulates the air flow to and from the lungs.
2. *Epiglottis* prevents inhalation of foreign bodies.
3. The ***vocal cords*** are responsible for voice production (phonation).

TRACHEA :

1. It is also known as ***"Wind Pipe".***
2. It is cartilagenous tube which extends from larynx to lungs.

3. It is made up of 50 - 60 incomplete 'C' shaped cartilagenous rings.
4. It is located on the ventral side of neck and passes into thoracic cavity and divides into bronchi.

Functions :

1. Passage for air.
2. Filters the air, removes dirt and dust.
3. Secretes mucin which moistens the dry air.

BRONCHI :

1. The trachea is divided into bronchi at hilus of lungs.
2. There are three bronchi in ox viz - ***left, right*** and ***apical.***
3. The right branch supplies to right lobes, left to left lobes and apical to the right apical lobe of lung.
4. Each bronchus divides and subdivides into small fine tubes as primary, secondary and tertiary bronchi.

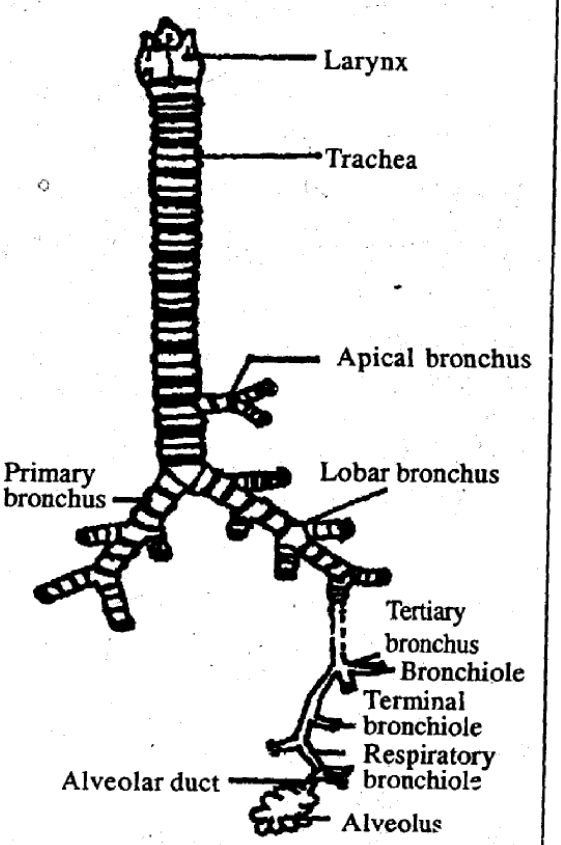


Fig. 3.2 : Trachea & branches of bronchi

5. The tertiary bronchi divides into minute ***bronchioles.***
6. The bronchioles ends into minute compartments known as ***alveoli.***

Function :

Passage for air.

LUNGS :

1. They are two in number i.e. left and right.
2. These are the main organ of respiration.
3. They are enclosed in membrane called ***pleura.***
4. They are soft, spongy and highly elastic.
5. They are brownish grey in colour, conical in shape and light in weight.
6. They crepitate on pressure and floats on water.
7. Right lung is larger than the left & average weight is 3.5kg.
8. Right lung consists of 4 lobes namely apical, cardiac, intermediate and diaphragmatic.
9. Left lung is divided into 3 lobes namely apical, cardiac and diaphragmatic.
10. Cardiac notch is larger in left lung than in right one.
11. It is located in thoracic cavity.

Functions :

1. Exchange of gases. - a) Supply of oxygen to blood.
   b) Removal of carbon dioxide from blood.
2. Regulation of body temperature.
3. Elimination of water.

Table 3. 1 : Difference between Right and Left Lung.

Particular	Right lung	Left lung
1) Size	Larger	Smaller
2) Weight	More	Less
3) Lobes	4 lobes	3 lobes
4) Apical lobe	Larger and divided	Smaller and undivided
5) Cardiac notch	Smaller	Larger
6) Bronchial supply	Supplied with two bronchi namely right and apical	Supplied with one bronchus i.e. left

Diaphragm : This is muscular, dome shaped partition between the thoracic and abdominal cavities.

Function : It is the chief inspiratory muscle.

Pleurae : These are the serous membranes which cover the inner wall of thorax and thoracic organs.

Thorax: The thoracic cavity is bounded by the thoracic inlet cranially, the diaphragm caudally, the thoracic vertebrae dorsally, the ribs laterally and the sternum ventrally.

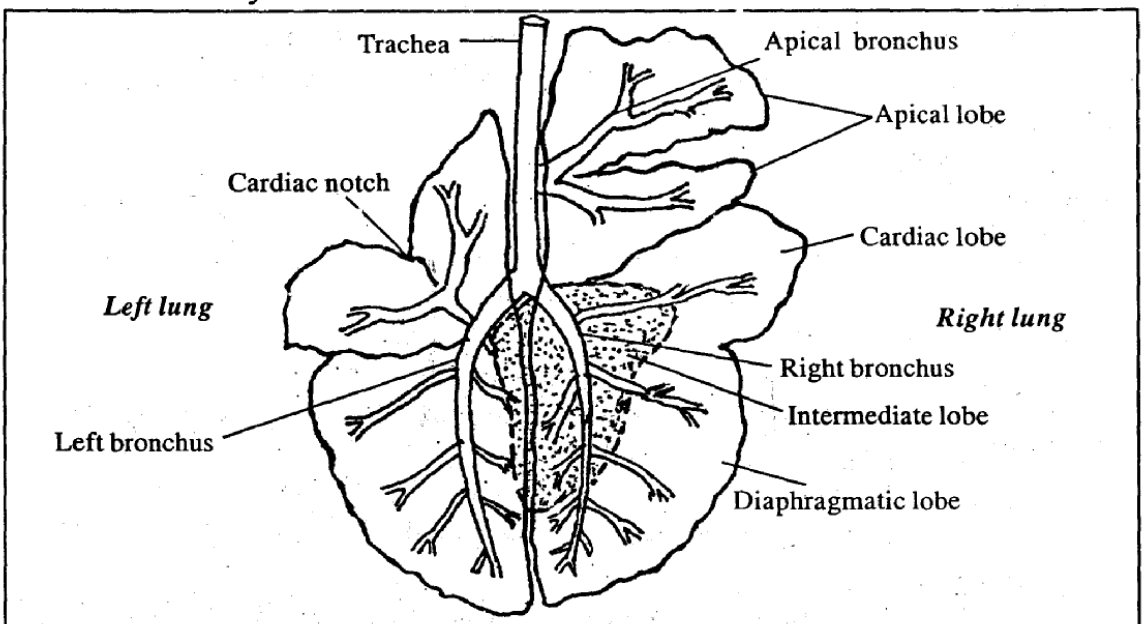


Fig. 3.3 : Lungs of Ox

MECHANISM OF RESPIRATION

Respiration is defined as exchange of gases between the organism and the environment. It includes breathing and external, internal as well as cellular respiration.

1) Breathing : It involves inspiration and expiration. During inspiration, air rich in oxygen is taken into lungs, whereas during expiration air containing more carbon di-oxide and water vapours is given out of the lungs.

a) Inspiration : It means inflow of air into lungs. It results whenever the volume of thorax is increased. During inspiration, intercostal muscles contracts and draw ribs forward and outward. This increases the volume of the thoracic cavity. It leads to lowering of air pressure in the lungs and thereby air gets entry into lungs.

b) Expiration : It means outflow of air from lungs. It results whenever the volume of thorax is decreased. The decrease in volume of thorax is largely passive because of the tendency of elastic structures like intercostal muscles, diaphragm, lungs and abdominal wall. The decrease in volume results in contraction of lungs which results in outflow of air from lungs.

2) External Respiration : This constitutes movement of O_2 from the alveolar air into the blood and release of CO_2 from the blood into the alveolar air.

3) Internal Respiration : This involves transfer of O_2 from the blood to the tissues and CO_2 from tissues to the blood.

4) Cellular Respiration : During the process of oxidation of glucose in tissues, CO_2, water and energy is produced. The CO_2 and water vapour thus produced are transported by blood to the lungs for expulsion.

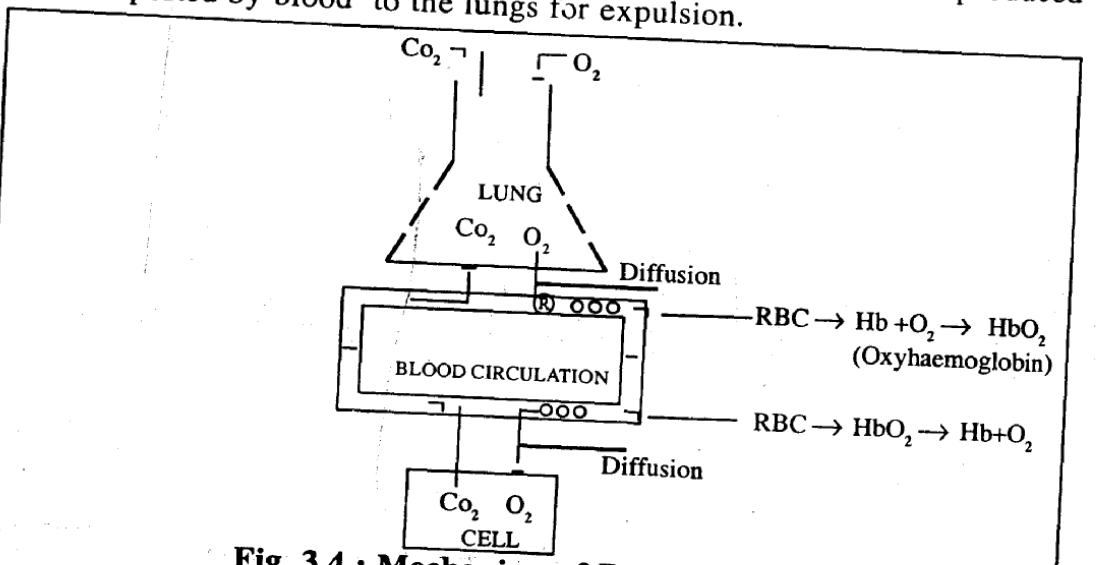


Fig. 3.4 : Mechanism of Respiration

In nutshell the mechanism of respiration is as follows :

I) The atmospheric oxygen having higher partial pressure diffuses through thin membrane of alveoli and capillaries into the blood. At the same time, Co_2 from the blood having higher partial pressure diffuses into alveoli.

II) The oxygen absorbed into blood combines with haemoglobin to form oxyhaemoglobin which is then carried to the tissues.

III) The oxygen tension in tissues is low, hence oxyhaemoglobin dissociates and O_2 is liberated. This O_2 is utilised by the cells for cellular respiration.

IV) The carbon dioxide produced during cellular respiration diffuses into the blood. Then it is carried to the lungs for elimination

FUNCTIONS OF RESPIRATORY SYSTEM :

A) ***Primary functions :***

1) Supply of Oxygen to the blood.
2) Removal of CO_2 from the blood.

B) ***Secondary functions :***

1) Regulation of pH of body fluids.
2) Helps in thermoregulation.
3) Elimination of water.
4) Voice production i.e. Phonation.
5) Sensation of smell

CHAPTER - 4 : URINARY SYSTEM

The urinary system of bovines consists of a pair of kidneys, two ureters, urinary bladder and urethra (Fig. 4.2)

KIDNEYS :

1. They are two in number i.e. right and left.
2. They are situated on dorsal aspect of abdominal cavity just below lumbar vertebrae.
3. They are oval to elliptical in shape and dark brown in colour.
4. They possess 20-25 lobes separated by fissures.
5. Each kidney is 15-17 cm in length, 8-10 cm in width and 5-6 cm in thickness.
6. They weigh about 600-700 gms.
7. The right kidney is ***fixed*** in position while left one is ***floating*** or movable.
8. The medial border of kidney is usually concave and has marked depression called ***renal hilus.***
9. Kidneys are covered by thin fibrous membrane called as ***renal capsule.***
10. The outer portion of kidney is called as ***cortex*** which is dark brown in colour.
11. The inner portion of kidney is called as ***medulla*** which is pale yellow or light brown in colour.
12. The medulla consists of conical triangular areas which are known as ***renal pyramids.***
13. The renal pyramids open into the ***minor calyces*** which in turn empties into ***major calyces.***
14. The major calyces open into the ureters directly.
15. The kidneys are made up of large number of ***nephrons***.

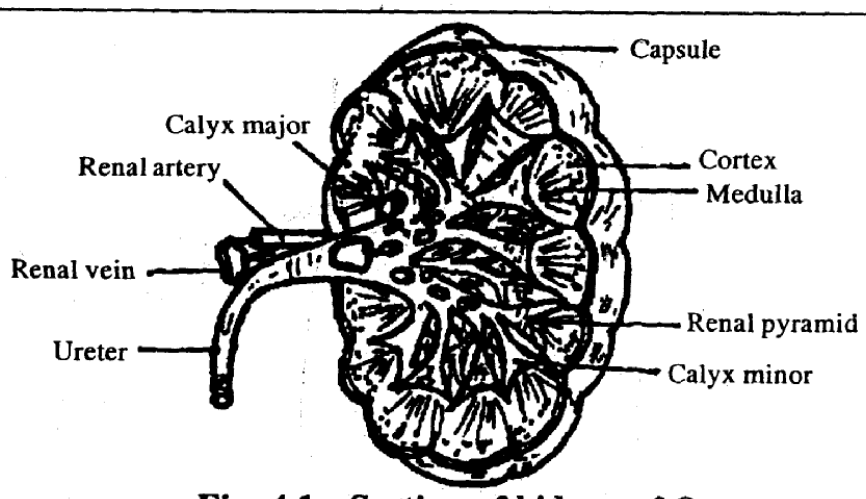


Fig. 4.1 : Section of kidney of Ox

Table 4.1 : Difference between Right and Left Kidney

Right Kidney	Left Kidney
1) Elliptical in shape with larger cranial end	1) Twisted & pear shaped with smaller cranial end.
2) Long but less thick	2) Short but more thick
3) Weighs less i.e. 600-650	3) Weighs more i.e. 700 gms
4) Located below last rib & I to III lumbar vertebrae on right side	4) Located below III to V lumbar vertebrae slightly on left side
5) It is fixed in position	5) It is floating or movable
6) Renal hilus is located on anterior side of the medial border	6) It is located on dorsal side of the medial border.

Functions :

1. The primary function of kidney is formation of urine.
2. It excretes nitrogenous waste products.
3. It maintains the normal pH of body fluids.
4. It helps to maintain the water balance of the body.
5. It eliminates drugs and various toxic substances from the body.
6. It helps to maintain the osmotic pressure in blood and tissues.
7. It helps in the maintenance of electrolyte balance.
8. It helps in the formation of ***erythrocytes*** by secreting ***erythropoietin.***
9. It plays an important role in Vit D metabolism.
10. It helps to maintain blood pressure by secreting ***renin.***

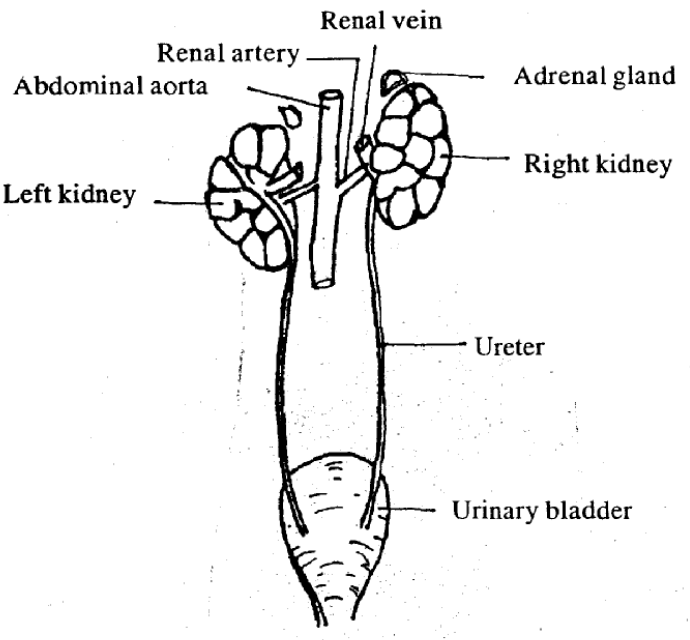


Fig. 4.2 : Urinary system of Ox

URETER :

1. These are two (i.e. right and left) excretory ducts of the kidneys.
2. ***Location :*** They passes over the roof of abdominal and pelvic cavity from kidneys to urinary bladder.
3. They are 50-60 cm in length and 6-8 mm in diameter.

Function :

They carry urine from the kidneys to urinary bladder.

URINARY BLADDER :

1. It is a hollow, muscular oval sac.
2. ***Location :*** It is situated on the floor of the pelvic cavity.
3. It conists of a vertex, body and neck.
4. The anterior blind end is known as ***vertex or Apex.***
5. The ***body*** is rounded and dorsoventrally flattened.
6. The ***neck*** is posterior, narrow, tubular portion of the bladder.

Function :

It serves as a ***store house*** of urine.

URETHRA :

1. It is a single musculo-membranous tube.
2. ***Location :*** It extends from the neck of the bladder to tip of glans penis in male and upto vagina in female.
3. Female urethra is shorter than male urethra.

Functions:

1. It acts as a passage for urine in female.
2. It serves as a common passage for the urine and semen in male.

Table 4. 2 : Difference between Male & Female urethra

Male Urethra	Female Urethra
1) It extends from the neck of the bladder to the tip of glans penis	1) It extends from the neck of bladder to vagina
2) It opens at the tip of the glans penis	2) It opens on floor of the vagina near clitoris
3) It is longer than female urethra.	3) It is very short as compared to male urethra .
4) It has got sigmoid flexure	4) Sigmoid flexure is absent
5) Its penile part acts as an organ of copulation.	5) It doesnot act as an organ of copulation
6) It is a passage for both semen and urine.	6) It is a passage for urine only
7) It is divided into pelvic and extra-pelvic part	7) It has only pelvic part.

STRUCTURE OF NEPHRON

Nephron : It is structural and functional unit of kidney.

Nephrons include glomerulus, Bowman's capsule, proximal convoluted tubule, Loop of Henle and distal convoluted tubule (Fig 4.3)

i) Glomerulus : It is the network of capillaries formed on the course of an arteriole.

ii) Bowman's Capsule : It is an expanded blind end of proximal convoluted tubule which almost entirely surrounds glomerulus.

The complex of glomerulus and Bowman's capsule is called as ***Malpighian corpuscle or renal corpuscle***. Renal corpuscle is the major site for filtration of fluid from the blood.

iii) Proximal Convoluted Tubule (P.C.T.) : It is connected directly with outer layer of the glomerular capsule. It is the longest and most winding portion of nephron. It forms much of the tissue of renal cortex. It reabsorbs most of the constituents of glomerular filtrate.

iv) Henle's loop : It is located between the proximal and distal convoluted tubule. It is U-shaped. The descending limb is thin, whereas ascending limb is thick. It reabsorbs Na^+, Cl^- and water.

v) Distal Convoluted Tubule (D.C.T.) : It is shorter and less twisted than proximal convoluted tubule. It extends from the termination of ascending limb of Henle's loop to the collecting tubule. It secretes few substances like potassium ions, dyes etc. in urine.

vi) Collecting Tubule : The DCT opens in collecting tubule which in turn opens in the renal pelvis.

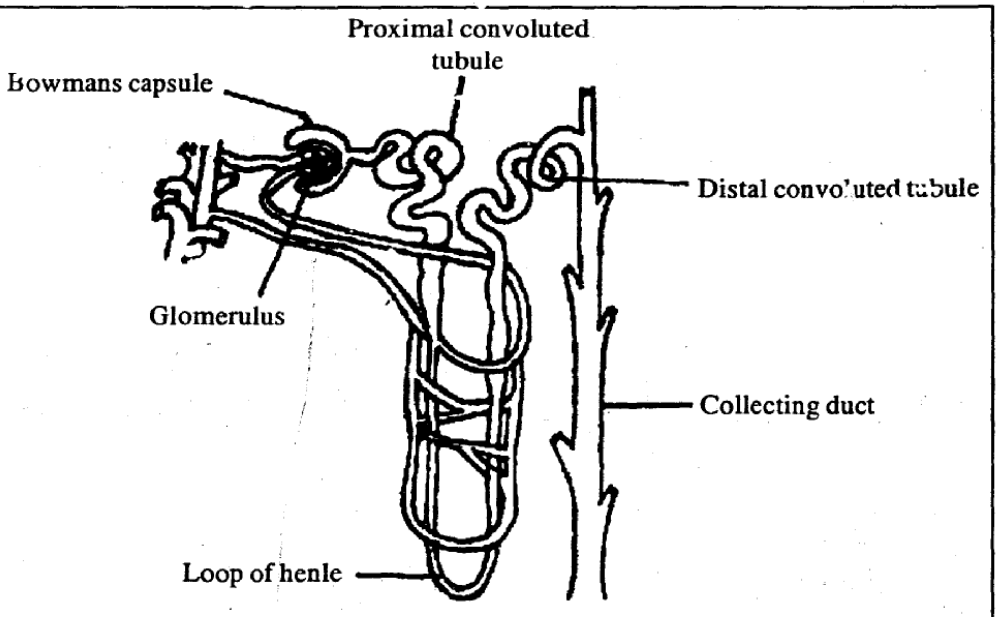


Fig. 4.3 : Structure of Nephron

FORMATION OF URINE

Formation of urine takes place in three steps-

I) Ultrafiltration II) Selective reabsorption III) Tubular Secretion

I) Ultrafiltration :

It takes place in Malpighian corpuscle. The blood in the glomerulus is under great pressure because the diameter of the efferent arteriole is smaller than that of afferent arteriole. Therefore all the constituents of blood except blood corpuscles/cells and few plasma proteins are filtered into the Bowman's capsule. This filtrate is called as ***glomerular filtrate.***

II) Selective reabsorption :

It takes place in the tubular region. When the glomerular filtrate reaches the tubule, the cells of the tubule reabsorb useful substances like glucose, amino acids, some salts and requisite quantity of water from filtrate and give it to blood separating out urea, surplus salt and water.

III) Tubular secretion :

This takes place in distal convoluted tubule. The substances which escapes the ultrafiltration in Bowman's capsule passes into the blood capillaries surrounding the tubular region. The cells of tubules separate the substances like ammonia, potassium ions, hydrogen ion, creatinine and put them back into the filtrate. The resulting fluid is the urine.

PROPERTIES OF URINE :

1. It is watery solution.
2. It is pale yellow in colour.
3. Its pH is alkaline i.e. 7.4 to 8.4
4. Its specific gravity is 1.032.
5. It is generally transparent.
6. The smell of urine is due to presence of volatile organic acids.
7. An adult cattle passes on an average 14 litres of urine per day.

IMPORTANCE OF EXCRETORY SYSTEM

Excretion means separation, collection and elimination of the liquid nitrogenous waste material resulting from the metabolic activities going on in the cells.

The ***main excretory organs*** are kidenys, though liver, lung and skin also serve as the part time workers in the process.

Removal of waste materials from the body is as essential as intake of food, water and oxygen. The metabolic activities going on in tissue cells produce nitrogenous byproducts like ammonia, urea and uric acid. These byproducts are not only useless but also poisonous and their accumulation in the body is harmful and may even prove fatal. To carry on the life processes smoothly, these poisonous substances must be eliminated.

✦✦✦

CHAPTER - 5 : DIGESTIVE SYSTEM

I] DIGESTIVE SYSTEM OF RUMINANTS.

The digestive system is composed of alimentary canal and its accessory glands. The alimentary canal consists of mouth, pharynx oesophagus, stomach, small and large intestines. (Fig 5.1) The accesory glands include salivary glands, liver and pancreas.

A) ALIMENTARY CANAL.

MOUTH :

1. It is cylindrical cavity containing tongue and teeth.
2. It is laterally formed by ***cheeks.***
3. The roof is formed by the ***hard palate.***
4. The floor is formed by ***mandible.***
5. It is anteriorly closed by ***lips.***
6. It is posteriorly separated from naso-pharynx by ***soft palate.***

Functions :

1. Prehension i.e. act of taking food into the mouth.
2. Mastication i.e. chewing of food.
3. Insalivation i.e. mixing of food with saliva.
3. Deglutition i.e. act of swallowing food.
4. Rumination i.e.process involving regurgitation, remastication, reinsalivation and redeglutition of food .

Regurgitation i.e. pushing back food into the mouth from the stomach.

Lips : They serve as a organ of prehension in sheep, goat and horse.

Cheeks : They help the tongue in postioning food between teeth for chewing.

Teeth : These are hard, dense whitish structures embeded in gum and projects into mouth.

There are four types of teeth -

1. Incisors - Front teeth.
2. Canines - Corner teeth.
3. Premolars - ┐
4. Molars - ┘ Cheek teeth

In early age, the teeth are temporary and called as ***milk teeth or deciduous teeth.*** They are replaced in adult animals by permanent teeth.

The dental formulas for cattle are as follows.

a) Deciduous $I\frac{0}{8}\ C\frac{0}{0}\ P\frac{6}{6}\ M\frac{0}{0} = 20$

b) Permanent $I\frac{0}{8}\ C\frac{0}{0}\ P\frac{6}{6}\ M\frac{6}{6} = 32$

The numerator indicates teeth in upper jaw and the denominator indicates the teeth in the lower jaw.

The special features of permanent dental formula for cattle are -

a) Absence of incisors in upper jaw.

b) Absence of canines in either jaw.

Function : Chewing of food material.

Tongue : It is muscular organ situated on the floor of mouth cavity. It consists of base, body and a tip.

Functions :

1. It is the chief organ of prehension in cattle.
2. It is an organ of taste.
3. It also helps in mastication and deglutition.

PHARYNX :

1. It is conical or funnel shaped musulo-membranous sac.
2. It is common for both digestive and respiratory tract.
3. It is located just behind mouth cavity.
4. There are seven openings in pharynx which are as below -

Mouth cavity (Anteriorly)	: 1
Posterior nares (Dorsally)	: 2
Eustachian tubes (Laterally)	: 2
Oesophagus (Posteriorly)	: 1
Larynx (Ventrally)	: 1

Function :

It is a common passage for food, water and air.

OESOPHAGUS :

1. It is a musculo-membranous tube extending from pharynx to the cardia of the stomach.
2. It is divided into two parts i.e. cervical and thoracic.
3. The average length is about 90 cm and diameter is about 5 cm.

Function :

Passage for food.

RUMINANT STOMACH (FIG. 5.2) :

1. It is also called as ***compound stomach.***
2. It is made up of four compartments viz. rumen, reticulum, omasum and abomasum.
3. The first 3 compartments are collectively called as ***forestomach*** while the fourth compartment, abomasum, is called as ***true stomach.***
4. The average capacity of the stomach in adult cattle ranges from 100 - 230 litres depending upon the size of animal.

1) Rumen (Pouch) :

1. It is the first and the largest compartment of ruminant stomach.

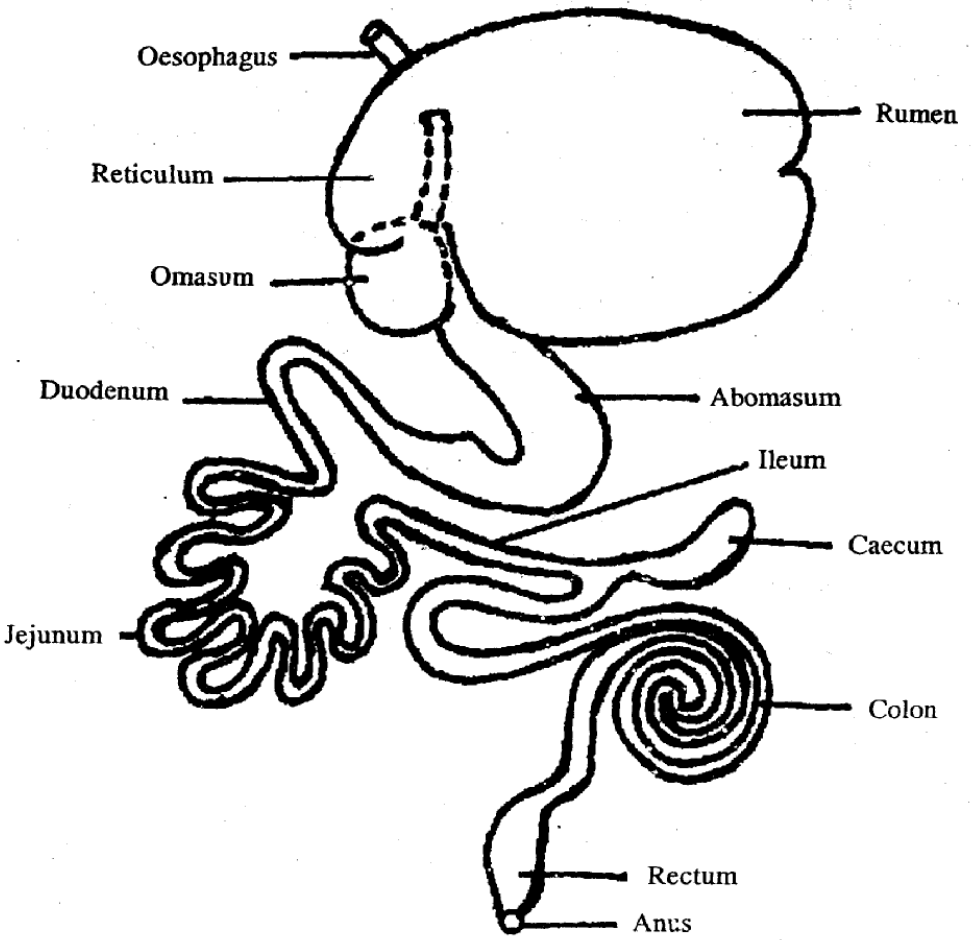


Fig. 5.1 : Digestive system of Ruminants

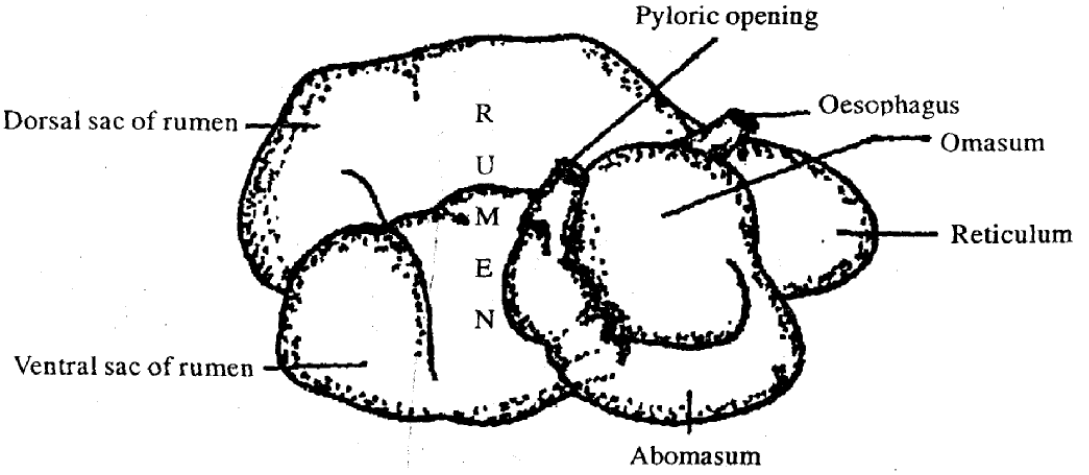


Fig. 5.2 : Ruminant stomach

2. It forms about 70-80% portion of ruminant stomach.
3. It is located in the left side of abdominal cavity from diaphragm to pelvis.
4. The rumen is subdivided into dorsal and ventral sacs by muscular pillars.
5. It is ***turkish towel*** like in appearance on its inner side.
6. It communicates with oesphagus and reticulum by means of cardiac and rumino-reticular openings, respectively.

Functions :

1. Storage of food
2. Churning of coarse fibrous feed.
3. Proper mixing of ingesta.
4. Synthesis of vitamins of B-complex group.
5. Microbial digestion of proteins, fats and carbohydrates.
6. Absorption of volatile fatty acids.
7. Expulsion of gases like CO_2 & methane.

2) Reticulum (Honeycomb)

1. It is the second and smallest compartment of ruminant stomach.
2. It forms approximately 5% portion of stomach.
3. It has ***honeycomb*** like structure on its inner side.
4. It is located behind diaphragm and opposite to heart.
5. It communicates with rumen and omasum by rumino-reticular and reticulo-omasal orifices, respectively.

Functions :

1. It separates foreign objects like nail, stone, wire from the ingested food.
2. It acts as a filter for food material.
3. It helps in regurgitation.

3) Omasum (Manyplies) :

1. It is third compartment of ruminant stomach.
2. It is spherical or elliptical in shape.
3. It forms approximately 7-8% portion of ruminant stomach.
4. It is located on right side of the abdominal cavity just behind reticulum.
5. It contains 100 crecent shaped folds called ***'laminae'.***
6. It communicates anteriorly with reticulum and posteriorly with abomasum by means of reticulo-omasal and omaso-abomasal orifices, respectively.

Functions :

1. It removes about 50% of water from ingested food material.
2. It absorbs volatile fatty acids.
3. It also grinds coarse food particles.

4) Abomasum (True stomach)

1. It is fourth compartment of ruminant stomach.
2. It is also called as ***true stomach*** of ruminant because it is glandular and resembles to the simple stomach in form and structure.
3. It is elongated, saccular in shape.
4. It forms approximately 7-8% portion of ruminant stomach.
5. It is situated on the floor of abdominal cavity, ventral to the omasum on right side of the rumen.

6. The anterior part of abomasum is known as *'fundus'* while the terminal part is known as *'pylorus'*.
7. There are about 12 oblique folds within the fundus.
8. It communicates anteriorly with omasum and posteriorly with duodenum by means of omaso-abomasal and pyloric openings, respectively.

Functions :

1. Passes food from omasum to small intestine.
2. Undertakes little digestion of food particularly microbial proteins.
3. Absorption of volatile fatty acids to some extent.
4. Secretes gastric juice which contains hydrochloric acid and enzymes like *pepsin* and *rennin*.

SMALL INTESTINE :

1. It extends from pylorus to ileo-caecal junction.
2. Its average length is about 50-52 meters in cattle.
3. Its average diameter is 5-6 cm.
4. The innermost lining of small intestine has long finger like projections called ***villi.***
5. The villi increases the surface area for absorption of food nurients.
6. It is divided into 3 parts viz. duodenum, jejunum, ileum.

1) Duodenum :

1. It is the first part of small intestine.
2. It forms 'S' shaped loop.
3. It is approximately 1 metre in length.
4. The bile and pancreatic ducts open into duodenum.
5. It is located in sublumbar region.

2) Jejunum :

1. It is indistinctly separated from duodenum.
2. It is approximately 48-50 meters in length (longest)
3. It is located on the floor of abdominal cavity on right side.

3) Ileum :

1. It is the terminal part of small intestine.
2. It extends upto ileo-caecal junction.
3. It is approximately 1 meter in length.

Functions :

1. Receives food from abomasum and passes to large intestine.
2. Secretion of digestive juices.
3. Digestion of carbohydrates, fats and proteins.
4. Absorption of digested food i.e. glucose, amino acids & fatty acids.

LARGE INTESTINE :

1. It extends from ileo-caecal junction to the anus.
2. It is about 11 - 12 meters in length.

3. Its diameter varies from 5-15 cm.
4. Villi are absent.
5. It is divided into 3 parts viz. caecum, colon, rectum.

1) Caecum :

1. It is a blind sac situated between ileum and the large colon.
2. It is located on right side of the abdominal cavity.
3. It is about 0.8 meter long and 5" in diameter.

2) Colon :

1. It is the second portion of large intestine.
2. It is located on the right dorsal part of the abdomen.
3. It is arranged in coils.
4. It is approximately 10 meters long and 5" in diameter.

3) Rectum :

1. It is the terminal part of large intestine.
2. It is located in the pelvic cavity.
3. It is little less than 30 cm in length.
4. Its wall is more thick and dilated than caecum and colon.
5. It is closed posteriorly by sphincter muscles called ***anal sphincter.***

Functions :

1. Microbial digestion of food material to some extent.
2. Absorption of food nutrients to some extent.
3. Absorption of water.
4. Stores food residue temporarily in rectum.

B) ACCESSORY GLANDS

SALIVARY GLANDS :

They are - i) Parotid ii) Mandibular and iii) Sublingual.

1) Parotid glands :

1. These are triangular, long & reddish brown glands .
2. These are situated at the base of ear.
3. They open in mouth opposite to fifth upper molar teeth as ***stenson's duct.***

2) Mandibular or Submaxillary glands :

1. These are elongated, pale yellow, lobulated glands.
2. These are situated along the medial border of the angle of mandible.
3. They open on the floor of mandible as mandibular or submaxillary duct.

3) Sublingual glands :

1. These are two glands situated under tongue.
2. They open in the mouth cavity by the side of submaxillary duct.

Functions :

1. They secrete saliva.
2. Saliva acts as lubricant and helps in mastication & deglutition.

3. Saliva maintains pH and fluidity of ruminal contents.
4. The saliva of domestic animals contains little or no amylase.

PANCREAS :

1. It is flat and irregularly quadrilateral in shape.
2. It is located in the duodenal loop.
3. It is reddish yellow in colour.
4. It weighs about 300-500 gms.
5. It is ***endocrine*** as well as ***exocrine*** gland.
6. It is communicated with duodenum by ***pancreatic duct.***

Functions :

1. The endocrine portion contains ***Islets of Langerhans*** which produces hormones like ***insulin*** and ***glucagon.***
2. The exocrine portion secretes ***pancreatic juice*** which contains three digestive enzymes namely:
   - ***a) Trypsin*** : helps in digestion of proteins.
   - ***b) Lipase*** : helps in digestion of fats / lipids.
   - ***c) Amylase*** : helps in digestion of carbohydrates / starch

LIVER :

1. It is the largest gland in the body.
2. It is situated on right side of the abdominal cavity near diaphragm.
3. It is irregularly rectangular with rounded corners.
4. It is reddish brown in colour.
5. It is soft and pliable.
6. It weighs about 3 - 5 kg in adult animals.
7. It consists of a body and two small lobes.
8. A pear shaped sac present near visceral surface of liver is called as ***gall bladder.***
9. A gall bladder acts as a reservoir or storehouse of ***bile.***
10. ***Bile duct*** carries bile from gall bladder to duodenum.

Functions :

1. It secretes bile which contains bile pigments and bile salts.
2. The bile salts help in emulsification and absorption of fats.
3. It plays important role in synthesis of plasma proteins like albumin, globulin, fibrinogen and prothrombin.
4. It helps in synthesis of tissue proteins.
5. It converts highly toxic ammonium salts into less toxic urea.
6. It helps in the synthesis and storage of glycogen.
7. It helps in the synthesis of fats from fatty acids and glycerols.
8. It stores minerals like Fe, Cu and Co.
9. It detoxifies toxins which have entered in blood circulation from digestive tract.
10. It helps in storage of fat soluble vitamins like Vit. A, D. E & K.

II. DIGESTIVE SYSTEM OF NON-RUMINANTS

The digestive system of non-ruminants (fig. 5.3) is very simple and it differs from ruminants mainly in the structure of stomach and to some extent in the large intestine.

SIMPLE STOMACH :

1. It is located just behind the left side of the diaphragm.
2. It is divided into three regions i.e. cardiac, fundic and pyloric.
3. The ***cardiac region*** is close to the oesophageal region.
4. The body of the stomach is called as ***'fundic region'.***
5. The caudal part of the stomach is called as ***'pyloric region'.***
6. The cardiac and pyloric sphincters separate the stomach from oesophagus and duodenum respectively.

Function :

It secretes gastric juice which contains hydrochloric acid, pepsin and renin.

Table 5.1 : Difference between Ruminants and Non - Ruminants

Ruminants	Non-Ruminants
1. They possess ruminant or compound stomach.	1. They possess simple stomach
2. Stomach is four chambered	2. Stomach is single chambered
3. Capacity of stomach is high	3. Capacity of stomach is less
4. Rumination takes place	4. No rumination
5. They ingest large quantity of food	5. They ingest small quantity of food
6. Microbial digestion is major	6. Microbial digestion is minor
7. Enzymatic digestion is minor	7. Enzymatic digestion is major
8. Maximum digestion & absorption of food takes place in rumen.	8. Maximum digestion and absorption of food takes place in intestine.
9. They can synthesize high quality proteins with the help of rumen microbes.	9. They can not
10. They can utilise non-protein nitrogenous (NPN) substances for protein synthesis.	10. They can not
11. They can digest cellulose.	11. They can not
12. End product of carbohydrate digestion is volatile fatty acids (VFA)	12. End product is glucose
13. Major carbohydrate digestion in rumen	13. Carbohydrate digestion takes place in intestine.
14. Major lipid digestion takes place in rumen	14. Lipid digestion takes place in intestine.
15. *e.g.*, Cattle, Buffalo, Sheep, Goat.	15. *e.g.*, Dog, Pig, Man, Horse.

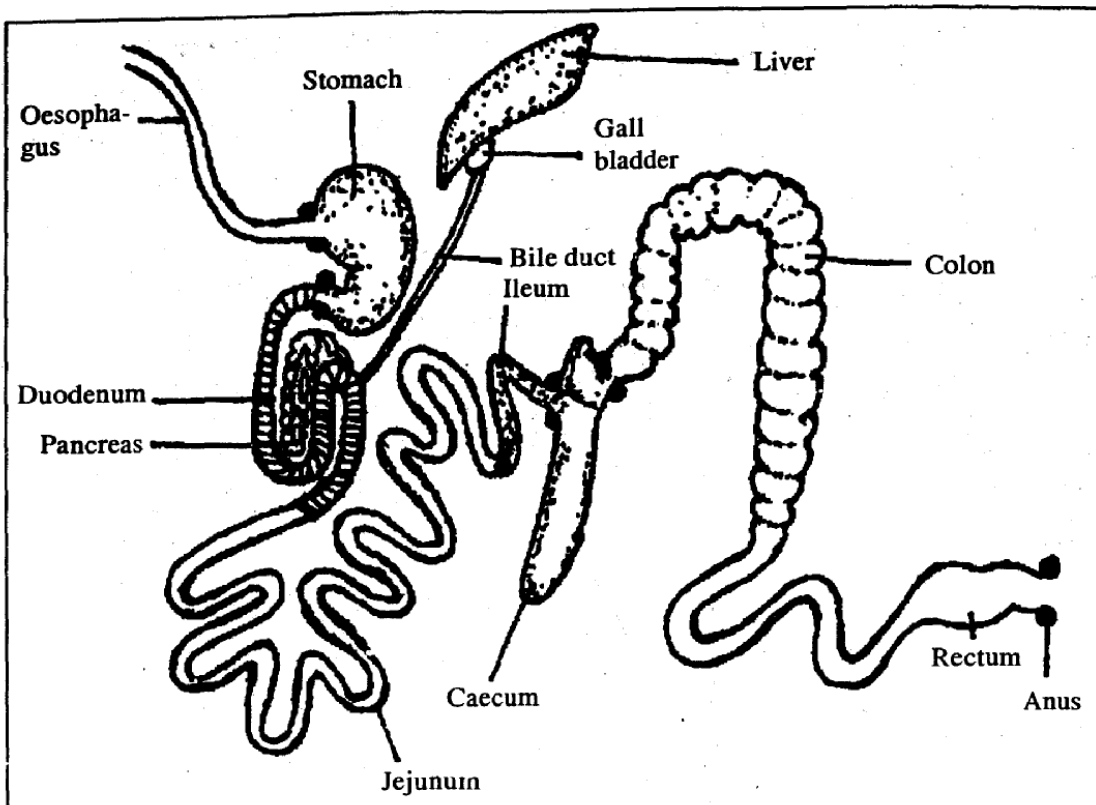


Fig. 5.3 : Digestive system of non-ruminant

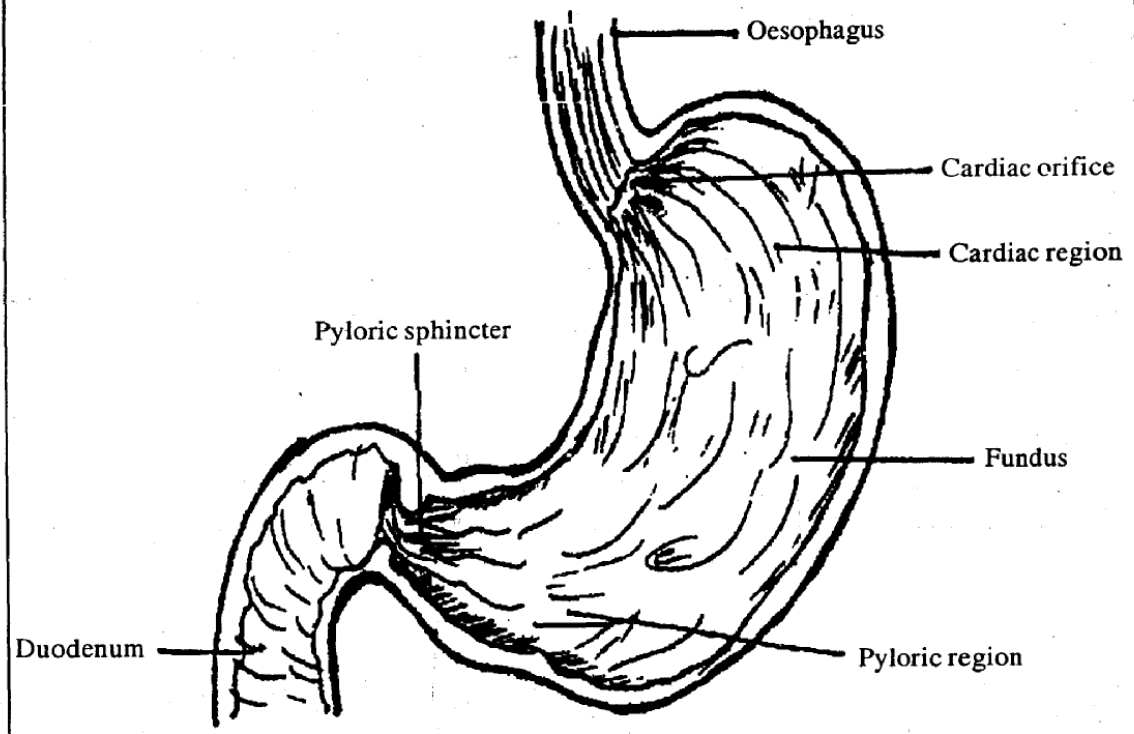


Fig. 5.4 : Simple stomach

DIGESTION IN SIMPLE STOMACH OR NON-RUMINANT ANIMALS

Mouth : Starch $\xrightarrow{\text{Salivary Amylase / Ptyalin}}$ Disaccharides

Stomach Secretion - Gastric juice

Pepsin	Hydrochloric acid	Rennin
↓	↓	↓
Protein → Polypeptides & Peptone	Maintains optimum pH for digestion	Coagulates milk protein

Small Intestine

Secretions - a) Pancreatic juice with trypsin, lipase & amylase
b) Bile - bile salts
c) Intestinal juice - dipeptidase & invertase consisting of lactase, maltase & sucrase

Proteins, Polypeptides & Peptones $\xrightarrow{\text{Trypsin}}$ Dipeptides.

↓ Dipeptidase

Amino acids

↓

Absorbed through small intestine

Fats/Triglycerides $\xrightarrow{\text{Bile salts}}$ Fat emulsion

↓ Lipase

Monoglycerides

↓

Absrobed through small intestine

Starch/Glycogen $\xrightarrow{\text{Amylase}}$ Disaccharides like

Maltose $\xrightarrow{\text{Maltase}}$ Glucose

Sucrose $\xrightarrow{\text{Sucrase}}$ Glucose

Lactose $\xrightarrow{\text{Lactase}}$ Glucose + Galactose

Absorbed through small intestine

Large intestine : Absorption of remaining digested nutrients. Undigested material is expelled as faeces through anus via rectum.

RUMINANT DIGESTION

Digestion : It is the process of conversion of complex food material into its simpler form.

Enzymes : These are soluble organic catalysts manufactured by living cells.

Mouth :

The offerred feed is taken up by the animal with the help of tongue and is partially chewed and swallowed. The swallowed food reaches rumen. Animal during rest brings back the food into mouth by regurgitation, where it is remasticated, reinsalivated and again swallowed. This act is called as ***rumination*** which is the typical feature of ruminant animals. After rumination, food reaches the rumen where major digestion takes place.

Rumintant Stomach :

In rumen, the carbohydrate components of the diet like cellulose, hemicellulose, starches, sugars are converted to volatile fatty acids i.e. ***Acetic acid, Propionic acid and Butyric acid*** along with production of gases viz. methane & carbon dioxide. These volatile fatty acids are absorbed through ruminal wall and the gases are eructed through mouth during rumination.

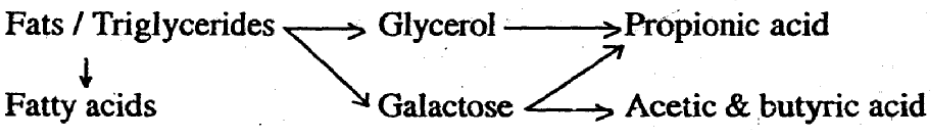
Cellulose
Hemicellulose
Pectin
Starch
} Carbohydrates —Microbial enzymes→ Volatile fatty acids like acetic acid, propionic acid & butyric acid + Gases like methane & CO_2

The feed proteins are hydrolysed to amino acids and peptides by the proteolytic enzymes produced by ruminal microbes , while small portion of dietary proteins escape ruminal action which are called as ***bypass proteins***. Some amount of amino acids formed are used by microbes for their body protein synthesis. The remaining amino acids are then deaminated to produce ammonia, CO_2 and short chain fatty acids. Further the NPN substances from the diet are also converted to ammonia in rumen. The ammonia thus formed in the rumen is mostly utilized by rumen micro-organisms to synthesize their body proteins. The ammonia reaching the liver is converted to urea. Some part of this urea recycles back in the rumen through saliva or ruminal wall, however major portion is excreted in the urine.

Protein
↓
Peptides
↓
Amino acids ⟶ Ammonia
↓
Microbial proteins

NPN
↓
Ammonia

Fats / Triglycerides are converted to glycerol and galactose which in turn are converted to volatile fatty acids (VFA) by microbial enzymes.



The heavier food components settles down in the reticulum, thus reticulum acts as a filter for food material. The food then reaches the omasum where about 50% of water from food material is removed. The omasum also helps in fine grinding of food material.

The food after reaching abomasum is acted upon by the gastric juice which contains hydrochloric acid, mucin and enzymes like pepsin, rennin and lipase.

a) Hydrochloric acid -

i) It activates pepsinogen to form pepsin.

ii) It provides suitable pH for enzymatic action of pepsin.

iii) It also protects body by killing most foreign bacteria ingested with food.

$$\text{Pepsinogen} \xrightarrow{\text{HCL}} \text{Pepsin}$$

b) Rennin - It is present only in calves and which coagulates milk proteins.

$$\text{Casein} + Ca^{++} \xrightarrow{\text{Rennin}} \text{Calcium Paracaseinate (Coagulum)}$$

c) Pepsin - It hydrolyses small amount of microbial body proteins & bypass dietary proteins into peptones / polypeptides.

$$\text{Microbial / Dietary bypass proteins} \xrightarrow{\text{Pepsin}} \text{Peptones and Polypeptides}$$

d) Gastric lipase - It hydrolyses fats into fatty acids and glycerols.

$$\text{Fats} \xrightarrow{\text{Lipase}} \text{Fatty acids + Glycerols}$$

Small Intestine :

The partially digested food then reaches to small intestine where the action of bile, pancreatic juice and intestinal juice completes the remaining digestion.

The ***bile*** secreted by liver reaches to duodenum through bile duct. The bile contains ***bile salts*** (sodium and potassium salts of taurocholic and glycocholic acids) and ***bile pigments*** (bilirubin and biliverdin). The bile activates the secretion of pancreatic lipase. Further bile salts help in the emulsification of the fats.

$$\text{Fats} \xrightarrow{\text{Bile}} \text{Fat emulsion}$$

The pancreas secretes pancreatic juice which is carried to duodenum by pancreatic duct. Pancreatic juice contains three enzymes namely ***trypsin, lipase or steapsin and amylase or amylopsin.***

a) Trypsin converts food and microbial proteins to short chain peptides.

b) Lipase hydrolyses fats into fatty acids and glycerols

c) Amylase converts disaccharides to monosaccharides.

The intestinal juice contains enzymes like ***enterokinase, peptidase & invertase***

a) Enterokinase - activates trypsinogen to form trypsin.

b) Peptidase converts peptides to amino acids.

c) Invertase is composed of 3 enzymes i.e. maltase, sucrase & lactase. They convert diasaccharides into monosaccharides.

The end products of nutrient digestion are then absorbed through villi of small intestine and reaches blood and lymph circulation.

Large intestine :

The digested but unabsorbed food components and water are absorbed through large intestine. While the undigested and unabsorbed portion mixes with the mucous secreted by large intestine and also with the glycerols and soluble soaps to form ***faeces.*** The peristaltic movement of large intestine expels out the faeces through anus via rectum.

CHAPTER - 6 : REPRODUCTIVE SYSTEM

I. FEMALE REPRODUCTIVE SYSTEM

Reproductive organs of cow can be divided in three parts as -

a) Primary sex organs : Ovaries
b) Reproductive tract : Fallopian tubes, uterus, cervix & vagina
c) External genitalia : Vestibule, clitoris and vulval lips.

OVARIES :

1. They are situated in pelvic cavity.
2. They are two in number i.e. right and left.
3. They are oval in shape.
4. Each ovary is about 1-3 cm in length, 1cm in thickness and 3 cm in width.
5. They weigh about 7-15 gms.
6. Right ovary is slightly larger than left.
7. Each ovary consists of number of primordial follicles ranging between 75,000 to 3,00,000.
8. The follicles reach maturity through successive developmental stages. Viz. primary, growing and mature follicle.

Functions :

1. Formation of Ova or eggs (Oogenesis)
2. Secretion of female sex hormones -
   a) Estrogen - secreted by follicular cells, is responsible for development of secondary sexual characters and sexual behaviour in females.
   b) Progesterone - secreted by corpus luteum, is essential for maintenance of pregnancy.

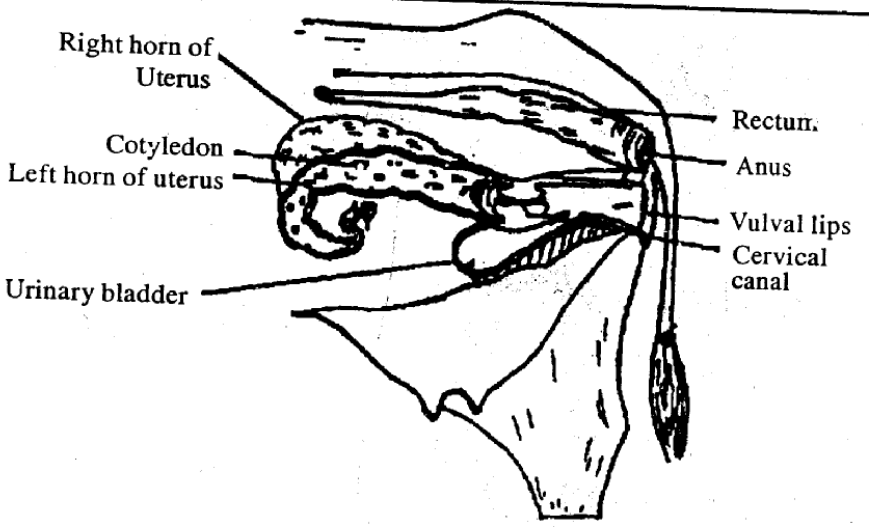


Fig. 6.1 : Genitalia of Cow

FALLOPIAN TUBES :

1. These are also called as oviducts or salpinx or uterine tubes.
2. These are slender, zigzag like tubes.
3. They are two in number.
4. They extend from ovaries to uterus.
5. They are about 20-25 cm in length and 2 mm in width.
6. Each fallopian tube is divided into -

a) Infundibulum - It is funnel shaped structure located at the ovarian end.

b) Ampulla - It is the middle part of fallopian tube.

c) Isthmus - It is constricted portion of fallopian tube which lies close to uterus.

Functions :

1. Infundibulum collects ovum or egg released by ovaries.
2. Fertilization of ova takes place in ampulla.
3. Transport of sperms to the site of fertlization.
4. Transport of zygote to the uterus.

UTERUS :

1. It is hollow, elongated, musculo membranous 'Y' shaped sac.
2. It consists of short body and two horns.
3. It is located in pelvic cavity in non-pregnant animals, however in pregnant animal it descends in abdominal cavity.
4. It continues anteriorly with fallopian tubes and posteriorly with cervix.
5. Each uterine horn is 35-40 cm in length and 2 to 5 cm in width.
6. The body of uterus is short i.e. 2.5 - 3 cm in length and tapers towards the cranial end.
7. The inner mucosa of uterus has raised spots called ***'caruncles'***.

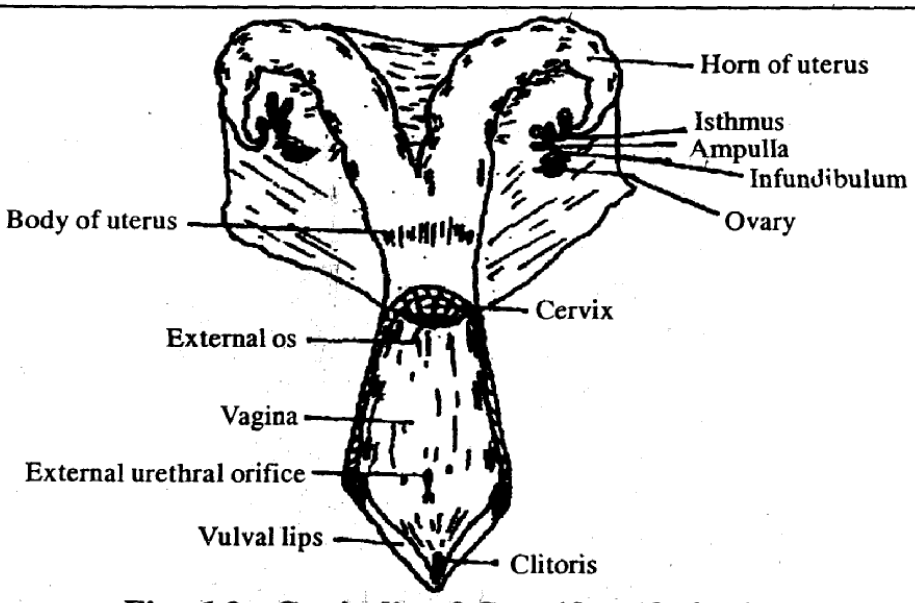


Fig. 6.2 : Genitalia of Cow (dorsal view)

Functions :

1. Transport of sperms towards the fallopian tubes.
2. Secretion of ***uterine milk*** for nourishment of embryo.
3. Implantation of zygote.
4. Maintenance of the pregnancy.
5. Uterine contractions help in expulsion of foetus during parturition.
6. Regulates oestrus cycle by secreting prostaglandins.

CERVIX :

1. It is also known as ***'neck of the womb'.***
2. It is thick walled fibrous structure.
3. It lies between the uterus and vagina.
4. It is about 10 cm in length and 3 cm in diameter.
5. Its inner wall is arranged in the form of annular rings which gives spiral shape to the cervical canal.
6. The cervical canal is tightly closed during pregnancy and anoestrus, however relaxes during oestrus and parturition.

Functions :

1. Storage and transport of sperms during oestrus.
2. Secretion of mucus during oestrus stage.
3. Acts as a barrier against ascending type of infections.
4. Formation of cervical seal during gestation/pregnancy.

VAGINA :

1. It is highly elastic musculo-membranous tube.
2. It is situated on floor of pelvic cavity above the urinary bladder and below rectum.
3. It is about 20-25 cm long and 10-15 cm wide.
4. It extends from cervix upto urogenital sinus or ***vestibule.***
5. Urethra opens on floor of vagina as external urethral orifice.

Functions :

1. It is the organ of copulation in females.
2. It acts as a birth canal.

VULVA :

1. It is the external opening of the uro-genital tract.
2. It lies just below the anus.
3. It has two lateral vulval lips, which are large, soft, thick and normally wrinkled.
4. The ***clitoris*** is a small, rod like, erectile muscular elevation present on the posterior floor of the vulva.
5. The ***hymen*** is a transverse membranous partition situated infront of urethral orifice between vulva and vagina.

II. MALE REPRODUCTIVE SYSTEM

The reproductive system of ox can be divided in 3 parts as

a) Primary sex organs	: Testicles
b) Secondary sex organs	: Epididymis, vas deferens and penis.
c) Accessory sex glands	: Seminal vesicles, Prostate and Bulbo-urethral glands.

TESTES :

1. They are suspended in the scrotum by ***spermatic cord.***
2. They are two in number.
3. They are oval in shape.
4. They are 12-16 cm in length and 6-8 cm in width.
5. The average weight of adult testis is 300 - 500 gms.
6. Each testes consist of a mass of ***seminiferous tubules*** surrounded by ***tunica vaginalis.***
7. Seminiferous tubule is made up of two types of cells i.e.
   a) Germ cells which forms spermatozoa and
   b) Sertoli cells which acts as ' sperm mother cells', or 'nurse cells'.
8. In between two seminiferous tubules, ***interstitial cells*** or ***leydig cells*** are present which produce male sex hormone i.e. ***testosterone*** or ***androgen.***
9. All the seminiferous tubules unite and form a duct called ***rete-testis.***
10. About 12-15 tubules arising from rete - testis join the epididymis to form ***vasa efferentia.***

Functions :

1. They produce sperms i. e. male gametes.
2. They produce male sex hormone i.e. androgen which promotes development of secondary sexual characters in males.
3. They produce ***'testicular fluid'*** for transport of immature sperms in epididymis.

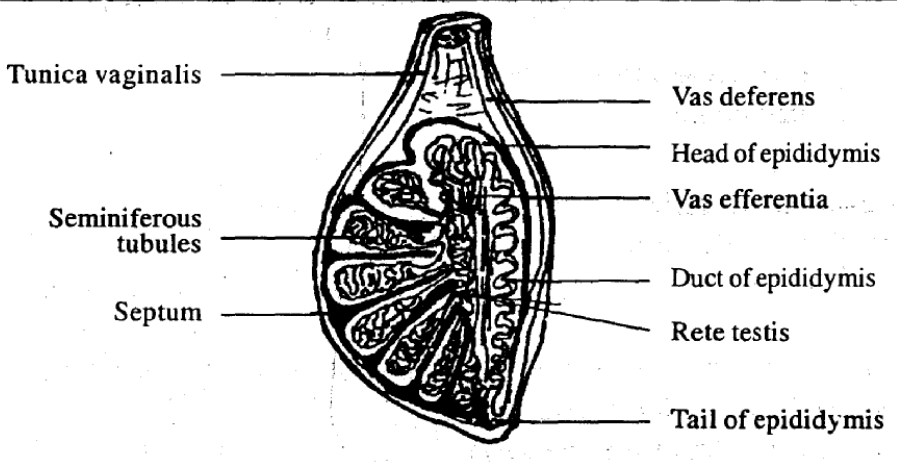


Fig. 6.3 : Longitudinal section of testis

SCROTUM :

1. It is a cutaneous pouch in which testicles are located.
2. The scrotal skin is thin, pliable and relatively hairless.
3. In adult bull, it is 20-25 cm long.
4. It is divided into two chambers by central membrane called ***'scrotal septa'***.

Functions :

1. It holds the testes external to the body.
2. It regulates the temperature of testes by contractions, relaxations and through sweating. Temperature of testes is less by 1-2°c than body temperature.

EPIDIDYMIS :

1. It is coiled tube originating at dorsal part of the testes.
2. It is approximately 30-35 meters long.
3. It consists of head ***(caput)***, body ***(corpus)*** and tail ***(cauda)***.
4. ***Head*** is located at the top containing coils of vas efferentia.
5. The ***body*** is narrow and runs parallel to the long axis of testis.
6. The ***tail*** of the epididymis continues as vas deferens.

Functions :

1. Transport of spermatozoa.
2. Concentration of diluted sperm suspension.
3. Maturation of sperms.
4. The tail (cauda) serves as store house of sperms.

VAS DEFERENS :

1. These are two slender tubes.
2. They extend from tail of epididymis upto urethra.
3. Spermatic arteries, veins, nerves, muscles, and vas deferens forms ***spermatic cord.***
4. Each vas deferens goes through the ***inguinal ring*** and opens into urethra.
5. Terminal portion of both the tubes is little dilated and called as ***'ampulla'***.

Function :

Transport of sperm from epididymis to urethra.

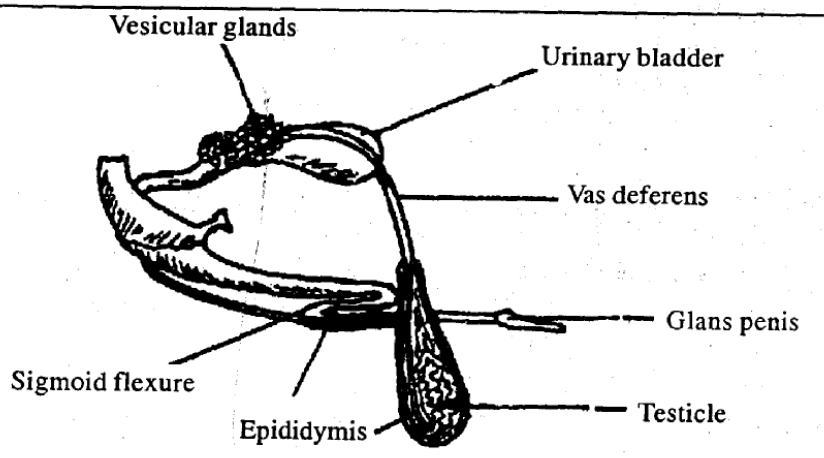


Fig. 6.4 : Urogenital organs of Ox

URETHRA :

1. It extends from the neck of the bladder to tip of the glans penis.
2. It has three distinct parts viz.
   a) The pelvic part - situated in pelvic groove.
   b) The bulb of urethra - situated at ischial arch.
   c) Penile part-incorporated within penis.

Function :

It is a common passage for urine and semen.

Penis :

1. It is cylindrical in shape.
2. It is about 3 feet long and 1 inch in diameter in adult bull.
3. It consists of 3 parts - root, body and glans.
4. The ***root*** begins at the ischial arch and is attached to the pelvis.
5. The ***body*** of penis consists of erectile tissue and major part of it is arranged in the form of ***'sigmoid flexure'*** ('S' shaped curve).
6. The ***glans penis*** is terminal part of the organ which is pointed and slightly twisted.
7. The free portion of penis in non-erectile state remains covered by a cutaneous pouch known as ***'prepuce'.***

Function :

Organ of copulation in male.

ACCESSORY SEX GLANDS

i) SEMINAL VESICLES :

1. These are two lobulated elongated glands situated in pelvic cavity.
2. They are located on either side of ampulla above the neck of urinary bladder.
3. Each gland is 10 - 12 cm long, 3 - 4 cm wide and 2 - 3 cm thick.
4. They secrete ***seminal fluid*** which is rich in fructose and citric acid.

ii) PROSTATE GLAND :

1. It is unpaired gland situated at the junction between neck of bladder and begining of urethra.
2. It is composed of body and glandular part.
3. Its average length is about 2cm & thickness is 1cm.
4. Approximately 30 ducts drain the secretion of gland into urethra.
5. Its secretion is high in proteins, enzymes and minerals.

iii) BULBO-URETHRAL GLANDS OR COWPER'S GLANDS :

1. These are two, small, round and compact glands.
2. These are situated above the urethra near ischial arch.
3. Secretion of Cowper's gland cleans the urethra of the deleterious effects of urine.

CHAPTER - 7 : NERVOUS SYSTEM

Nervous system performs important functions of co-ordination, integration and smooth activities of various parts of the animal body.

The nervous system consists of brain, brain stem, spinal cord, nerves and meninges.

NEURON

Neuron is the structural and functional unit of nervous system.

1. Each neuron consists of cyton (nerve cell) and its processes.
2. Cyton contains nucleus, nucleolus and Nissl bodies.
3. The cyton possesses two types of processes axon and dendron.
4. The ***dendrons*** are smaller processes which receives impulses.
5. An ***axon*** is the long process which conducts impulse away from the cyton.
6. The groups of axons travelling together are called as ***nerve fibres.***
7. At periphery nerve fibres group together to form ***nerve***.
8. The axon is covered with myelin sheath that forms constrictions at interval known as ***Node of Ranvier.***
9. Cytons with dendrons form the grey matter while the area predominantly containing nerve fibre forms the white matter of CNS.
10. Neurons are connected to each other by ***synapsis.***
11. ***Synapse*** is the connection between dendrons of one neuron with the axon of other neuron.
12. Neurons are unipolar, bipolar, multipolar depending on number of processes.

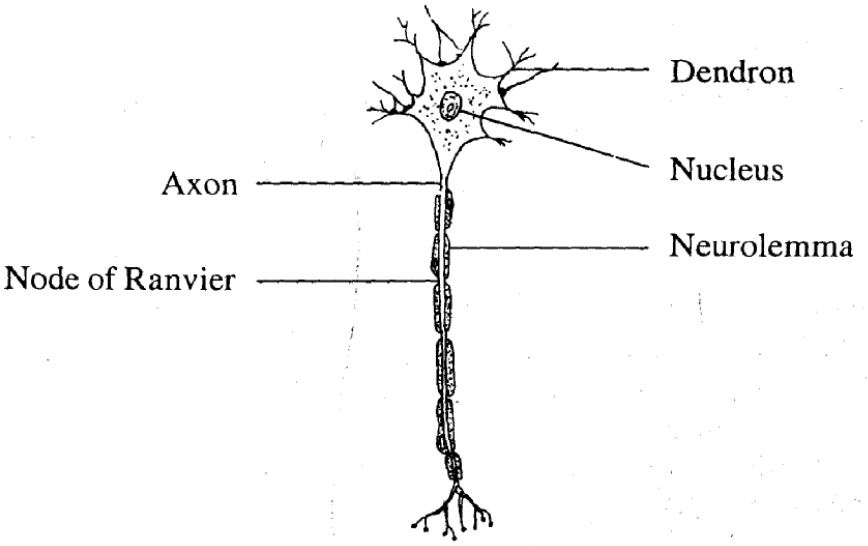


Fig. 7.1 Stucture of Neuron

13.Neurons are medullated or non-medullated based on presence or absence of myelin sheath on axon.

14.Neurons are also classified as

a) ***Sensory neurons :*** They conduct impulses towards CNS.

b) ***Motor neurons :*** They carry impulses from CNS to the effector organ/periphery.

Neuroglia : These are the supporting interstitial cells of nervous tissue.

Ganglion : It is aggregation of number of nerve cell bodies.

MENINGES

1. *Meninges are the membranous covering of the brain and spinal cord.*
2. These consist of three layers viz, dura mater, arachnoid and pia mater.
3. ***Dura mater :***
   a) It is the outermost tough fibrous covering
   b) It contains channels filled with blood called *sinuses*.
   c) The space located between dura mater of spinal cord and the surrounding vertebral column is *epidural space*.
4) ***Arachnoid :***
   a) It is the middle layer of meninges
   b) It is very thin delicate membrane
   c) The space between arachnoid and pia mater is called as *subarachnoid space* which is filled with CSF.
5) ***Pia mater :***
   a) It is the innermost delicate layer of meninges close to brain and spinal cord.
   b) It contains blood vessels which penetrate the CNS.

The nervous system is divided as

I) Central Nervous system : Brain, Spinal cord

II) Peripheral Nervous System ; Cranial and Spinal nerves

III) Autonomic Nervous System : Sympathetic and Parasympathetic

I. CENTRAL NERVOUS SYSTEM

A) BRAIN

1. It is present in cranial cavity of skull.
2. It consists of
   i) cerebrum ii) cerebellum and iii) brain stem (pons and medulla oblongata)
3. The brain is divided in three parts as
   a) Fore brain (Prosencephalon)
   b) Mid brain (Mesencephalon) and
   c) Hind brain (Rhombencephalon)

a)Fore Brain :

***Cerebrum* :**

1. It is ovoid in shape and represents largest part of brain.
2. It is divided in two symmetrical halves called *hemispheres*.
3. Hemispheres are separated by deep longitudinal cerebral fissure.
4. The outer surface of cerebrum possesses numerous folding to form convex ridges called *gyri* & furrows called *sulci* or *fissures*.
5. The cerebral hemisphere consist of anterior frontal pole and posterior occipital pole.
6. The frontal pole comprises two oval elongated structures called *olfactory lobes*.
7. The occipital pole is separated from cerebellum by means of transverse fissure.
8. The dorsal surface is convex whereas ventral surface is plano-concave.
9. *Cerebral cortex*/grey matter is the outer layer of the cerebral mass.
10. *Cerebral medulla* is the inner layer of cerebral mass.
11. *Corpus callosum* is an arch curved structure present at the roof of lateral ventricles.
12. *Fornix* is a white fibrous structure situated at the base of corpus callosum.
13. Corpus callosum is medially covered by transparent white membrane called *septum lucidum*.
14. There are two lateral ventricles viz, right and left situated in each cerebral hemisphere.
15. *Hippocampus* is an invagination of the cerebral cortex present at the lateral ventricles.

Functions :

1. It is concerned with most highly developed functions of CNS like memory, intelligence and moral sense.
2. It comprises centres for sense of smell, sight, taste and hearing.

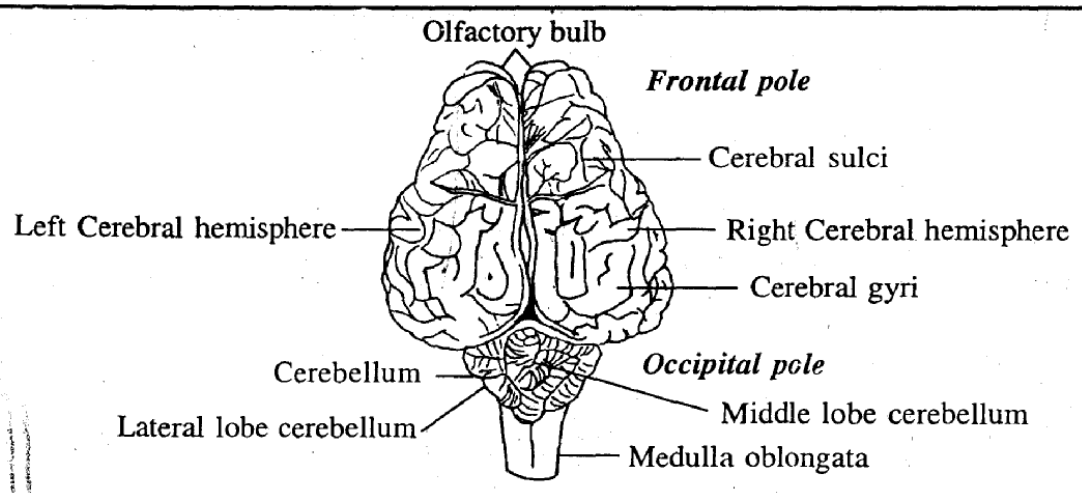


Fig. 7.2 Dorsal surface of the brain

b. Mid brain :

It consists of i) Corpora quadrigemina ii) Cerebral peduncles and iii) Aqueductus sylvi.

i) Corpora quadrigemina :

1. There are two pairs of rounded bodies which forms dorsal part of mid brain.
2. They comprises of superior and inferior colliculi
3. These colliculi are associated with sense of sight and hearing.

ii) Cerebral peduncles (crura cerebri) :

1. These are two broad bundles that forms the base of mid brain.
2. They contain nerve fibres that carry motor impulses.

iii) Cerebral aqueduct :-

* It is small passage that connects 3rd and 4th ventricle.

c. Hind brain :

i) Cerebellum :

1. It is irregularly globular structure located above pons and medulla oblongata
2. It consists of two lateral hemispheres and a median ridge called *vermis.*
3. The surface of cerebellum consists of many laminae called *folia.*
4. The cortex of cerebellum is made up of thin layer of gray matter which covers the white matter.
5. It has three pairs of peduncles.
   a) Anterior peduncle : Connects cerebellum with midbrain
   b) Middle peduncle : Originates from pons
   c) Posterior peduncle : Runs from spinal cord and enters the cerebellum.
6. It forms roof of the 4th ventricle.

Functions :

1. Monitoring the voluntary movements.
2. Maintenance of equilibrium
3. Regulation of posture by maintenance of reflex muscle tone.

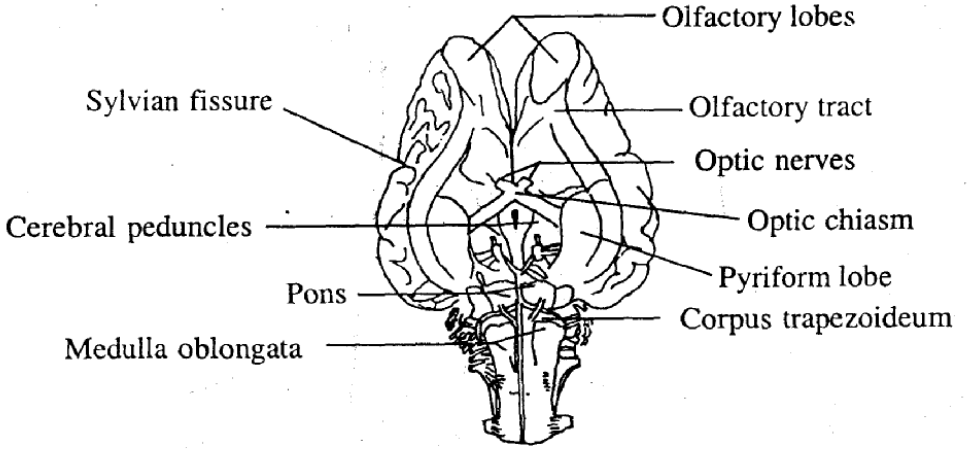


Fig. 7.3 Ventral surface of the brain

ii) Pons :

1. It is a transverse square structure situated ventral to the cerebellum.
2. It is separated from Crura cerbri anteriorly and medulla oblongata posteriorly by means of transverse fissure.
3. It forms anterior floor of fourth ventricle.

Function :

* It takes part in the control of respiration.

iii) Medulla Oblongata :

1. It is the cranial continuation of the spinal cord.
2. It extends from foramena magnum to the caudal margin of pons.
3. It is separated from pons anteriorly by means of transverse fissure.
3. The ventral surface bears, immediately behind the pons, a transverse band called *Corpus trapezoideum.*
4. Pyramids are present on either side of median groove of corpus trapezoideum.
5. On lateral side of each pyramid rounded mass is present called *olivary body.*

Functions :

1. It controls the involuntary actions such as respiration and heart rates, coughing, vomiting and reflex part of swallowing.
2. It also accommodates centres for thermoregulation

Ventricles :

1. These are large cavities in the brain which are interconnected.
2. There are two lateral ventricles i.e. right and left located within each cerebral hemisphere.
3. Third ventricle is located within diencephalon and connected to fourth ventricle by cerebral aqueduct.
4. Fourth ventricle is located between cerebellum above and pons and medulla oblongata below.
5. Ventricles of the brain contain cerebrospinal fluid (CSF)
6. CSF is formed by choroid plexuses
7. The CSF flows from lateral ventricles into third ventricle and then to fourth ventricle and finally into the subarachnoid spaces of brain and spinal cord.
8. *Functions of CSF* :
   a) Protection of brain and spinal cord
   b) Nourishment of brain and spinal cord
   c) Maintenance of balance of fluid pressure inside the cranial cavity.

B) SPINAL CORD

1. It is the thick, cylindrical structure located in the vertebral column.
2. It extends from the foramena magnum to the middle of sacrum.
3. The long roots attached to spinal cord at the termination of vertebral canal is termed as *cauda equina.*
4. The spinal cord is composed of central grey matter surrounded by white matter.

5. It receives sensory afferent fibres by way of dorsal roots of the spinal nerves.
6. It gives off motor efferent fibres to the ventral roots of spinal nerves.
7. The pairs of spinal nerve arise from the lateral aspect of spinal cord. These are cervical, thoracic, lumbar, sacral and coccygeal.

Functions :

1. It conveys nerve impulses to and from the brain.
2. It deals with spinal reflex action

II. PERIPHERAL NERVOUS SYSTEM

1. It includes nervous structures outside the brain and spinal cord.
2. It provides communication of external and internal environment stimuli toCNS
3. It comprises of A) cranial and B) spinal nerves.

A) CRANIAL NERVES :

* There are 12 pairs of cranial nerves
* The cranial nerves are either sensory, motor or mixed (sensory & motor)

The number, name and distribution of various cranial nerves is as below :

No.	*Name*	*Type*	*Distribution*
I	Olfactory	Sensory	Nasal mucosa (Smell)
II	Optic	Sensory	Retina of eye (Sight)
III	Oculomotor	Motor	Eye muscles
IV	Trochlear	Motor	Eye muscles
V	Trigeminal	Sensory	Face and Eye
		Motor	Muscles of mastication
VI	Abducens	Motor	Eye muscles
VII	Facial	Motor	Muscles of facial expressions.
		Sensory	Ear, tongue
VIII	Acoustic	Sensory	Ear (hearing & equilibrium)
IX	Glosso -	Sensory	Pharynx, tongue,
	pharyngeal	Motor	Muscles of pharynx
X	Vagus	Sensory	Pharynx and larynx
		Motor	Muscles of larynx.
XI	Accessory	Motor	Muscles of shoulder & neck
XII	Hypoglossal	Motor	Muscles of tongue

B) SPINAL NERVES :

* These includes a) Cervical b) Thoracic c) Lumbar d) Sacral & e) Coccygeal nerves.
* The pairs of spinal nerves in various species is as below
  Ox - 37, Horse - 42, Dog - 35, Fowl - 36

a) Cervical nerves :

* The first cervical spinal nerve leaves the spinal canal through lateral vertebral foramena of atlas.

* The second cervical spinal nerve emerges through lateral vertebral foramena of axis.
* Other cervical nerves passes through corresponding intervertebral foramena.
* The ventral primary branches of 5th, 6th and 7th cervical spinal nerves unite together to form phrenic nerve which supplies to diaphragm.

b) Brachial plexus :

* It is formed by convergence of ventral rami of 6th, 7th and 8th cervical and 1st and 2nd thoracic nerves.
* It is present in between thoracic wall and medial surface of shoulder.
* The nerves originating form brachial plexus and the region supplied is as below :

	Nerve	*Region supplied*
1.	External thoracic	Shoulder
2.	Thoraco-dorsal	Shoulder
3.	Pectoral	Shoulder
4.	Long thoracic	Shoulder
5.	Subscapular	Shoulder
6.	Suprascapular	Shoulder
7.	Axillary	Shoulder
8.	Musculo-cutaneous	Arm
9.	Radial	Arm and forearm
10.	Ulnar	Forearm and digit
11.	Median	Forearm and digit

c) Lumbosacral plexus :

* It is formed by ventral branches of 4th, 5th and 6th lumbar and 1st and 2nd sacral nerves.
* The right and left lumbosacral plexuses supply nerves to the respective hind limbs.
* The nerves of lumbosacral plexus and the region supplied is as below :

	Nerve	*Region supplied*
1.	Cranial gluteal	Rump
2.	Caudal gluteal	Rump
3.	Femoral nerve	Thigh
4.	Obturator nerve	Thigh
5.	Ischiatic/sciatic	Thigh
6.	Tibial	Leg
7.	Peroneal	Leg

d) The pudendal nerve is formed by union of ventral primary branches of 2nd, 3rd, 4th sacral nerves. The branches of pudendal nerve are pelvic, proximal cutaneous, distal cutaneous and deep perineal.

e) The Muscular/ middle hemorrhoidal nerve receives branches from 3rd and 4th sacral nerve and combines with pudendal nerve/ caudal rectal nerve.

f) Caudal rectal nerve is derived from ventral primary branches of 4th or 5th sacral nerve.

III. AUTONOMIC NERVOUS SYSTEM (ANS)

1. It is the visceral component of the nervous system.
2. The nerve fibres are distributed to the viscera, blood vessels, glands and smooth muscles.
3. ANS is divided in 2 sections i.e. parasympathetic and sympathetic.

a) Parasympathetic System :

i) It is derived from cranial and sacral portions of nervous system
ii) The preganglionic fibres are relatively long and the postganglionic fibres are short.
iii) The post-ganglionic ending liberates acetyl choline.
iv) It is controlled by anterior part of hypothalamus
v) It works during tranquillity

b) Sympathetic system :

i) It is derived from thoracic and lumbar segments of spinal cord.
ii) The pre-ganglionic fibres are shorter than post ganglionic fibres.
iii) Post-ganglionic ending liberates nor-adrenaline expcept in sweat gland and blood vessels of skeletal muscles.

4. The action of sympathetic and parasympathetic stimuli on various organs is as below.

Organ	Sympathetic	Parasympathetic
1. Heart		
a) Heart rate	Increased	Decreased
b) Cardiac output	Increased	Decreased
c) Contractility	Increased	Decreased
2. Bronchi	Dilation	Contraction
3. Sweat gland	Secretion	No reaction
4. Pilomotor muscles	Erection of feather or hairs	No reaction
5. Uterus	Contraction	Inhibition of Contraction
6. Eye-pupil	Dilatation (Mydriasis)	Constriction (Miosis)
7. Blood vessels	Vasoconstriction (hypertension)	Vasodilation (hypotension)
8. Salivary gland	Mucus secretion	Serous secretion
9. Bladder sphincter	Contraction	Relaxation
10. Sex organs	Ejaculation	Erection

CHAPTER - 8 : SENSE ORGANS

I. EAR

V. M. Salunke and A. U. Bhikane

- The ear is an organ of hearing.
- It is also responsible for maintenance of balance and equilibrium.
- Two ears are present in normal mammals.
- In most species, ears are held horizontally and slightly raised.

The ear consists of 3 portions

A) External ear B) Middle ear C) Internal ear

A) External ear :

The external ear comprises of following parts

1) *Auricula or pinna :*

* It is funnel shaped portion composed of thin elastic cartilage covered with skin.
* It helps in collecting sound waves.

2) *Auricular cartilage :*

* It comprises a single piece of fibroelastic cartilage.
* It connects the ear to temporal bone by ligaments.

3) *External auditary / acoustic canal :*

* It is a membrane lined tube that connects the external ear to skull.
* It transfers the sound waves to tympanic membrane.

4) *Tympanic Membrane (Ear drum)*

* It separates the external ear from middle ear.
* It is a vibratary structure and converts sound waves to mechanical action.

B) Middle Ear :

1. It is a hollow chamber enclosed by petrous temporal bone.
2. It contains ossicles or ear bones.
3. The ossicles are composed of three bones namely malleus (hammer), incus (anvil) and stapes (stirp)
4. These bones serve to transmit and amplify the vibrations of tympanic membrane to inner ear.
5. The middle ear has four openings ;
   a) ***External acoustic meatus*** - opens the auditary canal to middle ear.
   b) ***Fenestra ovalis*** - It is a oval window.
   c) ***Fenestra rotundum*** - It is a round window
   These oval and round windows communicate middle ear to internal ear.
   d) ***Eustachian tube*** : It connects middle ear to nasopharynx. Its function is to equalize the air pressure between middle and external ear. It also prevents the buldging of ear drum and impairment of receiving sound waves.

C) Internal Ear :

* It is essential portion of the organ of hearing and equilibrium.
* It is also called as *labyrinth.*
* It is divided into osseous labyrinth and membranous labyrinth.

a) *Osseous labyrinth :* It is divided into 3 parts

1) *Vestibule :* It is a bony cavity, oval in outline and communicates cochlea in front and semicircular canals behind.

2) *Semi-circular canals :* These are three curved bony tubes which communicate with vestibule and form complete circle.

3) *Cochlea :* It is a conical and helical cavity resembling snail shell.

* It forms rostral part of labyrinth.
* It consists of organs and nerve endings concerned with balance and equilibrium.

b) *Membranous labyrinth* :

1. It consists of a series of closed membranous sacs containing fluid i.e. endolymph.
2. The sac occupies the central position in labyrinth.
3. It includes cochlear duct, saccule, utricle and three ducts of semicircular canals.
4. The vestibule contains two membranous sacs *utricle* and *saccule.*
5. The *cochlear duct* contains auditary apparatus of the *organ of corti.*
6. The organ of corti is made up of a series of rod-like bodies arranged in rows and these bodies are contacted by a vibratory portion called *tectorial membrane.*
7. The organ of corti receives and converts sound waves to nerve impulses.

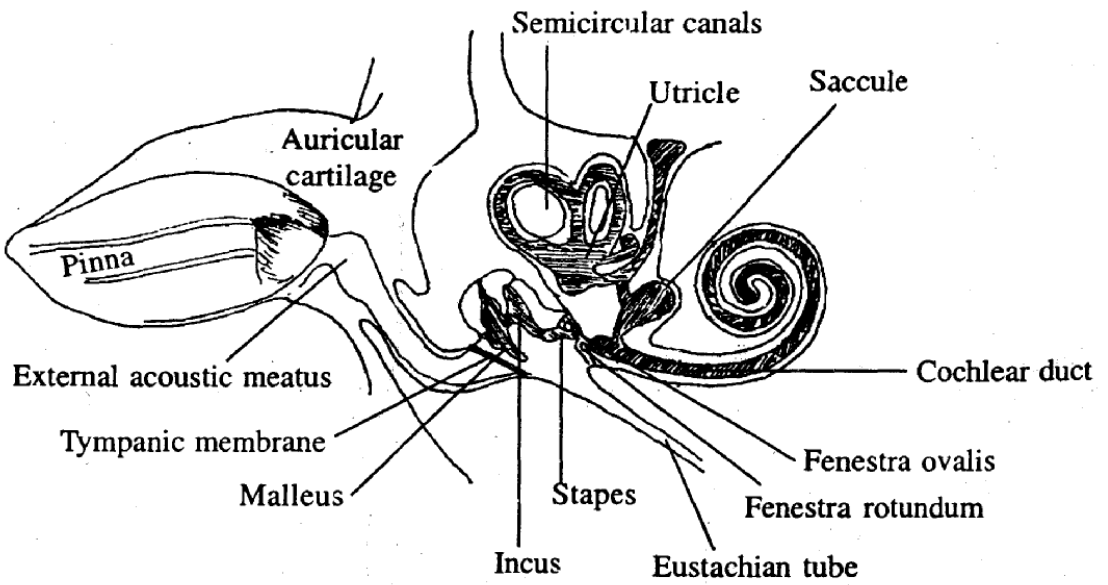


Fig. 8.1 Structure of ear

Mechanism of hearing :

The size of ear pinna is bigger than ear drum which helps in concentrating the sound waves on ear drum. When sound waves falls on ear drum, it is set into the vibrations which leads to vibrations of the ossicular chain in the middle ear. Then the foot plate of stapes, a connecting portion between middle and inner ear transmits these vibrations into the inner ear fluid. This stimulates the organ of corti from where the impulses are send to the brain via acoustic nerve and sound is interpreted.

II. EYE

G. U. Yadav and A. U. Bhikane

- The eyeball is situated within the bony cavity known as ***orbit***.
- The anterior part of eye comprises eyelids, conjunctiva, cornea, sclera, iris, pupil and anterior capsule of lens.
- The posterior part includes the remaining portion of eye.

Eyelids :

1. They are two in number.
2. They protect front portion of the eyeball.
3. They possesses stiff hair termed ***eyelashes***.
4. The angles at corners of the eyelids are known as ***canthi***. The canthi are two in number medial and lateral.
5. The margin of each eyelid has number of sebaceous tarsal and meibomian glands. They secrete waxy substance which helps to prevent overflow of tears on face.
6. The eyelids maintain the amount of light entering in eye.
7. ***Third eyelid/membrana nictitans*** is present at medial canthus of eye.
8. ***Harderian glands*** are situated on inner surface of third eyelid close to its outer border.

Conjunctiva :

1. It is mucous membrane of eye.
2. The portion of conjunctiva which lines/covers the eyelids is known as ***palpebral conjunctiva***.
3. The portion covering eyeball proper is termed as ***bulbar conjunctiva***.
4. ***Cul-de-sac*** is the pouch formed by junction of palpebral and bulbar conjunctiva.
5. ***Fornix*** is the transition portion of bulbar to palpebral conjunctiva forming a fold between lid and globe.

Lacrimal gland :

1. It lies in the depression beneath supraorbital process.
2. It opens into conjunctival fornix by means of small openings.

3. It secretes tears which -
   a) Lubricates the eyeball.
   b) Nourishes cornea.
   c) Has got bactericidal property.

Eyeball :

The eyeball proper consists of 3 layers or tunics

a) *External tunic* :

1. It is the outer protective fibrous coat of the eyeball.
2. It comprises of cornea and sclera.
3. *Cornea* is a transparent anterior portion of external tunic of eye.
4. *Sclera* is opaque (whitish) posterior portion of external tunic.
5. *Limbus* is junction between cornea and sclera.

b) Vascular tunic :

1. It is the layer in between sclera and retina.
2. It consists of iris, ciliary body and choroid.
3. *Iris* is muscular diaphragm between cornea and lens with an opening at centre called as *pupil.*
4. *Ciliary* body is anterior thickened part of choroid having ridges, called ciliary processes and ciliary muscles.
5. *Choroid* is a dark coloured, thin vascular membrane that includes reflective layer called *tapetum lucidum* which gives greenish glare to eyeball at night.

c) Internal tunic :

1. It is the deepest layer of eyeball.
2. It is also called as nervous tunic or retina.
3. It is formed by expansion of optic nerve.
4. It (retina) contains rods and cones which are receptive to light stimuli.
5. The rods are more sensitive to light than cones. They are important for visual perception when the light is of low intensity as in dark.
6. The cones are less sensitive to light. They are most important when light intensity is high i.e. in day light.
7. The colour sensation is controlled by cones and rods

Anterior chamber : is a space between iris and cornea.

Posterior chamber : is a space between iris and lens.

***Aqueous humor* :**

1. It is clear fluid present in both anterior and posterior chambers.
2. It serves as a refractive medium.
3. It also nourishes avascular tissue like lens and cornea.

***Vitreous humor* :**

1. It is jelly-like mass lying between posterior surface of lens and retina i.e. posterior compartment of eyeball.

2. It acts as refractive medium.
3. It also helps to maintain shape and pressure of the eyeball.

***Lens*:**

1. It is biconvex transparent disc enclosed in a capsule.
2. It is located behind the pupil and infront of vitreous humor.
3. It is held in position by suspensory ligament.

* Dogs are colour blind & myopic because cones and rods are poorly developed.
* *Hyperopia* (far sighted) : cannot see object near to individual.
* *Myopia* (near sighted) : cannot see object at a longer distance.

Mechanism of vision :

1. Eye is considered as a camera in which a small and inverted image of external objects is formed on retina.
2. Rays of light passes from cornea to aqueous humor then through the pupil which is automatically narrowed or widened according to the strength of the light that passes through it.
3. The lens present immediately behind iris makes automatic alterations in their curvature and brings the light rays to a focus upon retina (via vitreous humor).
4. The rays which passes from lens and falls on retina do not bent however rays from peripheral region of the pupil bent back to a focus on retina.
5. Light reaching to retina is absorbed and a photochemical reaction converts this light into electrical impulses.
6. The electrical impulses then passes through optic nerve, optic chaisma, optic tract and into the lateral geniculate body from where optic radiations travels to the occipital lobe of cerebrum.
7. The cerebral cortex interprets the inverted image on retina as an upright one i.e. true image.

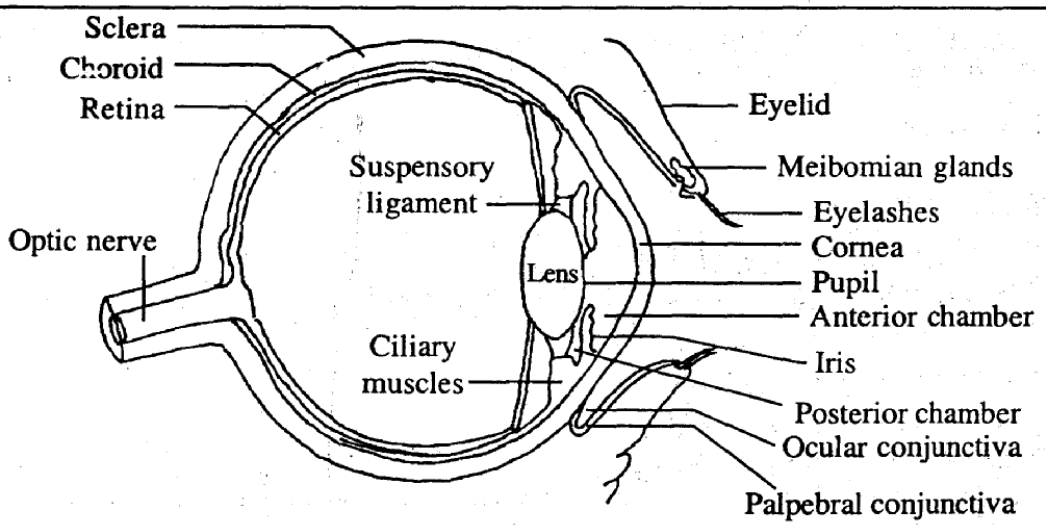


Fig. 8.2 Structure of eye

III. SKIN

- The skin is formed by embryonic ectoderm and mesoderm.
- It is tough, resilient and highly elastic tissue.
- It is stratified tissue consisting mainly two layers :
  a) Epidermis and
  b) Dermis or corium

a) Epidermis :

1. It is avascular, superficial layer of skin coat.
2. It covers the whole body.
3. It is made up of stratified squamous epithelium.
4. It contains keratinocytes and melanocytes
5. The colour of skin is related to the number of melanocytes present.
6. The epidermis comprises of two main layers :
   a) Stratum corneum.
   b) Stratum Malpighii.
7. ***Stratum corneum :***
   a) It is the outermost layer of epidermis.
   b) It is composed of dead keratinized cells which are shed continuously from skin surface.
   The process of drying and hardening of the superficial cells is called as keratinization.
8. ***Stratum Malpighii :***
   a) It is deeper layer of epidermis.
   b) It is again subdivided into stratum germinativum and stratum spinosum.
   c) *Stratum germinativum* is succulent viable one cell thick layer of columnar epithelium containing melanocytes. It is just above the dermis.
   d) *Stratum spinosum* is also called as prickle cell layer. This is broad layer of polyhedral cells filled with keratohyalin granules.
9. The associated structures like hair, horns, nails, claws, hooves develop from epidermis.

b) Dermis (corium) :

1. It lies between epidermis and subcutaneous layer.
2. It acts as a supportive stroma for the epidermis.
3. It is subdivided into papillary layer and reticular layer.
4. *The papillary layer* consists of ridges and nipple like projections.
5. *The reticular layer* forms the major part of dermis.
6. It contains arrector pili muscles.
7. It consists of fibrous connective tissue layer, collagen, capillaries and nerve endings.

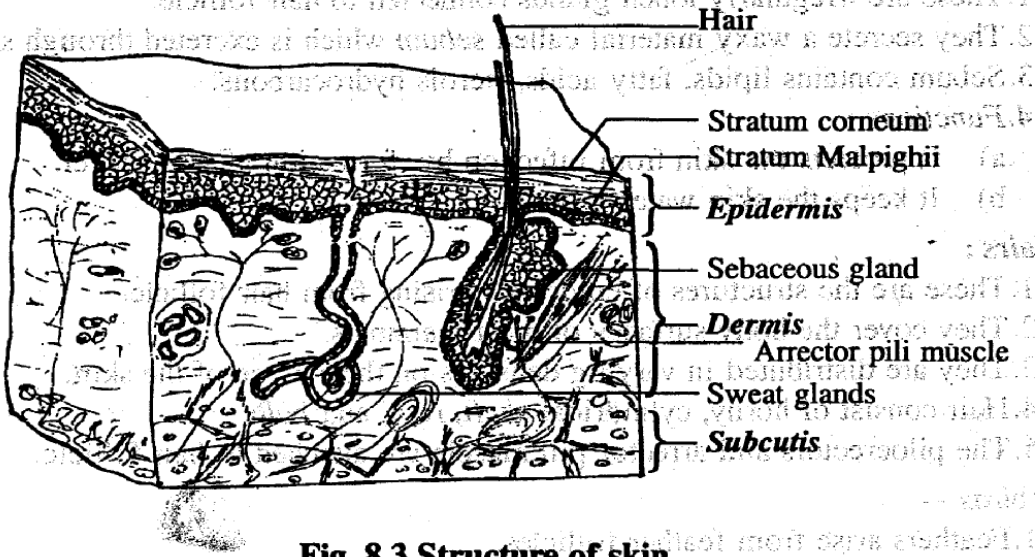


Fig. 8.3 Structure of skin

Subcutis or hypoderm :

* It is located below reticular layer of the dermis.
* It supports dermis and epidermis.
* It attaches skin to underlying structure.
* It stores fat which act as heat insulation.

Functions of skin :

1. It acts as a sensory organ which receives the sensation of touch, temperature and pain.
2. It protects the animal from mechanical injuries, noxious agents and irradiation.
3. It acts as excretory and secretory organ and so helps to maintain water and electrolyte balance.
4. It helps in thermoregulation by means of conduction, convection and radiation.
5. It is involved in Vit. D synthesis.

Associated structures :

The important associated structures of skin includes sweat glands, sebaceous glands, hairs and feathers.

***Sweat glands*:**

1. These are coiled tubular structures derived from epidermis and present into dermis.
2. They open to the skin surface by sweat pore and secrete sweat.
3. *Sweat* is watery fluid containing water, sodium chloride, lactic acid, urea, amino acids and glucose.
4. *Function* : Cooling the surface of body by evaporation.

Sebaceous glands :

1. These are irregularly lobed glands connected to hair follicle.
2. They secrete a waxy material called *sebum* which is excreted through skin.
3. Sebum contains lipids, fatty acids, sterols hydrocarbons.
4. *Functions* :
   a) It protects the skin from infection by formation of waxy layer.
   b) It keeps the skin water-proof.

Hairs :

1. These are the structures of epidermis arising from hair follicle.
2. They cover the body surfaces of most mammals.
3. They are distributed in varying densities on the surface of the skin.
4. Hair consist of horny, cylindrical *shaft, root,* and *bulb.*
5. The piloerectors and arrector pili muscle are attached to hair follicle.

In birds - - -

1. Feathers arise from feather follicles.
2. Feather follicles are rarely associated with skin glands.
3. Birds donot have sweat glands.
4. Birds/fowl have large sebaceous gland called *uropygial gland* dorsal to the tail.

CHAPTER - 9 : ENDOCRINOLOGY

N. Z. Gaikwad and A. U. Bhikane

Endocrinology is a branch of science which deals with endocrine glands and hormones.

Gland : It is group of cells having secretory and excretory function.

There are two types of glands :

a) Exocrine glands b) Endocrine glands

a) ***Exocrine glands :*** These glands are having ducts to carry away their secretions to the particular place or external surface of the body.
e.g. Liver, pancreas, seabaceous glands, peptic glands.

b) ***Endocrine glands :*** These are ductless glands that discharge their secretions directly in the blood or indirectly via. lymph. e.g. Pituitary, thyroid, parathyroid, adrenal glands, pancreas (Islets of langerhans cells)
Hormones are the chemical substances of endocrine gland that are directly secreted into blood which stimulate or inhibit the function of target organ.

Properties of hormones :

1. They are water soluble.
2. They are organic catalysts.
3. They have low molecular weight.
4. They are readily destroyed or inactivated as soon as their function is over.
5. They are very specific and act only on their target organs.
6. They produce slow lingering and long lasting effects.

The different endocrine glands, their site of action and functions are as below:

1. HYPOTHALAMUS

Hormone	Site of Action	Functions
1. Gonadotropin releasing hormone (GnRH)	Anterior pituitary	Releases LH and FSH
2. Thyrotropin releasing hormone (TRH)	---- ,, ----	Releases TSH.
3. Corticotropin releasing hormone (CRH)	---- ,, ----	Releases ACTH
4. Somatotropila releasing hormone (STH - RH)	---- ,, ----	Releases STH
5. Somatatropin inhibiting hormone (STH - IH)	---- ,, ----	Inhibit STH output
6. Prolactin inhibiting hormone (PTH)	---- ,, ----	Inhibit prolactin output
7. Prolactin releasing hormone (PRH)	---- ,, ----	Releases prolactin

2. PITUITARY GLAND

* Pituitary gland is oval, pea sized, reddish grey coloured structure located at the base of brain.
* It consist of three lobes namely anterior, intermediate and posterior.

I. Anterior pituitary gland :

This gland produces 6 hormones viz Growth hormone, Adrenocorticotropin, Thyrotropin, Prolactin, Luteinizing hormone and Follicle stimulating hormone.

1. Growth hormone (GH)/Somatotropic hormone (STH)

Site of action : All tissues.

Functions :

1. It stimulates overall protein synthesis in all living cells of body.
2. It is a hyperglycaemic hormone and works antagonistic to insulin.
3. It is mildly lipolytic and mobilises fat from adipose tissues.
4. It assists in increased absorption of Ca^{++} from intestine and kidney tubules and helps in its deposition in bones.
5. It promotes growth and elongation of long bones.
6. It has lactogenic effect.

2. Thyroid stimulating hormone (TSH)

Site of action : Thyroid gland

Functions :

1. Stimulates growth and metabolic activity of thyroid gland.
2. Enhances production of thyroxine.

3. Adrenocorticotropic hormone (ACTH)

Site of action : Adrenal cortex

Function :

* Maintenance of adrenal cortex

4. Prolactin

Site of action : Mammary gland and ovary

Functions :

1. It stimulates growth of mammary gland.
2. It initiates secretion of milk from properly developed mammary gland.
3. It maintains corpus luteum and stimulates progesterone secretion.
4. It produces maternal instinct.
5. It is also responsible for brooding behaviour in hens and nesting behaviour in birds.

5. Follicle Stimulating Hormone (FSH)

Site of action : Ovaries and testes (seminiferous tubules)

Functions :

1. Growth and maturation of ovarian follicles and oogenesis.
2. Helps in spermatogenesis.

6. Luteinizing Hormone (LH) / Interstitial Cell Stimulating Hormone (ICSH)

Site of action : Ovaries and Testes (Leydig cells)

Function :

1. Maturation of follicle and ovulation.
2. Development of corpus luteum and progesterone secretion.
3. Stimulation of androgen secretion by testes.

FSH and LH are also called as gonadotropins.

II. Intermediate Lobe :

This lobe of pituitary gland secretes melanocyte stimulating hormone (MSH)

Melanocyte stimulating hormone (MSH)

Site of action : Melanophore cells.

Function : maintenance of skin colour.

III. Posterior pituitary Gland

It secretes two hormones viz. Vasopressin and oxytocin.

1) Antidiuretic hormone (ADH) / Vasopressin :

Site of action : Renal tubules.

Functions :

1. Regulation of water excretion by reabsorption of water.
2. Constriction of blood vessels (Pressor effect)

2) Oxytocin :

Site of action : Mammary epithelium and uterine myometrium.

Functions :

1. Helps in milk let down by causing contraction of mammary myoepithelium.
2. Promotes uterine contractions and thereby helps in parturition process.
3. Transport of sperm to the oviduct following coitus.

3. THYROID GLAND

* It is roughly 'H' shaped gland comprising two lobes one on each side of trachea just below the larynx
* It secretes thyroxin, triiodothyronine and calcitonin hormones.

1. Thyroxine and Triiodothyronine.

Site of action : All tissues.

Functions :

1. It stimulates glucose absorption from GI tract, glucose utilization in different cells and hepatic glycogenolysis.
2. It increases the rate of fat mobilisation from its stores.
3. It enhances protein synthesis.
4. It converts carotene to vit.A
5. It assists in growth of hard and soft tissues.

2. Calcitonin :

Site of action : Bone and Kidney

Function :

* It lowers blood calcium by increasing calcium deposition in bones and decreasing reabsorption of calcium from kidney.

4. PARATHYROID GLANDS

* These are four reddish yellow coloured small bodies situated very close to thyroid gland.
* They secretes parathormone

Parathormone / Parathyroid Hormone (PTH)

Site of action : Bone, Kidney and intestine.

Functions :

1. It increases the level of calcium in blood by a) mobilizing calcium from bones, b) active reabsorption of calcium from kidney tubules and c) activation of Vit.D which in turn assists in absorption of calcium from intestine.
2. It lowers plasma phosphorus level by increasing phosphate excretion through kidneys.

5. PANCREAS

* The islets of langerhans of pancreas secretes two hormones namely.
  a. Insulin - Secreted by beta cells.
  b. Glucagon - Secreted by alpha cells.

1. Insulin :

Site of action : Liver, muscle and adipose tissue.

Functions :

1. It lowers blood glucose by favouring glycogen synthesis in liver and muscles.
2. It stimulates protein synthesis.
3. It promotes formation of adipose tissue from glucose.

2. Glucagon :

Site of action : Liver and muscle

Function : Glucagon is antagonistic to insulin and helps to elevate blood glucose by favouring liver and muscle glycogenolysis.

6. ADRENAL GLANDS

* These are situated close to the anterior aspect of corresponding kidney.
* They consist of two parts viz : inner medulla and outer cortex.

a. Adrenal medulla :

It secretes two hormones-epinephrine and nor-epinephrine.

1. Ephinephrine :

Site of action : Heart, skeletal muscle and liver.

Functions :

1. It raises blood glucose by promoting hepatic and muscle glycogenolysis.
2. It increases strength of heart contraction and heart rate.

2. Nor-epinephrine :

Site of action : Peripheral blood vessels and smooth muscles.

Functions :

1. Constriction of peripheral blood vessels.
2. Contraction of smooth muscles.

b. Adrenal cortex :

It secretes two hormones - Glucocorticoids and mineralcorticoids.

1. Glucocorticoids :

Site of action : All tissues.

Functions :

1. It helps in the process of gluconeogenesis from non-carbohydrate substances viz. proteins and fat.
2. It inhibits peripheral utilization of glucose by the muscles, adipose tissue and skin.
3. It works as anti-inflammatory agent.
4. It helps the body in stress conditions.

2. Mineralcorticoids / Aldosterone :

Site of action : Kidney and other tissues indirectly.

Functions :

1. It increases reabsorption of sodium and chloride ions from kidney.
2. It increases excretion of K^+ ions through urine.

7. OVARY

Ovary secretes three hormones :

1. Oestrogen,
2. Progesterone,
3. Relaxin.

1. Oestrogen :

Site of action : Mammary gland and reproductive tract.

Functions :

1. Growth and development of female reproductive tract.
2. Increases the motility of uterus and fallopian tube which helps in transport of gametes.
3. Growth of duct system of mammary gland.
4. Responsible for female sex behaviour.
5. Development of secondary sexual characters viz. skin become thin and glossy.
6. Promotes fat and protein synthesis.

2. Progesterone :

Site of action : Mammary gland and female genital tract.

Functions :

1. Maintenance of pregnancy.
2. Helps in nidation and growth of zygote.
3. Secretion of uterine milk.
4. Causes alveolar growth of mammary gland.

3 Relaxin :

Site of action : Pelvic symphysis and pelvic ligaments.

Function : Relaxation of pelvic symphysis and pelvic ligaments to facilitate parturition.

8. TESTES

The interstitial cells / leydig cells secretes male sex hormone i.e. testosterone / androgen.

Testosterone :

Site of action : Testes and accessory sex organs

Functions :

1. Growth of accessory male sex organs.
2. Development of secondary sexual characters in males.
3. Increases protein synthesis and causes musculinization.
4. Aids in the descend of testicles just before birth.

9. PLACENTA

It secretes five hormones a) Human Chorionic Gonadotrpoin (HCG), b) Pregnant Mare Serum Gonadotropin (PMSG), c) Oestrogen, d) Progesterone, e) Relaxin.

HCG : Mainly it has LH like function but to some extent FSH - like property.

PMSG : It is mainly FSH like but to some extent LH - like property.

The functions of estrogen, progesterone and relaxin hormones secreted by placenta are same as that of the ovarian hormones.

CHAPTER - 10 : ANATOMY & PHYSIOLOGY OF FOWL

I. SKELETAL SYSTEM

The skeletal system of fowl consists of axial and appendicular skeleton

AXIAL SKELETON

It consist of skull, vertebral column, ribs and sternum

SKULL :

1. It is small and conical.
2. The anterior extremity is elongated and ends into a pointed beak.
3. The posterior extremity possess single occipital condyle for articulation with atlas.

The important features of the skull of the fowl are as follows-

* Teeth and paranasal sinuses are absent
* Orbital fossa is very large
* Upper jaw is movable

VERTEBRAL COLUMN :

The vertebral formula for the fowl is $C_{14}\ T_7\ L+\ S_{14}\ Cy_6$. The vertebral column of fowl consists of - 1) Cervical vertebrae, 2) Thoracic vertebrae , 3) Lumbar and sacral vertebrae and 4) Coccygeal vertebrae.

1. Cervical vertebrae :

1. They are 14 in number.
2. ***Atlas*** is the first cervical vertebra which is thin and ring like.
3. ***Axis***, second vertebra, is short.
4. The infraspinous processes are very prominent in first three or four vertebrae.
5. The supraspinous processes are prominent in 3 rd to 6 th and 13 th to 14 th vertebrae.
6. Transverse processes are thick, irregular and tuberous.

2. Thoracic Vertebrae :

1. They are seven in number.
2. The first and sixth vertebrae are free where as second to fifth are fused with first lumbar vertebra.
3. The infraspinous processes are well developed.
4. The supraspinous processes are flat, wide and fused with each other.
5. The transverse processes of fused vertebrae forms a bony plate.

3. Lumbar and Sacral vertebrae :

1. They are 14 in number.
2. They fuse to form lumbo-sacral mass.

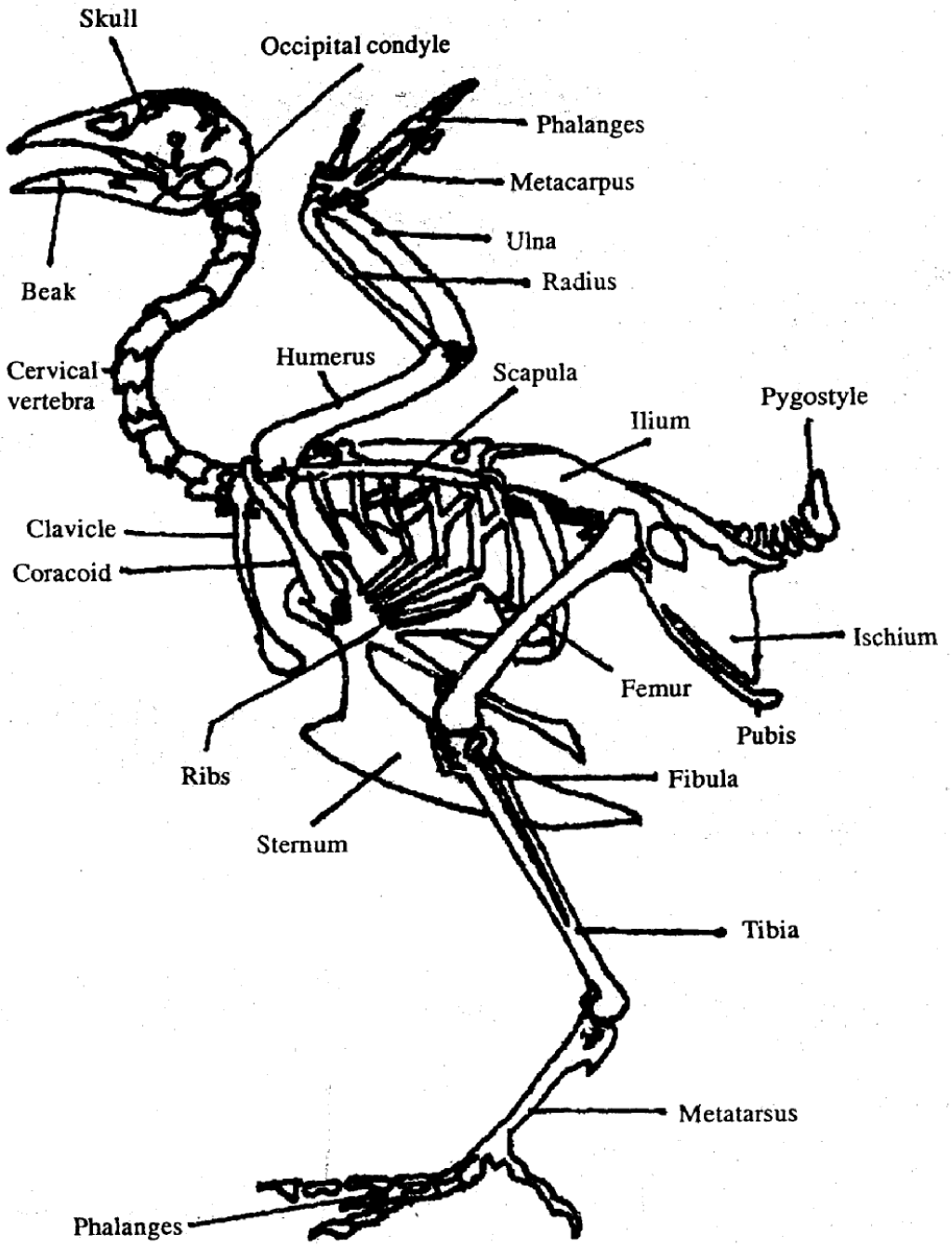


Fig. 10.1 : Skeletal system of Fowl

4. Coccygeal Vertebrae :

1. They are six in number.
2. The first coccygeal vertebra is fused with lumbo sacral mass.
3. The last two or more vertebrae unite to form a three sided pyramid like structure called as ***' Pygostyle'***.

RIBS :

1. There are seven pairs of ribs.
2. They form lateral wall of thoracic cavity.
3. They articulate above to the thoracic vertebrae and below to the sternum.
4. Rib consists of head, neck, tubercle, shaft and uncinate process.

STERNUM :

1. It is also called as ***'breast bone'***.
2. It is quadrilateral curved plate of bone.
3. It forms the floor of thoracic cavity and part of the abdominal cavity.

APPENDICULAR SKELETON

Appendicular skeleton of fowl consists of bones of -
(A) Pectoral limb and (B) Pelvic limb.

A] BONES OF PECTORAL LIMB :

1. Pectoral Girdle :

It comprises of i) Clavicle , ii) Coracoid and iii) Scapula.

i) *Clavicle* :

1. It is slightly bent, thin rod of bone.
2. The proximal extremity rests against the scapula and the coracoid.
3. The distal end unite with the opposite bone to form 'V' shaped structure called *furculum or wish bone.*

ii) *Coracoid* :

1. It is long, three sided, rod shaped bone.
2. The proximal end is in the form of hook which articulates with scapula and clavicle.
3. The distal end is flat and articulates with sternum.

iii) *Scapula* :

1. It is thin elongated bone.
2. It is situated parallel to the vertebral column .
3. It articulates cranially with the coracoid and humerus.
4. The caudal end is free and non-articular.

2. Humerus:

1. The proximal extremity presents an oval head, which articulates with the scapula and the coracoid.
2. The body is slightly twisted.
3. The distal extremity is condyloid and articulates with the radius and the ulna.

3. Radius and Ulna :

1 The ulna is longer and larger than radius.
2. The radius is placed external to the ulna.
3. Radius and ulna are separated by a wide interosseous space.
4. These bones articulate with the humerus proximally and with carpus distally.

4. Carpals :

1. There are two bones, namely radial carpal and ulnar carpal in the proximal row.
2. The distal row bones are fused with the metacarpal bones.

5. Metacarpals :

1. There are three metacarpal bones.
2. The first metacarpal is a small projection while the second and third are fused at both extremities.

6. Digits :

1. There are three digits in fowl.
2. The first and second digits have two phalanges while the third digit has one.

B] BONES OF PELVIC LIMB :

1. Pelvic Girdle :

1. It comprises of ilium, ischium and pubis or ***'lay bone'***.
2. The ***ilium*** is the largest pelvic bone and is fused with sacrum.
3. The ***ischium*** is smaller than ilium.
4. The ***pubis*** is thin bone and has a tendency to straighten out when a bird is in production.
5. The ***acetabulum*** is large, deep and perforated.

2. Femur :

1. The proximal end presents head and greater trochanter.
2. The shaft is bent along the length.
3. The distal extremity comprises of trochlea and two condyles.

3. Patella :

*It is thin triangular bone.

4. Tibia :

1. It is the largest bone of the limb.
2. The proximal end presents ridge for the attachment of fibula.
3. The shaft is nearly straight.
4. The distal end is fused with proximal row of the tarsus.

5. Fibula :

1. It is thin, rod shaped bone.
2. The proximal end has a massive head for articulation with femur.
3. The distal end is pointed and extends up to lower third of the tarsus.

6. Tarsals :

1. They are not found separately in the adult birds.
2. The tarsal bones of the proximal row are fused with the tibia to form ***tibio-tarsus.***
3. The tarsal bones of distal row are fused with metatarsal bone to form ***'tarso-metatarsus'.***

7. Metatarsal :

1. It is a single large bone in adult fowl.
2. The proximal end is irregular and fused with tarsus.
3. The distal end presents three condyles for articulation with II, III and IV digits .

8. Digits :

1. There are four digits (toes) in fowl.
2. The first and second digits have three phalanges.
3. The third has four phalanges and the fourth has five phalanges.

II. DIGESTIVE SYSTEM

The digestive system of fowl consists of mouth, oesophagus, stomach small intestine, large intestine, cloaca, liver and pancreas.

MOUTH :

1. It is triangular in shape.
2. It is closed by upper and lower beaks.
3. It is characterised by absence of cheeks, lips and teeth.
4. The shape of tongue is like the barbed head of an arrow.
5. It is directly continuous with the pharynx.

Functions :

The main functions are prehension and deglutition.

OESOPHAGUS :

1. It is thin walled elastic tube.
2. It begins at pharynx and terminates at proventriculus.

Function :

It is a passage for food.

Crop :

1. It is an enlargement of the oesophagus.
2. It is simple, oval, musculo-membranous pouch.

Functions :

1. It stores food material.
2. It secretes mucus which lubricates and softens food material.
3. It sends food to the proventriculus.

STOMACH :

It consists of two parts viz. proventriculus and gizzard.

a) Proventriculus :

1. It is also called as ***glandular stomach.***
2. It is located 2-3" beyond the crop.
3. It is about $^{1}/_{2}$ to $^{3}/_{4}$" in diameter and $1^{1}/_{4}$ to $1^{1}/_{2}$" long.
4. It is an oval thick walled tube.

Functions :

1. It passes food from the crop to gizzard.
2. It secretes gastric juice and some acids.
3. It helps in further softening of the food material.

B) Gizzard :

1. It is also called as ***muscular stomach.***
2. It is located just behind the proventrilculus.
3. It is larger than proventriculus.
4. It is the largest single organ of the body.
5. It is reddish green in colour.
6. It is composed of two thick, powerful muscles.

Functions :

1. Its main function is crushing or grinding of ingested food.
2. It acts as a filter for food material.

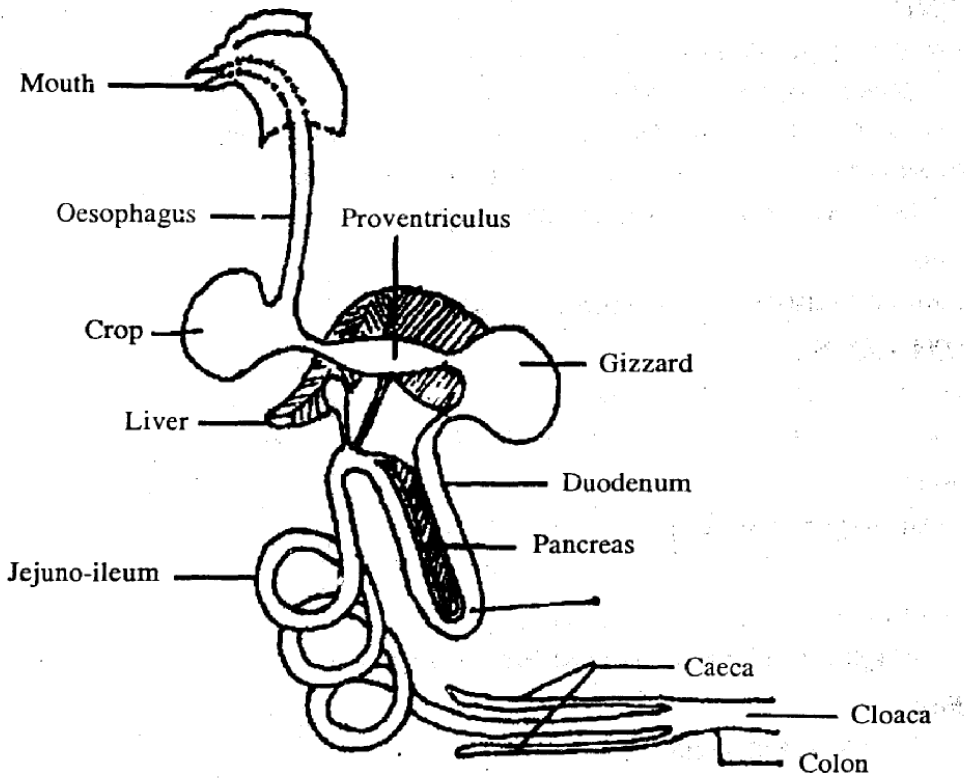


Fig. 10.2 : Digestive system of Fowl

SMALL INTESTINE :

1. It extends from the gizzard to the caeca.
2. It is about 2 $^{1}/_{2}$ ft long in mature bird.
3. Its inner surface is lined with ***villi.***
4. It consists of three parts - duodenum, jejunum and ileum.
5. The duodenum begins from gizzard and forms a loop.
6. The bile and pancreatic ducts open near each other at the termination o duodenum.
7. The jejuno-ileum is arranged in the form of coils.

Functions :

1. Gastric digestion together with some pancreatic digestion takes place i duodenum.
2. It secretes intestinal juice which helps in digestion of food material.
3. It acts as an organ for absorption of the digested food material.

LARGE INTESTINE :

It extends from ileo-caecal junction to cloaca and consists of two caeca and a colon.

a) Caeca :

1. These are two blind sacs about 5 - 7" in length.
2. These are present at the junction of small and large intestine.

Functions :

1. They help in digestion of fibre
2. They act as temporary storage organs for faecal material.
3. The absorption of some digested food material may take place in caeca.

b) Colon :

1. It is a small straight tube.
2. It lies between the caeca and the cloaca.

Function :

It helps in absorption of water.

Cloaca :

1. It is a tubular common cavity for digestive, urinary and genital tracts.
2. The ***vent*** is an external opening of cloaca.

Function :

The faecal material and urine are mixed and excreted through vent.

PANCREAS :

1. It lies between the folds of the duodenum.
2. It is a thin, narrow and lobulated gland.
3. It is pale yellow or reddish in colour.
4. Two ***pancreatic ducts*** carry pancreatic juice from pancreas to duodenum.

Function :

It secretes ***pancreatic juice*** which contains digestive enzymes viz. trypsin, amylopsin and steapsin.

LIVER :

1. It is the largest gland in the body.
2. It lies on the floor of the abdominal cavity.
3. It is dark red in colour.
4. It consists of two lobes i.e right and left
5. A sac is situated on visceral surface of the right lobe of liver called as ***'gall bladder'*** which stores bile.
6. There are two ***bile ducts*** which carry ***bile*** from liver to the duodenum.

Functions :

1. It secretes the bile which helps in digestion of fats.
2. It helps in protein, carbohydrate and fat metabolism.

III. MALE REPRODUCTIVE SYSTEM

The male reproductive system of fowl consists of testes, vas deferens and papillae (Fig. 10.3)

1. TESTES :

1. They are two in number
2. They are situated at the anterior end of kidneys in sublumbar region.
3. They are bean shaped or oval in shape and pale yellow in colour.
4. The left testis is usually larger than right.
5. They consist of large number of slender convoluted tubes known as seminiferous tubule.

Functions :

1. They produce sperms and seminal fluid.
2. They produce male sex hormone i.e. ***testosterone.***

2. VAS DEFERENS :

1. These are two tortuous tubes.
2. They extend from testes to the cloaca.
3. They are narrow at their origin but becomes gradually wider towards the cloaca.

Function :

They carry sperms and seminal fluid from testis to the cloaca.

3. PAPILLAE :

1. They are located on the median ventral portion of the cloaca.
2. They are rudimentary copulatory organs of the male.

Function :

They introduce sperms into the oviduct during coitus.

The male reproductive system of fowl differs from that of mammals on following aspects-

1. Testes are intra-abdominal & sperms are produced at body temperature .
2. Sperms remain alive for several days in female genital tract.
3. Epididymis is very short.
4. The accessory glands like seminal vesicles, prostate and Cowper's glands are absent.

IV. FEMALE REPRODUCTIVE SYSTEM

The repoductive system of the female consist of ovary, oviduct and vagina (Fig 10.4)

1) OVARY :

1. There are two ovaries in early life, but only left ovary is functional in adult.
2. The left ovary is situated in the upper part of the abdominal cavity opposite to the last two ribs.
3. The functional ovary appears as a cluster of ***ova or yolks.***
4. The ovum or yolk is enclosed in a thin membrance called as ***vitelline membranc.***
5. The yolk is pale straw or yellow or orange coloured.
6. The yolk and vitelline membrane is enclosed by ***follicle,*** which helds the ovary by ***follicle stalk.***

Functions :

1. Formation of ova.
2. Secretion of female sex hormones viz. oestrogen and progesterone.

2) OVIDUCT :

1. There are two oviducts during early life, but only left oviduct is developed in adult.
2. It is a large, long coiled tube.
3. It occupies much of the left side of the abdominal cavity.
4. It is divided into a) Infundibulum b) Magnum c) Isthmus d) Uterus and e) Vagina.

a) Infundibulum :

1. It is located just below and behind the ovary.
2. It is funnel shaped, delicate, membranous structure.
3. Its anterior end is expanded and presents opening.
4. It measures about 9cm in laying bird.

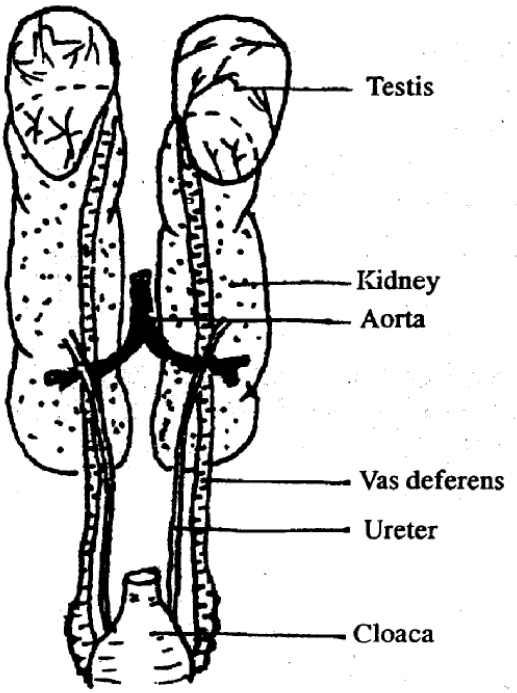


Fig. 10.3 : Male reproductive system of Fowl

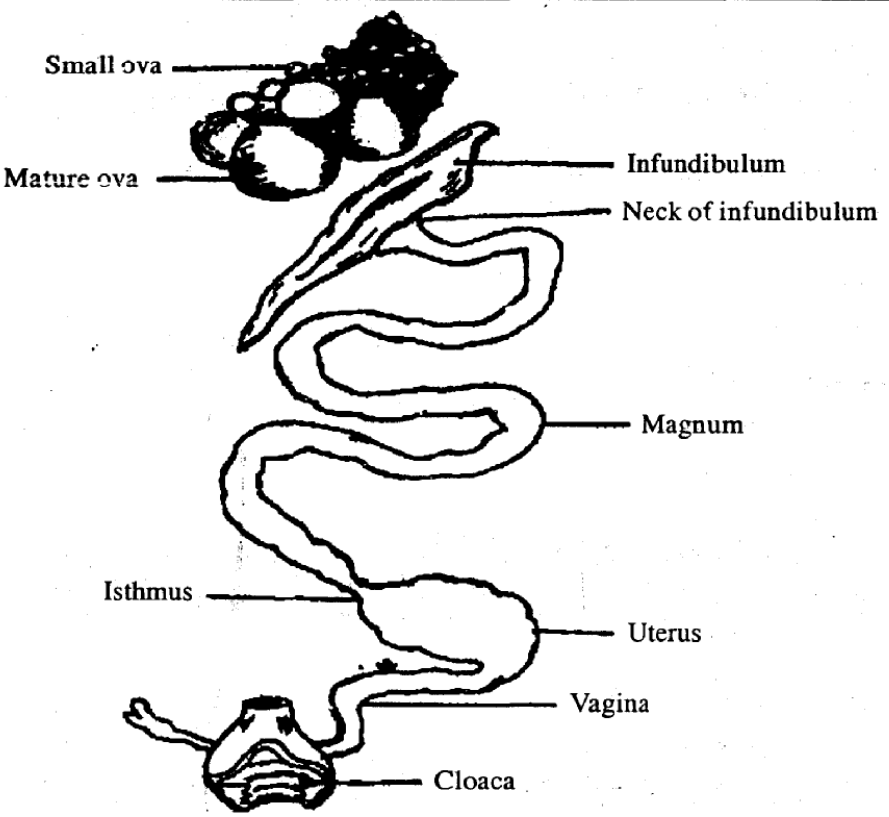


Fig. 10.4 : Female reproductive system of Fowl

Functions :

1. It receives ova or yolk from the ovary.
2. It is the site of fertilization.

b) Magnum :

1. It is the second portion of oviduct.
2. It forms more than half of the total length (33 cm)of oviduct.
3. Its wall is very thick.

Function :

It secretes thick albumin or egg white .

c) Isthmus :

1. It is third part of the oviduct.
2. It is narrow and somewhat constricted portion .
3. It is about 10 cm in length.

Function :

It secretes the shell membranes.

d) Uterus :

1. It is also known as *shell gland.*
2. It is placed next to the isthmus.
3. It is thick walled, pouch like structure.
4. It is 10 - 12 cm in length.

Function :

It secretes thin egg white, the shell and the shell pigment.

e) Vagina :

1. It is the terminal portion of oviduct.
2. It is short narrow portion.
3. It opens into colaca.

Function :

It holds the egg until it is laid

The female reproductive system of fowl differs from that of mammals on following aspects-

1. Only left ovary and left oviduct are functional in adult fowl.
2. Egg or ovum is an article of food.
3. Egg is large and enclosed with food supply for nourishment of embryo.

Formation of egg :

1. When ovary becomes functional, few ova increases in size due to deposition of yolk.
2. The ovum with yolk is enclosed in a ***vitelline membrane***.
3. The yolk and vitelline membrane are enclosed into the highly vascular connective tissue called ***follicle***.

4. The ovum with yolk when grows in size gets suspended in its follicle and held to the ovary by a ***stalk***.
5. The ovum grows rapidly with the formation of concentric layers of light and dark yolk.
6. At maturity, ovum released from follicle (ovulation) is engulfed by the **infundibulum**. If hen is mated with cock then fertilization takes place in infundibulum. The fertilized or unfertilized ova remains for about 18 minutes in infundibulum.
7. Then it moves to magnum where goblet cells secretes ***egg albumen***. The ovum remains in magnum for about 3 hours.
8. The peristaltic movement of the magnum propels ovum to isthmus where inner and outer ***shell membranes*** are formed and also shape of egg is determined. Egg remains in isthmus for about 1 hour 14 minutes.
9. The egg then reaches uterus where watery fluid secreted by the tubular glands of uterus forms inner as well as outer layers of ***thin white***. The uterine secretion also contains material (mainly calcium carbonate) for ***egg shell*** formation. The shell pigments are also formed in uterus during last 5 hours before laying. The egg remains in uterus for about 21 hours.
10. The contractions of uterus propels the fully developed egg to cloaca through vagina during the act of laying.

CHAPTER -11 : INFECTIOUS DISEASES

INTRODUCTION TO DISEASES

Health denotes physical, physiological and mental wellbeing of an individual.

Disease means any deviation from normal state of health.

Table 11.1 : Signs of Healthy and Diseased Animals

Sr.	Parameter	Healthy	Diseased
1)	Appetite	Normal	Reduced or absent
2)	Water intake	Normal	Usually reduced
3)	Milk yield	Normal	Decreased
4)	Rumination	More frequently	Less frequently or stops
5)	Body condition	Normal	Mostly emaciated i.e. weak
6)	Look of the animal	Active	Dull
7)	Gait	Move freely & with ease	Move slowly & with difficulty
8)	Head	Forward and raised	Downward
9)	Eyes	Bright Wet Wide open	Dull Dry or profuse lacrimation Partially or completely closed
10)	Ears	Erect & move frequently	Drooping & move less frequently
11)	Mouth	Wet & without odour	Dry or profuse salivation & usually bad odour
12)	Nose	No discharge	May be some discharge
13)	Muzzle	Moist	Dry
14)	Skin / hair coat	Smooth & glossy	Rough & dull
15)	Dung	Semisolid	Hard or loose
16)	Urine	Slightly yellowish	Dark yellow, coffee coloured or pinkish
17)	Tail movement	Quite frequently	Less frequently
18)	Temperature	Normal (101.6^0F)	Mostly increased
19)	Respiration	Normal	Increased, laboured
20)	Pulse rate	Normal	Usually increased

CLASSIFICATION OF DISEASES :

A) According to mode of origin :

i) Hereditary diseases : are transmitted from parents to the offspring.
e.g., Haemophilia

ii) Congenital diseases : are acquired during intra-uterine life. e.g., T.B.

iii) Acquired diseases : are acquired after birth.

B) According to causes :

1) *Specific diseases :* are produced by a specific pathogen or factor.
They are subdivided into-

i) Infectious diseases : are caused by pathogenic organisms.

e.g. a) Viral diseases - Rinderpest (RP), Foot & Mouth disease (FMD)
b) Bacterial diseases - Black quarter (BQ), Haemorrhagic septicemia (HS)
c) Protozoan diseases - Surra, Theileriosis.

ii) Non-infectious diseases: are caused by physical or chemical or poisonous agents, nutritional deficiency or disturbed metabolism.

e.g. a) Deficiency diseases - Rickets.
b) Metabolic diseases - Milk fever.
c) Poisoning - Pesticide poisoning

2) *Non- specific diseases :* those diseases whose causes are indefinite or multiple.
e.g. Diarrhoea.

C) According to mode of spread :

i) Contagious diseases : spread by means of direct or indirect contact of diseased animal
e.g. FMD., HS.

All infectious diseases may or maynot be contagious but all contagious diseases are infectious.

ii) Non-contagious diseases: do not spread by means of direct or indirect contact. e.g. Rickets.

D) According to duration and severity :

i) Peracute disease is characterised by very short course (few hours to 48 hours) and very severe symptoms. e.g. Anthrax.

ii) Acute disease is characterised by a sudden onset, short course (3-14 days) and severe symptoms. e.g. BQ, HS.

iii) Subacute disease : whose course is 2 - 4 weeks and severity is lesser than acute one. e.g. Subacute mastitis, FMD.

iv) Chronic disease : whose course is more than 4 weeks and signs are not severe in character. e.g. Tuberculosis.

E) According to area of spread :

i) Sporadic disease : affects one or two animals and shows little or no tendency to spread within the herd. e.g. Johne's disease.

ii) Enzootic/Endemic disease: means an outbreak of disease among animals in a definite area or particular district. e.g. Anthrax, H.S.

iii) Epizootic/Epidemic disease : which affects a large population of animals in large area at the same time and spreads with rapidity. e.g. FMD, RP.

iv) Panzootic/Pandemic disease : is a widespread epidemic disease usually of world wide distribution. e.g Influenza.

v) Zoonotic disease : a disease which can be transmitted from animal to man and vice versa. e.g. Anthrax, Brucellosis.

GENERAL MEASURES FOR PREVENTION OF CONTAGIOUS DISEASES.

1. Identification and isolation of infected and incontact animals.
2. Treatment of affected animals.
3. Slaughter of animals suffering from incurable diseases.
4. Disposal of dead animals either by burning or deep burial.
5. Destroy contaminated fodder by burning.
6. Proper disposal of contaminated water.
7. Regular disinfection of cattle shed and its premises with 1-2% phenyl.
8. Don't allow grazing in affected area.
9. Restrict the movement of animals from affected to clean area.
10. Don't allow animals to drink water from ponds, rivers etc. during outbreak of disease.
11. Close animal markets, cattle shows etc. during outbreak of disease.
12. Regular spraying of insecticide to control external parasites.
13. Regular deworming to control internal parasites.
14. Avoid stress associated with long distance transportation, inclement weather and undernutrition.
15. Provide adequate ventilation and sunlight.
16. Provide ample fresh and clean water.
17. Provide sufficient quantity of balanced ration.
18. Avoid overcrowding.
19. Keep the animal house clean and dry.
20. Give enough exercise to animals.

IMMUNITY

Immunity - It is the capacity or ability of animal body to resist infection.

Antigen - A substance which stimulates formation of specific antibodies.

Antibodies - A substance developed or synthesized in the animal body against an antigen.

Classification :

Immunity is classified as follows :

A) Inherited / Innate Immunity - It is received by birth.

It is of 3 types -

a) Species immunity - some species are immune against some diseases e.g., Fowls are resistant to tetanus and anthrax.

b) Breed immunity - some breeds are resistant to some diseases e.g. Indian cattle are more resistant to FMD or Theileriasis than the exotic cattle breeds.

c) Individual immunity - some individuals show resistance against certain diseases.

B) Acquired immunity - It is received or acquired after birth.

It is of two types-

a) Active immunity - It is that type of immunity which is developed in the animal body itself in response to infection / antigen.

It may be natural or artificial

i) Artificial active immunity can be produced by injecting vaccines.

ii) Natural active immunity is developed in animals following attack of infectious disease for short or long period.

b) Passive immunity - It is that type of immunity which is borrowed by the animal from outside sources.

It may be natural or artificial

i) Natural passive immunity can be developed by feeding colostrum.

ii) Artificial passive immunity can be produced in diseased animals by injecting antiserum

Table 11.2 : Difference between Active And Passive Immunity

Active Immunity	Passive Immunity
1) It is developed by the host itself	1) It is borrowed by the host from outside sources.
2) It develops in 2-3 weeks	2) It develops immediately
3) It is long lasting or It provides immunity for longer period i.e. in months / years.	3) It is short lived or It provides immunity for short period i.e. 1 to 3 weeks
4) It is mainly used for prophylactic purpose.	4) It is used for both therapeutic & prophylactic purpose.
5) Examples	5) Examples
a) Natural - Animal recovered from disease	a) Natural - Calf receiving colostrum from mother/dam
b) Artificial - Animal vaccinated against RP / FMD	b) Artificial-Animals getting antisera

TERMS USED IN VETERINARY MEDICINE

Etiology : Study of causative agents of disease.
Epidemiology : Study of disease outbreaks with an effort to trace down the original inciting cause.
Predisposing factor : Anything that makes the aninal more prone to infection.
Stress : A condition characterised by reduction in resistance power of animals to disease.
Morbidity : Sick rate
Mortality : Death rate
Incubation period : The period between occurrence of infection and appearance of the symptoms.
Symptoms : Outward clinical manifestations of disease
Postmortem : Examination after death.
Lesion : Visible changes in size, shape, colour or structure of an organ.
Pathogenic : Disease producing.
Purulent : Containing pus.
Prognosis : Forecast regarding outcome of the disease.
Diagnosis : An art of confirming a disease with the help of case history, symptoms and laboratory tests.
Therapy : Treating disease
Specific treatment : Administration of specific curative drugs against certain diseases.
Symptomatic treatment : Administration of drugs to get rid of symptoms.
Palliative treatment : Administration of drugs to prolong life in incurable diseases.
Vaccine : A suspension of attenuated or killed micro-organisms (Bacteria/ virus/ Rickettsiae) administered for prevention of infectious diseases.
Immunity : Power of an animal to resist and/or overcome an infection.
Antiserum : A serum containing specific antibodies used to treat the specific disease.
Vaccination : Protective inoculation with vaccine.
Metabolic diseases : Diseases resulting from disturbances in body metabolism.
Bacteria : Minute, one celled microscopic plant like organisms which multiply by fission and lack chlorophyll.
Virus : A smallest living organism not visible under ordinary microscope.
Protozoa : Single celled parasitic organism.
Fungi : A group of organism including moulds and yeasts.
Parasite : Organism that benefits by nourishing itself at the expense of the other.
Infection : Invasion of tissues by pathogenic organisms resulting in a disease state.

Septicaemia : Presence of multiplying bacteria and their toxins in blood.
Bacteremia : Presence of non-multiplying bacteria in blood.
Viremia : Presence of virus in blood.
Toxaemia : Presence of toxin in blood.
Fever : Rise in body temperature associated with infection.
Hypothermia : Decrease in body temperature.
Anorexia : Loss of appetite.
Hyperorexia : Excessive appetite.
Pica : Depraved/abnormal appetite.
Polydipsia : Excessive thirst.
Dysphagia : Difficulty in swallowing.
Stomatitis : Inflammation of oral mucosa.
Pharyngitis : Inflammation of pharyngeal mucosa.
Vomition : Forceful emptying of stomach contents.
Diarrhoea : Frequent passage of loose faeces.
Dysentery : Frequent passage of loose faeces mixed with blood, mucus and accompanied by strainings.
Colic : Abdominal pain.
Tenesmus : Straining
Nephritis : Inflammation of kidney.
Cystitis : Inflammation of urinary bladder.
Anuria : Cessation of urination.
Oliguria : Decrease in urine volume
Dysuria : Difficulty in urination.
Urinary incontinence : Dribbling of urine drop by drop
Azotaemia/Uraemia : Elevation of non-protein nitrogenous substances in blood.
Haematuria : Blood in urine.
Haemoglobinuria : Haemoglobin in urine.
Pyuria : Pus in urine.
Spasm : Involuntary contraction of group of muscles.
Tremor : Very fine jerkey involuntary contractions of muscle.
Inco-ordination : Inability to move the limbs in normal sequence
Ataxia : Incoordination of gait.
Tetany : Tonic symmetrical muscular contractions.
Trismus : Lock-jaw.
Hyperaesthesia : Increased sensitivity/ response to external stimuli viz touch and noise.
Recumbency : A state of lying down.
Convulsions : A powerful involuntary contraction followed by relaxation of muscle.
Nystagmus : Involuntary constant fine jerky movements of an eyeball.

Opisthotonus : Upward deviation of neck.
Paralysis : Incomplete or complete loss of nervous control over any bodily functions.
Coma : The state of unconciousness in an animal.
Epilepsy : A condition characterised by tono-clonic convulsions accompanied with unconciousness.
Alopecia : Loss of hair, wool or feather.
Pityriasis / Dandruff : A condition characterised by presence of bran like scales over the skin surface.
Erythema : Reddish discolouration of skin.
Papule : A small, solid elevation over the skin.
Nodule : A papule greater than 1 cm in diameter.
Vesicle : A small fluid-filled elevation over the skin.
Pustule : A vesicle containing pus.
Scab : Dried exudate, blood, pus and skin debris.
Scar : A lesion healed up by the proliferation of fibrous tissue.
Pruritus : A sensation that gives rise to desire of scratching.
Wheal : A circumscribed semisolid elevation with round or flat top.
Urticaria : A condition characterised by appearance of wheals over skin surface.
Erosion : It is a loss of superficial epithelium.
Ulcer : Break in the continuity of epidermis, exposing dermis and so is deeper than erosion.
Dermatitis : Inflammation of skin tissue.
Eczema : An inflammatory reaction of the epidermal cells to substances to which the cells are sensitized.
Emaciation : It is an excessively thin condition of body due to loss of body weight.
Pot-bellied : The abdomen is excessively pendulous and the lower line of the belly is markedly convex.
Dehydration : Loss of water from the body.
Anaemia : Decrease in the quality and / or quantity of red blood cells.
Oedema : Abnormal accumulation of fluid in the intercellular spaces.
Ascites : Accumulation of fluid in the peritoneal sac.
Hepatitis : Inflammation of the hepatic cells.
Jaundice : Yellowish discolouration of the visible mucus membranes of the body.
Congestion : The accumulation of blood in a part due to over filling of it's blood vessels.
Carcass : The body of the dead animal.
Shock : State in which there is generalised, acute and serious reduction in the perfusion of tissue and is characterised by severe reduction in the effective circulating blood volume and blood pressure.

(1) HAEMORRHAGIC SEPTICAEMIA

Synonyms : Pasteurellosis, Shipping fever, ***Ghatsurp.***

*It is an acute infectious disease of cattle, buffalo, sheep and goat.

*It usually occurs during extreme environmental conditions, malnutrition and long distance transportation.

*It generally occurs during rainy season.

*The disease is ***enzootic*** in India.

Etiology :

It is caused by ***Pasteurella multocida*** which is bipolar organism.

Transmission :

The disease spreads through -

a) ingestion of contaminated feed and water

b) inhalation

Symptoms :

1. ***High fever*** (106 - 107°F)
2. Loss of appetite
3. Suspended rumination
4. Dullness and depression
5. Rapid pulse & heart rates.
6. Profuse salivation and lacrimation.
7. Congestion of mucosae.
8. ***Profuse nasal discharge***
9. ***Difficult / snoring respiration***
10. ***Swelling of throat region*** (submandibular oedema)
11. Shivering
12. Recumbency and death within 10-72 hours.

Diagnosis :

1. ***History*** : Season, climate and stress factor.
2. ***Symptoms*** : High fever, swelling of throat region, dyspnoea.
3. ***Postmortem findings*** :Haemorrhages throughout body and submandibular oedema.
4. Examination of blood smear and smears from oedematus fluid.
5. Isolation of the organism from blood and oedematus fluid.

Treatment :

Treatment is effective if given in early stage of disease.

a) Specific treatment :

1. Inj. Enrofloxacin @ 2.5 - 5 mg/kg IM daily for 3 days **or**
2. Inj. Sulphadimidine @ 150mg/Kg body weight IV daily for 3 days **or**
3. Inj. Oxytetracycline @ 10 mg/Kg body weight IV or IM daily for 3 days.

b) Supportive treatment :

1. Use of antipyretics e.g. Inj. Vetalgin @ 20-30ml IM.
2. Use of antihistaminics e.g. Inj. Avil / Cadistin / Anistamin 5-10 ml IM.
3. Fluid thearpy - Inj. DNS IV

Control :

a) General measures :

1. Isolation and treatment of the affected animals.
2. Close animal markets, cattle shows etc.
3. Burning or burial of dead animals
4. Proper disposal of contaminated feed and water.
5. Disinfection of cattle shed.
6. Avoid long distance transportation and exposure to extreme weather .

b) Vaccination :

1. Alum Precipitated H.S. vaccine @ 5 ml subcut every year before monsoon.
2. The immunity develops in 2 to 3 weeks and remains for 6 months.

(2) BLACK - QUARTER

Synonyms : Black -leg, ***Farrya***

*It is an acute infectious and highly fatal, bacterial disease of cattle.
*Buffaloes, sheep and goats are also affected.
****Young cattle*** between 6-24 months of age, in ***good body condition*** are mostly affected.
*It is ***soil-borne*** infection.
*It generally occurs during ***rainy*** season.
*The disease is ***enzootic*** in India.

Etiology :

1. It is caused by ***Clostridium chauvoei***
2. The bacteria is Gram positive, rod shaped and spore-forming.

Transmission :

The disease spreads through -
a) Ingestion of contaminated feed and
b) Contamination of wounds.

Symptoms :

1. ***Fever*** (106-108^{0}F)
2. Loss of appetite
3. Depression, dullness
4. Suspended rumination
5. Rapid pulse and heart rates
6. Difficult breathing (dyspnoea)
7. ***Lameness in affected leg***

8. ***Crepitating swelling*** over hip, back & shoulder.
9. Swelling is hot & painful in early stages whereas cold and painless later.
10. Recumbency (Prostration) followed by death within 12-48 hrs.

Diagnosis :

1. ***History*** **:** Age, body condition and season.
2. ***Symptoms*** **:** High fever, crepitating swelling and lameness.
3. ***P.M. findings*** **:** Dark coloured muscles with gaseous infiltration.
4. Examination of smears made from affected tissues or fluid from the swelling.
5. Isolation of the organism.

Treatment :

1. Penicillin @ 10,000 units/Kg body weight IM & locally daily for 5-6 days.
2. Oxytetracycline in high doses i.e. 10 mg/Kg body weight IM or IV
3. Incise the swelling and drain off.
4. B.Q. antiserum in large doses, if available.
5. Use of Antipyretics e.g. Inj. Vetalgin 20 to 30 ml IM
6. Use of Antihistaminics e.g. Inj. Avil / Cadistin / Zeet @ 5-10 ml IM.
7. Fluid therapy- Inj. DNS IV

Prophylaxis :

a)General measures :

1. Isolation of infected and incontact animals.
2. Disposal of carcass either by deep burial or burning.
3. Proper disinfection of surgical instruments prior to operation.
4. Don't allow grazing in affected area.

b) Vaccination :

1. Alum Precipitated B.Q. Vaccine @ 5ml S/C each year before rainy season.
2. The immunity develops in 2 to 3 weeks and remains for 6 months.

(3) ANTHRAX

Synonyms : Splenic Fever, Wool sorter's disease, ***Fanshi, Kalpuli***

*It is an acute widespread infectious disease of all warm blooded animals especially cattle, buffalo, sheep, goat.

*It is ***communicable*** to man i.e. zoonotic disease.

*It is ***soil-borne*** infection.

*It usually occurs after major climatic change.

*The disease is ***enzootic*** in India.

Etiology :

1. This disease is caused by bacteria called ***Bacillus anthracis.***
2. The bacteria is Gram positive, spore forming and rod shaped.

Transmission :

1. It usually spreads through ingestion of contaminated feed and water.
2. Sometimes, it also occurs by inhalation and biting flies.

Symptoms :

1. ***Sudden rise in body temperature (104-108^{0}F).***
2. Loss of appetite i.e. off-feed.
3. Severe depression or dullness.
4. Suspended rumination.
5. Increased respiration and heart rate.
6. Bloat or tympany.
7. ***Dyspnoea i.e. difficult breathing.***
8. Dysentery or diarrhoea.
9. Blood in milk.
10. Abortions in females.
11. Trembling and convulsions.
12. ***Bleeding from natural openings like anus, nostrils, vulva etc.***
13. ***Sudden death in peracute cases.***

Diagnosis :

1. ***History*** : Sudden change in climate and sudden death.
2. ***Symptoms*** : Sudden death and bleeding from natural openings.
3. ***Postmortem findings*** : Oozing of dark-tarry coloured blood from natural openings, enlargement of spleen i.e. splenomegaly.
4. Microscopic examination of blood smears.
5. Isolation and identification of organism.

Treatment :

Treatment is effective, if given in the initial stage of the disease.

1. Penicillin - @ 10,000 units/kg body weight IM.
2. Oxytetracycline @ 10 mg/kg body weight. IM or IV
3. Anti-anthrax serum @ 100-200 ml IV may be given, if available.
4. Supportive treatment with antipyretics, antihistaminics and fluid therapy.

Control :

a) General measures :

1. Identification and isolation of affected animals.
2. Movement of animals from infected area to clean area should be stopped.
3. Deep burial of dead animals.
4. Destroy contaminated fodder by burning.
5. Thorough disinfection of cattle shed by using 10% caustic soda or formalin or 5% phenyl.

Never conduct post-mortem of the animal suspected to be died of anthrax.

b) Vaccination :

1. Anthrax Spore Vaccine @ 1ml subcut every year before onset of monsoon in areas where anthrax outbreaks are common.
2. The immunity develops in 2 to 3 weeks and remains for 1 year.

(4) BRUCELLOSIS

Synonyms : Bang's Disease, Contagious abortion

It is an acute or ***chronic*** contagious disease of domestic animals. In India, disease causes an annual economic loss of Rs 240 million due to abortion, infertility and reduced milk yield. It is common in ***sexually mature*** animals. It is major ***zoonotic*** disease in India.

Etiology :

It is caused by ***Brucella abortus***

Transmission :

The disease spreads through-

a) Ingestion of feed & water contaminated with discharges of aborted foetuses.
b) Inhalation.
c) Vagina during coitus.
d) Abraded skin or conjunctiva.

Symptoms :

1. ***Abortion mainly during advance or late pregnancy.***
2. Retention of placenta.
3. Opaque vaginal discharge.
4. Infertility i.e. low conception rate.
5. Orchitis i. e. swelling of scrotum in bull.
6. Weak calves are born from affected cows.

Diagnosis :

1. History of storm of abortions in herd.
2. Isolation of the organism from aborted foetuses, placenta etc.
3. Milk ring test (M.R.T.)
4. Plate or tube agglutination test.

Treatment :

1. There is no known treatment which can cure brucellosis in domestic animals.
2. Oxytetracycline, Streptomycin may, however, be tried.

Control :

a) General measures :

1. Test entire herd for brucellosis atleast once in a year.
2. Slaughter of infected or carrier animals.
3. Adopt AI practice as far as possible.
4. Proper disposal of aborted foetuses, placenta and uterine discharge.
5. Disinfection of infected premises.
6. Newly purchased animals should be tested for brucellosis twice at an interval of 30 days before introduction in a herd.
7. Pregnant animals should not be purchased.

b) Vaccination :

If incidence of disease in herd is more, then calves between 4-8 months of age should be vaccinated by using Brucella Cotton - 19 strain vaccine @ 5ml subcutaneously called as ***calfhood vaccination.***

Table 11.3 : Some other bacterial diseases of animals

Name of disease:aetiology and species affected	Characteristic signs & lesions	Line of treatment
1. Actinobacillosis ***(Wooden Tongue)*** **Actinobacillus lignieresi* *Ruminants	***Acute form*** : *Swelling of tongue* & lymphnodes of head region, protrusion of tongue, chewing movements, inability to take feed & water, salivation. ***Chronic form*** : Abscessation of lymphnodes	NaI 10% @1g/12kg IV Streptomycin IM KI @4 - 8 g po daily for 7-10 days Surgical drainage of abscess
2. Actinomycosis ***(Lumpy Jaw)*** **Actinomyces bovis* *Bovines	*Chronic immobile, hard, painless swelling* of jaw bones Adjacent lymphnodes are not affected	Treatment as above Response to treatment is very poor.
3. Johne's Disease ***(Paratuberculosis)*** **Mycobacterium johnei* *Ruminants *Age: 2-6 years	*Chronic diarrhoea.* May be continuous / intermittent Faeces soft, homogenous & without offensive odour. Fever is absent.Emaciation. Appetite is usually normal. ***Lesion*** : *Corrugation & thickening of intestine.*	Treatment is not advocated. Streptomycin is useful
4. Tuberculosis ***(Pearl's Disease)*** **Mycobacterium bovis* *All species	Recurrent fever, capracious appetite,gradual emaciation, rough hair coat, chronic cough, dyspnoea ***Lesion*** : *Tubercles in different organs*	Treatment is uneconomical. Streptomycin IM for 3 months. Isoniazid @ 5mg/kg orally.
5. Listeriosis ***(Circling Disease)*** **Listeria monocytogenes* *All species	Fever, circling, head-pressing, *deviation of head* to one side, facial paralysis, *Abortion* at about 7th month of pregnancy. Septicaemia in young animals.	Penicillin @ 44,000 IU/ Kg IM for 7 - 14 days. Antipyretic, analgesic & anti-inflammatory drugs. Fluid therapy Nervine tonics in case of paralysis

6. Leptospirosis ***(Weils Disease)*** **Leptospira interogans* *All species	Fever, anorexia, *haemoglobinuria,* anemia, jaundice, haemogalactia, *abortion* in 5 - 9 month pregnant animals	Streptomycin / tetracyclines for 5 - 7 days Haematinics Liver tonics
7. Colibacillosis ***(Calf Scour)*** **Eschercia coli* *Newborn animals	*Profuse, white, watery, foul-smelling diarrhoea.* Soiling of buttocks & tail, dehydration, sunken eyes, recumbency & death	Antibiotics orally & parenterally Fluid & electrolyte therapy Astringents
8. Salmonellosis ***(Paratyphoid)*** **Salmonella typhimurium* *All species	High fever, anorexia, *diarrhoea or dysentery* Faeces contain mucus, blood, fibrinous casts, shreds of mucosa. Colic, straining, dehydration & death.	As above
9. Enterotoxaemia ***(Pulpy kidney disease)*** **Clostridium perfringens type D* *Lambs,kids,calves,sheep	Circling, staggering, falling, recumbency, convulsions, sudden death ***Lesion*** : *Soft pulpy kidneys*	Treatment is not effective but oral antibiotics may be tried
10.Tetanus ***(Lock Jaw)*** **Clostridium tetani* *All species * Horses are highly susceptible	*Tetany* i.e. stiffness of muscles, prolapse of third eyelid, lockjaw, hyperaesthesia, convulsions & death Evidence of wound or umbilical infection History of castration, docking, shearing, parturition or vaccination	Penicillin in high doses Muscle relaxant : inj.Largactil @1mg/kg IM twice daily for 8-10 days Tetanus antitoxin @ 3 lakh IU IV Fluid therapy Good nursing
11. Botulism **Clostridium botulinum* *All species	Progressive muscle weakness & *paralysis affecting limbs, head & neck,* incoordination, inability to rise & lift head, inability to chew or swallow, drooling of saliva, recumbency & death. H/o osteophagia or pica	No reliable treatment Antitoxic serum, purgatives & nervine tonics may be tried

12. Bacillary Haemoglobinuria **Clostridium haemolyticum* *Bovines	Fever, anorexia, colic, coffee coloured urine, anemia, jaundice & death. ***Lesion** : Large necrotic infarct in liver*	Penicillin in high doses Blood transfusion Haematinics Liver tonics
13. Foot Rot **Spherophorus necrophorus* *Sheep, Goat, cattle	Fever, anorexia Necrosis & ulceration of interdigital space Lameness	Broad spectrum antibiotics Dressing of foot lesions
14. Contagious Caprine Pleuro-pneumonia(CCPP) * *Mycoplasma mycoides* * Sheep & goats	Fever, anorexia, nasal discharge, dyspnoea, dry painful cough, Abdominal respiration ***Lesion** : Fibrinous pleuro-pneumonia*	Tetracyclines in high doses or enrofloxacin or tylosin Anti-inflammatory, analgesic & antipyretic drugs
15. Contagious Bovine Pleuro-pneumonia(CBPP) * *Mycoplasma mycoides* * Bovines	Fever, depression, anorexia, reluctance to move,chest pain,dyspnoea, nasal discharge, dry friction sounds on auscultation ***Lesion** : Marbled appearance of lungs*	Tylosin @10mg / kg IM or Tetracyclines or Enrofloxacin Anti-inflammatory, analgesic & antipyretic drugs
16. Strangles * *Streptococcus equi* * Young equines	High fever, nasal discharge, dyspnoea, coughing, enlargement of submaxillary lymphnodes	Penicillin/ampicillin are highly effective
17. Glanders **Malleomyces mallei* *Equines	Chronic nasal discharge, cough, dyspnoea, ulcers on nasal septum, *nodules & ulcers on skin at medial aspect of hock*	Affected animals are to be destroyed as per Glanders & Farcy Act.
18. Vibriosis **Vibrio foetus* *Ruminants	Abortion during mid-pregnancy Retention of placenta Repeat breeding Cloudy oestrus discharge Frequent & irregular oestrus	Antibiotics Use of AI for breeding

II - VIRAL DISEASES

(1) RINDERPEST

Synonyms : Cattle plague, Bovine typhus, ***Bulkandi***

It is an acute highly contagious viral disease of ruminants and pig. Exotic, crossbred and young cattle are more susceptible to this virus. The disease most commonly occurs during rainy season. The morbidity rate is 100% while mortality rate is 25-90%. The disease has now nearly been eradicated from India.

Etiology :

It is caused by ***paramyxovirus.***

Transmission :

1. It spreads primarily through inhalation
2. It also spreads through ingestion of contaminated feed and water.

Symptoms :

1. ***Fever usually persists for 3 days.***
2. Loss of appetite (off feed)
3. Drop in milk yield
4. Suspended rumination
5. Conjunctiva becomes dark red i.e. congested
6. Lacrimation
7. Nasal discharge
8. ***Necrotic ulcers or erosions on oral mucus membrane.***
9. ***Salivation***
10. ***Shooting diarrhoea.***
11. Abdominal pain / colic
12. ***Dehydration.***
13. Recumbency.
14. Death within 6-12 days.

Diagnosis :

1. History of an outbreak and symptoms.
2. Postmortem findings : ***Zebra markings in intestine.***
3. Isolation of virus from blood, spleen and lymphnodes.
4. Serological tests.

Treatment :

It is of very little help in rinderpest, however, the following treatment may prove beneficial in reducing the death rate among affected animals.

1. Antibiotics like Penicillin., Streptomycin, Oxytetracycline should be given to check secondary bacterial infection.
2. Astringents or antidiarrhoeal drugs.
3. Anti-rinderpest serum - 50-100 ml IV to affected and incontact animals.
4. Fluid and electrolyte therapy - Dextrose saline IV.

Control :

a) General measures :

1. Identification and isolation of sick animals.
2. Complete prohibition on import of domestic ruminants, pig and animal products from affected area.
3. Restriction of animal movements.
4. Disposal of dead animals.
5. Disinfection of contaminated shed and premises.

b) Vaccination :

1. Tissue Culture Rinderpest Vaccine (TCRPV) @ 1 ml SC every alternate year. It can be given in all animals.
2. Freeze dried goat tissue vaccine (FDGTV) @ 1ml subcut once in a life. It should not be given in exotic and crossbred cattle, sheep and goats.

(2) FOOT-AND-MOUTH DISEASE

Synonyms : Apthous fever, ***Khurkut***

It is highly contagious viral disease of ***cloven footed animals*** viz. cattle, buffalo, sheep, goat and pigs. ***Crossbreds and young cattle*** are severely affected. In India, the disease causes an annual economic loss of Rs. 1000 crores due to reduction of milk, meat and working capability of draft animals. The disease usually occurs at the end of winter i.e. in February and March.

Etiology :

1. It is caused by filterable virus namely ***Picorna virus*** (Apthovirus)
2. There are 7 major strains of the virus namely O, A, C, Asia-1, SAT-1, SAT- 2, SAT-3. In India, O, A, C and Asia - 1 are responsible for disease.

Transmission :

1. It usually spreads through ingestion of contaminated feed and water.
2. Air-borne infection can also occur.
3. Suckling calves may pick up infection from dam/mother.

Symptoms :

1. Fever (104 - 106^{0}F) for 24 - 48 hours.
2. Loss of appetite.
3. Drop in milk yield.
4. ***Blisters/vesicles and ulcers on tongue, dental pad and oral mucosa.***
5. Profuse salivation.
6. Painful mastication.
7. ***Vesicles & ulcers develop in interdigital space & on the coronet.***
8. ***Lameness.***
9. Stamping of feet.
10. Recovery within 8 days, if complication doesn't occur.

Diagnosis :

1. Based on symptoms.
2. Isolation of virus from vesicular fluid.
3. Serological tests.
4. Animal inoculation test.

Post FMD complications :

1. Abortion,
2. Infertility
3. Mastitis
4. Pneumonia
5. Deformity in hooves
6. Anemia
7. Excess growth of hair.
8. Panting

Treatment :

There is no specific treatment, however symptomatic treatment can be done to speed up recovery and to avoid complications.

1. Inj Oxytetracycline @ 4 - 5 mg/kg body weight IM for 3 - 5 days.
2. Mouth wash with 1% $KMnO_4$ or 2% Sodium bicarbonate solution.
3. Apply Boroglycerine on mouth lesions.
4. Foot wash with 2% Copper sulphate or 2-4% Sodium carbonate solution.
5. Apply mixture of Coal-tar and Copper sulphate (5:1) on foot lesions.

Control :

a) General measures :

1. Isolation of all affected animals immediately after detection.
2. Slaughter of all affected and incontact animals.
3. Restriction of animal movements by regulation.
4. Contaminated bedding and fodder should be burnt.
5. Cattle shed must be cleaned and disinfected with 1-2% caustic soda or formalin.
6. Human movement to and from infected premises must be reduced to minimum.
7. Thorough disinfection of all the utensils and cloths of the attendants.
8. Animals should not be allowed to graze in common grazing pasture or to drink water from ponds and rivers.
9. Calves should not be allowed to suckle affected mothers.

b) Vaccination :

1. Raksha FMD vaccine @ 3ml SC or FMD vaccine (Hoechst/ BAIF) @ 5ml SC every six months i.e. in September/October and March / April.
2. Clovax (Hoechst) @ 3 ml SC in bovines & 2 ml SC in small ruminants in September/October. This provides immunity for one year.

(3). RABIES

Synonyms : Hydrophobia, Madness, ***Pisalne***

It is a highly fatal viral disease of all warm blooded animals. It is ***communicable*** to man.

Etiology :

It is caused by ***Rhabdo virus.***

Transmission :

1. It spreads almost always by the bite of rabid animal.
2. Through contamination of skin wounds by fresh saliva of infected animal.

Symptoms :

a) Furious form :

1. Change in behaviour.
2. Restlessness and excitement.
3. Sexual excitement
4. Hypersensitive to sound and movement
5. Tendency to bite either animate or inanimate objects.
6. Profuse salivation.
7. Frequent and loud bellowing/barking with hoarse voice.
8. Death within 2 - 4 days in cattle and 8-10 days in dog.

b) Paralytic/Dumb form :

1. Decreased sensation.
2. Hanging of lower jaw and protrusion of tongue
3. In-coordination in gait
4. Drooling of saliva
5. Voiceless attempts to bellow/bark (yawning movements) in late stage.
6. Inability to swallow food and water.
7. Progressive paralysis
8. Recumbency and death within 6-7 days.

Diagnosis :

1. History of bite by the rabid animal
2. Based on symptoms
3. Detection of ***negri bodies*** in brain (Hippocampus) smears.
4. Isolation of rabies virus from brain tissue of affected dog/animal.

Treatment :

There is no specific curative treatment for clinical rabies, however after dog bite following treatment should be given-

1. Irrigation of the wound with soap water immediately after exposure.
2. Treat wounds with antiseptics like iodine.
3. Post-bite vaccination with -

a) Antirabies vaccine 5% (IVBP, Pune) @ 10ml SC for 14 days in cattle and buffaloes.

b) Raksharab / Rabisin vaccine @ 1 ml SC on days 0, 3, 7, 14, 28 and 90th post bite in all animal species.

Keep the suspected animal under observation in isolation for 10-14 days.

Control :

1. Identification and destruction of rabid animals.
2. Destruction of stray dogs.
3. Control of wild life vectors like foxes.
4. Compulsory prophylactic antirabies vaccination of dogs with-
   a) Rabisin / Raksharab @ 1ml SC every year.
   b) Antirabies vaccine (20%) @ 5mi SC every six months.

Table 11.3 : Some other viral diseases of animals

Name of disease : etiology & species affected	Clinical signs & lesions	Symptomatic treatment
1. Peste de Petits Ruminants (PPR) ***(Bulkandi)*** **Morbillivirus* *Sheep & Goat	Fever, erosions & bran like deposits on tongue, dental pad & innerside of lips, diarrhoea, dehydration, coughing, nasal discharge, dyspnoea, corneal opacity, abortion	Antibiotics for 3-7 days Mouthwash, Astringents Cough mixtures, Fluid therapy Multivitamins
2. Bluetongue (BT) ***(Niljeeva)*** **Arbovirus / Reovirus* *Sheep *Transmitted by Culicoides *Common in monsoon	Fever, swelling/oedema of lips, gums and tongue, *ulcerative lesions on tongue*, salivation, nasal discharge, cyanosis of tongue, *lesions on coronet,* lameness	Antibiotics for3 -7 days Mouth wash Dressing of foot lesions Multivitamins
3. Sheep & Goat Pox ***(Devi)*** * *Pox virus* *Severe in lambs & kids	Fever, *pustular scabby lesions* mostly on non- wooly/non-hairy parts of the body like udder, inside of thighs, axilla, face, lips, ears, under the tail	Antibiotics for 3-7 days Dressing of cutaneous lesions
4. Contagious Ecthyma ***(Mawa)*** **Parapoxvirus* *Sheep & Goat	Thick, *tenacious scabby lesions* on lips, muzzle, nostrils Negligible mortality	Antibiotics for 3 days Dressing of lesions with boroglycerine

5. Canine Distemper (CD) **Paramyxovirus* *Dog *Young pups (3-12 months of age) are more susceptible	Biphasic fever, anorexia vomition, diarrhoea, dehydration nasal discharge,coughing, *pustules on ventral aspect of abdomen* Nervous signs - chorea	Antibiotics Antiemetics Astringents Fluid therapy Multivitamins Dressing of skin lesions
6. Haemorrhagic Gastroenteritis **Parvovirus* *Dog *Pups are more susceptible	Anorexia, polydipsia, vomition, *bloody foul-smelling diarrhoea*, dehydration & death. sometimes myocarditis	Antibiotics, Antiemetics,Astringents Ascorbic acid IV Intensive fluid therapy Styptics parenterally
7. Infectious Canine Hepatitis (ICH) **Canine adenovirus* * Severe in young pups	Saddle shape fever, anorexia, vomition, diarrhoea, jaundice, abdominal tenderness, corneal opacity	Rest Antibiotics Dextrose IV Liver tonics
8. Ephemeral Fever **Rhabdovirus* *Bovines *Insect borne - Sandflies	*Three day fever*, anorexia, rapid breathing, nasal discharge, weakness, stiffness of muscles, lameness, recumbency	Antibiotics for 3 days Analgesics and antipyretics
9. Infectious Bovine Rhinotracheitis (IBR) **Herpes virus* *Bovines	Fever, nasal discharge conjunctivitis, respiratory distress, abortion	Antibiotics Antipyretics
10. Bovine Malignant Catarrh (BMC) * *Herpes virus* *Bovines	High persistent fever, anorexia, nasal and ocular discharge,dyspnoea, diarrhoea, enlargement of lymphnodes, nervous signs	Antibiotics Antipyretics Astringents Fluid therapy
11. Mucosal Disease/BVD *Bovine Viral Diarrhoea* **Pestivirus / Togavirus* *Young cattle (8 - 24 months)	Fever, diffuse erosive stomatitis, salivation diarrhoea, dehydration skin lesions, lameness	Antibiotics Antipyretics Astringents Fluid therapy

12. Swine Fever ***(Hog Cholera)*** **Toga virus* *Pigs	Fever,anorexia,depression, constipation, diarrhoea, vomition, purplish discolouration of abdominal skin. Nervous signs: circling, tremors, incoordination, convulsions, paralysis ***Lesion**: Turkey egg kidneys*	Antibiotics Antipyretics Fluid therapy
13. Swine Influenza **Influenza virus* *Pigs	Fever, anorexia, reluctance to move,nasal discharge, dyspnoea, coughing	Antibiotics Antipyretics & analgesics
14. South African Horse Sickness (SAHS) ***(Equine plague)*** **Arbo virus* *Horses *Mosquito-borne	***Pulmonary/Dunkup form**: Fever, nasal discharge, dyspnoea, cough & death within 4 - 5 days ***Cardiac/Dikkup form**: Fever, oedema of head, cyanotic mucosae,evidence of hydropericardium on auscultation.	Treatment is usually ineffective
15. Equine Influenza **Myxovirus* *Horses	High fever, anorexia, nasal discharge dyspnoea, cough	Antibiotics Antiseptic inhalations
16. Equine Infectious Anemia ***(Swamp Fever)*** **Lentivirus* *Insect borne disease	Intermittent/recurrent fever, anemia, jaundice, oedema of dependent parts, weakness, abortion, emaciation,	Antibiotics Blood transfusion Haematinics
17. Bovine Spongiform Encephalopathy (BSE) ***(Mad cow disease)*** *Prion-a proteinaceous agent *Consumption of infected tissues *Transmitted to humanbeings through consumption of beef	Incubation period 6 months to 4 years Hyperaesthesia, ataxia, staggering, incoordination, dashing head against hard objects, grinding of teeth, dyspnoea and death within month.	No specific treatment

III -PROTOZOAN DISEASES

(1) TRYPANOSOMIASIS

Synonym : Surra

It is an important ***protozoan*** disease found in cattle, buffalo, sheep, goat, horse and camel. It is more common in ***monsoon or rainy season.***

Etiology :

The disease is caused by a protozoa named ***Trypanosoma evansi.***

Transmission :

It is transmitted through the bites of flies mainly of ***Tabanus species.***

Symptoms :

(a) Acute form :

1. Fever
2. Circling movements
3. In-coordination
4. Head pressing against hard objects.
5. Blindness
6. Convulsions & death.

(b) Chronic form :

1. Intermittent fever
2. Poor appetite
3. Drop in milk production
4. Loss of body weight
5. Anaemia

Diagnosis :

1. Based on symptoms.
2. Blood smear examination.
3. Biological test e.g. mice inoculation test.
4. Serological tests.

Treatment :

a) Specific treatment -

1. Quinapyramine (Triquin, Tribexin) 20%@3-5 mg/kg body wt. subcut or
2. Suramin (Naganol or Antrypol) - 10% @ 12mg/kg body wt. IV. or
3. Diminazene (Berenil or Nilbery) @ 8-10 mg/kg B.wt IM. or
4. Isometamedium (Samorin) 1% @ 0.25 mg/kg body wt. IM.

b) Supportive treatment

1. Inj. Dextrose 25% IV
2. Inj. Liver extract with vit B -complex IM

Control :

1. Control of vectors like flies.
2. Hygienic and sanitary measures
3. Detection, isolation and treatment of infected animals.
4. Prophylactic chemotherapy with quinapyramine in endemic areas

(2) THEILERIOSIS

Synonym : East coast fever, Tick fever

It is an important ***protozoan*** disease of ***exotic and crossbred*** cattle. The disease is mostly observed during summer and rainy season. ***Young calves*** are more susceptible to this disease.

Etiology :

It is caused by ***Theileria annulata*** or ***Theileria Parva***

Transmission :

It is transmitted by ***ticks***.

Symptoms :

1. ***High fever lasting for several days.***
2. Slight to complete anorexia.
3. Increase in heart and respiration rates.
4. Depression and weakness.
5. Dyspnoea i.e. difficult respiration.
6. Ocular and nasal discharge.
7. ***Swelling / Enlargement of superficial lymphnodes.***
8. ***Anemia - pale mucous membranes.***
9. ***Jaundice*** - dark yellow coloured urine.
10. Death within 7-10 days.

Diagnosis :

1. Based on history and symptoms.
2. Blood smear examination.
3. Lymphnode biopsy-presence of ***Koch's blue bodies.***
4. Postmortem findings - ***Punched out ulcers in abomasum.***
5. Serological test.

Treatment :

a) Specific treatment :

1. Inj. Oxytetracycline @ 15-20 mg/kg body wt. IV daily for 5-7 days.
2. Inj Oxytetracycline @ 5 - 10 mg/kg body wt. IM daily for 6 days alongwith Inj. Nivaquin @ 20-30 ml IM daily for 3 days.
3. Single dose of Inj. Buparvaquone (Butalex) @ 2.5 mg/kg body .wt IM is highly effective.
4. Inj. Berenil (Diminazene) @ 0.8 to 1.6 gm/100 kg body wt. IM.

b) Supportive treatment :

1. Antipyretics eg. Inj. Novalgin @ 20 to 30 ml. IM.
2. Inj. Dextrose saline IV.
3. Inj. Liver extract with vit. B-complex.
4. Iron preparations.
5. Blood transfusion in severe cases.

Control :

1. Control of ticks by spraying of insecticides on animal body and in cattle shed.
2. Vaccination of susceptible cattle with Rakshavac - T vaccine @ 3ml SC. every three year.

Note : The vaccine should be stored in liquid nitrogen.
Animals in advance pregnancy should not be vaccinated.

(3) BABESIOSIS

Synonyms : Tick fever, Piroplasmosis, Red water

It is an important protozoan disease of domestic animals. It is more common in ***exotic*** and ***crossbred*** cattle. The disease has serious economic impact due to obvious reasons of death, decreased production and lowered working efficiency.

Etiology :

It is caused by protozoa- ***Babesia bigemina or Babesia bovis*** in bovines.

Transmission :

The disease is transmitted mainly through ***tick bites.***

Symptoms :

1. ***High fever***
2. Loss of appetite
3. Depression and weakness
4. Drop in milk yield
5. Increased heart and respiratory rates
6. Anaemia
7. ***Passage of coffee coloured urine i.e. haemoglobinuria***
8. Jaundice.
9. Dyspnoea i.e. diffcult breathing
10. Death

Diagnosis :

1. Based on history and symptoms.
2. Examination of blood smears
3. Post mortem lesions like enlargement of spleen and liver, anaemia, jaundice, coffee coloured urine in bladder
4. Serological tests.

Treatment :

a) Specific treatment :

Inj. Berenil (Diminazene) @ 0.8 - 1.6 gm/100 kg body wt. IM is most effective.

b) Supportive treatment :

1. Inj. Liver extract with vit-B complex.
2. Iron preparations orally or parenterally.
3. Blood transfusion in severe cases.

Control :

1. Control of ticks by periodical spraying of insecticides
2. Use of live or killed vaccines.

Table 11.4 : Some protozoan and Rickettsial Diseases of Animals.

Disease:	Diagnosis	Treatment
1. Anaplasmosis **Anaplasma marginale* *Goats, sheep, bovines * Tick-borne disease	***Signs:** Presistent fever anorexia, lacrimation, nasal discharge, dyspnoea, emaciation, anemia, jaundice ***Lesions:** Enlargement of spleen & liver, jaundice *Examination of blood smear	*Oxytetracycline @10 mg/kg IV for 5-7 days *Berenil:single dose *Haematinics *Liver tonics
2. Canine Ehrlichiasis **Ehrlichia canis* *Canines *Tick-borne disease	***Signs:** Undulating fever Anorexia, anemia, epistaxis, haemorrhagic diarrhoea enlargement of lymphnodes *Blood smear examination	*Oxytetracycline IV *Haematinics *Vit. B-complex *Fluid therapy *Blood transfusion
3. Giardiasis **Giardia canis* *Dog *Ingestion of contaminated food	***Signs:** Greasy stools containing blood & mucus, straining during defecation, loss of body weight *Recovery of cysts in faeces	*Metronidazole @20mg/kg orally TID for 7-14 days
4. Amoebiasis **Entamoeba histolytica* *Dogs, pig, cat *Ingestion of contaminated food	***Signs:** Chronic diarrhoea or dysentery, abdominal pain, loss of body weight *Recovery of cyst in faeces	*Metronidazole @20mg/kg orally TID for 7-14 days
5. Coccidiosis **Eimeria spp.* *Calves,lambs,kids,pups *Ingestion of contaminated food	***Signs:** Diarrhoea or dysentery, faeces contain blood & mucus, straining, dehydration *Recovery of oocysts in faeces	*Furazolidone @10mg/kg PO or *Sulphamezathene @ 110 mg/kg PO for 5-7 days
6. Trichomoniasis **Trichomonas foetus* *Mostly bovines *Transmitted by coitus	***Signs:** Early abortion, mucopurulent-vaginal discharge Retention of placenta, pyometra *Demonstration of organism in vaginal discharge	*Self - limiting *Give breeding rest for 3 oestrus period

IV - PARASITIC DISEASES

Parasites are of two types :

I) ***Endoparasites*** - those parasites that live within animal body.

II) ***Ectoparasites*** - those parasites which live on the outside of animal body.

I) ENDOPARASITES

Endoparasites are divided into three groups as :

A) ***Nematodes or round worms*** - They are elongated, cylindrical and tapered at both ends.

B) ***Cestodes or tapeworms*** - They are flat, segmented or tape like worms. They range in length from 2mm to 20 meters.

C) ***Trematodes or flukes*** - They are flat, unsegmented leaf like worms.

A) *ROUNDWORMS*

Roundworms found in ruminants are as follows -

1. Stomach worms - eg. ***Haemonchus, Ostertagia, Trichostrongylus.***
2. Small intestinal worms - eg. ***Neoascaris or Toxocara, Cooperia***
3. Large intestinal worms - eg. ***Trichuris, Oesophagostomum.***

Transmission :

Through ingestion of eggs or infective larvae

Symptoms :

1. Loss of body weight.
2. Dry and rough hair coat.
3. Poor growth rate.
4. Pot-belly.
5. Continuous diarrhoea.
6. Anaemia.
7. Pica or depraved appetite - eating of soil & clothes, chewing of stones etc.

Diagnosis :

1. Based on symptoms
2. Faecal examination reveals presence of eggs.

Treatment :

1. Piperazine salts @ 100 mg/kg B.wt orally are effective against ascarids.
2. The anthelmintics which are effective against most of the gastrointestinal nematodes are as follows.
   a) Albendazole (Valbazen, Albomar) @ 5-10 mg/kg B.wt orally
   b) Fenbendazole (Fentas, Panacur, Curaminth) @ 5 mg/kg B.wt orally
   c) Mebendazole (Wormin, Zodex) @ 5-10 mg/kg B.wt orally
   d) Tetramisole (Nilverm) @ 15 mg/kg B.wt orally
   e) Morantel citrate (Banminth forte) @ 6 mg / kg B.wt. orally.
   f) Inj. Ivermectin (Neomec, Mectin) @ 200 μg/kg Bt.wt. SC

Control :

1. Isolation and treatment of affected animals.
2. Cleaning of animal shed.
3. Feed and water should not get contaminated with dung.
4. Do not keep young and old animals together.
5. Overcrowding is to be avoided.
6. Rotational grazing has to be encouraged.
7. Deworming should be done atleast twice in a year i.e. before and after monsoon.
8. Provide balanced ration.
9. Examination of faecal samples of the herd at regular interval.

B) *TAPEWORMS OR CESTODES :*

The tapeworm infestation have little effect on the health of farm livestock but heavy infestation may cause clinical illness in young animals.

Etiology :

1. The common tapeworms found in ruminants are of ***Moneizia species.***
2. The mature tapeworms are found in the intestine.

Transmission :

Orbatid mites are the intermediate hosts of the tapeworms.

Symptoms :

The heavy tapeworm infestation in young animals results in -

1. Loss of body weight.
2. Stunted growth.
3. Rough body coat
4. Pot belly
5. Diarrhoea and constipation
6. Anaemia
7. Excretion of tapeworm segments in the faeces.

Diagnosis :

1. Based on symptoms.
2. Presence of eggs or white segments of the tapeworm in faeces.

Treatment :

1. Niclosamide (Cestonex - N powder, Niclex) @ 75-100 mg/kg B.wt orally.
2. Albendazole (Valbazen) @ 10-15 mg/kg B.wt orally.
3. Praziquantel (Prazik, Fentas plus) @ 5 mg/kg B.wt orally.

Control :

1. Spray intsecticide to control the orbatid mites.
2. Avoid grazing in infective pasture before sunrise and after sunset.
3. Regular deworming.
4. Maintain hygienic conditions.

C) *FLUKES OR TREMATODES :*

Hepatic Fascioliasis.

Liver flukes are large, flat, leaf shaped worms found in the liver and bile duct of ruminants.

Etiology :

1. It is caused by ***Fasciola hepatica or Fasciola gigantica.***
2. Fresh water ***snails*** are the intermediate hosts.

Transmission :

It spreads through ingestion of contaminated pasture and drinking water.

Symptoms :

1. Loss of appetite.
2. ***Weight loss (emaciation)***
3. Weakness
4. Fall in milk yield
5. ***Bottle jaw i.e. swelling below chin***
6. Anaemia
7. ***Chronic diarrhoea***
8. Death within 2-3 months

Diagnosis :

1. Symptoms like diarrhoea, emaciation and bottle jaw.
2. Presence of eggs in the faeces
3. Postmortem findings like presence of flukes in liver and bile duct.

Treatment :

a) ***Specific treatment*** with following flukicides.

1. Oxyclozanide (Distodin/Neozide tab.) @ 10-15 mg/kg. B.wt orally or
2. Triclabendazole (Fasinex bolus/Suspension) @ 10-12 mg/kg orally or
3. Nitroxynil (Inj. Trodax) @ 10 mg/kg B.wt subcut.
4. Hexachlorophene (Flukin tab.) @ 10-20 mg/kg. orally

b) ***Supportive treatment*** with-

Inj. Liver extract with Vit.B.-Complex @ 5-10 ml IM twice in a week.

Control :

1. Treatment of affected animals.
2. Control of snails.
3. Avoid grazing in low lying or marshy areas like banks of river, ponds etc.
4. Use of flukicides twice a year i.e. before and after monsoon in areas where disease is common.

II) ECTOPARASITES

The ectoparasites of animals can be divided into following groups.

1) Lice 2) Ticks 3) Fleas 4) Mites 5) Flies

Symptoms :

1. Irritation/itching
2. Loss of hair i.e. alopecia
3. Restlessness
4. Anaemia
5. Loss of body weight
6. Decreased milk and meat production

7. Decreased growth rate
8. Some flies produces maggoted wound
9. Can transmit bacterial, viral, protozoan and rickettsial diseases.

Diagnosis :

1. Symptoms
2. Detection of ectoparasites on body

Treatment :

1. Spraying or dusting with following insecticides-
   Deltamethrin (Butox) @ 2-3 ml/lit. water as spray or
   Cypermethrin (Pektocide, Cyprol, Clinar) @ 1-2 ml/lit. water as spray
   Malathion - 0.5% spray or Sumithion - 1% spray or
   B.H.C. (Gammexane) or DDT 5% dust
2. Spraying of insecticides in drainage channels and in animal shed.

Control :

1. Isolation and treatment of affected animals.
2. Spraying of insecticides in cattle shed at regular interval.
3. Close cracks and crevices on the walls of animal shed.
4. Maintain sanitary conditions.
5. All vegetation surrounding the animal shed should be cleared.

Table 11.5 : Common Endoparasitic Diseases of Animals

Disease: Etiology	Diagnosis	Treatment
1. Paramphistomiasis *(Stomach fluke disease)* **Paramphistomum spp.* **Int. host* : Snail ** Host* : Ruminants	***Signs:** Persistent foetid diarrhoea, anorexia, weight loss dehydration, bottle jaw, weakness *Recovery of immature parasites from duodenum	*Oxyclozanide **or** Niclosamide *Fluid therapy
2. Nasal granuloma **Schistosoma nasalis* **Int host* : Snail **Host* : Ruminants	***Signs:** Coryza, sneezing, Snoring respiration,granulomatous growth in nostril *Eggs in nasal washings	*Anthiomaline @15ml IM in cattle 4 inj. every alternate day
3. Ascariasis *Dog: *Toxocara canis* *Calves: *Toxocara vitulorum* *Pigs: *Ascaris suum* *Horse: *Parascaris equorum* **Habitat*:Small intestine	***Signs:** Poor growth, rough coat, emaciation, colic constipation, diarrhoea, pot-belly, coughing, sometimes intestinal obstruction *Ova/eggs in faeces	*Piperazine or any other broadspectrum anthelmintic

4. Oesophagostomiasis		
(Nodule worm disease)	***Signs:** Chronic profuse	*Broad spectrum
**Oesophagostomum spp.*	diarrhoea, emaciation, anemia,	anthelmintics
***Host:** Ruminants, pigs	weakness, dehydration	
***Habitat**:Large intestine	*Recovery of eggs in faeces	
	***Lesion:** Pimply gut	
5. Bunostomiasis		
(Hookworm disease)	***Signs:** Weakness, anemia, loss	*Fenbendazole or
**Bunostomum spp.*	of appetite, dry skin coat,	albendazole
***Host:** Ruminants	diarrhoea, colic, bottle jaw	*Haematinics
***Habitat:**Small intestine	*Presence of eggs in faeces	*Proteinous diet
6. Ancylostomiasis		
(Hookworm disease)	***Signs:** Pale mucosae, weakness	*Levamisole or
**Ancylostoma spp.*	emaciation, stunted growth	mebendazole
***Host**: Dog	bloody diarrhoea, itching of skin	*Haematinics
***Habitat**:Small intestine	*Presence of eggs in faeces	*Liver tonics
		*Protein rich diet
		*Blood transfusion
7. Strongylosis		
**Strongylus spp.*	***Signs:** Weakness, anemia,	*Broadspectrum
***Host** : Equines	emaciation, anorexia, colic,	anthelmintic
***Habitat**:Large intestine	diarrhoea or constipation.	*Haematinics
	*Detection of eggs in faeces	
8. Trichuriosis		
(Whip worm disease)	***Signs:** Diarrhoea with blood	*Broadspectrum
**Trichuris vulpis*	tinged faeces, anemia, stunted	anthelmintic
***Host**: Ruminants, dog	growth, dehydration.	
***Habitat**: Caecum	*Recovery of eggs in faeces	
9. Haemonchosis		
(Barber's pole worm)	***Signs:** Anemia, weakness,	*Broadspectrum
**Haemonchus contortus*	emaciation, bottle jaw,	anthelmintic
***Host** : Ruminants	sometimes sudden death.	
***Habitat** : Abomasum	*Detection of eggs in faeces	
10. Trichostrongylosis		
**Trichostrongylus spp.*	***Signs:** Anorexia, emaciation	*Broadspectrum
Ostertagia spp.	stunted growth, foetid	anthelmintic
Cooperia spp.	black-coloured diarrhoea,	
Nematiodirus spp.	dehydration and death.	
***Host** : Ruminants	*Detection of eggs in faeces	

11. Verminous pneumonia ***(Lung worm disease)*** **Dictyocalus spp.* ***Host* : Ruminants ***Habitat*: Bronchioles	***Signs:** Hacking cough, dyspnoea, nasal discharge, diarrhoea, anorexia, stunted growth and death. *Presence of larvae in faeces	*Tetramisole or *Broadspectrum anthelmintics
12. Dirofilariasis ***(Heart worm disease)*** **Dirofilaria immitis* ***Host*: Dogs ***Habitat*: Heart ***Int. Host*: Mosquito	***Signs:** Dyspnoea, chronic cough, poor exercise tolerance, anorexia, anemia, epistaxis, haematuria. *Recovery of microfilaria in direct blood smear.	*Ivermectin or *Levamisole or *Diethyl carbamazine
13. Thelaziasis ***(Eye worm disease)*** **Thelazia rhodesii* ***Host*: Ruminants ***Habitat*: Eyes	***Signs:** Lacrimation, photophobia, corneal opacity. *Presence of worms in conjunctival sac	*Manual removal *Inj. Ivomec
14. Spirocercosis ***(Oesophageal worm)*** **Spirocerca lupi* ***Host*: Dog ***Habitat*: Oesophagus	***Signs:** Persistent vomition, diarrhoea, emaciation, difficulty in swallowing. *Eggs in faeces/vomitus	*Broadspectrum anthelmintics or Diethylcarbamazine
15. Kidney worm of dog **Dioctophyma renale* ***Host*: Dog ***Habitat*: Kidney	***Signs:** Renal colic, red urine, retention of urine, dysuria *Detection of eggs in urine	*Inj. Ivomec or *Broad-spectrum anthelmintics
16. Tapeworms in dog **Diphyllobothrium latum* **Dipylidium caninum*	***Signs:** Stunted growth, diarrhoea, vomition, pot-belly, rubbing of anus on ground, biting of anal region. *Tapeworm segments in faeces	*Niclex tab @ 1gm/7.5 kg body weight orally *Fentas plus @1tab/10 kg orally

CHAPTER - 12 : SYSTEMIC DISEASES

1. STOMATITIS

It is inflammation of the oral mucosa.

Etiology :

1. ***Physical*** **:** Trauma or injury caused by spines on plants, foreign bodies.
2. ***Chemicals*** **:** Irritant drugs, acids, alkalies.
3. ***Viruses*** **:** RP, FMD, BMC, BVD, PPR, BT, Sheep and goat pox, Contagious ecthyma, Vesicular stomatitis, Vesicular exanthema.
4. ***Bacteria*****:** Oral necrobacillosis (*Fusobacterium necrophorus*) Actinobacillosis, Streptococci, Staphylococci.
5. ***Fungi*** **:** Moniliasis, Candidiasis, Aspergillosis.
6. ***Nutritional deficiency*** **:** Vit. A, Vit. B complex, Niacin - Black tongue.
7. ***Allergy*** **:** Certain plant allergens, Stinging plants.

Clinical signs :

* Partial or complete anorexia.
* Increased thirst.
* Slow and painful mastication.
* Difficulty in ingestion of food.
* Salivation either frothy or profuse or drooling.
* Smacking of the lips and chewing movements.
* Foul smell from mouth.
* Enlargement of local lymphnodes.
* Oral lesions : Vesicles, ulcers, erosions, necrosis, papules.

Treatment :

1. Correct the primary cause.
2. Mouth wash with 0.1% PP lotion or 2% $CuSO_4$ solution or any other antiseptic solution.
3. Apply boroglycerine.
4. Cauterization of ulcers with Tin. iodine or Silver nitrate stick.
5. Antibiotics.
6. Multivitamin therapy : e.g. Inj. multivet @ 1 ml/10 kg B.Wt. IM/IV
7. Give easily digestible soft diet.
8. Intravenous fluid therapy in severe cases.
9. Antifungals like mycostatin in fungal diseases.
10. Surgical repair of injuries/removal of foreign bodies.

2. GASTRITIS

* Gastritis means inflammation of gastric mucosa.
* Gastritis is common in dogs and cats.
* Gastritis is usually accompanied by enteritis.

Etiology :

1. ***Physical agents*** **:**
   * Overfeeding.
   * Ingestion of foreign bodies / grass with sharp leaf blades.
   * Ingestion of too hot or too cold food or water.
   * Ingestion of mouldy, decomposed or highly fermented food.
   * Drinking of dirty water.
2. ***Chemical agents*** **:**
   * Irritant chemicals viz. As, Pb, Cu.
   * Acids / Alkalies.
   * Drugs - Aspirin, Phenylbutazone.
   * Fungal toxins.
3. ***Bacteria*** **:** *E. coli, Salmonella, Leptospira.*
4. ***Viruses*** **:** Canine Distemper, Parvovirus and Infectious canine hepatitis.
5. ***Fungi*** **:** *Aspergillus, Monilia, Mucor.*
6. ***Parasite*** **:** *Toxocara canis.*
7. ***Allergy*** **:** Food allergy.

Symptoms :

A] ***Acute*** **:**

* Loss of appetite.
* Intense thirst.
* Abdominal pain / colic, discomfort, restlessness.
* Vomition.
* Vomitus may contain blood or mucus.
* Salivation, Coated tongue.
* Retching.
* Belching of offensive smelling gases.
* Pain on deep palpation over the epigastric region.
* Severe dehydration.
* Death.

B] ***Chronic*** **:**

* Poor / Depraved appetite i.e. Pica.
* Vomiting after intake of food.
* Vomitus viscid and foetid in odour.
* Moderate abdominal pain.
* Aerophagia.
* Body coat dry and rough.
* Emaciation : Gradual loss of body weight.
* Anaemia.

Diagnosis :

History, Clinical signs, Endoscopy, Radiography, Faecal examination.

Treatment :

A] *Acute* :

1. Withheld food for 12-24 hrs.
2. Give antacids 3-4 times in a day 10-15 min. before meal.
3. Pain killers like Vetalgin / Cyclopam to relieve gastric pain.
4. Antiemetics (Inj. Siquil / Perinorm) to stop vomition.
5. Fluid therapy to correct dehydration : DNS, Ringer's solution.
6. Antibiotics orally to check fermentation and gas production.
7. Vit. B complex parenterally or orally to improve appetite and GI tone.
8. Give milk, soup for small animals.

B] *Chronic* :

1. Anthelmintics
2. Antacids four times / day
3. Bland food and milk at 4 hrs. interval in small animals.
4. Antibiotics orally
5. Haematinics to correct anaemia.

3. ENTERITIS

Synonyms : Enteropathy, Diarrhoea, Malabsorption.

* It means inflammation of intestinal mucous membrane.
* It may be acute or chronic.

Etiology :

1. ***Dietary*** **:**
   * Overfeeding
   * Sudden change in feed / fodder.
   * Coarse / fibrous food.
   * Green lush pasture, green grass, green leaves.
   * Mouldy feed
   * Decomposed / spoiled / rotten food.
   * Excess dietary carbohydrate.
   * Excess feeding of milk and inferior milk replacer to calf.
   * Ingestion of poisonous plants.
2. ***Physical agents*** **:**
   Sand, Soil.
3. ***Chemical agents*** **:**

* Irritant chemicals: Arsenic, Copper, Flourine, Mercury, Nitrate.
* Drugs : Antimicrobials, Anthelmintics.

4. ***Bacterial agents*** **:**

* All species : Colibacillosis *(E. coli)*, Salmonellosis, *Campylobacter jejuni, Pseudomonas, Proteus, Shigella, Pasteurella, Streptococci, Staphylococci.*
* Ruminants : Enterotoxaemia and JD.

5. ***Viral agents*** **:**

* BVD, BMC $\rightarrow$ Bovines.

* PPR → Sheep and Goat.
* Rinderpest, Rotavirus, Corona virus → Ruminants.
* Parvovirus, Canine Distemper and ICH → Dogs.

6. *Protozoal agents* :

* Coccidiosis, Balantidiasis, Cryptosporidiasis → Ruminants.
* Giardiasis and Amoebiasis → Dog.

7. *Fungal agents* : *Candida, Aspergillus.*

8. *Parasites* :

a) Roundworms :

* *Ostertagia, Trichostrongylus, Oesophagostomum, Bunostomum, Trichuris, Cooperia* → Ruminants.
* *Ascariasis* in calf .
* *Toxocara canis, Ancylostoma, Trichuris* → Dog.

b) Tapeworms :

* *Moniezia sp* - Ruminants.
* *Dipylidium caninum, Diphyllobothrium* → Dog.

c) Flukes :

* *Fasciola hepatica, F. gigantica* → Ruminants
* *Paramphistomum* → Ruminants.

9. *Nutritional deficiency* :

* Deficiency of Copper (peat scours), Cobalt, Vit. A.

10. *Emotional causes* :

* Excitation, tension, fear, stress, over work, transportation, work after feeding, exposure to unaccoustomed environment.

11. *Miscellaneous* :

* Disaccharidase deficiency in calves, foals, dogs.

Symptoms :

A] *Acute* :

1. Diarrhoea / Dysentery
2. Faeces are soft or fluid in consistency, have foul or fishy odour, abnormal colour and may contain blood, mucus, epithelial shreds, casts etc.
3. Frequency of defaecation is increased.
4. Soiling of buttocks and hindquarters.
5. Straining or tenesmus may occur.
6. Dehydration : Sunken eyes, rough coat, tenting of skin.
7. Abdominal pain : Looking at belly, rolling, stretching of back.
8. Abdomen may be distended in early stages whereas gaunt in later stages.
9. Pain may be evidenced on deep palpation of abdomen in young and small animals.
10. On auscultation, fluid-rushing sound i.e. borborygmi is heard.

11. Fever may be present.
12. Muscle weakness.
13. Loss of appetite.
14. Oliguria.

B] *Chronic* :

1. Faeces are usually soft and homogenous in consistency.
2. Faeces contain considerable mucus.
3. Faeces usually do not have abnormal odour.
4. Emaciation is common.
5. No systemic abnormalities.
6. Dehydration is not marked.

Table 12.1 : Difference between small and large bowel diarrhoea

S.N.	Small bowel diarrhoea	Large bowel diarrhoea
1.	Appetite is decreased	* Unaltered
2.	Loss of body weight is marked	* Minimum loss
3.	Faeces are voluminous	* Small quantity at frequent interval
4.	Tenesmus is usually absent	* Invariably present

Table 12.2 : Difference between diarrhoea and dysentery.

S.N.	Diarrhoea	Dysentery
1.	Voluminous fluid faeces	* Scanty sticky faeces
2.	Blood, mucus or fibrin in faeces : Absent	* Present
3.	Less straining	* More straining

Diagnosis :

1. History of feeding, stress, deworming etc.
2. Clinical signs : Diarrhoea, Dysentery, Colic, Dehydration.
3. Faecal examination for parasitic eggs.
4. Faecal culture for isolation of pathogenic micro-organisms.
5. Haematology : Hb, PCV, TLC.
6. Serum biochemistry : HCO_3, Na, K, Cl, BUN, Proteins.
7. Plain and contrast radiography.

Differential diagnosis of various diseases responsible for diarrhoea.

1. ***Dietary diarrhoea*** **:**

* Animal looks normal.
* Faeces soft and voluminous.
* Temperature is normal.

2. ***Poisoning*** **:**

* Severe haemorrhagic enteritis.
* Subnormal temperature.

3. ***Endoparasitism*** **:**

* Appetite normal, no temperature, no toxaemia.
* Progressive emaciation, anaemia, pot-belly, bottle jaw, chronic diarrhoea.

4. ***Fascioliasis*** **:**

* Faeces may be passed like pipe water.
* Jaundice may be present.

5. ***JD*** **:**

* Mature cattle are affected.
* Faeces contain gas bubbles.
* Chronic nature, no response to treatment.

6. ***RP, BVD, PPR*** **:**

* Diarrhoea + mouth lesions.
* Fever may be present.

7. ***Coccidiosis in calf*** **:**

* Smudge pattern : Soiling of buttocks with sticky faeces.

8. ***Copper deficiency*** **:**

* Chronic diarrhoea.
* Depigmentation of hair and skin is characteristic

9. ***Salmonellosis*** **:**

* All ages are affected.
* Stress-induced.
* Fever, acute diarrhoea/dysentery.

10. ***Colibacillosis*** **:**

* Newborn calves.
* Acute diarrhoea.

11. ***Enterotoxaemia*** **:**

* Young calves / lambs.
* Haemorrhagic enterotoxaemia, rapid death.

Treatment :

1] ***Removal of causative agents*** **:**

a) Antibacterial drugs orally and parenterally in bacterial infections and as supportive in viral infections.

1. *Oral use* :

* Tetracyclines @ 10 mg / kg orally ***or***
* Sulphadimidine @ 100-200 mg / kg orally ***or***
* Amoxycillin @ 10 mg / kg ***or***
* Norfloxacin @ 22 mg / kg orally for 3-7 days.

2. *Parenteral use* :

* Inj. Enrofloxacin @ 2.5-5 mg / kg IM ***or***
* Inj. Gentamycin @ 2-4 mg / kg IM ***or***
* Inj. Cefotaxime @ 20-40 mg/ kg IV twice daily.

b) Anticoccidial drugs are used in coccidiosis.

* Furazolidone @ 10-20 mg / kg orally for 5 days. ***or***
* Sulphadimidine @ 150-200 mg / kg orally for 5 days.

c) Anthelmintics in worm infestation.

* Albendazole @ 5-10 mg / kg orally ***or***
* Fenbendazole @ 5-10 mg / kg orally.

2] *Astringents* :

* Astringent mixture (kaolin 30 g + creta prep. 30 g + pulv. catechu 30 g as drench) twice daily ***or***
* Neblon / Kabjol powder @ 30-50 gm twice daily orally for large animals and @ 10-15 gm for small animals.

3] *Fluid and electolyte therapy* :

* *Mild dehydration* : Electrolyte solution orally.
* *Moderate dehydration* : Inj. Dextrose saline and Ringer lactate solution / Sodium bicarbonate 1.3% IV.
* *Severe dehydration and acidosis* : Sodium bicarbonate 5% @ 5-7ml/kg IV.

4] *Antispasmodics to control colic and straining* :

* Inj. Dicyclomine (Cyclopam / Spasmovet) @ 0.5 mg/kg IM ***or***
* Inj. Atropine sulphate @ 0.03 mg/kg IM.

5] *Alteration in diet* :

* Withheld food for first 24 hours.
* Then provide soft liquid easily digestible food.

4. RUMINAL TYMPANY

Synonym : Bloat

Ruminal tympany is abnormal distension of the rumen and reticulum caused by excessive accumulation of the gases of fermentation either due to increased production of gas or physical obstruction of the process of eructation of gas.

Etiology :

A] *Primary tympany*

1. Excessive intake of greens (*pasture / leguminous bloat*).

* Grazing on green lush pasture (*pasture bloat*).
* Excess intake of immature leafy leguminous plants (*Leguminous bloat*).
* Large intake of immature cereal crops, vegetable crops, cabbage, potato etc.

2. Feeding of large quantities of grain (feedlot / grain bloat)

* Excess intake of soluble carbohydrates - finely ground grains.
* Excess intake of stale left over *roti, chapati* or boiled rice.

3. Less intake of dry roughages i.e. lack of fibrous food.
4. Sudden change of feed.
5. Individual susceptibility : It may be attributed to -

* Secretion of small quantity of saliva.

* Difference in composition of salivary protein.
* Motility of rumen and rumen structure.
* Process of cellulose digestion.

B] *Secondary bloat* :

1. Oesophageal obstruction (choke) due to foreign body, stenosis, pressure from enlargement outside the oesophagus viz. lymphomatosis, oesophagitis
2. Vagus indigestion
3. Diaphragmatic hernia
4. Traumatic reticuloperitonitis
5. Reticular abscess
6. Tetanus - due to spasm of oesophagus and inability to eructate.
7. Anaphylaxis / Allergy - decreased muscle tone
8. Hypocalcaemia/milk fever - decreased muscle tone.
9. Diseases responsible for decreased tone and motility of rumen and decreased rumination.
10. Unusual postures like lateral recumbency.

Table : 12.3 Difference between primary and secondary ruminal tympany.

Primary tympany	*Secondary tympany*
1. It is due to excessive production of gas.	1. It is due to failure of eructation of free gas.
2. It is dietary in origin and occurs in cattle on legume pasture and in feedlot cattle on high grain diet.	2. It is because of physical obstruction in the process of eructation of gas.
3. It is usually frothy type of bloat	3. It is usually gaseous bloat.
4. It is usually peracute to acute in nature	4. It is usually subacute to chronic in nature.

Symptoms :

* Enlargement of abdomen particularly in left flank.
* Anorexia.
* Dullness and depression.
* Abdominal pain - grinding of teeth, kicking at belly, rolling on the ground.
* Dyspnoea - extension of head, neck, protrusion of tongue.
* Respiratory and heart rates are increased.
* Cyanotic eye mucous membranes.
* Ruminal motility is initially increased and atony in later stages.
* Frequent defaecation and urination.
* Passage of scanty faeces. Sometimes diarrhoea.
* Tympanic sound on percussion.

* Crepitating sound on palpation
* On trocarisation, only small amount of gas will be passed in frothy bloat and huge amount of free gas in gaseous bloat.

Line of treatment :

1. Withdrawal of food and water.
2. To reduce the pressure on diaphragm, keep the animal with its anterior portion at elevated position.
3. Tie wooden stick in mouth to promote salivation.
4. Trocarisation of rumen with trocar -canula or large bore needle to give relief from gaseous pressure.
5. Pass stomach tube or probang to remove gas from rumen.
6. Give carminative mixture comprising Turpentine oil 30-60 ml and Sweet oil 400-500 ml orally as drench.
7. Give 500 ml to 1 lit liquid paraffin or sweet oil to adult cattle or buffalo
8. Give inj. Oxytetracycline @ 15-20 ml Intra-ruminally or Tab. Terramycin/ Steclin @ 4-6 orally.
10. Antihistaminics : Inj. Avil / Cadistin/Anistamin/Zeet @ 5-10 ml IM
11. Use of bloatosil (dimethicone susp.) @ 50-100 ml as drench in frothy bloat.
12. Correction of rumen pH.
13. Cud transplantation.
14. Exploratory rumenotomy in severe/non-responsive tympany.
15. Massage of left flank and exercise.

5. SIMPLE INDIGESTION

It is simple digestive disturbance clinically characterised by inappetance, anorexia, ruminal atony and abnormal faeces (scanty / voluminous)

Etiology :

A] *Dietary causes* :

* Overfeeding of grains, legumes, protein rich diet, silage.
* Sudden change of feed - quality and quantity.
* Ingestion of large amount of undigestible coarse roughages.
* Feeding of mouldy or decomposed feed.
* Consumption of overheated or frosted feeds.
* Drinking of drain or sewage water.
* Non or less availability of drinking water.
* Prolonged or heavy oral dosing with sulphonamides or antibiotics causes inhibition of normal ruminal microflora.

B] *Animal factors* :

* Greedy/voracious feeding.
* Depraved appetite i.e. pica
* Old age, debility, weakness, transportation, exertion.
* Improper / incomplete mastication.

Clinical signs :

* Partial or complete anorexia
* Fall in milk yield.
* Mild depression and dullness
* Rumination is suspended
* On palpation rumen is usually firm and doughy sometimes distended
* Faeces initially dry and scanty. Lateron voluminous and soft.
* Sometimes mild abdominal pain.
* Temperature, respiration and pulse is normal.

Diagnosis :

1. History of feeding
2. Clinical signs
3. Rumen function tests : pH is between 5-7.5 (normal 6.5-7), Cellulose digestion time is more than 30 hrs.

Treatment :

1. Correction of ruminal pH to reactivate ruminal microflora.
   * If pH is acidic, give alkalisers like sodium bicarbonate, magnesium carbonate.
   * If pH is alkaline, give acidifiers like Venegar 5-10%, 200-500 ml orally.
2. Rumen cud transplantation.
3. Use of rumenotoric drugs to improve ruminal motility
   * Nux vomica, Ammonium chloride, Antimony salts. ***or***
   * Rumentas / Rumenton / Bovirum bolus @ 2-3 orally daily for 2-3 days.
4. Use of parasympathomimetic drugs to induce peristalsis
   * Neostigmine 0.02 mg/kg bw IM
5. Liver extract with B complex parenterally.
6. Fluid therapy to combat dehydration.
7. Rumenotomy if there is no improvement.
8. Massage of left flank from downward to upward.
9. Give exercise.
10. Withheld feed for 24 hrs and then give laxative diet.

6. ACID INDIGESTION

Synonyms : Rumen overload, Acute carbohydrate engorgement.

It is an acute rumen dysfunction caused by ingestion of large amount of highly fermentable carbohydrate rich feeds and clinically characterised by severe toxaemia, dehydration, ruminal stasis, weakness, recumbency and high mortality rate.

Etiology :

1. Accidental ingestion of excess amount of cereal grains viz. Jawar, rice, wheat, oat, maize.
2. Overfeeding of whole or crushed grains.

3. Sudden change in nature of grains.
4. Feeding of left over *roti, chapati* or rice.
5. Ingestion of apples, grapes, sugar beet.

* *Ground powdered grains produce more acid than whole or partially crushed grains.*
* Feeding of cereal grains @ 25-62 g / kg produce severe acidosis.

Clinical signs :

The speed of onset is faster with ground grain than whole grain.
The severity increases with the amount of feed eaten.

* Anorexia
* Suspended rumination
* Amplitude and frequency of ruminal motility is decreased initially and lateron complete atony.
* Rumen is distended with fluid in mild to moderate acidosis however it is firm and doughy in cattle which have consumed large amount of grains.
* Abdominal pain : looking at flank, kicking at belly, grinding of teeth.
* Gurgling fluid sound from rumen.
* Faeces : Hard, dark, mucous coated, scanty in early stages and usually diarrhoeic in later stages, light coloured with sweet sour odour, may contain coat or kernels of grain.
* Dehydration:Sunken eyes & supraorbital fossa, dry muzzle, tenting of skin.
* Oliguria or anuria.
* Subnormal temperature (90 °F – 101 °F)
* Tachycardia (70 – 130/min).
* Respiration mainly shallow and rapid (60 – 90 /min)
* Severe depression, staggering, recumbency (milk fever like posture) in severe cases.

Diagnosis :

1. History of access to grains.
2. Signs : anorexia, depression, ruminal stasis, diarrhoea and staggering gait.
3. Clinical pathology.

Ruminal fluid :

a) pH : Mild → 5.5-6.5, Moderate → 4.5-5.5, Severe → 4.0 - 4.5
b) Absence of ruminal protozoa.
c) Ruminal fluid : Colour → Milky grey, Odour → Sour

Urine : pH - acidic / lowered, proteinuria.
Blood : High PCV, BUN, Blood lactate and low bicarbonate.

Treatment :

1. Correction of ruminal pH by giving sodium bicarbonate /magnesium oxide
2. Use of systemic alkalisers viz. sodium bicarbonate (2.5 – 5 %) solution IV

to correct blood pH.

3. Isotonic fluids and balanced electrolyte solutions to restore fluid and electrolyte losses and maintain circulating blood volume e.g. DNS.
4. Use of oral antibiotics to prevent further production of lactic acid e.g. Tetracycline, Ampicillin 5 - 10 g orally.
5. Calcium borogluconate @ 200 - 300 ml IV for 2-3 days to combat mild hypocalcaemia.
6. Liver extract with B- complex vitamins for 3-5 days.
7. Thiamine HCl @ 2-4 g IV to promote the metabolism of lactic acid.
8. Antihistaminics and corticosteroids to prevent shock.
9. Rumenotorics to restore motility of rumen.
10. Ruminal massage.
11. Rumenotomy is indicated in severe cases.
12. Rumen cud transplantation (10-20 lit.)

7. ALKALINE INDIGESTION

It is caused by ingestion of protein rich feeds and characterised by anorexia, depression, alkaline rumen PH and atony of rumen. It is less common in animals.

Etiology :

1. Ingestion of protein-rich concentrates - GNC, soybean.
2. Ingestion of leguminous fodders like lucerne, berseem.
3. Sudden change from carbohydrate to protein.
4. Exclusive paddy straw feeding for long period.
5. Feeding of urea.

Signs :

* Inappetance to anorexia.
* Ruminal motility is decreased in frequency and amplitude.
* Rumination is suspended.
* Passage of semisolid faeces.
* Increased pulse and respiration rates.
* Abdominal pain.
* Tremor, ataxia and convulsions.

Diagnosis :

1. History & Clinical Signs.
2. Rumen fluid : Increased pH, Dark brown colour , Ammoniacal odour.
3. Blood : BUN is increased from 15 mg% to 70 mg %

Treatment :

1. Correction of ruminal PH : Acetic acid 10% @ 5 - 10 ml orally.
2. Oral antibiotics
3. Rumenotorics
4. Cud transplantation
5. Liver extract with B-complex vitamins.

Table 13.4 : Some other Systemic Diseases of Animals

Disease : Etiolgy	Clinical signs	Line of treatment
Systemic Diseases :		
1. Pharyngitis *Trauma *Chemicals *Bacteria *Viruses *Foreign body	*Dysphagia *Stretching of neck & head *Coughing while feeding/drinking water *Regurgitation of food & water through nostrils *Bilateral nasal discharge	*Soft diet *Antibiotics *Anti-inflammatory & analgesics *Fluid therapy *Antihistaminics *Multivitamins
2. Hepatitis *Toxic drugs/chemicals *Plant toxins *Fungal toxins *Viruses - ICH *Bacteria *Parasites	*Anorexia, dullness *Jaundice *Constipation/diarrhoea *Anaemia, weakness *Dark yellow urine *Vomiting in dogs *Nervous signs in severe cases	*Remove cause *Rest *High energy, low fat diet *Antibiotics *Liver tonics *Dextrose 5-10 % IV *Flukicides
3. Ascites *Fibrosis of liver *Renal insufficiency *Congestive heart failure *Hypoproteinaemia	*Enlarged abdomen *Hollow flanks *Dyspnoea, anaemia *Emaciation *Fluid thrill on tactile percussion	*Salt free diet *Protein rich diet *Diuretics *Taping of fluid *Corticosteroids *Remove cause
4. Anaemia *Deficiency of proteins, Cu, Co, Fe *Haemoprotozoan infections *Leptospirosis *Phos. def. haemoglobinuria *Ecto & endoparasites *Haemorrhage	*Loss of appetite *Loss of body weight *Muscle weakness *Dyspnoea, tachycardia *Pale mucosae *Red urine & edema may be present *Poor growth	*Removal of cause *Haematinics *Liver tonics *Dewormers *Nutritious diet *Mineral-Vitamin supplementation *Blood transfusion
5. Nephritis *Bacteria : *E. coli*, *Corynebacterium renale*. *Viruses *Parasites *Chemicals *Drugs : Aminoglycosides.	*Anorexia/polyphagia *Polydipsia, polyuria *Oliguria, anuria, dysuria *Pyuria, haematuria *Renal colic *Enlargement of kidney *H/o recent calving	*Antibiotics e.g. Ampicillin *Fluid therapy *Diuretics *Low protein diet *Rest
6. Cystitis *Bacteria *Trauma *Calculi *Urine stasis	*Reduced appetite *Urine : Cloudy / red *Frequent, painful urination *Bladder wall thickened & painful on palpation	*Antibiotics *Antispasmodics *Urinary sedatives or antiseptics

7. Bronchitis/Pneumonia *Bacteria *Viruses *Fungi *Parasites *Allergens *Faulty drenching *Stress	*Fever, anorexia *Dyspnoea, coughing *Nasal discharge *Rales on auscultation of chest *H/o stress - exertion, sudden change of climate	*Rest, warmth *Antibiotics *Expectorants *Anti-inflammatory & analgesics *Antihistaminics *Bronchodilators *Anthelmintics
8. Pleurisy *Foreign body *TB, CBPP, CCPP *Pasteurellosis *Neoplasms *Viruses *Fungi *Lung worms	*Fever, anorexia *Dyspnoea, tachycardia *Abdominal respiration *Severe chest pain *Disinclination to move/lie down *Frictional rub on auscultation initially	*Rest, warmth *Antibiotics *Corticosteroids *NSAIDS *Multivitamins *Diuretics *Removal of pleural fluid
9. Rhinitis *Stress & strain *Bacteria *Viruses, fungi *Parasites *Allergens	*Fever, anorexia *Sneezing, dyspnoea *Nasal discharge *Shaking of head *Rubbing of nose & muzzle	*Antibiotics *Antihistaminics *Antiseptic inhalations *Remove primary cause
10. Epistaxis *Trauma *Hot summer *Vit K, C & Ca deficiency *Tumor *Nasal granuloma	*Bleeding from nose *Sneezing *Shaking of head a) Tumor b) Nasal granuloma	*Ice packs over head or nose *Inj-Stadren *Inj. Vit K, Calcium IV a) Surgical removal b) Inj. Anthiomaline
11. Meningitis / Encephalitis *Viral diseases : BMC, IBR, CD, Rabies *Bacteria: *Listeria, Salmonella* *Parasites *Fungi *Toxins : Lead, Arsenic	*High fever *Tremors, convulsions *Circling, head pressing *Mania, hyperaesthesia *Ataxia, nystagmus *Rigidity of neck muscles in meningitis *Bradycardia, oligpnoea. *Paralysis in later stage	*Antibiotics : Chloramphenicol/ Sulphonamides *Sedatives *Corticosteroids *Mannitol IV *Analgesics *Good nursing
12. Epilepsy a) *Idiopathic* : Unknown cause b) *Symptomatic*: Trauma, space occupying lesions, Inflammation, Infection & Metabolic disturbances	*Falling on ground *Straight & rigid limbs *Fixed eyes with staring look *Convulsions, frothy salivation *Temporary unconciousness *In-coordination in gait	*Phenobarbitone *Diazepam *Dog* : Gardenal 30 mg B.I.D. or Tab. Eption ½ -1 B.I.D. orally
<u>Systemic states</u> :		
1. Hypothermia *Exposure to cold climate, prolonged rain *Hypocalcaemia *Shock.	*Subnormal temperature *Dullness, depression *Cold skin & extremities *Tachycardia, weak pulse *Dyspnoea	*Dextrose 5-10 % IV *Corticosteroids *Provide warmth

2. Heat stroke *Exposure to high environmental temperature	*High body temperature *Tachycardia, Polypnoea *Nervous signs *Open-mouth breathing *Protrusion of tongue	*Keep in well ventilated shady place *Cold bath *Cold drinking water *Ice-cold DNS IV. *Antipyretics *Tranquilizers
3. Fever *Bacteria *Viruses *Protozoa	*Rise in body temperature *Tachycardia, Polypnoea *Anorexia, dullness *Suspended rumination *Oliguria, Constipation	*Antibiotics *Antipyretics *Vit. B - complex
4. Toxaemia *Bacterial toxins *Metabolic toxins	*Hyperthermia followed by hypothermia, *Anorexia *Depression, weakness *Tachycardia, weak pulse *Congested mucosae *Anuria, cold skin *Constipation / diarrhoea	*Antibiotics *Intensive fluid therapy *Corticosteroids in high doses *Liver tonics with Vit.-B complex
5. Shock *Haemorrhage *Dehydration *Severe trauma *Toxaemia *Cardiac diseases *Anaphylaxis	*Hypothermia *Skin cold & clammy *Mucosae - Pale & dry *Respiration shallow *Weak pulse *Recumbency *Severe weakness *Oliguria / anuria	*Restoration of blood volume *Corticosteroids *Antibiotics *Antihistaminics *Adrenaline in anaphylactic & vasogenic shock.
<u>Skin Diseases :</u>		
1. Dermatitis *Bacteria, Viruses, Fungi *Mites *Allergens *Vit.-A deficiency *Zinc deficiency	**Bacterial infection* : Pyoderma **Fungi* : Ringworm **Mites* : Mange **Allergic* : Urticaria/Eczema **Vit. A deficiency* : Hyperkeratosis **Zinc deficiency* : Parakeratosis	*Remove primary cause *Antihistaminics *Corticosteroids *Antibiotics *Inj. Vit.A & B complex *Zinc supplementation.
2. Eczema *Food :Milk, egg *Worms *Ectoparasites *Chemicals *Drugs	*Lesions usually over neck, back, rump and abdomen **Moist* : Oozing of fluid, matting of hairs, pruritus **Dry* : Dry, thickened skin, pruritus	*Change of food *Antihistaminics *Corticosteroids *Antibiotics *Antibiotic-steroid oint. *Dewormers.
3. Urticaria *Insect bite *Stinging plants *Drugs *Chemicals *Parasites	*Sudden appearance of wheals on skin *Pruritus / itching	*Antihistaminics *Corticosteroids If no response then, *Change of place/food *Dewormers *Insecticide spray

4. Photosensitization *Hepatotoxic plants, viz. *Tribulus*, *Lantana sp*, weeds, fungi, chemicals *Ingestion of photodynamic substances	*Erythema, oedema, inflammation and extensive sloughing of skin. **Bovines* : Lesions mostly over dorsal part of the body **Sheep* : Lesions usually over ear, eyelids and face	*Change of feed/fodder *Avoid exposure to sunlight *Antihistaminics *Liver tonics *Antibiotics *Local dressing.
5. Alopecia *Deficiency of Vit.A, Zn, Iodine *Ectoparasites *Endoparasites *Subabul toxicity *Hypothyroidism *May be seasonal	*Loss of hairs or wool **Iodine def.*: Partial or complete alopecia in newborns **Hypothyrodism in dog* : Bilateral alopecia over trunk **Zn def.* : Alopecia mainly over head and neck region in calves. **Mange* : Alopecia with itching.	*Remove primary cause *High protein diet *Vit.- A, Zn, Iodine supplementation *Castration may be helpful in dogs.
6. Ringworm *Fungi : *Trichophyton sp* *Microsporum sp* *Zoonotic disease *Pre disposing factors - Over crowding, malnutrition, hot climate, young age	*Discrete circular whitish asbestos like lesions usually on head, face, neck, shoulder & back. *Mild itching, alopecia, dandruff, *Diagnosis-Clinical signs, cultural exam. *	*Clip the hairs & clean the area. *Apply Tin. Iodine / Salicylic acid oint. / Candid cream / Zole oint. topically for one month *Antifungals orally
7. Sarcoptic mange (Scabies) **Sarcoptes scabei* *Predisposing factors* : *Malnutrition, debility, *Unhygienic conditions *Worms *Bath with alkaline soaps.	*Severe itching, excoriations, *Alopecia *Erythema *Scales *Thickening & wrinkling of skin. *Emaciation. *Lesions over head, neck & forelimbs.	*Clean the affected area. *Apply acarcides Viz. Butox / Ektodex *Inj. Ivermectin at weekly interval *Vit. A & Mineral suppl. *Antihistaminics *Antibiotics.
8. Demodectic Mange *Dog *Demodex canis* *Cattle : *D. bovis* *Goat : *D. Caprae* *Sheep : *D. ovis* *Predisposing factors* : *Young age group (8-12 mths.) *Worms *Debility *Malnutrition	a) ***Squamous form (Scaly)*** *Scaly wrinkled skin *Lesions generally over head & neck (around eyes) *Seborrhoea, foul smell ***b) Pustular form (follicular)*** *Affects almost any part of the body. *Alopecia, erythema, pustules, *Disagreable odour, emaciation. *Papules / nodules (pin-head to tennis ball size) develop over head, neck & shoulder region.	*Clip & clean the area. *Antiseptic bath. *Antibiotics *Antihistaminics *Multivitamins *Acaricides - Butox spray *Inj.Ivomec @0.4mg/kg SC at weekly interval *Inj. E-care Se @ 1 ml / 25 kg IM *Acaricides *Inj. Ivermectin
9. Psoroptic Mange *Psoroptes Ovis* ***Sheep*** : Sheep scab ***Goat*** : Ear mange ***Cattle*** : Body mange	***Sheep*** : Lesions mostly over shoulder, sides, back. Itching, alopecia, scabs. ***Goat*** : Typical scabs appear on ear, nose and poll. ***Cattle*** : Lesions over wither, neck and around the base of tail. Itching, alopecia and scabs.	*Acaricides-Butox *Inj. Ivermectin. (Neomec/mectin)

CHAPTER-13 : PRODUCTION RELATED DISEASES

1. MASTITIS

Synonyms : Mammitis, ***Dagadi***

Mastitis denotes an inflammation of the udder.

This disease is responsible for heavy financial losses to dairyman due to discarding of abnormal milk, reduced milk production and butter fat, decreased market value of cow and cost of drugs and veterinary services.

In addition to this, the mastitic milk causes dreadly diseases like tuberculosis, brucellosis, sore throat, food poisoning etc. in human being.

Etiology :

a. ***Infectious agents*** **:**

1. Bacteria : *Spreptococcus, Staphylococcus, E.coli*
2. Viral diseases : Cow pox, FMD
3. Fungus : *Aspergillus, Candida, Cryptococcus.*
4. Mycoplasma

b. ***Predisposing factors***

1. Trauma or injury to teat and udder.
2. High milk yield.
3. Incomplete or irregular milking.
4. Improper milking techniques.
5. Pendulous udder and long cylindrical teats.
6. Rough flooring.
7. Unhygienic conditions.

Transmission :

* It spreads through infected water, contaminated bedding, utensils, milkers hands.

Symptoms :

a. ***Acute form*** **:**

1. Fever
2. Loss of appetite.
3. Udder is swollen, hot and painful.
4. Milk may be yellowish or brownish.
5. Milk contains flakes or clots.

b. ***Chronic form*** **:**

1. No swelling of udder.
2. Udder becomes hard due to fibrosis.
3. Milk may show visible changes on careful examination.
4. Reduced milk yield.

Diagnosis :

1. Physical examination of the udder i.e. shape, size and consistency.
2. *Strip cup test* : A strip cup consists of a flat black enamelled plate partitioned into four areas. The milk from all four quarters is stripped directly into cup. The presence of clots or flakes will indicate abnormality of milk.
3. *California Mastitis Test (CMT)* : This test requires plastic paddle with four chambers. Milk is stripped directly into chambers. Then CMT reagent is added in the equal quantity. The milk and reagent is rotated by movement of the paddle and the reaction is observed immediately. Formation of greenish blue precipitate or jelly like clot indicates positive test.
4. Isolation of the organism from milk.

Treatment :

1. Evacuate the udder.
2. Intramammary antibiotic therapy/infusion with Vetclox plus or Pendistrin SH or Tilox @ 1 tube twice daily for 3 days

Milk should not be used for human consumption for atleast 72 hours after last infusion.

3. Give antibiotics like enrofloxacin, amoxycillin, ampicillin or chloramphenicol IM for 3 days.
4. Hot fomentation of udder with magnesium sulphate to releive inflammation.

Control :

1. Isolation and treatment of affected animals.
2. Treatment of all teats of all cows at drying.
3. The healthy non-infected cows should be milked first and known infected cows should be milked at last.
4. The udder of cow and hands of milker should be washed with antiseptic solution before and after milking.
5. The floor of the milking shed should be washed with running water.
6. Cows should be provided with soft bedding following parturition.
7. Unsterile objects should not be passed in teat.
8. Teat sores should not be neglected but treated at an earliest.
9. Regular testing of cow milk for mastitis.
10. Use of proper milking method i.e. full hand milking followed by stripping.
11. Protect teats and udder from injuries.
12. Maintain hygienic conditions in cattle shed.
13. The non-responsive quarter should be permanently dried up.
14. Culling of non-responsive cases.
15. Proper disposal of mastitic milk.

2. MILK FEVER

Synonyms : Parturient paresis, Hypocalcaemia.

It is metabolic disease of adult females occurring most commonly about the time of parturition and characterised by hypocalcaemia, severe muscular weakness, sternal and lateral recumbency.

Etiology :

The principle cause is hypocalcaemia which may be due to -

I. Excessive loss of calcium in the colostrum and milk. The colostrum is rich in calcium.

II. Decreased absorption of calcium from the intestine at the time of parturition.
   1. Reduced feed intake at parturition.
   2. Ruminal atony / indigestion.
   3. Deficiency of Vit. D.
   4. Improper calcium - phosphorus ratio in diet.
   5. Diseases of intestine.

III. Slow mobilization of calcium from bone.
   1. Parathormone deficiency.
   2. High calcitonin level in blood.
   3. Excessive calcium intake during dry period depresses the activity of PTH

Epidemiology :

1. It is sporadic disease
2. ***Species*** : The cows and buffaloes are mostly affected. Sometimes ewes, does, sows, mare and bitches are affected.
3. ***Breed*** : Jersey cows and Jaffarabadi buffaloes are more susceptible.
4. ***Age*** : Disease is most common in 5-10 year age group.
5. ***Sex*** : It is disease of females.
6. ***Season*** : Most cases occur during calving season.
7. ***Number of lactations*** : It occurs in cows/buffaloes with their third to seventh calving.
8. ***Stage of lactation*** : Disease occurs at 3 main stages in the lactation cycle-
   a. Most prepartum cases occur in last few days of pregnancy.
   b. Some cases occur few hours before calving or at the time of parturition.
   c. Majority of cases (80 %) occur within the first 48 hours after calving.
9. ***Milk yield*** : High yielding animals are mostly affected.
10. ***Predisposing factors*** :

* Cold climate
* long distance transport, forced exercise.
* Sudden deprivation of food.
* Grazing on oxalate rich plants
* Digestive disturbances.

Clinical signs :

The signs develop in 3 stages.

I. ***First stage or Stage of excitement.***

* Excitement
* Tetany
* Hypersensitiveness
* Muscle tremors
* Ataxia

II. ***Second stage or Stage of sternal recumbency.***

* Animal is unable to stand and rests on sternum with head turned towards shoulder or flank.
* Drowsiness.
* Cold skin and extremities, dry muzzle.
* Dilatation of pupil with absence of pupillary light reflex.
* Relaxation of anus with loss of anal reflex.
* Heart sounds muffled, Tachycardia.
* Suspended defaecation and urination.
* Low venous pressure.

III. ***Third stage or Stage of lateral recumbency.***

* Animal is unable to stand or sit and remains in lying down condition.
* Markedly subnormal body temperature.
* Extremely cold skin and body extremities.
* Severe tachycardia with inaudible heart sounds.
* Bloat
* Impossible to raise the vein.

Diagnosis :

1. History of parturition and high milk yield.
2. ***Symptoms :*** Sternal or lateral recumbency with subnormal body temperature.
3. ***Clinical pathology*** **:** Low serum calcium level.
4. Response to the calcium therapy.

Treatment :

* Parenteral injection of Calcium salt is the standard treatment.
* Calcium borogluconate 25% (Inj. Calboral/Intacal) @ 400 - 800 ml IV.
* Calcium is cardiotoxic drug.

The following care should be taken to avoid unusual reactions during calcium therapy -

1. Warm the bottle to body temperature prior to administration.
2. Give injection slowly.
3. Perform cardiac auscultation repeatedly during calcium therapy.
5. Avoid overdosing of drug.

The unusual reactions to calcium can be treated with following drugs -

1. Atropine sulphate in cardiac arrythmia / bradycardia.
2. Magnesium sulphate 10% @ 100 - 400 ml IV in cardiac excitation.

Control :

1. Feeding of low calcium diet during last 1-2 weeks of gestation.
2. Inj. Vit. D_3 (Arachitol) @ 10 million units IM, one week before calving.
3. Incomplete milking after calving.
4. Prophylactic injection of calcium soon after calving is effective.
5. Give exercise to maintain normal GI function and also to stimulate bone metabolism.
6. Provide good shelter and protect from cold stress.
7. Avoid stress of transportation during advance pregnancy.
8. Maintain appetite at calving.
9. Give roughages to stimulate rumen functions.
10. Provide Ammonium chloride to the pregnant animals along with grain @ 25 g orally over last few weeks of pregnancy and increase to 100 gm/day at calving.

3. PHOSPHORUS DEFICIENCY HAEMOGLOBINURIA

Synonym : Metabolic or Nutritional haemoglobinuria.

It is a metabolic disease of high producing dairy cows and buffaloes characterised by intravascular haemolysis, haemoglobinuria and anaemia.

Etiology :

1. Deficiency of phosphorus in the diet.
   a. Soil deficient in phosphorus.
   b. Hay, *kadbi* and straws are naturally deficient in phosphorus.
   c. Drought conditions reduces phosphorus content in the forage.
2. Impaired absorption of phosphorus.
   a. Excess calcium, aluminium or iron in diet.
   b. Vit. D deficiency.
   c. Improper calcium : Phosphorus ratio.
3. Increased requirements of phosphorus.
   a. Heavy drain of phosphorus through milk in recently calved animals.
   b. Increased requirement for development of foetus during advance pregnancy.
4. Feeding cruciferous plants like rape, kale, turnip etc.

Recently calved or advance pregnant buffaloes maintained on dry roughage and exposed to cold climate are usually affected.

Epidemiology :

1. It has been reported from many states of our country viz. Maharashtra, Hariana, Punjab, Gujarat, Uttar Pradesh.
2. ***Species*** **:** Cattle and buffaloes. Buffaloes are more susceptible than cows.
3. ***Sex*** **:** It is primarily a disease of females.
4. ***Age*** **:** Adult females are affected.
5. ***Stage of production*** **:** Disease occurs in both pregnant as well as lactating animals.
6. ***Lactation*** **:** It is more common during 3rd to 6th lactation.
7. ***Stage of lactation*** **:** It mostly occurs between 2-6 weeks after calving.
8. ***Stage of pregnancy*** **:** Usually advance pregnant buffaloes are affected. Occasional cases may occur during early and mid pregnancy.
9. ***Milk yield*** **:** High yielding animals are more prone to this disease, however cases do occur in low to moderate yielders.
10. ***Season*** **:** Disease mostly occurs during dry season (January to July in Maharashtra).
11. ***Predisposing factors*** **:** Exposure to cold weather, Malnutrition.

Clinical signs :

1. Partial to complete anorexia.
2. Dullness, depression, weakness.
3. Marked drop in milk yield.
4. Temperature usually normal, sometimes elevated or subnormal.
5. Heart rate is usually increased.
6. Rapid breathing in early stage and dyspnoea in later stages.
7. ***Light to dark coffee colored urine is characteristic symptom.***
8. Pallor of mucosae usually noticed 2-3 days after onset of disease.
9. Jaundice is mostly seen in very late stage of disease.
10. Passage of pasty faeces with straining.
11. Sometimes abortion in pregnant animals.

Diagnosis :

1. ***History*** **:** Advance pregnancy / early lactation, sole feeding of dry roughage.
2. ***Symptoms*** **:** Light brown to coffee colored urine.
3. ***Lesions*** **:** Anaemia, jaundice, enlargement of liver and spleen, coffee coloured urine in urinary bladder.
4. ***Clinical pathology*** **:**
   * *Haematology* : Low Hb, PCV and TEC values.
   * *Biochemistry* : Low Serum inorganic phosphorus values.
   * *Urinalysis* : Urine positive for haemoglobin.
5. Response to the phosphorus treatment.

Treatment :

A] *Specific treatment* :

1. Sodium acid phosphate @ 80 gm IV as a 20% solution in 5% dextrose or distilled water for 2-4 days is highly effective. ***or***
2. Inj. Tonoricin / Tonophosphon @ 30 ml IV daily for 2-4 days is also effective ***or / and***
3. Inj. Ascorbic acid @ 15-20 mg / kg IV daily for 2 - 4 days can also be used.

B] *Supportive Treatment* :

1. Inj. Dextrose 20% 500 ml IV for 2-3 days.
2. Inj. Liver extract with B-complex @ 5 ml IM daily for 5-7 days.
3. Inj. Imferon @ 5ml IM daily for 5-7 days ***or*** Haematinic mixture ($FeSo_4$ 5g+$CuSo_4$ 0.2g + $CoSo_4$ 0.1 g) in jaggary daily orally for 7-10 days.
4. Blood transfusion in severe cases.
5. Mineral mixture @ 25-50 gm daily orally.

Control :

1. Regular provision of mineral mixture containing phosphorus according to the requirement for maintenance and production.
2. Protect the recently calved or advance pregnant animals from cold stress.

4. KETOSIS

Synonym : Acetonaemia

It is metabolic disease of high yielding animals characterised by hypoglycaemia, ketonaemia and ketonuria.

Classification :

1. ***Primary ketosis***:It indicates starvation or underfed or uncomplicated ketosis.
2. ***Secondary ketosis*** : It is caused by various systemic or infectious diseases viz. metritis, mastitis, pneumonia. In this type animal takes inadequate feed due to loss of appetite eventhough sufficient feed is offered.

Etiology :

1. ***Undernutrition / Starvation or feeding of low carbohydrate diet*** : This leads to decreased production of propionate, hypoglycaemia, fat mobilization and ketone body formation.
2. ***Feeding of excess amount of protein-rich diet*** : This is responsible for increased production of ketogenic acids viz. butyric acid.
3. ***Excess feeding of silage*** : Silage is rich in butyric acid so more ketogenic.
4. ***High milk-yield*** : Heavy drain of glucose for formation of lactose.
5. ***Deficiency of cobalt and phosphorus*** : Cobalt deficiency results into failure to metabolize propionic acid whereas phosphorus deficiency may lead to decreased feed intake.

6. ***Lack of exercise*** : This leads to decreased oxidation i.e. utilization of ketone bodies.
7. ***Hepatic insufficiency*** : The normal liver stores glycogen which is converted to glucose in emergencies.
8. ***Adreno-cortical deficiency*** : The adrenal cortex secretes glucocorticoids which stimulates gluconeogenesis. Adrenal cortex may get exhausted due to overactivity in stress such as pregnancy and parturition.
9. ***Hypothyroidism*** : Thyroid hormone promotes gluconeogenesis and maintains BMR.
10. ***Loss of appetite due to various diseases*** : Metritis, mastitis, pneumonia, abomasal displacement, nephritis, TRP, surra, diaphragmatic hernia.

Epidemiology :

1. ***Feeding systems*** : It is more common in housed or stallfed animals.
2. ***Morbidity*** : Variable.
3. ***Mortality*** : Very low.
4. ***Species*** : Bovines, ovines and caprines are affected.
5. ***Breeds*** : Buffaloes and crossbreds are more susceptible than indigenous cattle.
6. ***Sex*** : Primary ketosis is actually a disease of female.
7. ***Stage of production*** : It is more common in lactating than pregnant animals in bovines. In sheep disease occurs during advance pregnancy.
8. ***Stage of lactation*** : It mostly occurs between 10 days to 2 months after calving.
9. ***Number of lactation*** : Disease incidence is higher during 3rd to 5th lactation.
10. ***Season*** : Higher incidence during calving season i.e. September to December.
11. ***Milk yield*** : Disease occurrence is more in high yielding animals.
12. ***Predisposing factors*** :
    * Genetic susceptibility.
    * Overfat or very thin at calving.
    * Cold stress.

Symptoms :

Ketosis can be grouped as clinical and subclinical, based on presence or absence of signs.

A] <u>*Clinical Ketosis*</u> :

It mainly occurs in two forms :

a. ***Digestive or wasting form*** : It is most common form of ketosis.
   1. Selective appetite : Animal refuses to eat concentrate feed however takes roughages.

2.Marked drop in milk production.
3.Rapid loss of body weight i.e. emaciation.
4.Moderate depression and disinclination to move.
5.Sweetish smell to breath, milk and urine.
6.Faeces are firm dry and covered with mucus.
7.Ruminal movements may be decreased in amplitude and rate.
8.Temperature, respiration and pulse rates are usually normal.

b. ***Nervous form*** : It is less common form of ketosis.
1.Circling movements.
2.Staggering gait, crossing of legs.
3.Head-pressing.
4.Apparent blindness.
5,Aimless wandering.
6.Nervous signs like hyperaesthesia, tremor, convulsions may occur in short episodes which last for 1-2 hours and may recur at an interval of about 8-12 hours.
7. Vigorous licking of skin and inanimate objects.
8. Chewing movements with profuse salivation.

B] *Subclinical ketosis* :
* It is also called as spontaneous ketosis.
* It may regress or remain as such or turn into clinical form.
* It is characterised by mild drop in milk yield.

Diagnosis :
1. ***History*** : Recent calving, underfeeding, high milk yield.
2. ***Symptoms*** : Refusal of concentrates, marked drop in milk yield and rapid emaciation.
3. ***Clinical pathology*** :

a) *Blood chemistry* :
1.Hypoglycaemia (Blood sugar 20-40 mg%)
2.Blood ketone level : 20-100 mg / dl

b) *Haematology* : DLC - Neutropaenia (10%), lymphocytosis. (60-80%) and eosinophilia (15-40%)

c) *Urinalysis* : Rothera's test is usually positive.

4. Response to glucose therapy.

Treatment :

A] *Specific Treatment* :
Ketosis can be treated by using any of the following therapy.
1. ***Glucose therapy alone*** : Glucose 20% @ 0.5 g / kg IV daily for 2-3 days.
2. ***Glucose + Insulin therapy*** : Glucose 20% @ 0.5 g / kg IV plus Insulin (short-acting) @ 0.5 IU/kg IM only once is highly effective.

3. ***Corticosteroids alone*** **:** They increase blood glucose by decreasing tissue uptake of glucose and reducing milk production for upto 3 days.

a) Triamcinolone acetonide (Vetalog) @ 0.05 mg / kg IM ***or***

b) Dexamethasone (Ketcort/Dexona) @ 0.04 mg/kg IM daily for 2-3 days.

4. ***Corticosteroids + Insulin therapy*** **:** Triamcinolone @ 0.05 mg/kg or Dexamethasone @ 0.04 mg/kg IM and Insulin @ 0.5 IU/kg IM/SC

5. ***Glucose precursors*** **:**

a) Sodium propionate @ 80 gm orally daily for 5-6 days. ***or***

b) Glycerol or Glycerine @ 110-220 g orally daily for 4 days.

6. ***Nicotinic acid*** **:** Nicotinic acid @ 8 gm orally daily for 5-6 days.

B] *Supportive Treatment* :

1. Inj. Liver extract with B complex @ 5-10 ml IM on alternate days.
2. Provision of mineral mixture comprising phosphorus and cobalt.

Control :

1. Cows and buffaloes should neither be starved nor overfed at calving.
2. Give extra allowance of concentrate ration during advance pregnancy.
3. After calving, the concentrate ration (protein-16%) should be fed depending upon the level of milk production i.e. 1 kg concentrate for every 2.5-3 kg of milk.
4. Feeding of ground maize : Ground maize contains α-polymerised glucose which is not fermented in the rumen but is passed to the intestine and absorbed from there.
5. Feeding of ration which increases propionate production and decreases acetate production. e. g. Finely ground roughage, cooked grains.
6. Feeding of whole cotton seed or soybean as a concentrated source of energy and glucogenic material.
7. Encourage maximum feed intake by providing palatable feed at frequent intervals.
8. Provide ample good quality hay and limited silage.
9. Ration should contain adequate amount of phosphorus, cobalt and iodine.
10. Give glucose precursors in problem herds e.g. Sodium propionate @ 110 g daily orally for 6 weeks commencing at calving.
11. Carry out blood glucose estimations twice during 2-6th week of lactation to know the subclinical form of the disease.
12. Perform Rothera's test on urine/milk sample at weekly interval till 6-8 wks after calving.
13. Give adequate exercise to lactating animals.
14. Select cows / buffaloes having good feed capacity and appetite.

Table 13.1 : Some other metabolic and deficiency diseases of animals

Name of disease : Cause & epidemiological features	Clinical signs	Line of treatment
1. Hypomagnesaemic Tetany *Grazing on lush pasture *Ruminants are affected *Mostly in high yielders *Sole feeding of milk in calves	Muscle tremors, Constant pricking of ears Hyperaesthesia Convulsions Death in 1/2 - 1 hr.	*Mag. Sulph.10%@ 1ml/kg IV for 1-2 days. *Mifex / Miphocal / Lactomag @ 1ml/kg IV for 2 - 4 days
2. Downer Cow Syndrome *Trauma to limb muscles *Trauma to nerves *Persistent low levels of Ca, P, Mg or K *Prolonged recumbency	Animal is alert & usually appetite, water intake, defecation, urination normal. Unable to rise even after treatment with calcium salts.	*Provide comfortable bedding *Frequent turning of animal from side to side. *Ca,Mg,P preparations *Use of nervine tonics *Massage/infrared therapy
3. Osteomalacia *Deficiency of Ca,P&Vit D *Common in adult bovines due to phosphorus def. *Mostly in lactating animals. *Mosty in high yielders	Loss of body weight and low milk production, ***pica***. weakness, ***stiff gait***, disinclination to move, difficulty in rising	*Sodium acid phosphate @30 gm orally daily for 15-30 days *Mineral mixture @60 gm orally for 15-30 days.
4. Rickets *Deficiency of Ca,P&VitD *Most common in young pups due to Ca def.	***Bending of the legs***, enlargement of the joints, stiff gait, arching of back & lameness	*Ostocalcium-B_{12} @10ml BID orally *Inj. Arachitol @1ml IM twice a week.
5. Pregnancy Toxaemia *Under/malnutrition *Starvation *Disease of sheep & goat *Common during pregnancy	Apparent blindness, Circling, star gazing, head pressing, convulsions recumbency & death	*Dextrose 20% @ 0.5 g/Kg IV *Liver tonics
6. Cobalt deficiency *Diet deficient in cobalt *Excess Ca & Mn in diet *Ruminants are susceptible	*Loss of appetite, Pica **Emaciation, anaemia* *Weakness, Infertility *Retarded growth	*Cobalt sulphate : C, B : 500 mg/day PO S,G:100-200mg/day PO Vit.B_{12} @1-2mg/kg IM

7. Copper deficiency *Diet deficient in Cu *Soil rich in molybdenum *Ruminants are susceptible	*Emaciation, Anaemia *Persistent diarrhoea *Depigmentation of skin & hair/wool ***Leucoderma in buffaloes*** *Infertility,Retarded growth ***Falling disease in cattle*** ***Enzootic ataxia in lambs*** ***Steely-straight-wool*** in sheep.	*$CuSO_4$ @ 4 g PO for calves & 8-10 g for adult cattle weekly for 3-5 weeks.
8. Iron deficiency *Sole feeding of milk *Excess Ca &Mn in diet *Chronic blood loss *Piglets are highly susceptible	***Anaemia (Microcytic)*** *Weakness *Retarded growth *Reduced appetite *Oedema *Bottle jaw	*$FeSO_4$ @ 2-4 g/day PO for 2 wks in adult cattle *Inj. Iron-Dextran IM
9. Iodine deficiency *Diet deficient in Iodine *Excess Ca in diet *Cruciferous plants	*Still-birth, abortion. ***Goitre***-Thyroid enlargement *Loss of libido in males ***Partial/Complete alopecia*** & weakness in newborn animals.	*Potassium Iodate @ 200 mg/kg common salt
10.Zinc deficiency *Dietary deficiency rare *Excess Ca in diet	*Retarded growth ***Parakeratosis in pigs*** *Loss of wool in sheep ***Alopecia around head & neck in calves*** *Wrinkling of skin	*Zinc sulphate C, B : 2-4 g/day PO S,G : @ 250 mg daily
11.Diabetes mellitus *Multifactorial Disorder *Hereditary *High carbohydrate diet *Drugs:Glucocorticoids *Destruction of β cells. *Pancreatic disease	***Polydipsia, Polyuria*** *Emaciation *Sustained hyperglycaemia *Sustained glycosuria *Common in dogs & cat*	*Insulin @ 0.5 IU/kg SC *Oral hypoglycaemics e.g.Tolbutamide tab. @ 0.5-3 g orally *Diet-low fat/sugar *Regular exercise.

CHAPTER - 14 : POULTRY DISEASES

General measures for prevention of poultry diseases :

1. Provide ample quantity of clean drinking water.
2. Offer good quality balanced ration / feed.
3. Avoid feeding of mouldy feed.
4. Don't make sudden changes in feed.
5. Maintain good ventilation in poultry house.
6. Avoid overcrowding.
7. Keep deep litter dry by frequent turning and periodical change.
8. Avoid exposure to inclement weather.
9. Regular cleaning of feeders & waterers.
10. Proper cleaning & disinfection of brooders, brooder houses, incubators & poultry house regularly.
11. Control of rodents, wild birds & insects.
12. Restrict the entry of visitors in the farm as far as possible & provide foot bath containing disinfectant at the entrance of the farm.
13. Rear/keep birds of different age groups separately.
14. Select genetically resistant strains.
15. Identification, segregation & treatment of sick/diseased birds.
16. Disposal of dead birds by burning or burial
17. Use of coccidiostats in feed particularly for starters and growers.
18. Testing of birds for salmonellosis & chronic respiratory disease at 16 weeks of age.
19. Regular deworming is essential for control of worms.
20. Periodical spraying of birds and poultry house to control ectoparasites.
21. Disinfection of incubator by fumigation with $KMnO_4$ 17.5 gm and formalin 355 ml / 100 cubic feet area.

Precautions to be taken while giving vaccines through drinking water :

1. Clean waterer thoroughly with water (Without disinfectant).
2. Use clean & cold water, free from chlorine or any other drug (If necessary, add small ice blocks to make it cool).
3. Proportion of vaccine & drinking water should be as per the manufacturers instructions.
4. Keep sufficient number of waterers so that every bird gets the vaccine.
5. Withhold drinking water 2-6 hours before giving water containing vaccine.

A] BACTERIAL DISEASES

1. **Fowl Typhoid**
   * ***Cause*** **:** *Salmonella gallinarum*
   * ***Age*** **:** All ages (common in adults)
   * ***Trans*** **:** Egg borne and ingestion of contaminated food and water.
   * ***Mortality*** **:** 10-50%
   * ***Signs*** **:** Loss of appetite, ruffled feathers, drooping of wings, sleepiness, greenish diarrhoea.
   * ***Lesions*** **:** Liver enlarged and bronze coloured.
   Ova deformed & discoloured.
   * ***Treatment*** **:** Bifuran tab. @ 1/lit water or Furasol (furaltadone) @ 0.5-1g/lit. water for 7 days.
   * ***Control*** **:** 9 - R vaccine

2. **Pullorum Disease :**
   * ***Synonym*** **:** Bacillary white diarrhoea
   * ***Cause*** **:** *Salmonella pullorum*
   * ***Age*** **:** Mostly baby chicks
   * ***Trans*** **:** Egg borne
   * ***Mortality*** **:** May be upto 90%
   * ***Signs*** **:** Dead in shell chicks, drowsiness, anorexia, gasping whitish diarrhoea, soiling of vent and sudden death
   * ***Lesions*** **:** *Chicks* - enlarged liver with white spots
   Adults - misshaped, discoloured ova
   * ***Treatment*** **:** Similar to fowl typhoid
   * ***Control*** **:** Testing of layer flock, fumigation of incubators

3. **Spirochaetosis**
   * ***Synonym*** **:** Tick fever
   * ***Cause*** **:** *Borrelia anserina*
   * ***Age*** **:** All ages
   * ***Trans*** **:** Tick-borne (*Argas persicus*)
   * ***Morbidity*** **:** 10-100 %
   * ***Signs*** **:** Fever, anorexia, increased thirst, greenish diarrhoea, pale comb and paralysis in later stages.
   Av. course : 5 days
   * ***Lesions*** **:** Enlarged liver and spleen
   * ***Treatment*** **:** Penicillin @ 20000 IU/kg IM/Oxytetracycline
   * ***Control*** **:** Control of ticks. Spirochaetosis killed vaccine @1ml IM at 6 & 16 wks of age

4) **Infectious coryza :**
   * ***Cause*** **:** *Haemophilus gallinarum*
   * ***Age*** **:** All age groups (severe in adults)
   * ***Trans*** **:** Air borne
   * ***Signs*** **:** Profuse nasal discharge, sneezing, dyspnoea, coughing lacrimation and swollen face. Duration of illness - one week

* ***Morbidity*** : high
* ***Mortality*** : low

* ***Treatment*** : Sulphamezathine @ 30ml/4 lit water or Hostacycline powder @ 5g/4.5 lit water for 5-7 days.
* ***Control*** : Infectious coryza vaccine

5. Fowl Cholera :

* ***Synonym*** : Avian pasteurellosis
* ***Cause*** : *Pasturella multocida*
* ***Age*** : All age groups
* ***Trans*** : Ingestion, inhalation.
* ***Mortality*** : upto 90%

* ***Signs*** : *Peracute*-sudden death *Acute*-anorexia, nasal discharge, sneezing, coughing, dyspnoea, bloody diarrhoea, cyanosis of comb and wattles. *Chronic* : Swollen comb and wattles.
* ***Lesion*** : Petechae on heart
* ***Treatment*** : Similar to infectious coryza.
* ***Control*** : Fowl cholera killed vaccine.

6. Chronic Respiratory Disease (CRD)

* ***Cause*** : *Mycoplasma gallisepticum*
* ***Age*** : All ages (severe in young chicks)
* ***Trans*** : Egg borne and airbone (slow spread)
* ***Mortality*** : 30-40% in chicks.

* ***Signs*** : Nasal discharge, sneezing, rattling sound, coughing, emaciation, reduced appetite and drop in egg production (upto 50%). Duration of illness - 3-8 wks.
* ***Lesion*** : Cloudy appearance of air sacs.
* ***Treatment*** : Tylan - 50 (tylosin) @ 1 g/lit of water or Tiamutin 45% @ 55g/100 lit of water.
* ***Control*** : Dipping of eggs in tylosin solution before incubation.

7. Air sacculitis and colibacillosis

* ***Cause*** : *E. coli*
* ***Age*** : Chicks (5-10 wks)
* ***Mortality*** : Usually 5-10%
* ***Predisposing factors*** : Stress, bad management, CRD.

* ***Signs***: Diarrhoea, soiling of vent, depression, loss of appetite, dyspnoea, sneezing
* ***Lesions***: Milky fluid in pericardium. Air sacs thick & cloudy.
* ***Treatment***: Furazolidone & antibiotics. Vit. A, & Vit. E supplementation.

B] VIRAL DISEASES

1. RANIKHET DISEASE

Synonyms : New Castle Disease, ***Manmodi***

It is the most dangerous viral disease of poultry.

Etiology : ***Paramyxovirus.***

Age group **:** All ages

Morbidity **:** 100%

Mortality **:** 50-90%

Transmission **:** The disease spreads through infected feed, water or air.

Symptoms :

1. Loss of appetite.
2. Dullness and depression.
3. Ruffled feathers.
4. Respiratory rales.
5. ***Gasping*** (difficult breathing)
6. Sneezing.
7. Coughing.
8. Nasal discharge.
9. ***Greenish watery diarrhoea.***
10. ***Paralysis of one or both legs or wings.***
11. Tremors (twitching)
12. ***Torticollis*** i.e. twisting of neck.
13. Drop in egg production in layers.
14. Finally death.



Fig. 14.1 : Ranikhet disease (torticollis)

Diagnosis :

1. Based on Symptoms
2. Lesions : ***Haemorrhages in proventriculus,*** ulcers in intestine
3. Isolation of virus.
4. Serological tests (HA, HI, VNT tests)

Treatment :

1. There is no specific treatment for this disease, however broad spectrum antibiotics should be given to check secondary bacterial infections.
2. Vitamin supplementation. e.g. Vimeral liquid @ 2ml/lit of drinking water.

Prophylaxis :

a) ***General measures :***

1. Control of visitors.
2. Depopulation of site.
3. Proper sterilization of poultry equipments.
4. Disinfection of poultry house.

5. Burial or burning of dead birds.
6. Control of rodents and free flying birds.
7. Isolation of affected birds.

b) *Vaccination* :

1. LaSota vaccine @ 1 drop in each eye or nostril in first week of life.
2. R_2B Mukteshwar vaccine @ o.5 ml IM or subcut in 8th and 18th week.

2. FOWL POX

Synonym : Avian Pox

Etiology : ***Avipox Virus.***

Age **:** It is mild in adults but severe in young chicks.

Morbidity **:** High

Mortality **:** May be upto 50% in chicks.

Transmission : It spreads through direct contact, wounds or insect bites.

Symptoms :

1. ***Scabs or wart like lesions on featherless parts of the body*** such as comb & wattles.
2. Yellowish cheese like deposits on tongue, palate and under eyelids.
3. Lacrimation.
4. Nasal discharge.
5. Reduction in appetite.
6. Loss of body weight.
7. Decreased egg production.
8. Course of diseases : 2-3 weeks.



Fig. 14.2 : Fowl pox
(Lesions on comb & wattles)

Diagnosis :

1. Based on symptoms & skin lesions.
2. Isolation and identification of virus.
3. Serological tests.

Treatment :

1. Broad spectrum antibiotics like a) Hostacycline powder @ 10gm/4.5 lit of drinking water ***or*** b) Terramycin poultry formula @ 5gm/4.5 lit of water.
2. Local application of antiseptic ointments.
3. Vimeral liquid @ 2ml/lit of drinking water.

Prophylaxis :

a) *General measures :*

1. Isolation of sick birds.
2. Disinfection of poultry house.
3. Avoid overcrowding of birds.

b) *Vaccination :*

Fowl Pox Vaccine in 6th and 16th week of life, by cutaneous scarification/wing web method.

3. MAREK'S DISEASE

Etiology : ***Herpes Virus.***
Age **:** It is primarily a disease of young chickens between 3-5 months of age.
Morbidity **:** High
Transmission : Inhalation of infective particles.

Symptoms :

1. Incoordination.
2. ***Paralysis of one or both legs and or wings.***
3. Drooping or hanging of wings.
4. One leg is extended forward and other backward.
5. Blindness in ***eye form*** of disease.
6. Skin tumours leading to enlarged feather follicles in ***skin form.***
7. Sudden death in ***acute form***.

Diagnosis :

1. Based on symptoms.
2. Postmortem lesions : ***Enlargement of one or more peripheral nerves.***
3. Isolation of virus from feather follicles.
4. Serological tests.

Treatment :

* This disease is not curable.

Prophylaxis :

a) ***General measures :***

1. Selection of genetically resistant stock.
2. Isolation of affected birds.
3. Sanitary measures.

b) ***Vaccination :***

* HVT (Herpes Virus of Turkey) vaccine given to chicks on the day of hatching @ 0.2 ml subcutaneously.



Fig. 14.3 : Marek's disease (paralysis of legs)

4. **Infectious laryngotracheitis (I.L.T.)**
* ***Etiology*** : Herpes virus
* ***Age*** : Mostly adult birds (5-9 months)
* ***Trans*** : Air borne (slow spread)
* ***Morbidity*** : 80-90 %
* ***Mortality*** : Young 10-15%
Adults 5-10%

* ***Signs*** : Nasal discharge, gasping, coughing of blood, rales, lacrimation. Drop in egg production (5-15%)
* ***Lesion*** : Haemorrhagic tracheitis
* ***Prevention*** : ILT vaccine in endemic areas

5. **Infectious Bronchitis (I.B.)**
* ***Etiology*** : Corona virus
* ***Age*** : All ages, mostly under 10-12 weeks
* ***Trans*** : Air borne (Rapid spread)
* ***Morbidity*** : 100%
* ***Mortality*** : Adults - negligible
young - 25-40 %

* ***Signs*** :
Young birds - rales, gasping, sneezing, nasal discharge, coughing, lacrimation.
Adult : Abnormal i.e. small, rough, thin shelled, and misshapened eggs. Drop in egg production (10-50%)
* ***Lesions*** : Catarrhal tracheitis, cheesy plugs in bronchi.
* ***Prevention*** : IB Masschusetts strain vaccine.

6. **Avian Leucosis**
* ***Synonym*** : Big liver disease
* ***Etiology*** : Onco virus
* ***Age*** : Older than 16 weeks
* ***Trans*** : Vertical i.e.egg borne
* ***Morbidity*** : Low
* ***Mortality*** : Negligible

* ***Signs*** : Abdominal distension, weakness, pale comb,emaciation, watery diarrhoea, inappetence, drop in egg production
* ***Lesions*** : Nodular or diffuse enlargement of liver and other visceral organs.
* ***Prevention*** : Selection for genetic resistance.

7. **Infectious Bursal Disease (IBD)**
* ***Synonym*** : Gumboro disese
* ***Etiology*** : Avian Reovirus/IBD virus
* ***Age*** : 3-6 weeks
* ***Trans*** : Ingestion of contaminated feed and water
* ***Morbidity*** : 100%
* ***Mortality*** : High upto 80%

* ***Signs*** : Sleepiness, ruffled feathers, diarrhoea, soiling of vent, pecking at vent, ataxia, tremors and death in 4-8 days
Lesions : Bursa is enlarged and haemorrhagic. Haemorrhages in thigh andn pectoral muscles.
* ***Prevention*** : IBD vaccine

8. Egg drop syndrome
* ***Etiology*** : Adeno virus
* ***Age*** : 6-8 months
* ***Trans*** : Vertical i.e. egg borne
* ***Signs*** : Drop in egg production (35-40%), thin shelled, cracked, depigmented eggs. Course : 2-6 weeks.
* ***Lesion*** : Atrophic uterus
* ***Control*** : EDS - 76 vaccine

9. Avian Encephalomyelitis :
* ***Synonym*** : Epidemic tremor
* ***Etiology*** : Picorna virus
* ***Age*** : Chicks (1-4 weeks)
* ***Trans*** : Egg borne and ingestion of contaminated food and water
* ***Morbidity*** : 40 - 60 %
* ***Mortality*** : 0-25 %
* ***Signs*** : Dullness, ataxia, inco-ordination, tremors, circling, paralysis and death
* ***Lesions*** : Congestion of meningeal vessels.
* ***Control*** : Vaccination of breeding stock

10. Inclusion Body Hepatitis (IBH)
* ***Etiology*** : Adenovirus
* ***Age*** : Young chicks (4-8 weeks)
* ***Morbidity*** : 50%
* ***Mortality*** : 10-40%
* ***Signs*** : Sudden onset of mortality without deterioration of body condition, depression, anorexia, anaemia.
* ***Lesions*** : Anaemia, swollen, & mottled liver, jaundice, hydropericardium.
* ***Treatment*** : Liver tonics, Vit C & Vit E

FUNGAL DISEASES

1. Aspergillosis :
* ***Synonym*** : Brooder pneumonia
* ***Cause*** : *Aspergillus fumigatus*
* ***Age*** : upto 10 weeks
* ***Mortality*** : 10-50 %
* ***Trans*** : inhalation
* ***Signs*** : Reduced appetite, increased thirst, dyspnoea, gasping, death in 24-48 hours.
* ***Lesions*** : Miliary caseous nodules in air sacs and lungs
* ***Treatment*** : $CuSO_4$ 1:2000 dilution for 7 days.
* ***Control*** : Avoid dampness of litter

2. Aflatoxicosis :
* ***Cause*** : Aflatoxin produced by *Aspergillus flavus*
* ***Age*** : All ages (more in chicks)
* ***Mortality*** : 50 - 90 %
* ***Source*** : Contaminated feed.
* ***Signs*** : Retarded growth, anorexia, ruffled feathers, anemia, ascites, ataxia & death
* ***Lesions*** : Liver-enlarged, pale, and mottled
* ***Treat & Control*** : Avoid use of contaminated feed.
Use feed additives viz. $CuSO_4$ @ 150g/ton of feed.

D] PARASITIC DISEASES

1. COCCIDIOSIS

It is serious ***protozoan disease*** of young stock upto ***10 weeks*** of age.It is most common in birds reared in ***deep litter system***. Disease outbreak occurs in warm and humid climate and ***damp litter*** condition.

Etiology : It is mainly caused by ***Eimeria tenella*** and ***Eimeria necatrix.***

Transmission : Disease spreads through contaminated feed, water or litter.

Symptoms :

1. Depression, weakness, ruffled feathers.
2. Reduced feed consumption.
3. ***Bloody diarrhoea,*** soiling of vent.
4. Loss of body condition.
5. Poor egg production.
6. ***Pale comb and wattles*** due to anemia.
7. Death.

Diagnosis:

1. Based on symptoms : ***Bloody diarrhoea.***
2. Postmortem lesion : ***Haemorrhages in caecum and intestine.***
3. Faecal examination reveals presence of ***oocysts in faeces.***

Treatment :

1. Administration of anti-coccidial drugs like-

a) Bifuran tablet @ 1tab/lit of drinking water for 7 days or

b) Amprolsol powder -20% @ 60 gms/50 lit water for 7 days or

2. Vimeral liquid @ 2ml/lit of drinking water.

Control :

1. Isolation and treatment of affected birds.
2. Use of proper waterers and feeders.
3. Use of dry litter or regular changing of litter.
4. Provide good ventilation and sunlight in poultry houses.
5. Use of anti-coccidial drugs as control measure.

2. INTERNAL PARASITES

There are 3 types of internal parasites (endoparasites) found in poultry.

1. Round worms (Nematodes) - eg. ***Ascaridia galli, Hetrakis gallinarum.***
2. Tapeworms (Cestodes) - eg. ***Davainea proglottina, Raillietina species.***
3. Flukes (Trematodes) are of little practical importance in India.

Symptoms :

Decreased growth rate, reduced appetite, weakness, anaemia, diarrhoea, loss of body weight and drop in egg production.

Diagnosis :

1. Presence of eggs or segments of worms in faeces/droppings.
2. Recovery of worms from the intestine at the time of postmortem.

Treatment :

1. Piperazine compound @ 100-500 mg/kg body weight orally.
2. Mebendazole @ 50 mg/bird orally.
3. Albendazole @ 20-30 ml/ 100 birds orally.
4. Dichlorophen @ 0.3 g/kg body weight orally.

Control :

1. Give diet rich in proteins, Vit. A and B-complex.
2. Avoid dampness in poultry house.
3. Provide sufficient space, ventilation and sunlight in poultry house.
4. Good sanitation.
5. Do not mix birds of different age groups.
6. Avoid contamination of feeders and waterers.
7. Control of flies, earthworms, fleas, snails and grass hoppers etc.
8. Deworming should be carried out at 4-6, 6-8, and 12 weeks of age.
9. Regular treatment of affected birds

3. EXTERNAL PARASITES

The external parasites (ectoparasites) of poultry are as follows.

1. Ticks : eg. ***Argus persicus (soft tick)***
2. Lice : eg. body louse, ***shaft louse,*** wing louse, head louse.
3. Mites : eg. red mites, feather mites, scaly leg mites.
4. Fleas : eg. stick tight flea.
5. Biting flies : eg. mosquitoes.

Symptoms :

* *General signs* : Itching or irritation, restlessness, reduced feed consumption, loss of blood, drop in egg production, retarded growth, & decrease in body weight.
* Loss of feathers in mange.

Diagnosis :

1. Symptoms 2. Presence of ectoparasites on body.

Treatment :

1. Spray or dust birds with Gammexane, D.D.T. or Malathion.
2. Roosts, nests and walls of poultry shed should be sprayed with insecticides

Control :

1. Isolation and treatment of diseased birds.
2. Maintain sanitary conditions.
3. Close cracks and crevices in poultry house.
4. Regular spraying of insecticides in shed.

✦✦✦

CHAPTER -15 : REPRODUCTIVE DISORDERS

N.M. Markandeya and A.U. Bhikane

TERMS USED IN REPRODUCTION

Fertility : Ability of an animal to reproduce maximum within the stipulated time as per the norms of the species.

Infertility : Temporary inability of the animal to reproduce.

Sterility : Permanent inability of the animal to reproduce.

Anoestrus : Absence of oestrus cycles and reproductive utility.

Repeat breeding : Condition in which female with normal oestrous cycle fails to conceive within 3 - 4 consecutive services.

Silent heat : A condition characterised by normal cyclical activity without well marked behavioural signs of heat or oestrus.

Anovulation : Absence of ovulation or failure of both rupture of mature graffian follicle and release of ovum.

Nymphomania : A condition in which female is contineously under the effect of oestrogenic hormones and shows increased sexual activity.

Mummification : Condition characterised by foetal death followed by autolysis of foetal and placental parts.

Maceration : It is a condition characterised by foetal death by wound and foetus is emphysemised and dissoluted.

Hydroamnion: Accumulation of excess amount of amniotic fluid in amniotic bag.

Hydroallantois:Accumulation of excess amount of allantoic fluid in allantoic bag.

Uterine hernia : Protrusion of gravid uterus through abdominal wall forming hernial ring and cavity.

Uterine torsion : Twisting of uterus on its long axis.

Uterine inertia : Condition characterised by failure of straining contractions.

Endometritis : Inflammation of endometrium.

Pyometra : Accumulation of pus in uterus.

Vaginitis : Inflammation of vagina.

Cervicitis : Inflammation of cervix.

Salpingitis : Inflammation of oviduct.

Hydrocephalus : Excessive accumulation of fluid in skull portion of foetus.

Monster:Organic deviation in structure or / and form in one or several body parts.

Abortion : Premature expulsion of dead foetus of recognizable size.

Still birth : Expulsion of dead foetus at the time of parturition.

Premature birth : Expulsion of foetus before completion of gestation period.

Orchitis : Inflammation of testis.

Balano-prosthitis : Inflammation of both prepuce and glans penis.

Prostatitis : Inflammation of prostate gland.

Intersex : Are the animals in which identification of sex is ambiguous.
Cryptorchidism : Means failure of one or both testes to descend into scrotal sac.
Libido : Sex drive necessary for the mating act to occur
Free-martin : A genetic female which is born as co-twin with a normal male.

1. DYSTOKIA

Dystokia is defined as a difficult birth or parturition or calving.

Classification : It is of two types -

a) ***Maternal Dystokia*** : due to abnormal condition of the genital passage of dam.
b) ***Foetal Dystokia*** : due to abnormal presentation or conditions of the foetus.

Etiology :

a) ***Maternal dystokia :***
   1. Narrow birth canal - deformity of pelvis.
   2. Failure of cervix to dilate.
   3. Twisting of uterus (uterine torsion)
   4. Weak or absence of uterine contractions (uterine inertia)
   5. Uterine hernia.

b) ***Foetal dystokia*** :
   1. Large size of the foetus.
   2. Developmental abnormalities of the foetus - monstrosities.
   3. Twins : two foetuses
   4. Diseases of foetus like dropsy, anasarca, hydrocephalus, emphysema
   5. Abnormal presentation or position of foetus.

Symptoms :

1. Restlessness.
2. Continuous straining.
3. Labour pains.
4. Appearance of foetal parts through vagina.

Treatment :

1. Manual correction of position, posture and presentation of foetus.
2. Withdrawal of foetus by forced traction.
3. Injection of epidosin, if cervical dilatation is incomplete.
4. Injection of oxytocin, if uterine contractions are weak or absent.
5. Rolling of the dam and rotation of foetus, if there is twisting of uterus.
6. Foetotomy i.e. cutting of foetus,-if foetus is dead or abnormal.
7. ***Caesarean section*** is the last choice to relieve dystokia.
8. After relieving dystokia, give parenteral and intrauterine antibiotic therapy

Prophylaxis :

1. Breed at proper age.
2. Provide adequate nutrition to pregnant animals.

3. Give adequate exercise during pregnancy.
4. Avoid long distance transportation, specially during advance pregnancy.
5. Avoid rolling, struggling, falling and jumping in pregnant animals.
6. Culling of animals with known pelvic deformities or kinked cervix.
7. Care and attention of parturient animals till normal expulsion of foetus.

2. PROLAPSE OF VAGINA AND UTERUS

* *It is defined as an eversion of genital organs.*
* It is seen either before or after parturition.

Etiology :

1. Inherited tendency.
2. Low levels of progesterone.
3. Urogenital infections like cervicitis & vaginitis.
4. Dystokia.
5. Breeding injury.
6. Retention of placenta.
7. Straining due to diarrhoea or constipation.
8. Consumption of estrogen rich plants or feeds.

Symptoms :

1. ***Protrusion of uterus cervix and / or vagina*** beyond vulva.
2. ***Continuous straining.***
3. Wounds or injury on the prolapsed mass.
4. Restlessness / uneasiness
5. Rise in body temperature
6. Loss of appetite and death in severe cases.

Treatment :

1. Washing of prolapsed mass with antiseptic solution.
2. Application of antiseptic ointment on prolapsed part.
3. Reduction of protruded part by cold fomentation.
4. Reposition of the prolapsed part manually.
5. Apply rope-truss to provide support and for retention.
6. Keep the animal in slanting position with hindlegs at higher level & head at lower level.
7. Give broadspectrum antibiotics parenterally
8. If antepartum prolapse, give injections of progesterone on every 10^{th} day.
9. If postpartum prolapse, give intrauterine antibiotic therapy.

Prophylaxis :

1. Eliminate causes of irritation or straining.
2. Avoid injury or unnecessary traction at delivery.
3. Early treatment of retention of placenta cases.
4. Don't apply weight to hanging placenta to remove it.

3. RETENTION OF PLACENTA

It means the failure of expulsion of placenta even after 12 hours of parturition.

Etiology :

1. Abortion
2. Dystokia
3. Premature delivery
4. Lack of exercise
5. Deficiency of hormones like oxytocin and / or estrogen.
6. Infections like Brucellosis, Vibriosis, Trichomoniasis
7. Nutritional deficiency of calcium or phosphorus

Symptoms :

1. ***Placenta retains even after 12 hours of parturition.***
2. Straining
3. Foul smelling discharge
4. Fever
5. Loss of appetite
6. Dullness and depression

Treatment :

1. Remove placenta manually.
2. Give injection Oxytocin IM at approximately 12 hours after parturition.
3. Keep 2-4 furea boluses intrauterine for 1-2 days.
4. Give Replanta powder @ 50 gm / day orally for 3-4 days.
5. Parenteral administration of antibiotics for atleast three days.

Prophylaxis :

1. Breed at proper age.
2. Avoid injury or unnecessary traction at delivery.
3. Provide adequate nutrition.
4. Control of infectious diseases.

4. METRITIS

* *Metritis means an inflammation of uterus.*
* It is commonly seen in recently calved/parturited animals.
* ***Pyometra*** means accumulation of pus in uterus.

Etiology :

1. Bacteria : *Brucella, Staphylococci, Streptococci.*
2. Protozoa : *Trichomonas foetus.*
3. Dystokia.
4. Retention of placenta.
5. Abortion.
6. Delayed involution of uterus.
7. Uterine inertia.

8. Lack of exercise.
9. Unhygienic conditions at the time of parturition.
10. Injury during insemination.

Transmission :

It is spread by infected cows.

Symptoms :

1. ***Rise in body temperature.***
2. Rapid pulse.
3. Loss of appetite.
4. Suspended rumination.
5. ***Drop in milk yield.***
6. Reduction in body weight.
7. ***Purulent (pus) discharge from uterus.***
8. Straining
9. Frequent urination.
10. On rectal palpation uterus appears thick walled, leathery and enlarged.

Treatment :

1. First remove uterine discharge by gentle per-rectal uterine massage.
2. Give antibiotics e.g. Strepto-Penicillin, Oxytetracycline, Gentamycin ampicillin, amoxycillin, enrofloxacin IM for 3-5 days.
3. Intra-uterine therapy with Furea / Cleanex /Cflox - TZ bolus : 2 per day for 2-3 days.

Prophylaxis :

1. Strict hygienic precautions.
2. Early treatment of retention of placenta cases.
3. Control of diseases like Brucellosis, Vibriosis, Trichomoniasis etc. responsible for abortion.
4. Isolation of the affected animals.

Table 15.1 : Common Names for the Sex, Young and parturition of Animals

Species	*Male*	*Female*	*Youngone*	*Act of parturition*
Cattle	Bull	Cow	Calf	Calving
Buffalo	Buffalo bull	She Buffalo	Calf	Calving
Goat	Buck	Doe	Kid	Kidding
Sheep	Ram	Ewe	Lamb	Lambing
Horse	Stallion	Mare	Foal	Foaling
Pig	Boar	Sow	Piglet	Farrowing
Dog	Dog	Bitch	Pup	Whelping
Cat	Tom	Queen	Kitten	Kittening

Table 15.2 : Reproductive Disorders in farm animals (females)

Disorders & their causes	Clinical signs	Treatment
1. Anoestrus		
a) *General causes* :		
* Mal/undernutrition * Deficiency of hormones * No GF/CL on ovary * Debility * Stress * Genetic	*Absence of oestrus *Smaller ovaries *No follicle or corpus-luteum(CL) on ovary (smooth ovaries)	* Provide concentrates & Vit-mineral mix. * Ovarian massage * Painting of cervix with Lugol's Iodine. * Herbal drugs * Hormonal therapy- Tab. Fertivet Inj. P-Depot
b) *Persistent CL* :		
* Uterine infections * Defective endometrial function	*Absence of oestrus *Persistant CL *Pathological condition of uterus	* Inj Lutalyse 25mg IM or * Inj Prosolvin 15mg IM * Antibiotic therapy
2. Repeat Breeding :		
a) *Non-infectious causes*: * Delayed ovulation * Anovulation * Untimely insemination * Blockage of fallopian tubes	*Animal fails to conceive within 3-4 consecutive services *Regular cycle on 21st day *Prolonged oestrus period *Oestrus discharge is clear	* Tab. Fertivet @ 1 orally 4 hrs before NS or AI * Timely insemination * Double insemination * GnRH preparations - Inj. Receptal / Fertagyl @ 2.5 ml IM at the time of AI or NS
b) *Infectious causes* : * Mild endometritis * Salpingitis * Cervicitis	*Oestrus discharge cloudy / whitish *Oestrus period usually normal	* Intrauterine & parenteral antibiotic therapy * Tab. Myron @ 10 daily orally for 20 days
3. Silent heat :		
* Low levels of oestrogen * Low levels of LH	*Signs of oestrous absent *Oestrous cycles are passed unnoticed *Owner fails to detect heat & breed the animal	* Regular per-rectal exam for heat detection * Use of controlled breeding programme on farm by oestrus synchronization technique

4. Ovarian Cysts		
a) *Follicular cyst* : * Low levels of LH * Intense signs of oestrus	*Short oestrus cycles *Continuous oestrus activity *Thin walled multiple cysts on ovary	* Inj. Chorulon @ 3000 IU IM or * Inj Receptal/Fertagyl @ 5 ml IM
b) *Luteal cyst* : * Low levels of LH	*No oestrous cycle *Thick walled, firm, single cyst on ovary	* Treatment as above or * Inj. Chorulon @ 3000 IU IM followed by Inj. Lutalyse 25 mg IM after 5 days
5. Mummification * Recessive genes * Failure of placental circulation * Factors leading to death of foetus	*Gestation period increases by several months *Uterine contents are hard, thick & ball-like *Fremitus is absent.	* Induction of parturition. * Inj. Lutalyse (PGF_2a) @ 5ml IM
6. Maceration * Invasion of pus forming bacteria in pregnant uterus	*Prolonged gestation period *Discharge of pus & some foetal parts through vagina in pregnant animal. *On P/R, crepitating sound of bones *Fremitus is absent	* Inj. Lutalyse 5ml IM * Inj. Stilbesterol 2ml IM * Parenteral & intra-uterine antibiotic therapy
7. Uterine Inertia * Low hormonal levels * Def. of Ca, P, Fe * General debility * Nervousness * Oversize of uterus	*Delay in parturition process *No strainings/absence of labour pains	* Inj Mifex 250ml IV * Inj. Dextrose IV * Give Inj. Oxytocin @ 4ml IM if cervix is dilated * Assisted delivery
8. Uterine Hernia *(Hysterocoele)* * Trauma * Weakness of muscle	*Protrusion of gravid uterus towards lateral or ventral side(s) of abdomen, perineum	* Surgical correction a) Caeserean section b) Herniorraphy

9. Uterine Torsion		
* Rolling, jumping, casting, transportation * Voluminous abdominal cavity * Uterine inertia	*Abdominal pain, *Straining & exhaustion *No progress of parturition process *Folds to rectal mucosa & vaginal passage	* Confirmation of direction of twist * Rolling of animal in the direction of twist * Caeserean section
10. Hydroamnion		
* Defective foetus * Disturbances in secretion & absorption of amniotic fluid * Foetal monstrocities	*Slow enlargement of the abdomen *Pear shaped abdomen *Discomfort	* Mild cases can be maintained with special care upto term. * Induction of parturition with Inj. Stilbesterol in severe cases.
11. Hydroallantois		
* Defective placenta * Placentitis * Altered circulatory mechanism of placenta	*Sudden enlargement of abdomen *Round, distended, frog like abdomen *Severe discomfort *Appearance of veins on abdomen	* Induction of parturition by giving Inj. Stilbesterol * Caeserean section
12. Post-partum bleeding		
* Injuries due to obstretical instruments * Forced traction for expulsion of foetus * Handling of parturition by striflers & quacks	*Bleeding seen after parturition *It may be profuse & continuous	* Inj. Stadren 10ml IM * Inj. Calboral 200ml IV * Application of ice cubes, cotton packs in birth canal.
13. Endometritis		
* Bacterial infections	*Mild purulent, discharge regularly *Repeat breeding *Cloudy oestrual discharge *On P/R exam, uterus is normal in mild cases whereas thick/ hard in moderate/ chronic cases	* Parenteral and intrauterine antibiotic therapy. * Tab Myron @ 10 orally daily for 20 days.

14. Kinked cervix		
* Hereditary predisposition * Injuries due to handling, obstetrical instruments during previous calvings	*Cervix no longer correspond with axis of vagina *AI gun cannot pass *Repeat breeding *Difficult parturition	* Selection of best parents for breeding * Inj. Epidosin @ 10ml IM
15. Vaginitis		
* Bacterial, viral and fungal infections	*Pustules, granules on vaginal mucosa *Red, hot vaginal passage *Continuous purulent discharge	* Tab Pivipol/ Canesten intra-vaginally * Antibiotic therapy
16. Abortion		
a)***Non-infectious/ Non-specific*** : * Trauma * Toxicities * Oestrogenic plants * Hormonal imbalance * Nutritional deficiencies	***Non-specific*** : *Seen in individual cases *Occurs throughout the gestation period	* Isolation of aborted animal * Removal of placenta * Intrauterine and parenteral antibiotic therapy * Lab. confirmation of infectious agent
b) *Infectious/Specific* : * Brucellosis, Vibriosis * Leptospirosis * Trichomoniasis * Infectious bovine abortion * Infectious pustular vulvo-vaginitis * Aspergillosis	***Specific/ Infectious*** : *Seen in more number of animals at a time *Month of abortion is generally specific ***Sequale*** : Retention of placenta Purulent uterine discharge	* Culling of Brucella positive animals

TIPS

* First carry out per-rectal palpation and then co-relate it with history.
* Correction of foetal posture to normal is an important pre-requisite for manual relieving of dystokia.
* Low grade endometritis can not be detected by per-rectal palpation.
* Do not enucleate the corpus luteum manually.
* For confirmation of persistency of corpus luteum, minimum two per-rectal examinations at 15 days interval are required.
* Cessation of oestrus is indicative of pregnancy in farm animals except in bitches.
* Pregnancy can be diagnosed much earlier but confirmation of pregnancy is possible only after 45 days of breeding.

Table 15.3 : Reproductive Disorders in farm animals (males)

Disorders & its causes	Clinical signs	Treatment
1. Orchitis * Injuries * Infections * Faulty castration	*Swollen, hot, painful scrotum *Discomfort and altered gait *Impotency, cessation of sperm production	* Antibiotics & Anti-inflammatory drugs * Sexual rest * Application of ice packs * In severe cases removal of affected testicle * Testing for brucellosis
2. Testicular degeneration * Insect bites * Injuries/laceration * Local dermatitis * Corrosive chemicals * Increased scrotal temperature	*No visible change in appearance of scrotum *Impotency, cessation of sperm production *Semen examination indicates azoospermia	* Correction and alleviation of cause * Symptomatic treatment * Sexual rest for regeneration of testicular tissue.
3. Penile affections * Accidental causes during dismounting * Tumors * Inflammatory conditions * Haematoma * Infections	*_Paraphimosis_- withdrawal of penis is difficult. *_Phimosis_ - failure of erection of penis *Difficulty in errection, penetration and withdrawal of penis	* Surgical corrections * Antibiotic therapy * Sexual rest * Antiinflammatory drugs * Prepucial washings with antiseptics.
4. Lack of Libido * Low levels of testosterone * Hereditary predisposition * Nutritional deficiencies Viz. Iodine deficiency	*Bull shows no interest in service *Reaction time increases upto 30 min. *Sexual behaviour is hampered	* Inj. Intavita/Vetade 10ml IM * Vit. + Mineral mixture * Inj. Chorulon 1500 IU IM * Potassium iodate orally * Tentex forte powder 10gm daily for 15 days
5. Cryptorchidism * Hereditary * Recessive gene	*Unavailability of one or both testicles in scrotal pouch *Watery semen samples *Libido is strong	* Culling of animal * Inj. Chorulon 1500 IU IM * Inj. Receptal @ 50-100 μg/kg IM * Surgical correction.

Table 15.4 : Reproductive problems in canines

Reproductive problem	Clinical signs	Treatment
1. Pyometra * Bacterial infection following oestrus or whelping	* Anorexia, polydipsia, Polyuria, lethargy, * *Open type* : Purulent vaginal discharge * *Closed type* : No vaginal discharge	* Inj. Stilbesterol @ 0.1mg/kg IM *or* * Inj. Oestradiol @ 0.01mg/kg IM for 1-3 days * Inj. Lutalyse (PGF_2a) @0.5mg/kg IM
2. Pseudopregnancy * High level of progesterone	* Symptoms like pregnancy * Enlargement of teats & mammary gland	-- do --
3. Misalliance/Mismating * Service by stray dog	* Owner is interested to prevent conception in bitch.	* Inj. Stilbesterol @ 0.5 mg/kg *or* Inj. Oestradiol @ 0.1 mg/kg IM within 3 days after mating
4. Termination of pregnancy * Service by stray dog	* Owner is interested to terminate the pregnancy in bitch.	* Inj. Lutalyse (PGF_2a) @0.03mg/kg IM every 12 hrs. for 3days
5. Anoestrus * Low hormonal levels * Undernutrition	* No oestrus cycles in seasons	* Herbal preparations * Tab Fertyl 25mg orally for 3 days
6. Inhibition of reproduction	* As per the desire of owner prevention of reproductive activity.	Females : Hysterectomy Males : Castration
7. Low libido (in males) * Low testosterone level	* No interest in breeding	* Tentex forte powder * Inj. Chorulon 100-150 IU IM twice weekly for 4 - 6 weeks
8. Excess libido (in males) * High testosterone level	* Strong vigour more attempts for service, Nuisance	* Inj. Oestradiol @0.3mg/kg IM Repeat every month if necessary
9. Prostatitis : * Senile dogs * Bacterial infection * Sertoli cell tumor * Prostatic hyperplasia	* Blood and pus in urine * Dysuria * Enlargment of prostate gland	* Antibiotics for 4-6 wks * Prostatectomy * Castration

Table 15.5 Reproductive traits in domestic animals

Particulars	*Cow*	*Mare*	*Buffalo*	*Ewe*	*Doe*	*Sow*	*Bitch*
Age of Puberty	24-36 mths	18-24 mths	36-42 mths	6-12mths	6-12 mths	5-8 mths	6-12 mths
Length of oestrous cycle	21 days	21 days	21 days	17 days	20 days	21 days	6 mths
Duration of heat	12-24 hrs	4-8 days	12-24 hrs	24-36 hrs	24-36 hrs	2-3 days	8-10 days
Time of ovulation	10-14 hrs after end of oestrus	24-48 hrs before end of oestrus	10-14 hrs after end of oestrus	Towards end of oestrus	Towards end of oestrus	36 hrs after onset of oestrus	1-2 days after Onset of oestrus
Period of maximum fertility	Last 8 hrs of oestrus	24 hrs before end of oestrus	Last 8 hrs of oestrus	2nd half of oestrus	2nd half of oestrus	12-36 hrs after onset of oestrus	Next 3 days after onset of oestrus
Gestation period	280 days	336 days	310 days	150 days	150 days	115 days	62 days
Period of involution of uterus	25-30 days	8-10 days	25-35 days	15-20 days	15-20 days	15-20 days	25-35 days
Breeding season	Throughout Year	Feb - April	Sept. - Feb.	June-Aug. Jan - Feb.	June-Aug Jan.-Feb.	Throughout Year	Aug.-Sept. Feb.-Mar.

CHAPTER -16 : SURGICAL CONDITIONS AND OPERATIVE TECHNIQUES

V.D. Aher and A.U. Bhikane

Surgery is an art of applying scientific and technical knowledge by mechanical means in the alleviation of the disease condition and correction of body deformities.

Terms used in surgery

Anaesthesia : A term used to indicate production of insenstivity.

General anaesthesia : Drug induced reversible loss of sensory and motor function with unconsciousness due to depression of CNS.

Local anaesthesia : Drug induced temporary loss of sensation in a limited area of the body without impairment of consciousness.

Sedation : A degree of CNS depression in which patient is awake but calm and free from nervousness / unaggressiveness.

Tranquilizers / ataractics : Drugs which cause sedation without drowsiness.

Suture : A fine cord like structure used for closing the wound.

Ligation : Tying of ligature (fine cord) to blood vessel or stump of tumor.

Restraint : Controlling the unwanted movements of the animal.

Casting : Making the animal fall down in lateral recumbency and tying the legs.

Inflammation : A purposeful reaction of living tissues to the irritant / injury.

Wound : Break in continuity of tissue in any part of body.

Ulcer : An open wound showing no tendency to heal.

Abscess : An abnormal cavity in the tissue containing pus.

Cyst : A sac or any closed cavity containing liquid or semiliquid material.

Tumor/Neoplasm : A mass of new tissue having no physiological use, which persists and grows independently of its surrounding structure.

Necrosis : Local death of tissue within the living individual.

Gangrene : Necrosis of tissue with putrefaction by saprophytic bacteria.

Hernia : Protrusion of an organ or tissue through accidental or natural opening.

Herniorrhaphy : Suturing of the hernial ring.

Hernioplasty : Repair of hernia by using a graft.

Sinus : A blind purulent tract showing no tendency to heal.

Fistula : An abnormal opening or passage between a cavity or duct and the surface of the body or between two cavities or two ducts.

Yoke gall : Localised acute inflammation of skin and subcutis on the neck of cattle due to constant friction caused by yoke.

Fracture : Break in continuity of bone.

Dislocation: Displacement of a bone from its normal position in relation to a joint.

Arthritis : Inflammation of joint.

Abduction : Movement of limb in a outward direction. from the plane of body.
Haematoma : Subcutaneous accumulation of blood.
Haemorrhage : Loss of blood from vascular system.
Epistaxis : Bleeding from the nostril.
Tourniquet : An appliance used for the temporary stoppage of the circulation in a limb or extremities.
Burn : Injury caused by dry heat (fire, hot solid, electric current).
Scald : Injury caused by moist heat (Steam, hot solid).
Frost bite : Injury caused by excessive cold.
Paralysis : Loss of function of muscle.
Paresis (Palsy) : A partial loss of function of muscle.
Hemiplegia : A condition in which one side of body is paralysed.
Paraplegia : Paralysis of hind quarters.
Intussuception : Invagination of a part of the intestine into an adjacent portion.
Volvulus (Torsion) : Twisting of a loop of intestine on its long axis.
Strangulation : Trapping of loop of intestine in a hernia.
Cystorrhaphy : Suturing of ruptured urinary bladder.
Membranoplasty : Anchoring of membrane nictitans (third eyelid) to the lateral canthus with mattress suture.
Tarsorrhaphy : Closure of the eyelid with sutures.
Corneal opacity : Lack of transparency of cornea.
Cataract : Opecity of lens and or its capsule.
Glaucoma : Increased intraocular pressure.
Exopthalmus : Buldging of the eyeball.
Hyphaemia : Accumulation of blood in anterior chamber of eye.
Hypopion : Accumulation of pus in anterior chamber of eye.
Entropion : Inward turning or inversion or inrolling of the eyelid.
Ectropion : Outward turning or eversion or outrolling of the eyelid.
Ptosis : Closure / drooping of upper eyelid.
Blepharospasm : State of partial or complete closure of eyelid.
Blepharitis : Means inflammation of eyelid.
Conjunctivitis : Inflammation of conjunctiva.
Keratitis : Inflammation of cornea.
Trichiasis : Misdirected or abnormal deviation of eyelashes.
Distichiasis : Presence of double row of eyelashes.
Pterygium : A fibrovascular wedge shaped growth over the limbus.
Dermoid : Congenital cyst like growth containing skin and hair.
Pannus : Subepithelial vascularization of the cornea.
Strabismus (squint) : Deviation of one or both globes from the normal visual axis.

COMMON SURGICAL CONDITIONS

Condition/Etiology	Symptoms / Diagnosis	Treatment
1. Inflammation *Trauma *Chemicals *Infection	**a)** ***Acute*** **:** Red, hot, firm, painful swelling **b)** ***Chronic*** **:** Hard, painless swelling	*Cold fomentation *Antiinflammatory & analgesic drugs *Hot fomentation *Massage with iodine ointment.
2. Abscess *Trauma *Infection	**a)** ***Immature*** **:** Firm, hot, painful swelling on palpation. Paracentesis reveal blood **b)** ***Mature*** **:** Soft, painless swelling having pointing at center and hard at periphery. Paracentesis reveal pus.	*Maturation by hot fomentation or iodine ointment. *Drainage, irrigation & dressing with Tr.Iodine /$MgSo_4$ + $CuSo_4$ + glycerine paste
3. Cyst *Congenital *Parasitic	Painless,uniform soft fluctuating swelling. Paracentesis reveal clear watery fluid.	*Drainage, irrigation and irritant antiseptic dressing with Tr. Iodine
4. Haematoma *Trauma	Doughiness and crepitations on palpation. Develop immediately after injury and doesnot 'point'. Paracentesis reveal blood tinged fluid.	***Fresh cases*** **:** cold irrigation,astringent application, ***Chronic cases*** **:** counter irritation and drainage
5. Tumor * Continuous irritation	Solid mass hard and painless to touch, bleeding tendency. Paracentesis reveal frank blood. Biopsy for confirmation	*Anti-cancerous drugs *Autovaccine *Surgical excision
6. Oedema *Fibrosis of liver *Cardiac failure *Renal failure *Parasites * Protein def.	Soft, painless, doughy, swelling which pits on pressure. Anaemia Hypoproteinaemia Faecal examination	*Rest and salt free diet *Protein supplement *Anthelmintics *Ectoparasiticides *Liver tonics *Diuretics
7. Hernia *Congenital weakness of muscles. *Trauma	Soft reducible swelling. Evidence of ring in external hernia. Symptoms vary depending upon part herniated in internal hernia.	*Herniorraphy *Hernioplasty, if hernial ring is large.

8. Fracture *Trauma/injury	Pain, crepitus, abnormal mobility, deformity, swelling. Radiography for diagnosis.	*Reduction (close or open) and fixation or immobilization
9. Dislocation *Trauma/injury	Pain, deformity, immobility of affected joint, shortening or apparent lengthening of limb Radiography for diagnosis.	*Reduction and extension. *Anti-inflammatory & analgesics
10. Wounds *Surgical operations *Trauma by sharp, blunt object * Maggots * Poisons	Gaping of edges of the wound Haemorrhage, inflammation, Pain, Purulent discharge. **a) *Fresh wound* :** **b) *Maggoted wound* :** **c) *Ulcerated wound* :**	*Check haemorrhage *Cleaning & disinfection of wound a) Suturing of edges Apply antiseptic/fly repellent ointment b) Remove maggots by using turpentine c) Cauterization
11. Haemorrhage *Trauma *Surgical operations	Pallor of mucosae Weakness Tachycardia Dyspnoea Shock Death in severe cases	*Check bleeding by - Rest - External compression - Ligation - Cauterization - Application of ice *Styptics *Blood transfusion
12. Arthritis *Trauma *Bacteria *Mycoplasma	Joint(s) swollen & painful Lameness. Sometimes fever & anorexia. Radiography for diagnosis.	*Intra-articular antibiotics & steroids . *Antibiotics IM *Anti-inflammatary and analgesics IM
13. Upward luxation of Patella. * Unknown	Jerky flexion or dragging of affected limb. Marked lameness initially	*Patellar desmotomy
14. Radial Nerve Paralysis * Casting on hard ground *Fracture of humerus	Appearance of longer limb and dropped point of elbow. Flexed fetlock and dragging of the affected forelimb.	*Physiotherapy (infrared therapy & farradic current) *Massage with liniment. *Nervine tonics.

15. Facial Nerve Paralysis *Trauma *Otitis media *Listeriosis	Drooping of ear, ptosis, accumulation of food in vestibule, pulling of lip towards sound side, Salivation	*Removal of primary cause. *Infrared therapy *Nervine tonics *Penicillin IM
16. Yoke gall *Rough Yoke *Unpaired bullock *Hard work *Overloading	Acute inflammatory, painful, swelling over neck. May contain exudate followed by pus(abscess) and fibrous tissue formation (induration) . a) Abscess formation b) Fibrous tissue formation	*Complete rest. *Anti-inflammatory drugs & antibiotics *Massage with iodine ointment. *Hot Fomentation a) Drainage of pus b) Radical excision
17. Horn Cancer *Chronic irritation *Paints *Solar radiation *Viruses *Genetic *Sex hormone imbalance	Rubbing of horn on hard ground or with limb. Deviation of horn, asymmetry, increased diameter at base of horn. Separation of horn from base and cauliflower like growth at base of horn. Bleeding tendency. On percussion dull resonant sound. Radiography for diagnosis.	*Amputation of horn. *Autovaccine & immunopotentiating drugs like Inj. levamisole @7.5mg/kg subcutaneously to prolong the recurrence.
18. Eye Cancer *Genetic *Irritation *Sunlight radiation *Viruses	Plaque or cauliflower like growth over cornea, limbus, conjunctiva and membrana nictitans. Biopsy of tissue for confirmation.	***Small growth*** : excision and cauterization with 1% Silver Nitrate ***Massive growth*** : Extirpation of eyeball.
19. Tail Gangrene *Trauma, *Infection *Ischaemia	Alopecia and loss of sensation at the site. Line of demarcation between healthy & gangrenous part.	*Amputation of tail proximal to gangrenous part.
20. Hard Milker *Trauma *Congenital	Milk coming in narrow strip due to contracted sphincter. Milking time is prolonged and more pressure is required for milking	*Incision over sphincter with Lichty's teat knife or bistoury
21. Free Milker *Trauma *Deficiency of Phosphorus	Spontaneous leakage of milk through teat orifice due to relaxation of sphincter. History of high milk yield or trauma to teat.	*Tonoricin 10ml IM *Inject 0.5 ml Lugol's Iodine around teat orifice using 22 G needle.

22. Teat Fistula *Congenital *Trauma	Milk leakage through fistulous opening other than teat orifice.	*Suturing of fistulous opening in two layers.
23. Fibrosis of teat canal *Infection *Rough hand milking	History of stoppage or reduced milk flow through teat. On palpation, local or generalised thickening or hardening of teat canal and obstruction in milk flow.	*Open teat surgery in localised fibrosis only. *No treatment for generalised fibrosis of teat canal.
24. Oesophageal obstruction *(choke)* ***Food material** : potato, beet mangoseed, apple, water melon. ***Foreign body** : Stone, piece of wood, leather, plastic, polythene, metal	Swelling and pain on palpation of oesophagus in ventral neck region. Profuse salivation, inability to swallow. Coughing Regurgitation of water after drinking. Acute tympany in complete obstruction. Failure to pass stomach tube and contrast radiography to locate the obstruction in thoracic part. Common in bovines	*Trocarization of rumen *Antispasmodics *Attempts to remove obstructed material through mouth or dislodge in the rumen. *Oesophagotomy for obstruction in cervical region. *Rumenotomy if obstruction is near cardia
25. Traumatic Reticulo - Peritonitis (TRP) *Ingestion of pointed metallic objects. *Common in bovines	History of pica, *Recurrent tympany or rumen impaction not responding to conservative treatment.* Fever, stiff gait, abducted elbows, arched back. Haematology-Neutrophilia X-ray exam. for diagnosis.	*Rumenotomy.
26. Diaphragmatic Hernia (DH). *Foreign body *Congenital weakness of diaphragm *Common in bovines	History of recent calving or advance pregnancy. ***Chronic frothy bloat not responding to conservative treatment.*** Scant pasty faeces. Splashing reticular sounds audible just posterior to cardiac area of ventral thorax. Radiography for diagnosis.	*Rumenotomy *Herniorraphy - i) transabdominal approach ii) transthoracic approach *Hernioplasty.
27. Pericarditis *Bacteria *Virus *Foreign body	History of chronic indigestion or recurrent tympany. Anorexia, reluctance to walk, stiff gait, arched back, abducted elbows, ***brisket oedema, jugular pulsation*** Radiography for diagnosis	*Antibiotics & diuretics. *Anti-inflammatory & analgesics *Pericardiocentesis *Pericardiotomy *Pericardiectomy

28. Vagus Indigestion *TRP *DH *Peritonitis *Reticular abscess *Reticular tumors	***Papple-shaped distension of abdomen***, chronic anorexia, emaciation, bradycardia, ***chronic frothy bloat not responding to treatment***. Scanty pasty faeces. Rumen hypermotility or atony. Radiography for dignosis.	*Nervine tonics *Parasyompathomimetics *Fluid therapy *Liquid paraffin 2-5 lit orally for 3-5 days *Rumenotomy for evacuation of rumen contents.
29. Abomasal Displacement *Poor exercise *Heavy feeding of concentrate *Hypocalcemia, ketosis, metritis *Act of calving	History of recent calving. Anorexia, drop in milk production, ketonuria. colic, scant pasty faeces. Buldging of lower left paralumbar fossa. Auscultation yield ping sound Liptek test for dignosis. ***Left sided displacement is more common.***	*Rolling and manipulation *Surgical correction - i) Lt. flank omentopexy ii) Lt. & Rt. flank abomasopexy iii)Rt.flank omentopexy iv) Ventral paramedian abomasopexy
30. Intestinal obstruction *Colic *Vigorous movements like rolling, falling , struggling, casting, jumping, *Pulling heavy load *Diarrhoea.	Suspended defecation, severe straining , colic. Passage of blood mixed mucous Bilateral distension of abdomen on ventral side. Per-rectal examination reveal presence of mass in sublumbar region and empty rectum. Staining of mucous or blood to the hand	*Intensive fluid therapy *Antibiotics *Antispasmodics *Analgesics *Rt. flank laparotomy *Enterotomy *Enterectomy
31. Atresia ani *Congenital	Distension of abdomen. Straining for defecation. Absence of anal opening.	*Surgical creation of anal opening at the normal site.
32. Recto-vaginal fistula *Congenital	Absence of opening of anus and passage of faeces through vagina	*Sugical correction by suturing of fistulous opening
33. Urinary calculi *Vit. A deficiency *Urinary tract inf. *Hard salty water	***Anuria or dysuria***, straining for urination, colic Per-rectal examination reveal ***distended bladder.***	*Urethrotomy for removal of calculi *Catheterisation of urethra.

34. Ruptured bladder *Urinary calculi	***Anuria/oliguria,*** dehydration ***Distension of abdomen*** & fluid thrill on its palpation. Per-rectal examination reveals empty collapsed bladder. Paracentesis abdominis reveal urine.	*Urethrotomy for removal of calculi. *Catheterization of urethra. *Left flank laparotomy for cystorrhaphy
35. Conjunctivitis *Irritants *Injury *Bacteria, viruses	***Redness & swelling*** of conjunctiva, serous or mucopurulent,ocular discharge Blepharospasm	*Instillation of antibiotic eye drops/ointments *Subconjunctival Inj. Dexona + Gentamycin
36. Keratitis *Injury *Infection	Lacrimation, ***cloudiness of cornea.*** photophobia and blepharospasm. In chronic cases blindness & corneal opacity Ophthalmoscopic examination for diagnosis.	Instillation of eye drop *Subconjunctival Inj. of steroid and antibiotic *Washing of eye with 1% Silver Nitrate. *Instillation of atropine eye ointment *Membranoplasty
37. Hyphaemia *Trauma *Post-operative complication of eye surgery	Partial or complete blindness. Accumulation of ***blood or clot in anterior chamber.*** Ophthalmoscopic examination for diagnosis	*Atropine eye ointment *Paracentesis of anterior chamber and irrigation with fibrinolysin and gentamycin.
38. Hypopion *Suppurative iritis or cyclitis *Trauma *Complication of eye surgery	Partial or complete blindness. ***White eye look*** due to accumulation of pus in anterior chamber. Ophthalmoscopic examination for diagnosis.	*Irrigation of anterior chamber with normal saline and gentamycin *Instillation or subconjunctival injection of antibiotics
39. Glaucoma *Cataract *Luxation of lens *Theileriosis	Increased intra-ocular pressure resulting in ***exopthalmus*** and swollen eye. Lacrimation, blepharospasm and blindness. Absence/sluggish corneal reflex. Digital palpation and tonometry for diagnosis.	*Conservative treatment i) Miotic drugs - Pilocarpine ii) Diuretics - Mannitol @ 1g/kg IV *Surgical treatment

40. Cataract *Congenital *Trauma to lens *Diabetes mellitus *Senility	Complete/partial blindness. ***White, opaque lens***. Ordinary torch/candle light and ophthalmoscopic examination for diagnosis.	*Intra/Extra capsular extraction of lens *Implantation of intraocular lens
41. Otitis media *Bacteria *Secondary to otitis externa	***Otorrhoea*** and swelling at the base of ear. Head shaking, ear rubbing and scratching. Rotation of head with affected side down. Otoscopic examination for diagnosis.	*Cleaning with H_2O_2 *Instillation of antibiotic ear drop/paste *Antibiotics parenterally *Modified Zepp's operation for lateral drainage of ear canal.
42. Veneral Granuloma * Virus * Transmitted through coitus	Swelling of vagina and prepuce ***Bleeding from genital passage*** ***Cauliflower like growth*** in vulva/vagina of bitch & prepuce and penis of dog	*Surgical excision *Anticancerous drug e.g. Vincristine @ 0.025 mg/kg IV weekly *Autovaccine *Radiotherapy

SUTURE MATERIALS

The suture material is broadly classified into absorbable and non-absorbable suture.

A] Absorbable suture material :

* These are absorbed into body tissue after a variable period of time.
* These include catgut, fascia lata, cargile membrane, polyglactin 910 (vicryl) and polyglycolic acid (Dexon) etc.

Catgut **:**

1. It is most commonly used absorbable suture material.
2. It is obtained from the submucosa of small intestine of sheep. Chromic acid treatment is done to delay the absorption time and to reduce irritation.
3. It is available in various numbers from 7-0 to 7 depending upon size.
4. It is used for suturing of soft tissues inside the body viz. muscles, mucosa, serosa.

B] Non-absorbable suture material :

* These are not absorbed by the tissues hence they are removed after healing is complete when used outside.
* These include cotton, nylon, silk, linen, vetafil, umbilical tape, metal like stainless steel, aluminium etc..

***Nylon* :**

1. It is most commonly used non-absorbable synthetic suture material.
2. It is non-capillary, strong, cheap and has a smooth surface.
3. Being stiff it is difficult to handle and secure knots.
4. It is available as plain monofilament or braided in different sizes.
5. It is commonly used for suturing of skin.

***Silk* :**

1. It is most commonly used non-absorbable organic suture material.
2. It is capillary, easily available, cheep, easy to handle and sterilize.
3. It is available in various numbers from 0-14 depending upon size.
4. It is preferred for herniorrhaphy due to its tension holding capacity.

***Cotton* :**

1. It is also commonly used non-absorbable organic suture material.
2. It is less irritating than catgut and silk.
3. It is capillary, easily available, easy to handle and sterilize.
4. It is available in various numbers from 2 to 4/0.
5. It is used for suturing of skin if nylon is not available.

SUTURING TECHNIQUES

Suturing patterns can be broadly classified as apposition and inversion sutures.

A] APPOSITION SUTURES :

These sutures are used to bring about apposition of wound on skin and muscle.

1. Simple interrupted sutures :

1. In this pattern the needle is pierced on one side of incision and inserted on the other side at right angle.
2. Then the ends of suture are tied with surgeons knot to one side of the incision.
3. The excess suture material is cut off distal to the knot.
4. Other sutures placed in similar fashion at a distance approximately 0.75 cm in small animals and 1.25 cm. in large animals.

These sutures are preferred to continuous sutures because if one suture in the line is broken, the other may not be affected.

2. Simple continuous sutures :

1. Simple interrupted suture is placed at one end of incision.
2. The smaller end is clamped with artery forcep and then successive bites are taken either at right angle or diagonally to the incision .
3. Finally the last bite is taken and knot is tied in between the loop and free end together.

This pattern is easy and less time consuming however, damage to suture at any place may let loose the sutures and disrupt the wound edges.

3. Continuous lock-stitch sutures :

1. This is similar to simple continuous suture pattern with few modifications.
2. In this pattern the suture material is passed through the loose loop before tightening.
3. Knotting is done as in continuous pattern.

The inter-locking between every bite avoids the chances of loosening of suture due to breakage.

4. Mattress sutures :

* These sutures are used where there is tension on suturing line and to reduce dead space.
* These sutures can be horizontal or vertical.
* In horizontal pattern, the suture line is parallel to the line of incision.
* In vertical pattern, the suture line is perpendicular to the line of incision.

a) ***Horizontal mattress :***

1. First bite is taken at right angle to the line of incision on right side and needle is withdrawn from left side.
2. The second bite is taken on the left side at a distance and then needle is withdrawn from right side.
3. Then the two ends are tied on right side and excess suture material is cut off.
4. Other sutures are placed in similar fashion till the complete wound is closed.

b) ***Vertical mattress* :**

1. First bite is taken very close to the line of incision on right side and the needle is withdrawn on left side at equal distance.
2. The second bite is taken at a distance exactly below the first bite on left side and needle is withdrawn from right side.
3. Then knot is tied which is at right angle to the line of incision.
4. A row of sutures is placed in the same fashion till complete suturing of the incision.

B] INVERSION SUTURES :

* These sutures are used to bring about inversion of wound edges and to bring them together.
* These are useful in suturing of hollow organs having serous layer like GI tract and uterus.
* These sutures prevent leakage of contents of hollow organs as wound edges and serous surface come in contact with each other due to inversion.
* The serous layer has fast healing tendency when brought in apposition.

1. Cushing sutures :

1. Firstly surgeons knot is tied at one end for anchoring of suture material.
2. Then the bite is taken on right side in serosa and muscle layer. The needle is then withdrawn at a distance on same side in forward direction.

***Nylon* :**

1. It is most commonly used non-absorbable synthetic suture material.
2. It is non-capillary, strong, cheap and has a smooth surface.
3. Being stiff it is difficult to handle and secure knots.
4. It is available as plain monofilament or braided in different sizes.
5. It is commonly used for suturing of skin.

***Silk* :**

1. It is most commonly used non-absorbable organic suture material.
2. It is capillary, easily available, cheep, easy to handle and sterilize.
3. It is available in various numbers from 0-14 depending upon size.
4. It is preferred for herniorrhaphy due to its tension holding capacity.

***Cotton* :**

1. It is also commonly used non-absorbable organic suture material.
2. It is less irritating than catgut and silk.
3. It is capillary, easily available, easy to handle and sterilize.
4. It is available in various numbers from 2 to 4/0.
5. It is used for suturing of skin if nylon is not available.

SUTURING TECHNIQUES

Suturing patterns can be broadly classified as apposition and inversion sutures.

A] APPOSITION SUTURES :

These sutures are used to bring about apposition of wound on skin and muscle.

1. Simple interrupted sutures :

1. In this pattern the needle is pierced on one side of incision and inserted on the other side at right angle.
2. Then the ends of suture are tied with surgeons knot to one side of the incision.
3. The excess suture material is cut off distal to the knot.
4. Other sutures placed in similar fashion at a distance approximately 0.75 cm in small animals and 1.25 cm. in large animals.

These sutures are preferred to continuous sutures because if one suture in the line is broken, the other may not be affected.

2. Simple continuous sutures :

1. Simple interrupted suture is placed at one end of incision.
2. The smaller end is clamped with artery forcep and then successive bites are taken either at right angle or diagonally to the incision .
3. Finally the last bite is taken and knot is tied in between the loop and free end together.

This pattern is easy and less time consuming however, damage to suture at any place may let loose the sutures and disrupt the wound edges.

3. Continuous lock-stitch sutures :

1. This is similar to simple continuous suture pattern with few modifications.
2. In this pattern the suture material is passed through the loose loop before tightening.
3. Knotting is done as in continuous pattern.

The inter-locking between every bite avoids the chances of loosening of suture due to breakage.

4. Mattress sutures :

* These sutures are used where there is tension on suturing line and to reduce dead space.
* These sutures can be horizontal or vertical.
* In horizontal pattern, the suture line is parallel to the line of incision.
* In vertical pattern, the suture line is perpendicular to the line of incision.

a) *Horizontal mattress :*

1. First bite is taken at right angle to the line of incision on right side and needle is withdrawn from left side.
2. The second bite is taken on the left side at a distance and then needle is withdrawn from right side.
3. Then the two ends are tied on right side and excess suture material is cut off.
4. Other sutures are placed in similar fashion till the complete wound is closed.

b) *Vertical mattress :*

1. First bite is taken very close to the line of incision on right side and the needle is withdrawn on left side at equal distance.
2. The second bite is taken at a distance exactly below the first bite on left side and needle is withdrawn from right side.
3. Then knot is tied which is at right angle to the line of incision.
4. A row of sutures is placed in the same fashion till complete suturing of the incision.

B] INVERSION SUTURES :

* These sutures are used to bring about inversion of wound edges and to bring them together.
* These are useful in suturing of hollow organs having serous layer like GI tract and uterus.
* These sutures prevent leakage of contents of hollow organs as wound edges and serous surface come in contact with each other due to inversion.
* The serous layer has fast healing tendency when brought in apposition.

1. Cushing sutures :

1. Firstly surgeons knot is tied at one end for anchoring of suture material.
2. Then the bite is taken on right side in serosa and muscle layer. The needle is then withdrawn at a distance on same side in forward direction.

3. The second bite is taken on opposite side in the same fashion.
4. Again third bite is taken similar to first bite.
5. In this fashion the suturing is completed like continuous sutures.

**In this pattern, there is inversion of serosal layer and the suturing is parallel to the line of incision.*

2. Connell sutures :

1. These are similar to cushing sutures except the depth of penetration of needle.
2. In this pattern the needle is penetrated in the mucosa i.e. in the lumen of the organ.

3. Lembert sutures :

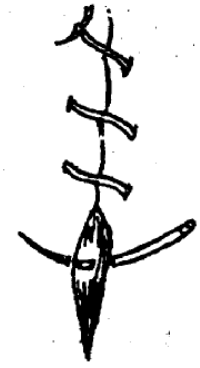
1. These are commonly used as supporting to the cushing sutures in hollow organs.
2. These are similar to cushing sutures, except suturing is perpendicular to the line of incision.
3. The bite is taken at right angle to the line of incision from far-near and near-far.
4. The bites are taken in similar fashion continuously till the end of suturing.
5. The suturing is completed by placing knot at the end like simple continuous pattern.



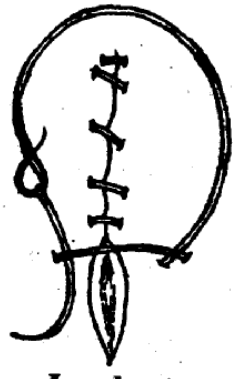
Simple interrupted



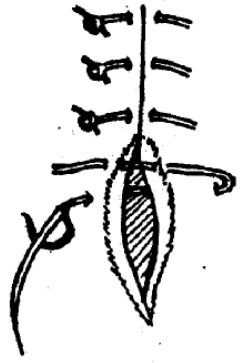
Lock-stitch



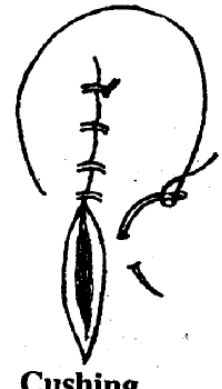
Simple continuous



Lembert



Vertical Mattress



Cushing

Fig. 16.1 : Suturing Patterns

COMMON SURGICAL INSTRUMENTS AND THEIR USES

Name of Instrument	Uses
1. Allis tissue forcep	To catch hold the tissue to facilitate deeper exposure of tissues. Also required for suturing.
2. Amputation saw	For amputation of horns.
3. Artery forcep	To check bleeding by pressing artery at the time of operation or in deep wounds.
4. Bistury or abscess knife	For opening of abscess
5. Burdizzo castrator	For castration of bull, sheep, goat, and pigs
6. Dressing forceps	For dressing the wounds.
7. Dressing syringe	For cleaning the deep wounds, ear or giving enema.
8. Emasculator	For cutting and sealing the cord during castration
9. Eye speculum	For retraction of eyelid during examination of eye or for ophthalmic surgery.
10. Feeding cup	For drenching medicines to small animals.
11. Gigli wire	To cut the hard tissue e.g. horn, bone, rib.
12. Haemostatic forcep	To clamp bleeding vessels (haemostasis)
13. Intestinal clamps	To hold the loop of intestine during surgery.
14. Irrigator/enema pot with rubber tube.	To irrigate wound or to give an enema and douche to small animal.
15. Lichty's teat knife	For incising the contracted sphincter.
16. Loman bone clamp	For holding fractured bones and plates.
17. Milk tube/siphon	For drainage of milk from blocked teat & in mastitis.
18. Mouth - gag	For examination of mouth and passing a probang and adminstration of medicines.
19. Needle holder	To hold needle for suturing.
20. Plaster saw enges	To cut thick or thin layer of plaster.
21. Plaster shears	To cut thin layer of plaster or to remove plaster.
22. Probang	To confirm and remove of obstruction in oesophagus.
23. Retractors	To maintain adequate exposure at surgical site.
24. Scalpel	For sharp cutting of tissue.
25. Scissors	For precision cutting of tissues and dressing material.
26. Tissue forcep	For grasping portions of tissues to maintain the hold.
27. Tooth rasper	For rasping of elongated molars in bovines.
28. Towel clamps	To hold the drapes in position.
29. Trephiner	To drill a hole in skull or bone.
30. Trocar and canula	For removal of gases from rumen in tympany and urine from abdomen in rupture of bladder.
31. Vulsellum forcep	To hold the rumen and fix it with Weingart's ring.
32. Weingart's rumenotomy set	For fixing rumen during rumenotomy to avoid contamination of peritoneal cavity.

OPERATIVE TECHNIQUES

1. Amputation of Horn (Dehorning)

Indications :

1. Horn cancer.
2. Horn fracture.
3. For easy control and management of animal.

Site :

Base of horn below the coronary band (junction of skin and horn).

Anaesthesia :

Cornual nerve block **:** The margin of frontal crest is palpated and 18 gauze needle is inserted subcutaneously midway between the base of the horn and lateral canthus of the eye just below the crest. About 10ml of local anaesthetic solution is deposited around the nerve.

Technique :

1. Animal is restrained in standing position.
2. The site is prepared aseptically and circular incision is given on junction of skin and base of horn.
3. The incision is extended towards poll region on one side and exactly in opposite direction towards frontal ridge on other side.
4. The skin and underlying tissues are seperated to form a flap.
5. The horn is cut with saw from the base.
6. The bleeding is checked with artery forcep or ligature.
7. The edges of flap are trimmed to bring in apposition and sutured with nylon by giving interrupted sutures.

Post-operative care :

1. Wound is cleaned with spirit or tincture iodine and dressed with antiseptic ointment.
2. Parenteral administration of broad spectrum antibiotic for 5-7 days.
3. Sutures are removed after 8-10 days or after wound healing.

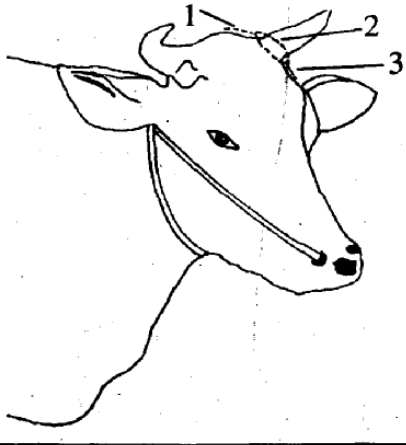


Fig. 16.2 : Amputation of horn

1. Skin incision towards poll region
2. Circular skin incision.
3. Skin incision towards frontal region

2. Exenteration/Extirpation of eyeball

Indications :

1. Irrepairable injury and / or suppurative destruction of the eye.
2. Eye cancer.

Site :

Between eyeball and orbital rim through the skin of both eyelids about 0.5cm apart from the palpebral border.

Anaesthesia :

1. Premedication with Diazepam @ 0.5-1.0 mg/kg IM
2. Supraorbital, Retrobulbar and auriculopalpebral nerve blocks.
   Supra orbital nerve block : Supraorbital foramena is palpated as a small depression mid-way across the supraorbital process on a vertical line running upwards from the medial angle of the eye. A 18-20 gauze needle is introduced in the foramena and 5ml of anaesthetic solution is deposited.
   Auriculopalpebral nerve block : A 18 gauze needle is inserted superficially under the subcutaneous tissue at the dorsal border of the zygomatic arch infront of base of ear and 5-10 ml of anaesthetic solution is injected.
   Retrobulbar nerve block : A 10 cm long, 18 gauze needle is introduced about 2.5 cm lateral to the medial canthus of the eye. It is pushed along the floor of the orbit directed towards the last upper premolar tooth on opposite side and 20-30 ml of 2% Lignocaine solution is injected.

Technique :

1. Animal is restrained in lateral recumbency.
2. The upper and lower eyelids are sutured together with 3-4 interrupted sutures leaving the suture ends at least 4-5" long for grasping and applying traction during the operative procedure.
3. A skin incision either elliptical or encircling the eyelids is made.
4. This incision is extended and undermined between the orbital rim and eye ball by blunt dissection taking care that conjunctival sac is not punctured.
5. The eyeball is made free from orbital rim attachments by careful dissection.
6. Haemorrhage is controlled either by forcipressure or ligation.
8. The stump containing optic nerve and associated vessels is clamped, ligated and cut.
9. The cavity is temporarily packed with gauge either plain or impregnated with Tr. iodine or Ferric perchloride to check the bleeding.
10. Then temporary pack and blood clots are removed and a bandage soaked in Tr.iodine or any other antiseptic solution is kept.
11. The skin edges are sutured with simple interrupted or horizontal mattress sutures by using nylon. A small gap at medial canthus is left for removal of the gauge and drainage of discharge.

Post-operative care :

1. After operation pressure bandage should be tied and kept for at least 24 hours.
2. Daily removal of gauge and dressing of orbital cavity with Tr. iodine till the discharge ceases, followed by dressing with antiseptic ointment or powder till complete healing.
3. Parenteral adminstration of broad spectrum antibiotics for 5-7 days.

3. Tracheotomy

Indication :

Upper respiratory tract obstructions (e.g. Haemorrhagic septicaemia)

Site :

Ventral midline at the junction between the upper and middle one third of neck region. (Fourth to sixth tracheal ring is preferred)

Anaesthesia :

Local infiltration anaesthesia.

Technique :

1. Animal is restrained either in standing or in lateral recumbency.
2. A 2-3" long incision is made on the skin and muscle.
3. After retracting apart sterno-hyoideus muscle, a semicircular incision is made between two adjacent tracheal rings, leaving half portion of ring intact.
4. A tracheotomy tube is inserted in the tracheal lumen through this incision. *Any sterilised plastic, rubber or metal tube of* ***half inches*** *diameter may serve the purpose in an emergency.*

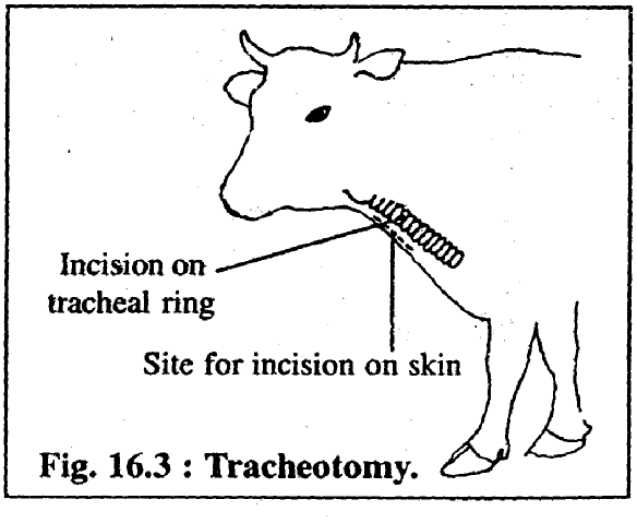


Fig. 16.3 : Tracheotomy.

5. The available tube is then fixed to the sides of skin by sutures.
6. The surgical wound is closed in routine manner keeping the tube intact.

Post-operative care :

1. Daily cleaning of the tube for patency and antisepsis.
2. Removal of tracheotomy tube after reduction of swelling and air way obstruction.
3. One or two interrupted sutures are placed to close the gap in skin after removal of tube.

4. Rumenotomy

Indications

1. Traumatic reticulitis
2. Acute severe frothy bloat.
3. Non penetrating foreign body syndrome
4. Traumatic pericarditis
5. Diaphragmatic hernia.
6. Vagus indigestion
7. Oesophageal obstruction near cardia.
8. Acute urea and other toxicosis
9. Persistent ruminal impaction.

Sites :

Left paralumbar fossa : a) Vertical incision in mid flank
b) parallel and near to the last rib in large sized animals.

Anaesthesia :

Paravertebral nerve block or Infiltration anaesthesia (Linear infiltration or Inverted 'L' or 'T' block.)

Paravertebral nerve block : The site is about 5 cm from midline, for T_{13} just cranial to the transverse process of the L_1 , for L_1 just cranial to the transverse process of the L_2 and for L_2 just cranial to the transverse process of L_3 .About 10 ml of 2% lignocaine solution is injected at each site above and below the transverse process to block dorsal and ventral branches of T_{13}, L_1 and L_2 spinal nerves.

Technique :

1. Animal is restrained in standing position & site is prepared for aseptic surgery
2. About 2" below the level of the lumbar transverse process, approx. 8-10" long incision is made on the skin.

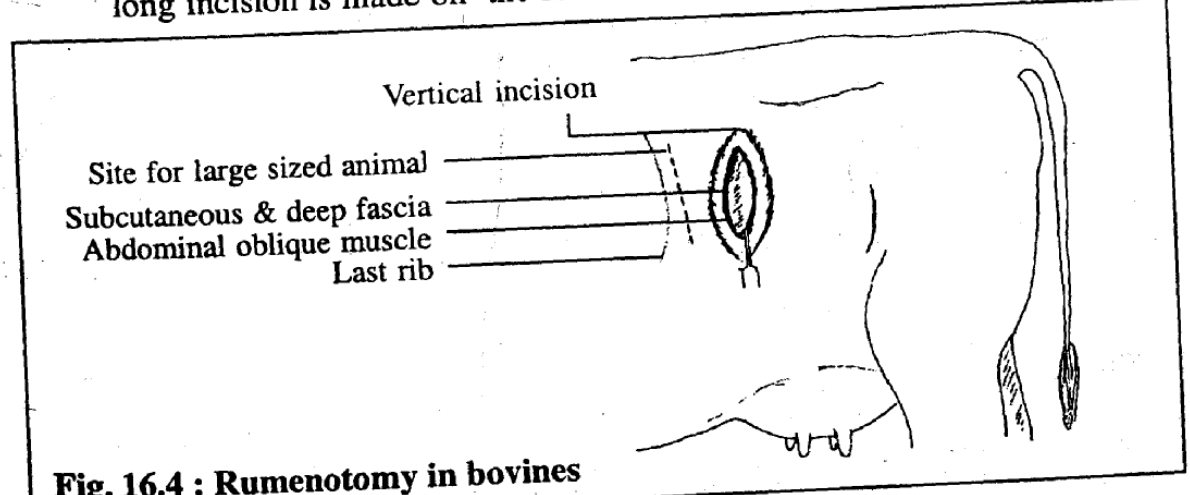


Fig. 16.4 : Rumenotomy in bovines

3. Muscles are incised and peritoneum is cut to expose rumen.
4. Hand is passed in abdominal cavity for detection of any abnormality or for palpation of diaphragm.
5. Rumen is exteriorised and fixed to skin edges either by two stay sutures or to Weingart's ring.
6. Surgical drapes are applied around the ruminal wall.
7. A nick is produced in the ruminal wall and rumen is incised with scissor.
8. Ruminal wall is fixed to the Weingart's ring by applying hook.
9. About 1/3rd of ruminal contents are removed and search is made for foreign bodies, diaphragmatic hernia , abscess, tumor, etc. in the reticulum.
10. Check the pH of ruminal contents and correct it if required.
11. Then the incision on rumen is closed by Cushing and Lembert suture with chromic catgut No. 1 or 1-0.
12. The stay sutures/ Weingart's ring is removed.
13. The muscles and peritoneum is sutured with catgut No.2 by continuous lock stitch sutures.
14. The skin incision is closed by interrupted sutures by using nylon.

Post-operative care :

1. Daily cleaning of sutured wound with spirit and dressing with antiseptic ointment.
2. Parenteral administration of broad spectrum antibiotic for 5-7 days.
3. It is better to maintain animal on fluid therapy for a day or two following the operation and then offer light diet preferably dry grass/hay for next few days.
4. The amount of feed to be given to the animal should be gradually increased.
5. Cud transplant is advised to improve rumen microflora.
6. Anti-adhesive agents are administered by intra-peritoneal route if adhesions are observed.
7. Removal of sutures after 8-10 days.

5. Cervical Oesophagotomy

Indications :

1. Oesophageal obstruction (cervical choke)
2. Neoplasm in the oesophagus.
3. Stricture or stenosis of oesophagus
4. Oesophageal diverticulum.

Site :

At the level of obstruction or neoplasm in the oesophagus or junction of middle and distal 1/3 rd part of cervical oesophagus in the jugular furrow.

Anaesthesia :

Local infiltration alone or in combination with sedation. The sedation of large animal is achieved by administration of diazepam @ 0.5 - 1 mg./kg body weight.

Technique :

1. Animal is restrained in right lateral recumbency.
2. After preparation of site, a 4-5" longitudinal incision is made through the skin and subcutaneous tissue.
3. Then the muscle is incised and oesophagus is located and exteriorized.
4. Oesophagus is incised either proximal or distal to the obstruction on healthy part . If the oesophagus appears normal then the incision is given on the site of obstruction itself. The length of incision should be large enough to remove the obstruction.
5. After removal of obstruction, the oesophageal incision is sutured with either cushing and lembert sutures or simple continuous sutures by using chromic catgut No. 1-0.
6. The muscle is sutured with catgut No 1 by continuous lockstitch suture.
7. Skin is sutured with nylon by simple interrupted sutures.

Post operative care :

1. Animal should be maintained on fluid for first 2-3 days, semisolid or liquid diet for next 2-3 days followed by green and dry fodder.
2. Daily cleaning of sutured wound with spirit and dressing with antiseptic ointment.
3. Parenteral administration of antibiotic for 5-7 days.
4. Removal of sutures after 8-10 days.

6. Medial Patellar desmotomy

Indication :

Upward luxation of patella.

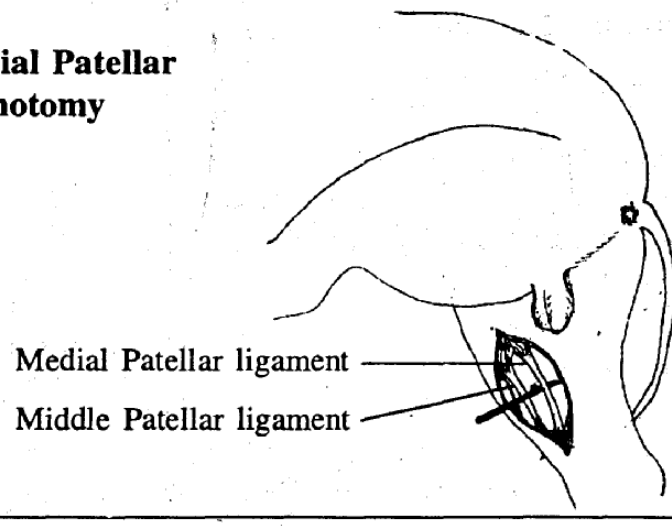
Site:

About 1.5-2" above the anterior tuberosity of tibia close to the insertion of medial ligament in a depression between middle and medial ligament.

Anaesthesia :

Local infiltration anaesthesia.

Fig. 16.5 : Medial Patellar desmotomy



Technique :

1. Animal is cast and secured in lateral recumbency on affected side.
2. A rope is tied to the affected limb at the pastern and pulled backward in the extended position.
3. The area of medial stiffle joint is prepared aseptically.
4. A stab incision is made into the skin with B.P. handle No. 3 (blade No. 11)
5. The medial ligament is cut carefuly starting from anterior border of ligament towards the skin.
6. An appreciable gap will be formed between the cut edges and confirm the same with the thumb.
7. Apply Tr. Iodine at the site.

Post-operative care :

It is generally not required.

7. Amputation of tail

Indications :

1. Tail gangrene
2. Irrepairable injuries
3. Malignant tumors

Site :

Above the site of injury/affection.

Anaesthesia :

Caudal epidural nerve block : The site of injection is sacrococcygeal /first intercoccygeal space. The tail from its base is moved in upward and downward fashion and the depression between the last sacral and first coccygeal or between the first and second coccygeal vertebra is located. A 10 cm, 18 gauze needle is inserted at median plane at right angle and skin weal is prepared. Then the needle is directed anteriorly and ventrally to a depth of 2-4 cm. The penetration of interarcuate ligament is noted. A syringe filled with local anaesthetic solution is fixed to the needle and piston slightly withdrawn for checking the blood. If blood comes out, the needle is withdrawn and reinserted. About 5 to 10 ml of lingocaine solution is injected. There is no resistance felt during injection if needle is in epidural space. If the resistance is observed then withdraw and redirect the needle.

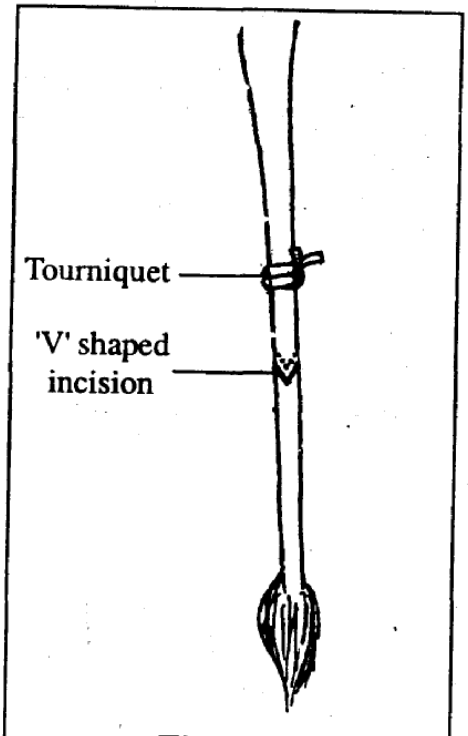


Fig. 16.6 : Amputation of tail

Technique :

1. Animal is restrained either in standing or in lateral recumbency.
2. A tourniquet is applied at the base of tail to check bleeding.
3. A "V" shaped incision is made on dorsal and ventral surface of the tail distal to the coccygeal joint to be disarticulated.
4. Both dorsal and ventral flaps are separated.
5. Two lateral veins and mid-coccygeal artery on ventral side are ligated.
6. Then tail is cut through intervertebral space.
7. The tourniquet is loosened and bleeding is checked.
8. Skin flaps are sutured by simple interrrupted or horizontal mattress sutures.

Post-operative care :

1. Daily dressing of wound with antiseptic ointment.
2. Parenteral administration of antibiotics.

8. Urethrotomy in bovines

Indication :

Urethral calculi.

Sites :

1. ***Post-scrotal site*** **:** About 3" behind the scrotum directly on midline over urethra.
2. ***Ischial site*** **:** About 2"below the ischial arch downwards on midline.

Anaesthesia :

Local infiltration

Technique :

1. ***Post-scrotal urethrotomy*** **:**
   1. The animal is secured in lateral recumbency.
   2. After preparation of site about 4-5" long incision is made along the midline on skin and muscles.
   3. The sigmoid flexure is pulled out and is made straight.

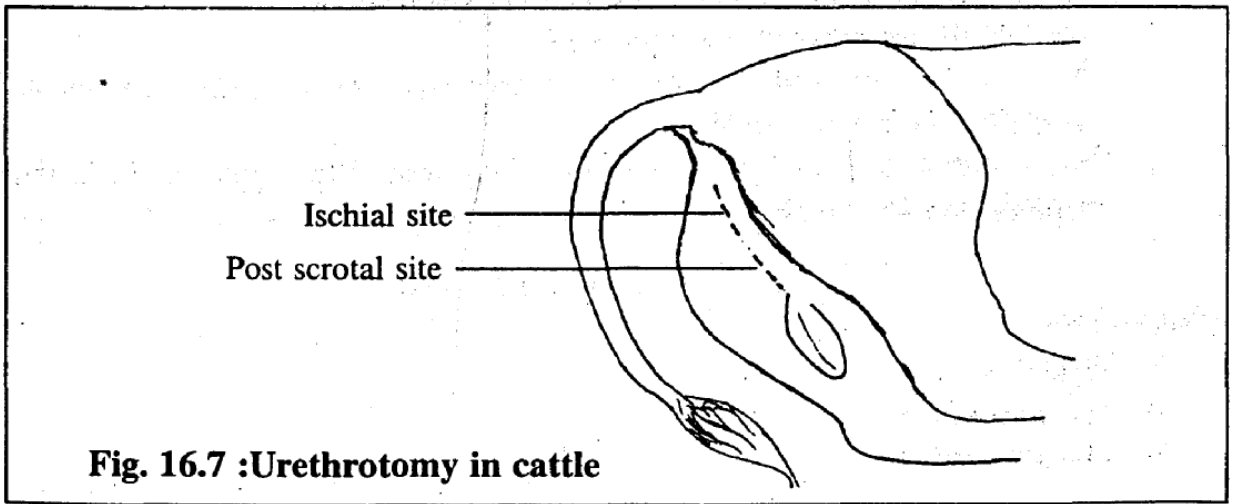


Fig. 16.7 :Urethrotomy in cattle

4. The urethra is palpated with finger to locate the calculi.
5. The calculi is removed by taking incision over urethra.
6. A polyethylene catheter is taken and its one end is passed towards bladder and other end towards tip of penis for clearing the passage of urethra.
7. The catheter is kept in urethra for drainage of urine from bladder.
8. The urethral incision is sutured with chromic catgut No. 3-0 by simple continuous sutures.
9. The muscle layer is sutured with catgut by continuous lockstitch sutures.
10. Skin is sutured with nylon by simple interrupted sutures.

2. *Ischial urethrotomy* :

1. The animal is restrained in standing position.
2. About 2-3" long incision is made along the midline on skin and muscle.
3. Rest of the procedure is similar to post-scrotal urethrotomy.

Post-operative care :

1. Daily cleaning of catheter and observation for the free passage of urine through the catheter.
2. Removal of catheter after 5-6 days.
3. Parenteral administration of broad spectrum antibiotics for 5-7 days.
4. Remove the sutures after 8-10 days or complete wound healing.

9. Urethrotomy in Dog

Site :

At the site of obstruction (most common site of obstruction is at the base of os-penis.)

Anaesthesia :

Epidural or local infiltration or general anaesthesia.

Technique :

1. A catheter is passed through urethral opening to locate the site of obstruction.
2. The glans penis is fully exposed and held in position and incision is made on midventral line of penis at the level of obstruction.
3. The calculi are grasped and removed.
4. The catheter is passed through the urethral opening to make sure that the urethra is clear upto bladder.
5. Either suture the urethra or leave it unsutured. The glans penis is then repositioned in sheath.

10. Caesarean section

Indications :

1. Dystokia
2. Hydroallantois
3. Uterine torsion.

Site :

***Ruminants* :**

1. Lower left abdomen oblique to milk vein. (Modified Young's Approach)
2. Vertical incision on lower left flank (for sow and cat)
3. Lateral and parallel to milk vein

***Dog* :** Ventral abdominal midline 1" behind the umbilicus.

Anaesthesia :

***Ruminants* :** Local infiltration

***Dog and Cat* :** General anaesthesia.

Technique :

1. The cow is restrained in right lateral recumbency.
2. The bitch is restrained in dorsal recumbency.
3. About 14 -16" long incision in cattle and 2-3" in bitches is made on the skin.
4. The abdominal muscles are incised and omentum is reflected cranially to expose the gravid uterus.
5. Uterus is brought at the site of incision and the wound is packed with surgical drapes to avoid contamination of abdominal cavity.
6. The uterus is incised carefully along its greater curvature between the rows of caruncles.
7. The foetus and foetal membranes are removed and furea boluses are kept in the uterus.
8. Uterine torsion is corrected if it exists.
9. Uterine incision is cleaned with saline and closed with Cushing and Lembert suturs by using chromic catgut No. 1 or 0.
10. Abdominal wound is closed in routine manner.

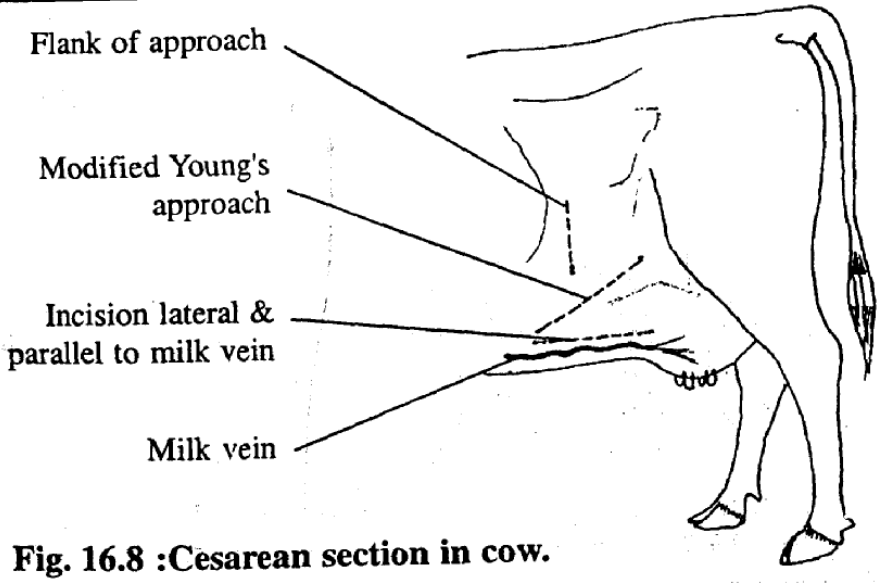


Fig. 16.8 :Cesarean section in cow.

Post-operative care :

1. Parenteral administration of broad spectrum antibiotics daily for 7-8 days.
2. Intra-uterine administration of furea boluses daily for 3 days.
3. Fluid therapy and multivitamins.
4. Regular dressing of wound and care is taken to prevent it's soiling.

11. Ovariohysterectomy or spaying in bitch

Indications :

1. To avoid breeding / for sterilization of bitch
2. Chronic endometritis or pyometra
3. Neoplasia of genital tract

Anaesthesia :

1. General anaesthesia in healthy bitches
2. Local infiltration anaesthesia in debilitated or toxaemic bitches.
   General anaesthesia in dog : General anaesthesia in dog is achieved with intravenous adminstration of 2.5 or 5% Intraval sodium @ 25mg / kg body weight. The dose of of intraval sodium can be reduced by 1/3rd (30%) in case of premedication with Triflupromazine hydrochloride or Chloropromazine hydrochloride @ 0.5 to 1mg / kg body weight.

Site :

1. ***Midline approach*** : Ventral midline abdominal incision about 2" posterior to umbilicus.
2. ***Flank approach*** : Oblique incision in right mid flank

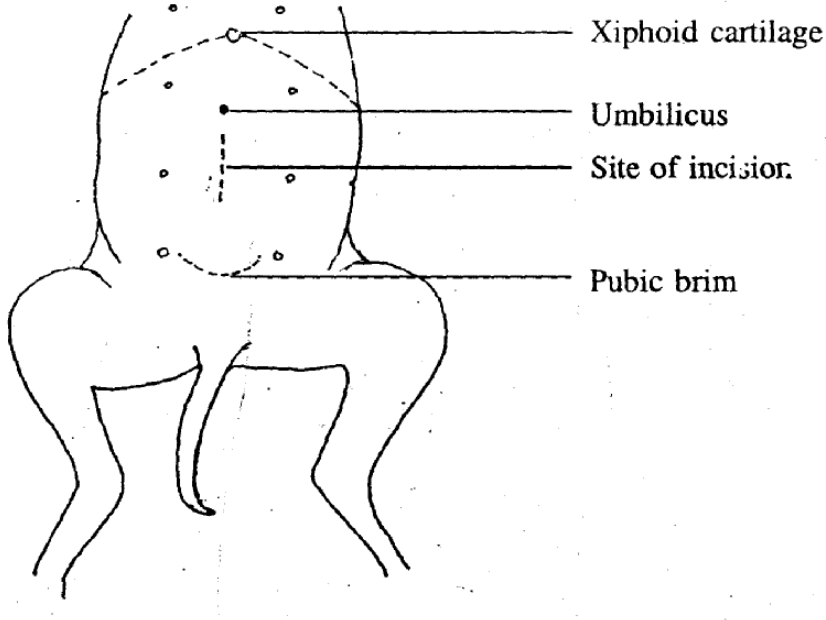


Fig. 16.9 : Ovario-hysterectomy in bitch

Technique :

***Midline approach* :**

1. The bitch is restrained in dorsal recumbency on operation table which is slightly tilted towards frontside.
2. About 1-2" long incision is made on midline 2" posterior to umbilicus.
3. The incision is extended deep upto peritoneum.
4. Left uterine horn is grasped with thumb forcep and followed up to the ovary.
5. The anterior ovarian ligament is cut and the anterior utero-ovarian vessels are ligated.
6. The ovarian bursa is cut and the ovary is disconnected from its anterior attachment.
7. The right ovary is then removed in the same manner.
8. Then posterior uterine arteries are ligated and cut in level with the cervix.
9. The broad ligament of uterus is torn to liberate the horn of the uterus.
10. Three artery forceps and ligatures are applied anterior to the cervix and uterus is disconnected.
11. Abdominal incision is closed in routine manner.

Post-operative care :

1. Daily dressing of wound with antiseptic ointment.
2. Parenteral administration of antibiotics for atleast 5-7 days.
3. Sutures are removed after 8-10 days of operation or complete healing.

12. Castration (orchiectomy) in dog.

Indications :

1. Prevention of breeding.
2. Malignant disease or any irrepairable injury of the testicles.
3. Prostatic enlargement.
4. Perineal hernia.
5. To make dog docile.

Site :

Prescrotal region or anterior to scrotum

Anaesthesia :

1. Local infiltration in combination with sedation ***or***
2. General anaesthesia.

Technique :

1. The dog is restrained in dorsal recumbency.
2. One testes is pushed forward to bring it under skin over the ventral aspect of sheath.
3. About 1" incision is placed over the skin above this testes and testes is squeezed out by mild pressure.
4. The cord is severed after ligation and the testes is removed.

5. The other testes is removed in same manner through the same incision.
6. The skin incision is sutured with subcuticular or simple interrupted sutures

13. Docking in pup

Indication :

Cosmetic surgery.

Site :

As per recommendations of kennels for various breeds i.e. Spaniel (2/3rd) Poodles and Terriers (1/3rd) Boxer and Doberman (at 2nd joint)

Anaesthesia :

No anaesthetic is required for pups in early age.

Technique :

1. The skin is pushed upward and cut in tail is made through the intercoccygeal joint by docking scissor.
2. Bleeding is controlled by placing tourniquet.
3. The skin is loosened to cover the stump and 2-3 sutures are placed for apposition

14. Trimming of nail in Dog

Indication:

Overgrown nails.

Technique :

1. The dog is restrained on table or in lap.
2. Avascular portion of nail is cut using dog nail cutter.
3. Take care to avoid overcutting which may cause pain and bleeding.
4. Apply Tr. Iodine or Betadine.

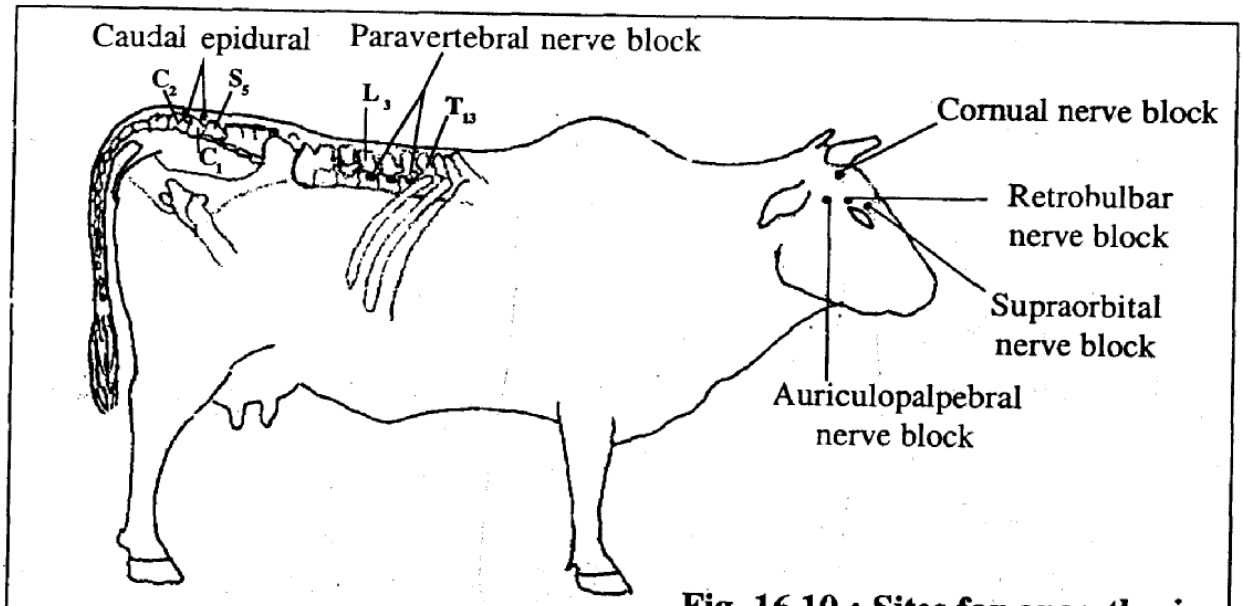


Fig. 16.10 : Sites for anaesthesia

CHAPTER - 17 : POISONING IN ANIMALS

A.U. Bhikane and A.A. Deshmukh

Toxicology **:** It is the study of nature and effects of poisonous or toxic substances.
Toxicity **:** It is inherent capacity of substance to produce harmful effects.
Poison **:** It is any substance (liquid / solid / gas) that causes deleterious effects in a living organism.
Venoms**:** These are substances produced by reptiles for their defence mechanism e.g. snake venom.
Toxins **:** These are the poisonous substances produced in animal tissues by the action of bacteria or waste products that are not recovered from body due to liver or kidney failure.
Antidote**:** These are the drugs or chemical agents that neutralise the effects of poison.

Sources of poisoning

There are two major sources of poisoning in animals -
A] Natural sources, B] Human oriented sources

A] Natural sources :

1. ***Plants*** **:** Ipomea carnea, Datura alba, Atropa belladona, Strychnus nuxvomica, Young shoots of sorghum, Nitrate rich plants.
2. ***Animals*** **:** Poisonous snake bite (Cobra, Krait, Russel viper and Rattle snake), Scorpion bite, Toad toxin, Tick toxins and Spider venom.
3. ***Minerals or metals :*** Arsenic, Lead, Mercury, Selenium, Fluorine.

B] Human oriented sources :

1. ***Accidental causes*** **:**

a) Fertilizers : Urea, Phosphate or Nitrate fertilizers.
b) Insecticides : Organophosphates, Organochlorines, Carbamates, Pyrethroids.
c) Rodenticides : Zinc phosphide.
d) Industrial effluents : Lead, Fluorine, Cyanide, Mercury, Nitrate.
e) Radiation hazards.

2. ***Malacious poisoning*** **:** Unlawful discriminal killing of animals by administering poisons e.g. Zinc phosphide, Strychnine, Abrus etc.

Classification of poisoning

The classification of poison on the basis of its effect on body is as follows :

A] ***Poisons causing respiratory insufficiency (anoxia)*** by

1. Hindering O_2 uptake from pulmonary alveoli.
   e.g. Petroleum products, Nitrous oxide, Sulfur oxide.
2. Hindering O_2 transport to tissues.
   e.g. Nitrate / Nitrites - Formation of methaemoglobin.
3. Inhibiting O_2 utilization by tissue cells.
   e.g. HCN / Cyanide - Inhibiting enzyme cytochrome oxidase.

Table 17.1 : Common Poisonings in Animals & their treatment

Poisoning & Causes	Symptoms	Line of Treatment
1. Hydrocyanic acid Poisoning *Ingestion of cyanogenetic plants e.g. immature jawar plants & Linseed *Stunted, wilted & drought affected plants *Common in ruminants	Severe dyspnoea, bloat, blood, & ***mucosae-bright red***, muscle tremor, staggering gait, restlessness, opisthotonus,. convulsions, nystagmus, ***bitter almond smell*** to rumen contents. Death within 1-2 hrs	**C, B :-** Sodium nitrite 3 g + Sodium thiosulfate 15 g + distilled water 200 ml IV **S, G :-** 1 g Sodium nitrite + 3g Sodium thiosulfate + 50 ml distilled water IV Repeat after 1-2 hrs. *Sodium thiosulfate 30-60g orally
2. Nitrate/Nitrite Poisoning *Accidental ingestion of fertilizers containing nitrates *Nitrate rich plants/water *Water from deep wells *Common in ruminants	Salivation, colic, diarrhoea., dyspnoea, brownish musosae chocolate colored blood, muscle tremors, staggering gait, convulsions. Death within 2- 6 hrs.	*Methylene blue @ 4-8 mg/kg IV as 1% solution *or* *Ascorbic acid @ 15 mg /kg IV
3. Oxalate poisoning *Ingestion of oxalate rich plants e.g. *Anagallis arvensis* ***(Dhorkakada)*** *Feeding of fodder infected with black fungus *Aspergillus niger* *Common in ruminants	Anorexia, weakness, ruminal atony, constipation, oliguria, haematuria, dribbling of urine, oedematous swelling on perineum and around genitalia	*Discontinuation of suspected fodder *Lime water @ 1-1.5 lit orally T.I.D. *Calcium preparations IV *Rumenotorics, Vit. B complex
4. Urea poisoning *Accidental ingestion of urea fertilizer *Feeding of large quantity of urea as protein supplement *Common in ruminants	Severe colic, inco-ordination, muscle tremor, dyspnoea, bloat. Violent struggling & bellowing. Ammoniacal smell to breath. Death within 3-4 hours	*Vinegar *or* 5% Acetic acid C, B : 2-4 lit. S, G : 0.5 lit. orally *Ca, Mg salts IV *Evacuation of rumen contents
5. Lead poisoning *Licking of lead, oil paints *Ingestion of lead products like Car batteries, bullets, golf balls *Ingestion of herbage contaminated by metal processing industries & automobile exhausts *All species susceptible	***Acute*** **:** Bellowing, staggering, muscle tremor, excitement, blindness, circling,headpressing, convulsions and death ***Subacute*** **:** Constipation or diarrhoea, vomition, colic ***Chronic :*** Blue-black discoloration of gums, locomotor disturbances, anemia, abortion,	*Cal. versenate (Ca EDTA) 6.6% sol^{n}. @ 70 mg/kg/day IV divided in 2-3 doses for 3-5 days *Sedatives-Diazepam IV, IM *Saline purgatives-orally
6. Fluorine poisoning/Fluorosis *Ingestion of fodder/water contaminated by industrial effluents *Drinking of fluorine rich water from deep wells *All species susceptible	Lameness, stiff gait, pain in bones & joints. Mottling, wear & tear of teeth	*No specific antidotal therapy *Aluminium sulphate @ 30 gm daily orally may be tried. *Supplementation of diet with Ca, P & Vit D.

7. Organochlorines & Pyrethroids : *Accidental ingestion or spraying of DDT, BHC Aldrin, Endrin, Permethrin, Cypermethrin, deltamethrin *All species susceptible	Salivation, grinding of teeth, ***hyperthermia***, dyspnoea, excitement, muscle tremor, inco-ordination, intermittent or continuous clonic tonic, convulsions, coma & death	*Anticonvulsants-Diazepam *Calcium preparations IV *Intensive fluid therapy *Saline purgatives - orally *Atropine sulphate @ 0.05 mg/kg IM
8. Organophosphates & Carbamates : *Accidental ingestion or spraying of Malathion, Parathion, Sumithion, Carbaryl etc. *All species susceptible	Profuse salivation, lacrimation, ***miosis***, diarrhoea, dyspnoea, muscle tremor, weakness, mild convulsions, paralysis, coma & death	*Atropine sulphate @ 0.25mg/kg (2/3 rd IV, 1/3rd IM) Repeat above dose, if necessary *Pralidoxime @ 4-6 mg/kg IV *Sedatives *Saline purgatives *Intensive fluid therapy
9. Strychnine poisoning *Strychnine is commonly used for killing dogs & rodents	Salivation, dyspnoea, clonic convulsions, opisthotonus & rapid death	*Intraval sodium @ 30 mg/kg IV *or* Diazepam @ 1-2 mg/kg IV *Emetics & fluid therapy
10. Snake bite *Poisonous snakes *Cobra* *Viper* *Krait* *All species susceptible	Evidence of fang marks on muzzle & lower extremities Local swelling & pain Nervous signs in cobra bite Red urine in viper bite Death within 1-10 hrs.	*Polyvalent anti-snake venom serum IV. Give 2 vials initially & then depending upon response to treatment. *Broadspectrum antibiotics, *Corticosteroids, Analgesics *Fluid therapy *Neostigmine : 5-7.5 mg IM

CHAPTER - 18 : CLINICAL EXAMINATION

The routine examination of patient includes -

1. History taking : Patient data, Disease history, General history.
2. Examination of patient
   A. Inspection
   B. General clinical examination : Temperature, Respiration, Pulse.
   C. Physical examination : Palpation, Percussion, Auscultation.
   D. Regional clinical examination : Examination of head, neck, thorax and abdomen.

1. HISTORY-TAKING (ANAMNESIS)

History - taking means obtaining the information regarding patients illness from animal owner or accompanying attendant through careful interrogation or cross-questioning.

History-taking helps in making accurate diagnosis and giving prognosis of disease.

Approach for History-taking :

1. Acquire the confidence of the owner by providing prompt and efficient service.
2. Handle the owner with diplomacy and tact.
3. Listen to the animal owner with patience and full attention.
4. Use polite, simple, humerous language.
5. Give sufficient time for history-taking.
6. Encourage owner to tell the history in his own language.
7. Do not ask for complete history.
8. Avoid leading and technical questions.
9. Choose right questions to ask.
10. Do not put direct questions like.
    * Why have you brought the animal? or
    * What is wrong with your animal?
    Instead, it is better to ask -
    * What have you noticed that worried you?
    * What abnormal actions have you observed in your animal?
11. Assess the accuracy of history by careful examination.

About animal owners ...

1. Co-operative owners give correct history.
2. Some owners are reluctant to tell the history.
   In this case, clinician should ask what was the first abnormal thing you noticed? Then what happened? What next? After that what did you notice?

3. Talkative owners volunteer story about the patient which includes relevant and irrelevant information. In this case, clinician should carefully select desired information leaving out the undesired.
4. Some owners give incorrect history to conceal their own negligence or ill advised efforts at treatment.
5. Some owners send their animals through labour / servant who is often unable to give information about illness.

History-taking includes :

A. Patient data. B. Disease history. C. General history.

A] Patient data

* This comprises information pertaining to species, breed, age and sex of animal.
* This help in identification of patient and also gives clue in diagnosis of certain diseases.

i]. Species :

There is marked species difference in the susceptibility to a particular disease.

1. Cattle and Buffalo: HS, BQ, RP, BVD, BMC, Ephemeral fever, TRP, Traumatic pericarditis, Diaphragmatic hernia.
2. Sheep and Goat : PPR, Contagious ecthyma, Blue-tongue, Pregnancy toxaemia, Fibrinous pericarditis, Enterotoxaemia.
3. Dog : Rabies, CD, ICH, Diabetes, Chronic valvular disease.
4. Pigs : Swine fever, Swine erysipelas, Swine influenza.
5. Horse : Glanders, Strangles, Equine infectious anemia, South African Horse Sickness, Equine influenza.

ii] Breed :

The susceptibility to different diseases vary from breed to breed.

1. Exotic breeds are more susceptible to FMD and haemoprotozoan diseases.
2. Jersey breed is more prone to milk fever.
3. High yielding breeds are susceptible to metabolic or production diseases.

iii] Age :

Some diseases are more common in young whereas some in old / adult animals. Some are not age related.

a) *Diseases common in young age group* :

1. Cattle and Buffalo: Colibacillosis, Naval-ill, Coccidiosis, Ascariasis, Dermatophytosis, Ricket, Tetanus, Avitaminosis, Black-quarter, Whole milk tetany.
2. Sheep and Goat : Enterotoxaemia/Lamb dysentery, Tetanus, Polyarthritis, Endoparasites.
3. Horse : Strangles.
4. Pig : Piglet anaemia.

5. Dog : Canine distemper, Ricket, Demodicosis, Ringworm, Endoparasites.

b) *Diseases common in adult / old animals* :

1. Cattle & Buffalo : Tuberculosis, Johne's disease, Osteomalacia, TRP, DH.
2. Dog : Chronic valvular disease, Chronic interstitial nephritis, Diabetes mellitus, Dirofilariasis, Prostatitis
3. Horse : Glanders.
4. All species : Malignant tumors, Chronic pulmonary diseases.

iv] Sex :

According to sex, the susceptibility of animal to certain diseases varies -

a) Female : Mastitis, Metritis, Pyometra, Milk fever, Ketosis, Haemoglobinurea , Pregnancy toxaemia in sheep.

b) Male : Orchitis, Scrotal hernia, Phimosis, Paraphimosis, Urolithiasis, Horn cancer

B] Disease history

Disease history includes
a) Present / immediate history.
b) Past / previous history.

a) Present / Immediate history :

It is concerned with the sequence of events associated with present illness.

Specific questions should be asked about -

1. Duration of illness.
2. Appetite : Normal, decreased, increased, abnormal.
3. Water intake : Normal, decreased, increased.
4. Defaecation : Frequency, quantity, colour, consistency, odour of faeces.
5. Urination : Posture, frequency, quantity, colour of urine.
6. Rumination.
7. Respiration.
8. Growth in young and milk production in lactating animals.
9. Physical activity, gait, posture.
10. Drugs used, doses given and duration maintained, if animal is treated.

If more number of animals from flock / herd / village are affected, then ask about-

1. Average course of disease.
2. Morbidity, mortality and case fatality rates.
3. Efforts made for diagnosis of disease.
4. Steps taken for treatment of affected animals and response obtained.
5. Gross lesions, if post-mortem is done.
6. Control measures adopted, if any.
7. A prior surgical and medical procedures such as castration, docking, shearing, vaccination etc.

b) Past / Previous history :

* It deals with past problems and sequence of events associated with it.
* If there is history of previous illness, then enquire about -

1. Nature and duration of previous illness.
2. Morbidity, mortality and case fatality rates.
3. Clinical signs observed, laboratory tests performed and diagnosis made.
4. Treatment given, control measures adopted and results obtained.

C] General History

It includes information pertaining to nutrition, reproductive and breeding status, environment and general managemental practices.

i] Nutrition :

1. Enquire about type, quality and quantity of feed given and compare it with standard nutritional requirements.
2. Changes made in the feeds / fodders, if any.
3. Drinking water : Source, quantity and quality.

S.N.	Cause	Disease
1.	Overfeeding of carbohydrates (cereals)	Lactic acidosis
2.	Change in feed, overfeeding, stale feed	Indigestion, Tympany, Diarrhoea.
3.	Overfeeding of green/lush pasture	Tympany, Diarrhoea.
4.	Feeding of poor quality fodder	Rumen impaction.
5.	Low carbohydrate diet, underfeeding in milch cattle and buffalo	Ketosis.
6.	Exclusive feeding of milk to calves	Hypomagnesaemia.
7.	Non-supplementation of diet with mineral mixture	Rickets in young and Osteomalacia in adults.
8.	Feeding of carbohydrate rich diet during rest period	Azoturia in horses.
9.	Excessive feeding of goitrogenic plants like cabbage	Goitre.
10.	Consumption of nitrate rich fodder and water	Nitrate poisoning.
11.	Feeding of plants containing phytotoxins e.g. *Lantana camera, Tribulus sp.*	Photosensitization.
12.	Feeding of immature jawar plants	HCN poisoning.
13.	Artesian and subartesian water	Fluorine poisoning.
14.	Faecal contamination of water	Salmonellosis.
15.	Algae in stagnant pools	Algae poisoning.
16.	Water contaminated with industrial effluents	Fluorine, Lead, Cyanide and Nitrate poisoning.

ii] Breeding / Reproductive status :

History pertaining to parturition / pregnancy suggests or eliminates diagnostic possibilities.

1. Ketosis in cows and buffaloes occurs during early lactation.
2. Pregnancy toxaemia in advance pregnant sheep.
3. Metritis within few days after parturition.
4. Milk fever usually occurs within 48 - 72 hours of parturition in cows and buffaloes.
5. Haemoglobinuria in advance pregnant or recently calved buffaloes or cows.
6. Breeding history may be of value in diagnosis of inherited diseases.

iii] Environment / Climate / Season :

The information pertaining to environmental temperature, humidity, rainfall etc. helps in diagnosis of certain diseases.

1.	High temperature (hot summer)	—	Heat stroke
2.	Extreme cold, windy weather	—	Hypothermia.
3.	High temperature and humidity	—	Endoparasites.
4.	High rainfall (monsoon)	—	Vector-borne diseases like Surra, Blue-tongue, Ephemeral fever.
5.	Sudden change in climate	—	H.S., Pneumonia.
6.	High rainfall following draught	—	Anthrax, Black-quarter.
7.	Prolonged draught	—	Vit. A and Phosphorus deficiency.

iv] General management :

Inadequate housing, ventilation and hygiene are possible causes of disease.

1.	Slippery floor	—	Fractures, Dislocation.
2.	Rough floor	—	Foot disorders.
3.	Over-crowding	—	Parasitic diseases, piglet/kid mortality.
4.	Inadequate ventilation	—	Pneumonia.
5.	Wet / damp floor	—	Coccidiosis, Foot rot.
6.	Unhygienic conditions	—	Colibacillosis, Salmonellosis, Mastitis.

2. EXAMINATION OF PATIENT

[A] INSPECTION

Inspection is a visual examination of the patient.

Prerequisites for better inspection of Animal :

1. It should be done preferably without taking the animal in trevis / crate or on examination table.
2. The animal should preferably be in standing posture during inspection.

3. It should be done from a distance to avoid unnecessary excitement of the patient. Some abnormalities are better seen from distance.
4. Inspection of animal from a distance should be followed by close examination.
5. It should be made from all sides through various angles.
6. Care should be taken to inspect each and every part of the animal body.
7. Clinician should have a keen observation power.
8. Clinician should have good knowledge of animal behaviour, normal posture, gait and appearance of each species.

The inspection comprises of the following :

1. Physical / Body condition :

The body condition is classified as normal, thin, emaciated, fatty or obese.

a) ***Normal*** **:** All the body prominences are adequately covered with flesh giving the body rounded appearance.

b) ***Thin*** **:** It is the state where the body prominences are visible but the animal is physiologically normal.

c) ***Emaciation*** **:** A condition characterised by markedly visible body prominences, deep supra-orbital fossa, lustreless, dry and leathery skin, pale mucous membrane and reduced work performance.

Common causes of emaciation :

1. Insufficient provision of feeds (Malnutrition)
2. Inadequate consumption of feed (FMD, Actinomycosis, Actinobacillosis)
3. Impaired digestion and absorption (Pancreatic defect, protein loosing enteropathy)
4. Disturbed metabolism (Ketosis)
5. Chronic debilitating diseases (T.B, J.D, Surra, CBPP)
6. Nutritional deficiency (P, CO, Cu, Fe, Zn, Na deficiency.)
7. Chronic systemic diseases (TRP, Pericarditis, pleurisy, DH, Vagus indigestion, Pyelonephritis)
8. Parasites (Parasitic gastroenteritis, Lice and Tick infestation.)
9. Old age
10. Disorders of endocrine gland

d) ***Fatty/Obesity*** **:** It is an abnormal state of health characterised by excessive deposition of body fat. It may produce disturbances like dyspnoea and difficulty in walking.

Causes of obesity.

1. Hereditary
2. High energy diet with minimum activity.
3. Hypothyroidism.
4. Castration in male and spaying in females.

2. Body confirmation /Appearance

The evaluation of body confirmation is based on symmetry, shape and relative size of different regions. The abnormalities in appearance and their indications are as follows:

1.	Stunted growth	Parasitic infestation,Undernutrition
2.	Bending of long bones	Rickets.
3.	Tucked up abdomen	Prolonged illness
4.	Swelling of joints	Arthritis.
5.	Gross distension of both sides	Advance pregnancy.
6.	Gradual distension of lower half of abdomen in late gestation	Hydroamnion
7.	Sudden distension of lower half of abdomen in late gestation	Hydroallantois.
8.	Papple shaped distension i.e. marked ..... distension of left abdomen and distension.. of lower half of right abdomen	Vagus indigestion, Diaphragmatic hernia.
9.	Marked distension of left flank	Tympany.
10.	Slight to moderate distension of right abdomen.	Intestinal obstruction.
11.	Bilateral distension of dorsal half of the abdomen	Pneumoperitoneum.

3. Posture :

Posture denotes anatomical configuration of animals when they remain in stationary condition i.e. standing, sitting or lying down.

Postural abnormalities can be of great help in disease diagnosis.

	Posture	***Disease / Disorder***
1.	Arching of back with the limb ..... tucked under the body	TRP, Pyelonephritis (Mild abdominal pain)
2.	Downward arching of back ..... and 'Saw Horse' straddling of legs	Severe abdominal pain
3.	Prolonged standing in cattle ..... and buffaloes	Pneumonia, Pleurisy and Pericarditis
4.	Abduction of elbows with ..... extension of head and neck	Pneumonia, Pleurisy and Pericarditis.
5.	Lateral deviation of head	Listeriosis and Gid
6.	A cow/buffalo adopting frog like posture ...	Bilateral hip dislocation.
7.	A cow/buffalo sitting on sternum and ... the head resting on flank	Milk fever
8.	A cow /buffalo keeping on knee/carpal.. joint and unable to stand	Osteomalacia, Rheumatic arthritis.

9. Listening attitude in sheep and goat	Early stages of Pregnancy toxaemia and Scrapie
10. Star gazing posture in goat	Polioencephalomalacia
11. "Frog-like" posture in sheep and goat ...	Parturient hypocalcaemia
12. A kid/lamb unable to extend knee	Arthritis
13. A horse shifting its weight ..... from one limb to another	Laminitis, Osteodystrophia fibrosa.
14. A horse adopting dog sitting ..... posture associated with rolling and kicking at belly	Acute gastric dilatation.
15. Typical rigid / wooden horse posture	Tetanus
16. A male dog urinating like bitch	Cystitis, Urolithiasis
17. A dog showing upward arching ..... of its back (kyphosis)	Accute nephritis
18. A dog sitting erect for a long period	Pneumonia
19. Abduction of forelimb with protrusion .. of scapulae above the line of wither	Muscular dystrophy.
20. Inability or lack of desire to rise	Muscle weakness, Pain in extremities-laminitis, Enzootic muscular dystrophy

4. Gait :

The clinician should ask the animal owner to move animal to and fro, as well as in either direction to know the abnormalities in gait.

Gait	*Disease / Disorder*
1. High stepping movement with ..... rigidity of limbs	Tetanus
2. Circling to either left or right side	Brain abscess / cyst / tumor, Gid. Ootitis, Listeriosis.
3. Circling on both sides	Ketosis, Pregnancy toxaemia, Hepatic insufficiency, Surra.
4. Goose-stepping gait	Pantothenic acid deficiency in pigs.
5. Jerky flexion or dropping of ..... affected hind limb	String halt (luxation of patella)
6. Compulsive walking in forward direction ..	Hepatic insufficiency.
7. Inco-ordination in gait	Ketosis, Liver disorders, Vit.B deficiency, Brain disorders, Surra.
8. Stiff gait	Arthritis, Laminitis, Rheumatism Myositis, Sprain, Osteomalacia. Traumatic pericarditis in cattle.
9. High stepping gait and bounding ..... form of progression	Louping ill.

10. Knuckling of fetlock joint	Neuritis, Nerve paralysis.
11. Sudden lameness	Accidental trauma, Nail pricking, Over stretching of tendon/ ligament/ muscle, Dislocation of joint or Fracture of bones.
12. Gradual increase in lameness	Osteomalacia, Fluorosis, Rickets, Osteoarthritis, Ageing process, Neoplasm in bones.

5. Behaviour / Demeanor :

Responsiveness of an individual animal towards a stimuli may be considered as a criteria to judge the behaviour of an animal.

The responses may be normal, decreased or increased.

a) ***Normal responses*** **:**

Normal animal react and respond very promptly against a stimuli with the movement of head, neck, eye, ear and tail.

b) ***Decreased responses*** **:**

1. *Dull or apathetic or depressed* : Animal remains recumbent and is unwilling to stand. It is commonly seen in febrile and toxaemic conditions.
2. *Dummy syndrome* : Animal remains standing and is able to move but doesn't respond at all to external stimuli. It seen in subacute lead poisoning, listeriosis, nervous form of ketosis in cattle and encephalomyelitis and hepatic cirrhosis in horse.
3. *Coma* : Animal is extremely depressed and unconscious. This is observed in severe toxaemia, in advance hypocalcaemia and terminal stages of hepatic, renal or cardiac failure.

c) ***Increased responses*** **:**

1. *Anxiety or Apprehension* : Animal appears alert and looks constantly and exhibit normal movement. It is seen in moderate constant pain or in early parturient paresis or in recent blindness.
2. *Restlessness* : It is more severe state in which movement is almost constant consisting of lying down, rolling, getting up again, looking at flanks, kicking at belly and groaning or bellowing. It indicates sharp intermittent or constant pain. It is commonly observed in equine colic and pyelonephritis.
3. *Mania* : It is characterised by aberration in behaviour.

The typical examples are as below :

a) Vigorous licking or biting the skin	Bovine Ketosis, Pseudorabies, Rabies
b) Head pressing	Meningitis
c) Compulsive walking in circle	Hepatic insufficiency.
d) Licking or chewing inanimate objects	Rabies.

4. *Frenzy* : It is characterised by wild and uncontrollable actions like restlessness, violent bulting, throwing straws or mud with horn, straining, biting tendency and vocalization.
This type of behaviour is seen in case of rabies, nervous form of ketosis, lead poisoning, encephalitis, meningitis, brain abscess and sunstroke.

6. Abnormal actions :

1. Reduced / absence or interference in prehension	Tetanus, Rabies, Listeriosis Painful conditions of neck, Fluorosis Paralysis of tongue, Foreign body in mouth, Osteomyelitis of jaw bones.
2. Reduced / absent / difficult mastication..	Tooth abnormalities, painful conditions of mouth
3. Pica (Abnormal/depraved appetite)	Phosphorus, Cu, CO or Salt def., Endoparasites, Gastritis, Ketosis
4. Cud droppings	Pharyngeal paralysis, Painful conditions of mouth, Tooth abnoramlities
5. Painful swallowing (dysphagia)	Pharyngitis, Oesophagitis, Calf diptheria, Strangles in horse.
6. Repeated swallowing movements ..... associated with flexion of neck and grunting	Partial oesophageal or pharyngeal obstruction.
7. Altempts at swallowing followed ..... by coughing up of feed or regurgitation through nostrils.	Oesophageal or pharyngeal obstruction, Pharyngeal paralysis
8. Excessive licking	Ketosis, Boredom, Salt deficiency, Water deprivation.
9. Straining	Constipation, Diarrhoea, Intussuception, Rectal paralysis or stenosis, Abortion, Metritis, Retention of placenta, Cystitis, Urethritis, Calculi
10. Involuntary defaecation	Severe diarrhoea, Paralysis of anal sphincter.
11. Frequent lifting of tail for defaecation ...	Intestinal obstruction.
12. Kicking at belly	Colic, Urolithiasis
13. Increase in frequency and volume of urine..	Diabetes mellitus, Sodium deficiency, Chronic nephrosis.
14. Frequent passage of small quantity of.... urine and the animal remains in urination posture for sometime after urination ceases.	Cystitis, Urethritis, Urolithiasis, Oxalate poisoning.

15. Coughing	Respiratory problem
16. Striking horn against wall	Horn cancer
17. Hoarse voice	Rabies
18. Voiceless bellowing	Rabies (Paralytic stage)
19. Yawning	Hepatic insufficiency, Digestive disturbance.
20. Persistent bellowing	Rabies, Colic, Nervous form of Ketosis.

7. Skin and hair coat :

The condition of body coat and skin indicate the state of health of animal.

a) *Hair coat* :

* Normal hair coat	Fine, lusterous, smooth and shining.
* Erection of hairs	Febrile condition, shivering, fear, excitement.
* Rough, lustreless, dry and coarse ..... hairs	Malnutrition, Chronic diseases like T.B., J.D.
* Loss of hair in summer season	Normal in some animal species
* Excessively long, coarse hairs ..... over dorsal and facial areas (Overgrowth of hairs i.e. hypertrichosis)	Malnutrition, Endoparasitism, Sequelae of FMD
* Straight and steely wool	Copper deficiency in sheep.
* Depigmentation of hair	Cu deficiency, Molybdenosis, J.D.
* Loss of hair (alopecia)	Mange, Ringworm, Eczema. Vit. A and Zn deficiency, Prolonged illness, Hypothyroidism and sertoli cell tumors in dogs.

b) *Condition of skin* :

* Normal skin	Smooth, soft, pliable and elastic
* Dryness of skin	Chronic skin diseases, Dehydration. Chronic diseases like T.B., J.D.
* Greasy skin	Seborrhoeic dermatitis.
* Tenting of skin	Dehydration.
* Skin adhered to subcutaneous ..... tissue and difficult to lift up	T.B., J.D., Diabetes mellitus, Malnutrition, Chronic parasitism.

c) *Colour of skin* :

* Reduced pigmentation of coat	Chronic diseases like J.D. Molybdenosis, Cu deficiency.
* Patchy depigmentation of ..... skin and hair.	Vitiligo, Albinism.

* Hyperpigmentation	Chronic skin diseases, Acanthoses nigricans in dog, Ovarian and testicular disorders, Chronic irritation.
* Yellow discolouration	Jaundice.
* Purplish discolouration of udder	Gangrenous mastitis.
* Bluish discolouration	Respiratory dyspnoea.
* Pallor of skin	Anaemia.
* Redness of skin	Acute dermatitis, Photosensitization Sunburn, Swine fever, Swine erysipelas.

d) Sweating :

* Normal sweating	Profuse in horse, moderate in cattle and little in buffalo
* Excessive sweating ..... (hyperhydrosis)	Equine colic, Azoturia, Exercise, Laminitis.
* Absence of sweating (non-sweating)...	Anhydrosis in horse.
* Decreased sweating	Severe diarrhoea, Continuous fever.

e) Skin lesions :

* Thickening and wrinkling of skin ...	Sarcoptic mange, Hyperkeratosis, Vit. A deficiency.
* Nodules and pustules over ..... head, face, neck & shoulder region	Demodicosis in cattle and goat.
* Reddening, oedema, exudation ..... and sloughing of skin mostly over dorsal parts of the body.	Photosensitization in cattle and buffaloes.
* Papules and scabs over nose & ear ...	Psoroptic mange in goat.
* Circumscribed scabs mostly on hairless. parts viz. axilla, udder, inguinal region.	Pox.
* Tenacious scabs around mouth	Ecthyma in goat and sheep
* Utricarial plaques/wheal over skin ...	Allergic reactions.
* Whitish asbestos like circular lesions ... mostly over head, face and neck.	Ringworm in calves, kids.
* Oozing skin lesions with matting of ..... hair particularly over back, rump, loin.	Eczema.
* Bilateral alopecia over trunk	Hypothyroidism in dog.
* Complete alopecia in newborn animals..	Goitre (Iodine deficiency)
* Dandruff/pitryiasis	Parasites, Vit. A deficiency, Chronic iodism Hyperkeratosis, Ringworm.

* **Pedunculated growths over body ..... Warts/papillomas.**
* **Nodules (pea to *amla* fruit size) on lateral aspect of foreleg and laterocaudal aspect of hock joint in cattle. ..... Skin Tuberculosis.**
* **Incomplete keratinization ..... Zinc deficiency, Ca excess.**
* **Itching (pawing, biting, licking and scratching) ..... Mange, Lice, Fleas (peripheral origin), Scrapie in sheep, Pseudorabies, Ketosis (central origin)**
* **Pawing of the ear with hindleg in dog... Otodectic mange.**
* **Pawing at mouth in dogs ..... Foreign body in mouth.**
* **Rubbing of anus against wall. ..... *Oxyuris equi* in horse.**
* **Rubbing of anus on ground ..... Tapeworms in dog.**

[B] GENERAL CLINICAL EXAMINATION

I. TEMPERATURE

* Recording of body temperature assists in -

1. Establishing diagnosis of febrile diseases.
2. Determining the progress and fate of disease.

* Site for recording of body temperature in domestic animals is *rectum.*
* It may be recorded in vagina in female but the vaginal temperature is 1°F higher than rectal temperature.
* Clinical thermometer ranging between 94°F to 110°F is used for recording body temperature.

Technique :

1. Clean thermometer with antiseptic solution.
2. Shake it to bring down mercury column to the lowest point.
3. Lubricate the bulb end of thermometer with liquid paraffin or vaseline particularly in case of small pup and kitten.
4. Introduce the thermometer in rectum and then tilt it towards lateral side to bring the bulb of thermometer in contact with rectal mucous membrane.
5. Keep the thermometer in site for at least 1 minute, then remove and read the temperature.

Precautions :

1. Animal should be given rest for atleast ½ hour, if it has travelled a long distance.
2. Animal should not be given hot or cool water prior to recording of temperature.
3. Animal should not be excited or frightened as far as possible.
4. The bulb of thermometer must touch the rectal mucosa.

Factors affecting body temperature :

1. ***Species*** **: In smaller species there is high body temperature.**
2. ***Breed*** **: Pure or crossbred animals have higher body temperature than local breeds.**
3. ***Sex*** **: Females have slightly higher body temperature than males.**
4. ***Age*** **: Young animals have more body temperature than adults.**
5. ***Body weight*** **: Higher the body weight, lower is the body temperature.**
6. ***Pregnancy*** **: There is rise in temperature towards end of gestation, whereas in bitches there is decrease in body temperature just before whelping.**
7. ***Oestrus*** **: Animals in heat have elevated body temperature.**
8. ***Diurnal variation*** **: The body temperature at evening is usually higher than at morning.**
9. ***Climate*** **: Hot - humid climate increases body temperature.**
10. ***Excitement, fever, pain, exercise may elevate body temperature.***

Degree of body temperature :

1. ***Mild*** **: Body temperature is above normal by 1-2°F.**
2. ***Moderate*** **: Body temperature is above normal by 3-4°F.**
3. ***High*** **: Body temperature is above normal by 5-6°F.**

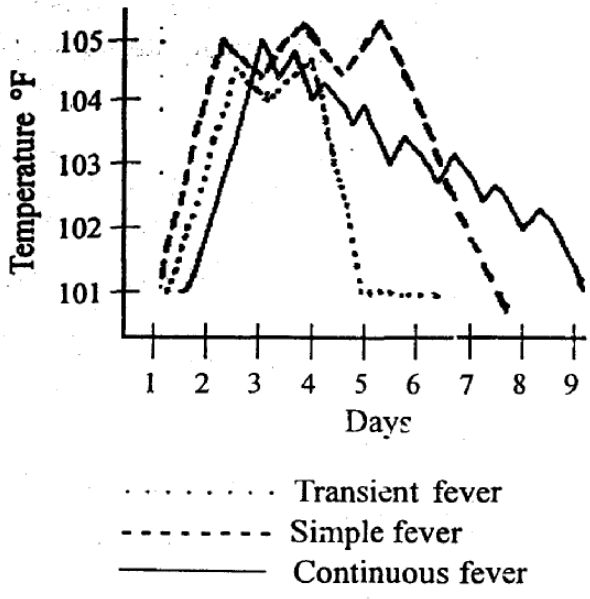
Clinical manifestations of body temperature **:**

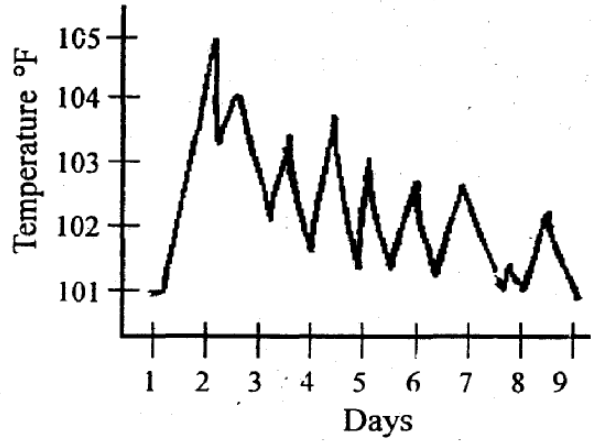
1. ***Hypothermia*** **: It means subnormal body temperature. It is observed in toxaemia, shock, circulatory collapse, milk fever, ruminal impaction, debility, diarrhoea, extreme cold environment.**
2. ***Hyperthermia*** **: It means the elevation of body temperature above critical point due to physical factors such as exercise and high environmental temperature. It is observed in heat stroke.**
3. ***Fever / Pyrexia*** **: It is stage wherein hyperthermia is combined with toxaemia. It is usually observed in infectious diseases.**

Types of fever :

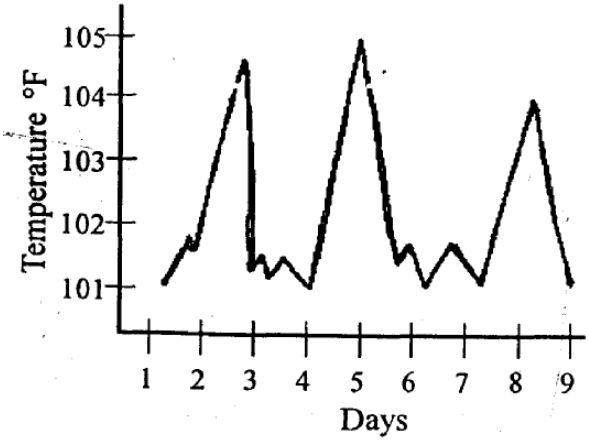
1. ***Transient fever*** **: Fever subsides within 24-48 hrs. after its development e.g. Bovine ephemeral fever.**
2. ***Simple fever*** **: Temperature rises and remains elevated with variation less than 1°C (2°F) for several days. e.g. Lobar pneumonia.**
3. ***Continuous fever*** **: Temperature remains elevated for longer period than in simple fever e.g. Theileriasis, Traumatic pericarditis.**
4. ***Remittent fever*** **: Temperature rises and falls by more than 1°C (2°F) at short and irregular interval.**
   e.g. Bronchopneumonia and urinary tract infection.
5. ***Intermittent fever*** **: Regular brief attacks of fever for 2-3 days with non-febrile periods. e.g. Equine infectious anaemia, Canine distemper.**

6. ***Recurrent fever*** : Prolonged attack of fever with non-febrile periods of equal duration.
7. ***Undulant fever*** : Prolonged attacks of high and mild fever at irregular interval. e.g. Brucellosis.
8. ***Atypical fever*** : Febrile reaction is irregular. e.g. Swine erysipelas, strangles
9. ***Biphasic fever*** : It is characterised by initial rise followed by a fall to normal and then a secondary rise. e.g. Canine distemper.





Remittent fever



Intermittent fever

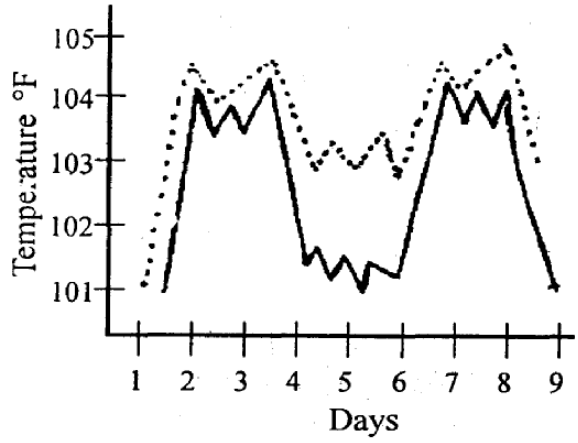


Fig - 18.1 : Types of fever.

II. RESPIRATION

Recording of respiration helps :

1. To assess respiratory tract functioning.
2. To know prognosis of various disease conditions.

Methods of counting respiration rate :

1. By observing the movement of rib - cage and flank.
2. By holding backside of palm against nostril.
3. By auscultation of thorax and trachea.

The following parameters are to be recorded after careful examination of respiration.

a) Rate or frequency of respiration :

Respiration rate can be defined as number of respiratory cycles per minute.

1. ***Eupnoea*** :Normal quiet breathing.
2. ***Polypnoea*** : Increase in respiration rate with reduction in depth. It is noted in fever, heart diseases, pleurisy, pneumonia, peritonitis, anemia.
3. ***Oligopnoea*** : Decreased rate of respiration. It is observed in uraemia, brain tumor / cyst / abscess, stenosis of upper respiratory tract.
4. ***Apnoea*** : Complete cessation of respiration. It is seen during terminal stage of disease and in respiratory failure.

Factors affecting rate of respiration :

1. *Species* : Respiration rate varies from species to species.
2. *Excitement, exercise, fear, stress* increases respiration rate.
3. *Climate* : High environmental temperature and humidity increases respiration rate.
4. *Young and small animals* have higher respiration rate.
5. *Obesity* increases the respiration rate.

b) Types of Respiration :

1. ***Thoracic / Costal*** : Thoracic muscles are predominantly involved in the process of respiration. It is observed in healthy dog and cat.
2. ***Thoraco-abdominal / Costo-abdominal*** : Both thoracic and abdominal muscles are equally involved in the process of respiration. It is normally seen in horse.
3. ***Abdominal***:Abdominal muscles are predominantly involved in the process of respiration. It is observed in healthy cattle, buffalo, sheep & goat.

* ***Wholly Thoracic respiration*** is observed in ascites, ruminal tympany, peritonitis and disorders of diaphragm.
* ***Wholly Abdominal respiration*** is observed in pleurisy, severe pneumonia, lung emphysema, pulmonary oedema, traumatic pericarditis and pharyngeal obstruction.

c) Respiration Rhythm :

* ***Respiration cycle consist of 3 phases*** **:**
  1) Inspiration 2) Pause 3) Expiration
* Normally the inspiratory period is shorter than expiratory period.
* ***Inspiratory period*** is prolonged in stenosis of respiratory tract.
  e.g. Nasal granuloma.
* ***Pause*** is absent or shortened in lung diseases.
* ***Expiratory period*** is prolonged in pulmonary emphysema.

d) Respiration depth / Amplitude / Quality :

* Respiration may be shallow or deep.
* ***Hyperpnoea*** i.e. increased depth of respiration is seen in anoxia, haemorrhage pulmonary congestion, emphysema, oedema and congestive heart failure.
* The depth of respiration is reduced in pneumonia, pleurisy, pericarditis, shock, heat stroke, grain overload and acidosis.

Cheyne - stokes Respiration **:**

It is characterised by gradual increase and then gradual decrease in depth of respiration, that ends in pause (apnoea).

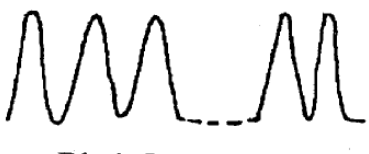
It is seen in advance cases of renal and cardiac disorders, severe toxaemia pulmonary insufficiency and space - occupying lesion in brain.

Biot's Respiration **:**

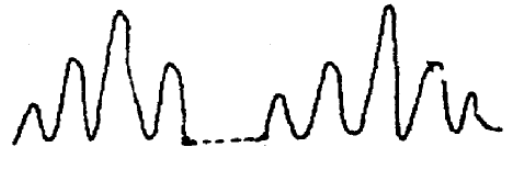
It is characterised by alternating periods of polypnoea and apnoea. It is seen in meningitis, encephalitis, heat stroke and poisoning.

Syncoptic respiration **:**

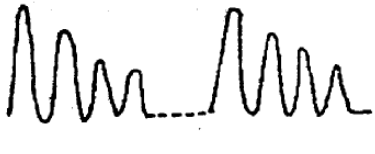
It is characterised by apnoea (pause) followed by hyperpnoea (deep breathing) which gradually becomes shallow till apnoea develops. This is serious condition indicating irreversible damage of respiratory centre.



Biot's Respiration



Cheyne - stokes Respiration



Syncoptic respiration

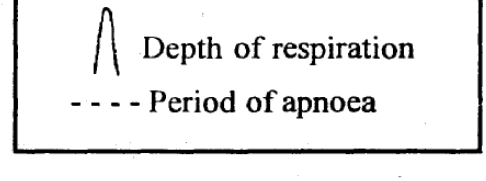


Fig. - 18.2 : Types of respiration

***Dyspnoea* :**

* It means difficult breathing.
* Very deep breathing is manifested as dyspnoea.
* Dyspnoea may be inspiratory or expiratory.
* *Inspiratory dyspnoea* is observed in pneumonia, pulmonary oedema, pleurisy and HCN poisoning.
* *Expiratory dyspnoea* is observed in pulmonary emphysema.

Respiratory noises :

1. ***Sneezing*** **:** It is due to nasal irritation e.g. Rhinitis.
2. ***Snoring*** **:** It is due to pharyngeal obstruction / stenosis.
3. ***Roaring*** **:** It is due to laryngeal stenosis.
4. ***Wheezing*** **:** It is due to stenosis of bronchi e.g. Asthma.
5. ***Coughing*** **:** It is due to irritation of respiratory tract mucosa.
6. ***Grunting (Groaning)*** **:** It is due to forceful expiration with closed glottis e.g. pleurisy, pneumonia, pericarditis, TRP.
7. ***Yawning*** **:** It is prolonged inspiration with widely open mouth and raised soft palate. e.g. Diseases of C.N.S., hepatitis, gastritis.
8. ***Hiccough*** **:** Repeated short jerkey respiration due to irritation of phrenic nerve. It is due to spasmodic contraction of diaphragm.

III. PULSE

Pulse is the expansion and elongation of arterial wall imparted by the column of arterial blood due to contraction of left ventricle.

Importance of recording pulse :

1. It helps to know the state of cardiovascular system.
2. It also assist in giving prognosis of disease.

Sites for recording pulse :

1. Horse :	1. *External maxillary artery* located on medial aspect of ventral border of mandible. 2. *Median artery* located on median aspect of foreleg at upper extremity.
2. Cattle and Buffalo :	1. *Middle coccygeal artery* located on ventral aspect of tail, 8-10 cm away from the base. 2. *Median artery* in foreleg.
3. Sheep, Goat, Pig, Dog, Cat, Calf :	Femoral artery high up in inguinal region on medial aspect of thigh.

Technique :

* Animal should not be disturbed prior to pulse recording.
* Pulse is recorded by means of digital feeling.
* Normally there is a pulse for each heart beat.
* Pulse should be recorded for atleast 30 seconds to 1 minute.

* The artery is held in position against bone with the help of index finger.
* The pulse rate is counted with the help of ball of middle finger.
* The size and strength of pulse is felt with the help of ball of index finger.
* A full pressure with index finger helps in obliteration of pulse wave.
* In the examination of pulse, following properties should always be noted.
  a) Pulse rate / frequency. b) Pulse rhythm. c) Pulse quality.

a) Pulse rate :

It indicates number of beats per minute.

1. ***Frequent / Rapid pulse*** **:** Pulse rate exceeds the normal range. It is observed in febrile diseases, toxaemia, septicaemia, painful conditions (colic, laminitis, fracture) severe anaemia and circulatory failure.
2. ***Infrequent/ slow pulse*** **:** Pulse rate is below the normal range. It is observed in jaundice, space occupying lesions of brain, partial or complete heart block, comatose condition, diaphragmatic hernia, vagus indigestion.

Physiological factors affecting pulse rate **:**

1. *Species* : Normal pulse rate differs from species to species.
2. *Size* : Bigger the body size, lesser is the pulse rate.
3. *Age* : In young animals, pulse is higher than adult one.
4. *Sex* : Males have less pulse rate than the females.
5. *Pregnancy* : Pregnant animals have more pulse rate than nonpregnant.
6. *Lactation* : High - yielding animals have more pulse rate than low-yielders.
7. *Parturition* : At the time of parturition pulse rate is increased.
8. *Excitement, exercise and pain* leads to increase in pulse rate.
9. *Ingestion of food and rumination* : Pulse rate is increased.
10. *Posture* : Pulse rate is slow in recumbency whereas fast in standing.
11. *Environmental temperature* : Exposure to either very high or very low temperature increases pulse rate.

b) Pulse rhythm :

It indicates regularity of pulse waves within the defined period.

1. ***Regular pulse*** **:** The interval between successive pulse wave is constant.
2. ***Irregular pulse*** **:** The interval between successive pulse wave is variable or different. It is observed in case of severe toxaemia, febrile diseases, pneumonia, myocarditis, atrial fibrillation, atrial flutter, sinus arrhythmia, heart block.

c) Pulse quality :

It is assessed on the basis of size and strength of pulse wave.

* *Size* indicates the height or amplitude of pulse wave. It is measured on the basis of lifting of finger by pulse wave.
* *Strength* denotes finger pressure required to obliterate the pulse wave.

Based on strength and size, pulse is classified as :

1. ***Small pulse*** : Artery is poorly distended i.e. empty. The height of pulse wave is smaller than the normal.
2. ***Weak pulse*** : Pulse wave can be easily obliterated by finger pressure. *A small weak pulse indicates reduced cardiac stroke volume and is usually observed in myocardial asthenia and mitral incompetence.*
3. ***Large pulse*** : Artery is extensively distended i.e. full. The height of pulse wave is larger than normal.
4. ***Strong pulse*** : Pulse wave can not be easily obliterated by finger pressure. *A large, strong pulse indicates increased cardiac stroke volume and is usually observed in cases of hypertension.*
5. ***Wiry pulse*** : Pulse is small, hard and quick or rapid. It may result due to vasoconstriction.
   e.g. Acute pleurisy, acute pericarditis, acute peritonitis and volvulus.
6. ***Thready pulse*** : Pulse is small, weak and rapid. It indicates the grave condition.
7. ***Large bounding or water-hammer pulse***: Pulse is large and rapid. Pulse pressure rises rapidly and then decreases quickly. e.g. Anaemia, insufficiency of aortic semilunar valve, patent ductus arteriosus.

Jugular pulse :

It may be true or false

1. ***True or positive jugular pulse*** : It can be obliterated by pressure. It is observed in case of TRP and incompetence of tricuspid valve. It is characterised by distension of jugular vein and brisket oedema.
2. ***False or negative jugular pulse*** : It can not be obliterated by pressure. It is observed in case of lean animal due to pulse wave of underlying carotid artery.

Table - 18.1 : Normal Clinical Values

Species	Temperature °F	Temperature °C	Pulse rate/ minute	Respiration / minute	Ruminal motility/5min
1. Cattle	100-102.5	37.8-39.2	45-60	16-22	8
2. Calf	101.5-103.5	38.6-39.8	80-100	27-30	-
3. Buffalo	99-102	37.2-38.9	42-62	22-28	8-11
4. Goat, Sheep	101.5-103.5	38.6-39.8	60-70	20-30	7-8
5. Pig	100-102	37.8-39.2	60-90	16-18	-
6. Horse	99-100.5	37.2-38.0	33-41	10-15	-
7. Dog (Large)	99.5-101.5	37.5-38.0	70-90	15-25	-
8. Dog (Small)	101.5-102.5	38.6-39.2	90-120	20-30	-
9. Fowl	105.8-107.6	41.0-42.0	130-160	15-30	-

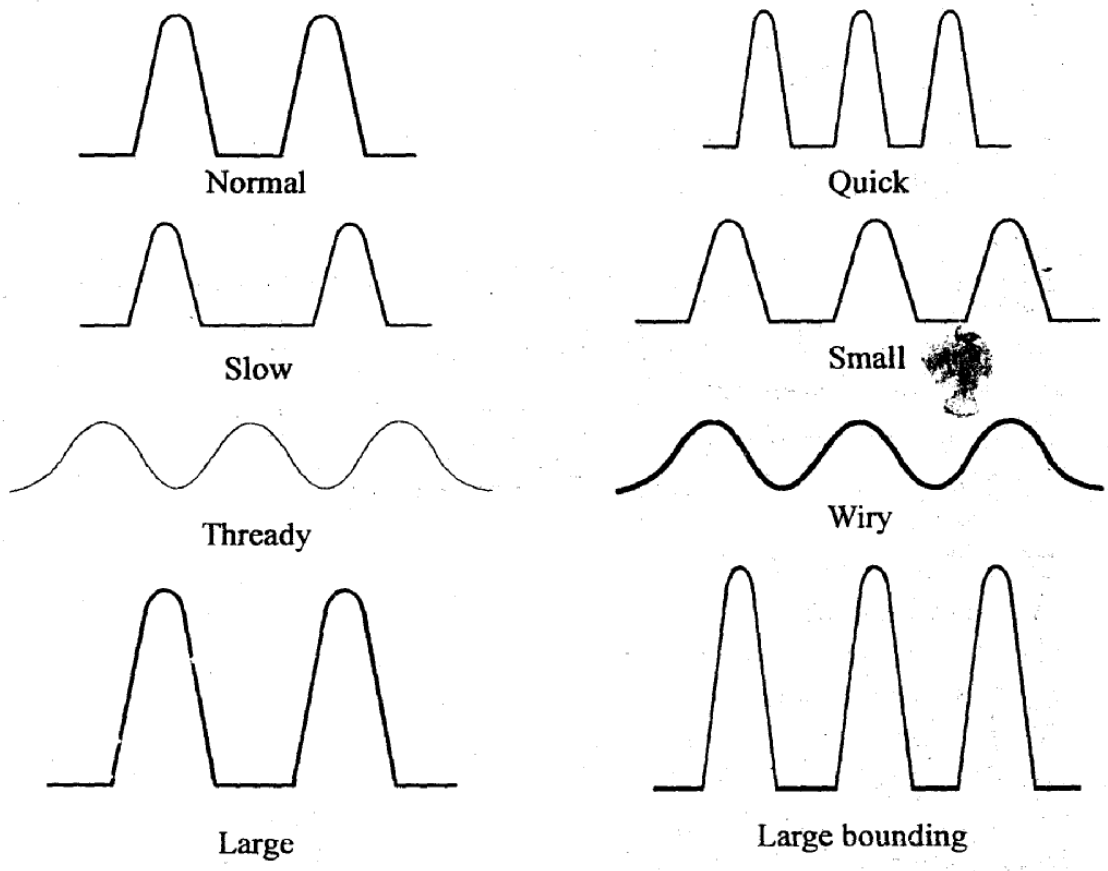


Fig - 18.3 : Types of Pulse

[C] PHYSICAL EXAMINATION

The common methods of physical examination are as follows :

I. Palpation.
II. Percussion.
III. Auscultation.

The accuracy of physical examination depends on clinicians own patience, persuasiveness and experience.

I. PALPATION :

Palpation is the act of handling the tissues, organs or parts of body of animal.

Importance of palpation :

1. It helps to determine the shape, size, presence and intensity of pain, consistency, temperature and sensitivity of a lesion or organ.
2. It is useful in recording of pulse.
3. Rectal palpation helps to detect abnormalities of abdominal and urogenital organs.

Types of palpation :

1. ***Direct palpation*** : It is done with finger tips or palm.
2. ***Indirect palpation*** : It is done with a probe or catheter or any such instrument.

Points to be considered during palpation :

1. Palpation of internal organs can be easily performed in small and medium sized animals.
2. It is difficult to palpate internal organs in cattle, buffalo and horse due to their large body size.
3. Animal should be in standing position while performing palpation.
4. The clinician should approach and reach to the animal very politely and slowly.
5. Palpation should be initiated from the adjacent part of the lesion and then actual lesion is palpated.

Types of consistency on the basis of palpation :

1. ***Doughy*** : The structure retains finger prints or pits on pressure .
   e.g. Oedema, Rumen impaction.
2. ***Firm*** : The consistency of structure is liver or muscle like.
   e.g. Neoplasm, abscess.
3. ***Hard*** : The consistency of structure is bone like
   e.g Exostosis of bone.
4. ***Fluctuating*** : The structure is soft, elastic and undulates on pressure but doesn't retain finger prints.
   e.g. Cyst, Hygroma, Haematoma, Mature abscess.
5. ***Emphysematous*** : The structure is puffy, swollen and produces crepitating or crackling sound on pressure.
   e.g. Subcutaneous emphysema, Black quarter.
6. ***Resilient*** : The structure quickly returns to normal position as soon as the pressure is withdrawn. e.g. Ascites.

Abnormalities detectable on inspection and palpation :

1.	General swelling of whole body which is painless and doughy (Anasarca)	Malnutrition, Cirrhosis of liver, Parasitism, Congestive heart failure.
2.	Hard swelling over bone or joint	Osteoarthritis, Exostosis
3.	Painful swelling of joints	Arthritis.
4.	Painless, fluctuating swelling over knee, elbow or hock joint	Hygroma.
5.	Firm swelling over chest just behind elbow on right side	Foreign body abscess in bovines.
6.	Acute crepitating swelling over shoulder / thigh and rump	Black Quarter (B.Q.)
7.	Progressive (slightly crepitating) swelling over upper portion (Shoulder/thigh) of limb ascended from lower part	Snake bite.

8. Oedematous swelling in perineal region ..	Oxalate poisoning, Renal oedema
9. Subcutaneous emphysema.	B.Q. in cattle and buffalo, Malignant oedema in sheep and horse. Leakage of air from rumen, oesophagus, intestine and lung due to trauma/surgical operation, Penetrating wound in the skin.
10. Soft reducible swelling with ..... evidence of hernial ring at umbilicus	Umbilical hernia.
11. Soft reducible swelling with ..... evidence of hernial ring over abdomen	Ventral hernia.
12. Firm / soft non-reducible swelling ..... at umbilicus in newborn animals.	Umbilical abscess (immature / mature).
13. Swelling over urethra in between ..... scrotum and umbilicus in male	Water-belly (Rupture of urethra).
14. Oedematous swelling extending ..... from udder towards umbilicus with variable degree of congestion of udder few days before parturition	Udder oedema.

II. PERCUSSION :

Percussion is an act performed by striking or tapping a part of the body.

* The purpose is to produce an audible resonance which will provide valuable information regarding the position, size and consistency of structure which has been struck.
* It is of limited value in buffalo and fatty animals.
* It may not be useful in diagnosis of disease conditions of deep seated organs.

Types of percussion

Percussion is of two types :-

1. ***Direct or immediate percussion*** : It is made by striking a part directly with finger tips or plexor.
2. ***Indirect or mediate percussion*** : It is conducted by keeping the fingers of the left hand flat on the region and striking it with flexed middle finger of right hand or by keeping pleximeter on the region and striking it with plexor.

Types of mediate percussion :

a) ***Acoustic percussion*** **:**

* It is done by using a small soft-tipped acoustic hammer to obtain different percussion responses.
* It is performed by keeping the pleximeter firmly pressed against the chest wall with left hand and then tapping adequately hard on pleximeter with the plexor/hammer.

* *Advantage* : It is possible to make a harder and deeper tap than the immediate percussion.

Prerequisites for satisfactory acoustic percussion :

1. It should be done in closed room.
2. The animal must be calm, quiet and in standing posture.
3. The pleximeter should be in close contact with skin.
4. The hammer should be held loosely between thumb and index finger.
5. The hammer should be held at high level to the pleximeter and the stroke is made perpendicular to the pleximeter.
6. The hand should be moved at wrist and the forearm is kept firm during hammering.
7. The stroke should be sharp and clear.
8. Usually 3 strokes not too close together are sufficient for getting clear percussion response.
9. It is better to percuss corresponding parts on each side of the body.
10. The stroke should not be heavier than necessary.

b) *Pain seeking percussion* :

1. It is carried out with heavy hammer having a nylon head.
2. The hammer is applied with short strokes starting with light blows.
3. It helps to locate the area of increased tenderness / pain.
4. It is useful in diagnosis of TRP in bovines.

Percussion Sounds

1. ***Dull sound*** : The sound produced by solid organs like heart and liver.
2. ***Resonant sound*** : The sound produced by organs containing air. It is observed over normal lung tissue where alveoli are filled with air.
3. ***Tympanic sound*** : The drum-like sound produced by organs containing gas under pressure. It is observed in tympany.

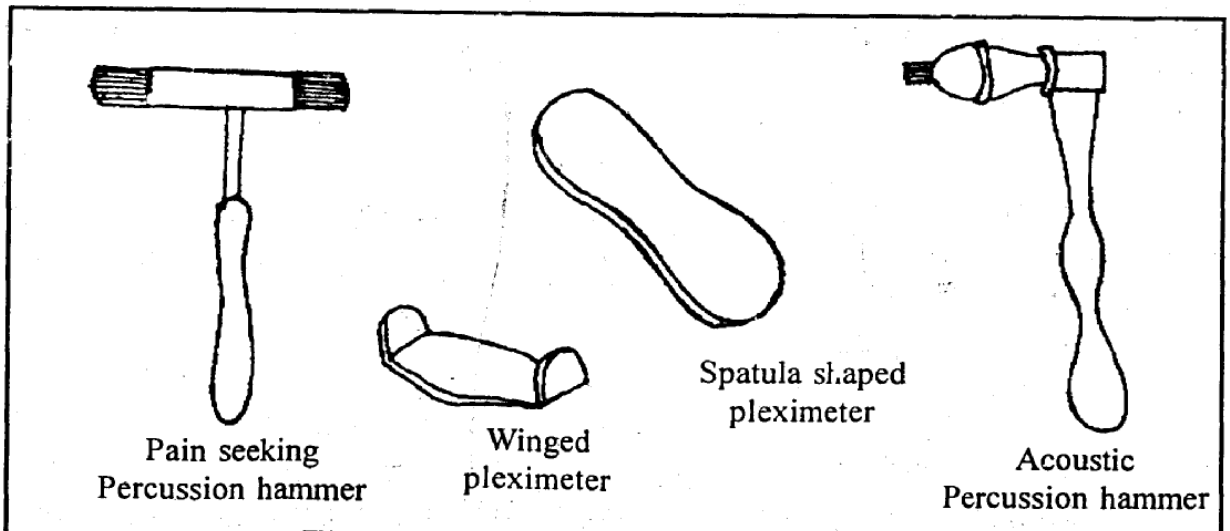


Fig. - 18.4 : Instruments for Percussion

4. ***Subtympanic sound*** **: It is low-pitched tympanic sound. It is observed over dorsal part of normal rumen, upper loop of intestine and also over emphysematous areas of lungs.**
5. ***Metallic sound*** **: It is high - pitched tympanic sound. It is usually observed in severe bloat.**

Modified Percussion

a) ***Ballottement*** **:**

1. This technique is used for floating viscera or masses in abdominal cavity.
2. In this technique, a firm push is given on abdominal wall with clenched fist or extended fingers to move away the underlying organ or mass and then rebounce of that organ/mass is felt with finger tips.
3. It helps in detection of pregnancy, large tumors and abscesses in the abdominal cavity.
4. The simultaneous ballottement and auscultation of the flanks in cattle is useful for detecting fluid splashing sounds. Fluid splashing sounds on left side indicates carbohydrate engorgement or left abomasal displacement where as fluid splashing sounds on right side suggest intestinal obstruction, caecal dilatation and paralytic ileus.

b) ***Tactile / fluid percussion*** **:**

* It includes percussion of abdominal wall on one side and detecting the fluid wave through palpation on other side.
* It is helpful in determining the fluid in peritoneal cavity e.g. ascites, uroperitoneum.

III. AUSCULTATION :

Auscultation is method of listening / hearing functional sounds produced by some internal organs.

Auscultation is useful for examination of lung, pleura, trachea, heart and certain parts of digestive system.

Types of auscultation :

1. ***Direct / Immediate Auscultation*** **:**

* It is done by placing the ear on the body surface over the organ to be examined.
* This method is less useful in non-cooperative animals.

2. ***Indirect / Mediate Auscultation*** **:**

* It is done with the help of stethoscope or phonendoscope.
* This technique is superior to direct method.

a) *Stethoscope* : It has 3 parts.

1. Chest piece with diaphragm
2. Connecting /conduction tubes
3. Ear pieces - 2 in number.

b. *Phonendoscope* : (Phone - Modified sound, Scope - Examination)

1. It is special form of stethoscope commonly employed in veterinary practice.
2. It comprises 2 ear pieces, connected to the chest piece by 2 rubber tubes and chest piece with diaphragm and rubber ring.
3. The chest piece (with diaphragm and rubber beading) is designed to make the animal's skin to act as second diaphragm.
4. The chest piece connected by 2 rubber tubes at specific angles amplifies the sounds.
5. The double diaphragm system helps in the precise localization and amplification of sounds.
6. The rubber ring also minimises frictional sounds.

* **Pre-requisites for satisfactory auscultation :**

1. The animal should be calm, quiet and in standing posture.
2. The place should be quiet and free of fast wind.
3. The chest piece should be firmly held against the body surface to avoid friction sound.
4. It is better to moisten the area to be examined.
5. Open bell shaped chest piece is used for detecting low pitch sounds and diaphragm for high pitch sounds.
6. In large animals, it is better to use the phonendoscope with diaphragm having 5 cm. diameter and rubber bell chest pieces.

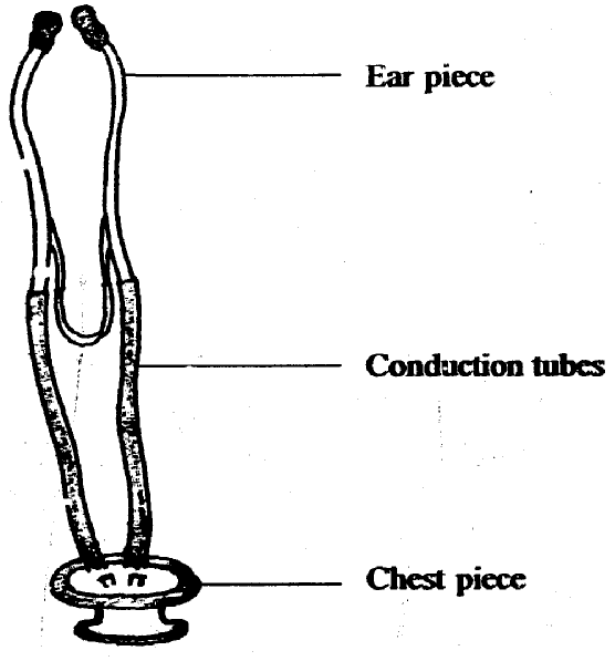


Fig. - 18.5 : Phonendoscope

[D] REGIONAL CLINICAL EXAMINATION

1. Examination of Head and Neck.

The examination of head and neck region includes examination of mouth cavity, nostrils, eyes, ears, horns and lymph glands.

The following abnormalities can be detected on general examination of head and neck regions.

1.	Doming of the forehead in newborn animal	Congenital hydrocephalus
2.	Swelling of facial bones	Frontal sinusitis in horse
3.	Hard, immovable swelling of maxillae and mandibles	Osteodystrophia fibrosa in horse and Actinomycosis in cattle.
4.	Swelling in submandibular region	
	a) Soft, doughy, painless (non-inflammatory)	Malnutrition, Parasitism, Anaemia Facioliasis, Strongylosis, J.D.
	b) Acute submandibular swelling ...	Haemorrhagic Septicaemia
	c) Swelling in the intermandibular space	Glossitis, Actinobacillosis
5.	Swelling of cheeks usually unilateral in adult or old animals.	Accumulation of cud, due to tooth abnormalities, Foreign body jammed between cheek and tooth, Unilateral facial paralysis.
6.	Swelling of cheeks usually bilateral in calves	Necrotic stomatitis.
7.	Swelling of head and face extending from muzzle / muffle	Snake bite
8.	Circumscribed firm/soft swelling over head and face ...	Abscess
9.	Firm swelling below the base of ear....	Parotitis
10.	Fluid filled swelling on lateral side of face	Sialolith, Salivary mucocoele
11.	Enlargement of thyroid gland	Goitre
12.	Local or general enlargement of oesophagus associated with vomiting or dysphagia	Oesophageal obstruction, stenosis, paralysis.
13.	Bilateral engorgement of jugular vein	Right sided congestive heart failure
14.	Firm, painful swelling over neck....	Yoke gall
15.	Swelling of prescapular lymphnodes...	Theileriasis, Neoplasms of lymphnode

16. Swelling in brisket region :

a) Brisket oedema ie. diffuse, soft, doughy, painless swelling	Pericarditis
b) Diffuse, firm/doughy, slightly painful swelling with or without itching.	Insect bite, Plant stings, Snake bite
c) Circumscribed firm swelling	Tumour, haematoma or immature abscess.
d) Circumscribed fluctuating swelling	Cyst or mature abscess
17. Opisthotonus	Tetanus, Strychnine poisoning, Lead Poisoning, Hypomagnesium tetany, Encephalitis, polioencephalomalacia
18. Lateral deviation of neck	Listeriosis
19. Inability to lower down head	Sprain in neck region
20. Deviation or asymmetry of horn or increased diameter of horn at base	Horn cancer

Mouth

The mouth cavity is examined for buccal mucous membrane, the odour of mouth and the condition of teeth.

1. ***Quantity of Saliva*** :

*	Ropy excess salivation with chewing movements	Stomatitis, FMD, MD, Actinobacillosis, Foreign body in mouth.
*	Excessive salivation	Nervous disorders, Rabies, Lead poisoning.
*	Dryness of mouth	Dehydration, Excess belladona, High levels of urea.

2. ***Oral lesions*** :

*	Vesicles and ulcer formation	FMD, VS, VE
*	Erosive necrotic lesions covered with bran-like deposits	PPR, RP
*	Ulcerative lesions on dental pad and tongue in sheep	Blue tongue
*	Diffuse, patchy areas covered with whitish film	Mycotic stomatitis.
*	Wart like lesions over lips, cheeks, tongue	Oral papillomatosis
*	Dark red coloured papules (0.5-1cm) on buccal mucosa	Bovine papular stomatitis.

3. ***Smell*** :

* Offensive smell	Teeth decay, Lung gangrene, Interstitial nephritis.
* Sour smell	Chronic indigestion, Necrotic stomatitis
* Fruity sweet smell	ketosis

4. ***Tongue*** :

* Hard i.e. Wooden tongue	Actinobacillosis
* Velvety tongue	Fungal infection
* Whitish coat over tongue in dog	Indigestion
* Copper coloured tongue in dog	Toxaemia, Uraemia
* Reduction in mobility and occasionally size of tongue	Paralysis
* Cyst beneath the tongue close to frenum linguae	Ranula

5. ***Teeth*** :

* Delayed eruption and uneven wear..	Deficiency of Ca, P, Vit D
* Excessive wear with mottling and pitting of enamel	Fluorosis
* Enlarged and irregular molars	Old age
* Irregular wear and tear	Sharp/step formed/wave formed molars.

6. ***Disturbances of eating and drinking*** :

* Partial reduction in appetite (Inappetence)	Most GI disorders, Mineral deficiencies, Fever, Toxaemia Haemoglobinuria, Ketosis
* Lack of appetite (Anorexia)	Severe toxaemia, High fever, Acute severe diseases.
* Selective appetite (Refusal of concentrates)	Ketosis, Abomasal displacement, Diaphragmatic hernia.
* Increased appetite (Hyperorexia) & increased feed intake (Polyphagia)	Pancreatic deficiency, Parasitic load Chronic gastritis, Functional diarrhoea, Diabetes mellitus
* Abnormal appetite (pica) (Eating faeces, chewing bones eating soil, excessive coat licking, litter eating)	Phosphorus, salt or cobalt deficiency Chronic gastritis, Parasites, Rabies, Ketosis, Hypoproteinaemia , Vit B deficiency., Inadequate feed, Lack of fibrous food in diet.

*	Increased consumption of water (Polydipsia)	Dehydration, Persistent vomiting, Diabetes, Chronic interstitial nephritis in dog, Initial stage of fever.
*	Decreased consumption of water (Adipsia)	Cold climate, Toxaemia, Fever
*	Quidding / Cud dropping	Salt/phosphorus deficiency Painful conditions of the mouth, Pharyngeal paralysis, Sharp molars.
*	Regurgitation of food/water through nostrils	Pharyngitis, Pharyngeal nerve paralysis, Oesophageal obstruction, Cleft palate
*	Difficulty in prehension or mastication	Facial paralysis, Fracture of mandible Foreign body in oral cavity.

Eyes

1. ***Eyeball*** :

*	Sunken eyeball	Dehydration, Extreme malnutrition, Emaciation.
*	Exopthalmus (protrusion of eyeball)	Acute theileriasis in calves, Iodine deficiency, Hyperthyroidism, Glaucoma, Trauma to orbit, Tumour in peri-orbital region.
*	Nystagmus (abnormal rotation of eyeball)	Coma, Poisoning, General anaesthesia.
*	Growths on eyeball	Eye cancer

2. ***Ocular discharge*** :

*	Watery	Obstruction of the lacrimal duct (Dacrocystitis)
*	Serous	Early stages of inflammation
*	Purulent	Later stages of inflammation
*	Unilateral discharge	Local inflammation
*	Bilateral discharge	Systemic diseases

3. ***Vision*** :

*	Night blindness (Nyctalopia)	Vit A deficiency
*	Congenital blindness	May be due to vit A deficiency in dam
*	Blindness	Brain abscess/ Tumour/ Cyst, Gid, Meningitis, Ketosis, Surra, Electrocution / Lightning stroke, Poisonings (lead/ selenium/ salt)

4. *Eyelids* :

*	Increased movements of eyelids.....	Painful eye conditions, Lead poisoning, Encephalitis, Hypomagnesaemia.
*	Closure of eyelids (photophobia)	Painful eye conditions, Acute conjunctivitis, Keratitis, Local oedema due to photosensitization or allergy, insect bite.
*	Blepharospasm	Irritation of cornea / conjunctiva by foreign body.
*	Protrusion of third eyelid :	
	a) On tapping lightly under the jaw....	Tetanus
	b) Continuous protrusion	Painful eye conditions and later stages of encephalitis and tetanus.
*	Inversion of eyelid (entropion)	Congenital or trauma to the orbicularis oculi muscle
*	Blepharitis	Canine distemper, Canine demodicosis.
*	Drooping of upper eyelid (ptosis) ...	Facial nerve paralysis
*	Chemosis or oedema of eyelid	Acute conjunctivitis, Insect bite, Allergy

5. *Eye lashes* :

*	Distichiasis (Double row of eye lashes)	.. Congenital
*	Trichiasis (Misdirected or abnormal direction of eye lashes).	Congenital

6. *Conjunctiva* :

The normal appearance of conjunctiva in different species of animal is as follows :

*	Cattle and Sheep	Light pink
*	Buffalo and Pigs	Pink / reddish
*	Goat and Cat	Pale
*	Dog and Horse	Pale pink

The abnormal colour of conjunctiva and their indications are as follows :

*	Pale watery	Anaemia
*	Pale dry	Shock, Peripheral circulatory failure
*	Congested	Febrile diseases, Toxaemia, Pneumonia, Encephalitis, Rabies
*	Cyanotic / bluish	Dyspnoea
*	Yellow	Jaundice
*	Petechae	HS, Glanders,Purpura haemorrhagica
*	Brownish	Nitrate poisoning
*	Bright red	Early stages of HCN poisoning

7. ***Pupillary reflex*** :

* Constriction of pupil (Miosis)	Organophosphate poisoning, Acute keratitis
* Dilatation of pupil (Mydriasis)	Encephalitis, Strychnine poisoning, Vit A deficiency, Optic nerve/ brain damage.

8. ***Cornea*** :

* Opaque cornea (corneal opacity)	BMC, Canine Distemper, Surra, Trauma
* Rupture or laceration of cornea	Trauma
* Corneal ulcers	Trauma
* Vascularization of cornea (Pannus)..	Corneal ulcer
* Absence of corneal reflex	Anaesthesia, Trigeminal nerve paralysis, Coma, Brain damage, Glaucoma
* Fibrovascular growth on cornea ..... or sclera.	Pterygium
* Hair growth over cornea or limbus...	Dermoid

9. ***Lens*** :

* Opacity of lens (cataract)	Diabetes mellitus, Chronic nephritis, Aged dogs, Traumatic injury

10. ***Iris*** :

* Protrusion of iris through ..... corneal rupture (staphyloma)	Trauma

Nostrils

1. ***Nasal mucosa*** :

* Bright red nasal mucosa	IBR, Allergic Rhinitis, Influenza
* Ulceration in horse	Glander
* Ulceration in sheep	Blue tongue
* Diffuse necrosis	BMC, MD, RP

2. ***Odour*** :

* Sweetish smell	Ketosis
* Foetid nasal discharge	Pulmonary gangrene, Necrosis in nasal cavity.
* Sour smell with eructation	Digestive disorder.

* *Smell originating in respiratory system is constant with each breath.*

3. ***Nasal discharge*** :

*	Bilateral	Systemic involvement
*	Unilateral	Local infection
*	*Consistency* :	
	a) Watery	Early stage of inflammation
	b) Muco-purulent	Later stage of inflammation
	c) Thick to cheesy	Chronic inflammation
*	Blood unevenly mixed ..... with discharge	URT bleeding
*	Blood evenly mixed ..... with discharge	LRT bleeding
*	Discharge containing coarse ..... bubbles	Discharge originated in pharynx and nasal cavity
*	Discharge containing fine bubbles..	Originated in bronchi and lungs
*	Nasal discharge increasing when.... animal lowers down the head.	Sinusitis
*	Blood in nasal discharge	Nasal polyp, Nasal granuloma Trauma, Bleeding disorders
*	Fresh red coloured blood ..... containing bubbles	Haemaptosis (bleeding from lung)
*	Dark tarry coloured (coffee) ..... blood without bubbles	Hematemesis (bleeding from stomach / vomit)

Ear

The ear should be carefully examined for injury, swelling, ectoparasites and the discharge.

*	Repeated shaking of head and ..... scratching the ear with hindleg	Ootitis externa
*	Granulomatous growth on ..... external ear	Ear sore in buffalo (*Stephanofilaria zaheeri*)
*	Unilateral circling or rotation ..... of head towards one side, swelling at the base of ear.	Otitis media or otorrhoea
*	Fluctuating painful swelling ..... on ear pinna in dog	Aural haematoma
*	Typical scabs on skin of the ..... ear in goat	Psoroptic mange
*	Drooping of ear	Facial paralysis

II. Examination of Thorax

1. Cardiac area.

The area for auscultation and percusion of heart is from 3rd to 6th rib inside the point of elbow on left side in cattle and inside olecranon process in horse.

A] Percussion :

The objective of percussion is to determine size of heart and extent to which heart is in contact with chest wall.

1. Relatively dull sound	Normal animal.
2. Absolute / Intense dullness	Pericarditis, Hydropericardium.
3. Tympanic/Sub-tympanic sound ..	Pneumopericardium.
4. Increased area of cardiac dullness	Cardiac hypertrophy/dilatation, pericarditis, hydropericardium.
5. Reduction in area of cardiac dullness	Overdistension of lung such as pulmonary emphysema.
6. Pain on percussion	Pericarditis.

B] Auscultation :

The purpose of auscultation is to determine the rate, rhythm and quality of heart sound.

* **In large animals, the auscultation is done keeping the animal in standing posture with its forelimb drawn forward.**
* **In small animals, the auscultation is carried out by placing the animal on examination table.**
* The intensity of heart sound can be increased by closing the mouth or eyelids by digital pressure.

i] *Heart rate :*

It means number of beats per minute.

a) ***Tachycardia*** : Indicates increase in heart rate. It is observed in fever, anaemia, painful conditions, atrial flutter and sinus / ventricular tachycardia.

b) ***Bradycardia*** : Indicates decrease in heart rate. It is observed in jaundice, increased intra-cranial pressure, atrial fibrillation, partial heart block, vagus indigestion.

ii] *Rhythm of heart :*

It is defined as regularity of successive pulse wave in time.

1. Normally the rhythm is in three phases viz. LUBB - DUPP - Pause.
2. The first Lubb (systolic) sound is dull, deep, long and loud.
   It is produced due to closure of A.V. valves and contraction of ventricles and is more clear at the apex of heart.

3. The second dupp (diastolic) sound is sharper and shorter. It is produced due to closure of semilunar valves and is more clear at the base of the heart.
4. There is pause between second and first sound.
5. Deviation from normal rhythm is called as *arrythmia*.

iii] ***Heart sounds :***

The intensity and abnormalities of heart sounds should be noted.

1. The heart sounds (both) are absolutely increased in intensity (loud) in anaemia, cardiac hypertrophy, fever, exercise, strenuous work.
2. Heart sounds (both) are decreased in intensity (low) in congestive heart failure, pericarditis, hydropericardium.
3. The heart sounds are less audible in obesity.
4. The *intensity of first sound* depends on force of ventricular contraction. It is increased in ventricular hypertrophy and decreased in myocardial asthenia.
5. The *intensity of second sound* depends upon closure of semilunar valve i.e. on arterial blood pressure. It is increased in pneumonia, pulmonary emphysema, hypertension and renal diseases, whereas decreased in hypotension (low BP).
6. *Pericardial frictional rub, splashing or muffled heart sounds :*

* These are heard in pericarditis.
* These are not related to cardiac cycle.
* These are more superficial, more distinctly heard than murmurs and have to and fro character.

7. *Cardiac murmurs :*

* These are abnormal sounds produced by flow of blood through the valve or abnormal openings.
* These are caused by valvular insufficiency or stenosis // narrowing of valves.
* These are related to cardiac cycle.
* The murmurs of stenosis are harsh and whirring in character whereas the murmurs of incomplete closure of valve are softer and hissing in tone.

Types of murmurs :

Organic murmurs	***Hemic / Functional murmurs***
1. These are due to valvular defect.	1. These are not due to structural defect in valves.
2. These are either systolic or diastolic.	2. These are usually systolic.
3. These persist even after treatment.	3. These may disappear after conservative treatment.

2. Lung area.

The area for auscultation as well as percussion of lung is triangular.

The points of this triangle are -

1. Caudal angle of scapula.
2. Olecranon process of ulna.
3. Second last intercostal space at the point of horizontal line drawn from the external angle of scapula to external angle of ileum i.e. tuber coxae. (16^{th} in horse and 11^{th} in cattle, buffalo, sheep, goat, dog)

A] Percussion :

The percussion sounds produced in lung area and their indications are as follows:

1. *Resonant sound* ..... Normal lung.
2. *Dull sound* ..... Pneumonia, Pulmonary oedema, Pulmonary abscess, Pleural effusion.
3. *Hyperresonant sound* ..... Pulmonary emphysema.
4. *Tympanic sound* ..... Pneumothorax.

B] Auscultation :

1. The chest piece of stethoscope should be held firmly against thoracic wall to minimise sound caused by friction against hair coat.
2. The whole lung area should be auscultated.
3. Stethoscope should be applied at each point on chest for duration of atleast one complete respiratory cycle.

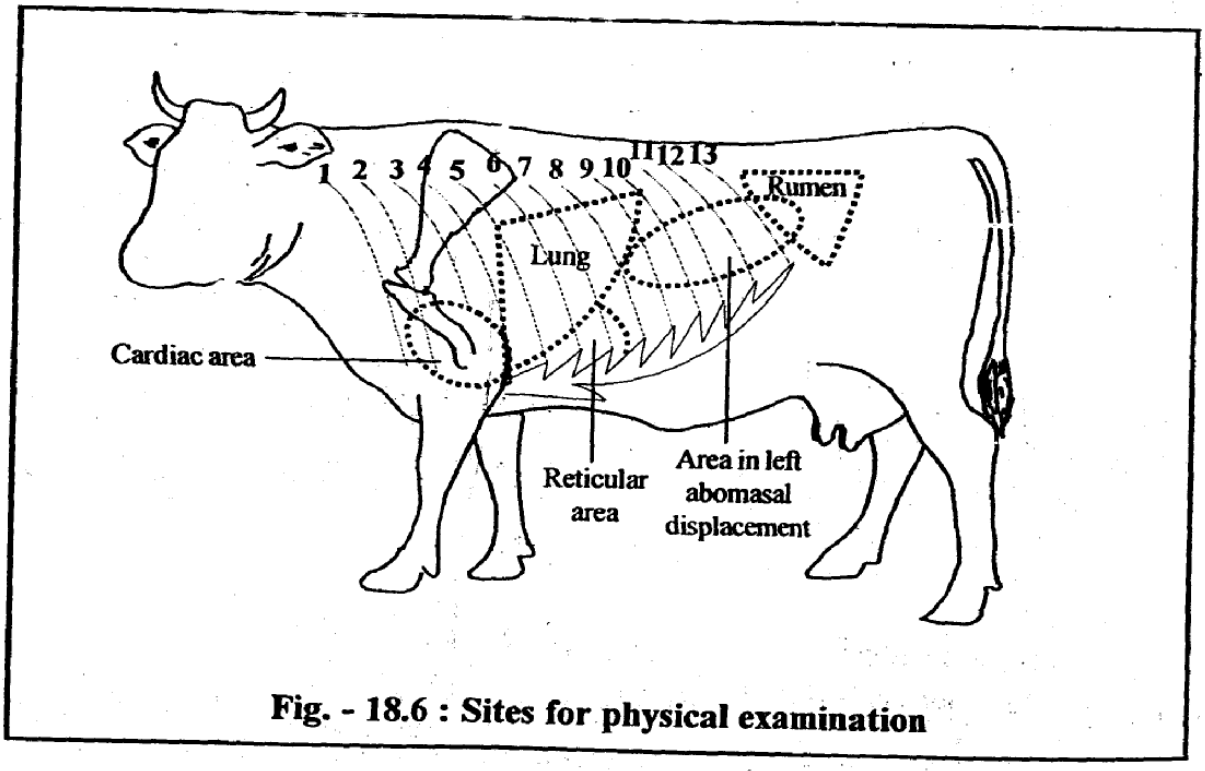


Fig. - 18.6 : Sites for physical examination

4. The intensity of lung sound may be increased and clarity is improved by mild exercise, such as walking or occlusion of both nostrils for 30-45 seconds.
5. Repeated auscultation should be carried out for clinical accuracy. The objective of auscultation is to determine the rate, rhythm and quality of lung sounds.

1] *Normal breath sounds* :

1. They are loudest over trachea and base of lung and quietest over the diaphragmatic lobes of the lung.
2. They are louder on inspiration than expiration.
3. The normal breath sound is soft sipping VEE - EFF.

2] *Increased loudness of breath sounds* is seen in fever, early pneumonia, after exercise and high environmental temperature.
Lung sounds are markedly loud in severe pneumonia.

3] *Decreased loudness of breath sounds* is observed in extreme obesity, shallow breathing and cold temperature.

4] *Breath sounds are not audible* in pleural effusion and space occupying lesions between lung and thorax.

5] *Crackles (moist rales) :*

1. These are described as bubbling or sizzling sounds.
2. These are discontinuous sounds heard primarily on inspiration.
3. This sound resembles the sound produced when air is blown from the end of narrow bore tube under water.
4. This sound indicates presence of exudate and secretions in air ways.
5. These are heard in exudative bronchopneumonia and aspiration pneumonia.
6. Harsh crackling sounds both on inspiration and expiration are heard in pulmonary emphysema.

6] *Wheezes (Dry rales)* :

1. These are continuous musical type, squeaking or whistling sounds.
2. This sound is similar to the sound produced by movement of tightly stretched paper.
3. These are frequently heard during inspiration and expiration.
4. This sound indicates narrowing of respiratory passage.
5. Inspiratory wheezing indicates upper respiratory tract (extra thorax) obstruction.
6. Expiratory wheezing usually suggests lower respiratory track (intra-thorax) obstruction.
7. These are heard in early stages of bronchitis, chronic bronchitis, asthma, neoplasm or T.B.

7] *Pleuritic friction rub* :

1. This sound is similar to sound produced by rubbing two pieces of dry leather over each other.
2. This sound is produced when inflammed visceral and parietal pleurae glide or rub over each other.
3. They are associated with the early pre-exudative stage of pleurisy.
4. This sound is loud, coarse and usually heard during inspiration.

III. Examination Of Ruminant Stomach

1. Rumen : The examination of rumen comprises inspection, palpation percussion and auscultation.

a) *Inspection* :

The fullness of left flank can be classified as

1.	Slight hollow to full	Normal
2.	Hollow (not filled up)	Starvation, Anorexia, Chronic illness
3.	Tucked - up or gaunt ..... appearance (Markedly hollow)	Prolonged alnutrition, Malabsorption, Chronic diseases, Prolonged severe dehydration.
4.	Moderate distension/ bulging	Simple indigestion, Grain overload
5.	Marked distension /bulging	Acute tympany, Vagus indigestion

* The ruminal motility can be counted by noting the undulating movements of abdomen on leftside.

* Markedly visible undulating movements of abdomen are seen in vagus indigestion and diaphragmatic hernia.

b) *Palpation* :

* The consistency of rumen is judged by the balls of fingers

1.	Slight tense	Normal
2.	Firm	Rumen impaction/atony, Dehydration.
3.	Balooning / Tense	Tympany /gaseous distension
4.	Fluctuations	Excess quantity of fluid (Grain overload, Vagus indigestion, Persistent rumen atony.)

c. *Percussion* :

*In case of normal animal, upper part of rumen produces subtympanic sound, middle part relatively dull sound and lower part complete dull sound.

* The abnormal percussion sounds and their indications are as follows.

1.	Tympanic/Drum-like sound	Tympany (Gaseous bloat)
2.	Metallic or ringing sound	Severe tympany

3. Dull sound ..... Rumen impaction, Rumen overload
4. Hyper-resonant sound even in ..... Frothy bloat
lower abdomen.

d) ***Auscultation*** :

* Rumen auscultation is done by keeping chest piece of stethoscope in the centre of left paralumbar fossa.
* The frequency and amplitude / strength of ruminal motility and ruminal sounds should be recorded.

i) *Frequency* :

* The normal rumen motility is 3 per 2 minutes.
* *Hypomotility* is observed in TRP, Indigestion, Rumen impaction, Toxaemia, Dehydration and Hypocalcaemia.
* *Hypermotility* is usually seen in Vagus indigestion, Diaphragmatic hernia and early stage of bloat.

ii) *Strength / amplitude* :

The strength of the rumen movement is studied by the force with which contractions occur and classified as -

1. Strong / Vigorous ..... Frothy bloat, Vagus indigestion Diaphragmatic hernia
2. Good ..... Normal
3. Weak ..... Indigestion, TRP, Febrile diseases

iii) *Ruminal Sounds* :

* The normal rumen movements produces gurgling fluid and booming sounds.
* High-pitched fluid and splashing sounds are characteristic of persistent rumen atony or advanced ruminal acidosis/ grain overload.
* Decreased frequency and volume of functional sound are indicative of rumen atony.
* The complete absence of motility and functional sounds are usually observed in severe toxaemia.
* In vagus indigestion, the ruminal movements are visible, palpable but increased in frequency with decreased volume of sound.

2 Reticulum :

* The examination of reticulum consists of palpation, percussion and auscultation.
* The area for percussion and auscultation is on the left side below the lung border between 6th and 7th ribs.

a) ***Palpation*** :

* In case of TRP, on applying strong upward pressure in the Xiphisternal region animal arches its back, moves away from the direction of pressure applied, strikes out with head and hindlegs and groans.

b) *Percussion* :

* A sharp blow over the reticular area with pain-seeking percussion hammer produces pain.

c) *Auscultation* :

* The reticular movements are normally 3 per 2 minutes.
* They are absent in local or diffuse peritonitis.
* They are decreased in indigestion and rumen atony.
* They are increased in initial stages of TRP and indigestion.
* Grunting is heard in TRP
* Splashing reticular sounds are audible just posterior to cardiac area in diaphragmatic hernia.

3. Omasum :

* The inspection, palpation and percussion of omasum is difficult.
* Auscultation site is the semicircular area posterior to 10^{th} rib on right side.

4. Abomasum :

* Bulging of left and right abdominal wall is observed in left and right abomasal displacement, respectively.
* Pain (Grunt or groan) on applying firm pressure with closed fist in abomasal area indicates painful condition of abomasum.
* On auscultation , splashing or tinkling sounds are audible over last two ribs in abomasal displacement.
* Abomasal displacement is common in recently calved cows and buffaloes.
* Impaction of abomasum is seen in young calves.
* Abomasal ulcers are noted in theileriasis, parasitic gastritis, RP, BMC and fungal infections.

CHAPTER - 19 : LABORATORY TECHNIQUES

EXAMINATION OF BLOOD

I. COLLECTION OF BLOOD :

A. Sites for collection of Blood

Sr. No.	Animal	Site	Needle size (gauze)
1.	Cattle & Buffalo	Jugular vein	16-18
2.	Horse	Jugular vein	16-18
3.	Sheep & Goat	Jugular vein	18-20
4.	Dog & Cat	Cephalic/Saphenous vein Jugular vein	20-22
5.	Pig	Anterior venacava/Ear vein	20
6.	Fowl	Wing vein & heart	18-20

B. Anticoagulants :

Sr. No.	Anticoagulant	Amount required for 10 ml blood	Remark
1.	EDTA 1%	1ml.	* Excellent for routine haematology.
2.	Sodium citrate 3.8%	1ml	* Good for blood transfusion.
3.	Heller's & Paul's oxalate mixture (Ammonium oxalate - 1.2 gm + Pot. oxalate - 0.8 gm + D.W. - 100ml.)	1ml.	* Good for haematological studies. * Not suitable for BUN estimation.
4.	Heparin. 1% (Natural anticoagulant)	0.1ml.	* Good for analysis of blood gas, BUN and electrolytes * Expensive.

C. Technique of blood collection:

1. Clip the area from where the blood is to be drawn.
2. Apply Tr. Iodine or spirit & allow it to dry.
3. Raise the vein by pressure.
4. Use dry and sterilized needle, as water haemolyses RBC's.
5. Insert the needle into vein and draw the required quantity of blood.
6. Transfer the blood from the syringe to specimen tube/vial containing anticoagulant mixture, after disengaging the needle.

7. Place the rubber stopper.
8. Make rotatary movements so that blood mixes with the anticoagulant.
9. Never shake the blood vigorously otherwise red blood cells will rupture.
10. Label the sample tube or vial properly.

II. HAEMATOLOGY

1. Haemoglobin Estimation

1. Fill the graduated measuring tube with N/10 HCl upto mark 2.
2. Draw well mixed blood upto 20 cumm mark in the pipette..
3. Wipe out excess blood on the sides of pipette
4. Transfer blood into the acid rinsing many times.
5. Keep the tube in a comparator and wait for 5-10 min.
6. Add N/10 HCl or distilled water drop by drop, mixing with stirring rod till the colour matches with the standard.
7. Read at the lower edge of meniscus in terms of gm %

2. Packed cell volume

A. *Macrohaematocrit Method/Wintrobe Method*

1. Fill the wintrobe haematocrit tube to 100 mark using long needle or fine pipette.
2. Centrifuge this tube at 3000 rpm for 30 min.
3. Read the height of red cell column as percent.

B. *Microhaematocrit Method*

1. Fill the microhaematocrit tubes by capillary attraction from a sample of blood or from a pricked ear.
2. Seal one end of the tube with clay or plasticine or sealing wax.
3. Keep closed end outwards in a microhaematocrit centrifuge and spin at 10,000 rpm for 5 min.
4. Remove tubes from centrifuge and read on microhaematocrit reader.

* *PCV is increased in haemoconcentration whereas decreased in anaemia.*

3. Total erythrocyte count

1. Draw well mixed blood upto 0.5 mark in RBC pipette.
2. Wipe out excess blood on the sides.
3. Suck RBC diluting fluid upto 101 mark.
4. Mix the contents by rotating the pipette between fingers.
5. Discard first 2-3 drops of fluid from diluting pipette.
6. Charge the Neubauer's counting chamber by touching the tip of pipette at the junction of chamber and coverglass.
7. Wait for 2 min & count all the cells in four corner and middle small squares using high power objective.
8. TEC = (No. of cells in 5 small squares x 10,000)/µl

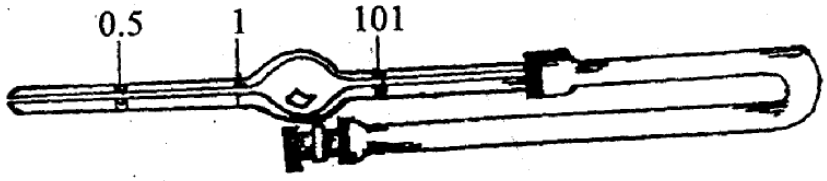
**Polycythemia i.e. increase in number of erythrocytes indicates haemoconcentration*

**Oilgocythemia i.e. decrease in number of erythrocytes is seen in anaemias.*

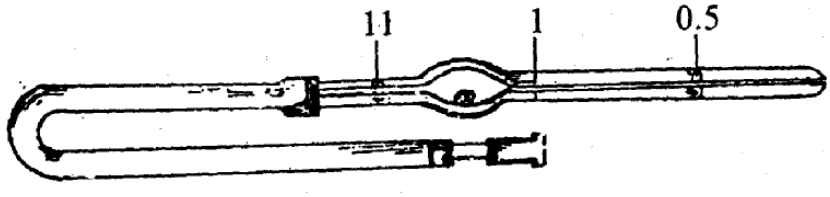
4. Total leucocyte count

1. Draw well mixed blood upto 0.5 mark in WBC pipette.
2. Suck WBC diluting fluid upto mark 11.
3. Mix the contents by rotating the pipette.
4. Charge counting chamber as per RBC count.
5. Count all cells in four corner squares using low power objective.
6. TLC = (No. of cells in 4 large squares x 50) / µl.

* *Leucopenia i.e. decrease in number of leucocytes is common in many viral diseases and bone marrow abnormalities.*
* *Leucocytosis is observed in bacterial infections, stress and localised infections.*



RBC Pipette



WBC Pipette

Fig. - 19.1 : Diluting Pipettes

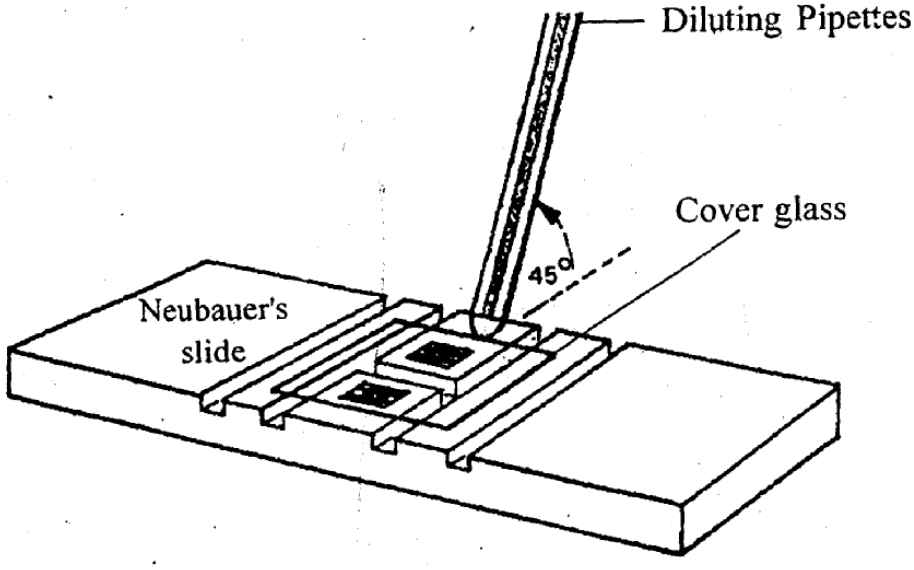


Fig. - 19.2 : Filling counting chamber

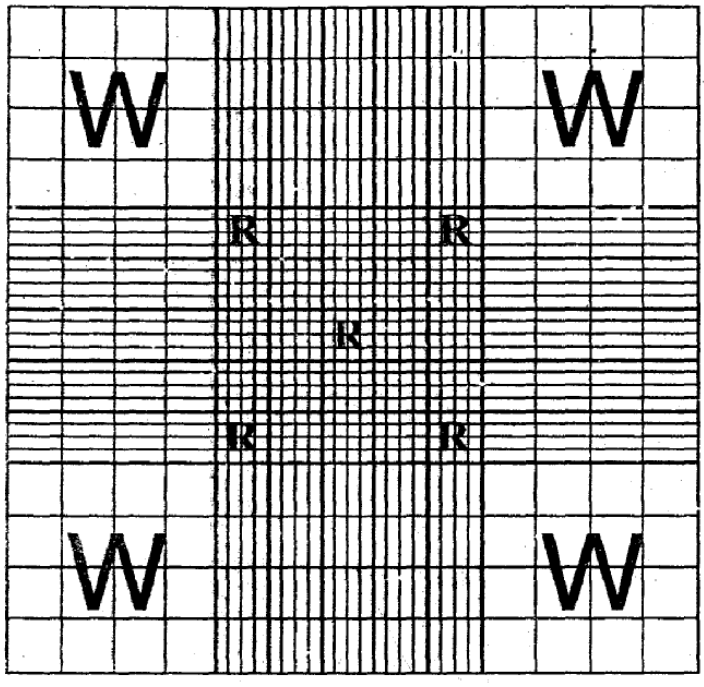


Fig. - 19.3 : Neubauer's ruling (Enlarged view)

5. Erythrocytic Indices

These are useful in determining the nature or type of anaemia and thus helps in deciding the line of treatment.

A) *Mean Corpuscular Volume* (MCV) :

* It is mean volume of red blood cells.
* It is calculated as follows :

$$\text{MCV (f}l\text{)} = \frac{\text{PCV(\%)}}{\text{TEC(million}/\mu l\text{)}} \times 10$$

* The MCV indicates normocytic, macrocytic or microcytic anaemias.

B) *Mean Corpuscular Haemoglobin* (MCH) :

* It is the weight of haemoglobin in an average red blood cell
* It is calculated as follows :

$$\text{MCH (pg)} = \frac{\text{Hb(gm\%)}}{\text{TEC(million}/\mu l\text{)}} \times 10$$

* The MCH indicates normochromic or hypochromic anaemias.

C) *Mean Corpuscular Haemoglobin Concentration* (MCHC) :

* It is percent haemoglobin concentration in average red blood cell.
* It is calculated as follows :

$$\text{MCHC (\%)} = \frac{\text{Hb (gm \%)}}{\text{PCV (\%)}} \times 100$$

Interpretation of MCV, MCH and MCHC :

1. The *microcytic hypochromic anaemia* results from dietary deficiency of iron, protein, copper, pyridoxine and chronic blood loss.
2. The *normocytic normochromic anaemia* occur due to depressed erythropoeisis resulting from chronic infectious diseases, nephritis, irradiation, malignant neoplasms, chemical poisoning.
3. The *macrocytic hypochromic anaemia* usually occurs in acute haemorrhage or acute haemolysis and also during recovery stage of diseases.
4. The *macrocytic normochromic anaemia* results due to deficiency of Vit B_{12} , cobalt, folic acid, intrinsic and erythrocyte maturation factors.

6. Examination of blood smear

A) *Preparation of blood smear :*

1. Place a drop of blood at one end of clean grease free slide.
2. Using another slide, allow the drop to spread along its edge
3. Hold the spreader slide at an angle of 45 degree and push it along the slide drawing the blood behind it until it all has been smeared
4. Dry the film in air and wrap it in paper & label it.

B) *Staining of blood smears* :

a) *Giemsa Staining Method*

1. Fix the blood smear in methanol for 2-3 minutes.
2. Prepare 1 in 10 dilution of Giemsa's stain in Phosphate buffer (pH: 5.8) or distilled water.

Phosphate buffer :	
Potassium dihydrogen phosphate	5.47 gm
Disodium hydrogen phosphate	3.80 gm
Distilled water	1000 ml.

3. Cover the smear with diluted Giemsa stain for 15-20 minutes.
4. Wash the smear with distilled water and air dry.
5. Examine under oil immersion objective.

b) *Leishman's Staining Method*

1. Cover the unfixed blood smear with Leishman's stain (5-10 drops) for 1-2 minutes.
2. Add double quantity of phosphate buffer or distilled water and mix by blowing air.
3. Let the diluted stain act for 10-15 minutes.
4. Wash the slide with distilled water and air dry.
5. Examine under oil immersion objective.

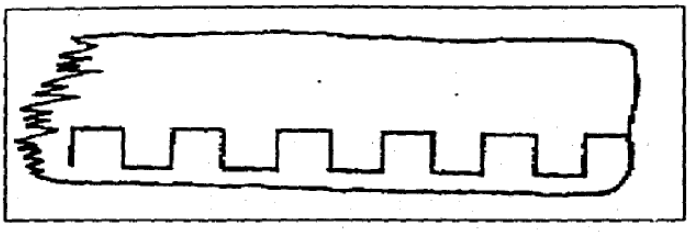


Fig. - 19.4 : Battlement counting method

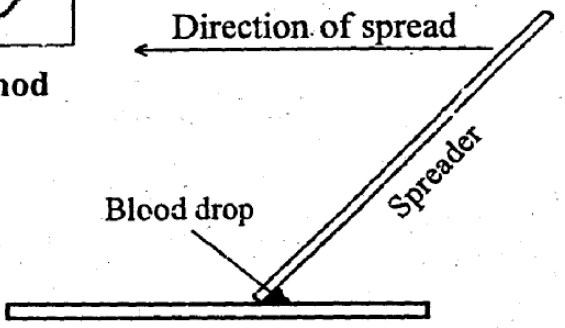


Fig. - 19.5 : Preparation of blood smear

C) *Examination of slide* :

1. Set the smear on the microscope under low power.
2. Put a drop of cedar wood oil & set the smear under oil immersion lens
3. Count at least 100 leucocytes by Battlement method i.e. count four fields horizontally, then four fields to the inside of slide, four fields again horizontally, four fields to the outside of the slide and then repeat it.

D) *Interpretations* :

1. *Neutrophilia* is seen in localised bacterial infections , stress, uraemia, blood loss and haemolytic conditions.
2. *Eosinophilia* indicates allergic condition or parasitic infestation.
3. *Monocytosis* is encountered in chronic infections
4. *Lymphocytosis* represents chronic infection.

Table - 19.1 : Normal Haematological values

Parameter	Cattle	Buffalo	Sheep	Goat	Horse	Dog
Haemoglobin (g %)	8-15	9-15	9-15	8-12	8-14	12-18
PCV (%)	24-46	30-36	27-45	22-38	24-44	37-55
TEC (x 10^6 / μl)	5-10	5-7.3	8-16	8-18	5.5-9.5	5.5-9.5
TLC (x 10^3 / μl)	4-12	5-10	4-12	4-13	5.5-12.	6-17
Neutrophil (%)	25-45	25-35	25-50	25-50	35-75	60-77
Lymphocyte (%)	45-75	45-65	40-75	40-75	15-50	12-30
Monocyte (%)	2-7	3-10	0-6	0-6	2-10	3-10
Eosinophil (%)	2-20	2-4	0-10	0-10	2-12	2-10
Basophil (%)	0-2	0-2	0-3	0-2	0-3	Rare
MCV(μ^3)	52	56	33	23	46	70
MCH(pg)	14	19.2	10.7	11	16	23
MCHC(pg)%	33	34.1	33	38	35	34

EXAMINATION OF URINE

A) COLLECTION OF URINE

1. *During Spontaneous Micturition* : The mid stream urine should be collected as it contains little contamination.
2. *By Manual Compression of Urinary Bladder* : This method is easier in small animals and could be done in large animals as well by compressing the bladder per-rectally.
3. Urination can be induced by upward massage of the perineum and vulval lips in cows.
4. Bulls may urinate if the preputial orifice is massaged and splashed with warm water.
5. In sheep, closing and then releasing of the nostrils can induce urination.
6. Sometimes, urine could be aspirated with the help of needle and syringe directly from the bladder in small animals. In such cases all aseptic precautions should be taken.
7. Catheterisation.

B) PRESERVATION OF URINE :

1. By keeping it in refrigerator and examine within an hour of collection.
2. By addition of chemical preservatives .

a) ***By mixing with toluene*** : In this method a thin layer of toluene is formed on the top of urine. This method is useful for chemical analysis of urine.

b) ***By adding one crystal of thymol in 1 lit of urine.*** This may give false positive reaction for protein.

c) ***By adding 3-4 drops of 40% formalin to 1 lit. of urine.*** This may give false positive reaction for glucose.

d) ***By adding few drops of phenol in urine sample.*** This may give false +ve reaction for glucose.

C) URINE ANALYSIS

I. Physical Examination:-

1. ***Colour***:
   - The normal colour is *light yellow to amber* which is due to presence of urochromes.
   - *Pale urine*: Diabetes, Chronic nephritis, Polydipsia
   - *Yellow* : Fever, dehydration, oliguria
   - *Greenish yellow* : Jaundice
   - *Red, brown, coffee coloured* : Haematuria, haemoglobinuria

2. ***Transparency*** :
   - The normal urine in ruminants and carnivores is clear and transparent
   - The urine of horse is normally cloudy and opaque due to presence of calcium carbonate and mucus.

* The presence of varying degree of opacity is due to epithelial cells, blood cells, casts, crystals and proteins.

3. *Smell* :

* The normal *uraemic smell* of urine is due to presence of volatile organic acids.
* *Penetrating ammoniacal / pungent smell* : Urinary tract infection.
* *Foul smell* : Suppurative urinary tract infection.
* *Sweetish / frutish smell* : ketosis, diabetes mellitus.

4. *Volume* :

* The urine volume varies from species to species, diet, fluid intake, climate etc.
* *Polyuria* : Diabetes, Polydipsia, Chronic nephritis.
* *Oliguria* : Fever, dehydration, acute nephritis, less water intake
* *Anuria* : Urinary calculi.

5. *Specific Gravity* :

* Fill the Cylinder with urine upto about one inch from the top.
* Place the urinometer in urine and spin between thumb and finger
* Read the specific gravity at the bottom of meniscus.
* *Specific gravity is increased in dehydration, fever, cystitis, diabetes mellitus, acute interstitial nephritis wheras it is decreased in chronic interstitial nephritis, diabetes insipidus and excessive fluid intake.*

II. Chemical Examination :

1. *Reaction of Urine* (pH)

* The pH of urine depends upon diet.
* The pH is alkaline in herbivores whereas acidic in carnivores.
* The urine becomes more acidic in ketosis, grain engorgement, fever, starvation and acidosis.
* The urine becomes more alkaline in cystitis, retention of urine and alkalosis.

Table - 19.2 : Normal values for urine volume, specific gravity and pH

Species	Urine Volume (Kg)		Specific gravity		pH
	Range	Average	Range	Average	
Cattle	8.8-22.6	14.2	1025-1045	1035	7.5-8.5
Buffalo	-	-	1010-1035	1025	7.8-8.2
Sheep & Goat	0.5-2.0	1.0	1015-1045	1030	8.0-8.2
Horse	2.0-11.0	4.7	1020-1050	1035	8.0-8.2
Pig	2.0-6.0	4.0	1010-1030	1015	6.5-7.5
Dog	0.5-2.0	1.0	1015-1045	1025	6.0-7.0

2. ***Robert's Test*** **(For Albumin)**
   1. Place 2 ml Robert's reagent in a test tube

Robert's Reagent :	
Saturated solution of magnesium sulphate	100 ml.
Conc. Nitric acid	20 ml.

   2. Stratify 2 ml urine on the reagent using dropper /pipette
   3. A white ring at the junction indicates positive test.
   * *Proteinuria is seen in nephritis, nephrosis, cystitis, urethritis, fever.*

3. ***Benedict's Test*** **(For Glucose)**
   1. Take 5 ml of Benedict's reagent in a test tube
   2. Add 0.5 ml (8 drops) of urine and boil it
   3. A greenish, yellowish or reddish precipitate indicates positive test.
   * *Glycosuria is observed in diabetes mellitus, chronic liver disease, emotional states, overactivity of adrenal cortex.*

4. ***Rothera's Test*** **(For ketone bodies)**
   1. Saturate 1 ml of urine with ammonium sulphate
   2. Add 1-2 mg of sodium nitroprusside and mix well
   3. Stratify 1 ml strong ammonia solution
   4. Read the reaction after 5 minutes
   5. A permanganate/purple colour is indicative of ketones.
   * *Ketonuria is noticed in ketosis, pregnancy toxaemia, diabetes mellitus, starvation and cachectic conditions.*

5. ***Benzidine Test*** **(For blood/haemolglobin)**
   1. Saturate 1 ml of glacial acetic acid with benzidine powder
   2. Add 2 ml urine
   3. Mix 1 ml of fresh 3% Hydrogen peroxide (H_2O_2) solution
   4. A blue colour is indicative of positive test.
   * *Haematuria is encountered in acute glomerulonephritis pyelonephritis, cystitis, urolithiasis, sweet clover disease, anthrax.*
   * *Haemoglobinuria is usually found in babesiosis, leptospirosis, post-parturient haemoglobinuria, bacillary haemoglobinuria, water intoxication, onion poisoning, snake bite.*

6. ***Fouchet's Test*** **(For bile pigments)**
   1. Take 5 ml of urine in a test tube
   2. Add 10% Barium chloride solution and mix well.
   3. Filter the mixture through Whatman filter paper No. 42
   4. Allow the precipitate to dry on filter paper itself.
   5. Put a drop of Fouchet's reagent on it.
   6. Green colour indicates the presence of bile pigments.
   * *Bilirubinuria is present in case of jaundice*

7. *Hay's Sulphur Test* (For bile salts)

1. Take 5 ml of urine in a test tube
2. Sprinkle a small amount of sulphur powder.
3. If bile salts are present, sulphur powder will sink.

8. *Sulkowitch Test* (For Calcium)

1. Test tube A (Control): Add 5 ml of urine to 5 ml of distilled water.
2. Test tube B (Test): Mix 5 ml of urine and 5 ml of Sulkowitch reagent.

Sulkowitch Reagent :	
Oxalic acid	2.5 gm
Ammonium oxalate	2.5 gm
Glacial acetic acid	5.0 ml.
Distilled water	150 ml.

3. Read the test for turbidity and report as follows :

No precipitate	-	(Calcium less than 5 mg %)
Mild precipitate	+	(5-10 mg %)
Cloudy	+ +	(10-15 mg %)
Milky white	+ + +	(15-20 mg %)
Heavy chalky	+ + + +	(20 mg % & above)

III. Microscopic Examination of Urine

1. Take 10 ml of fresh urine in centrifuge tube.
2. Centrifuge for 5-10 min. at 1000-1500 rpm.
3. Discard the supernatant fluid and resuspend the sediment.
4. Place 1 drop of sediment on a clean slide and put coverslip on it.
5. Examine under low and high power for cast, epithelial cells, crystals etc.

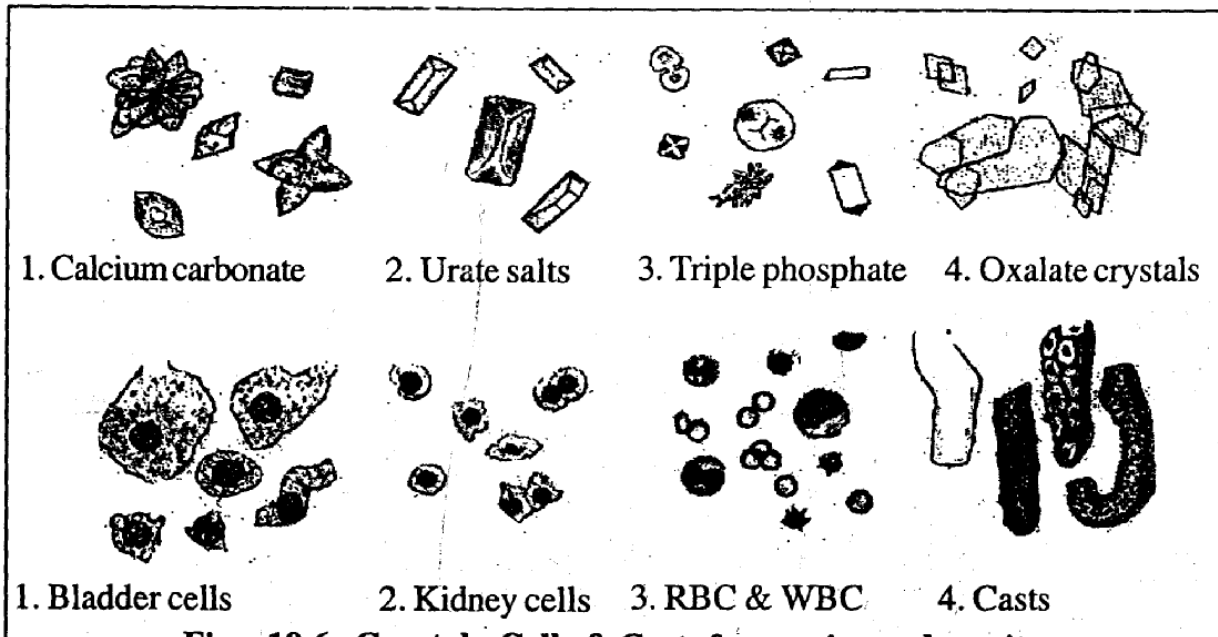


Fig. - 19.6 : Crystals, Cells & Casts from urinary deposits

KIDNEY FUNCTION TESTS

* Kindney /Renal function tests evaluate the functional capacity of the kidney.
* Renal function tests are used to assess blood flow to the kidneys, glomerular filtration and tubular function.
* The kidney function can be assessed by examination of blood and urine.

The following are commonly used kidney function tests :

1. **Specific gravity of urine:**
   * It is the simplest and most direct test.
   * In normal animal, the specific gravity is around 1.030 but in cases of chronic renal diseases it is reduced up to 1.010.
   * In kidney dysfunction, the specific gravity is not appreciably altered by either administration of large quantities of water or deprivation of water for 24 hrs.
2. **Blood-Urea Nitrogen :**
   * It is simplest and reliable test.
   * The normal BUN level is 6 to 24 mg %.
   * The values higher than the normal indicates renal dysfunction.
3. **Serum Creatinine :**
   * In the normal animals, creatinine ranges between 1 to 2 mg %.
   * The elevation of creatinine suggests kidney damage.
4. **Methylene blue excretion test :**
   * In this test methylene blue (2 %) @ 0.4 ml/ kg is injected intramuscularly and urine is examined for clearance of dye.
   * Normally the excretion of dye reaches its maximum after 1 hr. and the clearance is completed within 24 hrs.
   * In kidney dysfunction, there is delay in excretion.
5. **Phenol sulphonphthalein clearance Test :**
   * A measured amount of phenol sulphonphthalein is injected intravenously and then urine is collected at intervals of 40 to 60 min.
   * The rate of disapperance of the dye from the plasma can be determined from blood samples taken prior to and then at regular intervals of 30 min. following its injection.
   * The dye clearance time is prolonged in renal disease.

EXAMINATION OF SKIN SCRAPINGS

A) Collection of Skin Scrapings :

1. Select the most active lesion i.e. periphery of lesion.
2. Clean the lesion with spirit.
3. Take a scalpel and dip its blade in mineral oil i.e. liquid paraffin.
4. Press the lesion between thumb and index finger

5. Hold the scalpel blade with thumb and finger firmly and scrape the ski deeply till little blood oozes out.
6. Collect the scrapings in petri dish / watch glass.

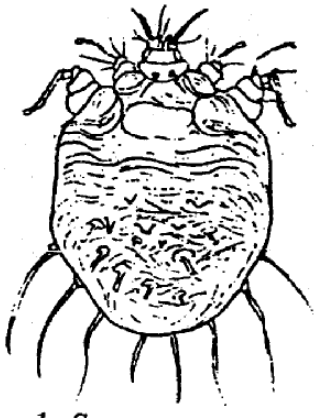
B) Methods of Examination :

a. *Direct Method*

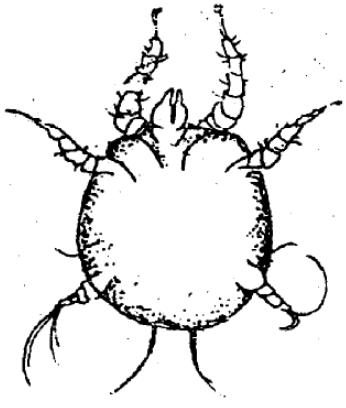
1. Place a small pinch of skin scraping on glass slide
2. Add 1-2 drops of 10 % KOH solution.
3. Apply mild heat to slide for few seconds or wait for 15-30 minutes.
4. Put a coverslip and examine under low power.

b. *Sedimentation Method*

1. Take sufficient quantity of skin scrapings in a test tube.
2. Add 5 ml of 10 % NaOH or KOH solution.
3. Keep it overnight or boil it till the solution becomes syrupy.
4. Centrifuge for 2 minutes at 1000 rpm.
5. Examine a drop of sediment under low power.



1. *Sarcoptes sp.*



2. *Psoroptes sp.*



3. *Demodex sp.*

Fig. - 19.7 : Skin scraping examination

FAECAL EXAMINATION

A) COLLECTION OF FAECAL SAMPLE :

1. The faecal sample can be obtained by following methods.

a) Directly from the rectum by introducing hand or indexfinger.

b) At the time of defaecation.

c) If the sample is to be collected from the ground, only middle portion should be taken with wooden spatula. The sample should be fresh and free from mud, dirt or other foreign materials.

2. The sample should be collected in small thin plastic envelope, ice-cream cups, match box, or any other suitable container not made of absorbent material.

3. The sample should be collected aseptically in sterile containers for bacteriological examination.
4. The quantity of sample required for examination is 10 gm.

B) STORAGE / PRESERVATION :

1. Store the faecal sample in refrigerator, if the material is to be examined sometime after collection.
2. Faecal samples suspected for parasitic eggs (except lung worms) can be preserved in 10 % formalin in the proportion of 1:3 parts. Formalin prevents hatching of eggs.
3. Faecal sample suspected for coccidia should be preserved in 2-4 % potassium dichromate or 1 % formalin. These chemicals prevent the growth of contaminating bacteria without affecting the normal development of oocysts.
4. No preservative should be added, if bacteriological or toxicological examinations are to be carried out.
5. For virological examination, 50 % glycerine phosphate buffer should be used as preservative.

C) PHYSICAL OR GROSS EXAMINATION :

1. Frequency of defaecation :

The normal frequency of defaecation in different species is as follows :

1. Cattle, Buffalo and Horse (stallfed) ..... 8 - 12 times / day.
2. Cattle, Buffalo and Horse (grazing) ..... 16 or more times / day.
3. Carnivores (meat) ..... 1 - 3 times / day
4. Carnivores (carbohydrate diet) ..... 1 - 3 times / day.

Frequency of defaecation	***Disorder***
*Increased frequency of defaecation.	Diarrhoea and dysentery
*Decreased frequency of defaecation	Constipation and decreased feed and water intake.

2. Quantity of faeces :

The normal daily output of faeces in different species is as follows :

1. Cattle 24 - 45 Kg.
2. Horse 15 - 20 Kg.
3. Pig 1 - 2.5 Kg.
4. Sheep and Goat 0.5 - 1.0 Kg.

Quantity of faeces	***Disorder***
* Voluminous faeces	Diarrhoea, High fibre content of feed.
* Scanty faeces	Constipation, Rumen impaction, Decreased feed and water intake, DH and Vagus indigestion
* Absence of faeces	Intestinal obstruction

3. Consistency :

The normal shape and consistency of faeces varies with type of feed and species of animal :

Cattle and buffalo (Grazing)	Semi- solid flat cakes.
Cattle and buffalo (Stall fed)	Firm.
Pigs, Cat and Dog	Firm, elongated, cylindrical, mass.
Sheep and Goat	Firm pellet
Horse	Large balls of regular shape.
Abnormal Consistency	***Disease condition***
Hard faeces	Constipation, Impaction
Soft watery faeces	Diarrhoea
Pasty faeces	Intestinal obstruction, Ruminal stasis and Abomasal displacement.

4. Colour :

It varies with type of feed and species.

Cattle, Buffalo and Horse (Stallfed)	Brown to dark brown.
Cattle, Buffalo and Horse (Grazing) ...	Dark Green.
Sheep and Goat	Dark green to black
Pig	Dark yellow
Dog	Yellowish brown.
Disease Conditions	***Abnormal colour of faeces.***
Constipation	Blackish brown.
Gastric/ abomasal ulcers (Theileriasis)	Black, tarry, coloured.
Rectal haemorrhage	Red streaks over stools.
Obstructive jaundice	Clay coloured or pale.
Haemolytic jaundice	Blackish green.
Ruminal acidosis	Light grey-green.

5. *Odour* :

The normal odour in carnivores is offensive whereas it is slightly unpleasant in herbivores.

Disease condition	***Abnormal odour***
* Decomposition of protein	Fishy
* Incomplete digestion, Pancreatic insuffciency. ...	Offensive
* Abnormal fermentation or due to pus or necrotic tissue	Foul
* Severe catarrhal or haemorrhagic enteritis or salmonellosis ..	Repugnent
* Lactic acidosis	Sour or acidic.
* Poisoning with mineral oil	Petroleum like.

6. Degree of communition of faeces :

This is judged by the length of the undigested fibres in the dung.

Fibre length	Digestion	Cause
1-2 cm	Partly digested	Failure of rumination Faulty mastication Accelerated passage of feed.
0.5 cm	Well digested	Normal function
< 0.5 cm	Over digested	Prolonged passage Abomasal displacement Caecal dilatation, Volvulus.

7. Abnormal constituents of faeces :

Abnormal constituent	*Disease conditions.*
1. Sand, soil, bone, wood, hair, metallic objects	Pica in pup, lamb and calf.
2. Gelatinous or sticky faeces made up of mucus and fibrin.	Coccidiosis in calf.
3. Mucus plug	Paralytic ileus.
4. Blood mixed with tenacious greyish white mucus	Intestinal obstruction
5. Mucus coated hard faeces	Ruminal stasis, Constipation Dehydration, Ketosis.
6. Liquid faeces mixed with mucus	Catarrhal enteritis.
7. Long strands of fibrin	Salmonellosis
8. Foamy gas bubbles in faeces.	J.D.,Enteritis in calf,Lactic acidosis
9. Blood in faeces	G.I. haemorrhages, Anthrax.

D) MICROSCOPIC EXAMINATION :

1. Direct Smear Method :

1. Place one drop of distilled water on clean slide.
2. Put a small amount of faecal sample.
3. Mix it uniformly using smooth glass rod or match stick
4. Place a coverslip and examine under low power.

* *It fails to detect low grade infections.*

2. Floatation Method :

1. Mix thoroughly 2 gm of faeces with 20 ml of saturated salt (264 gm/lit) or magnesium sulphate (410 gm/lit) solution in a beaker.
2. Pour the suspension in the centrifuge tube upto brim through strainer or muslin cloth.
3. Put coverslip touching the surface of fluid.
4. Allow it to stand for 20-30 minutes.
5. Take off coverslip, put it on slide and examine under low power.

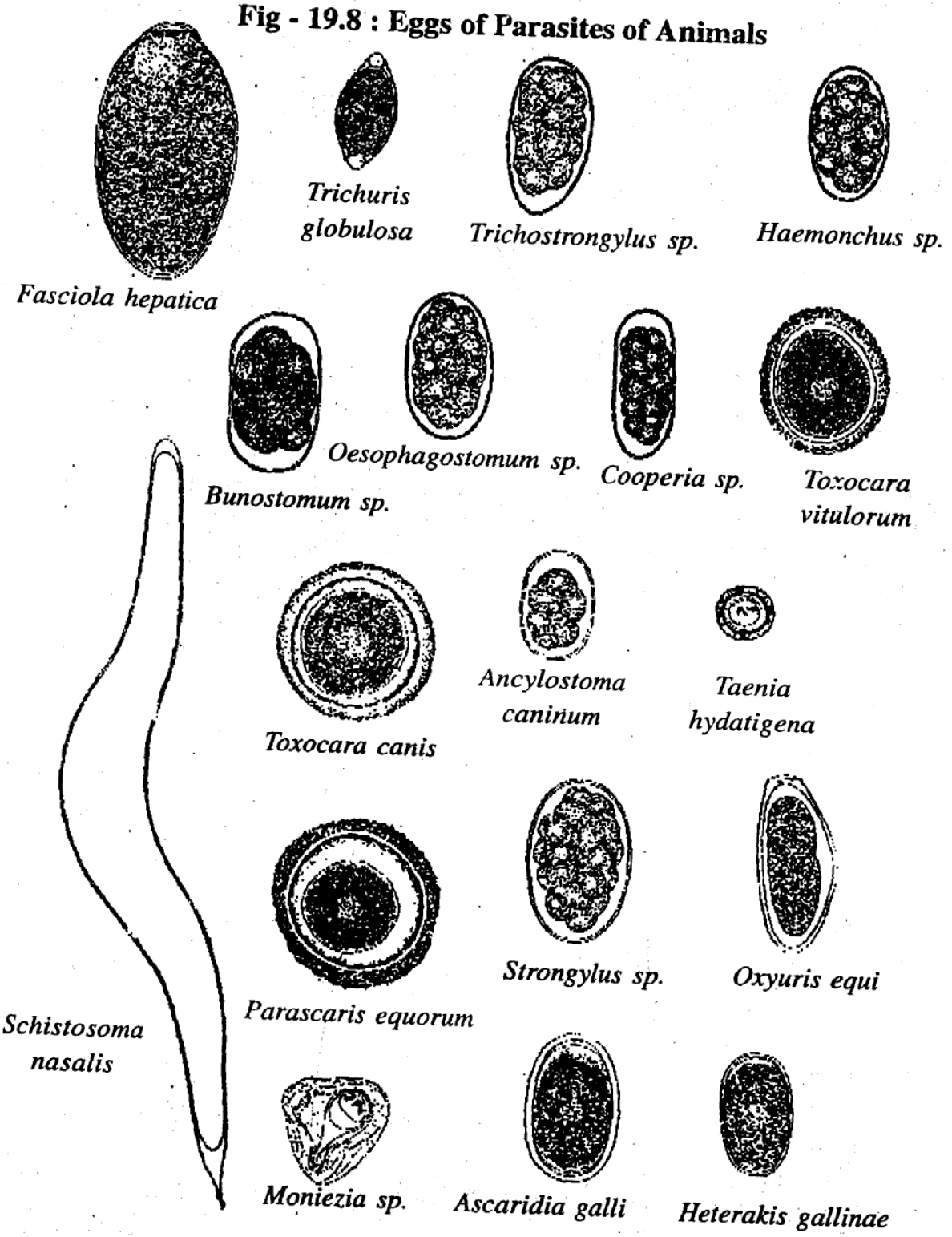
* *It is suitable for nematode eggs and oocysts.*

3. Sedimentation Method :

1. Mix thoroughly 2 gm faeces with 20 ml distilled water in a beaker.
2. Pour the suspension in the centrifuge tube through strainer.
3. Centrifuge tube at 1000 rpm for 2-3 min.
4. Discard the supernatant and take 1-2 drops of sediment on slide.
5. Put a coverslip and examine under low power.

* *It is suitable for trematode/fluke eggs.*

Fig - 19.8 : Eggs of Parasites of Animals



TOXICOLOGICAL TECHNIQUES

1. **Diphenylamine blue test (For Nitrate / Nitrite poisoning)**
   DPB Reagent : 0.5 g. Diphenylamine + 20 ml Distilled water + Conc. H_2SO_4 to make up 100 ml.
   Procedure :
   1. Place 1-2 drops of plasma / urine / rumen fluid on glass slide.
   2. Put 1-2 drops of DPB reagent by the side of same and allow to mix.
   3. Development of blue colour indicates positive test.
2. **Picrate paper test (for HCN poisoning)**
   Reagent : Sodium bicarbonate 5 g. + Picric acid 0.5g + Distilled water to make 100 ml. Dip filter paper strips and dry in cool place.
   Procedure :
   1. Put few drops of rumen fluid on picrate paper.
   2. Change of paper colour from *Yellow to brown / red* indicates presence of cyanide.

EXAMINATION OF MILK

A) Collection of milk Sample :

1. First clean the udder with water.
2. Then wipe it with clean cloth
3. Apply 70 % alcohol or Tr. iodine to the teat orifice.
4. Label sterile tubes/ vials as RF, RH, LF & LH.
5. Discard first 2-3 streaks of milk
6. Then collect 5 ml (approx.) of milk from each quarter in respective tubes/vials.

B) Storage : On ice or in refrigerator upto 6 hours.

C) California Mastitis Test (CMT) (for detection of subclinical mastitis)

CMT Reagent :

1. *Solution A* : Sodium lauryl sulphate 30g dissolved in 1000ml distilled water, heated to 50^0 C to make clear solution.
2. *Solution B* : Bromocresol purple 0.5g dissolved in 100ml distilled water. Mix 100ml solution 'A' & 2ml solution 'B'

Procedure :

1. Take 2-3ml of milk from each quarter into four chambers of plastic paddle/ clean petri dish
2. Add equal quantity of CMT reagent.
3. Mix the milk with reagent by gentle rotating movement.
4. Formation of gel indicates positive reaction.
   Cows in early and late stages of lactation may give false positive reactions.

LIVER FUNCTION TESTS

1. Van den Bergh test

Diazo reagent **:**

Solution A : Sulphanilic acid 1g + Conc. HCl 15ml + DW to make 1000ml.

Solution B : Sodium nitrite 0.5 gm + DW 100ml

Mix 10ml of soln. A with 0.3ml of soln B just before use.

Procedure **:**

1. Place 1ml. serum in a test tube.
2. Stratify 0.5ml. of the diazo reagent.
3. If reddish purple ring develops at the junction within 30 seconds indicates *direct test.*
4. Mix the contents, add 3ml of 95 % alcohol & shake well
5. Development of pink colour after shaking indicates *indirect test.*
6. If there is pink colour in the direct test & if it intensifies on addition of alcohol, then it is considered as *biphasic test.*
7. Absence of pink colour is indicative of negative test.

Interpretation **:**

Sr.No.	*Observation*	*Inference*
1.	Negative test	Normal
2.	Direct test	Obstructive jaundice
3.	Indirect test	Haemolytic jaundice.
4.	Biphasic test	Hepatic jaundice.

2. Icterus Index

It measures the degree of jaundice by measuring intensity of yellow colour of serum or plasma which is diluted with normal saline until it matches the colour with 1: 10,000 solution of potassium dichromate. The dilution factor is termed as *Icterus Index*

Reagents **:**

1. Potassium dichromate (1: 10,000)
   ($K_2Cr_2O_7$ 0.1g + Conc. H_2SO_4 0.1 ml + DW 1000 ml.)
2. Normal saline (0.9 % NaCl.)

Procedure **:**

1. Take 1 in 10,000 $K_2Cr_2O_7$ solution in a test tube as a standard.
2. In another tube, take 1 ml. of serum and add normal saline until the colour matches with the standard.
3. The total solution in ml. gives the icterus index.
   The icterus index is markedly increased in jaundice.

3. **Clotting time**

It is the time between the appearance of blood and filling the tubes and formation of fibrin / clot.

Procedure :

1. Insert a sterile needle in the vein.
2. Start a stop watch when blood begins to flow out of the needle.
3. Collect about 2ml. of blood in a watch glass.
4. Plunge 6-8 capillary tubes into the blood and allow the blood to rise into the tubes by capillary action.
5. Break small pieces of the capillary tube at half minute interval.
6. Note the time when string of clot appears.

Clotting time is increased to 15-17 min. in fibrosis of liver.

Table - 19.3 : Normal values for icterus index and blood clotting time.

Species	Icterus Index	Blood clotting time
Cattle	8.4 - 9.8	7 min.
Buffalo	7.1 - 9.8	9 min.
Horse	15.5 - 18.0	11 min.
Sheep	6.8 - 10.7	2-3 min.
Dog	5.8 - 6.0	4 min.

RUMEN FLUID EXAMINATION

A] COLLECTION OF RUMEN FLUID :

The various methods of collection of rumen fluid are as follows :

1. **By paracentesis :**

Technique :

1. Restrain the animal properly
2. Clip the hair & sterilise the area with spirit swab, just below the paralumbar fossa.
3. Insert the sterile needle (4" long, 14 guage) in single stroke.
4. Connect glass or disposable syringe to the needle and aspirate about 5-10 ml rumen fluid by making to and fro movements.
5. Inject antibiotic & then withdraw the needle quickly in one jerk.

Advantage : Easy to perform

Disadvantages :

i) Larger amount of fluid can't be collected.

ii) There are chances of peritonitis.

iii) It is painful method.

2. **By passing probang :**

Technique :

1. Restrain the animal properly.
2. Put the mouth gag
3. Lubricate the probang.

4. Raise the head & pass the probang through mouth gag till it reaches rumen.
5. Then lower down the head slightly to collect rumen fluid.

3. By passing ruminal fluid extraction pump :

Technique :

1. Restrain the animal with nose grip.
2. Open the mouth by pulling out the tongue to one side or put the mouth gag.
3. Hold the head of animal high.
4. Then introduce the suction strainer until it reaches the rumen
5. Operate the suction pump & collect the required quantity of rumen fluid.

Advantages :

i) Large amount of fluid can be collected.
ii) No danger of peritonitis.

Disadvantages :

i) Need special equipment.
ii) Chances of injury to pharynx & oesophagus, if equipment is not operated properly.

B] EVALUATION OF RUMEN FLUID

Test	Observation	Inference
1. Colour :	1. Pure green to olive green	1. Feeding of green fodder
	2. Yellowish brown	2. Straw feeding
	3. Milky grey	3. Acid indigestion
	4. Dark brown	4. Alkaline indigestion
	5. Greenish black	5. Prolonged stasis / Impaction & vagus indigestion
2. Odour :	1. Aromatic, Vinegar like	1. Healthy animal
	2. Pungent / sour	2. Acidic indigestion
	3. Ammoniacal	3. Alkaline indigestion
	4. Putrid / fishy	4. Protein decomposition
	5. Musty or faecal	5. Vagus indigestion
	6. Bitter almond	6. HCN poisoning.
3. Consistency:	1. Slight viscous	1. Normal
	2. Porridge or gruel like	2. Acidic indigstion
	3. Hard caked, scanty	3. Impaction
	4. Foamy, semiliquid	4. Frothy bloat, D.H., Vagus indigestion
	5. Watery	5. Inactive rumen fluid
4. pH :	1. 6.3 - 7.0	1. Normal
	2. 5.6 - 7.4	2. Simple indigestion
	3. 4.0 - 5.5	3. Acid indigestion
	4. 7.5 - 8.5	4. Alkaline indigestion

5. Stratification or Sedimentation Activity Time (SAT) :-

Technique :

100ml freshly collected rumen content (filtered through gauze if necessary) is observd as it settles in a glass cylinder.

Interpretation :

Observation	*Inference*
1. Complete sedimentation & floatation in 4 - 8 minutes	1. Normal
2. Rapid sedimentation & absence or retardation of floatation	2. Starvation/Anorexia, feeding of poor quality feed
3. No sedimentation & floatation	3. Acute rumen acidosis, Vagus indigestion, Diphragmatic hernia

6. Cellulose Digestion Test (CDT) :

CDT is the time required for the cotton thread to get digested by microorganisms.

Technique :

1. Take 10 ml of strained rumen fluid strained through double layered muslin cloth in a glass cylinder.
2. Suspend single strand of cotton thread with a button or glass bead in rumen fluid.
3. Then tightly close the test tube & incubate at 37°C.
4. Observe the thread from time to time.
5. Break in thread indicates cellulose digestion time.

Interpretation :

1. The normal cellulose digestion time is about 30 hrs.
2. This is prolonged in ruminal disorder.

7. Methylene Blue Reduction Time (MBRT) :

MBRT is the time taken for reduction of methylene blue dye.

Technique :

1. Take 20 ml of strained, centrifuged rumen fluid.
2. Then add 1 ml of 0.5 % methylene blue solution and mix.
3. Incubate at 37°C.
4. Note the time required for discolouration of the sample.

Interpretation :

MBRT time		*Inference*
1. Upto 3 min.	-	Normal active microflora
2. Upto 3 - 5 min.	-	Only straw ration
3. More than 5 min	-	Rumen dysfunction

8. Microscopic Examination for Protozoa :

Procedure :

1. Place a drop of rumen fluid on clean glass slide.
2. Put coverslip & examine under low power.
3. Assess the characters like protozal motility, density & iodophilic activity.

a) *Protozoan motility* :

Motility	*Grade*	*Inference*
1. Swirls / vigorous	+ + + +	Healthy
2. Moderate	+ + +	Straw ration
3. Slow	+ +	Ruminal disorder
4. Wagging/sluggish	+	Ruminal disorder
5. No motility	0	Severe ruminal disorder

b) *Density* :

No. of protozoa per LPF	*Grade*		*Inference*
1. More than 30	+ + +	(Abundant)	Healthy
2. 10 - 30	+ +	(Moderate)	Mild ruminal dysfunction
3. 1- 10	+	(Few)	Moderate ruminal dysfunction
4. Nil	-	(None)	Severe ruminal dysfunction

c) *Iodophilic activity* :

Procedure :

1. Add a drop of Lugol's Iodine to 2-3 drops of rumen fluid on a glass slide.
2. Place a coverslip on it & examine under microscope.

Interpretation :

Iodophilic activity of protozoa can be recognised by 'Black Colouration' of starch content in the protozoa.

It can be graded as 0, +, + +, + + + depending on the quantity of starch content. The quantum of starch content of protozoa reflect the degree of digestive disorder.

CEREBRO-SPINAL FLUID EXAMINATION

A] COLLECTION OF CSF :

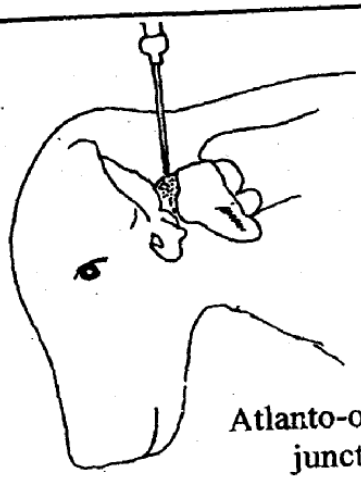
a) Sites for collection of CSF in animals :

Species	Needle		Site
	size	length	
1. Cattle, Buffalo	15-16 G	3.5"-4.5"	Lumbo-sacral junction
2. Sheep, Goat	16-18 G	2.5"	Lumbo-sacral junction
3. Horse	15- 16 G	3.5"- 4.5"	Atlanto-occipital junction
4. Dog, Cat	22-24 G	1.5"-2.5"	Atlanto-occipital junction or Cisterna magna

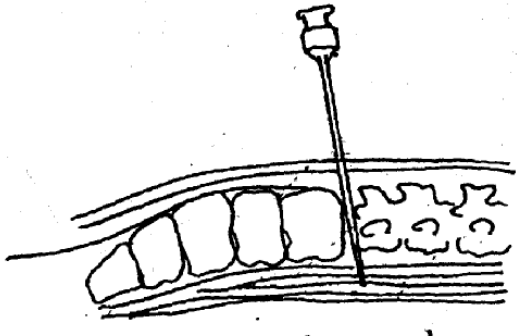
b) Technique for collection of CSF :

i) *Lumbo-sacral puncture* :

1. Prepare the site i.e. depression found in the midline between the spinous process of last lumbar vertebrae & sacrum surgically
2. Sedate the animal and give local anaesthesia
3. Insert the needle first vertically and then slightly oblique with gradual forward and backward adjustment.
4. Raise the jugular vein with digital pressure so that CSF flows dropwise otherwise suck with syringe.



Atlanto-occipital junction



Lumbo-sacral junction

Fig. - 19.9 : Sites for CSF collection

ii) *Atlanto-occipital area* :

1. Prepare the site surgically and give general anaesthesia.
2. Flex/bend the head of the animal forward and downward firmly.
3. Insert spinal needle perpendicular to the skin in the direction of nose.
4. Pass the needle slowly with stylet until a definite snapping sensation is felt at the hub.

B] EVALUATION OF CSF :

a) Physical Examination :

Test	Observation	Inference
1. Colour :	1. Colourless 2. Blood tinged 3. Yellow (Xanthochromia) 4. Gray / green	1. Normal 2. Haemorrhage 3. Jaundice 4. Suppuration
2. Transparency	1. Clear 2. Turbidity/white clots	1. Normal 2. Meningitis/Encephalitis
3. Coagulation	1. Absence of coagulation 2. Coagulation	1. Normal 2. Meningitis

b) Cytological examination :

1. *Total Leucocyte Count* :

Diluting fluid :

Glacial acetic acid - 10ml
Distilled water - 90ml
Crystal violet - 0.1gm

Filter the diluting fluid before use.

***Procedure* :**

1. Fill TLC pipette upto the mark 1 by diluting fluid.
2. Then suck CSF upto the mark 11.
3. Discard first 2 drops and charge the Neubauer's chamber.
4. Count the cells in all ruled areas on both the sides of chamber.
5. Multiply counted cells by 0.6 to get the total number of cells per mm^3.

Interpretation :

1. Normal counts : Cattle - upto 15/ mm^3.
   Dog, Horse - upto 25/mm^3.
2. High count i.e. pleocytosis - Meningitis, encephalitis, myelitis
3. Extremely high count - Pyogenic meningitis

2. Differential Leucocyte Count :

***Technique* :**

1. Centrifuge the fluid and discard the supernatant.
2. Prepare the smear from sediment.
3. Stain it with Giemsa/Leishman's stain.
4. Examine under microscope and count 100 cells.

Interpretation :

1. Presence of neutrophils - Brain abscess, Suppurative encephalitis meningitis
2. Increase in number of lymphocytes - Viral, fungal or chronic infections.

c) Chemical examination for proteins :

1. Pandy's method :

***Reagent* :** Carbolic acid 10gm + Distilled water 100 ml

Technique :

1. Take 1ml reagent in a test tube
2. Add few drops of CSF and mix properly.

Interpretation :

1. Slight turbidity - Normal
2. Marked turbidity - Brain diseases.

2. None-Apelt test :

1. Take 1ml of saturated ammonium sulphate in a test tube.
2. Layer 1ml of CSF.
3. Allow it to stand for few minutes.
4. White to greyish ring at junction indicates presence of globulin.

DISEASE DIAGNOSTIC TESTS

A] PULLORUM DISEASE

Rapid whole blood test/whole blood agglutination test.

1. Puncture wing vein of bird and take one drop of blood (0.02 ml.) on a slide/plate using platinum loop.
2. Add two drops (0.05 ml.) of coloured pullorum antigen.
3. Mix it in a circular fashion by rotating the slide for about two minutes.
4. Clumping within one minute denotes positive reaction.

B] BRUCELLOSIS

a) Plate agglutination test

1. Take one drop of serum on white enamel tile.
2. Place one drop of coloured antigen next to serum.
3. Mix serum and antigen with a broom stick.
4. Rotate the tile for 4 minute and then read it.
5. Clumping of stained antigen indicates positive test.

b) Milk ring test/ABRT (Abortus Bang Ring Test) :

1. Take 2 ml of milk into a test tube.
2. Add two drops of coloured antigen with 1 ml pipette.
3. Mix it by rotating test tube between palms.
4. Then incubate at 37°C in waterbath for 1 hour.
5. Remove the tube and keep it at room temperature for 1 hour.
6. Cherry red cream layer/ring at the junction indicates positive test.

C] GLANDERS

Mallein Test /Intradermopalpebral Test (IDP) :

1. Inject 0.2 ml of mallein intradermally into lower eyelid 2 cm below the eyelashes and read the test after 36 - 48 hours.
2. Oedema of eyelid, congestion of conjunctiva and mucopurulent ocular discharge indicates positive test.

D] TUBERCULOSIS

Tuberculin test

a) Single intradermal test (S I D)

1. Clip an area of about 4" in the middle of neck on left side.
2. Hold the skin tightly between the forefinger and thumb.
3. Then inject 0.1 ml tuberculin intradermally.
4. Diffuse swelling at the site of injection at 48 hours indicates positive test.

Disadvantages :1. Lack of specificity
2. Less sensitive

b) Double intradermal test (D I T)

1. Inject 0.1 ml tuberculin intradermaly in the middle of neck.
2. Diffuse swelling at site of injection at 48 hours indicates positive test.
3. If there is no swelling, then inject 0.1 ml of tuberculin at the same site.

4. The development of hot, painful swelling at the site after 72 hours indicates positive test.

Advantage : It is helpful in detecting poorly sensitized animals

False positive reactions	*False negative reactions*
1. Animals sensitized to Avian tuberculosis.	1. Incubating, advanced disease.
2. Animals vaccinated against tuberculosis.	2. Old age.
3. Animals infected with Johnes disease.	3. Recent calving/advance pregnancy.

D] JOHNES DISEASE

Johnin test

a) Intravenous Johnin test.

1. Inject 2 ml of Johnin into the jugular vein.
2. Rise in body temperature by 1.5°C at 6-8 hours indicates positive test.

Advantage : More accurate

Disadvantage : More quantity of Johnin is required.

b) Double Intradermal Johnin test.

1. Inject 0.1 ml Johnin intradermaly in the middle of neck.
2. Increase in skin thickness/swelling after 48 hours indicates positive test.
3. If there is no swelling after 48 hours then inject 0.1 ml Johnin at the site of first injection and examine at the end of 72 hours.
4. An increase in thickness of skin by 5 mm or more indicates positive test.

False positives	*False negatives*
1. Animal infected with tuberculosis.	1. Incubating or advance disease.
2. Animals sensitized to Avian tuberculosis	2. Advance pregnant or recently calved animals.

LIVER BIOPSY

Indications :

1. Fibrosis or neoplasms of liver
2. Metabolic diseases like Amyloidosis
3. Poisoning : Arsenic, molybdenum, selenium.
4. Estimation of Vit A, Vit E, Cu, Zn, Liver glycogen.

Limitations :

1. Focal lesions like abscess, neoplasms are easily missed.
2. Chances of peritonitis and damage to internal organs.
3. Biopsy is contraindicated in liver abscess.

Sites :

1. ***Cattle and buffalo*** : 11th - 12th intercostal space on right side. The site is located by extending a horizontal line cranially from the middle of the right paralumbar fossa to the 11th intercostal space.
2. ***Sheep*** : 8th intercostal space.

3. ***Dog*** **:** 7th intercostal space at the level of costo-chondral junction.
4. ***Horse*** **:** Right 14th intercostal space at the intersection of line drawn from tubercoxae to the point of shoulder.

Instrument : Vim - silverman needle or Tru-cut needle.

Technique :

1. Prepare the site aseptically
2. Infiltrate the local anaesthetic
3. Make small stab incision at the site with 11 No. blade.
4. Introduce stylet fixed biopsy instrument through incision in twisting manner till it enters liver capsule.
5. Then withdraw the stylet and push the biopsy needle about 1-1.5 cm deep into liver parenchyma.
6. Withdraw the biopsy needle and collect the tissue in 10% formalin.

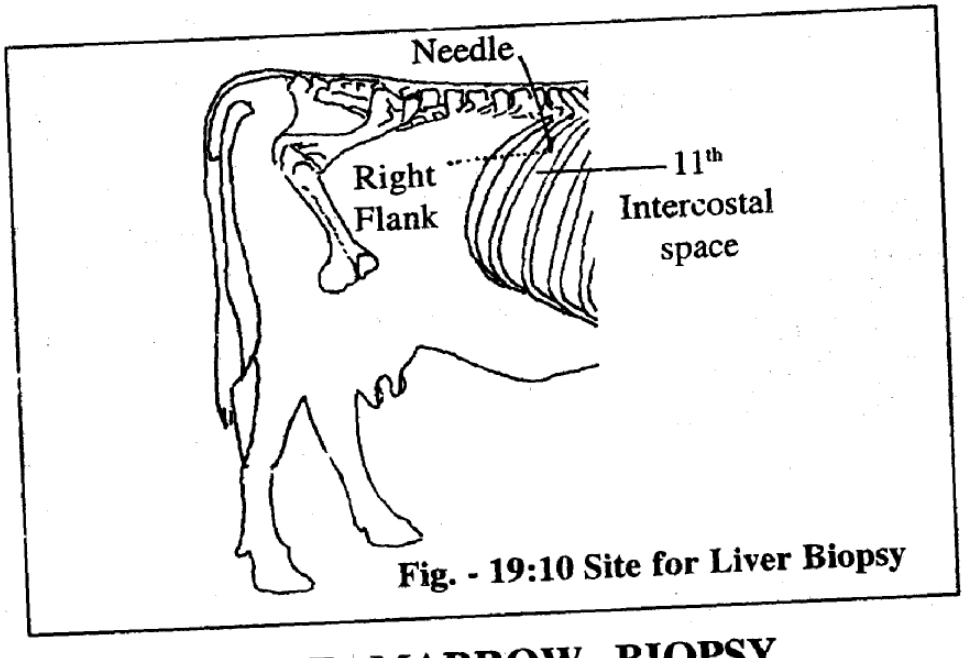


Fig. - 19:10 Site for Liver Biopsy

BONE MARROW BIOPSY

Indications :

1. Non-regenerative anaemias.
2. Neoplastic diseases of bone marrow.

Limitations :

1. It is difficult technique
2. Problems in collection of samples without contamination of blood.
3. Quantitative evaluation and accurate interpretation is difficult.

Sites:

1. Catte, Buffalo, Horse : ..... Iliac crest, Sternal crest, Rib (2" below the costo-vertebral articulation of 11th / 12th rib).

2. Sheep : ..... Sternum.
3. Dog : ..... Trochanter fossa of femur, Iliac crest, Sternum, Rib (junction of upper and middle third of 7/8/9th rib on right-side)

Technique :

1. Prepare the site aseptically.
2. Infiltrate the local anaesthetic.
3. Make small stab incision in the skin with scalpel blade No. 11
4. Pierce aspiration needle (16-18 gauze 1.5" long) through bone cortex by rotating movements.
5. Withdraw the stylet at the point when there is sudden reduction in resistance to the penetration of needle.
6. Attach heparinized syringe, aspirate the bone marrow and transfer it in vial.
7. Prepare the smear immediately and stain it with Giemsa.
8. Count atleast 500 nucleated cells for differential count.

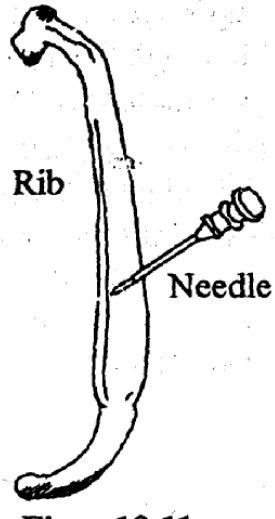


Fig. - 19.11 : Bone marrow biopsy

Interpretation:

M.E. Ratio : It is ratio of number of myeloid cells (granulocytes) to number of nucleated erythroid cells.

* The normal M.E. ratio in cattle is 1:15.
* *Increased M.E. ratio indicates* :
  a) Increased granulocyte production : Normal or neoplasms.
  b) Erythroid hypoplasia i.e. decreased erythroid cells : Chronic infections, renal diseases.
* *Decreased M.E. ratio indicates* :
  a) Decreased granulocyte production
  b) Increased erythroid cell production i.e. erythroid hyperplasia.
* *Normal M.E. ratio indicates* :
  a) Normal marrow
  b) Aplastic anaemia, Lymphosarcoma.

LYMPHNODE BIOPSY

Indications:

1. Diagnosis of infectious diseases like Theileriasis, Tuberculosis, Actinobacillosis, Equine Lymphangitis.
2. Confirmation of neoplasms of lymphoid organs e.g. Lymphosarcoma.

Technique:

1. Select affected / enlarged superficial lymphnode. Prescapular lymphnode is preferred for making lymph smear because it is easy to locate and handle.
2. Lymphnode is pulled anteriorly and hold firmly.
3. The needle is directly passed into the centre of gland and lymph is sucked with the help of syringe.
4. If the lymphnode is small, then inject 1-2 ml. of normal saline and after little massage, aspirate the fluid.
5. Place drop of aspirated fluid on slide and prepare the smear.
6. Stain it with Giemsa and examine it under oil immersion, for lymphocytes, bacteria or Koch blue bodies.
7. Collect a piece of lymphnode (0.5 - 1cm) and preserve it in 10% formalin for histopathological examination.

COLLECTION OF PLASMA AND SERUM

Indications :

1. Serum / Plasma : for biochemical analysis
2. Serum : For serological tests in diagnosis of infectious diseases

Technique :

A) *Plasma* :

1. Collect about 10-15 ml. of blood in anticoagulant vial.
2. Pour the blood in centrifuge tube and centrifuge it at 3000 rpm. for 15 minutes.
3. Transfer the supernatant i.e. plasma in a separate vial and label it.

B) *Serum* :

1. Collect about 10-15 ml. of blood in clean large bore test tube or glass vial.
2. Fill up only half of vial / test tube with blood.
3. Keep the vial or test tube undisturbed in slanting position and allow blood to clot.
4. Usually within 2-3 hours sufficient serum can be obtained. If serum is not clear then centrifuge it at 3000 rpm for 5 minutes.
5. Pour the clear serum in clean sterilized vial and label it.

Preservation :

1. ***Refrigeration*** **:** Serum/plasma samples can be preserved for 8 days at 2-8°C whereas it can be preserved for long duration at -20°C.
2. ***Chemical*** **:** Merthiolate 0.01% (1:1,0000)or Phenol (0.5%) 1ml for 10 ml serum.

BLOOD CHEMISTRY

The biochemical analysis of blood is of considerable value in confirming the diagnosis, giving prognosis and judging response to the treatement in various diseases.

Table - 19.4 : Pathological causes of variation in blood biochemicals.

Biochemical	Variation	Significance / Indication
1. Calcium	Low	Milk fever, Eclampsia, Rickets, Osteomalacia, Hypoparathyroidism, Hypoproteinemia.
	High	Hyperparathyroidism, Hypervitaminosis-D,
2. Inorganic Phosphorus	Low	Post parturient Haemoglobinuria Osteomalacia, Rickets, Pica.
	High	Hypervitaminosis-D, Severe renal damage.
3. Magnesium	Low	Whole milk tetany in calves, Grass/lactation tetany.
4. Glucose	Low	Ketosis in cattle, Starvation, Pregnancy toxaemia in sheep, Adrenocortical insufficiency.
	High	Diabetes mellitus, Stress, Anoxia.
5. Urea	Low	Nephritis, Urolithiasis
	High	Low protein diet, Liver dysfunction.
6. Creatinine	High	Nephritis, Wasting diseases
7. Bilirubin	High	Haemolysis, Hepatitis, Biliary obstruction.
8. Sodium	Low	Diarrhoea, Salt deficiency, Excess sweating.
9. Potassium	Low	Vomition, Diarrhoea.
	High	Acidosis.
10. Bicarbonate	Low	Acidosis, Acid indigestion.
	High	Alkalosis, Urea poisoning.
11. Chloride	Low	Vomition, Diarrhoea, Salt deficiency.
12. SGPT & SGOT	High	Hepatic dysfunction, Myocardial infarction, Muscular dystrophy.

Table - 19.5 : Normal serum / Plasma biochemical values

Parameter	Cattle	Buffalo	Sheep	Goat	Horse	Dog
Calcium (mg %)	8-12	8-12	11-13	8-12	11.2-13.8	8.6-11.2
Phosphorus (mg %)	4-7	5-7	4-7	3-11	3.1-5.6	2.2-5.5
Magnesium (mg %)	1.7-3.5	2-3.4	1.9-2.5	2-3	1.8-2.5	1.8-3.0
Glucose (mg %)	35-55	50-70	30-65	45-60	60-100	60-110
Cholesterol (mg %)	39-177	10-100	40-58	55-200	46-77	110-250
Urea (mg %)	6-27	5.6-7.8	8-20	13-28	10-20	12-25
Creatinine (mg %)	1-2.7	1-2	1.2-3.9	0.9-1.82	1.2-1.9	0.5-1.5
Total Proteins (g %)	5.7-8.1	6-8	6.0-7.9	6.25	6.0-7.7	5.4-7.7
Bilirubin (mg %)	0-1.9	0.3-0.4	0-0.4	0-0.1	0.2-6.0	0.1-0.6
Sodium (mmol /L)	132 -152	145-150	145-160	137	132-150	147-153
Potassium (mmol /L)	3.9-5.8	5-6.2	4.8-5.9	3.6	4.7-7.1	3.7-5.8

COMPTON METABOLIC PROFILE TEST

This test as carried out to determine metabolic status of herd / individual animal.

Objectives :

1. Helps in early detection of subclinical metabolic disorders.
2. Gives guidelines for correction in feeding strategy.
3. Aids in selection of superior individuals and prediction of future production potential.

Limitations :

1. It is expensive
2. It is useful for diagnosis and prognosis in extreme variations from normalcy.
3. It is reliable on herd basis however less reliable in individual.

Methodology / Procedure :

a) ***Data collection*** **:**

1. For conducting this test on herd, information regarding average daily feed intake, nutritional composition of feed, total herd production, number of cows in milk, recent milk quality data, rate of decline in production should be recorded.
2. For individual animal, a data of age, exact milk yield, mastitis status, date of calving, amount of concentrate and forage offered should be collected.

b) ***Blood sampling*** **:**

1. The blood samples are collected from 3 groups comprising seven animals each. viz. dry, medium and high yielding cows.
2. The samples are collected atleast 3 times in a year in different seasons coinciding the time of suspected nutritional imbalance.
3. Collect about 5 ml blood in anticoagulant vial for Hb and PCV estimation while about 10-20 ml of blood for analysis of serum biochemicals.
4. Blood should be collected at same time with minimum excitement of animal and should be sent immediately to the laboratory.

c) ***Blood / serum analysis*** **:**

In this test blood / serum samples are analysed for

* Haemoglobin, packed cell volume
* Serum glucose, protein, albumin, urea-nitrogen
* Serum inorganic phosphorus, calcium, magnesium, sodium, potassium. In specific cases serum iron, copper and plasma non-esterified free fatty acids are also estimated.
* In some cases urine is collected for monitoring ketone bodies and results are correlated with blood glucose levels.
* Mini-profile test can also be conducted by estimating blood/serum glucose, urea - nitrogen and albumin in cows 4-10 weeks after calving to know adequacy of energy and protein intake.

Observations and interpretation :

* The results obtained are compared with normal values and interpreted.
* The final interpretation should be done after taking into account the herd individual information collected, physiological status and common causes of variation.

Observation	Interpretation	Dietary supplementation Suggested
1. Low glucose	Energy inadequacy	Energy rich concentrates e.g. maize, jowar.
2. Low urea, proteins, Hb and PCV values	Low protein status	Protein-rich concentrates e.g. oil cakes, pulse chuni
3. Low Ca, P, Mg, Na level.	Specific mineral deficiency	Mineral supplementation.

BACTERIOLOGICAL TECHNIQUES

A.G. Karpe

1. SIMPLE STAINING

Simple staining solution contains only one stain dissolved in a solvent, e.g. dilute carbol fuchsin, methylene blue etc.

A] Positive staining :

Methylene blue staining :

This is useful for studying the morphology of bacteria.

***Reagent* :**

Saturated solution of methylene blue in alcohol - 300 ml.
(1.5 g Methylene Blue in 100 ml. of 90% alcohol)
Potassium hydroxide (1% aqueous solution.) - 10 ml.
Distilled water - 990 ml.

***Method* :**

1. Prepare a smear, allow to dry and then fix with gentle heat.
2. Apply the stain for 3 minute.
3. Wash with water and blot dry.

***Result* :** Bacteria stain blue.

B] Negative stain :

This is useful for studying the morphology of bacteria.

India ink method :

***Reagent* :**

India ink (as available commercially)

Method **:**

1. Mix a small quantity of India ink on slide with the culture or specimen containing bacteria.
2. Make a thin film with the help of platinum loop or another glass side.
3. Allow to dry.

Result **:** Bacteria are seen as clear transparent objects on a dark brown background.

2. GRAMS STAINING

Gram staining classifies bacteria into two groups :

1. Gram positive : Stains dark purple / Violet.
2. Gram negative : Stains pink.

Reagents :

Crystal violet, Grams iodine solution, 95% alcohol (ethanol), Safranin solution.

Principle :

* *The crystal violet* stains all bacteria deep violet.
* *Iodine solution* fixes the violet colour more or less strongly in the bacteria.
* *95% ethanol* decolourizes certain bacteria when the violet stain is not strongly fixed by iodine solution. It does not decolourize other bacteria when the violet stain is strongly fixed by iodine solution.
* *Safranin solution* : Restain (Pink) the bacteria discoloured by ethanol. It has no effect on the other bacteria which remain dark violet.

Technique:

1. Fix the smear and allow to cool.
2. ***Crystal violet*** - 1 minute.
* Pour the crystal violet on the slide to cover it completely. Leave for 1 minute.
* Rinse with tap water and drain.
3. ***Gram's Iodine solution*** - 2 minutes.
* Flood the slide with Gram's Iodine solution and let it stand for 2 minutes.
* Drain off the solution and rinse with tap water.
4. ***95% ethanol*** - 1/2 minute:
* Cover the slide with 95% ethanol. Leave for 1/2 minute.
* Flood with water and drain.
* Look at the smear : If violet patches remain, treat it again with ethanol for 15 to 30 seconds.
* Rinse well with water and drain.
5. ***Safranin solution*** - 10 sec.
* Leave safranin on the slide for 10 sec.
* Wash briefly with tap water once.
* Drain and allow to dry in the air.

What to look for ?

* ***Bacteria stained deep violet*** : Gram positive e.g. Staphylococci, Streptococci, Micrococci, Pneumococci, Enterococci, Diphtheria bacilli, Anthrax bacilli.
* ***Bacteria stained pink*** : Gram negative. e.g. Gonococci, Meningococci, Coliform bacilli, Salmonella.

Sources of error.

I. *False Gram positive reactions* may occur because :

1. The smear was fixed before it was dry.
2. The smear was too thick.
3. There was sediment in the bottle of crystal violet. (filter before using)
4. The Gram iodine solution was not thoroughly drained off.
5. The ethanol was not left long enough.
6. The safranin solution was too strong or was left on the slide too long.

II. *False Gram negative reactions* may occur because :

1. The Grams iodine solution was not left long enough.
2. The ethanol was left for too long and not washed off properly.

3. ZIEHL-NEELSEN'S STAINING

Principle :

The Mycobacteria are acid fast, i.e. once they are stained red by carbol fuchsin they cannot be decolourized by acid or alcohol.

Carbol fuchsin : Stains all the organisms red.

Acid and ethanol : Decolourize all organisms and cellular elements except acid fast bacilli.

Methylene blue : Stains blue all the organisms and elements decolourized by the acid and ethanol, but the acid fast bacilli remain red.

Reagents :

1. ***Carbol fuchsin for Ziehl - Neelsen stain*** : This should preferably be filtered before use. Fresh stain should be prepared every three months.
2. 25% Sulphuric acid.
3. 90% Alcohol or Methylated spirit.
4. Aqueous methylene blue.
5. Methylated spirit (for burning).

   Add acid very carefully to water in a large boiling flask, constantly mixing the contents. The flask should be kept in a sink filled with water for cooling the contents. Store in a glass stoppered bottle.

Technique

1. Prepare the smear and heat fix and allow it to cool.
2. Place the numbered slides on two glass rods over the staining tray with the smears facing upwards.

3. ***Carbol fuchsin staining*** - 5 min. with heat.
* Cover the smear with piece of cut filter paper. Pour carbol fuchsin from a drop bottle on the filter paper till it is completely covered.
* Dip the cotton wool swab in the methylated spirit, ignite and pass slowly under the slide to heat it. As soon as steam begins to rise, set the timer at 5 min. After 2½ min. heat it once again until steam is seen, but do not let it boil.
* At the end of another 2½ min. remove the filter paper.

4. Wash with distilled water :
* Cool the slide.
* Drain off the stain.
* Wash the slide gently with water until the water that runs off is colourless.

5. ***Decolourization with acid and ethanol.***
* Cover the slide with 25% sulphuric acid.
* Let it act for 5½ min. to remove the colour of carbol fuchsin.
* Wash the slide in tap water and drain.
* The smear may now have a faint pink colour.
* Pour 90% alcohol or methylated spirit on the smear and leave for 2 min.
* Wash with water and drain.

6. ***Methylene blue counterstaining*** - 10 sec.
* Cover the slide with the stain
* Leave for 10 sec.
* Wash well with tap water and drain.
* Leave to dry in air on a slide rack.

What to look for ?
* See under oil - immersion objective.
* Tuburcle bacilli are bright red on a blue background, straight or slightly curved quite short (1-4 μ), often granular and arranged in groups of 3-10 bacilli , like bits of strings or forked shapes.

4. DRUG/ ANTIBIOTIC SENSITIVITY TEST

Clinical definitions :

Sensitive : An organism is said to be sensitive to a drug, when the infection caused by it, is likely to respond to treatment at the normal dosage.

Moderately or intermediate sensitive : The organism is likely to respond only to higher dosage of the drug.

Resistant : The organism is not likely to respond to even higher dosage of the drug.

Bauer and Kirby's disc diffusion method :

This disc diffusion method provides a simple and reproducible means of testing bacterial susceptibility to different antibiotics.

Reagents :

1. Nutrient broth.
2. Mueller Hinton agar pH - 7.2 - 7.4 or Nutrient agar.

Technique:

1. Mueller Hinton Agar or Nutrient Agar plates are dried at 37°C for 30 minute before inoculation.
2. Inoculate nutrient broth with a loopful of bacterial culture.
3. Incubate the inoculum for 2-4 hr. at 37°C to obtain necessary turbidity.
4. Using a sterile cotton swab, spread the test culture evenly over nutrient agar plate to obtain even microbial growth after incubation.
5. Allow the plate to dry for 3-5 min. Place antibiotic discs on the surface, 15 mm from edge of plate with a distance of 24 mm between discs. Incubate at 37°C for 18 hr.
6. Measure the zones of inhibition in mm including disc diameter. Faint growth, swarming etc near the edge of zone of inhibition are ignored.
7. Record the results as "sensitive", "Intermediate / moderately sensitive" or "Resistant" according to the interpretation chart provided by the manufacturer of the antibiotic discs.

Note:

1. High concentration discs should be used for urine and stools.
2. Fastidious organisms requiring increased CO_2 tension or an aerobic atmosphere and slow growers cannot be tested by this method.
3. If necessary plates may be read after 6-8 hr of heavy inoculation.

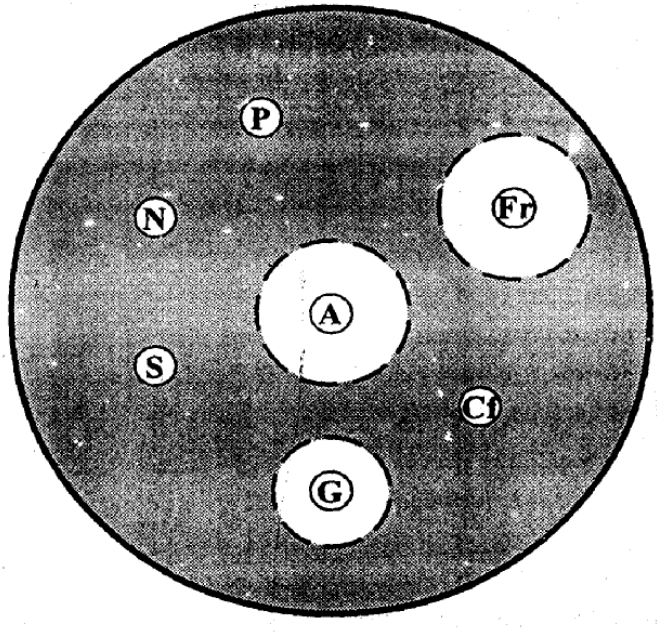


Fig. - 19.12 : Zones of inhibition due to antibiotics

COLLECTION AND DISPATCH OF MATERIALS FOR LABORATORY INVESTIGATION

M.A. Khan and A.U. Bhikane

Materials for laboratory investigation of disease is collected from living (Ante-mortem) or dead animal (Post-mortem)

In this topic,some diseases with similar signs, and lesions are grouped and material in common to be collected is listed. This is for easy rememberance to clinician and autopsists to send material which will also help in differential diagnosis in laboratory.

In order to achieve correct diagnosis the proper material is to be collected from ailing or dead animal and be send as early as possible to laboratory.

Labelling and identification of specimens :

* Name and address of owner
* Species, age, sex and breed of animal
* Morbidity and mortality percentage.
* Clinical signs recorded.
* Lesions found
* Estimations desired
* Suspected for ....
* Material collected.
* Name and address of clinician or autopsists.

Collection and despatch of material for different laboratory examinations

1. ***Histopathological*** **:**
   * Material at antemortem or postmortem is collected in wide -mouth bottle containing formal saline (10%) / Zenker's fluid.
   * Collect pieces of 2 to 3 cm thickness from tissue showing gross lesions along with normal tissue and then add 10 to 20 times preservative to it.

   Formal saline (10%) solution :

Formalin (40% formaldehyde soln)	100 ml
Sodium chloride	8.5 gm
Distilled water	900 ml.

   Zenker's fluid :

Potassium dichromate	25 gm
Mercuric chloride	50 gm
Sodium sulphate	10 gm
Distilled water	1000 ml

   Add glacial acetic acid 50 ml to above solution just before use.

2. ***Bacteriological*** **:**

   Send material in sterilized vials in referigerated condition (+4°C) i.e on ice. No preservative should be added.

3. ***Mycological*** :

Skin scrapings \ Scales collected in paper (dry) without any preservative.

4. ***Virological*** :

* Material should be sent on ice within 24 hrs for tissue culture.
* 50% Glycerine phosphate buffer (GPB) is used in general for biological test.

50% GPB

Phosphate buffer :

Solution - I

i) Disodium hydrogen phosphate	7.13 gm
ii) Distilled water	1000 ml

Solution - II

i) Potassium dihydrogen phosphate	5.45 gm
ii) Distilled water	1000 ml

Mix six parts of solution-I and one part of solution-II and adjust PH to 7.2.
Mix equal parts of phosphate buffer and glycerine to make 50% GPB solution.

Oxalate - Carbolic Acid Glycerine (O.C.G.)

Potassium oxalate	50 gm.
Phenol / Carbolic acid	50 gm.
Glycerine	500 ml.
Distilled water	500 ml.

5. ***Serological*** :

Collect paired sera i.e. one at onset of disease and other at 2-3 wks later for serological /immunological tests.

6. ***Biochemical*** :

Collect and send serum/ plasma samples for blood biochemical analysis on ice

7. ***Parasitological*** :

* Faecal sample is collected and preserved in 10% formal saline for identification of parasitic eggs\cysts.
* Endoparasites are collected in 5% hot formalin or 70% hot alcohol till examination and then preserved in 10% formal saline.
* Ectoparasites are collected and preserved in 70% alcohol.
* For mange, mites skin scrapings are preserved in 10% potassium hydroxide (KOH) solution.

8. ***Toxicological*** :

* Samples should be labelled as "Suspected for poisoning"
* Send stomach and intestinal contents ,liver, kidney in saturated solution of sodium chloride or in strong unmethylated spirit in glass container.
* Material should be sent immediately through messenger, not by post, to forensic laboratory.

* The following are the minimum quantities of the specimen to be sent for toxicological examination :

1	Blood	30 to 50ml
2	Urine	All available
3	Stomach and Intestinal contents	500 to 1000 gms
4	Liver	500 to 1000 gms
5	Brain	Entire
6	Kidneys	One
7	Fat	200gm
8	Hair	5 to 10 gms

Material collections for laboratory diagnosis of diseases

Name of the disease and material collection at antermortem	Material collection at postmortem
A) BACTERIAL DISEASES :	
1. Anthrax :	
* Blood smear from ear vein or tail * Citrated blood in vial on ice (I)	* Piece of ear/muzzle on ice (I) * Swab of blood or exudate on ice(I) * Piece of spleen and lymphnode on ice, if carcass is opened (I).
2. Black-quarter	
* Exudate smears * Exudate from swelling in vial on ice(I)	* Exudate smears. * Pieces of affected muscle on ice(I) and 10% formal saline (H.P.)
3. Haemorrhagic Septicaemia :	
* Blood and exudate smears. * Whole blood and odematous fluid in sterile vial on ice (I)	* Smears from odematous fluid. * Heart blood swab, pieces of lung, spleen, liver, intestine on ice (I) and in 10% formal saline (H.P.)
4. Enterotoxaemia :	
* Faecal smears * Urine in vial on ice (I)	* Loop of intestine tied at both ends plus few drops of chloroform on ice (ST)
5. Botulism :	
* Suspected feed. * Blood	* Stomach and intestinal content plus few drops of chloroform on ice (ST)

6. Infectious abortions :

***Dam* :**

* Smears from vaginal discharge
* Cervical and vaginal swabs (I)
* Serum samples on the day of abortion and 21 days after abortion (ST)

***Sire* :** (In case of natural service)

* Preputial washings and semen (I)
* Serum sample.(ST)

Aborted foetus : Abomasal content heart blood, piece of lung, foetal membranes, bone, liver on ice (I)

7. Actinobacillosis / Actinomycosis :

* Heat fixed pus smears from lesion.
* Pus in sterile tube on ice.(I)
* Pus smears and pus in vial on ice(I)
* Pieces of lesions in 10% formal saline (H.P.)

8. Tuberculosis :

* Smears of sputum and nasal discharge.
* Sputum swab, milk from affected quarter and faeces (I)
* Lymphnode biopsy on ice (I)
* Heat fixed impression smears from lesions.
* Involved lymphglands in 50% GPB (I)
* Pieces of affected organs in10% formal saline (H.P.)

9. Johne's disease :

* Heat fixed smears from rectal mucosal pinch.
* Swab from rectal mucosa.(I)
* Impression smears from ileocaecal valve and mesentric lymphnode.
* Portion of affected bowel in 25% Glycerol saline (I)
* Pieces of bowel and mesenteric lymph gland in 10% formal saline (HP).

10. Mastitis :

* Milk from affected quarter on ice before treatment.(I)
* Blood smear.
* Milk and pus from affected quarter on ice (I)

11. Contagious bovine \Caprine pleuro-pneumonia :

* Serum and nasal discharge (I)
* Mediastinal lymph node, piece of lung and pleural fluid on ice (I)
* Piece of lung and lymph node fixed in Zenkers fluid (H.P.)

12. Glanders and Strangles :

* Smears from pus and nasal discharge.
* Nasal discharge and pus in vial on ice(I)
* Smears of discharge and affected parts
* Pieces of lung and other lesions on ice (I) and in 10%formal saline (H.P.)

B) VIRAL DISEASES :

1. **Foot and Mouth Disease (FMD) : Vesicular Exanthema, Vesicular Stomatitis.**
   * Epithelium covering vesicles in 50% GPB vial or on ice (I)
   * Vesicular scrapings, pieces of heart, spleen and pancreas in 50% GPB vials or on ice (I)
   * Pieces of heart and other affected organs in 10% formal saline (H.P.)

2. **Rinderpest (RP), Mucosal disease (M.D.) : Peste des petits ruminants (PPR)**
   * Blood at hyperthermic phase on ice (I)
   * Paired sera samples on ice (ST)
   * Mouth lesions in 50% GPB vial on ice (I)
   * Lymphnode biopsy on ice (I).
   * Pieces of spleen and mesentric lymph nodes on ice (I)
   * Pieces of spleen, lymphnode, lung & intestine in 10% formal saline (H.P.)

3. **Bovine Malignant Catarrh (BMC) :**
   * Citrated blood at hyperthermic phase on ice (I)
   * Paired sera samples (SE)
   * Superficial lymphnode on ice (I)
   * Brain, lymphnode, liver, adrenal gland and kidney pieces in 10% formal saline (H.P.)

4. **Infectious Bovine Rhinotracheitis :**
   * Nasal swab, nasal discharge and vaginal mucosa in Earl's soln in vial on ice (I)
   * Serum samples (ST)
   * Lung piece on ice (I)
   * Piece of lung, trachea and turbinate bone in 10% formal saline (H.P.)

5. **Blue Tongue :**
   * Blood in OCG at hyperthermic phase on ice (I)
   * Mouth lesions in 50% GPB (I)
   * Paired sera samples on ice (ST)
   * Pieces of spleen and lymphnode on ice (I)
   * Pieces of papillary and gluteal muscles and all vital organs in 10% formal saline (H.P.)

6. **Contagious Ecthyma / Pox :**
   * Scabs dry or in 50% GPB vials (I)
   * Scabs dry in 50% GPB vial (I) and in 10% formal saline (H.P.)

7. **Rabies :**
   * Saliva and ocular discharge in sterile vial on ice (I)
   * Corneal impression smears.
   * Impression smears from cornea and brain.
   * Half of brain (Hippocampus) in 50% GPB on ice.
   * Half of brain in 10% formal saline and Zenker's fluids separately (H.P.)

8. **Canine Distemper (CD) :**
   * Citrated blood on ice and nasal discharge in 50% GPB vial / ice (I)
   * Pieces of spleen, brain and lung in 50% GPB vial / on ice (I) and in 10% formal saline (H.P.)

9. Infections Canine Hepatitis (ICH) :

* Serum (ST)
* Mediastinal lymphnode on ice (I)
* Pieces of liver, gall bladder, kidney, in 10% formal saline (H.P.)

10. Canine parvo-virus (C.P.V.) :

* Vomitus and faeces in sterile vial on ice (I)
* Paired sera samples (ST)
* Mesentric lymphnode on ice (I)
* Pieces of vital organs in 10% formal saline (H.P.)

11. Equine Infectious Anaemia (EIA) :

* Whole blood (I)
* Serum
* Spleen in 50% GPB/Frozen (I)
* Pieces spleen & liver (H.P.)

12. South African Horse Sickness :

* Nasal discharge on ice (I)
* Blood at hyperthermic phase on ice / OCG (I)
* Paired sera samples (ST)
* Spleen and brain on ice / OCG (I)

13. Swine Fever (Hog cholera) :

* Whole blood and citrated blood at hyperthermic phase on ice (I)
* Paired sera samples on ice (S.T.)
* Pieces of spleen, liver, kidney, lung in 50% GPB or on ice (I)
* Pieces of kidney, small intestine, brain&mesenteri clymphnode (H.P.)

C) PROTOZOAN DISEASES :

1. Surra / Anaplasmosis / Babesiosis :

* Peripheral blood smears
* Citrated blood
* Impression smears from lungs, liver, spleen and brain.

2. Theileriosis :

* Peripheral blood smears
* Citrated blood
* Smear from enlarged lymphnode
* Impression smears from lymphnodes & visceral organs
* Pieces of affected organs and lymphnode in 10% formal saline (H.P.)

3. Coccidiosis :

* Faeces in 2% potassium dichromate solution.
* Mucosal scraping in 2% potassium dichromate or in 1% formalin
* Piece of intestine in 10% formal saline (H.P.)

D) POISONINGS :

1. Cyanide / HCN / Nitrate and Nitrites :

* Oxalated blood, Urine
* Suspected feed / water
* Stomach content
* Liver

2. Insecticide :

* Oxalated blood, whole blood
* Suspected feed / water
* Stomach content
* Liver, Fat

3. **Lead / Arsenic :**
   * Acute - Urine, blood
   * Chronic - Hair

   * Liver, Kidney, Stomach contents
   * Bone, Hair, Liver, Kidneys

4. **Rodenticides / Strychnine :**
   * Urine

   * Stomach content, Liver

5. **Fluorosis :**
   * Urine, Blood

   * Bone, Liver, Kidney, Heart

E) POULTRY DISEASES :

a) ***Viral Diseases :***

1. **Newcastle diseases (Ranikhet Diseases) :**
   * Serum samples
   * Dried droppings
   * Ailing birds

   * Lungs, air sac, proventriculus, spleen and brain in 50% GPB (I)
   * Piece of intestine, proventriculus, liver, spleen, caecal tonsils and brain in 10% formal saline (H.P.)

2. **Infectious Bronchitis/ Infectious Laryngotracheitis :**
   * Paired sera or sera samples

   * Sterile swab from trachea and lungs in 2ml broth containing Penicillin 1000 IU/ml and streptomycin 10mg/ml (I)
   * Piece of trachea and lungs on ice (I) and in 10% formal saline (H.P.)

3. **Marek's Disease :**
   * Sera sample, citrated blood and base of feather follicle dry on ice (I)
   * Ailing birds

   * Piece of sciatic, vagus nerve and organs showing lesions in 10% formal saline (H.P.)

4. **Fowl pox:**
   * Scabs / pox lesions in 50% GPB (I)

   * Lesions in 50 % GPB

5. **Avian leukosis complex : (Lymphoid leukosis)**
   * Blood smears
   * Ailing bird

   * Affected organs in 10% formal saline (H.P.)

6. **Infectious Bursal Disease (I.B.D.) :** (Gumboro Disease)
   * Paired sera
   * Ailing bird

   * Bursa and kidney on ice (I)
   * Pieces of lung, liver, heart, spleen, kidney, & bursa (H.P.)

7. **Egg Drop Syndrome:**
   * Serum

   * Piece of liver in formalin (H.P.)

8. **Inclusion body hepatitis:**
   * Serum

   * Liver & Bursa of fabricius on ice (I)
   * Pieces of liver in formalin (H.P.)

b) *Bacterial Diseases* :

1. **Bacillary White Diarrhoea (B.W.D.) : Fowl typhoid / salmonellosis**
   * Serum of sick & recovered birds (ST)
   * Ailing bird (H.P.)
   * Liver, spleen, bone marrow, intestine, gall bladder on ice.
   * Liver, spleen, lungs in formalin
2. **Fowl cholera :**
   * Blood smears
   * Blood on ice (I) heart
   * Heart blood & spleen on ice (I)
   * Impression smears from liver &
3. **Infectious coryza :**
   * Swab from nasal exudate on ice (I)
   * Pieces of all visceral organs (H.P.)
   * Swabs from infraorbital sinus, trachea, nasal exudate on ice. (I)
   * Piece of nose, trachea, lungs (H.P.)
4. **Colisepticaemia :**
   * Ailing bird
   * Pieces of liver, heart, air sacs and intestines in formalin (H.P.)
   * Swabs from spleen and heart blood on ice (I)
5. **Chronic respiratory disease :**
   * Ailing bird
   * Serum
   * Trachea tied at both ends on ice (I)
   * Pieces of lungs and air sacs (H.P.)

c) *Other Diseases* :

1. **Coccidiosis :**
   * Faeces in 2% potassium dichromate
   * Caecal scrapping and faeces in 2% potassium dichromate solution.
2. **Spirochaetosis :**
   * Ailing birds and ticks
   * Blood smears and blood in citrate vial at hyperthermic phase (I)
   * Impression smears of spleen and spleen on ice (I)
   * Pieces of affected organs in 10% formal saline (H. P.)
3. **Aspergillosis :**
   * Ailing bird (I)
   * Lung/caseous masses from air sac
   * Lung & trachea in 10% formalin (HP)
4. **Mycotoxicosis**
   * Ailing bird
   * Suspected feed
   * Suspected feed

Note - **I :** Isolation
HP: Histopathological examination
ST: Serological tests

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CHAPTER - 20 : DRUG THERAPY

TERMS IN USED PHARMACOLOGY

Antibiotics : These are antibacterial substances produced by mould or bacteria.
Anthelmintics : Drugs which kill or removes worms.
Deworming : Administering suitable drugs to kill or expel intestinal worms and parasites.
Parasiticides : Drugs which destroy parasites on the skin.
Antipyretics : Drugs which reduce body temperature in fever.
Analgesics : Drugs which relieve pain.
Anti-inflammatory : Drugs which reduce the inflammation
Antihistaminics : Drugs which counteract various reactions caused by histamines.
Stomachics : Drugs which stimulate gastric secretions.
Carminatives : Drugs which prevent the formation of gases and helps in their expulsion from the stomach and intestine.
Antacids : Drugs which neutralise the acidity in the stomach.
Emetics : Drugs which cause vomiting.
Antiemetics : Drugs which prevent vomiting.
Antizymotics : Drugs which arrest or control fermentation.
Astringents : Drugs that cause constriction of mucus surfaces, stop secretion and check discharges.
Purgatives : Drugs which increase the evacuation of the bowels.
Laxatives : Drugs which produce normal stool or faeces.
Antispasmodic : Drug which relieves spasm of bronchi or intestine.
Expectorant : Drugs which increase, liquify and expel bronchial secretions.
Analeptics : Drugs which increase the depth and the number of respirations.
Diuretics : Drugs which increase the secretion and flow of urine.
Urinary sedatives : Drugs which relieve the irritation of the urinary tract.
Keratolytics : Drugs which dissolve scales on the surface of the body.
Emollients : Drugs which have a soothing, protecting and softening influence on the part to which they are applied.
Counter-irritants : Drugs which act against an existing irritation or inflammation.
Caustics : Drugs that cause the death of the tissue.
Styptics : Drugs which control the bleeding.
Haematinics : Drugs which increase the number of red blood cells or the haemoglobin content of blood.
Antiseptics : Drugs which inhibit the growth of bacteria.
Disinfectants : Drugs which kill the bacteria and their spores.
Ecbolics : Drugs which cause contraction of uterus.
Galactagogues : Drugs which increase the secretion of milk.
Euthansia : Painless killing of animals.

Myotics : Drugs which produce contraction of the pupil.
Mydriatics : Drug which produce dilatation of the pupil.
Liniments : is a liquid preparation in oil, alcohol or soap solution for external use.
Ointments : are semisolid soft preparations in fatty, oily or paraffin base for external use.
Cream : is a soft or semisolid preparation for external application.
Lotions : are solutions or drugs generally prepared in water for external use.

ADMINISTRATION OF DRUGS

Administration of drugs orally (per os i.e. mouth)

1. ***Bolus/tablets/capsules*** :
   i) *Bolus* : are solid, long, flat-large sized bodies containing medicines.
   ii) *Tablets* : are solid, round, flat bodies containing medicine/drug.
   iii) *Capsule* : is a gelatin sac containing some nauseous or disagreeable drug.

   Technique :
   1. First raise the head of animal.
   2. Then introduce left hand through interdental space and grasp the tongue.
   3. Hold the bolus in between fingers of right hand.
   4. Then pass the bolus along the palate & place it in the region of pharynx.
   5. Then withdraw both the hands simultaneously.
   6. Keep the head slightly raised for sometime.

2. ***Powders*** :
   These are adminstered in feed or in drinking water. If the powder is of small bulk it can be smeared on tongue.

3. ***Electuries*** :
   1. These are prepared by mixing powdered medicines with honey, treacle or jaggery.
   2. These are the safest means of administering drugs by mouth to domestic animals.
   3. These are particularly advised in respiratory affections.
   4. These are smeared on tongue by hand.

4. ***Drenches*** :
   1. These are prepared by mixing or dissolving drug in water.
   2. The act of giving drenches is called as "*Drenching*".
   3. Drenching is done with drenching bottle in cattle & stomach tube in equines.
   4. Feeding cups are used for giving drenches in calves, sheep & goat.

   Technique :
   1. First raise the head slightly so as to bring the head and neck in straight line.
   2. Then pass fingers of left hand over tongue through interdental space but tongue should be left loose.
   3. Pass drenching bottle from other side & pour medicine.

Administration of Drugs Per Nose

1. ***Nasal douche*** :
   It is simple irrigation of the nostril with a non-irritating antiseptic lotion.
2. ***Inhalation or vapour*** :
   1. Fill the bucket with boiling water.
   2. Pour volatile drugs like eucalyptus oil, oil of terpentine or Tr. benzoin.
   3. Hold the head of the animal over the vapours of drug so that it may breath in the vapour.

Administration of Drugs Per Rectum

1. ***Enema*** :
   1. This is the technique of giving liquid drugs through rectum.
   2. Enema pot & Enema syringe are used for this purpose in large & small animals respectively.
   3. Soap water or glycerine enema is usually given for evacuation of bowels in cases of constipation.
2. ***Suppositories*** :
   1. These are the conical bodies inserted into the rectum.
   2. These are given in cases of constipation.

Administration of Drugs Through Uro-genital Tract

1. ***Vaginal or uterine douche*** :
   It is simple irrigation of the vagina/uterus with a non-irritating antiseptic lotion.
2. ***Pessaries*** :
   These are conical bodies inserted into the vagina & uterus.
3. ***Intra-uterine injections*** :
   These are injections given with inseminating pipette into the uterus.
4. ***Intra-mammary injections*** :
   These are injections given through teats into the mammary gland.
5. ***Catheterisation*** :
   1. In this technique, catheter is inserted through urethra into bladder.
   2. It is useful for collection of urine.
   3. Antiseptic lotions can be introduced through catheter.

Administration of Drugs on Body surface

1. ***Poultices*** :
   1. These are composed of linseed meal or bran stirred up in boiling water until a pasty consistency is obtained.
   2. These are applied when bearably hot.
   3. These are applied to produce mild counter-irritant effect.
2. ***Fomentation*** :
   1. Moist fomentation is done with bearably hot water. This technique consist of soaking sponge, cotton wool or cloth in hot water & squeezing the water over the part.

2. Dry fomentation is done with the help of glass bottle or rubber bag filled with hot water or hot sand wrapped in cloth.
3. They act as counter-irritants.

3. ***Dips*** :

These are insecticidal baths given to kill ectoparasites.

4. ***Inuctions*** :

These consist of application of ointments, liniments, oils etc. on the surface of the body for their local action.

Administration of Drugs Parenterally

Parenterally means giving injections under one or more layers or mucus membranes.

1. **Intravenous injections :**

These are injections given directy in the blood stream via vein.

Sites :

1. Cattle, buffalo, Horse - Jugular vein.
2. Sheep, Goat - Jugular vein.
3. Dog & Cat - Femoral or cephalic vein.
4. Pig - Ear vein at the base of ear.

Advantages :

1. Irritant drugs can be injected.
2. Large volume of drugs can be given.
3. Drug action is very quick.

Disadvantages :

1. Air embolism may occur, if air bubbles are introduced.
2. Shock may result if injections are given very rapidly.
3. Abscess/phlebitis may occur if there is extravasation of irritant drug.

2. **Intramuscular injections :**

These are the injections given into muscles.

Sites :

Large animal :

Neck region : Triceps muscle

Gluteal region : A few inches infront of the point of buttocks.

Small animals :

Buttocks in between semitendinous & semimebranous muscles.

Advantages :

1. Irritant drugs may be given but not usually advised.
2. Easy to administer.
3. Absorption is very quick.
4. Less danger of shock.

Disadvantages :

1. Large volume of drugs can not be given.
2. Possibility of injecting an irritant drug into nerve.

3. ***Hypodermic/subcutaneous injections*** :

These are injections given beneath the skin.

Sites :

Large Animals : Middle 3rd of the neck.

Small Animals : Inner aspect of thigh or ventral aspect of abdomen.

Technique :

1. The site is painted with Tr. Iodine
2. The skin fold is held between index finger and thumb of left hand.
3. Then the needle is passed in an oblique manner with right hand.

Disadvantages :

1. Irritants should not be injected.
2. Absorption of drug is slow.

4. ***Intraperitoneal Injections*** :

These are injections given into the pertonial cavity.

Site : Left flank.

5. ***Epidural injections*** :

These are injections given in the epidural space.

Sites :

a) Between first and second coccygeal vertebrae in cattle and horse.

b) Between the last lumbar and first sacral vertebrae in dog.

6. ***Intra-cardiac Injections*** :

These are injections given directly into the heart muscles.

MODEL PRESCRIPTIONS

Antipyretic mixture (for fever)

Sodium salicylate	30 gm.
Potassium nitrate	8 gm
Pulv. chirrata	30 gm
Treacle	q.s
Mft : Elect.	Sig : BID

Purgative mixture (for ruminal stasis)

Magnesium sulphate	180-250 g
Sodium chloride	125-180 g
Pulv. Ginger	15 g
Aqua	q. s
Mft : Haust	Sig : Give once

Astringent mixture (for diarrhoea)

Creta preparata	30 g
Catechu/Tannic acid	15 g
Kaolin	30 g
Pulv. Ginger	15 g
Gruel	500 ml.
Mft : Haust	Sig : BID

Tonic mixture (for anorexia)

Ferrous sulphate	4 g
Magnesium sulphate	60 g
Pulv. Gentian	15 g
Pulv. Nuxvomica	4 g
Treacle	q.s
Mft : Elect	Sig : BID

Carminative mixture (for tympany)

Turpentine oil	30-60 ml
Sweet oil	500-600 ml

Mft : Haust Sig : Give immediately

Expectorant mixture (for cough)

Ammonium carbonate	4 g
Potassium iodide	4 g
Camphor	2 g
Pulv. glycerrhiza	30 g
Treacle	q.s
Mft : Elect	Sig : BID

Urinary Antiseptic (for urinary tract infection)

Hexamine	4 g
Sodium acid phosphate	60 g
Treacle	q.s
Mft : Haust	Sig : once daily

Iodine Ointment (for painful swelling and sprain)

Iodine	4 gm
Potassium Iodide	4 gm
Glycerine	12 gm
Vaseline	80 gm

Tincture Iodine (for antisepsis)

	Mitis	*Fortis*
Iodine	2.5 gm	10 gm
Potassium Iodide	1.5 gm	6 gm
Distilled water	2.5 ml	10 ml
Rectified spirit	100 ml	100 ml

Liniment Ammonia (for sprain)

Liq. Ammonia fortis	30 ml
Oil Turpentine	30 ml
Aqua	30 ml
Vegetable oil	250 ml

Mix by shaking and store in tightly corked bottle.

Haematinic mixture (for anaemia)

Ferrous sulphate	5 g
Copper sulphate	0.2 g
Cobalt sulphate	0.2 g
Treacle	q.s
Mft : Elect	Sig : once daily

Urinary Sedative (for painful micturition)

Tin. Hyoscyamus	30-60 ml
Sodium bicarbonate	30-60 g.
Aqua	q.s
Mft : Elect	Sig:BID

Ecbolic mixture (for retention of placenta)

Ergot prep.	30 g
Mag Sulph.	350 g
Pulv. Ginger	30 g
Pulv. Anisi	60 g
Aqua	1 lit
Mft : Haust	Sig : stat

Lugol's Iodine (for antisepsis)

Iodine	2 gm
Potassium Iodide	3 gm
Distilled water	80 ml

Salicylic Acid Ointment (for ringworm)

Salicylic Acid	6 gm
Carbolic Acid	6 gm
Vaseline	88 gm

Sulphur Ointment (for mange)

Sulphur sublimated	10 gm
Vaseline	90 gm

Antiseptic Powder

Boric Acid	2 Part
Iodoform	1 Part
Zinc Oxide	2 Part

Table No. 20.1 Some Commonly Used Drugs : Their Actions, Uses and dosages

Product Name (e.g.)	Content	Actions	Indications	Dose & Route
Corticosteroids				
1. Inj.Dexona/Ketocort 2 ml, 5 ml, 10 ml	Dexamethasone 4 mg/ml	Antinflammatory Antiallergic Gluconeogenesis	Allergic / Inflammatory conditions, Ketosis• Toxaemia, Shock*	0.04 mg/Kg•.IM. 1 mg/kg* IM, IV
2. Inj. Vetalog 1 ml & 5 ml	Triamcinolone acetonide 5 mg/ml	- do -	- do -	0.02-0.05 mg/kg IM.
3. Inj.Betnesol 2 ml	Betamethasone 4 mg/ml	- do -	- do -	0.04 mg/kg IM.
4. Inj.Prednisolone 10 ml	Prednisolone acetate 10 mg/ml.	- do -	- do -	0.25 - 1 mg/kg IM.
Antihistaminics				
1. Inj. Avil 10 ml & 30 ml	Pheniramine maleate 22.75 mg/ml	Antihistaminic Antiallergic	Allergic conditions, Skin diseases, Rumen atony, Toxaemia/septicaemia	0.5 - 1 mg/kg. IM.
2. Inj. Cadistin/ Anistamin/Zeet 10 ml & 30 ml	Chlorpheniramine maleate 10 mg/ml.	- do -	- do -	0.25 - 0.5 mg/kg IM.
3. Inj.Phenergan 2 ml & 10 ml	Promethazine HCl 25 mg/ml	- do - Sedative	- do -	0.5 - 1 mg/kg. IM.
Analgesics & Antipyretics				
1. Inj.Zobid/3D-Vet/ Diclovet 30,100 ml	Diclofenac sodium 25 mg/ml	Non-steroidal Anti-inflammatory Analgesic & Antipyretic	Inflammatory conditions Painful conditions, Fever.	R : 1 mg/kg. IM.
2. Inj.Melonex 2, 15, 30 ml	Meloxicam 5mg/ml	- do -	- do -	0.2-0.5mg/kg IM

Product Name (e.g.)	Content	Actions	Indications	Dose & Route
3. Inj.Esgipyrin N 3 ml & 5 ml	Phenylbutazone + Analgin	- do -	- do -	L.A. : 10-15 ml IM S.A. : 1-3 ml IM.
4. Inj. Vetalgin 30 ml	Analgin 0.5 g/ml (Metamizole)	Analgesic & Antipyretic	Painful conditions Fever	L.A. : 20-30 ml IM. S.A. : 1-5 ml IM.
5. Inj.Valginate 30 ml	Analgin 0.5 g/ml + Valethamate bromide 2 mg/ ml	Antipyretic Analgesic & Antispasmodic	Fever Painful conditions Spasms of intestine	L.A. : 20-30 ml IM. S.A. : 1-5 ml IM.
6. Inj. Paracetol Vet. 30 ml	Paracetamol 150 mg/ml.	Analgesic & Antipyretic	Painful conditions Fever	L.A. : 10 mg/kg IM. S.A. : 10-20 mg/kg IM.
7. a. Inj.Spasmovet b. Inj. Cyclopam 30 ml.	Dicyclomine 10 mg/ml.	Antispasmodic & Analgesic	Abdominal pain/ colic Spasms of intestine	0.5 mg/kg IM
8. Inj.Bascopan 1ml	Hyocine butyl bromide 20 mg	Antispasmodic	- do -	L.A. : 15ml IV.
9. a. Rumalaya Vet.bolus	Ayurvedic	Analgesic Antipyretic &Anti-inflammatory	Sprains, arthritis, inflammatory conditions.	L.A. : 1 BID PO S.A. : ½ BID PO
10. a. 3 D Vet plus	Diclofenac 300 mg + paracetamol 1500 mg	- do -	Inflammatory conditions, fever, painful conditions	LA : 1-2 BID PO SA : ½-1 BID PO
b. Oxalgin DP blous	Diclofenac 50 mg + Paracetamol 500 mg	-do-	- do -	L.A. : 3-4 BID PO S.A. : ½-1 BID PO
c. Inflavet/Diclovet	- do -	- do -	- do -	- do -
11. Inj.Fortwin 1 ml	Pentazocine 30 mg/ml	Analgesic	- do -	C, B : 0.5 -1mg/kg IV. H. : 0.33 mg/kg IV
Pre-anaesthetics/Anaesthetics				
A. Benzodiazipines				
1. Inj.Anxol/Calmpose 2 ml , 10 ml	Diazepam 5 mg/ml	Tranquilizer Anticonvulsant Antiepileptic	To control convulsions In poisonings & nervous disorders - epilepsy	C&B : 0.25-0.5mg./kg Dog:1-2 mg/kg IV.IM.

Product Name (e.g.)	Content	Actions	Indications	Dose & Route
B. Barbiturates				
1. Tab. Gardenal 30, 60, 100 mg.	Phenobarbitone	- do -	- do -	Dog & Cat :4-16 mg/kg. PO
2. Intraval sodium 0.5 & 1 gm	Thiopentone sodium	General anaesthetic Anti convulsant	Surgical operations To control convulsions	Dog : 15-30 mg/kg IV LA : 10-15 mg/kg IV
C. Tranquilizers				
1. Inj. Siquil/Anicalm 5 ml	Triflupromazine HCl 20 mg/ml	Sedative Tranquilizer Antiemetic	As pre-anaesthetic Restraint of animal To increase tolerance to pain To prevent Vomition	R : 0.1 mg/Kg. IV H : 0.2-0.3 mg/kg IV D : 1 - 2 mg /kg. IV 2 - 4 mg/kg. IM.
2. Inj. Largactil 2 ml	Chlorpromazine HCl 25 mg/ml	- do -	- do -	C & B : 1 mg/kg. IM, IV D : 1-2 mg/kg IM, IV.
3. Inj.Acepromazine	Acetylpromazine maleate	- do -	- do -	C & B : 0.2 mg/kg. IM D : 0.1 to 0.2 mg/kg IM
D. Alfa- 2 Adrenoceptor agonists				
1. Inj.Xylaxin/ Inj. Xylazine 5, 10, 30 ml	Xylazine 20 mg/ml	Tranquilizer Muscle relaxant Analgesic	As pre-anaesthetic Restraint of animal Muscle relaxation	C & B : 0.05 - 0.2 mg/kg IM S & G : 0.1 - 0.3 mg/kg. IM Dog : 1-2 mg/kg. IM
2. Inj.Domosedan 10 ml	Detomidine 20 mg/ml	Tranquilizer Muscle relaxant Analgesic	As pre-anaesthetic Restraint of animal Muscle relaxation	C & B : 15 - 40 µg/kg IM S & G : 40-60 µ g/kg IM Dog : 60-80 µg/kg. IM
E. Local Anaesthetics				
1. Inj.Xylocaine 30 ml	Lignocaine HCl 2%	Anaesthesia	Local infiltration Epidural anaesthesia	LA : 5-10 ml, SA : 1-2 ml

Product Name (e.g.)	Content	Actions	Indications	Dose & Route
F. Non-barbiturate agents				
1. Inj. Ketmin 5, 10 ml	Ketamine 50 mg/ml	General anaesthetic Analgesic	Surgical operations Restraint of animal	C & B : 11. mg/kg IV, IM. Cat : 22-33 mg/kg IM, IV.
2. Chloral hydrate	Chloral hydrate	Narcosis Hypnosis	General anaesthesia Equine colic	C & B : 90-100 mg/kg. IV or 6 -10 g/50 kg PO H : 6.5 g/50Kg IV or PO
3. Chloral hydrate + Magnesium sulphate	Chloral hydrate 2 part Magnesium sulphate 1 part	Narcosis Hypnosis	General anaesthesia	Calf : 140 mg/Kg IV H & C : 5gm/50Kg IV or orally by stomach tube.
Anti-emetics				
1. Inj. Stemetil 1 ml	Prochloroperazine	Antiemetic	Vomition 12.5 mg/ml	Dog : 0.25 - 0.5 mg/kg IM 1 mg / kg TID PO
2. Inj. Reglan/Perinorm 2 ml	Metaclopromide	Antiemetic	Vomition 5 mg/ml.	Dog : 0.1 - 0.3 mg/kg IM 0.2-0.4 mg/kg PO
Antacids				
1. Inj. Histac 2 ml Tab Histac.	Ranitidine 25 mg/ml Ranitidine 150 mg	Antacid (H_2 blocker)	Chronic gastritis Gastric ulcers	Dog : 1-2 mg/kg IV PO BID
Diuretics				
1. a. Inj. Lasix 2,10 ml b. Inj. Ridema 10 ml	Furosemide 10 mg/ml Furosemide 50 mg/ml	Diuretic	Oedema of any type	R : 1-2 mg/kg IM, IV Dog : 5 mg/kg IM, IV.
Respiratory stimulants				
1. Inj. Coramine 2 ml	Nikethamide 25%	Respiratory stimulant	Respiratory failure in accidents, anaesthesia surgical shock.	R : 7 - 11 mg/kg IV, IM SC Dog :20-40 mg/kg IV, IM

Product Name (e.g.)	Content	Actions	Indications	Dose & Route
Bronchodilators				
1. Inj. Aminophylline 10 ml	Aminophylline 25 mg/ml	Bronchodilator	Bronchial asthma Lung emphysema	Dog : 6-11 mg/kg IV
2. Inj. Deriphylline 2 ml	Etophylline : 84.7 mg + Theophylline 25.3 mg/ml	- do -	- do -	Dog : 5 mg/kg IM, PO LA : 1-2 mg/lg IV
3. Inj. Atropine sulphate 1 ml	Atropine sulphate 0.6 mg/ml	- do -	- do -	0.04 mg/kg IM, IV TID
Parasympathomimetic				
1. Inj. Myostigmin 1 ml	Neostigmin 0.5 mg/ml	Parasympathomimetic	Atony of GI tract & Urinary bladder.	R : 0.02 mg/kg IM H : 0.004-0.02 mg/kg SC
Parasympatholytic				
1. Inj. Atropine sulphate 1 ml	Atropine sulphate 0.6 mg/ml	Parasympatholoytic Antispasmodic	*Diarrhoea & colic Bronchial asthma # Antidote for organo-phosphate poisoning	* 0.03-0.06 mg/kg IM, SC # 0.2-0.4 mg/kg IV, IM every four hour
Sympathomimetic				
1. Inj. Adrenaline 1 & 10 ml	Adrenaline 1 mg/ml	Sympathomimetic Cardiac stimulant	Cardiac arrest Ananphylactic shock Bronchial asthma Haemostatic locally	C & B : 8-16 μg/kg IM 4-8 μg/kg IV D & Cat : 10-30 μg/kg. IM, IV
Styptics				
1. Inj. Stardren/Adchrome 10,30 ml	Carbazochrome salicylate 2 mg/ml	Styptic	To control external & internal bleeding	LA : 10 ml IM SA : 2-5 ml IM
2. Inj. Botropase / Reptilase 1 ml	Haemocoagulase of bothrops	- do -	- do -	Dog : 0.5 - 1 ml IM
3. Tab. Styplon 100	Ayurvedic	- do -	- do -	LA : 16-24 PO TID

Product Name (e.g.)	Content	Actions	Indications	Dose & Route
Drugs for digestive disorders:				
1. Bovirum bolus/ Rumentas bolus	Antimony potassium tartrate - 2 g $FeSO_4$ - 2 g $CuSO_4$ - 50 mg Cobalt chloride 100 mg	Ruminotoric Indigestion Anorexia	Ruminal stasis	C.,B. : 2-3 boli daily PO
2. Tab. Rumenton	Antimony Pota. tartrate- 2g. Ferrous sulphate 2 g	- do -	- do -	C.,B. : 2-4 tab per day PO
Rumen bolus	Cobalt sulphate 100 mg			
3. Anorexon bolus	Ferrous sulphate 200 mg Thiamine, $VitB_{12}$, chloline	Appetiser	Primary & Secondary anorexia	C.,B. : 1-2 bolus daily PO
4. Himalayan Battisa 100 gm	Ayurvedic	- do -	Anorexia	
5. a. Bioboost bolus	Live yeast culture, amino acids, live lactobacillus, sporogens culture, liver extract	Digestive disorder	Constipation Anorexia, Liver diseases	C.,B. : 40-60 g BID PO S.,G. : 10-15 g BID PO LA : 2 bolus BID PO S.A.: 1 bolus BID PO
b. Boostup bolus	- do -	- do -	- do -	
6. Bloatosil 100 ml	Silica in dimethicone 1% W/V	Carminative	Frothy Bloat/tympany	LA : 1-2 bolus BID PO SA : 1 bolus BID PO C.,B. : 100 ml PO S.,G. : 20 ml PO
7. Timpol Powder 100 gm.	Ayurvedic	- do -	- do -	C.,B. : 80 g PO S.,G. : 20 g PO as drench
8. Tyrel liq. 100 ml	Ayurvedic	- do -	- do -	C,B : 100 ml PO S.G. : 50 ml PO
9. Neblon powder 100 g	Ayurvedic	Astringent	Diarrhoea/dysentery	C.,B.: 39-50 g PO S.,G.: 5-10 g PO.

Product Name (e.g.)	Content	Actions	Indications	Dose & Route
10. Becknor bolus	Ayurvedic	- do -	- do -	C.B. : 1-2 bolus BID PO S.G. : 1 bolus BID PO
11. a. Ceflox T2 bolus b. Cflox T2 tab	Ciprofloxacin + Tinidazole	Antibacterial Antiprotozoan	- do -	LA - 1-2 bolus/ 300 kg PO SA - 1 tab/25 kg BW PO
12. 3 care bolus	Halquinol	Gut acting antimicrotial	Enteritis, coccidiosis	C,B - 1 - 2 boli BID PO S,G - ½ - 1 BID PO
Liver tonics				
1.. Zigbo bolus	Ayurvedic	Liver tonic	Liver dysfunction anorexia.	LA : 2 bolus PO 3-5days SA : 1 bolus PO 3- 5 days
2. Livol 100 g.	Ayurvedic	Liver tonic	Jaundice, Hepatitis Liver dysfunction	C.,B.: 40 - 60 g PO S.,G. : 8-12 g. PO
3. Liv - 52 100 g.	Ayurvedic	- do -	- do -	C.,B. : 10 g PO S.,G. 3 g. PO
4. Inj. Livogen/Belamyl 10, 30 ml	Liver extract with B-complex	- do -	- do -	L.A. : 5 - 10 ml IM
5. Inj. Neohepatex 2 ml	- do -	- do -	- do -	S.A. : 1-2 ml IM. Dog : 1- 2 ml IM

Product Name (e.g.)	Content	Indications	Dose & Route
Antiprotozoan Drugs			
1. Inj. Berenil 5, 22.5 g.	Diminazene aceturate 0.44 g/g.	Treatment of Babesiosis, Theileriasis, Surra	3.5 - 7 mg/kg IM as 20% sol.
2. Inj.Berenil/Nilbery 20 ml	Dimiazene aceturate 70 mg/ml	- do -	1 ml/20 kg. IM
3. Triquin/Tevansi 2.5 gm	Quinapyramine sulphate (1.5gm) & Chloride (1gm)	Prevention & treatment of Surra.	5 mg/kg SC as 10% sol.
4. Gilpol/Naganol	Suramin 1 g.	- do -	10-12 mg/kg IV as 10% sol
5. Samorin	Isometamidium	- do -	0.5 mg/kg IM as 2% sol.
6. Inj.Butalex 20 ml	Buparvaquone 50 mg/ml	Theileriasis	2.5 mg/Kg IM once
7. Inj. Terramycin	Oxytetracycline 50 mg/ml	Theileriasis, Anaplasmosis	10-20 mg/Kg IV for 5-7 days.

Product Name (e.g.)	Content	Indications	Dose & Route
8. a. Tab. Flagyl	Metronidazole 400 mg.	Amoebiasis, Giardiasis	20-50 mg/kg day PO 20 mg/kg day IV
b. Metrofurol bolus / Fazole bolus	Metronidazole 1000 mg + Furazolidone 500 mg	Antibacterial	LA : 4 - 6 bolus PO SA : 1-2 bolus PO
9. Tab. Fasigyn	Tinidazole 600 mg.	- do -	30-50 mg/kg/ day PO
10. Tab.Neftin/Furoxone	Furazolidone 200 mg.	Coccidiosis, Giardiasis	10 mg/kg PO for 5 days.
11. Amprolsol (20%) 100	Amprolium 60 gm	Coccidiosis	50 mg/kg PO for 5-7 days.
Intramammary Preparations			
1. Pendistrin - SH Oint. 6 ml tube	Procaine penicillin 1 lakh Streptomycin 100 mg + Sulfamerazine 500 mg + Hydrocortisone 20 mg	Acute & chronic Mastitis	1 tube per infected quarter every 12 hrs.
2. a. Vetclox - Plus 10 ml b. Tilox 10 ml	Cloxacillin 200 mg + Ampicillin 75 mg.	- do -	- do -
3. Vetimast 10 gm.	Cephacetrile 23.5 mg.	Bacterial mastitis	1 tube every 24 - 48 hour.
4. Boracil mastitis Oint. 10 ml	Ampicillin 75 mg + Griseofulvin 35 mg + Prednisolone 3 mg.	Mastitis caused by bacteria, fungi & yeast	1 tube every 12 - 24 hour.
5. Rifijet intrammammary	Refamycin 50 mg/ syringe	Mastitis caused by strepto- & staphylococci.	1 syringe every12-24 hours.
6. Wokadine solution 100 ml	Povidine iodine 1%	Mastitis caused by bacteria, fungi.	10 - 20 ml intrammammary.
7. Mammitel 10 gm syringe	Colistin sulfate + Cloxacillin sodium	Bacteral mastitis	1 syringe every 12 hour.
8. Chlorcetin intrammammary	Chloramphenicol Sodium succinate	- do -	1 tube every 12 hrs.
9. Amoxirum 0.3 g.	Amoxycillin sodium 200 mg + sulbactam sodium 100 mg	- do -	300 mg/Infected quarter every 12 - 24 hrs.
10. Cobactan - LC	Cefquinome 75 mg	- do -	1 syringe every 12 hours

Product Name (e.g.)	Content	Indications	Dose & Route
Dog soap / Shampoo			
1. Tetmosol Soap 75 g.	Monosulfiram 5%	E ctoparasiticide	Use for bath.
2. Notix Talc 150 g.	Carbaryl 5%	- do -	Apply once weekly.
3. Canifur 120 gm		Antidandruff, ectoparasiticide	Use for bath.
Gynaecological Drugs			
1. a. Inj.Lutalyse 5 ml b. Inj.Prosolvin 1ml x10	Dinoprost 5 mg/ml Luprositiol 7.5 mg/ml (PGF_2 a like)	Synchronisation of oestrus. Silent oestrus, suboestrus, Luteal cyst. Peristent CL, Pyometra,Pseudopregnancy in bitches Inductionof parturition and abortion	LA: 25 mg. IM S.G. : 10-15 mg IM Bitch : 0.5 mg/kg IM Repeat after 11 days. if necessary
c. Inj. Iliren 10 ml	Tiraprost 0.15 mg/ml (PGF_2 a like)	- do -	LA : 15 mg IM S & G :7.5 mg IM. L.A. : 5 ml IM.
2. a. Inj. Fertagyl 5 ml	Gonadorelin 0.1 mg/ml (GnRH)	Anoestrus, Silent heat, Prevention of abortion, Follicular and Luteal cyst. * Delayed ovulation	
b. Inj. Receptal 10 ml	Burserlin 4 mg/ml (GnRH like)		*2.5 ml IM at the time of AI or natural service.
3. Inj.Chorulon	Chorionic Gonadotrophin 1500 IU/Vial (LH like)	Anoestrus, Silent heat. Delayed ovulation Improvement of conception rate Ovarian cysts.	LA:1500-3000 IU IM S & G 400-800 IU IM Bitch : 100-500 IU IM.
4. a. Tab Fertivet	Clomiphene citrate 300 mg	* Anoestrus, Silent heat	* 1 mg/kg PO for 5 days.
b. Tab. Fertyl fore.	Clomiphene citrate 50 mg.	+ Repeat breeding,	+ 1mg/kg PO for 6 hrs. be-
5. a. Inj.P -depot 2, 3 ml	(LH like) Hydroxyprogesterone 250 mg/ml	Delayed ovulation * Prepartum uterine prolapse.	AI or Natural service. * LA : 250 mg IM
b. Inj. Proluton depot 1 ml	- do -	* Maintenance of pregnancy	Repeat 4-5 times at every 10 days interval
c. Inj. Duraprogen 1, 2 ml	- do -	+ Induction of oestrus	+ LA : 250 mg IM once.

Product Name (e.g.)	Content	Indications	Dose & Route
6. a. Inj. Folligon b. Inj.Trophovet	Pregnant Mare Serum Gonadotrophin (PMSG) 1000 IU/Vial	True anoestrus Impaired spermatogenesis	LA : 1500 - 3000 IU IM S& G : 100-500 IU IM Bitch : 150 - 200 IU IM Repeat after 2 wks. if necessary.
7. a. Inj.Progynon depot 1 ml	Oestradiol valerate 10 mg/ml	Expulsion of uterine contents Mummification, Maceration, Pyometra Pseudopregnancy & misalliance in bitches	LA : 30 mg IM. SA : 10 mg IM
8. a. Inj. Oxytocin 1 ml b. Inj.Pitocin 1 ml c. Inj.Gynaetocin 1 ml	Oxytocin 5 units/ml (Ecbolic)	* Uterine inertia Dystokia Retention of placenta + Letting down of milk	*LA : 75-150 IU IM, IV S& G :25-50 IU IM, IV Bitch : 10-20 IU IM, IV + LA : 10-20 IU IM, IV SA : 5 - 10 IU IM, IV
9. Inj. Ergometrine 1 ml	Ergometrine 0.5 mg/ml	Post partum bleeding	LA : 1-3 mg IM SA : 0.4-1 mg IM
10. Inj. Duvadilan 2 ml	Isoxsuprine 5 mg/ml	Uterine prolapse (Uterine spasmolytic)	All species 0.5 mg/kg IM
11. Inj.Epidosin 5 ml, 30 ml	Valethamate bromide 10 mg/ml	For Cervical dilatation Kinked cervix	LA : 40-50 mg IM SA : 10-20 mg IM.
12. a. Cap.Prajana/Sajani	Ayurvedic	Anoestrus	3/day PO for 2 days
b. Cap.Oestrona	- do -	- do -	2/day PO for 3 days
c. Cap.Hitali	- do -	- do -	1/day PO for 2 days.
d. Tab.Aloes compound	- do -	- do -	10/day PO for 20 days.
e. Oestro-care	- do -	- do -	3 Cap./day PO 2 day
f. Sajani	- do -	- do -	3 Cap./day PO 2 day
g. Heat quick	- do -	- do -	25 gm powder once orally
13. a. Cyclomin bolus	Cobalt -0.056 g, Cu -0.7g Iodine -0.140 g, Mn-0.5 g, Se -0.004 g, Zn -0.02 g.	To improve breeding efficiency maintain healthy pregnancy & ensure the normal delivery.	1 bolus per animal once a week. PO.
b. Repromax bolus			LA :2 boli/day PO. SA : 1 bolus/day PO.

Product Name (e.g.)	Content	Indications	Dose & Route
14. Minotas bolus	Microminerals with yeast	Anoestrus, silent heat, delayed maturation, anorexia, anaemia, hypoglycaemia1	LA : 2 boli PO S.A. : ½ bolus PO
15. a. Replanta powder	Ayurvedic	Retention of placenta	LA : 50 - 60 gm PO SA : 8 - 12 gm PO
b. Exenta liquid 500 ml	100, 500, 1000 gm. - do -	Uterine tonic - do -	LA : 60 ml PO. SA : 20 ml PO.
16. Tab. Myron Vet. 100, 1000 tabs.	Ayurvedic	Repeat breeding Cervicitis, Endometritis	LA : 10 BID PO SA : 2-3 BID PO for 20 days.
17. Tab. Leptaden Vet. 100, 1000	- do -	Galactogogue	LA : 10 BID PO for 2 weeks.
18. a. Furea bolus b. Cleanex	Nitrofurazone 60 mg + Urea 6 gm.	Retention of placenta Metritis	2-4 boli IU for 2-3 days.
19. Ceflox-Tz bolus, suspension 60 ml	Ciprofloxacin 1500 mg + Tinidazole 1800 mg/bolus	- do -	1-2 bolus IU
20. a. Lixen IU bolus	Cephalexin 750 mg + Urea 2.5 g.	- do -	60 ml. IU
b. Lixen IU suspension 60 ml (4g)	Cephalexin 1.5 g.	Metritis, Endometritis, Pyometra, Cervicitis,	2 boli IU. 60 ml IU.
Vitamin & Minerals			
1. Inj.Prepalin forte 2 ml	Vit A 3 lakh 1U/ml	Ocular infections, Night blindness, Infertility, Skin diseases, Stomatitis.	LA: 4 to 8 ml IM SA : 0.5 - 2 ml IM
2. Inj.Multivet 30 ml	Vit A, D_3, E, & B.Complex	General tonic in debility, anaemia Milk fever, better growth	1ml/10 kg IM / IV
3. a. Inj.Vetade 10 ml	Vit A 2.5 lakh IU Vit D_3 25000 IU +	Vit A deficiency Rickets,	LA : 6 - 10 ml SA : 1- 2 ml IM
b. Inj. Intavita 10 ml	Vit E 100 IU/ml - do -	Infertility - do -	- do -

Product Name (e.g.)	Content	Indications	Dose & Route
4. Inj.Arachitol 1 ml	Vit D_3 6 lakh IU/ml	Rickets, Osteomalacia	11,000 IU/Kg IM
5. Inj.E-care Se 10 & 100 ml	Tochopheryl acetate 50 mg (Vit.E 55 iu) + Selenium 1.5 mg/ml	White muscle disease, mastitis, demodecosis, abortion, anoestrous.	1ml /25 - 50 kg IM
6. Inj.Kapilin 1 ml	Acetomenaphthone (Vit.K) 100 mg/ml	Styptic-Delayed clotting, haemorrhage	0.5-2 mg/kg. IV, IM
7. Inj.Ascorbic Acid 5 ml	Ascorbic acid 100mg/ml (Vit.C)	Stomatitis, diarrhoea haemoglobinuria	15-20 mg/kg. IV
8. a. Inj.Livogen/Belamyl 10, 30 ml	Liver extract with B-Complex	Anorexia, debility, anaemia, liver disorder	LA : 5 - 10 ml IM SA : 1- 2 ml IM
b. Inj.Neohepatex 2 ml	- do -	- do -	Dog : 1-2 ml IM
9. a. Inj.Tribivet-10ml	Vitamin-B_1, B_6, B_{12}	General tonic in	21LA : 50 - 10 ml IM
b. Inj.Neurobion Forte 2ml		debility, anaemia,	SA : 1 - 2 ml IM
c. Inj.Trineurasol-H 5 ml		Nerve Paralysius	
10. a. Inj.Caldee - 12, 15 ml	Ca, Vit.B_{12} & Vit D_3	Hypocalcaemia	LA : 10 - 15 ml IM
b. Inj.Macalvit 15 ml		Debility	SA : 0.5 - 1 ml IM
c. Inj.Sanclivit 15 ml	- do -	- do -	- do -
11. a. Inj.Imferon 10 ml	Iron 50 mg/ml	Iron deficiency, Anaemia	LA : 5-10 ml IM
b. Inj.Jectofer 1.5 ml	Iron Vit B_{12}-folic acid	- do -	SA : 1- 2 ml IM
12. a. Tonophosphon	Sodium salt of 4 dimethyl	* Haemoglobinuria	C, B 25 - 30 ml IV
b. Tonoricin/T-Phos 5 ml & 30 ml	amino 2 methyl phenyl-phosphinic acid 0.2g/ml	+Chronic phos.def. Osteomalacia, pica	daily for 3 - 4 days +C, B : 5 ml IM on alternate days
13. Alphos - 40/Urimin 30 ml	Sodium acid phosphate 40%	Phosphorus deficiency	LA : 5 ml IV, Im, SC SA : 1ml IV, IM, SC
14. a. Inj.Calboral 450 ml	Calcium borogluconate	Milk fever in cattle	C,B : 400 - 800 ml IV
b. Calcium borogluconate	25%	Hypocalcaemia in sheep, goat,	S,G : 60 ml IV
c. Intacal 450 ml		bitches & mares	Dog : 2.5 ml IV
15. a. Mifex - 450 ml	Calcium, Phosphorus,	Milk fever, Hypomagnesaemia	C, B : 400 ml IV
b. Lactomag 450 ml	Magnesium , dextrose	Hypophosphataemia Hypoglycaemia	S, G : 60 ml IV
16. Inj.Calsandoz 10 ml	Calcium gluconate 10%	Hypocalcaemia	Dog. : 0.5 - 1.5 ml/kg IV

Product Name (e.g.)	Content	Indications	Dose & Route
17. a. Milkmin/Agrimin 1kg.	Macro & Micro Minerals	Prevention & treatment of mineral deficiencies	C, B : 25-50 g daily orally
b. Dosmin 1 kg			
18. a. Nutrimilk/Minfa 1kg.	Minerals & Vitamins	Prevention & treatment of	C, B : 2 - 50 g daily orally
b. Supplivite- M 1 Kg	- do -	mineral & vitamin deficiencies	
19. a. Cadisol -DC	Ca,P, Vit D_3 ,B_{12}, Fe	Rickets, anaemia	Dog : 10-20 ml BID orally
b. Ostocalcium liquid	Ca, P, Vit D_3 & Vit B_{12}	Rickets, Stunted growth	Dog : 10-20 ml BID orally
c. Doscal 170 ml	- do -	- do -	- do -
d. Sharkoferol	- do -	- do -	- do -
20. Vimeral liquid 30, 120, 500 ml	Ca, Fe, Vit D_3 , B_{12} Vit A, D3, E & B12	Vitamin supplement for better growth & production	LA : 20 ml daily orally SA : 5 - 10 ml daily orally.
ANTISEPTICS			
1. a. Himax Oint. 50 g.	Ayurvedic	Mange, Ringworm.	Apply locally twice.
b. Himax lotion 100 ml	- do -	Wounds, Eczema	daily till complete cure.
2 Ectosep Oint 50 g.	- do -	Maggoted wounds	
3 a. Lorexane cream 50g	Gamma BHC 1% +	Maggoted wounds	Apply locally
b. Lorexane spray 50 ml	- do -	- do-	Apply locally as spray.
c. Dress vet cream 30 g.	- do -	- do -	Appply locally.
4. Topicure spray 75/125 ml	Ayurvedic	Ringworm, maggoted wound	Apply locally as spray.
5. Saaf kit	Iodine, Glycerine, Sorbitol	Disinfection of udder and teat.	Apply locally as spray.
6. Dipal solution 500 ml		Antiseptic	Teat dip.
7. Kohrsolin 50 ml and	Glutaraldehyde 10 g +	Prevention of Mastitis.	Add 1 ml in 150 ml water
	1, 6 dihydroxy 2, 5 dioxyhexane 10.4 g + polymethyl urea 7.2 g.		dip each teat every time after milking. 150 ml solution sufficient for 5 animals.
8. G vet cream 50 g.	Gentamycin sulphate	Topical Antimicrobial	Apply locally.
9. Framycetin cream 15,20,100 g.	Soframycin	- do -	- do -
10. Furacin cream 20 g. /Oint.-25g/ powd. -10 g.	Nitrofurazone	- do -	- do -

Product Name (e.g.)	Content	Indications	Dose & Route
11. Neosporin oint 5,15 g./ powder 10 g.	Polymyxin B sulphate + Neomycin sulphate + Zinc Bacitracin	Topical antimicrobial	Apply locally
12. Nebasulph oint.15 g/ powd. 10 g.	Neomycin sulphate + Bacitracin + sulphacetamide	- do -	- do -
13. Vetbacin Oint. 20 g	Neomycin sulphate + Zinc Bacitracin.	- do -	- do -
14. a. Pivipol 100 ml	Povidone iodine 1 %	- do -	- do -
b. Wokadine Oint/Powd. 15,125g solution 100 ml spray 50 ml	- do -	- do -	- do -
c. Betadine oint.15,125 g. powd.10 g.	- do -	- do -	- do -
15. Wisprec oint.	Ayurvedic	Topical anti inflammatory in mastitis and broad spectrum dermatological	- do -
16. Dos spray 100 ml	Gamma B.H.C., Cetrimide, Neem oil	Skin diseases like mange, ringworm, eczema, maggoted wounds	Apply locally as spray
17. Skin Heal spray 100 ml	Ayurvedic	- do -	- do -
18. Dermanol cream 50 gm	Ayurvedic	- d0 -	Apply locally

Note : * R : Ruminants. * C : Cattle, B : Buffalo, S : Sheep, G : Goat, D : Dog, LA : Large animal, SA : Small animal.
* IM : Intramuscular, IV : Intravenous, SC : Subcutaneous, PO : Orally, IU : Intrauterine, BID : Twice daily
* The list of trade/product names given in this chapter is neither complete nor specifically recommended.

Name of Drop	Content	Indications
*** Eye/Ear/Nasal Drops**		
1. a. Francip 5 ml b. Ciplox 5 ml	Ciprofloxacin 3%	Infectious otitis, conjunctivitis Corneal ulcer and post surgical therapy of eye and ear.
2. a. Norflox 5 ml	Norfloxacin 3%	- do -
b. Floxnor 5 ml	Norfloxacin 3%	
3. Olflox 5 ml	Ofloxacin 3 %	- do -
4. Genticin 5 ml	Gentamycin	- do -
5. Dexoren 5 ml	Chloramphenicol	- do -
6. Albucid 20% 5 ml	Sulphacetamide 20%	Ocular infections
7. a. Pyricort 5 ml b. Pyrimon 5 ml	Gentamycin + Dexamethasone	Infectious otitis, allergic / infective conjunctivitis, corneal opacity.
8. Benecort 5 ml	Neomycin + Betamethasone	- do -
9. Dexoren - S	Chloramphenicol + Dexamethasone	- do -
10.Itone 10 ml	Ayurvedic	Allergic, infective conjunctivitis corneal opacity, corneal ulcer, wounds in the occular region and dressing of eye.
11.Ocuhist 5 ml	Chloropromazine hydrochloride 0.2% + Nephazoline HCl + boric acid + zinc sulphate	Allergic conjunctivitis, Keratitis and eye dressing
12.OTEK - AC 5 ml	Chloramphenicol + Betamethasone + Clotrimazole + Lignocaine	Fungal, Infective, parasitic Otitis and painful conditions of ear.
13.a. Solvcin 5 ml b. Soliwax 5 ml	Paradichlorobenzene	For removal of wax & parasites from ear.
14.Otrivin 10 ml	Xylometazoline HCl	Severe rhinitis, common cold.

Sl. No.	Name of the drug	Action(s)	Uses	Dose & route (in adult cattle)
1.	Ammonium chloride	Expectorant Diuretic	Treatment of cough To releive ascites/oedema	8 - 15 gm orally
2.	Camphor	Expectorant Antiseptic	Treatment of cough Treatment of wounds/ulcers	4 - 8 gm orally Dusting powder
3.	Pulv. Glycerrihza	Expectorant	Treatment of cough	15-30 gm orally
4.	Eucalyptus oil	Expectorant Antiseptic Febrifuge	To treat cough To treat wounds To reduce fever	As vapours Locally 4-15 ml orally
5.	Turpentine oil	Expectorant Carminative Parasiticide Counterirritant	Treatment of chronic cough To treat tympany To treat Maggoted wounds Treatment of sprain/swellings	As vapours 30-60 ml orally Locally Externally
6.	Pulv. Ginger	Carminative Stomachic	To treat indigestion/tympany	15-30 gm orally
7.	Pulv. Asafoetida	Carminative Antispasmodic	To treat tympany/indigestion To releive colic/abdominal pain	15-30 gm orally
8.	Pulv. Nux Vomica	Stomachic Appetiser	To treat indigestion To increase appetite	4 - 8 gm orally
9.	Creta preparata (Chalk powder)	Astringent Antacid	To treat diarrhoea/dysentery To lower acidity	30 gm orally
10.	Kaolin	Astringent Adsorbent	To treat diarrhoea/dysentery	30 gm orally
11.	Catechu	Astringent	To treat diarrhoea/dysentery	30 gm orally

Sl. No.	Name of the drug	Action(s)	Uses	Dose & route (in adult cattle)
12.	Sodium salicylate	Febrifuge Anodyne	To reduce fever To releive pain	8 - 16 gm orally
13.	Potassium nitrate	Febrifuge Diuretic	To reduce fever To increase flow of urine	8 gm orally
14.	Pulv. Chirrata	Febrifuge Stomachic	To treat fever To increase appetite	15-30 gm orally
15.	Magnesium Sulphate	Febrifuge Diuretic Purgative Antiseptic Anodyne	To treat fever To releive oedema To treat indigestion / constipation To treat wounds To treat sprain & inflammed joints	30-60 gm orally 250-350gm orally Externally Externally
16.	Sodium chloride	Febrifuge Purgative Antiseptic	To treat fever To releive constipation To wash wounds	15 - 30gm orally 200 gm orally 2.5% sol^{n} locally
17.	Castor oil	Purgative Emolient	To treat constipation	0.5-1 lit. orally Externally.
18.	Linseed oil	Purgative Demulcent	To treat constipation Vechicle for irritant drugs like turpentine oil	0.5-1 lit. orally.
19.	Tincture Iodine	Antiseptic Stimulant	To treat superficial wounds.	Locally
20.	Tincture Benzoin	Antiseptic Expectorant	To dress fresh, deep wounds especially when there is bleeding. Treatment of cough.	Locally As vapours

Sr. No.	Name of the drug	Use	Dose & route of administration
21.	Hydrogen peroxide	Antiseptic	To treat old deep wounds	Locally
22.	Boric acid	Antiseptic	To treat simple wounds / eczema.	10% ointment
			As a mouth wash in FMD	5% solution
23.	Zinc oxide	Antiseptic	Dressing of wounds / eczema	15% ointment
24.	Potassium permangnate	Antiseptic	To wash wounds	1% solution
		Deodorant	Mouth wash in FMD	1% solution
		Disinfectant		
		Caustic	To treat ulcers	4% solution
25.	Copper sulphate	Antiseptic	Washing of wounds	0.5% solution
		Caustic	Washing of ulcers	20% solution
		Haematinic	Treatment of anemia	0.5 gm orally.
26.	Ferrous sulphate	Haematinic	Treatment of anemia	8-16 gm orally
27.	Sodium bicarbonate	Antacid	To reduce gastric acidity	30 gm orally
28.	Sulphur	Parasiticide	Treatment of mange/scabies	10% ointment
		Laxative	Treatment of constipation	90-120gm orally
39.	Salicylic acid	Keratolytic	Treatment of ringworm/eczema	6% ointment
30.	Phenyl	Disinfectant	Disinfection of cattle shed	
31.	Chloral hydrate	Anodyne	Treatment of colic / abdominal pain	15-30 gm orally
		Hypnotoxin	Treatment of tetanus / convulsions	
32.	Alum	Haemostatic	To check bleeding	Externally
		Antizymotic	To treat tympany	8-16 gm orally
33.	Ergot liquid	Ecbolic	To expel placenta	4-8 ml orally.
34.	Hexamine	Urinary antiseptic	Useful in urinary tract infection	4 - 8 gm orally.
35.	Tin. Hyoscyamus	Urinary sedative	Treatment of painful conditions of urinary tract	30-60 ml orally.

Table - 20.2 : Some commonly used Poultry Drugs

Trade name (e.g.) Presentation	Composition	Dose (* Prvention, + Treatment)
Antimicrobials :		
1. Floxidin/Enrox 10% liquid 100 ml	Enrofloxacin 100 mg/ml	* 1 ml/2-4 lit drinking water + 1 ml/lit water for 3-5 days.
2. Pelwin powder 100 gm	Fetloxacin 50 mg/gm	* 0.5 g / lit + 1 g /lit.
3. Ciprin / Microflox powder 100 g	Ciprofloxacin 10% 100 mg /g	* 0.25 g / lit + 0.5 g / lit
4. Vendox / Xidox powder 50, 100, 500 g	Doxycycline 1.25%	* 0.5 g / lit for first 3 days of life in chicks + 1 g / lit.
5. Cephalexin / Lexin powder 20, 200 g	Cephalexin 7.5%	* 30 g daily for 3000 chicks
6. Amoxisol powder 50 g	Amoxycillin 50%	+ 20 g for 200 layers for 3-5 days
7. Inj. Terramycin LA 30 ml	Oxytetraycline 200 mg/ml	+ 2 g / lit water + 0.25 ml/kg SC.
8. Inj. Gentamycin 2 ml, 10 ml	Gentamycin 40 mg/ml	1-2 mg / kg IM
Antimycoplasma Drugs :		
1. Tylan / Tylogil 100 g	Tylosin 50%	* 1 g / lit for first 3 days of life + 2 g / lit for 3-5 days.
2. Tiamutin / Mycomulin 30 g, 100 g.	Tiamutin 50%	*0.45 g/lit for first 3 days of life + 0.55 g/lit for 3-5 days.
Anticoccidials :		
1. Amprolsol powder/ Amprolium powder 30 g, 150 g	Amprolium HCl 20%	* 0.3 g / lit + 1.2 g / lit
2. Bifuran Tab. 50 tab.	Nitrofurazone 100 mg + Furazolidone 14.5 mg	* 1 tab / 4 lit + 1 tab / lit
3. Codrinal powder 100 mg	Tetracycline 0.05g + Sodium salt of p-toluene sulphonyl beta - methoxy ethyl urethane 0.55 g + Lactose 0.37 g + Sodium sulphite 0.025 per gm.	* 1 gm / lit + 4 gm / lit
4. Furasol powder 30 g, 450 g	Furaltadone HCl 20%	+ 1 g / lit
5. Bancoxy-plus powder/ Duocoxin powder 30 g, 50 g, 500 g	Amprolium 16.67% + Sulfaquinoxaline 16.67%	+ 0.5 g / lit
6. Dimidine 16% 450 ml	Sulphadimidine 16%	+ 10 ml / lit

Anthelmintics :		
1. Wormin powder 50 g	Mebendazole 500 mg/g	2 g / 100 birds in feed / water
2. Panacur suspension 450 ml	Fenbendazole 10%	5-7 ml / 100 birds
3. Analgon / Valbazen liquid 60 ml.	Albendazole 2.5%	20-30 ml/100 birds in water
4. Piperazine liquid 115, 500 ml	Piperazine hydrate 45%	50 ml/100 birds in water
5. Dicesto - V 1 kg	Dichlorophen 100 mg/g	100 g / 100 birds in 5 kg feed
Ectoparasiticides :		
1. Butox liquid 50 ml, 1 lit.	Deltamethrin 1.25%	Birds : 2-4 ml/lit for spray
2. Ectomin liquid	Cypermethrin	Birds : 2-4 ml / lit spray House : 20-40 ml/lit spray
3. Sumicidin 20% 100 ml, 250 ml, 2 lit.	Fenvalerate	Birds : 0.5 ml / lit spray House : 1-2 ml / lit spray
Minerals and vitamins :		
1. Agrimin	Minerals + Methionine, Lysine	1-2 kg/100 kg feed
2. Nutrilay	Vitamins + Minerals	250 gm/100 kg feed
3. Supplivite - M	Vitamins + Minerals	Layer 250 g / 100 kg
4. Ventrimin - 17	Vitamins + Minerals	Layer 250 g / 100 kg Broiler 500 g / 100 kg
5. Vitablend WM forte	Vit. A	10 ml / day / 100 birds in water
6. Vimeral liquid 30, 60, 500 ml	Vit. A, D_3, E, B_{12}	Chicks-5ml / 100 birds / day Layers : 10 ml / 100 / day
7. Ventriplex - M	Vit. B complex	15-20 ml / 100 birds.
8. Hyblend AB_2D_3	Vit. A, B_2 and D_3	20 g / 100 kg feed
9. Nutrimix.	Vit. A, B_2, D_3	20 g / 100 kg feed
10. Ostocalcium - B_{12} liquid	Ca + P, Vit. D_3 & B_{12}	20-100 ml/day for 100 birds in evening water.
11. Vetkal B_{12} liquid	Ca + P, Vit. D + B_{12}	20-100 ml/100 birds/day as top dressing in feed.
12. San Trace	Trace mineral mixture	100 g/100 kg feed
Liver tonics :		
1. Ventriliv liquid	Ayurvedic	Chicks - 5 ml, Layer - 20 ml Broiler - 10-20 ml per 100 birds per day
2. Livol powder	Ayurvedic	0.25% in feed.
3. Livfit vet	Ayurvedic	0.2% in feed.
4. Inj. Livogen	Vit. B complex with liver extract	0.25 ml IM

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CHAPTER - 21 : ANTIMICROBIALS

Classification of Antimicrobials

A] *Based on antibacterial spectrum* :

1. *Narrow spectrum antibiotics* -
   They are effective against limited number of bacteria.
   a. Effective against Gram positive bacteria.
      e.g. Penicillin, Erythromycin, Lincomycin, Bacitracin
   b. Effective mostly against Gram negative bacteria.
      e.g. Gentamicin, Streptomycin, Neomycin, Kanamycin
2. *Broad-spectrum antibiotics* -
   They are effective against both Gram positive and Gram negative bacteria.
   e.g. Tetracyclines, Chloramphenicol, Amoxycillin, Ampicillin, Cephalosporins, Fluroquinolones.

B] *Based on nature of action* :

1. *Bacteriostatic antibiotics* -
   They suppress growth and multiplication of bacteria.
   e.g. Tetracyclines, Chloramphenicol, Sulfonamides, Macrolides.
2. *Bactericidal antibiotics* -
   They kill the bacteria.
   e.g. Penicillin, Amoxycillin, Ampicillin, Gentamycin, Streptomycin, Kanamycin, Nitrofurons, Cephalosporins, Fluoroquinolones

C] *Based on mechanism of action* :

1. *Inhibition of cell wall synthesis*
   e.g. Penicillin, Cephalosporins.
2. *Inhibition of protein synthesis*
   e.g. Tetracyclines, Chloramphenicol, Aminoglycosides.
3. *Inhibition of nucleic acid i.e. DNA synthesis*
   e.g. Quinolones, Fluroquinolones
4. *Interference with utilization of PABA by the bacteria for DNA synthesis*
   e.g. Sulfonamides, Trimethoprim

Characteristics of an ideal antimicrobial

1. It should have broadspectrum activity
2. It should be bactericidal
3. It should be easily available
4. It should be economical/cheap
5. It should be stable
6. It should not be inhibited by exudates, body fluids, proteins etc.
7. It should not develop drug resistance
8. It should not produce untoward reaction
9. It should be least toxic
10. It should get easily distributed in all body tissues and fluids.

Principles of antimicrobial therapy

1. Consider the age, sex, species, diet, physiological and vaccination status of animal.
2. Identification of disease causing organisms to select most appropriate antimicrobial drug.
3. Determination of microbial susceptibility *in vitro* to antimicrobial drugs is necessary for patients with severe or complicated infection.
4. Use of an appropriate dosage regimen which comprises drug, dose, route, dosing interval and duration of treatment.

a) ***Drug formulation*** :

* Oily preparations have prolonged action whereas aqueous preparations are short acting.
* Irritant preparations and drugs in oily vehicles should not be given in horses.

b) ***Dose of drug*** :

* Adequate doses must be given to acheive desirable therapeutic concentration.
* Underdosing results in therapeutic failure or drug resistance whereas overdosing causes toxicity.

c) ***Route of administration*** :

* It depends upon drug chosen, disease being treated, likely duration of therapy and temperament of the patient.
* IV route is preferred in acute or life threatening diseases.
* IM route is commonly used for giving maintenance doses.
* Oral antimicrobial therapy is generally recommended for young ruminants and monogastric animals. However it is not advisable in adult ruminants.
* Oral antimicrobial therapy is effective in enteritis.

d) ***Dosing interval*** :

* The frequency of administration should be scheduled based on biological half life of selected antimicrobial.

e) ***Duration of treatment*** :

* It varies with the disease and individual patient.
* The antimicrobial therapy should be continued for 1-2 days after disappearance of clinical signs.

Disorder	Duration of treatment (Minimum) in days
1. Fever	3
2. Pneumonia, bronchitis	7 - 10
3. Pleurisy	7 - 10
4. Urinary tract infection	10 - 14
5. GI disorders	3 - 5
6. Meningitis / encephalitis	7 - 10

* In acute cases, the antimicrobial therapy should be continued generally for 3-5 days.
* Chronic pyogenic infections may require treatment for 2-4 weeks period or even longer.

5. ***Monitor results or treatment*** :
   * The assessment of therapy should continue throughout treatment period.
   * This helps to assess success or failure of treatment.
   * The assessment of therapy is made on the basis of improvement in clinical signs, haematologic changes, radiologic signs and results of microbiologic tests.
6. ***Investigate causes of therapeutic failure*** :
   * Therapeutic failure can result from several factors.
   * When response to the treatment is poor, then cause should be searched and problem corrected.

Causes of Therapeutic failure :

a) Incorrect diagnosis
b) Inappropriate drug
c) Delay in therapy
d) Inappropriate dose regimen
e) Insufficient host defence mechanism
f) Inactivation of drug due to presence of pus or necrotic tissue
g) Toxicity of drug
h) Irreversible condition of the patient
i) Interaction of drugs due to simultaneous medication
j) Development of drug resistance
k) Inappropriate drug absorption, distribution and excretion

7. ***Restrict concomitant use of antimicrobial drugs*** :
   * The combination of bactericidal drugs generally results in synergism whereas combination of bactericidal with bacteriostatic drug may result in antagonism.
   * The combination of antimicrobial drugs are used

i) either to achieve synergistic effect in case of single infection or
ii) to achieve a broadspectrum activity in the case of infection involving more than one agent to combat the emergence of drug resistant mutants during therapy.

Concomitant use of Antimicrobial drugs

Potentially beneficial :	*Undesirable* :
Penicillin + Aminoglycoside	Penicillin + Tetracycline
Sulpha + Trimethoprim	Chloramphenicol + Erythromycin
Penicillin + Sulfonamide	
Tetracycline + Sulfonamide	

8. Attend the adverse drug reactions which develop in some patients as a result of drug or host-related factors.

Misuses of antimicrobial drugs :

1. Treatment of incurable infections
2. Low or high dosage
3. Failure to continue medication large enough
4. Failure to stop medication in face of untoward reaction.
5. Superinfections due to prolonged oral antibiotic therapy.

Damaging effects of antimicrobials :

1. Direct host toxicity
2. Adverse interaction with other drugs
3. Disturbance of function of microbial flora in GI tract
4. Promotion of antimicrobial resistance
5. Tissue necrosis at site of injection
6. Production of residues in animal products for human consumption
7. Impairment of the host's immune or defence mechanism

* *Beta-lactams are very safe whereas aminoglycosides are very toxic.*

Factors affecting selection of an antimicrobial drug :

1. Knowledge of the susceptibility of suspected pathogen.
2. Knowledge of factors that affect drug concentration at the site of infection.
3. Knowledge of drug toxicity and factors that enhance it.
4. The cost of treatment
5. Drug withdrawal time.

Factors affecting drug concentration in tissue :

1. Route, dose and frequency of administration.
2. Rate and extent of absorption i.e. bioavailability
3. Extent of distribution and rate of excretion.
4. Drug penetration through physiological anatomic barriers.
5. Plasma protein and / or tissue binding.

Factors affecting effectiveness of treatment :

1. Susceptibility of organism.
2. State of host defence.
3. Nature and severity of infection.
4. Removal of necrotic tissue, pus or foreign bodies.
5. Duration of treatment.

Suggested oral administration in relation to feeding :

1. *Better when fasting* : Ampicillin, Amoxycillin, Tetracyclines, Sulphonamides, Cephalosporins, Rifampcin, Isoniazid.
2. *Better with food* : Doxycycline, Metronidazole, Griseofulvin.
3. *Indifferent to feeding* : Ciprofloxacin, Pefloxacin.

(1) TETRACYCLINES

* The tetracyclines used in veterinary practice include oxytetracycline, tetracycline and doxycycline.
* These are in general safe and cheap drugs.

Pharmacokinetic properties :

* Tetracyclines are adequately absorbed from GI tract in dogs and cats.
* They are well distributed in most body tissues and body fluids except CSF.
* They are excreted unchanged in urine except doxycycline.
* They have longer half life i.e. 6-10 hours because they undergo enterohepatic circulation.
* They have chelating properties and form insoluble complexes with calcium and other metals.

Mechanism of action :

* The tetracylines are *bacteriostatic* antibiotics.
* They act by inihibiting protein synthesis in susceptible microorganisms.

Antimicrobial spectrum :

* These are *broad-spectrum* antibiotics active against gram-positive and gram-negative bacteria, mycoplasma, chlamydia, rickettsia and some protozoa.

Indications :

Mixed bacterial infections of respiratory, genito-urinary and GI tract, HS, BQ, anthrax, leptospirosis, listeriosis, brucellosis, strangies, swine erysipelas, rikettsiosis, mycoplasmosis, chlamydiosis, ehrlichiosis, anaplasmosis, theileriosis, balantidiosis, amoebiasis.

Table 21.1 Usual Dosages of Tetracyclines in Animals

Sr. No.	Tetracycline	Trade names (e.g.)	Dose (mg/kg)	Route	Interval (hrs.)
1.	Doxycycline	Doxat/Doxial 100 mg cap.	D, C 5 - 10	PO	24
2.	Tetracycline	Steclin bolus 500 mg	R : 5 -10	PO	08
		Neocyclin bolus 500 mg	D, C:10-20	PO	08
3.	Oxytetracycline	Terramycin tab 500 mg	D : 20	PO	12
		Terramycin 30,100 ml	R, P : 5-10	IM, IV	12-24
		Intamycin 30, 100 ml	D,C : 10-20	IM, IV	12
		Oxytetracycline 30, 100ml (Oxytetracycline 50mg/ml)	H : 5	IV	12
4.	Oxytetracycline in long acting 2-pyrrolidone base	Intamycin LA 30, 50 ml Terramycin LA 30, 50 ml (Oxytetracycline 200mg/ml)	R : 20	IM	72

R : Ruminants P : Pig H : Horse D : Dog C : Cat

Drug interactions :

* Tetracyclines are synergistic with tylosin and other macrolides.
* Doxycycline is synergistic with streptomycin in the treatment of brucellosis and with pyrimethamine in case of toxoplasmosis.

Toxic and side-effects :

* Tissue damage at injection site and vomiting after oral administration due to their severe irritant nature.
* Disturbance of intestinal microflora, superinfection and avitaminosis due to its oral use for prolonged period.
* Discolouration of teeth in young growing animals.
* Acute collapse syndrome due to rapid IV injection of tetracyclines.
* Severe renal tubular damage due to administration of outdated and improperly stored preparations.

Contraindications and precautions :

* Avoid oxtetracycline in neonates and pregnant animals.
* Contraindicated in hypersensitivity and renal or hepatic impairment.
* Avoid milk feeding after oral administration.
* Intraarticular and intramammary injections are contraindicated.
* Long acting preparations are indicated in ruminants only.
* Avoid IM injections of oxytetracycline in horses.

(2) CHLORAMPHENICOL

Chloramphenicol is a stable, lipid-soluble neutral substance/compound.

Pharmacokinetic properties :

* Chloramphenicol is well absorbed from GI tract in monogastrates and calves, however in ruminants the drug is inactivated in rumen.
* The drug is widely distributed and attains effective concentration in most body tissues (brain) and fluids (CSF, aqueous humour) because of its lipophilic nature.
* The drug readily crosses blood-brain, pleural and placental barriers.
* The half life of drug varies from 1hr in horses to 5-6 hrs. in cats.
* Negligible amount of active drug is eliminated by renal excretion in herbivores.
* Drug is metabolised in liver and inactive metabolites are excreted through urine and bile.

Mechanism of action :

Chloramphenicol, a *bacteriostatic* antibiotic, is a potent inhibitor of microbial protein synthesis by reversibly binding to the 50s ribosomal subunit.

Antimicrobial spectrum :

It is *broad-spectrum* antibiotic effective against most gram-positive (*Actinomyces pyogenes, Bacillus anthracis, Corynebactrium sp., Listeria,*

Erysipelothrix, many staphylococci and streptococci) and many gram-negative (*E. coli, Klebsiella sp., Proteus sp., Salmonella sp., Bordetella sp., Haemophilus, Pasteurella, Actinobacillus*) aerobes.All anaerobes viz.*Bacteroides, Fusobacterium* and *Clostridium perfringens* are susceptible to chloramphenicol.

Indications:

It is useful for treatment of enteric infections (salmonellosis), meningitis (second choice to bactericidal drug), pneumonia, ocular infections, otitis, mastitis and metritis.

Doses :

Chloramphenicol sodium succinate	C,B:	2-4 mg / kg IV BID
		20-30 mg/kg IM
[Chlorcetin 2.5 g,750 mg,Lykacetin 2g,	S,G:	10-15 mg/kg IV BID
Neochlor 10,30 ml, Chlorovet 30 ml]		30-40 mg / kg IM
	D:	25-50 mg /kg IV
	H:	30-50 mg/kg IM BID

Drug interactions:

* The drug is antagonistic to penicillin G, lincosamides and macrolides.

Toxic and side effects :

* The drug causes reversible bone marrow supression (blood dyscrasis).

Contraindications :

* Avoid use in neonates, pregnant animals and hepatic impairment.

Thiamphenicol, a derivative of chloramphenicol, is considered less toxic to bone marrow as compared to chloramphenicol.

(3) PENICILLINS

Penicillins are betalactam bactericidal antibiotics.

Classification:

Penicillins are classified in to following groups depending upon their antibacterial spectrum and resistance to beta-lactamases-

a. ***Narrow-spectrum penicillins*** : These are penicilinase sensitive natural penicillins. e.g. Benzyl penicillin / penicillin G (Benzathene penicillin, Procaine penicillin) and penicillin V / Phenoxymethyl penicillin (acid stable oral penicillin G)

b. ***Penicillinase stable / Beta-lactamase resistant penicillins*** : These are narrow spectrum,semisynthetic penicillins. e.g. Cloxacillin and Methicillin.

c. ***Broad -spectrum penicillins*** : These are penicillinase sensitive semisynthetic penicillins. e.g. Amoxycillin and ampicillin.

d. ***Potentiated penicillins*** : The aminopenicillins in combination with sulbactum or clavulanic acid are called potentiated penicillins. Clavulanic acid and sulbactum inhibit beta-lactamases produced by penicillin resistant bacteria and make them susceptible to amoxycillin /ampicillin. Hence they are synergistic with amino-penicillins.

Pharmacokinetic properties :

* Penicillins are available as sodium or potassium salts.
* They are stable in dry crystalline form but lose their activity when dissolved.
* They are well distributed in ECF but poorly penetrate biological membranes.
* They are excreted almost through kidneys.
* Penicillin G is not stable in acidic environment whereas aminopenicillins are relatively stable in acid environment of stomach.
* Systemic availability of amoxycillin is more than ampicillin.
* Amino penicillins are better distributed than penicillin G.
* ***Clavulanic acid*** is well absorbed after oral administration and is well distributed in tissues and ECF but penetration in to milk and CSF through uninflamed udder and meninges is poor.
* Sulbactum-Amoxycillin combination is poorly absorbed orally but well absorbed after IM injection.

Mechanism of action :

* These are *bactericidal* antibiotics.
* They act by interfering with cell wall mucopeptide synthesis.

Antibacterial spectrum :

a) ***Penicillin G (Narrow-spectrum penicillins)*** : Good activity against gram-positive bacteria viz. *Clostridium, Fusobacterium, Corynebacterium, Streptococci, Bacillus, Actinomyces, Erysipelothrix*, Listeria and some gram-negative bacteria. (*Haemophilus somnus*).

b) ***Cloxacillin (Penicillinase resistant penicillins)*** : Effective against penicillinase producing bacteria viz *Staphylococus aureus.*

c) ***Amoxycillin and Ampicillin (Broad-spectrum penicillins)*** : They are slightly less effective than penicillin G against gram-positive anaerobic bacteria. But they have greater activity against gram-negative bacteria such as *E.coli* and *Salmonella*. They are not effective against *S.aureus, Klebsiella, Pseudomonas aeruginosa* and *Enterobacter sp.*

Indications :

a) ***Penicillin G*** : Black quarter, tetanus, anthrax, listeriosis, actinomycosis, streptococcal mastitis, swine erysipelas, strangles in horses, foot root in sheep, corynebacterial and streptococcal infections.

b) ***Ampicillin / Amoxycillin + Cloxacillin*** : Respiratory tract, urinary tract, GI tract, skin and soft tissue infections, otitis, mastitis, metritis, septicaemia.

c) ***Amoxycillin + Sulbactum / Clavulanic acid*** : Pneumonia, mastitis, calf scour, UTI, skin and soft tissue infections.

Table 21.2 Usual Dosages of Penicillins in Animals

Sr. No.	Type of Penicillin	Trade names (e.g.)	Dose (per kg)	Route	Interval (hrs)
1.	Penicillin G sodium + Procaine Penicillin G	Fortified procaine Penicillin 20, 40 lakhs	R,P:5000-10,000 IU H,D:20,000 IU	IM IM	24 12
2.	Benzathene Penicillin G	Longacillin - Vet Penidure LA 6, 12, 24 lakhs	R,H,P : 10 - 20,000 IU D : 40,000 IU	IM IM	72 72 - 120
3.	Phenoxymethyl Penicillin (Penicillin V)	Kaypen tab (125, 250 mg)	D : 10 mg	PO	8
4.	Ampicillin + Cloxacillin	Vetclox forte 2 g Ac vet 2, 3 g Ampoxin 125, 250 mg tab	R, H:5 - 10mg D : 5 - 10mg D : 10 - 20mg	IM, IV IM, IV PO	12 12 8 - 12
5.	Amoxycillin + Cloxacillin	Intamox 0.5. 3,4 g Moxel 0.5, 2, 3 g Dosmox 2, 3 g Megamycin 2, 3 g Novamox 250,500mg	R,H : 5 -10mg D : 5 - 10mg D : 10 -20mg	IM, IV IM, IV PO	12-24 12 12
6.	Amoxycillin (2 g) + Sulbactum (1g)	Amoxirum0.3g,3 g	7 - 10 mg 300 mg	IM, IV, Intramammary	12 - 24 12 - 24
7.	Amoxycillin Trihydrate	Amoxirum bolus 1.5 g	All sp. : 7.5 mg	PO	12
8.	Amoxycillin(140mg/ml) + Clavulanic acid (35 mg/ml)	Synulox inj 40 ml	B : 8.75 mg	IM	24

R : Ruminants *P : Pig* *H : Horse* *D : Dog* *B : Bovines*

Drug interactions :

* Penicillin G and amino penicillins are commonly synergistic with aminoglycosides against gram-positive and gram-negative bacteria.
* The betalactamase inhibitors such as cloxacillin, clavulanic acid and sulbactum shows good synergism with aminopenicillins against betalactamase producing bacteria.

Toxic and adverse effects :

* *Penicillin G* : Acute anaphylaxis and mild hypersensitivity reactions characterised by urticaria and mild fever are common.
* *Aminopenicillins* : Large oral doses disturb natural intestinal flora and cause diarrhoea. Hypersensitivity reactions may sometimes occur.
* *They are free of toxic effects even at high doses.*

Contraindications :

* Hypersensitivity.
* *Procaine penicillins are contraindicated in felines.*

(4) CEPHALOSPORINS

* Cephalosporins are broad-spectrum bactericidal beta-lactum antibiotics
* They are more resistant to beta-lactamase than penicillins.
* They are relatively non-toxic.

Classification :

A) ***First generation*** **:**
   a) Oral-Cephalexin, cefadroxil, cefadrine.
   b) Parenteral- cefazolin, cephalothin, cefacetrile.

B) ***Second generation*** **:**
   a) Oral- Cefachlor
   b) Parenteral-cefamandole, cefuroxime.

C) ***Third generation*** **:**
   Parenteral - cefotaxime, ceftriaxone, ceftiofur, cefoperazone.

Pharmacokinetic properties :

a) ***Oral cephalosporins*** **:**
   * They have pharmacokinetic properties similar to penicillinV and the aminopenicillins.
   * They are quickly and largely absorbed after oral administration in simple stomached animals.
   * They are poorly absorbed after oral administration in ruminants and horses.
   * They have short half life usually < 1 hr.

b) *Parenteral cephalosporins* :

* They are not absorbed after oral admnistration.
* They are rapidly and well absorbed after intramuscular and subcutaneous administration.
* They have short half life i.e. 1-2 hrs.(Cefotaxime) except ceftriaxone (8hrs) and ceftiofur (7-10 hrs).
* They are widely distributed in most body tissues and fluids but penetration across biological membranes (udder, brain) is poor.
* They are found in higher concentrations in urine and bile.
* There is poor CSF penetration but meningeal inflammation significantly enhances it.

Mechanism of action :

* These are *bactericidal* antibiotics.
* They interfere with bacterial cell wall synthesis by inactivating transpeptidase enzymes.

Antimicrobial spectrum :

a) *Cephalexin / Cefadroxil* :

* Fair activity against gram-positive bacteria viz. *Staphylococcus aureus* (including penicillinase producing), streptococci (not enterococci), *Actinomyces, Bacillus, Corynebacterium, Listeria,* and *Clostridium.*
* Moderate activity against some gram-negative bacteria such as *Bordetella, Haemophilus, Pasteurella, Actinobacillus, Brucella.*
* Not effective against enterobacteriacae.

b) *Cefotaxime / Ceftriaxone*: Excellent activity against aerobic gram-negative (*E.coli, Salmonella, Proteus, Klebsiella, Pasteurella, Enterobactor, Haemophilus, Bordetella, Moraxella, Actinobacillus*) and gram-positive bacteria (Streptococci, Staphylococci, *Bacillus sp.*) with variable activity against anaerobic bacteria. (*Clostridium, Fusobacterium, Bacteroides*)

c) *Ceftiofur* : Effective against a wide range of gram-negative (*Pasteurella multocida, P. haemolytica, Haemophilus somnus, Fusobacterium, Actinobacillius*) and gram-positive (*Staphylococci, Streptococci* and *Actinomyces*) bacteria.

In general with introduction of each cephalosporin group there has been a loss in gram positive and an increase in gram negative activity and spectrum with increased resistance to beta lactamase enzymes.

Indications :

a) *Cephalexin / Cefadroxil* : Urinary tract,respiratory tract, skin and soft tissues infections.

b) Cefotaxime / Ceftriaxone : Urinary tract, respiratory tract, gastro-intestinal tract, bone, joint, skin and soft tissue infections, meningitis and mastitis.

* *They are drug of choice for bacterial meningitis because of their exceptional activity against Enterobacteriaceae.*

c) ***Ceftiofur :*** Respiratory tract infections in ruminants, swine and horses, UTI associated with *E. coli* and *Proteus* in canines, metritis, pyometra.

d) ***Cefacetrile, cefuroxine and Cefquinome :*** They are widely used for treatment and prevention of mastitis by intramammary route.

Table 21.3 Usual Dosages of Cephalosporins in Animals

Sr. No.	Cephalosporin	Trade names (e.g.)	Dose (mg/kg)	Route	Interval (hrs)
1.	Cephalexin	Ceff 125, 500 mg Lixen bolus 1.5 g	D, C:10-30 R.H.P.: 10	PO PO	8 - 12 12
2.	Cefadroxil	Cefadrox 125,500 mg Cefodril 125,500 mg	D, C : 10-20 Calves : 35	PO PO	12 12
3.	Cefotaxime	Vetaxim 500 mg, 2 g Lyfovet 2 g	R : 15-24 H,D,C:20-40	IV IV, IM	12 08
4.	Ceftriaxone	Vetaceph 0.5, 2, 3 g Intacef 0.5, 2, 3 g Safevet 3 g	All sp. : 5-10	IM, IV	24
5.	Ceftiofur	Xceft 1 g	R :1.1 - 2.2 H, D : 2.2 P : 3 - 5	IM IM IM	24 24 24

R : Ruminants H : Horse D : Dog C : Cat P : Pig

Drug interactions :

Cephalosporins are potentially synergistic with aminoglycosides.

Toxic and side-effects :

* Allergic (urticaria, fever) and hypersensitivity reactions are rare.
* They may cause nephrotoxicity at very high doses.
* They may cause coagulopathy associated with hypoprothrombinemia which is reversible by vitamin K.
* Vomiting and diarrhoea may occur in simple stomached animals given oral cephalosporins.

They are safe in pregnant as well as young animals.

Contraindications :

* Hypersensitivity.
* Severe renal failure .
* Oral cephalosporins are contraindicated in herbivores because they are inactivated by the intestinal microflora.

(5) FLUROQUINOLONES

The fluroquinolones of general and current veterinary interest are ciprofloxacin, enrofloxacin, pefloxacin and norfloxacin.

Among these ***ciprofloxacin*** is most potent antimicrobial agent with antibacterial spectrum wider than aminoglycosides, third generation cephalosporins and other fluroquinolones.

Pharmacokinetic properties :

* They are rapidly absorbed from GI tract (except norfloxacin) in simple stomached animals, however they are poorely absorbed following oral administration in ruminants.
* They penetrate well in CSF, bronchial secretions, bone and cartilage.
* They are found in higher concentrations in bile and urine.

Mechanism of action :

* These are *bactericidal* antibiotics.
* They inhibit the enzyme DNA gyrase responsible for coiling and super coiling of DNA.

Antimicrobial spectrum :

* These are *broad-spectrum* antibiotics.
* They are highly active against gram negative aerobes- *E. Coli., Klebsiella, Proteus, Salmonella, Bordetella, Actinobacillus, Brucella, Haemophilus, Leptospira, Pasteurella* and *Pseudomonas aeruginosa.*
* They show moderate activity against gram positive aerobes viz. *Listeria, Erysipelothrix, Corynebacterium*, streptococci and staphylococci.
* They are also effective against mycoplasma and rickettsia.
* They are not effective against anaerobes.

Indications :

* Drug of choice for UTI.
* Effective for treatment of respiratory tract,GI tract, ENT, skin, soft tissues, bone, and joint infections.
* Useful in meningitis (if given by IV route) and rickettsial and mycoplasma infections.
* Norfloxacin is indicated in UTI and GIT infections.

Table 21.4 Suggested Dosages of Fluoroquinolones in Animals

Sr. No.	Fluoroquinolone	Trade names (e.g.)	Dose (mg/kg)	Route	Interval (hrs)
1.	Ciprofloxacin	Cflox-IU 50 ml Ciprovet 10 ml Ciprolet 250,500 mg	R : 5 D : 5-10	IV, IU IV, PO	12 - 24 12
2.	Enrofloxacin	Floxidin 15,50ml Enrox 15,100 ml Quinintas 15,30 ml Enrodac 15 ml	R, P : 2.5 - 5 D : 2.5 - 5	IM IM	24 12
3.	Pefloxacin	Pelwin 100 ml Peflox 200, 400 mg	R : 2.5 - 5 D : 10	IV IV, PO	12 12
4.	Norfloxacin	Norflox 200,400 mg	D : 22	PO	12

R : Ruminants *D : Dog* *P : Pig*

Drug interactions :

* They show little or no synergism or antagonism with penicillins, cephalosporins, macrolides, or aminoglycosides.
* They are antagonistic to nitrofurans and chloramphenicol.
* They may be used with metronidazole to widen the antibacterial spectrum particularly against anaerobes.

Contraindications and precautions :

* *Contraindicated in horses.*
* Use with caution in patients with renal impairment and severe dehydration.
* Avoid in neonates, growing animals and pregnancy .

Toxic and side-effects :

* Nausea, diarrhoea, vomition, abdominal pain, headache and restlessness
* Arthralgia due to erosion of cartilage in young growing animals.

Quinolones :

* The original quinolones include nalidixic acid and flumexine
* They are effectives only against gram negative bacteria.
* They are mostly used for treatment of urinary and GI. tract infections.
* They are hepatoxic and neurotoxic in dogs.
* Nalidixic acid (Negadix 500 mg tab and suspension) is given in dog and cat @ 25 mg / kg orally twice daily.

(6) AMINOGLYCOSIDES

The important aminoglycosides include Streptomycin, Neomycin, Kanamycin, Gentamicin, Amikacin and Tobramycin.

Pharmacokinetic properties :

* They are poorly absorbed from GI tract.
* They are poorly distributed in body tissues.
* They do not readily attend therapeutic concentration in CSF and ocular fluid.
* They have short half-lives in animals (1-2 hours)
* They are entirely eliminated through kidneys.

Mechanism of action :

They exert *bactericidal* action by inhibiting bacterial protein synthesis.

Antimicrobial spectrum :

* The aminoglycosides have good activity against aerobic gram-negative bacteria and limited activity against gram positive bacteria and no activity against anaerobic bacteria.
* Amikacin has greater activity than tobramycin and gentamicin. Gentamicin is superior to Neomycin and Kenamycin. Streptomycin is least effective amongst all aminoglycosides.
* Aminoglycosides are in general effective against gram-negative bacteria such as *E. coli, Salmonella sp., Klebsiella sp., Proteus, Shigella, Bordetella, bronchiseptica, Fasteurella* and gram-positive bacteria viz. *S. aureus.*
* In addition gentamycin is effective against *Pseudomonas aeruginosa*, *Streptococci, Corynebactrium* and *Mycoplasma.* Whereas streptomycin is especially useful in TB, Brucellosis and Leptospirosis.

Indications :

a) ***Streptomycin :*** Used in combination with penicillin for bovine mastitis, respiratory tract, urinary tract and ear infections, Bovine tuberculosis, Salmonellosis, Actinomycosis, Brucellosis, Leptospirosis.

b) ***Neomycin :*** Recomended for the treatment of enteric, urinary tract, skin or ear infections.

c) ***Kenamycin :*** Useful for treatment of enteric, respiratory, ocular and uterine infections.

d) ***Gentamicin :*** Indicated in respiratory, urinary tract, GI tract, ocular and ear infections, mastitis, metritis, meningitis and osteoarthritis.

e) ***Amikacin :*** Septicaemias, urinary tract, respiratory tract, GI tract, bone, joint, CNS, skin and soft tissue infections.

f) ***Tobramycin :*** Septicaemia, urinary tract and lower respiratory tract infections, meningitis, peritonitis.

Table 21.5 Suggested Dosages of Aminoglycosides in Animals

Sr. No.	Aminoglycoside	Trade names (e.g.)	Dose (mg/kg)	Route	Interval (hrs)
1.	Gentamicin	Gentamicin 30, 100 ml	R, H, P : 2	IV, IM	12 - 24
		G - cin/Aminocin (Gentamycin 40mg/ml)	D, C : 2 - 4	IV, IM	8 - 12
2.	Amikacin	Mikacin 2ml (100, 250, 500 mg)	D, C : 10	IV, IM	8
			H : 4 - 8	IV, IM	8 - 12
3.	Kanamycin	Kancin 1 gm	B : 5 - 10	IV, IM	12
			D, C : 5	IV, IM	8 - 12
4.	Neomycin	Urimycin 15 ml (Neomycin 140mg/ml)	R, P : 2.5 - 5	IM, IV	12
			R, P : 10	PO	
		Neocare forte powder 25w/w	D : 11	IM, IV	8
			D : 20	PO	
5.	Streptomycin + Penicillin	Dicrysticin-s 2.5 g Munomycin forte 2.5 g Bistrepen - V 2.5 g	All sp. : 10	IM	12
6.	Tobramycin	Tobacin 20, 60, 80 mg	D : 1	IM	8

R : Ruminants, H : Horse, P : Pig, D : Dog B : Bovine

Drug interactions :

* Aminoglycosides are commonly synergistic with bet-lactam drugs viz. penicillins, aminopenicillins, cephalosporins.
* Streptomycin is synergistic with penicillin.
* Gentamicin is synergistic with beta lactam antibiotics and sulpha-trimethoprim combinations.

Toxic and side-effects :

Aminoglycosides are in general ototoxic (Vestibular and cochlear damage), nephrotoxic (acute tubular necrosis) and neuromuscular (neurotoxic) blockade

* Neomycin is highly ototoxic and nephrotoxic.
* Kenamycin is moderately nephrotoxic.
* Streptomycin is moderately ototoxic and least nephrotoxic.
* Gentamicin and Amikacin are least ototoxic and moderately nephrotoxic.

* *Risk factors for toxicity of aminoglycosides include higher doses of drug, prolonged drug therapy, young age and renal impairment.*

Contraindications :

* Hypersensitivity
* Avoid in neonates, pregnancy and renal impairment.
* Avoid aminoglycosides in cows prone to milk fever.

(7) SULFONAMIDES

Classification of sulfonamides :

1. ***Systemic***- a) Short acting - Sulfadimidine (sulfamethazine),
   b) Intermediate acting - Sulfadimethoxine, sulfamethoxazole, sulfadiazine, sulfadoxine.
2. ***Gut acting***- Sulfaguanidine, phthalylsulfathiazole.
3. ***Topical*** - Sulfacetamide.

Pharmacokinetic properties:

1. They are rapidly absorbed from GI tract.
2. They are distributed widely in all tissues and body fluids including CSF.
3. They have relatively long half- lives probably due to extensive binding to plasma albumin.
4. They are eliminated by combination of renal excretion and biotransformation.

Mechanism of action:

Sulfonamides competitively inhibit enzyme dihydrofolate synthase and thereby cause interference in utilisation of para-aminobenzoicacid (PABA) by bacteria.

Antimicrobial spectrum:

* *Broad-spectrum* antimicrobial inhibits bacteria, chlamydia and protozoa such as coccidia and toxoplasma.
* Good activity against *Actinomyces, Erysipelothrix, Bacillus, Brucella, Listeria*, Streptococci, Chlamydia, Coccidia and Cryptosporidium.
* Moderate activity against Staphylococci, Enterococci and Enterobacteriaceae.
* Resistance to *Clostridium* species except *Clostridium perfringens*, Anaerobic cocci, *Mycobacterium, Mycoplasma* and *Pseudomonas*.

Indications:

Respiratory tract infections (pasturellosis, strangles), GIT infections (colibacillosis, salmonellosis), Meningitis, Actinobacillosis, Actinomycosis, Foot rot, Coccidiosis and Toxoplasmosis.

Widespread resistance has greatly limited the use of sulfonamides in treating bacterial diseases of animals and hence it is better to give sulfonamides in combination with trimethoprim.

Table 21.6 Suggested Dosages of sulfonamides and sulfa-trimethoprim combinations in Animals

Sr. No.	Drug	Trade names (e.g.)	Dose (mg/ kg)	Route	Interval (hrs)
1.	Sulfamethazine (Sulfadimidine)	Sulfadimidine33.3% Sulpha bolus 5g Pabadin bolus 5g Diadin tab 5g	100-200 followed by 50-100	IV,PO	24
2.	Sulpha-methoxy pyridazine	Aldazin long-acting (250 mg/ml) 30 ml	25	IV, IM, SC	---
3.	Sulfaguanidine	Sulfagut bolus 5g	100 - 300	PO	24
4.	Phthalyl sulphathiazole with astringents	Pesulin bolus Suifta bolus	100	PO	12
5.	Sulfadiazine 400 mg + Trimethroprim 80 mg	Bactrisol 30ml Biotrim 10, 30ml Solbac 10, 30ml	15 30	IM, IV PO	12-24 12-24
6.	Sulfamethoxazole 400 mg+ Trimethroprim 80 mg	Oriprim vet 30ml Oriprim bolus 2.4g Intrim forte 2.4g Cotrimal Ds bolus 3g	15 30	IM, IV PO	12-24 12-24
7.	Sulfadoxine 200 mg - Trimethroprim 40 mg	Bactridox 30ml	15	IM	12-24

* Sulfadimidine is most widely used sulfonamide as it can attain effecive plasma concentration when administered either orally or parenterally.
* Sulpha drug therapy should be initiated with priming dose and effective concentration can then be maintained by administering maintenance doses (50 % of priming dose)

Drug interactions:

* They are synergistic with trimethoprim.
* Penicillins are antagonistic to sulpha drugs.

Toxic and side-effects:

* The most common adverse effect of sulpha drug is impairment of renal function characterised by crystalluria, haematuria and obstruction of renal tubules.
* Haemopoeitic disorders viz. thrombocytopaenia, leucopaenia and anaemia.
* Rapid IV injection of high doses of sulfanomides may cause shock like reaction.
* Sulfaquonixaline is antagonistic to vit. k and causes haemorrhagic diathesis.

Renal tubular damage can be minimised by -

1) Maintaining hydration of patient throughout the course of sulfa therapy by providing adequate drinking water or parenteral fluid therapy.
2) Alkalinizing urine as alkalinity increases solubility of sulfa drugs in urine.
3) Using most soluble sulfonamides.

Contraindications and precautions:

* Contraindicated in neonates and pregnancy.
* Hepatic and renal dysfunctions.
* Blood dyscrasis.
* Hypersensitivity to either sulfonamides or trimethoprim.
* Sulfonamides are only used in horses in combination with trimethoprim.

Potentiated sulfonamides:

Sulfonamides in combination with trimethoeprim potentiates antibacterial action of sulfonamides by inhibiting dihydrofolate reductase.

* Trimethoprim is a bacteriostatic drug.
* Trimethoprim is a broad-spectrum drug active against gram- negative aerobic bacteria, but not usually against anaerobes.
* Trimthoprim is a relatively nontoxic drug.

Advantages of sulfa-trimethoprim combination :

* The combination is bactericidal.
* The combination reduces toxicity risk of sulfonamide.
* The dose of combination is low.

(8) LINCOSAMIDES, MACROLIDES AND PLEUROMUTILINS

Classification:

1) ***Lincosamides*** - Lincomycin, and Clindamycin.
2) ***Macrolides*** - Erythromycin, Roxithromycin, Azithromycin, Tylosin.
3) ***Pleuromutilins*** - Tiamulin.

Pharmacokinetic properties:

These antibiotics have similar pharmacokinetic features like high lipid solubility, wide distribution in the body and capacity to penetrate tissue barriers.

Mechanism of action :

* These are bacteriostatic antibiotics.
* They inhibit protein synthesis by binding to the 50's ribosomal subunit.

Antimicrobial spectrum:

a) ***Lincosamides:***

These are moderate spectrum antimicrobial drugs effective against-

* Gram-positive aerobes: *Bacillus* sp., *Corynebacterium* sp., *Erysipelothrix*, Staphylcocci (not enterococci).
* Gram-negative aerobes: *Campylobactor* sp.
* Anaerobes: *Actinomyces* sp., *Clostridium perfringes, Bacteroides* sp. Clindamycin is more effective than lincomycin particularly against *S.aureus* and anaerobes (*Fusobacterium* sp., anaerobic cocci and *Treponema* sp.)

b) ***Macrolides:***

Macrolides are active against gram-negaive bacteria and mycoplasma than lincosamides.

* Erythromycin is effective against gram-positive aerobes and anaerobes and in addition it is moderately effective against enterococci, *Bordetella, Haemophilus* sp.and *Pasteurella* and inactive against enterobacteriaceae and mycoplasma.
* Tylosin has a similar spectrum of activity to erythromycin but it is more active against mycoplasma.
* Roxithromycin and Azithromycin have similar spectrum of activity to erythromycin and have considerably longer half-lives.

c) ***Tiamulin*** :

* The antimicrobrial spectrum of tiamulin is similar to tylosin but has greater activity.
* This drug is more effective against anaerobic bacteria and mycoplasma than macrolides.

Indications :

a) ***Lincosamides*** : Staphylococcal infections (pyoderma, osteomyelitis), respiratory tract infections, mastitis, metritis and anaerobic infections.

b) ***Erythromycin and Roxthromycin*** : URT, pneumonia, bronchitis, pharyngitis, otitis, swine erysipelas, UTI, skin and genital infections.

c) ***Tylosin*** : URT, pneumonia, foot rot, swine erysipelas, cellulitis, metritis, mastitis, arthritis, otitis, leptospirosis in dog.

d) ***Tiamulin***: Pneumonia, mycoplasmal arthritis, swine erysipelas and swine dysentery, CRD in poultry.

Table 21.7 Suggested Dosages of Lincomycin and Macrolides in Animals

Sr. No.	Drug	Trade names (e.g.)	Dose (mg/kg)	Route	Interval (hrs)
1.	Lincomycin (300 mg/ml)	Alincomycin vet 5ml (Alved pharma)	10 - 20 10 - 20	IM, IV PO	12 - 24 8 - 12
2.	Clindamycin (300 mg/2ml)	Dalacin - C 2ml Clincin 150, 300 mg cap	3 - 5 5 - 11	IM, IV PO	12 12
3.	Erythromycin	Althrocin 250, 500 mg	D : 10 - 20	PO	8 - 12
4.	Roxithromycin	Roxid 50, 150 mg	D : 2.5 - 5	PO	12
5.	Tylosin (50 mg/ml)	Tysin 30, 50, 100 ml (Vet India)	R : 10-20 D : 20 - 40 P : 5 - 10	IM IM IM	24 24 24
6.	Tiamulin (100 mg/ml)	Tiamutin 10% 14, 100ml (Novartis)	R : 6 - 8 P : 10 - 15	IM IM	24 24

R : Ruminants, *P : Pig,* *D : Dog*

Drug interactions :

* Clindamycin combined with aminoglycosides can be used for treatment of aerobic-anaerobic infections.
* Combination of lincomycin with spectinomycin gives more activity against mycoplasma.
* Lincosamides and macrolides and chloramphenicol are antagonist.

Toxic and side effects:

* Pain and irritation may occur on IM injections.
* Large oral doses may cause vomition and diarrhoea.

Contraindications :

* Hypersensitivty.
* Highly irritating so not indicated in horses, guineapigs and rabbits.
* Erythromycin is hepatotoxic hence avoided in liver diseases.

(9) NITROFURANS

Nitrofurans used in veterinary medicine include nitrofurazone, nitrofurantoin and furazolidone.

Pharmacokinetic properties :

* Nitrofurazone and furazolidone are poorly soluble and are not absorbed after oral administration.
* Nitrofurantoin is well absorbed following oral administration.

Mechanism of action:

* These are bactericidal drugs.
* These are converted to some metabolities which interfere with the function of DNA in pathogenes.

Antimicrobial spectrum:

* These are relatively broad-spectrum antimicrobials.
* These are active against bacteria such as *Staphylococcus aureus*, streptococci, *Corynebacterium* sp., *E.coli., Salmonella, Klebsiella* and protozoa viz. *Histomonas* and *Giardia.*

Indications:

a) ***Furazolidone :*** GI tract, udder, uterine and skin infections, coccidiosis, giardiasis.
b) ***Nitrofurantoin :*** Urinary tract infections.
c) ***Nitrofurazone :*** Skin, eye, ear and uterine infections.

Table 21.8 Suggested Dosages of Nitrofurans in Animals

Sr. No.	Drug	Trade names (e.g.)	Dose (mg/ kg)	Route
1.	Furazolidone	Furoxone tab 100 mg	10 - 12	PO
2.	Nitrofurantoin	Furadentin tab 100 mg	Calves, H : 10 Dogs : 4 - 5	PO PO
3.	Nitrofurazone	Furacin oint 20, 25 g	2 % oint	Topical application

Drug interactions:

Nitrofurans are antagonistic to nalidixic acid.

Toxic and side-effects:

Anorexia, nausea, vomition, neuritis, haemorrhagic diathesis.

Contraindications :

* Hypersensitivity.
* Early pregnancy.

(10) NITROIMIDAZOLES

The nitroimidazoles used in veterinary medicine are metronidazole and tinidazole.

Pharmacokinetic properties:

* These drugs are well absorbed after oral administration.
* These drugs are well distributed in tissues and body fluids (brain and CSF).

Mechanism of action:

* These are bactericidal drugs.
* They cause extensive breakage of DNA strands and inhibit DNA repair enzyme, DNA ase 1.

Table 21.9 Suggested Dosages of Nitroimidazoles in Animals

Sr. No.	Drug	Trade names (e.g.)	Dose & Route
1.	Metronidazole	Flagyl / metrogyl (500 mg/100 ml) Flagyl tab 200, 400mg Flagyl suspension (200 mg/5 ml)	20 mg/kg/day IV in divided doses 25-50 mg/kg/day in two divided doses PO
2.	Metronidazole + Furazolidone	Metrofurol bolus 1.5g Fazole bolus 1.2 g	Large animals : 4-6boli/day Small animals : 1-2boli/day
3.	Norfloxacin + Metronidazole	Vetflox-M Norflox tab200,400mg	Dog : ½ - 1 tab BID PO
4.	Tinidazole	Fasigyn (500 mg, 1 g)	D & C : 30-50 mg/kg/day in 2 divided doses PO
5.	Ciprofloxacin1500mg + Tinidazole 1800 mg	C flox -TZ bolus	Adult bovines : 1 bolus/300 kg bw PO
6.	Ciprofloxacin 250mg + Tinidazole 300 mg	C flox TZ tab	Sheep, goat, dog, calves : 1 tab / 25kg bw PO

Antimicrobial spectrum:

These drugs are active against most gram-negative and many gram-positive anaerobic bacteria and variety of protozoa. However they are not effective against aerobic bacteria.

Indications:

Anaerobic bacterial infections, amoebiasis, giardiasis, trichomoniasis, gingivitis, and balantidiasis.

Toxic and side-effects:

* Vomiting, nausea, and uneasiness in dogs.
* Higher doses may cause neurological disturbances.
* Carcinogenic effects in case of prolonged and repeated use.

Contraindications:

* Avoid use in pregnancy.
* Avoid prolonged use.

(11) POLYPEPTIDE ANTIBIOTICS

A] Polymyxin - B and Colistin:

* They disrupt structure of cell membranes phospholipids and increase cell permeability by detergent- like actions.
* These drugs are very slowly absorbed from GI tract or even denuded skin.
* These are bactericidal to most gram-negative bacteria particularly *E.coli, Salmonella* and *Pseudomonas*.
* These drugs are used for treatment of skin, eye and ear infections. They are also useful in treatment of Coliform mastitis.
* These drugs are nephrotoxic and neurotoxic when given by parenteral route.
* Colistin is more potent and less toxic than polymyxin.
* They are combined with neomycin and bacitracin in some topical preparations (Neosporin powder 10 gm / ointment 5,15 gm) to widen the antimicrobial activity for topical use.

B) Bacitracin :

* It acts by inhibiting bacterial cell-wall synthesis.
* It is bactericidal to gram-positive bacteria.
* It is highly nephrotoxic following parenteral use.
* It is mainly used for topical infections especially against *Staphylococcus aureus*.
* It is usually combined with an aminoglycoside (neomycin) or polymyxin B for broad-spectrum activity in treatment of wounds.

Table 21.10 Antifungal drugs - their indications and doses in Animals

Sr. No.	Drug	Indication	Dose & Route
	Systemic		
1.	Amphotericin B Fungizone iv (50 mg vial)	Systemic mycoses viz. Histoplasmosis, candidiasis, blastomycosis, coccidiomycosis	D : 0.25 - 0.5 mg/kg IV every 48 hrs. through 5% dextrose in slow drip on 10 occasions
2.	Griseofulvin (Grisovin Fip tab) (250, 500 mg)	Dermatophytes viz. *Trichophyton* and *Microsporum*	B: 7.5 - 10 mg/kg PO D, C : 20 mg/kg/day PO for 30 days
3.	Nystatin Mycostatin tab (5 lac u)	Candidiasis	D : 20,000 units/kg/day PO
4.	Ketoconazole Fungicide/Nizral tab (200 mg)	Broad-spectrum effective against systemic mycoses as well as dermatophytosis	D, C : 10 mg/kg PO daily for 45 - 60 days
5.	Itraconazole Itrole cap 100 mg	More potent than ketoconazole useful in systemic mycoses and dermatomycosis	D : 10 mg/kg PO daily
6.	Fluconazole Fungid 150 mg	Candidiasis, Cryptococcosis, Aspergillus pneumonia	D : 5 - 10 mg/kg PO daily
	Topical		
1.	Clotrimazole Canesten/Candid 1% solution (15 ml), Cream (15 g) Spray (50 ml)	Broad-spectrum antifungal useful in dermatophytosis, cutaneous aspergillosis and candidiasis, fungal mastitis candidiasis	* Topically for 4 - 6 wks. * Intramammary infusion of 100 - 200 mg/quarter for 3 - 4 days
2	Miconazole Zole oint, Powder (15 g) and lotion (15 ml)	Dermatophytosis and superficial mycoses viz. candidiasis including fungal mastitis	* Topically for 4 wks. * Intramammary infusion of 50 - 100 mg in 60 ml water/quarter for 3-4days

Antimicrobial therapy - special considerations

1. Mastitis

* The intramammary route of administration is preferred for the treatment of mild subacute to chronic mastitis.
* The parenteral and intramammary routes are useful for treatment of acute severe mastitis.

Cause	Drug of choice	
1. Gram-positive bacteria	Parenteral	- Aminopenicillins, Penicillin G, Macrolides
	Local	- Cephalosporins, Aminopenicillins, Strepto-penicillins
2. Gram-negative bacteria	Parenteral	- Gentamycin, Chloramphenicol, Sulfa-trimethoprim
	Local	- Cephalosporins, Gentamycin, Aminopenicillins.
3. Mycoplasma		- Macrolides (Tylosin), Tiamulin
4. Yeast, fungi	Local	- Clotrimazole, Miconazole

2. Meningitis

* Drugs which penetrate the blood-brain barrier are effective for treatment of meningitis.

Causative organism	Drug of choice	Alternative drugs
1. Enterobacteriaceae (Calves & foals)	Cefotaxime / Ceftriaxone	Aminopenicillins Fluoroquinolones Aminoglycosides Sulfa - trimethoprim
2. Beta-haemolytic streptococci (Foals & piglets)	Penicillin / Aminopenicillins	New cephalosporins
3. Adult ruminants : *Haemophilus somnus* *Listeria monocytogenes*	------ do -------	Sulfa - trimethoprim
4. Pigs : *H. Suis, S. Suis*	------ do -------	------ do -------

3. Bone and joint infections

* ***Osteomyelitis*** - Fluoroquinolones in high doses for 3-4 weeks by parenteral route.
* ***Septic arthritis*** - Joint aspiration once or twice a day for 7-10 days, irrigation with isotonic solutions and betalactam antibiotics in high doses parenterally for 2 weeks.

4. Anaerobic infections

* ***Causative bacteria*** - *Bacteroides, Fusobacterium, Clostridium, Actinomyces.*
* ***Sources of anaerobes*** - Abscesses, peritonitis, chronic sinusitis, chronic pleuro-pneumonia, genital tract intections, bite wounds and cellulitis.
* ***Drug of choice*** - Chloramphenicol, metronidazole, beta-lactam drugs (amoxy-cillin-clavulanic acid / cloxacillin, cephalosporins). Penicillin is drug of choice for clostridia but *B. fragilis* and *Bacteroides* are resistant.

5. Mycoplasma infection

* Mycoplasma organisms are sensitive to fluoroquinolones, tiamulin, tylosin and tetracyclines.

6. Ocular infections

a) ***Routes of administration*** - Topical, subconjunctival and systemic.

* Intraocular penetration of antimicrobial drugs in normal eyes varies depending upon route of administration
  a) Systemic - Chloramphemicol (Good), tetracycline (fair)
  b) Topical - Chloramphenicol (Good), polymyxin, neomycin, penicillin-G and tetracyclines (fair)
  c) Subconjunctival - Chloramphenicol, penicillin / ampicillin, polymyxin (Good), gentamycin, kanamycin and streptomycin (fair)
* *Topical application* is route of choice for superficial ocular infections.
* Ointments persist longer than drops.
* *Subconjunctival administration* results in high concentrations in cornea and aqueous and vitreous humors. So this route is preferred for treatment of suppurative keratitis and endophalmitis.
* *Systemic adminstration* gives lower concentration than subconjunctival administration.

b) ***Antibiotics of choice in ocular infections :***

* Gram-positive infections - Chloramphenicol
* Gram-negative infections - Gentamycin, fluoroquinolones
* Suitable first choice combination - Neomycin - polymyxin - bacitracm and cephalosporin - aminoglycosides

7) Antimicrobials in Pregnancy

a) ***Drugs Contraindicated :*** Fluoroquinolones, tetracyclines (antibacterial) and griseofulvin (antifungal).

b) ***Drugs to be avoided :*** Aminoglycosides, chloramphenicol, sulfonamides, metronidazole, nitrofurantoin, trimethoprim (antimicrobials), imidazoles and triazoles (antifungal)

c) ***Drugs usually safe :*** Beta-lactam drugs (Penicillins, amino-penicillins, cephalosporins), macrolides and lincosamides.

Antimicrobials in Renal failure :

a) ***Drugs contraindicated :*** Neomycin, Nalidixic acid, Tetracyclines, Polymyxin-B and Nitrofurantoin.

b) ***Drugs to be avoided :*** Drugs eliminated by renal route viz. Gentamycin, Kanamycin, Streptomycin and Quinolones.

c) ***Drugs to be used :*** Drugs eliminated by hepatic or non-renal mechanisms such as chloramphenicol, aminopenicillins, macrolides and some cephalosporins.

CHAPTER - 22 : BLOOD TRANSFUSION AND FLUID THERAPY

A.U. Bhikane and L.G. Anantwar

BLOOD TRANSFUSION

Indications:

1. *Anaemia* :

a) *Acute haemorrhage :* Trauma, Accidents, Surgical operations.

b) *Chronic haemorrhage :* Parasites-*Haemonchus*, *Strongyles*, Hookworms, Abomasal ulcers.

c) *Haemolytic anaemia :* Theileriasis, Babesiosis, Anaplasmosis, Leptospirosis, Phosphorus deficiency haemoglobinuria, Bacillary haemoglobinuria

2. *Bleeding disorders* :
Thrombocytopaenia, Coagulopathies.

3. *Hypoproteinaemia* :
Undernutrition, Parasitism.

4. *Burns*

5. *To provide specific and non-specific resistance against infection*

* Whole blood is preferred in haemorrhagic anaemia
* Packed blood cells are good for treatment of haemolytic anaemia
* In bleeding disorders, hypoproteinaemia and burns, plasma is preferred.
* Serum is the best blood component for providing immunity.

Blood groups :

* Blood types are genetic markers on erythrocyte surfaces that are antigenic and specific for each species.
* In animals number of blood group systems are present and some of these systems are complex having many subgroups called factors.
* The number of blood group systems in different species are as follows.
  Cattle-13, Sheep & Goat - 8, Horse--9, Pig--16, Dog--8, Cat--2, Chicken - 11

Selection of donor :

1. It should be from same species and preferably from same breed.
2. It should be apparently healthy.
3. It should be free from infectious diseases.
4. It should have normal body temperature and pink colour eye mucosae.
5. It should have high haemoglobin and PCV values
   (Dog : PCV > 40 %, Hb > 13 gm %)
6. The most ideal canine blood donor should be negative for CEA-1, CEA-2 and CEA-7 factors.

Blood Compatibility / Cross-matching

* The blood compatibility testing is done to prevent life threatening antigen-antibody reactions caused by major blood group mismatching.
* Cross-matching to determine compatibility is not often practiced in animals except horse and dog.
* In cattle first transfusion can be done without cross-matching however, it is essential if the recipient is given more than one transfusion.

1. Rapid/Direct Method :

1. Mix one drop of donor's blood with 3 ml normal saline.
2. Add 2 drops of above mixture to 2 drops of recipient serum on glass-slide and then gently agitate it for 3-5 min.
3. Uniform distribution of cells indicate compatibility.

2. Indirect Method :

1. ***Major cross-match :*** 2 drops of Donor's RBCs +2 drops of recipient serum.
2. ***Minor cross-match :*** 2 drops of Donor's Serum +2 drops of recipient RBCs
3. ***Control*** : a) Donors : 2 drops RBCs + 2 drops serum
   b) Recipient : 2 drops RBCs + 2 drops serum
4. Mix the contents of 4 test tubes and incubate for 30 min at 37 °C.
5. Centrifuge it at 5000 rpm for 1 min.
6. Haemolysis or agglutination indicates incompatibility.

Preparation of RBC Suspension :

1. Collect anticoagulated blood from both the donor and the recipient.
2. Centrifuge the blood samples at 3000 rpm for 2 min.
3. Discard the supernatant and wash the packed red blood cells with normal saline three times by centrifugation.
4. Prepare 10 % red blood cell suspension.

3. Oehlecker's Biological Test:

* This test is suitable under field conditions where cross-matching is not possible
* Inject 10 ml. of blood to recipient and observe for 10-20 min.
* If there is no untoward reaction, then remainder of blood can be transfused without risk.

Blood collection and storage

1. Collection systems :

The blood can be collected in -

a) Sterile autoclaved saline glass bottles.
b) Acid Citrate Dextrose (ACD) / Citrate Phosphate Dextrose, Adenine (CPD-A) readymade polythene bags.

2. Anticoagulants :

a) ***Sodium citrate* (3.85 %) :** Suitable for immediate transfusion. It is used @ 10 ml for each 100 ml of blood.

b) ***ACD / CPD anticoagulant* :** Good for storage of blood and it's components. CPD is preferred to ACD because red blood cell viability is prolonged to 4 weeks as compared to 3 week in ACD.

ACD Solution :

1. Dextrose	14.7 gm	The solution is autoclaved for
2. Tri-Sodium Citrate	13.2 gm	sterilization.
3. Citric acid	4.8 gm.	It is used @ 15 ml / 100 ml blood.
4. Distilled water	1000 ml.	

CPD- A Solution :

1. Dextrose	31.9 gm.
2. Sodium citrate (dihydrate)	26.3 gm
3. Citric acid (anhydrous)	2.99 gm
4. Monobasic sodium phosphate (monohydrate)	2.2 gm.
5. Adenine (unhydrous)	0.275 gm
6. Water	1000 ml.

It is used @ 15 ml/100 ml of blood.

3. Site : Preferably from jugular vein using 14 - 15 guaze needle.

4. Rate of bleeding : Usually @ 10 ml /kg body weight of donor.

5. Storage :

* Blood stored at room temperature should be used for transfusion within 4-8 hrs of collection.
* Blood can be stored for 3-4 weeks at 4^0 c

Administration of blood

1. Routes of administration :

a) *Intravenous :* It is commonly used route.

* Jugular vein is preferred for this route. In dogs, cephalic or recurrent tarsal vein is also used.
* It is satisfactory for treatment of hypovolemic shock.

b) *Intra-peritoneal :*

* It is indicated in shocked and unco-operative animals.
* It is not satisfactory for treatment of hypovolemic shock.
* There is delay in absorption of RBCs however the cells are absorbed in an unaltered state.
* It may be of value in replacement of erythrocytes i.e.haemolytic anaemia.
* It is not recommended in ascites, peritonitis, abdominal distension and recent abdominal surgery.

2. **Rate of transfusion :** @ 10 -.20 ml / kg /hour.

3. **Dose of blood :**

* It varies with the size of recipient and volume of the blood that is lost.
* It can arbitarily given @ 10-15 ml /kg body weight.
* Administration of 1 ml whole blood/lb elevates PCV by 1 %. (If PCV of donor is 40 %).
* Administration of 0.5 ml packed blood cells /lb elevates PCV by 1 %.
* The actual requirement of blood is calculated by using either of the following formulae.

a) Blood (in ml) required to raise Hb level by 1% $= \frac{40 \times \text{Body weight in pounds}}{100}$

b) Blood volume to be transfused

$$= \text{Body wt. (kg)} \times K \times \frac{(\text{Desired PCV} - \text{PCV of recipient})}{\text{PCV of donor}}$$

Where, K = 90 in dogs, 66 in cats.

* In most instances, replacing 20-40 % of the calculated blood loss is sufficient to maintain life.

Adverse Reactions to Transfusion

A. Causes :

1. Improper compatibility
2. Improper storage
3. Improper administration

B. Types of reactions :

* Transfusion reactions can be immediate i.e. within 2 - 4 hours or delayed for few days.
* Transfusion reactions may be immunogenic or non-immunogenic.

a) *Immunogenic* :

1. *Haemolytic reaction* :
   a) Acute / intravascular haemolysis is characterised by haemoglobinuria, icterus, dyspnoea, tachycardia, lethargy and death.
   b) Delayed / extravascular haemolysis : It may not produce clinical signs.
2. *Allergic reaction* : Urticaria, pruritus, dyspnoea, vomiting, facial oedema, diarrhoea.
3. *Anaphylaxis* : It is very sudden, severe reaction characterised by weak pulse, bradycardia, dyspnoea, urination, vomition, defecation, nervous signs and death.

b) ***Non- immunogenic*** **:**

1. Fever associated with tremor, salivation, lacrimation, coughing, hiccough.
2. *Hypothermia* : It is usually due to use of cold blood in debilitated animals.
3. *Citrate toxicity* : It is used due to massive transfusion of citrated blood at rapid rate and is characterised by hypocalcaemia, restlessness, tremors and cardiac arrythmia.
4. *Congestive heart failure* in animals with pre-existing heart disease and / or due to rapid blood transfusion.
5. Disease transmission through donors.

C. Therapeutic management :

1. Monitor the recipient continuosly for signs of incompatibility during transfusion.
2. Stop blood transfusion, if any type of reaction develops.
3. Give antihistaminics and corticosteroids, if reaction is mild.
4. Inject adrenaline @ 0.01 - 0.02 ml / kg IM, if reaction is severe.
5. In case of citrate toxicity, give calcium preparations IV @ 10 ml / lit of blood transfused.
6. Consider giving antipyretics, if temperature is high.
7. Diuretics are indicated in case of congestive heart failure.

D. Precautions :

1. Careful selection of healthy donors.
2. Keep the bottle rotating during blood collection.
3. Perform cross-matching of blood prior to transfusion.
4. Administer only needed blood components.
5. Warm the stored blood to body temperature before transfusion.
6. Filter the blood through sterile gauze, if froth is formed.
7. Transfuse blood slowly.
8. Avoid giving large amount of blood.
9. Give antihistaminics (e.g. inj. Avil 5 ml.) before transfusion.

FLUID THERAPY

Indications :

1. Shock
2. Severe and prolonged diarrhoea and/or vomiting
3. Anorexia due to infections, pyrexia, digestive disorders and postoperative.
4. Acute carbohydrate engorgement
5. Abomasal displacement
6. Intestinal obstruction
7. Renal insufficiency
8. Burns
9. Copious sweating
10. Lack of thirst or inability to drink water.

The common forms of fluid and electrolyte imbalances are -

A] Dehydration

B] Electrolyte imbalances

C] Acid-base imbalance

A]DEHYDRATION

Dehydration means loss of water and electrolytes from the body.

Causes :

Dehydration is either due to failure of water intake or excessive loss of water.

a) *Failure of water intake* :

1. Water deprivation
2. Inability to drink due to painful conditions of mouth, pharyngitis, pharyngeal paralysis, oesophageal obstruction, coma.
3. Lack of thirst due to toxaemia or debility.

b) *Excess loss of water* :

1. Gastroenteritis - vomition, diarrhoea.
2. Acute carbohydrate engorgement in ruminants.
3. Abomasal displacement, impaction, pyloric stenosis
4. Intestinal obstruction.
5. Severe peritonitis and ascites.
6. Polyuria - Diabetes mellitus, Diabetes insipidus, Chronic renal failure.
7. Burns and profuse sweating.

Clinical Signs :

* Dryness and wrinkling of skin
* Sunken eyes
* Loss of body weight
* Muscular weakness
* Dry mucous membranes
* Oliguria
* Hypothermia - Cold skin and extremities
* Anorexia

Table 22.1 : Assessment of degree of dehydration :

Degree of dehydration (%)	Sunken eyes	Retention of skin fold (Sec)	PCV (%)
04-06	-	nil	40-45
06-08	Slight	02-04	50
08-10	Moderate	06-10	55
10-12	Deep	20-45	60

Types of Dehydration.

1. ***Isotonic dehydration*** :
   * Equal loss of water and electrolytes from the body.
   * Dehydration usually moderate in nature.
   * *Causes* : Simple enteritis, Profuse sweating, Nephrosis
   * *Treatment* : Normal saline or Ringer's solution IV.
2. ***Hypertonic dehydration*** :
   * It means loss or deprivation of water with minor loss or deprivation of sodium.
   * It is uncommon and dehydration is usually mild in nature.
   * *Causes* : Water deprivation, Inability to drink water, Diabetes.
   * *Treatment* : Water orally and / or dextrose 5% IV.
3. ***Hypotonic dehydration*** :
   * It occurs when there is loss of electrolytes in excess of water.
   * Dehydration is severe / fatal in nature.
   * *Causes* : Severe diarrhoea (Salmonellosis / Colibacillosis), Intestinal obstruction.
   * *Treatment* : Normal saline, Ringer's solution or Sodium chloride (5%) IV.

B] ELECTROLYTE IMBALANCES

* Electrolytes maintain osmotic pressure of body fluids and thereby maintain constant volume of different fluids.
* The electrolytes of major importance are sodium, potassium, chloride and bicarbonate.
* The electrolyte imbalances occur commonly as a result of loss of electrolytes, shifting of certain electrolytes or relative changes in concentration.

1. **Hyponatraemia :**
   * It means depletion of sodium ion.
   * Sodium is the most abundant ion in extracellular fluid and is mainly responsible for maintenance of osmotic pressure of extracellular fluid.
   * ***Causes*** : Colibacillosis, Salmonellosis, Acute diarrhoea.
   * ***Signs*** : Muscular weakness, mental depression, hypothermia, dehydration.
   * ***Treatment*** : Normal saline or Hypertonic salt solution.
2. **Hypokalemia :**
   * Potassium is predominant ion in intracellular fluid.
   * Hypokalemia means decrease in serum potassium level.
   * ***Causes*** : Abomasal disorders, Intestinal obstruction (High), Enteritis, Low dietary intake, Gastritis in dog, Prolonged use of mineral corticoids.
   * ***Signs*** : Muscular weakness, recumbency, depression, cardiac arrhythmia, tachycardia.
   * ***Treatment*** : Normal saline or Ringer's solution or Isotonic saline + Potassium chloride (2 g/lit.)

3. Hypochloraemia :

* Hypochloraemia means decrease in chloride level.
* ***Causes*** **:** Abomasal disorders, Intestinal obstruction (High), Enteritis, Acute gastric dilatation in horse, Gastritis in dog.
* ***Signs*** **:** Anorexia, weight loss, dullness, mild polydipsia and polyuria.
* ***Treatment*** **:** Similar to hypokalemia.

C] ACID - BASE IMBALANCE

The blood PH is maintained in the range of 7.35 - 7.45 by buffering system. The proportion of the components of buffer system viz. dissolved CO_2 and bicarbonates are maintained at constant level by respiratory adjustment and urinary excretion of bicarbonate and hydrogen ions.

The acid-base imbalance may lead to either acidosis or alkalosis.

1. ACIDOSIS :

* It develops due to excess production of acid metabolites or as a result of loss of alkali. (i.e. bicarbonates) from body or retention of CO_2.

Causes :

a) ***Metabolic acidosis*** **:** It is due to

1. Excess loss of alkali i.e. bicarbonates - diarrhoea.
2. Increased production of acid in starvation, fever, shock, burns, diabetes mellitus, ketosis, acute carbohydrate engorgement in ruminants.
3. Retention of phosphates, sulphates etc. in renal failure.
4. Administration of excess quantities of acidifying solutions.

b) ***Respiratory acidosis*** **:**

* It develops when there is retention of CO_2 in blood due to interference with normal respiratory exchange.
* It is commonly observed under following circumstances.

1. Poor pulmonary ventilation : Pneumonia, Pulmonary emphysema, Pleurisy, Congestive heart failure.
2. Depression of respiratory centre due disease or drugs (anaesthesia)

Signs : Depression, muscular weakness, increased rate and depth of respiration.

Treatment : Ringer lactate solution or sodium bicarbonate orally and/or IV.

2. ALKALOSIS :

* It results from excess loss of acids or increased absorption of alkali or deficit of CO_2.

Causes :

a) ***Metabolic alkalosis*** **:** It may be due to

1. Excessive loss of acids : Gastric dilatation in horse, Abomasal disorders and intestinal obstruction in ruminants.
2. Overdosing with alkali viz : bicarbonates.
3. Excess absorption of alkali : Urea toxicity.

b) *Respiratory alkalosis* :

1. It occurs in cases of hyperventilation resulting in excessive expulsion of CO_2 and low blood carbonic acid.
2. The common causes are high fever, toxaemia, encephalitis and brain tumor.

Signs : Slow, shallow respiration (to preserve CO_2), muscle tremor and tetany

Treatment : Normal saline, Ringer's solution/Potassium chloride (1.1%) sol.

Table - 22.2 : Commonly used fluids : their composition and indications.

Fluid & its composition	Indications
1. Normal saline (Sodium chloride 0.9%)	Expand circulating blood volume. Severe sweating, Vomiting, Pyloric obstruction, Abomasal disorder.
2. Dextrose saline (Sodium chloride 0.9%, Dextrose 5%)	Dehydration, Vomition, Heat stroke, mild diarrhoea.
3. ***Balanced Electrolyte Solutions***	
a) Ringer's solution (NaCl 0.9 g + KCl 0.03 g $CaCl_2$ 0.03 g + D W 100 ml)	Dehydration, Acidosis, Alkalosis, Electrolyte losses.
b) Lactated Ringer's solution (As for Ringer's solution + Sodium lactate)	Mild to moderate acidosis with dehydration.
c) Rintose/Intalyte 500 ml (Dextrose 20 g + NaCl 0.6 g + KCl 0.04 g + $CaCl_2$, 0.027 g + Na lactate 0.31 g)	Dehydration, Ketosis, Mild to moderate aciodosis
4. ***Sodium bicarbonate solutions***	
a) Sodium bicarbonate 1.3% (Isotonic)	Acidosis
b) Sodium bicarbonate 5% (Hypertonic)	Severe acidosis
5. Mixture of isotonic KCl_2 (1.1%) and Dextrose saline.	Metabolic alkalosis
6. ***Dextrose Solutions***	
a) Dextrose 5% (isotonic)	High fever, starvation, decreased water intake
b) Dextrose 20% , 25% (hypertonic)	Parenteral nutrition, Ketosis, Hypoglycaemia, Surra.
7. Amino acid solution (Hermin 200 ml, Amino drip 200, 500 ml)	Parenteral nutrition, Liver disorders Hypoproteinemia, Extensive burns
8. ***Plasma Expanders***	
a) Dextran -70, 500 ml (Dextran 6% in normal saline) *Dose : 10-20 ml / kg / day IV*	Shock, Haemorrhage, Burns, Severe dehydration. Surgical operations.
b) Haemacel, 500 ml / (Polymer form degraded gelatin 3.5% + Electrolytes Na + K + Ca + Cl)	Hypovolemic shock Haemorrhage, Burns, Endotoxic shock
9. Mannitol 20% *Dose @ 0.5 g / kg IV*	Cerebral oedema.

Table - 22.3 : Fluid Therapy indicated in various diseases.

Disease/Disorder	Major abnormalities	Fluid therapy suggested
1. Enteritis (Diarrhoea)	Low Na^+, HCO_3^-, K^+, Cl^- Metabolic acidosis Dehydration	Normal saline / Dextrose saline & Ringer's solution / Sodium bicarbonate (1.3% or 5%) solution.
2. a) Gastritis (Vomition) b) Abomasal Disorders c) Intestinal obstruction in cattle d) Alkaline indigestion	Low H^+, Cl^-, K^+ Metabolic alkalosis Dehydration	Normal saline / DNS and Ringer's solution / Isotonic potassium chloride (1.1%) solution.
3. Acidic indigestion (Carbohydrate engorgement)	Low HCO_3^-, Dehydration Metabolic acidosis	Sodium bicarbonate followed by Ringer's sol.
4. Stomatitis / pharyngitis Choke / starvation Anorexia / fever / simple indigestion	Dehydration Energy deficit Na level - normal to slightly decreased.	Dextrose 5% or / and Dextrose saline
5. Toxaemia : Black-leg, Botulism, Entertoxaemia, Cclibacillosis,Salmonellosis	Dehydration Metabolic acidosis Hypoglycaemia	Dextrose saline and Ringer's solution.
6. Heat siroke	Dehydration, Low Na^+	Dextrose saline
7. Acute renal failure (oliguric)	Hydration normal High Na^+, K^+, Acidosis	Dextrose 5% and Sodium bicarbonate
8. Chronic renal failure (polyuric)	Dehydration Low Na^+	Dextrose 5% and DNS in 2:1 proportion
9. Urolithiasis in bullock	Dehydration, Low Cl^-, Ca^+, High P^+ Usually alkalosis	Isotonic saline & Potassium chloride (1.1%) along with calcium borogluconate
10. Hepatitis	Low glucose	Dextrose 5%, 10%
11. Ketosis	Low glucose Metabolic acidosis	Dextrose 20% followed by sodium bicarbonate.
12. Diabetes mellitus	High glucose Dehydration	Normal saline
13. Milk fever	Hypocalcaemia	Calcium borogluconate
14. Metabolic haemoglobinuria	Hypophosphataemia	Sodium acid phosphate 20% sol.
15. Burn, Haemorrhage Shock, Severe diarrhoea	Low plasma volume	Dextran-70, Haemacel or plasma.
16. Cerebral oedema	- - -	Mannitol 10%, 20%
17. Poisoning	- - -	Dextrose 5%, 10%

ADMINISTRATION OF FLUID

1] Dose :

The quantity of fluid required depends upon degree of dehydration, losses occurring during the treatment and maintenance requirement of animal

The fluids are given in two stages.

a) *Hydration therapy* :

* It is given in first 4 - 6 hours
* It restores circulating blood volume and corrects electrolyte imbalance.
* Intravenous route is preferred for this therapy.
* The dose of fluid for hydration therapy is calculated as follows :

Degree of dehydration		*Dose (ml/kg bw)*
1. Mild	(4-6%)	25
2. Moderate	(6-8%)	50
3. Severe	(8-10%)	75
4. Very severe	(10-12%)	100

b) *Maintenance therapy* :

* It is given in next 24 hrs. (following hydration therapy)
* It is given for maintaining restored blood volume.
* It can be given by both intravenous and oral route.
* The maintenance dose is calculated @ 50-100 ml/kg body weight over period of 24 hours.

2] Route :

The route of administration of fluid depends upon type of disease, condition of the patient, severity of dehydration and type of electrolyte / acid-base imbalance

The fluids can be given by following routes.

1. *Oral route* :

* It is easiest route.
* It is preferred for maintenance therapy.
* It is unsatisfactory for hydration therapy.
* It is advocated in mild cases.

2. *Intravenous route* :

* It is preferred for hydration therapy and correction of electrolyte and acid-base imbalance.
* Hypotonic solutions are not used.
* Hypertonic solutions may be given.
* Large doses of fluids can be given.
* Fluid and electrolyte imbalances can be rapidly corrected.

3. *Subcutaneous route* :

* Hypertonic solutions and plain glucose solutions are not given.
* Large amount of fluid can't be administered.
* It is contraindicated in oedema.

4. ***Intraperitoneal route*** :

* It is preferred in large animal practice.
* Asepsis is important.
* Contraindicated in ascites.

3] Rate of administration :

It depends upon following factors

1. ***Size of animal*** : Fluids can be given at rapid rate in large sized animals.
2. ***Severity of dehydration*** : In severe cases, fluids are given rapidly.
3. ***Type of fluid being administered*** : Hypertonic solutions should be given slowly as compared to isotonic solutions.
4. ***Type of illness*** : In pneumonia and cardiac diseases fluid should be given slowly.

In general the fluids are given at the following rates.

* First hour of administration ..... 13-14 ml / kg / hour
* Second hour ..... 10 ml / kg / hour
* Third hour ..... 4-5 ml / kg / hour
* Fourth & subsequent hours ..... 2 ml / kg / hour.

4] Frequency of administration :

The frequency of fluid administration depends upon the severity of the condition.

* Very severe cases ..... Continuous drip / Thrice daily.
* Moderate cases ..... Twice daily.
* Mild cases ..... Once daily.

5] Response to fluid therapy

During the fluid therapy, the animal must be constantly monitored for clinical and laboratory evidence of improvement or deleterious effects.

A] ***Favourable responses*** :

* Urination within 30-36 min.
* Improvement in mental attitude viz alertness, active.
* Evidence of hydration on performing skin fold test and examination of eye.

B] ***Unfavourable responses*** :

* Dyspnoea due to pneumonia.
* Pulmonary oedema - usually due to rapid administration.
* Failure to urinate - indicate renal failure or paralysis of bladder.
* Tetany - results from excess administration of alkalies.

C] ***Unusual responses*** :

* Fever, shivering, trembling, champing of jaws, restlessness.
* Sometimes frequent defaecation and urination, urticaria.
* Sweating particularly in horses.

Untoward Reactions

Causes **:**

1. Fluid containing flakes / contamination of fluid / pyrogen in the fluid
2. Administration of cold fluid in shocked animals.
3. Mixing of too many drugs in fluid.
4. Rapid administration of fluid.
5. Overdosing of fluid.
6. Cardio-pulmonary or renal insufficiency.

Therapeutic management **:**

* Stop the drip.
* Give antihistaminics and corticosteroids.
* Inject respiratory stimulants viz. coramine.

Prevention / Control **:**

1. A fluid showing change in its normal colour or flakes should not be used.
2. Donot mix two many drugs in fluid.
3. It is always better to warm IV fluids to body temperature prior to administration.
4. Infusion set should be properly sterilized prior to use.
5. The direction of needle should be cranial rather than towards heart to avoid speed shock.
6. The solutions containing potassium should be given slowly as it causes fibrillation of heart.
7. Hypertonic solutions should always be given slowly.
8. The solutions containing calcium should be given very slowly because it causes tachycardia and sometimes shock.
9. Infusion of fluid at rapid rate may cause overloading of right ventricle and death due to acute heart failure.
10. Intravenous fluid therapy proves dangerous in cardio-pulmonary or renal insufficiency.
11. In liver and kidney dysfunction, a more strength of glucose should not be used as liver is not in a position to store glucose and kidneys are not able to excrete excess of glucose.
12. Overdosing of fluid should be avoided as it causes haemodilution.
13. Keep close watch on respiration, pulse and cardiac rhythm during fluid therapy.

Fluid	Contraindications
1. Dextrose 5%	Milk fever, After blood transfusion
2. DNS / Normal saline	Ascites, oedema
3. Ringer's solution	Milk fever
4. Lactated Ringer's solution	Liver dysfunction, Rumen acidosis, Metabolic alkalosis Congestive heart failure.
5. Mannitol	Intracranial haemorrhage.

CHAPTER - 23 : HEALTH CONTROL MEASURES

A. U. Bhikane and B. N. Ambore

I. VACCINATION

"Vaccines are preparations of material such as virus, bacteria or the protozoa that is injected into a host to prevent harm from infectious disease or products of harmful infectious organisms."

A vaccine is used specially to stimulate host immune response against the organism by stimulation of immune response against non-harmful infectious organism.

Types of Vaccines :

The various types of vaccines used against harmful organisms in man, animals or birds are of the following types.

a) *Killed vaccines :*

* These vaccines are prepared by culturing organisms and then by inactivating them by heat or chemicals such as phenol to make them safe for immunization.
* These vaccines use whole dead organisms to stimulate the host-immune system.
* Most common examples of killed vaccines are Alum precipitated HS and BQ vaccines.

Advantages :

* They are safest to use as there is no residual virulence.
* They are relatively easy to store.
* There is less chance of contamination.

Disadvantages :

* The immunity is of poor quality.
* They produce immunity of shorter duration.
* Adjuvants are necessary for preparation of these vaccines.

b) *Live attenuated vaccines :*

* These vaccines are prepared by attenuating the organisms either by exposing them to high temperature or gamma radiation or by long culture in abnormal host or abnormal culture medium.
* These vaccines use live attenuated organisms.
* These attenuated organisms are weakened to such an extent that they loose their ability to infect host cell.
* The best examples of live attenuated vaccines are Tissue culture, Rinderpest vaccine, Tissue culture PPR vaccine.

Advantages :

* They generate potent immune response against the organisms.
* They produce long lived immunity.
* They induce both humoeral and cellular immunity.
* These vaccines are required in low doses.
* There is no need of addition of adjuvants for preparation of these vaccines.

Disadvantages :

* These vaccines may sometimes prove hazardous, if live attenuated form of virus revert to the wild type strong form of virus under certain circumstances.
* The live attenuated vaccine which is safe for majority of individuals some times can cause disease and death in certain individuals who have weak immune system.

c) *Toxoids :*

* These vaccines are prepared from inactive or specific parts or products of infectious agents such as toxins.
* The toxins are made harmless but still able to stimulate an immune response.
* The best example of toxoid is Tetanus toxoid

d) *DNA vaccine :*

* These are prepared from DNA, isolated in highly purified form, from an infectious organism such as virus, bacteria or protozoa.
* These DNA vaccines are under production and in future if they are produced, the men/animals shall have to be vaccinated only once in lifetime and shall give protection from all diseases for lifelong.

Vaccination : Do's and Dont's

1. Prior to vaccination, ectoparasitic burden should be lessened by spraying insecticides.
2. Worm load should be controlled with appropriate anthelmintic one week before vaccination.
3. Sufficient vitamins and minerals should be provided to make animal healthy since sound health imbibes solid immunity.
4. Vaccine should always be given to healthy animals / birds
5. A potent and safe vaccine of standard company must be used.
6. Vaccine should be stored and transported at appropriate temperature.
   a) Anthrax / FMD / MD / RD / Fowl Pox / Brucella vaccines are to be stored at refrigeration temperature i.e. 2-8^{0}C.

b) HS / BQ vaccines can be stored at room temperature i. e. 20°C but their shelf life increases if stored at 5-10°C.
c) Theileriosis vaccine should be stored in liquid nitrogen.

7. Dose and route of vaccine should be strictly followed as per the manufacturer's instructions.
8. Dose of vaccine for young, old, thin and fatty animal is usually same.
9. Vaccinate all the animals / birds at a time.
10. Vaccination should be done during cool hours of the day (morning / evening.)
11. Two different vaccines should not be mixed together while administering.
12. Needles and syringes sterilised in boiling water should be used. Dont use chemicals for sterilization.
13. Donot apply spirit / Tr. iodine at the site of inoculation of vaccine.
14. Reconstituted vaccine should be used as early as possible i.e. within 2 hours.
15. Reconstituted vaccine should be stored in ice till vaccination is completed.
16. Left over vaccine should not be stored and used.
17. Record of source, kind and batch number of vaccine should be kept.
18. Animals should not be subjected to excessive exertion for about a week after vaccination.
19. Immunosuppressive drugs like corticosteroids should not be used prior to or following vaccination.
20. Vaccination schedule (primary vaccination,booster dose) should be followed.
21. Give antistress drugs like antibiotics and vitamins 3 days before and after vaccination in poultry.

Vaccination Reactions / Hazards

1. Anaphylactic reactions may occur immediately after vaccination.
2. Local inflammatory reactions usually occur with HS, BQ, ETV vaccines.
3. Systemic reaction viz fever, anorexia, depression and drop in milk yield may occur with Anthrax & Brucellosis vaccines.
4. In advance pregnant animals, abortions may occur with Brucella and Bluetongue vaccines

Remember :

1. Milk from vaccinated cows should be discarded for 72 hours after injecting Anthrax spore vaccine.
2. Syringes & needles used for injecting anthrax spore vaccine should be sterilised in boiling water for 1 hour.
3. Anthrax spore vaccine and Brucella Cotton - 19 Strain vaccine should be handled carefully at the time of vaccination to avoid infection to vaccinator.
4. Shee pox and Rakshavac T vaccines are not indicated in advance pregnant animals.

Reasons / Causes of Vaccination Failure :

a) ***Manufacturers defect :***
   1) Less number of active agents in vaccines.

2) Use of some other strains for vaccines.
3) Improper storage of vaccine.
4) Over killing/inactivation of agents.

b) *Animal defect :*

1) Immuno suppressed animals.
2) Weak and debilitated animals.
3) Administration of immunosuppressive drugs like corticosteroids.
4) Absence of thymus.
5) Old age.
6) Presence of other diseases.
7) Incubating disease.
8) Nutritional disorder / malnourished animal.
9) Presence of maternal antibodies.
10) Stress of high milk production / pregnancy.
11) Parasitic load.

c) *Veterinarians defect :*

1) Killing of live vaccine by over swabbing with alcohol.
2) Under dosing of vaccine.
3) Improper route / method of vaccination.
4) Vaccination during outbreak or improper season.
5) Non-maintenance of cold chain during transportation of vaccine.
6) Irregular vaccination.

d) *Epidemiological factors :*

1) Prevalence of some other strain in that area, other than the vaccine content i.e antigenic variation.
2) Exposure to extreme weather.

Measures to avoid vaccination failure :

1. Use of potent vaccine with proper dose and route
2. Proper storage/transportation of vaccine i.e. maintenance of cold chain
3. Regular vaccination of all animals/birds in herd/flock at one time.
4. Adequate nutrition
5. Standard management.

Management of Disease Outbreaks / Measures For Dealing with Outbreaks

A. *General measures* :

1. Isolation & confinement of the affected animals/birds immediately after detection.
2. Animals should not be allowed to graze in common pasture.
3. Animals should not be allowed to drink from ponds/streams/rivers.

4. Treatment of the affected animals.
5. Restrict to and fro movement of animals from affected area
6. Close animal markets and fairs/shows etc.
7. Destruction of the affected animals
8. Disposal of carcasses either by deep burial or burning.
9. Proper disposal of contaminated feed, fodder, bedding material, litter etc.
10. Thorough disinfection of animal/poultry shed.

B. *Prophylactic treatment in face of outbreak* :

The incontact/ suspected animals should be treated as follows -

1. *HS* - Give injection of long acting oxytetracycline at 4 days interval till cases cease to occur.
2. *BQ* and *Anthrax* - Give injection of long acting penicillin once or twice at weekly interval.
3. *Coccidiosis* - Furazolidone/sulphamezathene tablets orally for 5-7 days.

C. *Vaccination* :

In the face of an outbreak, vaccination should be carried out from the peripheral villages, then in the villages immediately surrounding the affected area and lastly in the affected village. The disease outbreak will come under control within 1-3 weeks time after vaccination.

Table 23.1 : Vaccination Schedule in Cattle and Buffalo

Sr. No.	Disease	Schedule	
		Primary Vaccination	Regular Vaccination
1.	Foot and mouth disease	3 wks. & above *Booster : 3 months after primary*	Oil adjuvant : Annually Gel vaccine : Twice a year *(September and March)*
2.	Haemorrhagic septicaemia	6 months and above	Annually before monsoon (twice in endemic area)
3.	Black Quarter	6 months and above	Annually before monsoon
4.	Anthrax	6 months and above	Annually in endemic area
5.	Brucellosis	Only once at 4 – 8 months of age in female calves in problem herds.	--------
6.	Infectious Bovine Rhinotracheitis (IBR)	4 wks. & above *Booster : 3 months after primary*	Annually
7.	Theileriosis	2 months and above	Every 3 years

Table 23.2 : Vaccination Schedule in Sheep and Goat

Sr. No.	Disease	Schedule	
		Primary Vaccination	Regular Vaccination
1.	Anthrax	6 months and above	Annually in endemic area
2.	Haemorrhagic septicaemia	6 months and above	Annually before monsoon
3.	Enterotoxaemia	· 4 months and above if dam is vaccinated · At 1 week if dam is unvaccinated	Annually before monsoon (May) *Booster : 15 days after Primary & every regular dose.*
4.	Black Quarter	6 months and above	Annually before monsoon (June)
5.	Peste des Petits Ruminants (PPR)	3 months and above	Every 3 years
6.	Foot and mouth disease	4 months and above	Twice in a year (Sept. & March)
7.	Sheep pox	3 months	Annually (Dec.)
8.	Goat pox	3 months	Annually (Dec.)
9.	Contagious Caprine Pleuro-pneumonia (CCPP)	3 months	Annually (Jan.)

Note : 1 to 6 and 9 ---- indicated in both sheep and goats.

Table 23.3 : Vaccination Schedule in Dogs

Sr. No.	Disease	Schedule - I		
		Primary	Booster	Regular
1.	Rabies	12-16 wks.	3-4 wks. after primary	Annually
2.	Canine Distemper (CD)	8-9 wks.	— do —	Annually
3.	Parvo-virus	— do —	— do —	Annually
4.	Leptospirosis	— do —	— do —	Annually
5.	Infectious Canine Hepatitis (ICH)	— do —	— do —	Annually
		Schedule - II		
1.	Canine Combined Vaccine (CD, Parvo-virus, Leptospirosis & ICH)	8-9 wks.	— do —	Annually
2.	Rabies	12-16 wks.	3-4 wks. after primary	Annually

Table 23.4 : Vaccination Schedule in Cats

Sr. No.	Disease	Schedule		
		Primary	Booster	Regular
1	Rabies	12 wks. & above	4 wks. after primary	Annually
2	Feline viral rhinotracheitis, Feline calici virus & Feline panleucopaenia virus combined	9-12 wks.	----- do -----	Annually

Table 23.5 : Vaccination Schedule in Swine

Sr. No.	Disease	Schedule	
		Primary Vaccination	Regular Vaccination
1.	Swine fever	6-8 wks	Annually
2.	Foot and Mouth disease	4-8 wks. *Booster : 3 wks. after primary*	Every 6 months
3.	Haemorrhagic septicaemia	3 months	Every 6 months
4.	Swine erysipelas	10 wks *Booster : 2-3 wks. after primary*	Annually
5.	Brucellosis	2 months	----------
6.	Swine influenza	As per necessity in endemic area	----------

Table 23.6 : Vaccination Schedule in Poultry (Layers)

Sr. No.	Disease	Schedule	
		Primary Vaccination	Booster dose
1.	Marek's disease	Day old chick	—
2.	Ranikhet disease		
	a) LaSota	1st week	4th – 5th week
	b) R_2B	8th week	18th week
3.	Gumboro disease	2nd-3rd week	18th -20th week
4.	Infectious Bronchitis	4th week	14th week
5.	Fowl pox	6th week	14th -16th week
6.	Infectious Coryza	8th week	12th week
7.	Fowl cholera	8th week	12th week
8.	Spirochaetosis	Above 6th week	——
9.	Egg drop syndrome	15th – 18th week	——

Table 23.7 : Vaccination Schedule in Poultry (Broilers)

Sr. No.	Disease	Schedule	
		Primary Vaccination	Booster dose
1.	Marek's disease	Day old chick	——
2.	Ranikhet disease - Lasota	1st week	4th – 5th week
3.	Gumboro disease	2nd -3rd week	——

Table 23.8 : Some commonly used Livestock Vaccines with their dose rates

Name of Vaccine	Type of Vaccine	Dose (sc)			Schedule
		C,B	S,G	Other	
1. Foot and Mouth disease (FMD)					
a. Raksha. FMD* (30, 90 ml)	Tissue culture inactivated FMD virus O, A, C & Asia - 1	3ml	1ml	- - -	P. : 4 months B. : 2-4 wks after primary R. : Twice a year
b. FMD gel vaccine** (50, 100 ml)	Super concentrated tetra-valent FMD virus types O, A_{22}, C & Asia-1	2.5 ml	2.5 ml	- - -	P. : 6- 8 month B. :4-6wks. after primary R. : Twice a year
c. Raksha - OVAC* (oil adjuvant) (10, 30, 50, ml)	----- do ----- (oil adjuvant)	2ml	1ml	**Pig** 2ml	P.: 4 months R.: Every 9 months
d. Clovax ** (30, 90 ml)	Inactivated FMD virus O, A_{22}, C & Asia-1	3ml sc / im	2ml sc / im	**Pig** 3ml im	P. : 3 wks and above B.: After 12-14 wks. R. : Annually
2. Haemorrhagic Septicemia (HS)					
a. Raksha. H.S. Vaccine* (100 ml)	Formalin inactivated culture of *Pasteurella multocida* adjuvanted in Aluminium hydroxide.	2ml	2ml	- - -	P.: 6 month & above R. : Annually before monsoon (Twice a year in endemic areas)
b. H.S. Vaccine ** (100 ml)	----- do -----	2ml	2ml	- - -	------ do -----
c. H. S. (Alum Ppt) vaccine *** (250ml)	Formalin inactivated culture of *Pasteurella multocida* adjuvanted with Potash alum	5ml	2.5 ml	- - -	----- do -----
d. H. S. Oil Adjuvant vaccine *** (90 ml)	Formalised *P. multocida* blended with liquid paraffin and lanolin	3ml im **Calf** 2ml	1ml im	- - -	----- do -----
3. Black Quarter (BQ)					
a. Raksha BQ vaccine * (100 ml)	Formalin inactivated culture of *Clostridium chauvoei* adjuvanted in Aluminium hydroxide.	2ml	2ml	- - -	P.: 6 month & above R.: Annually before monsoon.
b. B.Q. vaccine ** (100 ml)	----- do -----	2ml	2ml	- - -	----- do -----

Name of Vaccine	Type of Vaccine	Dose (sc)			Schedule
		C,B	S,G	Other	
c. Alum ppt. BQ vaccine ***(250ml)	Inactivated *Cl. chauvoei* in anaerobic medium	5ml	2.5 ml	- - -	P.: 6 month & above R.: Annually before monsoon
4. H.S. + B.Q					
a. Raksha H.S. + B.Q vaccine * (90 ml)	Formalin inactivated culture of *Pasteurella multocida* & *Clostridium chauvoei* with Aluminium hydroxide gel.	3ml	- - -	- - -	P.: 6 month & above R.: Annually before monsoon.
b. HS + BQ vaccine ** (100 ml)	----- do -----	4ml	2ml	- - -	----- do -----
5. HS + BQ + FMD					
a. Raksha Triovac * (30, 90 ml)	Combined oil adjuvant vaccine contains antigens against O, A, C & Asia -1 formaldehyde inactivated *Pasturella multocida* and *Clostridium chauvoei* culture	3ml	1ml	- - -	P.: 4 months & above R.: Annually before monsoon
6. Anthrax				Horse& Camels	
a. Anthrax spore vaccine**(100ml)	Live spores of *Bacillus anthracis* in glycerine saline	1ml	1ml	1ml	Annually in endemic area
b. Anthrax spore vaccine***(100ml)	Live spores of *B. anthracis* in 50% glycerine saline	1ml	0.5 ml	- - -	----- do -----
7. Brucellosis					
a. Brucella vaccine ** (25 ml)	Live strain of *Brucella abortus* C-19 in sterile freeze-dried form	5ml	- - -	- - -	Only once i.e. at 4- 8 months of age in female calves in problem herds
b. Brucella cotton 19 strain vaccine *** (10 ml)	Live strain of *B. abortus* of low virulence in buffered saline solution	5ml	- - -	- - -	----- do -----
8. Infectious Bovine Rhinotracheitis(IBR)					
a. Ibrivivax**(20 ml)	Inactivated *Bovine Herpes* virus with oil adjuvant	2ml sc/ im	- - -	- - -	P.: 4-6 weeks B.:3month after primary R. : Annually

Name of Vaccine	Type of Vaccine	Dose (sc)			Schedule
		C, B	S, G	Other	
9. Theileriosis					
a. Rakshavac - T * (15 ml)	Attenuated live schizont grown in lymphoblast cell culture.	3ml	- - -	- - -	P.: 2 month & above R.: Every 3 years.
10. Enterotoxaemia (ET)					
a. Raksha E.T. Vaccine * (100 ml)	Inactivated *Clostridium welchii* type-D adjuvanted with Aluminium hydroxide gel	- - -	2ml	- - -	P.: 4 month & above R.: Annually in May B.:15days after every primary & regular dose.
b. ETV type C&D** (100 ml)	Toxoids *Clostridium welchii* type-C & D with Aluminium hydroxide gel	Calf 5ml	5ml	- - -	P.: 1 week (if dam is unvaccinated) **or** 4-6 wks (if dam is vaccinated) B.: 2-3wks after primary R.: Every 6 months.
c. Multicomponent Vaccine** (100ml)	Toxoids of *Clostridium welchii* type B, C, D, *Cl. oedematiens* type-B and *Cl. septicum* with Aluminium hydroxide gel.	Calf 5ml	5ml	- - -	----- do -----
d. ETV-type C&D*** (250 ml)	Culture vaccine of highly toxigenic strains of *Cl. perfringenes* type C & D in anaerobic medium	5ml	2.5 ml	- - -	----- do -----
11. Peste des petits Ruminants (PPR)					
a. Tissue culture PPR Vaccine (IVRI)	Tissue culture PPR virus	- - -	1ml	- - -	P.: 3months R.: Every 3 years.
12. Goat Pox					
a. Goat Pox vaccine (IVRI)	Live attenuated goat pox virus	- - -	1ml	- - -	Annually (December)
13. Sheep Pox					
a. Raksha SP * (25, 50, 100 ml)	Live attenuated sheep pox virus	- - -	1ml im	- - -	P.: 3 month. R.: Annually (Dec.)
b. Sheep Pox vaccine** (25, 50 ml)	----- do -----	- - -	1ml	- - -	----- do -----

Name of Vaccine	Type of Vaccine	Dose (sc)			Schedule
		C,B	S,G	Other	
c. Sheep Pox vaccine ***	Live attenuated freeze cell culture sheep pox virus	- - -	0.5 ml	- - -	P.: 3 month R. : Annually (Dec.)
14. Tetanus				**Horse**	
a. Tetanus toxoid (SII, Pune)	Active immunzing agent against tetanus	5ml im	0.5 im	5ml im	Two doses at 6 - 8 weeks interval during pregnancy **In Horse :** P.: At birth R.: Annually
15. Rabies				**Horse & Pig**	
a. Raksharab* (1, 5, 10 ml)	Inactivated rabies virus CVBS strain adjuvanted with Aluminium hydroxide	1ml	1ml	1ml	All species Post-bite vaccination : 0, 3rd, 7th, 14th, 30th & 90 th day
b. Candur - R** (1, 10 ml)	Inactivated cell culture rabies virus.	1ml	1ml	1ml	**In Horse :** P.: 3 months R.: Annually
c. Rabisin (SII, Pune) (1, 10 ml)	Inactivated rabies virus	1ml	1ml	1ml	
d. Nobvac-Rabies ** (1, 10 ml)	Inactivated cell culture rabies virus pastur RIV strain	1ml	1ml	1ml	
16. ContagiousCaprine Pleuro-pneumoina (CCPP)					
a. CCPP vaccine (IVRI, Izatnagar)		- - -	0.2 ml id	- - -	Annually (Jan)
17. Swine Fever				**Pig**	
a. Swine Fever vaccine ** (5 ml)	Attenuated strain of swine fever virus.	- - -	- - -	1ml im	P.: 6 - 8 wks R.: Annually
b. Swine fever vaccine *** (2, 5, 10 doses)	Freeze dried rabbit adapted swine fever virus in yolk buffered base	- - -	- - -	1ml sc/im	---do---

sc : Subcut *im : Intramuscular* *id : Intradermal*
P : Primary *B : Booster* *R : Regular*

C : Cattle, *B : Buffalo,* *S : Sheep,* *G : Goat*

*** Indian Immunologicals, Hyderabad** **** Intervet (India) Ltd., Pune**
***** IVBP, Pune.** **SII - Serum Institute of India, Pune**

Table 23.9 : Some commonly used Canine and Feline Vaccines

Name of Vaccine	Type of Vaccine	Dose (SC)	Schedule
1. Rabies (In Canines/Felines)			
a. Raksharab * (1, 5, 10, 30 ml)	Inactivated rabies virus CVBS strain adjuvanted	1 ml	***Primary :*** 3 months & above If primary dose is given below 3 with Aluminium hydroxide month booster should be given at 3 month age ***Regular :*** Annually
b. Megavac-R*(1,10 ml)	Inactivated tissue culture rabies virus CVS strain	1 ml	- do -
c. Nobivac-Rabies ** (1, 10 ml)	Inactivated cell culture rabies virus Pasteur RIV strain	1 ml	- do -
d. Rabdomum*** (1 ml)	Inactivated rabies virus flurry egg passage (FEP) strain	1 ml	- do -
e. Rabguard TC**** (1, 10 ml)	Inactivated tissue culture rabies virus	1 ml	- do -
f. Candur-R** (1,10 ml)	Inactivated cell culture rabies virus	1 ml	***Primary :*** 7 wks. & above ***Booster:***4-6wks.after primary ***Regular :*** Annually
g. Rabisin° (1, 10 ml)	Inactivated rabies virus	1 ml	***Primary :*** 4 wks. & above ***Booster :*** 4 wks. after primary ***Regular :*** Annually
h. Anti rabies vaccine□ (5 ml)	Rabies virus inactivated with phenol	5 ml	**Primary** : 3 months & above ***Booster:***6months after primary ***Regular :*** Annually
2. Canine Distemper			
a. Megavac - D* (1 ml)	Freeze dried live attenuated DC virus	1 ml	***Primary :*** 6 wks. & above ***Regular :*** Annually
3. Canine Parvovirus			
a. Megavac - P* (live) (1 ml)	Freeze dried live attenuated Parvo virus	1 ml	***Primary :*** 6 wks. & above ***Regular :*** Annually
b. Megavac - P* (inactivated) (1 ml)	Inactivated antigen of canine Parvo virus	1 ml	***Primary :*** 8-9 wk. ***Regular :*** Annually
c. Nobivac-Parvo-C** (1 ml)	Live attenuated strain of canine Parvo virus	1 ml	***Primary :*** 9-12 wk. ***Regular :*** Annually
d. Vanguard - CPV **** (1 ml)	Killed Parvo virus	1 ml	***Primary :*** 16 wk. ***Regular :*** Annually
e. Parvocin° (1 ml)	Stable Parvo virus strain	1 ml	***Primary :*** 9-12 wks. ***Booster :*** 15-16 wks. ***Regular :*** Annually
4. Canine Corona virus			
a. Megavac - CC	Inactivated tissue culture canine corona antigen grown on a continuous cell line	1 ml	***Primary :*** 8-9 wks. ***Booster :*** 3-4 wks. after primary ***Regular :*** Annually

5. Canine Leptospirosis			
a. Nobivac - L** (1 ml)	Inactivated bivalent leptospira organisms	1 ml	***Primary :*** 9-12 wks. ***Booster:***2-4wks.after primary ***Regular :*** Annually
6. Combined Canine vaccines			
a. Megavac - 6* (CD, ICH-I, ICH-II, Parvo & Leptospirosis)	Freeze dried live attenuated CD, ICH-II, Parvo virus & inactivated ICH-I, *Leptospiora canicola, L. ictereohaemorrhagiae*	1 ml	***Primary :*** 8-9 wks. ***Booster :*** 3-4 wks. after primary ***Regular :*** Annually
b. Megavac-DHRL* (CD, ICH-II, Rabies & Leptospirosis)	Freeze dried live attenuated CD, ICH-II and inactivated rabies, L. *canicola, L. ictereohaemorrhagiae*	1 ml	- do -
c. Megavac - DHL * (CD ICH-II & Leptospirosis)	Freeze dried live attenuated CD ICH-II and inactivated *L. canicola, L. ictereohaemorrhagiae*	1 ml	- do -
d. Nobivac - DHPPi ** (CD, ICH-II, Parvo & Parainfluenza)	Combined live attenuated strains of CD, ICH-II, Parvo and Parainfluenza virus	1 ml	***Primary :*** 9-12 wks. ***Regular :*** Annually
e. Nobivac-DH + LR ** (CD, ICH, Rabies & Leptospirosis)	Combined live attenuated strains of CD, ICH & inactivated rabies virus and leptospira.	1 ml	***Primary :*** 7-9 wks. ***Booster :*** 12-14 wks. ***Regular :*** Annually
f. Nobivac-DHL ** (CD, ICH-II and Leptospirosis)	Combined live attenuated strains of CD, ICH virus and inactivated bivalent leptospira	1 ml	- do -
g. Candur-DHL + P** (CD, ICH, Leptospirosis & Parvo virus)	Freeze dried live attenuated CD, inactivated leptospira, parvo and hepatits virus adjuvanted with Aluminium hydroxide and Aluminium phosphate	1 ml	- do -
h. Nobivac-Puppy DP ** (CD & Parvo)	Combined live attenuated CD and Parvo virus	1 ml	***Primary :*** 9-12 wks. ***Booster :*** 3 wks. after primary ***Regular :*** Annually
i. Pentadog° (CD, ICH, Leptospira & rabies)	Freeze dried live attenuated CD, hepatitis & inactivated rabies virus, leptospira	1 ml	***Primary :*** 7 wks. and above ***Booster :*** 4 wks after primary ***Regular :*** Annually
7. Combined Feline vaccine			
a. Nobivac-Tricat ** (Feline viral rhinotracheitis, Feline calici virus and Feline Panleucopaenia virus)	Live freeze dried vaccine	1 ml	***Primary :*** 9-12 wks. ***Booster :*** 4-6 wks. after primary ***Regular :*** Annually

* Indian Immunologicals, Hyderabad.
** Intervet (India) Ltd, Pune.
*** Sarabhai-Zydus Animal Health Ltd., Vadodara.
**** Pfizer Ltd., Mumbai.
° Serum Institute of India, Pune.
□IVBP, Pune.

Table 23.10 : Some commonly used poultry vaccines

Disease / Name of Vaccine	Type of Vaccine	Dose and Route	Schedule
1 Marek's Disease (MD)			
a) Marek's disease vaccine (500 & 1000 doses)	HVT-FC-126 strain	0.2 ml sc, im	Day old chick
b) Marek's disease vaccine (500, 1000, 2000 & 2500 doses)	-do-	-do-	-do-
c) Marek's disease vaccine (500, 1000 & 2000 doses)	-do-	-do-	-do-
d) Marek's disease vaccine (1000 & 2000 doses)	-do-	-do-	-do-
2 Ranikhet Disease (LaSota)			
a) NDV – Lasota (100, 500, 1000, 2000 & 5000 doses)	Live freeze dried laSota strain in chicken embryo	1 drop in nostril / eye	P : 4-7 days B : 21 – 28 days through drinking water.
b) New castle disease vaccine living (Lasota strain) (100, 200, 500, 1000, 2000, 5000 & 10000 doses)	-do-	-do-	P : 4-10 days. B: 15-16wks.
c) Lasota strain (100, 200, 500, 1000, 2000, 5000 & 10000 doses)	-do-	-do-	P: 4-5 days B: 21 days
d) Cevac New L (1000 & 2500 doses)	-do-	-do-	-do-
3 Ranikhet disease(R_2Bstrain)			
a) NDV - R_2B (100, 500 & 1000 doses)	Live freeze dried R_2B strain in chicken embryo	0.5 ml sc, im	P: 10-12 wks. B: 16-18 wks.
b) New castle disease vaccine living (R_2B strain) (200, 400 & 1000 doses)	-do-	0.5 ml sc	P: 8-10 wks. B: 16-18 wks.
c) Mukteshwar strain (R_2B) (100, 400 & 1000 doses)	Live freeze dried Mukteshwar R_2B strain in chicken embryo	0.5 ml sc, im	-do-
4 Gumboro Disease (IBD)			
a) Gumboro vaccine Nobilis strain D-78 (1000 & 2500 doses)	Live freeze dried D-78 strain of IBD virus	1 drop in nostril/ eye or through drinking water	14 – 21 days
b) Infectious Bursal Disease Live vaccine (200, 500, 1000&2000 doses)	Intermediate strain of live IBD virus	-do-	-do-

c) IV – 95 strain (200, 500,1000&2000 doses)	Freeze dried intermediate strain (IV-95) of IBD virus	Oral (in drinking water with skim milk @ 3g/lit)	10 days to 14 wks.
d) Cevac IBD-L (1000 & 2500 doses)	Winterfield 2512 G – 61 strain of IBD virus	1 drop in nostril/ eye or through drinking water	-do-
5 Infectious Bronchitis (IB)			
a) IB vaccine Nobilis strain H-120 (1000 & 2500 doses)	Live freeze dried IB virus (H-120 strain)	1 drop in nostril/ eye or through drinking water	P : 1-3 wks. B : Every 3 months for layers/breeders For (booster) revaccination only at 16th week in layers/ breeders
b) IB vaccine Nobilis strain H-52 (1000 & 2500 doses)	Live freeze dried IB virus (H-52 strain)	-do-	
c) Avian IB vaccine living (MASS) (200, 500, 1000, 2000 & 5000 doses)	Freeze dried mild IB virus (Massacuhsetts type)	-do-	P : 4-6 weeks
d) Bronkichick (500, 1000 & 2000 doses)	-do-	In drinking water	P : 7th week B : 16th week
e) Cevac Bron 120 –L (1000 doses)	-do-	1 drop I/nasal, Ocular / drinking water	-do-
f) Infectious Bronchitis Vaccine (1000 & 2000 doses)	-do-	-do-	P : 1st Day B : 10-18 wks.
6 Fowl Pox			
a) Fowl pox vaccine (200 & 500 doses)	Live freeze dried fowl pox virus in chicken embryo	0.2 ml im	P : 6-8 wks. B : 13th week
b) Fowlpox vaccine (200, 500 & 1000 doses)	-do-	-do-	P : 6 – 8 wks. B : 18–20 wks
c) Fowl pox (500 & 1000 doses)	-do-	-do-	P : 6-8 wks. B : 16-18 wks.
d) Fowl pox vaccine (1000 doses)	-do-	At wing web.	Day old chick

7 Infectious Coryza (IC)			
a) Nobivac Coryza (1000 doses)	In activated strain of *Haemophilus paragallinarum* in oil emulsion	0.5 ml sc	P : 5th week B : Before laying
b) Infectious Coryza killed vaccine (400 & 1000 doses)	-do-	0.5 ml sc, im	P : 8th week B : 12th week
8 Fowl Cholera (FC)			
a) Nobivac FC (1000 doses)	Inactivated *Pasteurella multocida* antigen (serotypes 1,3& 4) in oil adjuvant emulsion	0.5 ml sc	P : 8-10 wks. B : 16-17 wks
b) Fowl cholera killed vaccine (400 & 1000 doses)	Killed *Pasteurella multocida* bacterin	-do-	-do-
c) FC vax (1000 doses)	Inactivated *Pasteurella multocida* (indigenous strain) in oil emulsion	-do-	P : 6-9 wks. B : 25th week
d) Cholerin triple (1000 doses)	Inactivated *Pasteurella multocida* antigen	-do-	P : 8 – 12 wks. B : 15-16 wks.
9 Spirochaetosis			
a) Spirochaetosis killed vaccine (100 doses)	Killed spirochaets bacterin	1 ml im	6th week
10 Egg Drop Syndrome (EDS)			
a) Nobivac EDS 76 (1000 doses)	Inactivated BC-14 adeno virus strain in oil emulsion	0.5 ml sc	At laying (18-20 wks.)
b) Proloc (500 & 1000 doses)	Inactivated EDS virus strain 127 in oil emulsion	-do-	-do-

a) Intervet (India) Ltd., Pune. **b) Venky's (India) Ltd., Pune.**

c) Indovax Pvt. Ltd., New Delhi. **d) Ranbaxy Animal Health, New Delhi.**

e) Sarabhai-Zydus Animal Health Ltd., Vadodara.

II. DEWORMING

Desirable characteristics of an ideal anthelmintic :

1. It should have broadspectrum activity.
2. It should be effective against both mature & immature stage of the worms.
3. It should have wide margin of safety.
4. It should not pose a problem of residue in the milk & meat.
5. It should be economical & easily available.
6. It should be easy to administer.

Causes of drug resistance by parasites :

1. Underdosing.
2. Continuous use of same class of anthelmintic.
3. Repeated use of anthelmintic.

Table 23.11 : Deworming Schedule for Cattle and Buffaloes

Type of worm	Deworming schedule
1. Roundworms	* First dose at 3 days of age and thereafter at monthly interval upto 6 months * Thrice a year in animals above 6 months of age
2. Liver flukes	* Twice a year in endemic areas (before and after monsoon)
3. Tapeworms	* Twice a year i.e in January and June in calves in problem herds.

Table 23.12 : Deworming Schedule for Sheep and Goats

Type of worm	Deworming Schedule
1. Roundworms	* Once a month from1 to 6 months of age. * Once in two months from 6-12 months of age * Thrice a year i. e. June, October and March after one year of age
2. Liver flukes	* Twice a year i. e. May and October in endemic areas
3. Tapeworms	* Twice a year i.e. January and June in kids/ lambs in problem flocks.

Table 23.13 : Deworming Schedule for Dogs and Cats

Type of worm	Deworming Schedule
1. Roundworms (Ascarids & Hookworms)	* Once a month from 1 week to 6 months of age. * Once in two months from 6-12 months of age * Once in 4 months after 1 year of age
2. Tapeworms	* Single dose as and when required.

Table : 23.14 Anthelmintics for animals with their dose rates and spectrum

Sr. No	Drug	Dose (mg/kg) & Route (PO)				Spectrum
		Ruminants	Horse	Pig	Dog & Cat	
1.	Albendazole	5 - 10	5-10	5-10	25 BID for 3 days	Roundworms & Tapeworms
2.	Fenbendazole	5 - 10	5-10	5-10	25 BID for 3 days	Roundworms & Tapeworms
3.	Mebendazole	5 - 10	5-10	5-10	25 BID for 3 days	Roundworms & Tapeworms
4.	Oxfendazole	5-10	5-10	5	----	Roundworms & Tapeworms
5.	Levamisole	7.5 SC	5 SC	7.5 SC	5 SC	Roundworms
6.	Tetramisole	15	15	15	----	Roundworms
7.	Morantel citrate	10	10	---	7.5	Roundworms
8.	Pyrantel Pamoate	- - - -	6.6	---	5 - 10	Roundworms
9.	Piperazine	110	110	110	110	Ascarids
10.	Niclosamide	50 - 100	100	---	100-150	Tapeworms
11.	Praziquantel	10	---	---	5	Tapeworms
12.	Dichlorophen	500	---	---	200	Tapeworms
13.	Oxyclozanide	10 - 15	---	---	- - - -	Liverflukes & Amphistomes
14.	Triclabendazole	10 - 12	---	---	---	Liverflukes
15.	Hexachlorophene	10 - 12	---	---	---	Liverflukes & Amphistomes
16.	Rafoxanide	7.5	---	---	---	Liverflukes & Amphistomes
17.	Diethylcarbamazine	---	---	---	6 Daily for 3 to 4 weeks	Heartworms (Dirofilariasis)
18.	Closantel	7.5 - 15	---	---	---	Endoparasites & Ectoparasites
19.	Ivermectin	0.2 SC	0.2 SC	0.2 SC	0.2 SC	Roundworms & Ectoparasites
20.	Doramectin	0.2 SC	0.2 SC	0.2 SC	0.2 SC	Roundworms & Ectoparasites

Table : 23.15 Some commonly used Anthelmintics with their dose rate

Product Name (e.g.)	Content	Indication	Dose & Route
1. a) Valbazen150/600 mg b) Albendos 3g.30ml ,1lit. c) Albomar 30 ml, 5 lit. d) Minthal bolus 200, 600 mg Susp. - 30 mi, 1 lit Powd. - 30 g, 300 g. e) Vetalben 60, 500 ml; 1,5 lit. f) Vibex 750 mg bolus Susp.30,60,500ml;1L Powd. 100 g.	Albendazole	Round &Tapeworms.	R,H,P:5-10 mg/Kg PO D&C:25mg/kgBID PO for 3 days.
2. a) Panacur 1.5g,150mg b) Curaminth 1.5 gm 150 mg. c) Fentas 1.5,3g,150mg	Fenbendazole	Round & Tapeworms	R,H,P:5-10 mg/Kg.PO D&C:25mg/kgBID PO for 3 days.
d) Vetfen 600 - 500 g.	Fenbendazole in pellet form	Round & Tapeworms	R : 7.5mg/kg PO
3. Oxefendol 1 lit.	Oxfendazole 2.26%	Round & Tapeworms	R : 5-7.5 mg/kg PO H : 10 mg/kg PO
4. a) Wormin 100, 500 mg b) Mebex 100 mg	Mebendazole	Roundworms.	R: 5-10 mg/kg PO D&C-25mg/kgBIDPO for 3 days
5. Nilverm 30% powder	Tetramisole	Roundworms	R,H,P: - 15 mg/Kg. PO
6. a) Helmonil inj. 10 ml b) Ketrax 50, 150 mg. c) Almizol 100 g d) Levamisole HCl 10% &30% 20g, 100 g, 1kg	Levamisole 182 mg/ml	Roundworms	R,H,P:7.5mg/kgSC PO D & C - 5 mg/Kg PO
7. a) Banminth bolus 118.8, 594mg Sol.: 500ml, 5 lit Powd.: 20 g, 100 g b) Minthex - M 500ml, 1lit, 5 lit.	Morantel citrate	Roundworms	R,H,: 10 mg/kg PO D & C - 7.5 mg/Kg Pig : 15 mg/Kg PO
8. a) Combantrin 8 ml b) Expent 250mg,10ml c) PA-PA 250mg, 8ml	Pyrantel Pamoate	Roundworms	D & C: 5-10 mg/kg PO Horse : 6.6 mg/kg PO
9. a) Piperazine 30ml,500ml b) Piperol 500 ml, 5 lit	Piperazine	Ascarids	R,H,P: 110 mg/kg PO D & C - 150 mg/kg PO

Product Name (e.g.)	Content	Indication	Dose & Route
10.Piyafin 0.5 gm	Dicholorophen	Tapeworms	D & C : 200 mg/kg PO
11.a) Niclex 0.5 & 1 gm b) Cestonex - N powder 50g, 100g	Niclosamide	Tapeworms	R,H,P:50-100mg/kg PO D & C:150 mg/kg PO
12.a) Prazik 50 mg tab. b) Cestonil 50 mg c) Paratak 50 mg	Praziquantel	Tapeworms	D & C : 5 mg/kg PO
13.Fentas plus 200mg tab	Fenbendazole+ Praziquantel	Round & Tapeworms	R,P : 1 tab/30kg PO D : 1 tab/10 kg PO
14.a) Fasinex bolus 900mg b) Fasinex suspension 1L	Triclabendazole	Liverflukes	R : 10 - 12 mg/kg PO
15.Endex 19.5% 30, 60, 250 ml	Triclabendazole+ Levamisole	Mature & immature liverflukes	R : 1ml/10 kg PO
16.Ranizole 900 ml	Triclabendazole+ Rafoxanide	Mature & immature liverflukes	R : 3-5 ml/10 kg PO
17.a) Distodin 0.2, 1.0 g b) Neozide bolus 1,2 g. c) Zanil suspension 100 ml / 1 lit.	Oxyclozanide	Liverflukes and Amphistomes	R : 10-15 mg/kg PO
18.a) Fasnil bolus/ Suspension 90ml/1lit. b) Tolzan-F 200mg,1g 90 ml, 1lit	Levamisole + Oxyclozanide	Round worms and flukes	R : 1 bolus/350 kg PO R : 1ml/2kg PO
19.Flukin tab 0.1, 1g	Hexachlorophene	Liverflukes & Amphistomes	R : 10-12 mg/kg PO
20.Vetalben -R 100,500ml	Albendazole 2.5% + Rafoxanide 2.27%	Roundworms, Tapeworms and Liver flukes	R : 1ml/3 kg PO
21.a) Zycloz susp.30,90 500 ml Zycloz bolus 1000 mg b) Hexinot 30 ml	Closantel	Endoparasites & Ectoparasites	R : 7.5 -15 mg/kg PO
22.a) Mectin Inj. 1, 7 ml b) Neomec 1 ml, 7 ml	Ivermectin	Roundworms & Ectoparasites	R,H,P: 200µg/kg SC D & C : 200µg/kg SC
23.Inj. Dectomax 1 ml	Doramectin	Roundworms & Ectoparasites	R,H,P: 200 µg/kg SC D & C : 200µg/kg SC
24.Hetrazan 50, 100 mg.	Diethyl carbamazine	Heartworms	D & C : 6 mg/kg PO.

R : Ruminants *H : Horse* *P : Pig* *D : Dog* *C : Cat*

III. CONTROL OF ECTOPARASITES

The parasites which live a part of or whole of their life on the body of animals are called as 'ectoparasites'. These include ticks, mites, lice and flies. All the domestic animals get infected with external parasites leading to enormous economic losses and severe harmful effects on animal health.

Losses through ectoparasites :

Following are the losses due to infection / infestation of ectoparasites on animals.

1. The external parasites suck the blood which may lead to anaemia.
2. They irritate the skin leading to severe itching and loss of hairs / wool.
3. Due to irritation of skin, animal become restless that adversely affects the appetite and water intake.
4. Some ticks are responsible to transmit dreadful diseases such as Babesiosis, Theileriosis, Anaplasmosis etc.
5. Fleas acts as intermediate host for some worms eg. *Dipylidium caninum.*
6. They cause skin diseases like mange, flea bite dermatitis, cutaneous myiasis.
7. Some ticks produce toxins and cause paralysis that is called as *'Tick paralysis'*.
8. Loss of body weight in all animals.
9. Drop in milk production in milch animals.
10. Retarded growth in young animals.
11. They decrease immune response to diseases.
12. They cause annoyance and worry to the animals.
13. The insect bites and blood sucking flies cause direct injury to the animal.

Measures to control ectoparasites :

The following measures may be undertaken to control the ectoparasites in animals.

1) *Alteration of habitat :*

The basic idea of altering the habitat is to make difficult survival for the ticks and fly larvae. This can be achieved through proper drainage, harrowing the soil, applying lime, ploughing , regular cleaning of sheds, proper disposal of dung and removal of vegetation in surrounding area of animal shed.

2) *Removal of animals from affected area :*

Removal of the animals from the affected to a clean place helps in killing the ticks, mites etc. in the previous place. This can be done by adopting loose housing system and alternate grazing of animals in clean area.

3) *Grass Burning :*

Burning of the grass in the affected area helps in destroying the parasites on

the grass but it can not kill the parasites on the animal body and those lying underground in the depth of vegetation.

4) *Use of insecticides :*

For the effective control of the ectoparasites, application of insecticides on the animal body and in animal shed is very essential.

Mehods of application of Insecticides :

a) *Spraying* :

1. In this method the properly diluted insecticides are sprayed on the animal body and in animals shed with the help of spray pump.
2. Small spray pump (1 lit capacity) can be used for spraying dogs whereas large spray pumps (Aspee Agriculture spray pump, capacity 16 lit.) can be conveniently used in large animals.
3. While spraying care should be taken to spray the insecticides on dewlap, medial aspect of legs, ventral part of abdomen and below the tail.
4. By this method animal sheds can also be sprayed very easily and effectively.

Advantages :

* It is very useful for large animals.
* It also helps to clean dung and dust on animal body.
* It is also suitable for spraying of animal shed.

Disadvantages :

* It is not advocated in sheep and goats as insecticides does not reach upto the base due to thick wool / hair coat.
* It also causes air pollution.

b) *Dipping :*

1. Dipping is the process of offering a bath with a mild parasiticidal drug / chemical in a specially prepared tank.
2. In this method the insecticide is diluted in a big water tank and animals are dipped in it one by one for atleast 2 minutes.
3. Dipping tank (concrete tank) with following dimensions may be used.

Depth	: 1.5 m. (5 ft)
Width	: 1.0 m. (3.3 ft)
Length at top	: 2.5 m (8.3 ft) and
Length at bottom	: 1.5 m (5 ft)

4. This method is generally adopted in sheep and goats.

Advantages :

* It is very useful for sheep and goats.

* It is easy and time saving method.
* It is highly effective for control of ectoparasites because there is complete wetting of wool / hairs.
* It helps to remove dust and dung from animal body.

Disadvantages :

* It is not convenient for large animals.
* It is also not suitable in advance pregnant sheep and goats.
* It is not suitable in animals having wounds.
* The cost of treatment is always high because of more requirement of insecticide solution.
* Accidently animal may drink dip solution.
* A specific tank is essential for dipping.

c) *Dusting :*

In this method the powder form of insecticides are dusted / sprinkled over the animal body either by hand or a machine i.e. duster.

Advantages :

* It is easy to apply the insecticides on animal body.
* It is suitable for application in animals having wounds.

Disadvantages :

* It is not suitable for sheep and goats due to long and thick wool and hair coat.
* While application wastage of dust powder is more.
* Dust powder is injurious to animal owner as it may be inhaled while application.

Table 23.16 : Commonly available Systemic (Oral & Parenteral) Ectoparasiticides

Sr. No.	Trade Name	Content	Class	Dose & Route
1	Exinot liquid 30 ml	Closantel 15% w/v	Salicylanilide	R : 7.5-15 mg/kg orally
2	a) Zycloz bolus b) Zycloz solution (30, 500 ml)	-do- -do-	-do- -do-	-do- -do-
3	Dectomax inj. (20, 50 ml)	Doramectin 10 mg/ml	Avermectine derivative	All species:0.2 mg/kg sc
4	Ivomec / Mectin / Neomec inj. (1, 7, 10, 20 ml)	Ivermectin 10 mg/ml	-do-	-do-
5	Ivomec Oral Solution (50, 250 ml, 1 lit)	Ivermectin 0.08% w/v	-do-	S.G.:2.5ml / 10kg orally

R : Ruminants *S : Sheep* *G : Goat*

Table 23.17 : Some commonly used topical ectoparasiticides

Sr. No.	Trade Name	Contents	Class	Concentration used (in water	
				Spraying/dusting On animal body	Spraying in animal shed
1.	Butox (15,50, 250 ml, 1 lit.)	Deltamethrin 12.5 mg/ml	Pyrethroid	2-3 ml/ lit	5 ml/lit
2.	Almethrin (50, 250 ml)	- do -	-do-	- do-	-do-
3.	Ektomin (15, 50ml, 1 lit)	Cypermethrin 100 EC	-do-	1 ml / lit	20 ml / lit
4.	Pektocide (15, 50 ml)	-do-	-do-	-do-	-do-
5.	Clinar (15, 50ml, 1 lit)	-do-	-do-	-do-	-do-
6.	Cyprol (15, 50 ml)	-do-	-do-	-do-	-do-
7.	Tik kill (15,50ml,5g,15g)	-do-	-do-	1 ml/lit 1 g/lit	10 ml/lit 10 g/lit
8.	Sumicidin (100, 250, 500ml, 1 lit, 5 lit)	Fenvalerate 20% w/v	-do-	0.5 ml / lit	---------
9	Ticomax (15, 50 ml, 1 lit)	Fenvalerate 200 mg/ml	-do-	2 – 6 ml/lit	---------
10.	Taktic (50, 250 ml)	Amitraz 12.5% w/v	-------	2 ml/lit	4 ml/llit
11.	Neocidol (30, 100ml, 1 lit, 5 lit)	Diazinon 20% w/v	Organo--phosphate	3 ml/lit	---------
12.	Cythion (250, 500 ml, 1 lit 5 lit)	Malathion 50% w/v	-do-	10 ml/lit	10 ml/lit
13.	Asuntol Powder (15 g)	Coumphos 50% w/w	-do-	2.5 g/lit	2.5 g/lit
14.	Notix Talc (150 g)	Carbaryl 5% w/v	Carbamate	Apply on body	---------
15.	Gammexane (10 %)	Benzene Hexa Chloride	Chlorinated hydrocarbon	Apply 5% dust on body	Sprinkle in the shed
16.	Pestoban (100 ml)	Ayurvedic	Ayurvedic	1:10 dilution	----------
17.	Zerokeet (100 ml)	Ayurvedic	-do-	1:2-4 dilution	----------