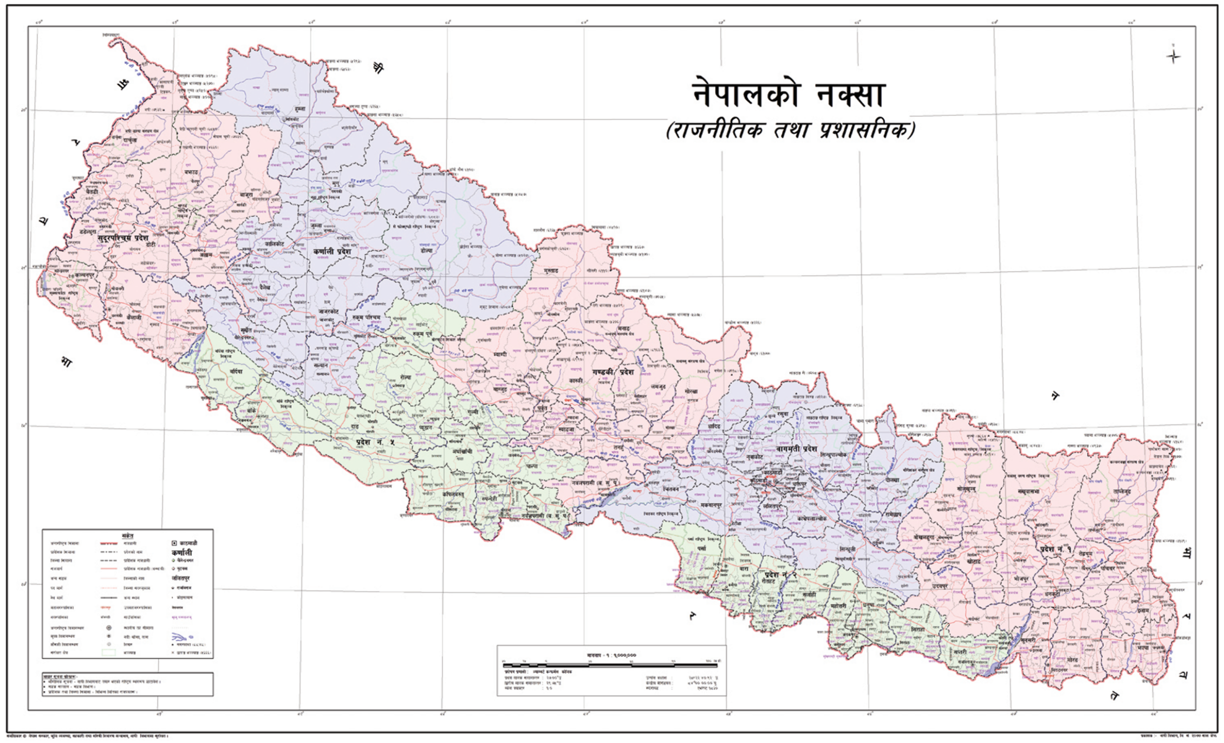

Animal Health - I

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Technical and Vocational Stream
Learning Resource Material

Animal Health - I
(Grade 9)

Secondary Level
Animal Science

Government of Nepal

Ministry of Education, Science and Technology

Curriculum Development Centre

Sanothimi, Bhaktapur

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Preface

The curriculum and curricular materials have been developed and revised on a regular basis with the aim of making education objective-oriented, practical, relevant and job oriented. It is necessary to instill the feelings of nationalism, national integrity and democratic spirit in students and equip them with morality, discipline and self-reliance, creativity and thoughtfulness. It is essential to develop in them the linguistic and mathematical skills, knowledge of science, information and communication technology, environment, health and population and life skills. it is also necessary to bring in them the feeling of preserving and promoting arts and aesthetics, humanistic norms, values and ideals. It has become the need of the present time to make them aware of respect for ethnicity, gender, disabilities, languages, religions, cultures, regional diversity, human rights and social values so as to make them capable of playing the role of responsible citizens with applied technical and vocational knowledge and skills. This Learning Resource Material for Animal Science has been developed in line with the Secondary Level Animal Science Curriculum with an aim to facilitate the students in their study and learning on the subject by incorporating the recommendations and feedback obtained from various schools, workshops and seminars, interaction programs attended by teachers, students and parents.

In bringing out the learning resource material in this form, the contribution of the Director General of CDC Dr. Lekhnath Poudel, Prof. Dr. D.K. Singh, Dr. Sudhir Kumar Singh, Dr. Manishaman Shrestha, Dr. Shishir Bhandari, Dr. Binod Kumar Yadav, Dr. Labakumar Jha, Dr. Manita Subedi, Dr. Ganesh Gautam is highly acknowledged. The book is written by Dr. Naresh Prasad Joshi, Dr. Hari prasad panta and Dr. Suraj Gurung, and the subject matter of the book was edited by Badrinath Timsina and Khilanath Dhamala. CDC extends sincere thanks to all those who have contributed in developing this book in this form.

This book is a supplimentary learning resource material for students and teachrs. In addition they have to make use of other relevnt materials to ensure all the learning outcomes set in the curriculum. The teachers, students and all other stakeholders are expected to make constructive comments and suggestions to make it a more useful learning resource material.

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Table of Contents

Unit 1
Concept of health and Disease

Learning Outcomes

After the completion of this unit, student will able to

- Explain the general concept of health and disease.
- Define common terminologies that is frequently used in veterinary science.
- Identify the healthy and sick animal.
- Classify the different animal disease.

Introduction

The concept of health and disease is regarded as an essentisl part of animal health science. In this unit you will study about the general concept of animal health and disease, sign of healthy and sick animal and classification of different animal diseases.

Health and disease

Health indicates physical, physiological and mental well being of an individual. Health also can be defined as normal condition of animal. In animal, health is also concerned with optimum level of productivity and work efficiency.

Any deviation from normal physical or physiological conditions will be considered as disease, which indicates the inability to perform the normal physiological functions though the nutrition and other environment factors are kept under optimum level. Any malfunction of the body process could be described as a disease condition.

Table 1.1 Difference between healthy and sick animals

Parameter	Healthy animals	Sick animals
Looks of animal	Smart,active,alert	Dull,inactive
Head	Raised upward	Downward
Eyes	Wide open bright	Dull, white

Nose/mouth	No discharge	May be some discharge
Movement	Active	Sluggish
Response to call	Quick	Slow
Consistency of dung	Normal	Abnormal(presence of blood,mucus,pus)
Hair coat	Normal smooth	Raised rough
Ear	Erect	Drooping
muzzle	Wet	Dry
Grazing	Normal	Will not
Rumination	Regular	Irregular
Temperature	38.5	More expect milk fever
Respiration/min	12-20	More
Pulse/min	60-70	More than 70
Milk yield	Normal	Reduced
Bowel motion	Evacuate usual amount 18-20	Not in normal quantity
Udder	Normal	Swelling

Terminologies related to Veterinary Science

Osteology: Study of bone and skeletal system

Arthrology: Study of joints or articulations

Abortion: The termination of pregnancy.

Anaemia: A reduction in the number or size of the red blood corpuscles or the haemoglobin in the blood.

Analgesic: Drug which cause temporary loss of sensation of pain without loss of consciousness.

Anaesthesis: The loss of feeling or sensation in all or part of the body .

Anatomy: Branch of biological sciences which deals with the form and structure of the body and its parts.

Veterinary Medicine: Veterinary medicine is the division of the medicinal science which deals with the Diagnosis, treatment, prevention and general studies of the diseases of the animals especislly domesticated one.

Diagnosis: It is the art of recognition and determination of the nature of disease.

Percussion: It is the art of striking any part of the body with a short, sharp blow to enable the underlying organs to vibrate and there upon generate an audible sound.

Auscultation: It is the process by which various functional sound produced by some thoracic and abdominal organ can be heard.

Dehydration: It means loss of water and dissolved salts from the body.

Pathology: It is that branch of medicine which treats the essentisl nature of disease especislly of the structural and functional changes in tissues and organs of the body which are caused by disease.

General pathology: Deals with fundamental process that are common to more than one tissue or organ.

Specisl Pathology: It is the study of diseases peculisr to certain systems or organs. Depending on the system, this may be sub-divided into Genito-urinary pathology, surgical pathology, Gynaecological and Obstetrical pathology etc.

Etiology: It is the study of the causation of the disease.

Predisposing causes: Are those that make the animal susceptible to the disease and are also known as remote, distant or preparatory causes.

Pathogenesis: Means the mechanism by which the cause produce the diseases.

Symptoms or sign: Outward manifestation of the patient suffering from diseases while alive.

Lesions: These are alterations in the structure, detectable macroscopically by the naked eye or microscopically.

Diagnosis: Is the art of determination of nature of disease, it causes, lesions, symptoms etc.

Incubation Period: Is the time that elapses between the action of a cause and manifestation of disease.

Course of disease: Is the duration of the time through which series of changes of charteristics of a disease pass through to their ultimate end.

Prognosis: A fate of a disease expected by veterinarisn.

Pharmacology: It is a science of drugs which includes the knowledge of history, adsorption, distribution, biotransformation, excretion, biochemical and physiological effects, adverse and toxic effects, therapeutic and other uses of drugs.

Pharmacy: It is science related to collection, compounding and dispensing of drugs, so as to make them fit for administration.

Posology: It is the study of drug dosage.

Laxatives and purgatives: These are drugs that promote evacuation of bowels and used for defecation.

Diurectics: These are drugs which increase the rate of urine formation and its excretion.

Chemotherapy: It is concerned with the use of certain chemicals in the treatment of infectious disease.

Veterinary Public Health: It comprises all the community efforts applied for the prevention of the disease, protection of life and promotion of well being and efficiency of man.

Zoonotic Disease: Those diseases which transmitted through animal to human being and human being to animal are called zoonotic disease.

Surgery: Branch of medicine which uses manipulative as well as other methods in the treatment of injury and diseases and removal of harmful and useless part.

Abattoir: A slaughter house

Acidosis: A condition of the blood which is brought about by an increase in acidity as a result of metabolic processes.

Ad libitum (ad lib) : Availability on free choice basis.

Anorexis: Lack of appetite.

Autopsy: Examination, including dissection of a carcass to learn the cause and nature of disease or cause of death. Also called Postmortem.

Bloat: A disorder of ruminants characterized by accumulation of gas in the rumen.

Culling: The process of eliminating nonproductive or undesirable animals.

Docking: Removal of the tail.

Drenching: A common method of administering medicine to an animal by mixing the medicine with water, elevating the animal's head and giving the dose from bottle.

Dystocia: Abnormal or difficult labor at parturition, causing difficulty in delivering the fetus and placenta.

Estrus Cycle: The period from one estrus, or heat period, to the next.

Free martin: A heifer, usually sterile born twin with a bull.

Mastectomy: Removal of the mammary gland.

Pica: An appetite for materisls not usually considered to be food such as is observed in phosphorus deficient animals; a depraved appetite.

Retained placenta: Placental membranes not expelled at parturition.

Rigor mortis: The stiffness of body muscles that is observed shortly after the death of an animal.

Stillborn: Born lifeless; dead at birth.

Syndrome: A group of signs and symptoms that occur together and characterize a disease.

Uremis: A toxic accumulation of urinary constituents in the blood.

Viscera: The large internal organs of the thoracic and abdominal and pelvic cavities of the body.

Haemorrhage: It is escape of blood from an artery, vein or capillary to the outside(external hemorrhage) or into a body cavity or into tissues(internal hemorrhage) .

Epistaxis: Bleeding from nose.

Hematemesis: Blood in vomit.

Hemoptysis: Blood in sputum.

Enterorrhagis: Bleeding from intestine.

Hematuris: Blood in urine.

Hemothorax: Blood in the thoracic cavity.

Hemopericardium: Blood in the pericardium.

Hemosalpinx: Bleeding in oviducts.

Thrombosis: Intravital, intravascular clotting of blood is called thrombosis.

Necrosis: Death of cells/tissue following injury within living individual is called necrosis.

Infraction: Acute ischemic necrosis of localized area.

Shock: Collapse of blood circulation.

Goitre: It is non inflammatory and non neoplastic enlargement of thyroid.

Inflammation: It is local complicated vascular and cellular reaction of an individual to an injury/irritant. Five cardinal sign of inflammation are redness, heat, swelling, pain and loss of function.

Cholangitis: Inflammation of bile ducts.

Cystitis: Inflammation of bladder

Vasculitis: Inflammation of blood vessel

Osteitis: Inflammation of bone

Osteomyelitis : Inflammation of bone marrow

Encephalitis: Inflammation of brain

Bursitis: Inflammation of bursa.

Typhlitis: Inflammation of caecum.

Colitis: Inflammation of colon.

Keratitis: Inflammation of cornea.

Otitis: Inflammation of ear.

Endocarditis: Inflammation of Endocardium.

Ophthalmitis: Inflammation of eye.

Cholecystitis: Inflammation of Gall Bladder.

Balanitis: Inflammation of Glans penis.

Enteritis: Inflammation of intestine.

Iritis: Inflammation of iris.

Arthritis: Inflammation of joints.

Nephritis: Inflammation of kidney.

Desmitis: Inflammation of Ligaments.

Cheilitis: Inflammation of lip.

Hepatitis: Inflammation of liver.

Pneumonia: Inflammation of lung.

Lymphadenitis: Inflammation of lymph nodes.

Meningitis: Inflammation of meniinges.

Stomatitis: Inflammation of mouth.

Myositis: Inflammation of muscle.

Rhinitis: Inflammation of Nasal cavity.

Neuritis: Inflammation of Nerve.

Oothoritis: Inflammation of ovary.

Salpingitis: Inflammation of oviduct.

Pancreatitis: Inflammation of pancreas.

Pericarditis: Inflammation of pericardium.

Periostitis: Inflammation of periosteum.

Peritonitis: Inflammation of peritoneum.

Pleuritis : Inflammation of pleura.

Posthitis: Inflammation of prepuce.

Pyelitis: Inflammation of renal pelvis.

Glomerulitis: Inflammation of renal glomeruli.

Sinusitis: Inflammation of sinus.

Dermatitis: Inflammation of skin.

Funiculitis: Inflammation of Spermatic cord.

Splenitis: Inflammation of spleen.

Gastritis: Inflammation of stomach.

Orchitis: Inflammation of testicle.

Glossitis: Inflammation of tongue.

Tracheitis: Inflammation of trachea.

Tympanitis: Inflammation of tympanum.

Metritis: Inflammation of uterus.

Vaginitis: Inflammation of vagina.

Vasitiss: Inflammation of vas deferens.

Phlebitis: Inflammation of vein.

Spondylitis: Inflammation of vertebra.

Vasculitis: Inflammation of vessels

Sign of Health and Disease

The sign and symptoms shown by an animal will help to know whether it is healthy or sick. Healthy and sick animal can be detected by observing the animal. For early detection of sick animal or birds, regular observation is important. Some of the important sign of diseased animals are described below:

Posture and gait: The general posture, gait of the animal, its movement and behavior will change during disease condition. Animal standing with head down or tendency to separate from the herd shows the sign of disease.

Appetite: Loss of appetite and stoppage of rumination in case of ruminants are early signs of several diseases.

Muzzle and nostrils: Muzzle and nostrils of healthy animals is moist and free from any discharges. The muzzle will be dry in animals having high temperature.

Skin: A coarse, dry and even sometimes skin gets covered with patches in different disease.

Hair: Raised hair coat, falling or brittle and lusterless hair also seen in different disease condition.

Temperature: Rise or fall in temperature also seen in many diseases. Fall in temperature is seen in milk fever. Rise in temperature is associsted with defense mechanism of body to fight against many diseases.

The normal body temperatures of different livestock are given below.

Pulse Rate: Varistion in pulse rate also indicates the diseased condition of animal. Pulse rate reflects the rate at which the heart pumps blood in the body. Pulse rate is generally higher in young and pregnant animals. Pulse rates of different species are given below.

Respiration: Varistion in rate and depth of breathing occurs in different disease condition. The normal respiration rates of different species are as follows.

Species	Temprature	Pulse Rate	Respiration
Cattle-	100-102.5 ˚F	42-60/minute	16-22/minute
Buffalo	99-102˚F	42-62/minute	22-28/minute
Goat	101.5-103.5˚F	60-70/minute	18-30/minute
Sheep	101.5-105.5˚F	60-70/minute	18-30/minute
Pig	100.0-102.5˚F	60-90/minute	16-18/minute
Dog	99.5-101.5˚F	70-90/minute	14-30/minute
Cat	100.0-102.5˚F	100-130/minute	20-30/minute
Fowl	105.5-107˚F	130-160/minute	15-30/minute

Eyes: Lacrimation is noticed during diseased condition. The eyes in healthy animals are bright and alert. In sick animal, excessive lacrimation, large size pupil could be observed.

Dung: Dung of healthy cows should be semi-solid in consistency, rich green in colour and free from gas bubbles or blood clots. Presence of part of parasite, liquid dung indicates the sick animals.

Urine: Urine is clear and straw coloured in healthy animal. Dark or bloody coloured urine is indication of disease.

Vulva: Vulva and tail should not show any presence of discharge from genital organs. Pus containing discharge may indicate septic condition of reproductive organs.

Milk Production: Change in volume and quality of milk yield is one of the early symptoms in several diseases.

Classification of Disease

There is no any single worldwide accepted way of classification of diseases. The disease can be classified in different ways that are discussed below.

According to the causative agents

a. Bacterial disease

Those disease caused by bacteria are called bacterial diseases

Example: Anthrax, Tuberculosis

b. Viral disease

Those diseases caused by virus are called viral diseases

Example: FMD

c. Fungal Disease

Those diseases caused by fungus are called Fungal diseases

Example : Aspergillosis

d. Protozoan Disease

Those diseases caused by protozoa are called Protozoan Diseases

Example: Babesiosis

e. Rickettsisl Disease

Those diseases caused by rickettsis are called rickettsisl diseases

Example: Anaplasmosis

According to mode of origin

a. **Hereditary disease:** It indicates those diseases which are transmitted to the offspring through sire or dam. Diseases are transmitted to the offspring through sperm or ovum of parents to the progeny.

   Example: Haemophilis

b. **Congenital disease:** It indicates those diseases which are acquired during intra-uterine life of an individual.

   Example: Atresis anai

c. **Acquired disease:** It indicates those diseases which are neither hereditary or congenital but are acquired during the entire life span of an individual.

   Example: Senile cataract

According to system Involved

a. Localised disease

A clinical change attributable to a disease is prominent and confined in a particular spot or organ.

Example: Abscess

b. Generalized disease

Disease which affects most or all parts of a body

Example: Toxaemis

According to changes in the organ

a. Primary Disease

Those diseases which originate independently and are not influenced by another disease.

Example: Canine distemper

b. Secondary disease

Those diseases which supervene out of already prevailing primary disease. Superimposed secondary bacterial diseases are very common outcome of primary viral diseases. Secondary pheumonis is very common after viral disease. Bordetella bronchoseptica causes secondary infectious bronchitis after primary disease of canine distemper.

c. Intercurrent disease

Disease which occurs as a sequel to primary disease.

Example: Chorea is the sequel to canine distemper

According to clinical Manifestations

a. Acute disease

Those disease that characterized by a sudden onset and a comparatively short course with severe manifestation, generally illness prevails for 3 to 14 days

Example: RP, FMD

b. Per-acute disease

These diseases have shorter duration then acute with a very severe course. Illness lasts for few hours to 48 hours.

Example: Per-acute Mastitis

c. Sub-acute disease

Those disease, whose onset and severity is lesser than the acute one. Usually, it has a course of 2to 4 weeks

Example: Sub acute mastitis

d. Chronic disease

Disease which has got a protracted course though the disease is not severe in character but in the long run may terminate fatally. Illness over 4 weeks is considered as chronic disease.

Example: Tuberculosis

According to the intensity and spread of disease

a. Sporadic disease

The diseases, which affects a single animal and shows no tendency to spread within the herd. This disease can be explained as separate disease observed in a given area during a certain length of time.

Example: Sporadic bovine encephalomyelitis

b. Enzootic disease

It denotes an outbreak of disease among animals in a definite area or particular district. The outbreak may be observed among certain species or breeds of animals.

Example: Enzootic haematuris in cattle

c. Epizootic disease

It is applied to disease which affects a large population of animals in large areas.

Example: RP, FMD

d. Panzootic disease

If the epidemic reaches an unusually large size in some country or spreads over many countries or even continents it is called a panzootic disease.

Example: Influenza

Summary

- Health indicates physical, physiological and mental well being of an individual.
- Any devistion from normal physical or physiological conditions will be considered as disease.
- Healthy and sick animal can be detected by regular observation of different part of body like hair, nose, eyes etc, body temperature , Pulse rate, respiration, urine, milk production etc.
- Diseases can be classified on several bases like mode of origin, system involved, organ involved, clinical manifestation disease ,etc.

Glossary

Posture: the position in which someone holds their body when standing or sitting.

Appetite: the desire for food

Exercise

A. Very Short Question.

1) What is Health?
2) What is disease?

B. Short Question.

1) How can disease be classified on the basis of causative agent?
2) How can disease be classified on the basis of mode of origin?
3) How can disease be classified on the basis of spread of diseases?

C. Long Question

1) Differentiste Healthy and diseased animals.
2) Classify the diseases.

Unit Two
Microbiology and Parasitology

Learning Outcomes

After the completion of this unit, the students will able to

- To explain the general concept of Microbiology and Parasitology.
- To define the common terminologies frequently used in Microbiology and Parasitology.
- To explain the difference between bacteria and Virus.
- To explain the concept of Immunity and Immunization.
- To explain different Endoparasites and Ectoparasites.

Introduction

Bacteria are prokaryotic, unicellular organisms containing DNA and ribosomes. Bacteria are divided into two major groups: Gram positive and Gram negative. Viruses are obligatory intracellular infectious agents of sizes ranging from 20 to 300 nanometer with an absolute dependence on living cells for their replication. A virus is a non cellular particle made up of genetic material and protein that can invade living cells. . They can only be seen with an electron microscope. An organism which lives in or on other organism and get shelter and nourishment are called as parasite. Parasitism is defined as an animal adaptation between two species in which one organism (the parasite) is dependent on another organism (the host) for its nutrition and survival for whole or part of its life. The parasites are definitely benefitted by this association, whereas the host is not benefitted and even sometimes proves lethal for them. Parasites that live on the surface of host are called Ectoparasites (e.g. lice, mite). Parasites that live inside the host are called Endoparasites (e.g. Liver flukes etc.)

Immunity is defined as the state of resistance or insusceptibility exhibited by the host to toxic molecules, micro-organisms and foreign cells. Immunity may be natural (innate) or acquired. Innate Immunity is also known as native immunity. It is a resistance with which a person or a lower animal is born. It is nonspecific.

Resistance acquired by an individual during life is called acquired or specific immunity. The resistance that is induced in the recipient by transfer of preformed antibodies against infective agent or toxin in another host is called passive immunity. The resistance that is induced in the recipient by transfer of preformed antibodies against infective agent or toxin in another host is called passive immunity.

Microbiology: Microbiology is the study of living organism of microscopic size. Microorganisms are very small, usually single-celled, organisms which are not individually visible to the naked eye. Microorganisms can only be seen through microscope. Microorganism includes bacteria, fungi, algae, protozoa and viruses.

Parasitology: The branch of science which deals with the multidisciplinary aspects of biochemistry, physiology, biology, immunology etc of parasite is called as parasitology. The applied part of this discipline explores a detailed profile of parasite morphology, pathogenesis and control regime as well. An organism which lives in or on other organism and get shelter and nourishment is considered as parasite.

Definitions and Terminology

Immunology: It is the study of defense mechanism of body against infection and disease.

Antigen: It is a foreign substance which can give rise to an immune response in the form of antibody production.

Autoimmunity: The process of mounting immune response to self antigen is called as autoimmunity and damage or disease occurred due to this process is known as autoimmune disease. Example: Rheumatoid arthritis

Sterilization: It is the complete killing or removal of all living organism from a particular location or material, Sterilization can be achieved by heat, certain gases, exposure to ionizing radistion some liquid chemicals and filtration.

Disinfection: It is the process of elimination of harmful micro organism by liquid chemical agents known as disinfectants.

Antiseptics: Antiseptics are disinfectant that can be used on the body surfaces such as the skin to reduce the number of normal flora and pathogenic organisms. They are less toxic and less effectives than the disinfectant.

Sanitation: It means providing an acceptable level of microbial cleanliness on inanimate objects like surfaces used in food preparation.

Asepsis: It means prevention of microbes from reaching a protected environment such as the microbiological inoculation in the operating room. The sterilization of all materials and equipments used is the basis of asepsis.

Pasteurization: It is the use of heat at temperature sufficient to kill certain harmful organism in a liquid such as milk below that required for sterilization, so as not to alter its quality but killing pathogenic organisms.

Parasite: An organism which lives in or on other organism and get shelter and nourishment.

Erratic Parasite: Parasite which is found in the organ other than its normal organ.

Accidental parasite: Parasite which is found in the host other than normal host.

Permanent parasite: Parasite which is found in the host throughout the life cycle.

Temporary parasite: Parasite which is found in the host in some of the part of life-cycle.

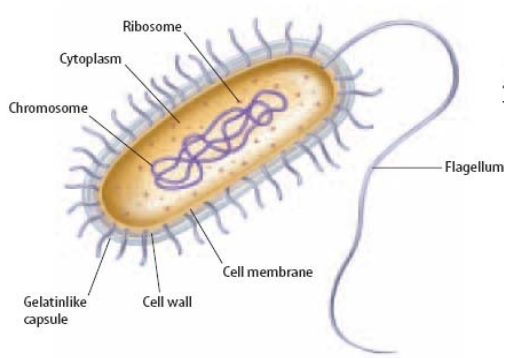
Hyperparasite: Parasite of parasites

Parasitism: A form of symbiosis in which one organism (called parasite) benefits at the expense of another organism usually of different species (called host).

Host: One that harbours the parasite.

Definitive host: Is the host in which the adult stage of the parasite lives or in which sexual reproduction takes place E.g. man is definitive host for *Ascaris, Anopheles pharoensis* for *Plasmodium* sp. parasites and pigs for *Taenis solium*).

Intermediste host: Harbours the larval (immature stages) or asexual stages of a parasite (e.g. *Culex* mosquito is an intermediste host for *Wuchereris bancrofti, Pirenella conica* is the intermediste host for *Heterophyes heterophyes,* *Biomphalarie* sp. for intestinal Bilaharzissis … etc.).



A typical Bacteria

Paratenic/ Transport host: These are second or third intermediste host in which the parasite remain encycted without further development and these are ingested by definitive host to give the infection.

Facultative parasite: One which has both option either to live in the host or as free life.

Obligatory parasite: One which cannot live without host.

Endoparasite: Parasite which is found within the body.

Ectoparasite: Parasite which found on the body.

Reservoir host: Usually a natural host, but host does not get infected from parasite but it is a source of infection for other host.

Vector: An arthropod or any other invertebrate which transmit disease from one animal to another.

Carrier: An animal/ person who harbors and excretes parasites.

Direct Life Cycle: Life cycle, in which no involvement of intermediste host.

Indirect life cycle: Life cycle, in which there is involvement of intermediste host.

Organisms causing infectious diseases: Bacteria, Virus, Parasites and Fungus

Bacteria

- Average size of bacteria is 0.5 -2.0 um in dismeter.
- Bacteria are prokaryotic, unicellular organisms containing DNA and ribosome.
- Bacteria have the characteristics of living things.

Structure of Bacteria

A bacteria consist of different structures. The structure and the function of a bacteria are given in following table.

Structure	Function
Cell Wall	Protects and gives shape
Outer Membrane	Protects against antibodies (Gram Neg. Only)
Cell Membrane	Regulates movement of materisls, contains enzymes important to cellular respiration
Cytoplasm	Contains DNA, ribosomes, essentisl compounds
Chromosome	Carries genetic information
Plasmid	Contains some genes obtained through recomb.
Capsule and Slime Layer	Protects the cell and assist in attaching cell to other surfaces
Endospore	Protects cell agains harsh enviornments
Pilus	Assists the cell in attaching to other surfaces
Flagellum	Moves the cell

Classification of Bacteria

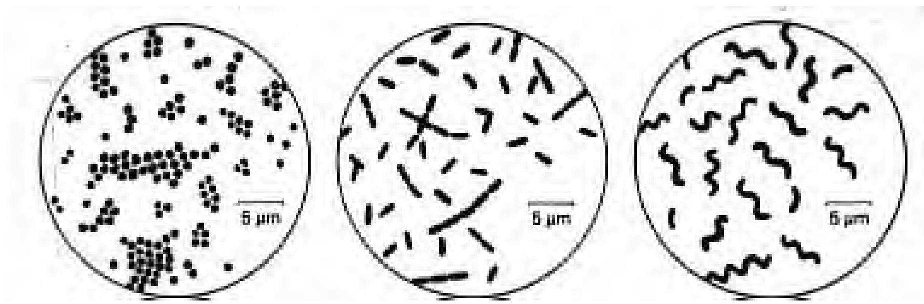
Bacteria is divided into two major groups: Gram positive and Gram negative. Both groups have a cell wall composed of peptidoglycan. In Gram-positive bacteria, the wall is thick, whereas in Gram-negative bacteria, the wall is thin.

Bacteria has **three distinct shapes**:

1) Spherical (cocci)

2) Rod-shaped (bacilli)

3) Spiral (spirilla)



Round Rod Spiral

Arrangement in different combination:

- Coccus: 2 cocci – diplococci , Chain = Streptoccus, Cluster = Staphylococcus
- Bacillus: Chain –Streptobacillus

Bacteria Reproduction

1. Binary Fission
2. Conjugation
3. Spore Formationt

1. Binary Fission

Cellular organism copies its genetic information then splits into two identical daughter cells

2. Conjugation

Two organisms swap genetic information, that is resistance to penicillin.

3. Spore Formation

Endospores are formed by vegetative cells in response to environmental signals that indicate a limiting factor for vegetative growth, such as exhaustion of an essentisl nutrient.

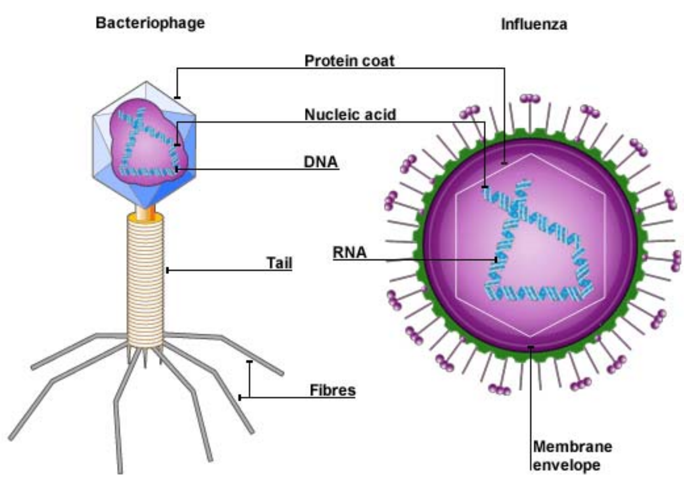
Virus

Viruses are obligatory intracellular infectious agents of sizes ranging from 20 to

300 nanometer with an absolute dependence on living cells for their replication.

General structure of viruses

- A virus is a non cellular particle made up of genetic materisl and protein that can invade living cells
- Viruses are smaller than bacteria; they range in size between 20-300 nanometer (nm).   They can only be seen with an electron microscope.
- Viruses contain only one type of nucleic acid, either DNA or RNA, but never both.
- Viruses consist of nucleic acid surrounded by a protein coat. Some viruses have additional lipoprotein envelope.
- Viruses lack cellular organelles, such as mitochondris and ribosomes.
- Viruses are obligate cellular parasites. Viruses are completely dependent on living cells, either eukaryotes or prokaryotes for replication and existence. They replicate only inside living cells. Viruses replicate through replication of their nucleic acid and synthesis of the viral protein.
- Viruses do not multiply by binary fission but by a complex process involving protein synthesis and nucleic acid production



Structure of virus

- Viruses do not multiply in chemically defined medis.
- Viruses do not undergo binary fission.

- Viruses is composed of nucleic acid either DNA or RNA, surrounded by a protein coat called the capsid.
- The capsid is composed of small structural units called capsomeres.
- The capsid protects nucleic acid from inactivation by the outer physical conditions.
- Some viruses have additional lipoprotein envelope , composed of virally coded protein and host lipid. The viral envelope is covered with glycoprotein spikes.
- Bacteriophages are viruses that infect bacteria.

Basic Components of Viruses

A virus particle or virion consists nucleic acid (DNA or RNA) that is coated by a protein called capsid. The combined nucleic acid and capsid is called nucleocapsid. The nucleocapsid can either be naked or enclosed by a membrane termed envelope. The capsid itself is made up of subunits called capsomere.

Viral Nucleic Acid

- This can either be RNA or DNA
- It contains the information necessary for directing the infected cells to synthesis virus specific proteins
- It may be single stranded or double stranded
- It may be linear or circular
- It may be positive sense or negative sense (a positive sense nucleic acid possesses the same polarity as the mRNA and so can be translated directly into protein without first being transcribed)
- It may be a single piece or segmented
- It is haploid except in retroviruses in which it is diploid

The Capsid

- It is made up of proteins arranged in multiple almost identical units called capsomere
- It offers protection for the nucleic acid against adverse conditions
- It facilitates attachment and entry of the virus into host cell
- It possesses antigens used for virus identification in serological tests

- It determines the symmetry of the virus

The Envelope

- Present only in some viruses
- It is made up of lipids
- It is derived from the plasma membrane of the host cell during the release of the virus from the cell by budding
- In enveloped viruses, capsomeres take the form of projections called spikes or peplomers protruding out through the lipid bilayer of the envelope
- The spikes are glycoprotein in nature
- There may be a stabilizing protein membrane beneath the envelope lipid bilayer. This is referred to as the membrane/matrix protein
- In some viral infections, the envelope is acquired from the endoplasmic reticulum, the Golgi apparatus or the nuclear membrane
- Enveloped viruses are usually susceptible to detergent and are rendered non infectious following damage to the envelope

Classification of viruses

Viruses are divided into two large groups:

- RNA containing viruses.
- DNA containing viruses.

Steps in virus replications

Viruses rely completely on living host cells for their replication. The small genome size put them at disadvantage. Also, they lack organelles and other machineries required for protein synthesis. Although some viruses enter the host cell with few virus-encoded enzymes, others do not possess any protein of their own and therefore depend completely on those produced by the host cell. Virus replication is facilitated by the host cell which provides the required energy and synthetic machinery and sometimes essentisl enzymes for replication and also by the viral nucleic acid which carries the genetic information required for the synthesis of viral components.

Parasites

An organism which lives in or on other organism and get shelter and nourishment is considered as parasite. The branch of science which deals with the multidisciplinary aspects of biochemistry, physiology, biology, immunology etc of parasite is called as parasitology.

Fungus

Fungi are eukaryotic, heterotrophic, unicellular (yeast form) or multicellular tubular (hyphal or mold form), rigid cell-walled, and spore-producing organisms. As eukaryotes, fungi contain membrane-bound nuclei and organelles such as mitochondris, Golgi apparatus, endoplasmic reticulum, ribosomes, microbodies, lysosomes, lipid bodies etc. Fungal cell membrane has the sterol, ergosterol. Biosynthesis of this integral membrane component is inhibited by the azole antifungals. Fungi are insensitive to antibacterial antibiotics. Fungi lack chlorophyll. Hence, they are heterotrophic organisms that are saprobes (living on dead organic matter) and/or parasites (utilizing living tissue). They secrete enzymes into the substratum and absorb the digested compounds through their cell walls resulting in extracellular digestion and absorptive nutrition. The cell walls of fungi contain chitin, chitosan, glucan, mannan and some other components. The antifungal compounds, polyoxins and echinocandins, inhibit the biosynthesis of chitin and glucan, respectively. Like animals, in fungi also glycogen is the storage polysaccharide materisl.

The fungus causes several diseases in animal out of which Ringworm is the most common transmissible infectious diseases affecting livestock and human.

Differences between Bacteria and Virus

S.N.	Characteristics	Bacteria	Viruses
1	**Size**	Larger (1000 nm)	Smaller (20-400 nm)
2	**Cell Wall**	Peptidoglycan or Lipopolysaccharide	No cell wall. Protein coat present instead.
3	**Ribosome**	Present	Absent
4	**Number of**	One cell	No cells

	cells	(Unicellular)	
5	**Living/Non-Living**	Living organisms	Between living and non-living things.
6	**DNA and RNA**	DNA and RNA floating freely in cytoplasm.	DNA or RNA enclosed inside a coat of protein.
7	**Reproduce**	Able to reproduce by itself	Need a living cell to reproduce
8	**Reproduction**	Fission- a form of asexual reproduction	Invades a host cell and takes over the cell causing it to make copies of the viral DNA/RNA. Destroys the host cell releasing new viruses.
9	**Under Microscope**	Visible under Light Microscope.	Visible only under Electron Microscope.
10	**Benefits**	Some bacteria are beneficisl (Normal Flora)	Viruses are not beneficisl. However, a particular virus may be able to destroy brain tumors. Viruses can be useful in genetic engineering.
11	**Treatment**	Antibiotics	Virus does not respond to antibiotics.
12	**Examples**	Staphylococcus aureus, Vibrio cholerae, etc	HIV, Hepatitis A virus, Rhino Virus, etc

Immunity and Immunization

Immunity is defined as the state of resistance or insusceptibility exhibited by the host to toxic molecules, microorganisms and foreign cells.

Immunity may be natural (innate) or acquired.

Innate Immunity

It is also known as native immunity. It is a resistance with which a person or a lower animal is born. It is nonspecific. This type of immunity is present for life.

Types of innate immunity

1. Species immunity: Animals of same species exhibit uniform pattern of susceptibility to infections. B. anthracis infects human but not chicken. Birds are immune to tetanus.
2. Racisl immunity: Algerisn race of sheep is immune to anthrax which is a common disease of other races of sheep.
3. Individual immunity: Certain individuals may be found within a highly susceptible population. This type of individual immunity is commonly observed in an endemic outbreak of an infection.

Acquired Immunity: Resistance acquired by an individual during life is called acquired or specific immunity. Acquired immunity is of two types: active and passive.

Active immunity: Active immunity is the resistance induced in an individual after effective contact with an antigen. It follows either natural infection or vaccination. The immune system actively participates producing antibody and, often, cell medisted immunity also. Active immunity develops slowly over a period of days or weeks but persists for a longer time, usually for years.

Types of active immunity: Active immunity may be acquired either naturally or artificially.

Natural active immunity: It is acquired by natural infection by the organism predominantly by subclinical infections after repeated exposure to small doses of the infecting organism which passes unnoticed. Such immunity is usually long lasting and plays important roles in preventing epidemics.

Artificial active immunity: It is the resistance produced by vaccination. The vaccines are preparations of live, attenuated or killed microorganisms, or their antigens or active materisls derived from them.

Passive Immunity: The resistance that is induced in the recipient by transfer of preformed antibodies against infective agent or toxin in another host is called passive immunity. Passive immunity is of two types: natural and artificial.

Natural Passive immunity: It is the resistance passively transferred from the mother to foetus and infant, e.g. transfer of maternal antibody to foetus transplacentally and to infant through milk (colostrum).

Artificial passive immunity: It is the resistance passively transferred to a recipient by the parenteral administration of antibodies. Passive administration of antibody is very useful in some clinical condition.

S.N.	Active immunity	Passive immunity
1	Produced actively by the immune system of host	Received passively by the host and the host's immune system does not participate.
2	Induced by infection or by contacts with immunogen eg vaccine	Conferred by introduction of ready-made anti bodies
3	Immune response – durable and effective	Immune response- short lived and less effective
4	Immunity develops only after a Lag period	Immunity effective immedistely
5	Immunological memory present due to presence of memory cells. Subsequent challenge with booster dose is more effective.	No immunological memory. Subsequent administration of anti body is less effective due to immune elimination.
6	After antigenic stimulus negative phase may occur due to antigen combining with any pre-existing antibody in blood.	No negative phase
7	Serves no purpose in immunodeficient host	Applicable in immunodeficient host

8	Used for prophylaxis to increase body resistance	Used for treatment of acute infection

Immunization: Immunization is the process by which an animal's immune system becomes fortified against an agent. Immunization is done through various techniques, most commonly vaccination. Vaccines against microorganisms that cause diseases can prepare the body's immune system, thus helping to fight or prevent an infection. Active immunization involves administration of vaccines containing antigenic molecules (or genes for these molecules) derived from infectious agents. Simply vaccination is the administration of vaccines. As a result, vaccinated animals mount acquired immune responses and develop prolonged, strong immunity to those agents. When properly used, vaccines are highly effective in controlling infectious diseases.

VACCINATION CHART FOR FARM ANIMALS AGAINST IMPORTANT DISEASES					
Name of disease	Vaccinated animals	Type of vaccine	Time of vaccination	Duration of immunity	Remarks
Anthrax	All animals	Spore vaccine	Once in year Pre monsoon	One season	
Black quarter	Cattle, buffaloes, sometimes sheep	Killed vaccine	Once in year Pre monsoon	One season	
Haemorrha gic Septicaemis	Cattle, buffaloes, sometimes sheep	Oil adjuvant vaccine	Once in year Pre monsoon	One season	
Brucellosis	Cattle and buffaloes	Live vaccine	6 month of age	3 or 4 calvings	To be done only in infected herds
Hog Cholera	Swine	Crystal Violet vaccine	After weaning	One year	
Pox Disease	All farm animals	Vaccine from pox lesion scabs	During outbreak	One Year	

FMD	Cattle, Buffalo, pig and sheep	Polyvalent tissue culture vaccine	At about 6 month of age and booster after 4 month	One Season	
Swine Erysipelas	Swine	Alum treated vaccine	After weaning	About one year	
Tuberculosis	All Farm Animals	B.C.G. Vaccine	At about six months of age	One to two year	To be repeated every 2 or 3 year

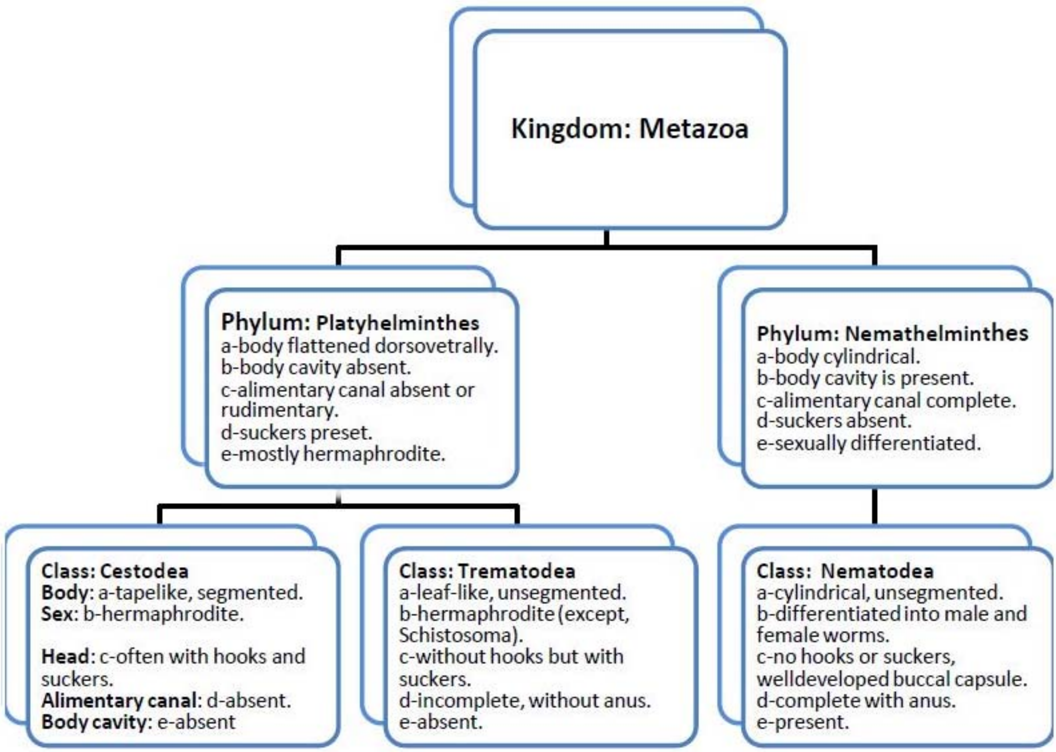
Common Internal and External parasites, their characteristics and control measures

An organism which lives in or on other organism and get shelter and nourishment are called as parasite. Parasitism is a unique form of animal adaptation on the pathway of "struggle for existence" and" Survival of fittest". It is defined as an animal adaptation between two species in which one organism (the parasite) is dependent on another organism (the host) for its nutrition and survival for whole or part of its life. The parasites are definitely benefitted by this associstion, whereas the host is not benefitted and even sometimes proves lethal for them. Parasites that live on the surface of host are called Ectoparasites. Some examples of ectoparasites are lice, mite etc. Parasites that live inside the host are called endoparasites. Some examples of endoparsites are *Gisrdis lamblis, Ascaris lumbricoides etc.*

Internal Parasites/ Endoparasites

Helminths important in veterinary medicine are in four distinct taxonomic groups: nematodes (commonly known as roundworms); cestodes (commonly known as tapeworms); trematodes (commonly known as flukes); and acanthocephalans (commonly known as thorny-headed worms). Globally, acanthocephalans of are of relatively little significance. Species of parasite within each of these four groups share structural, functional and ecological characteristics. These are also called metazoa. The metazoa are classified into two phyla: Platyhelminthes and Nemathelminthes. Platyhelminthesis divided into two classes: Cestodea (tapeworms) and Trematodea (flukes) while nemathelminthes has only one class

Nematodea (roundworms).



Characteristics of Important Phyla

Platyhelminthes (Trematoda)

- These are also called flukes. They have dorso-ventrally flattened leaf like body.
- They don't have body cavity.
- Have suckers, hooks or clamps for attachment to the host.
- Sub class Digenea are of Veterinary importance and have indirect life cycle.
- Digestive system includes mouth and alimentary tract but no anus (blind alimentary tract). Mouth leads into pharynx and intestine. Intestine divides into 2 branches, which may branch themselves.
- Excretory system has flame cells, which discharges into an excretory bladder.
- Respiratory and circulatory systems absent.
- Reproductive system hermaphrodite except Family Schistosomatidae.
- One Trematode egg may produce many individuals unlike Nematoda. This

multiplicative reproductive ability is called Polyembryony.

Nemathelminthes (Nematoda)

- They are free-living or parasitic.
- They are cylindrical and elongated, unsegmented body. Extremities are tapering.
- Body is covered with cuticle which is continuous with cuticular lining of buccal cavity, alimentary tract and distal portion of genital tract. Cuticular extension may form specisl adhesive structures.
- Internal organs are suspended in body cavity. Digestive system consist of tubular-mouth (buccal capsule), esophagus, intestine, anus (cloaca).
- Excretory system contains unbranched vessels (canal) which is opened by a ventral pore.
- Nervous system consists of a number of ganglis connected by fibres (nerve ring), which surrounds oesophagous.
- Sexes are usually separate. Male organs- single testis, a vas deferens, a seminal vesicle, spicules, ejaculatory duct and cloaca. Female- two ovaries, two uteri, and vulva.
- Life cycle generally consists of egg, L1, L2, L3, L4 and adult stage. Larval stages pass through 4 ecdyses to become adult.
- Life cycle may be direct or indirect.

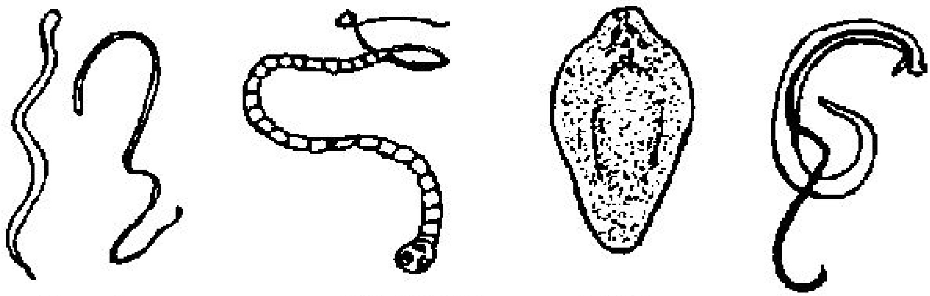
Acanthocephala

- Body of this parasite is cylindrical, covered with thick tegument. Nutrient absorbed through the tegument.
- No digestive system.
- Sexes separate. Male- two testes, ejaculatory duct and penis. Female- Ovary which discharges eggs in body cavity, received by uterine bell.
- Excretory system is absent or contains a pair of Nephridis.
- Egg contains larva with hooks (Acanthor larvae).

Annelida (Hirudinea- leech)

- They have soft body, dorso-ventrally flattened, true segmentations .

- Anterior region forms head- bears sucker.
- They are Hermaphrodite. Contains many testes and a pair of ovaries.
- Excretory organs are Nephridis.
- Digestive system includes- esophagus, stomach (crop), blind sack (for storage of blood), intestine and rectum.



Important parasites of Trematodes

Fasciola

These parasites are of great economic constraint in the livestock industry causing great economic loss as a result of significant loss of production and mortality. Fasciola hepatica and fasciola gigantic are common species under the genus fasciola.

Salient Morphology

1. These flukes are flattened. The shape may be either broad or elongated leaf-like.
2. The tegument is spiny.
3. The size is widely varisble.
4. The colour is grey, dark grey or grayish brown.
5. There is presence of anterior cone which is simply one anterior prominence.
6. Two suckers are present, oral and ventral.
7. The ventral sucker is present at the level of the shoulder.
8. Branched intestine is present.

9. The eggs are typical. These are oval and yellowish in colour. At one side there is presence of an operculum.

Hosts: Cattle, sheep, goat and other ruminants. Elephant, horse, pig, dog and cat are affected by the parasites.

Site: Bile duct and liver

Disease:Fasciolosis, Liver fluke disease

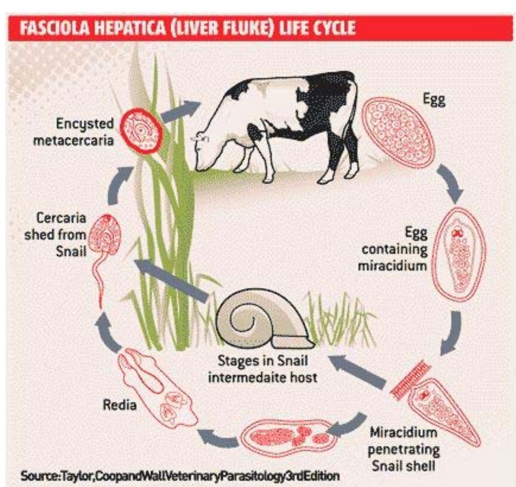
Life Cycle

Definitive host- Cattle, goat, sheep and other ruminants.

Intermediste Host-Lymnaea truncatula, L.auricularis, L.bulimoides, L.rufescenos etc

Development Stages

- Egg
- Miracidium
- Sporocyst
- Redis
- Cercaris
- Metacercaris(Infective stage)
- Adult



Clinical Signs

In acute phase

- Clinical signs in acute stage occurs due to migrating fluke in the liver. The sheep dies suddenly due to migrating fluke in the liver exhibiting the clinical signs like anthrax.

In chronic phase

- Anaemia and paleness of mucus membrane occur.
- The animal refuses to take food and water and becomes cachexic.
- Constipation and Diarrhoea occur. The constipation is the characteristic clinical feature.

Diagnosis

- Fecal examination is traditional disgnostic way for fasciolosis. Examination of feacal sample reveals the presence of eggs of fasciola spp. The eggs of the Fasciola are oval in outline and operculated. Color of the eggs is yellowish.
- Enzyme estimation- Enzyme estimation (Glutamate dehydrogenase and Glutamyl transpeptidase) is the indicative step for Diagnosis of the disease. Elevation of level of these enzymes is the indication of fasciolosis.
- Complement Fixation Test (CFT)
- ELISA

Treatment

The following drugs are used to treat against Fasiola spp.

Oxyclozanide, Triclabendazole, Bithionol, Hexachlorethane, Nitroxynil

Control

The following control measures may be taken:

1. Treatment of the animal by using Appropriate anthelmantics.
2. The animal should not be allowed to graze in the field of low land areas where water reservoir like river, pond, lake are present.
3. Water reservoir should be fenced off.
4. Faeces should be disposed properly.

5. The grasses in the form of hay or silage should be provided
6. Underground water should be provided for drinking .
7. Control of intermediste host (mollusca) is done by use of molluscicidal agent like copper sulphate solution and N-Tritylmorpholine in spring and mid summer.
8. Vaccination is a recent trend for control.

Paramphistomum

These are thick fleshy amphistomes occurring in the rumen and reticulum of the ruminants. These are globally important parasites.

Salient Morphology

- The fluke is thick and fleshy and are called conical flukes.
- The shape of the fluke is indicative of identification. The dorsal surface is convex and the ventral surface is concave.
- Two suckers are present at two ends
- Testes are at tandem and situated anterior to ovary
- The flukes are pink to red in color and the shape is comparable to the food prepared from rice.

Host- Cattle, sheep, goats and other ruminants

Site- Rumen, reticulum, small intestine

Life Cycle

Development Stages

- Egg
- Miracidium
- Sporocyst
- Redis
- Cercaris
- Metacercaris(Infective stage)
- Adult

Clinical signs

- The animals exhibit the disease symptoms at the onset of monsoon.
- Several abdominal pains due to plug feeding is caused by the immature amphistome.
- Profuse fluid Diarrhoea occurs
- The affected animals show increased thirst which is due to loss of large amount of body fluid through Diarrhoea.
- The affected animals may die.

Diagnosis

- Fecal examination is traditional disgnostic way for amphistome. One thing is to be kept in mind that negative finding of eggs in the faeces doesn't indicate absence of amphistomosis. Because when clinical signs occur in the animals due to amphistomosis it means the immature amphistomes are causing damage at that time. In positive cases, the pink coloured immature flukes are found in the foetid Diarrhoea.
- Enzyme estimation- Enzyme estimation (Glutamate dehydrogenase and Glutamyl transpeptidase) is the indicative step for Diagnosis of the disease. Elevation of level of these enzymes is the indication of fasciolosis.
- ImmunoDiagnosis
- Direct ELISA and Indirect ELISA

Treatment

The following drugs are used to treat against Fasiola spp.

Oxyclozanide, Rafoxanide, Triclabendazole, Bithionol, Hexachlorethane, Nitroxynil

Control

The following control measures may be taken:

1. Treatment of the animal by using Appropriate anthelmantics.
2. The animal should not be allowed to graze in the field of low land areas where water reservoir like river, pond, lake are present.
3. Water reservoir should be fenced .

4. Faeces should be disposed properly.
5. The grasses in the form of hay or silage should be provided
6. Underground water should be provided for drinking water.
7. Control of intermediste host (mollusca) is done by use of molluscicidal agent like copper sulphate solution and N-Tritylmorpholine in spring and mid summer.
8. Vaccination is a recent trend for control.

Important parasites of Cestodes

Moniezis

These are cosmopolitan distributed medisn to large-sized tape worms inhabiting the small intestine of the sheep, goat and cattle. The tape worms are of less pathogenic significance. However, large number of the cestodes may cause some amount of pathogenicity.

M. expansa

M. benedeni

Common name: Double-pored tape worm

Hosts- Sheep, goat and cattle

Site- Small intestine

Salient morphology

- The head is almost round.
- There are four suckers. The suckers are stout and unarmed
- The rostellum is absent
- The segments are broad
- Two sets of reproductive organs are present
- The shape of eggs of M. expansa is trisngular and of M. benedeni is square. Prominent pyriform apparatus is visible in the eggs.

Life cycle

Developmental stages

- Eggs
- Oncosphere
- Cysticercoid in the intermediste host
- Adults

Clinical signs

- Low level of infection fails to produce any significant damage to the hosts
- High level of infection causes Diarrhoea
- General weakness
- Nervous disorder i.e. in-coordination of movement and circling movement.

Diagnosis

- Faecal examination
- clinical signs

Treatments

Praziquantel, Albendazole, Niclosomide, Fenbendazole, Bithionol

Important parasites of Nematode

Oesophagostomum

These are important bursate nematodes inhabiting the large intestine of the ruminants and non-ruminants.

Species

- O.columbisnum (Found in sheep, goat)
- O. radistum (Found in cattle)
- O. venulosum (found in sheep and goat)
- O. dentatum (found in pig)

Common name- Nodular worm

Site-Large Intestine

Disease caused – Nodule disease, knotty gut disease

Salient morphology

- In the head region a prominent cervical alae is present.

- At the anterior margin of the head a mouth collar is present.
- A ventral cervical groove is present at the lateral region of the body.
- Hind end of female is pointed
- vagina ends in a kidney shaped pars ejectrix which is considered to be a silent morphological feature of this parasite.

Life Cycle

Development stages

- Egg
- Larva 1
- Larva 2
- Larva 3 (Infective)
- Larva 4
- Adult

Clinical signs

- The animals exhibit the clinical signs of persistent Diarrhoea which is considered to be a differentisl disgnostic feature of the infection as the color of disrrheic faeces is specific (dark green).
- The animals become dehydrated and debilitated.
- Anemis is caused due to hypo nutritive condition
- Young animals may die due to severe Diarrhoea.

Diagnosis

- Faecal Examination may not reveal presence of eggs as the parasites remain in the nodules
- Rectal palpation may reveal the presence of large number of nodules.
- ELISA

Treatments

Thisbendazole, Albendazole, Cambendazole, Parbendazole, Fenbendazole, Oxfenbendazole

Control

- Treatment
- Grazing management
- Biological control by using nematode trapping fungi

Haemonchus

These are small wire worms found in the abomasums of sheep, goat and cattle. They are voracious blood sucker worms and cause unaccounted mortality and significant loss of productivity.

Species

- H. contortus
- H. placei
- H. similis
- H.bubalis
- H. longistipes

Site- Abomasum

Common name- Stomach worm, wire worm or barber's pole worm

Salient morphology

- The worms are small, grey or reddish in colour. As the worms are blood suckers, the colour of the parasite is reddish or grey due to digestion of the blood
- Anteriorly there is a presence of prominent cervical papillae which is easily discernible.
- Red intestine is surrounded by the white ovary giving the appearance of barber's pole
- The terminal part of female worm is sharply pointed.

Life cycle

Developmental stages

- Egg
- Larva 1
- Larva 2

- Larva 3 (Infective stage)
- Larva 4
- Adult
- Signs
- Anaemia
- Abomasitis
- Oedema in the submandibular region

Diagnosis

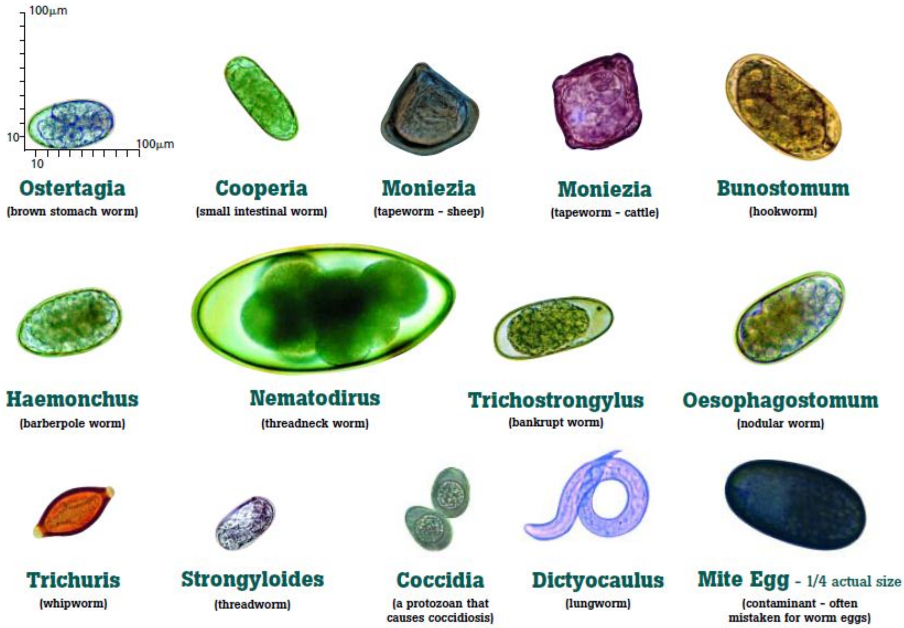
- Faecal examination shows presence of eggs
- Coproculture technique for further confirmation by identification of the larvae
- Clinical signs
- FAMACHA guide (guide to assess anemis)
- ImmunoDiagnosis by immunodominant defined antigen

Treatment

Fenbendazole, Albendazole, Mebendazole, Thisbendazole, Oxfenbendazole

Control

- Treatment of affected animals
- Regular deworming
- Restriction of animals from grazing on the infected pasture. Alternate grazing can be practiced
- Silage can be used as feed.
- Biological control by nematode
- Spray of urea solution to kill the larvae
- vaccination



Eggs of different internal Parasites

External Parasites/ Ectoparasites:

Ectoparasites live on the skin or hair for shelter and feed. Common ectoparasites are:

1. Lice
2. Fleas
3. Flies
4. Tick
5. Mite

Lice (order-Phthiraptera)

They are dorsoventrally flattened, wingless insects and divided into two suborder; Mallophaga and Anoplura. The lice are very strictly host specific. Mallophaga are biting lice as their mouth parts are not adapted to piercing skin of animals. The entire life cycle is spent on the host.The transmission is through body contact particularly under conditions of close confinement. Female lice feed and mate repeatedly and the eggs(nits) are laid and glued on the hairs of the host. The eggs hatch within 1-2 weeks to produce nymphs. They feed repeatedly and moult several times to became adult. Heavy infection cause irritation and loss of productivity in poultry. The effect of these lice on small and large ruminants are not usually severe. However, intense lousiness in sheep reduces market value of wool considerably.

Anoplura are sucking lice where the mouth parts are adapted for piercing host skin and suck blood. Anoplura do not occurs in the birds. They are also host specific and life cycle is same as that of Mallophaga. Heavy infection can accumulate on livestock leading to anaemia, biting stress and anorexis.

Control of Lice

Wide variety of insecticides and good management system. The insecticides like Lindane, Malathion etc. can be applied through dips, sprays, pour-on methods.

Fleas (Order-Aphaniptera)

Fleas are laterally flattened ectoparasites of animals and birds. They bear piercing and sucking mouth parts and undergo complete metemorphosis. They are not rigidly host specific.

The female lay very small ovoid eggs on the hairs. The eggs fall on the ground and hatch into larvae which are not parasitic. They undergo 2-3 moults, the last being within the cocoon. The fleas break out of the cocoon after moult and development. Life cycle complete in 3 weeks.

Control of Fleas: Same as lice. Flea larvae should be destroyed by spraying on the bed, cages and floor of the house.

Flies (Order-Diptera)

They are true flies, with only one pair of wing and the last pair of wing is modified into small balancing organs, the halters, or even completely wingless. The life cycle comprises egg, larva, pupa and adult. The midges, sand flies, buffalo gnats, louse flies, mosquitoes comes under flies.

Control of Flies: It varies for different families. The use of insecticide like synthetic pyrethroids as spray, pour-on or ear tag application may be useful for control.

Ticks

There are two types of ticks: 1) Hard Ticks and 2) Soft Ticks

Hard Ticks

The tick of this family have a hard shiny scutum or dorsal shield. The ticks differ from the mites by their larger size, leathery skin, armed hypostome and the presence of a pair of spiracles behind the coxae of the third or fourth pair of legs. The ticks are dorsoventrally flattened containing head or capitulum and fused thorax and abdomen called opisthosoma. Mouth parts consists of hypostome, chelicerae and pedipalpi.The life cycle comprises egg, larvae, nymph and adult.

Ticks injure their hosts mainly by 1) sucking blood 2) irritation on bites 3) serving as vector of bacterial, rickettsisl, viral and protozoal diseases 4) producing tick paralysis.

Soft Ticks

They are called soft ticks as they don't have a hard shiny scutum. However, they are extremely tough and the adult stages are adapted for survival in hot, dry conditions for long periods without food. Their life cycle and feeding patterns are different from hard ticks. In general, they feed on small blood meals repeatedly to support themselves during transition from one stage to next. Similarly, the adult females take repeated small blood meals to support the production of repeated small batches of eggs.

Control of Ticks

DDT, BHC are no longer used because of the development of resistance by the ticks and their varying toxicity. Now days, the synthetic pyrethroids and organophosphorous acaricides are widely used as dip, spray, pour-on, ear tag etc. Ivermectin injection is also available for the control of ticks and wide variety of parasites.

Mites

The members of the suborder Mesostigmata, Trombidiformes and Sarcopteformed under the order Acarina are called mites. Most of th e mites are free living. Parasitic mites are most frequently ectoparasites of skin and feathers but few are tissue invaders. The morphological features are similar to those of ticks. During metamorphosis mites usually pass through 4 stages; egg, larva, nymph and adult.

Control of Mites

The intradermal mites Sarcoptidae and Demodicidae are susceptible to a wide variety of acaricides. Systematic treatment such as an Ivermectin injection may be helpful. Sarcoptic mange in herds of cattle can be controlled by spraying conventional organophosphates. Repeat spraying after 1-2 weeks is necessary.

Summary

- Bacteria are prokaryotic, unicellular organisms containing DNA and ribosomes.
- Bacteria are divided into two major groups: Gram positive and Gram negative.
- Viruses are obligatory intracellular infectious agents of sizes ranging from 20 to 300 nanometer with an absolute dependence on living cells for their replication.
- A virus is a non cellular particle made up of genetic materisl and protein that can invade living cells.
- Viruses are smaller than bacteria; they range in size between 20-300 nanometer (nm). An organism which lives in or on other organism and get shelter and nourishment are called parasite.
- Parasitism is defined as an animal adaptation between two species in which one organism (the parasite) is dependent on another organism (the host) for its nutrition and survival for whole or part of its life.
- Parasites that live on the surface of host are called Ectoparasites (e.g. lice, mite). Parasites that live inside the host are called Endoparasites (e.g. Liver flukes etc.)
- Immunity is defined as the state of resistance or insusceptibility exhibited by the host to toxic molecules, microorganisms and foreign cells.
- Immunity may be natural (innate) or acquired. Innate Immunity is also known as native immunity.
- Resistance acquired by an individual during life is called acquired or specific immunity.

- The resistance that is induced in the recipient by transfer of preformed antibodies against infective agent or toxin in another host is called passive immunity.
- The resistance that is induced in the recipient by transfer of preformed antibodies against infective agent or toxin in another host is called passive immunity.

Glossary

Prokaryotes Cell: a cell lacking a true membrane-bound nucleus

Nanometer: one billionth of a meter.

Obligate parasite: A parasite that entirely depends upon a host for its nourishment, reproduction, habitat, and survival.

Heterotrophic organisms : dependent on absorption of organic carbon compounds from their habitat for their nutrition

saprobes : living on dead organic matter.

Exercise

A. Very Short Question.

1) What are bacteria?
2) What is a virus?
3) What is fungus?
4) Write the name of common internal parasites of livestock.
5) Write the name of common external parasites of livestock.

B. Short Question.

1) Draw well labeled disgram of bacteria.
2) Draw well labeled disgram of virus.
3) Differentiste bacteria and virus.
4) Explain the control measures of Fasciola and Paramphistomum.
5) Explain the control measures of common external parasites of livestock.

Unit Three

Pharmacology

Learning outcomes

After the completion of this unit students will able to:

- Define pharmacology.
- Explain the different drug, route of drug administration and antibiotics used in animal.
- Explain the poison and poisoning condition

Introduction

Pharmacology means science of drugs. It is derived from two Greek words, *Pharmakon* (drugs) and *logos* (study). The subject deals with all the aspects of study of drugs including, development, biological system interaction, therapeutics and toxicology of drugs. Pharmacology can be defined as the study of substances that interact with the living systems through chemical processes. Pharmacology is the knowledge of history, source, physical and chemical properties, compounding, biological and physiological effects, mechanism of action, absorption, distribution, biotransformation and excretion and therapeutic and other uses of drugs. Pharmacology is a science based upon an understanding of organic chemistry, biochemistry, physiology, pathology and microbiology. Veterinary pharmacology is defined as the science of substances used to prevent, Diagnosis and treatment of animal disease.

Pharmacokinetics is the study of drug absorption, distribution, biotransformation (metabolism), and excretion. Pharmacokinetic processes affect the route of administration, doses, dose intervals, and toxicities of drugs given to animals.

Pharmacodynamics is the study of cell/tissue responses and selective receptor effects.

Branches or types of pharmacology

1. Clinical pharmacology
2. Pharmacy

3. Therapeutics
4. Pharmacognosy
5. Chemotherapy
6. Pharmacogenetics
7. Posology
8. Toxicology

Table 3.1. Some abbrevistion used in pharmacology

Abbrevistions	**Meaning**
As	Before meal
Pc	After meal
Sid	Once a day
Bid	Twice a day
Tid	Three times a day
Gid	Four times a day
o.d	Every day
Gs	Sufficient quantity
Qr	Correct quantity
Sos	If necessary
Stat	Immedistely
Sig/s	Write on the lable
Haut	Drench

Route of drugs/medicines administration

Principles of drug administration

Once a drug has been dosed by any route other than IV, it must be absorbed into the blood stream from the site of administration. The drug then is distributed into various body fluids and tissues to attain an effective, safe, concentration of the drug for a sufficient period of time at the site of action. Subsequently, the drug is inactivated or eliminated from the body, generally by metabolism and excretion (mainly renal and bilisry routes).

Drugs can be administered through a variety of routes. The choice of Appropriate route in a given situation depends on drugs as well as animal patient related factors. There are three factors which decide the route of drugs administration, they are physio-chemical properties of the drug, the disease and the condition of the animal patient.

The main routes of drugs administration are:

1. Enteral :- oral, sub-lingual, rectal
2. Parenteral :- I/v, I/M, S.C
3. Topical or external
4. Inhalation

1. Enteral route/ administration

- Preferred route of administration by most of the patient.
- More extensive metabolism by liver
- Varisble absorption

b. Oral administration

- Common route of drugs administration.
- Safe and painless.
- No need to sterilization.
- Convenient route because drugs can be given in the form of tablets, bolus etc.

c. Sub-lingual administration

- Some of the drugs, which are usually highly lipid soluble get rapidly absorbed from the sub-lingual and buccal mucosa.

d. Rectal administration

- A drug is administered in the form of a rectal suppository (Retained form).

1. Parenteral route/ administration

The term parenteral administration is often used in a restricted sense to including the drug administration by injections like I/V, I/M, S/C.

a. Intravenous (I/V routes)

- Drugs are injected though nerves.

b. Intramuscular (I/M routes)

- Drugs are injected through muscles.

c. Sub-cutaneous (S/C routes)

- Drugs are injected through under the skin.

Some others routes/administrations are

a. Intradermal route

- Drugs are given within the skin layers (dermis).
- Used for testing the hypersensitivity of drugs.

b. Intra cardisc route

- Drugs are directly injected through the heart muscles.

c. Intramedullary route

- Drugs are injected through in medullary cavity of the bone.

d. Intramammary route

- Drugs are injected in the mammary gland canal (in case of mastitis).

e. Intrauterine route

- Drugs are injected directly though the uterus in uterine infection.

2. Tropical or external administration

Drugs are administered through this route generally affects to the part to which they are applied externally. External route drugs are solution, ointment, suppositories and powders.

3. Inhalation route/administration

Some drugs are gaseous in nature or volatile liquid are administered by inhalation. They are administered both for systemic and local affects.

Antibiotics

Antibiotics are chemical substances produced by several microorganisms (bacteria, fungi, actinomycetes) that suppress the growth of other microorganisms and eventually destroy them. But common uses often extends the term antibiotics to include synthetic antibacterial/antimicrobial agent.

Antimicrobial agents

These are substances having antimicrobial property but they may or may not be microbial origin.

Spectrum of action

Broad spectrum

Affects wide range of microorganisms including some but probably not all Gram positive and Gram negative bacteria. Some antimicrobial agents may also extend to Mycoplasma and blood protozoans. Example: Tetracycline, Enrofloxacin etc.

Narrow spectrum

Affects narrow range of microorganisms that is either against Gram positive or Gram negative organisms only. Example : Benzylpenicillin against Gram positive and Mecillinam against Gram negative bacteria.

Limited spectrum

Effective only against certain microorganisms.

Factors affecting dosage of drugs

Factors affecting dosage of drugs are:

Species

Even within species, there is size varistion.

Acidic PH of rumen acts as reservoir for basic drugs. e.g. alkaloids,

Cats are deficient in hepatic glucuronyl transferase and thus drugs or, their metabolites which are inactivated by glucuronidation, can be either toxin or , long acting for species.

Age

Drugs tend to produce greater and more pronounced effect at the extremes of age (some exceptions). The main reason that affects drugs action is that drugs metabolism and renal function are less efficient, in very young and adult animals.

Sex

Females: less rapidly metabolism occurs , so there is relatively longer duration of action . Lipid soluble drugs are largely accumulate in female due to the presence of much body fat.

Male: drugs are rapidly metabolized because of testosterone predominance, so there is less duration of drugs action.

Time varistion

Genetics factors

Pathological factors

Environmental factors

Therapeutics factors

Route of drugs administration.

Frequency of drugs administration.

Drug-drug interaction.

Pharmaceutical factors.

Poisoning

A **poison** is any substance that is harmful to the body. The effects of **poisoning** range from short-term illness to brain damage, coma, and deathA toxic agent is referred to as a toxicant or poison. The term **toxin** refers to a poison produced by a biologic source (eg, venoms, plant toxins); the redundant term biotoxin is occasionally used. **Toxicosis**, **poisoning**, and **intoxication** are synonymous terms for the disease produced by a toxicant. **Toxicity** (sometimes incorrectly used instead of poisoning) refers to the amount of a toxicant necessary to produce a detrimental effect.

Acute toxicosis refers to effects during the first 24-hr period. Effects produced by prolonged exposure (≥3 mo) are referred to as **chronic toxicosis**. Terms such as subacute and subchronic are used to cover the large gap between acute and chronic.

All toxic effects are dose dependent. A dose may cause undetectable, therapeutic, toxic, or lethal effects. A dose is expressed as the amount of compound per unit of body weight, and toxicant concentration as part per million or part per billion. These quantitative expressions are also used for feedstuffs, water, and air, as well as for tissue levels.

LD50 is the dose that has been found lethal to 50% of a test sample. It is an estimator of lethality and the most common expression used to rate the potency of toxicants. Other terms used for prediction of illness or lethality include no observed effect level (NOEL), maximum nontoxic dose (MNTD), and maximum tolerated dose or minimum toxic dose (MTD).

Table 3.2.Toxic condition of different poison

Poison e.g.(toxic dose) Toxicokinetics	**Mechanism of action**	**Important clinical sign and pathological lesion**	**Antidote**
Arsenic e.g.Arsenic trioxide, CCA, sodium arsenate	Trivalent form – bind to sulphydryl that inactivate lipoic acid then inhibit formation of acetyl, succinyl, and propionyl coenzymes i.e. inhibit glycosis and TCA Pentavalent form-competitive inhibition of oxidative phosphorylation	Abdominal pain, nausea, vomiting, garlic odour, metallic taste, bloody Diarrhoea, headache, dizziness, drowsiness, weakness, lethargy, delirium, shock, kidney insufficiency, neuropathy, sitting dog posture	Dimercapol/british anti lewisite LA-3,SA -2.5 Thioctic acid 50mg Na-Thiosulphate20-30 Emetic, activated charcoal, gastric lavage correction of shock animals kept at warm sufficient vit and antibiotic
Cyanide		**muscle tremors, difficult, rapid respiration** and **convulsions**	
Mercury organic (fungicide) Methyl mercury	Affinity to combine with sulphydryl or disulphide group and others in a sequence of SH>$CONH_2$ >NH_2>COOH>PO_4 which inhibit protein synthesis.	Metallic taste, paresthesiss, tremor, headache, weakness, delirium, ataxis, visual changes, dermatitis, renal dysfunction	
Copper	Excess amount in liver damage hepatocytes which inhibit essentisl metabolic enzymes Excess amount in blood oxidized haemoglobin to methaemoglobin.	Abdominal pain, vomiting, skin/airway/mucous membrane irritation, renal dysfunction, coma	

Lead	Inhibit sulphydryl group, δ-amine levonillic acid, glucose 6-phosphate, AchE.		
Nitrate/nitrite	Nitrite convert haemoglobin to methaemoglobin by oxidation of ferrous(Fe^{++})to ferric Hb (Fe^{+++})which can't carry oxygen Relax vascular smooth muscles leads to intracellular conversion to the reactive free radicles (NO) which activate guanylate cyclase ↑cyclic GMP Leads to dephosphorylation of myosin light chain.	**trembling, staggering, rapid breathing**, and **death**. Chronic poisoning may result in **poor growth, poor milk production** and **abortions**. In cattle, there is evidence that vitamin A storage is affected.	
Selenium	Abnormal synthesis of protein and enzymes by replacing sulphur of amino acids. Decreases ATP synthesis by inhibition of SH- containing enzymes. Reduction in the t/s glutathione (GSH)due to competition between selenium and sulphur Tissue ascorbic acid decreases because of oxidation by ascorbic oxidases.	**dullness, stiffness of joints, lameness, loss of hair from mane or tail and hoof deformities**. The acute form of poisoning is often called **"blind staggers"**.	
Common salt	Acts as saline purgative and withdraw of water from surrounding t/s result Diarrhoea In blood shrink capillary vascular endothelium in brain , meninges result ↑ capillary permeability water escape out into Interstitial space causes oedema, ascities, hydrothorax		
Fluorosis	Highly irritant result severe gastroenteritis ↑permeability and coagulatory defect Inhibit preglycolytic , phosphatases and cholinesterase result inhibit Glycolysis and ↑sensitivity of Ach Improper mineralization of teeth.		

organochlorine	OC are non specific CNS stimulant so no competitive antagonist Diphenyl aliphatic OC enter into neural membrane interfere with Na- K channel i.e. Na-K imbalance (↑Na influx and inhinition K ion) ↑RMP and neuronal excitation. Cyclodene compound binds with GABA receptor result Cl ion dysfunction may leads uncontrol excitation.	Behavioral apprehension aggressiveness abnormal posture wall climbing cholinergic nausea, vomiting salivation (ropy) urination , brady or tachycardis Neuronal excitability, dizziness, headache, restlessness, tremors, convulsions, coma, , confusion, cardisc arrhythmiss, acidosis Locomotory stiff gait and walking on tiptoes , ataxis	
Organophosphorous (insecticides) Malathion, parathion, dichlorvos, chlorpyrifos (1mg-80mg/kg bw) A Skin lung GI tract D body (no accumulation in t/s) M (op + esterase → op water soluble) E vis urine	OP binds with esteratic site of AchE.Irreversible inhibition of AchE resultaccumulation at nerves junction , smooyh m/s glands which show overstimulation of muscarinic and nicotinic receptor.	Parasympathetic sign Headache, dizziness, bradycardis, weakness, anxiety, excessive sweating, fasciculations, vomiting, Diarrhoea, abdominal cramps, dyspnea, miosis, paralysis, salivation, tearing, ataxis, pulmonary oedema, confusion, acetylcholinesterase inhibition	Atropine sulphate (0.2-0.5mg/kg bw) ¼ iv and rest im Suppurative therapy(control convulsion by diszepam)
Carbamate e.g. aldicarp, isocarp (307mg/kgbw) A Skin lung GI tract D throughout body (no accumulation in t/s) Livermicrosomal enzyme break down	CAR binds both anionic and esteratic site of AchE so reversible inhibitors of AchE	Malaise, weakness, dizziness, sweating, headache, salivation, nausea, vomiting, Diarrhoea, abdominal pain, confusion, dyspnea, dermatitis, pulmonary oedema	Atropine sulphate (antimuscarinic drug) Suppurative therapy(control convulsion by diszepam) 2-PAM not effective
Phosphorous	Yellow phosphorous is a protoplasmic poison. Acts as strong irritant and corrosive nature so necrotized stomach mucosa and direct cardiotoxic effect.		
Strychnine (nuxvoica poisoning)		Muscle rigidity, opisthotonus, rhabdomyolysis	

(rodenticide) Strychnine			
Synthetic pyrethroid pesticides		Allergic reactions, anaphylaxis, dermatitis, paresthesiss, wheezing, seizures, coma, pulmonary oedema, Diarrhoea, abdominal pain	
Thalium		Abdominal pain, nausea, vomiting, bloody Diarrhoea, headache, weakness, liver injury, hair loss, paresthesiss, neuropathy, encephalopathy, cardisc failure	
Phenol		Skin, airway, and mucous membrane irritation, contact dermatitis, dyspnea, disphoreses, urticaris, tachycardis, headache, abdominal pain, fever, tremor	
Lantana (*lantana camera* plant)			
Rathi(Abrus poisoining)			
Ergot		**dry gangrene in the extremities, possible abortion in pregnant animals and death , lack of appetite, dullness, abdominal pain, and subnormal temperature**	
Warfarin		Echymoses, epistaxis, excessive bleeding, haematuris, prolonged prothrombin time, intracranisl bleed, anaemia, fatigue, dyspnea	

Unit Four
Anatomy and Physiology

Learning outcomes

After the completion of this unit, the students will able to:

- Define anatomy and physiology.
- Explain the cell type, tissue type and different organ involved in different body system
- Explain the anatomical structure of different animal.
- Demonstrate to understand the process of body working mechanism.

Introduction

Anatomy is the branch of biological sciences which deals with the structure and form of organism. It is derived from two Greek words, *ana* means apart and *tomy* means to cut. It includes the study of shape, weight, color, texture, and relative position of various organs and tissues of the organisms when they are in a state of normal health. Anatomy started some 300 years ago when a Greek scientists Herophilus first conducted a post mortem on a human body.Herophilus is now called Father of anatomy.Tissues of one organism is made up of a group of cell , a group of tissue make an organ,a group of organs make a system and group of system make a human body.

Function of anatomy

- Anatomy gives an idea about form, shape, structure and relative position of various organ and tissues comprising abnormal and healthy body.
- Anatomy helps us to understand the function of various parts, their correlation and coordination and their physical and functional relationship.
- When normal shape, structure and function are known, a deviation from this normal can be recognized with great ease. Thus, it helps in the Diagnosis and recognisation of diseases.
- Anatomy helps to give knowledge about collection of sample for the definite Diagnosis.

Branch of anatomy

There are various brances of anatomy , they are :

Gross Anatomy: It is the study of structures that can be dissected and observed with the naked eye.

Histology :It is the study of minute structures too small to be seen without a microscope.

Cytology :It is the study of minute structures in even greater detail, with the help of an electron microscope.

Morbid Anatomy :It is the study of diseased structures of an organism. **Applied Anatomy** :It is the practical application of a normal structural study in relation to Diagnosis and treatment of pathology or surgical condition. **Developmental Anatomy** :It is the study of the development of an individual from the zygote to adult.

Embryology :It is the study of structure from fertilized egg to birth. **Comparative Anatomy** :It is the study of comparison of the structures of animals and it form the basis of their classification.

Specisl Anatomy :It is the description of structure and form of a single type or specie e.g. hippotomy (anatomy of horse).

Veterinary Anatomy :It is the study of structure and form of domesticated animals e.g. horse, ox, dog, sheep, goat, and poultry birds.

Method of study of anatomy

There are basically two methods of study of anatomy.

1. Systemic Study
2. Topographic Study

Systemic Study

In this approach, the body is regarded as a consisting of different organs which are similar in origin and structure and are associsted in the performance of certain functions.

Divisions of Systemic Anatomy

Osteology

1. It deals with the components of skeleton.
2. Arthrology :The description of the Joints.
3. Myology : The description of the muscles.
4. Spanchnology : The description of the Viscera. This includes the following subdivisions of the soft organs of the body:-

   Digestive System. Respiratory System, Urinary System , Genital System (Reproductive System)
5. Angiology : The description of the organs of circulation.
6. Neurology : The description of the nervous system
7. Esthesiology : The description of the sense organs and com

Topographic Terms

Following are some specisl terms which are usually employed in anatomical study. There is assumed that the animal is in a standing position.

Dorsal / Superior: relatively nearer to the top of head, body, back of neck, trunk or tail.

Ventral / Inferior: towards or relatively nearer to the underside of the head or body.

Medisl: toward or relatively nearer to the medisn plane.

Lateral: relatively away from the medisn plane.

Cranisl / Anterior: toward or relatively nearer to the head.

Caudal / Posterior: toward or relatively nearer to the tail.

Rostral: relatively nearer to the nose; applies to the head only.

Oral: towards the oral cavity.

Aboral: away from the oral cavity.

Internal / Inner: close to, or in the direction of, the cavity of a hollow organ.

External / Outer: away from the center of a hollow organ.

Superficisl: relatively nearer to the surface of a body, or a solid organ.

Deep: relatively nearer to the center of a body or solid organ.

Proximal: relatively nearer to the main mass of the body or trunk.

Distal: away from the main mass of the body or trunk.

Radisl and Tibisl: denote the medisl sides of the forelimb and hind limb in which the radius and tibisl are located respectively.

Ulnar and Fibular: denote the lateral sides of the forelimb and hind limb in which the ulna and fibula are located respectively.

Volar and Palmer: denote caudal aspect of the forepaw on which the pads are located.

Planter: denotes caudal aspect of the hindpaw on which the pads are located.

Axis: the central line of a body or any of its parts.

Axisl: relatively nearer to the axis.

Abaxisl: away from the axis of a body or part.

Different tissue of animal body

Tissue

All living organisms are made up of cells. Some organisms are unicellular and multicellular . Cells having similar in structure, origin and functions are termed as tissues. e.g., muscle, nerve

Four Basic Types of Tissue

Types of animal tissues

There are four main types of animal tissues:

A. Epithelial tissue

B. Connective tissue

C. Muscular tissue

D. Nervous tissue

A. Epithelial tissue

Epithelial tissues is a sheet of cells that covers a body surface as well as the various internal organs and body spaces inside. The cells are held together by intercellular substances.

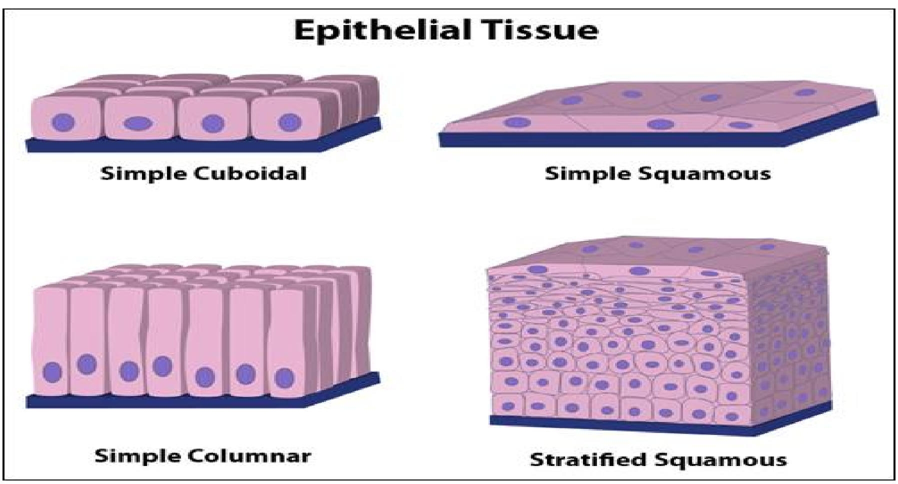
Types of Epithelial tissue

On the basis of their structures and functions epithelial tissue are classified into three types:

A. **Simple :** The epithelial cells are arranged in single layers.

B. **Stratified :** The epithelial cells are arranged in multiple layers.

C. **Specislized :** Some epithelial cells become specislized for certain other function.



Epithelial tissues

Functions of epithelial cells includ

- Movement of materisls in, out, or around the body.
- protection of the internal environment against the external environment.
- Secretion of a product.

Glands can be single epithelial cells, such as the goblet cells that line the intestine. Multicellular glands include the endocrine glands. Many animals have their skin composed of epithelium. Vertebrates have keratin in their skin cells to reduce water loss. Many other animals secrete mucus or other materisls from their skin,

B. Connective tissue

Connective tissues bind different types of cells or tissues together in an organ. These are developed from mesoderm. Connective tissues consist of different kind of cells and fibers. These tissues constitute about 30% of the body and has a large amount of non-living intercellular substance known as matrix.

Functions

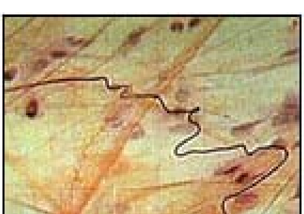
- Provides mechanical support.
- Provides place for metabolite exchange.
- Provides place for energy storage.
- Provides place for inflammation.
- Provides place for fibrosis – healing.

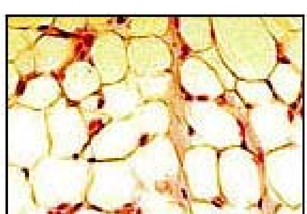
Types of connective tissues

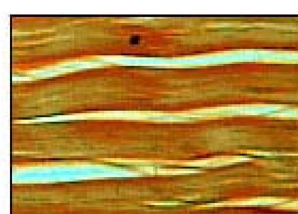
1. Proper connective
2. Skeletal
3. Fluid (Blood and Lymph)

1. Proper connective

Connective tissue proper is made up of soft matrix which is of various types, made from different tissue. The tissues consists of a jelly like substance and white collagen fibers or yellow elastic fibers or both together with the cells. These fibers formed by fibroblasts.


Areolar connective tissue


Adipose tissue


Fibrous connective tissue

Connective tissues

(A) Areolar Tissue

This tissue is most widely distributed connective tissue in the animal body.

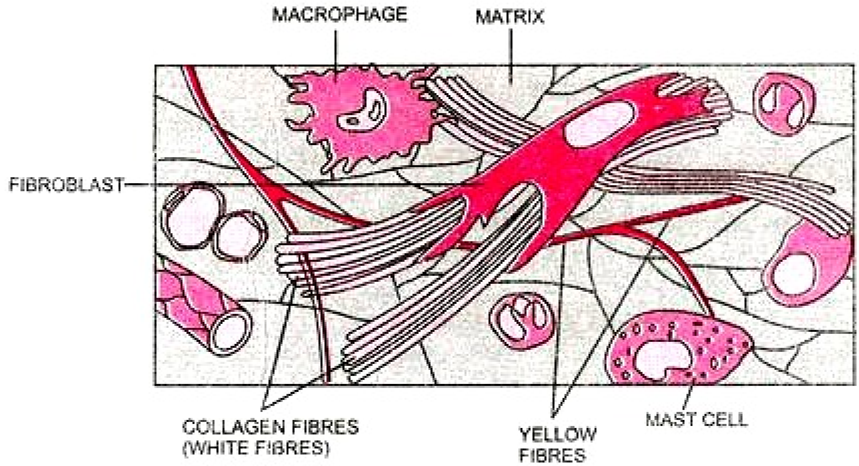


Fig. 7.15. Areolar tissue

Areolar Tissues

Structure

Areolar tissues is named so because it takes the form of fine threads crossing each other in every direction leaving small spaces called areolae.

The areolar tissue consists of ground substance, the matrix, white, yellow and reticular fibres and cells like fibroblasts, mast cells, macrophages (histocytes or clasmatocytes), lymphocytes, plasma cells, mesenchyme cells, chromatophores.

Fat cells can be seen in small groups. Description of matrix, fibres and cells has already been given in the general structure of connective tissue.

Location

As stated earlier, the areolar tissue is the most widely distributed connective tissue in the body. It is present under the skin as subcutaneous tissue in between and around muscles, nerves and blood vessels in sub-mucosa of gastrointestinal tract and respiratory tract, in the bone marrow, between the lobes and lobules of compound glands and in mesenteries and omenta.

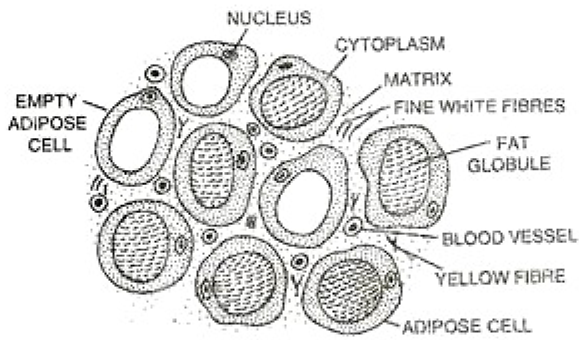
It also forms the internal frame work (stroma) of many solid organs. In fact in nearly all organs.

Functions

To bind parts together is the primary function of areolar tissue. Other functions are to provide strength, elasticity, support to the parts where this tissue is present. It also provides rapid diffusion of materisls and migration of wandering cells towards areas of infection and repair.

(B) Adipose Tissue

It is a fat storing connective tissue.



Adipose tissues

Structure

The adipose tissue consists of several spherical or oval adipose cells. Each adipose cell contains fat globules, due to which the nucleus and the cytoplasm are displaced to the periphery.

These cells are often called signet ring cells because they resemble a signet ring when seen in cross section. There are two types of adipose tissue: white (or yellow) fat and brown fat. White fat contains large adipose cells, each having a single large fat globule and hence, called monolocular.

The cytoplasm in these cells is pushed to a peripheral layer containing nucleus. The adipose cells of brown fat are multilocular, each cell with several small fat globules. Brown colour is due to iron containing cytochrome pigment in fat.

Brown fat is found in those mammals which have an oxidation power 20 times more than that of yellow fat because brown fat cells are loaded with a large number of mitochondris.

Brown fat is found in hibernating mammals such as rats and other rodents and in new born human babies. The fibres are few in number and form a loose network for supporting the fat laden cells. If these cells are treated with alcohol, the fatty substance is dissolved and the cells become vacuolated.

Location

The adipose tissues are found in the subcutaneous tissue, around the heart, kidneys, eyeballs, mesenteries and omenta, where fat is stored. Adipose tissue is also found in the blubber of whales and elephants, hump of camel, fat bodies of frog and yellow bone marrow.

Functions

The adipose tissue is chiefly a food reserve or 'fat depot' for storage. The sub cutaneous fat prevents heat loss from the body and also rounds off the body contour.

It forms a shock-absorbing cushion around the eye balls and kidneys. It also provides support and protection. This tissue also helps in the production of blood corpuscles. We gain weight when our body cells accumulate fat globules. Excessive accumulation of fat is called adiposis.

(C) White Fibrous Connective Tissue

It consists of mainly white (collagen) fibres which are arranged in bundles. The fibroblasts are present in rows between the bundles.

(i) White Fibrous Cords (Tendons)

The white fibrous connective tissue forms cords called tendons which connect the skeletal muscles with the bones.

(ii) White Fibrous Sheets

White fibrous connective tissue also forms flat plates or sheets. It occurs in the dermis of the skin, connective tissue sheaths of muscles and nerves and tunica adventitis (outer coat) of large blood vessel, periosteum of the bone, perichondrium of the cartilage, pericardium of the heart, dismeter of the brain and spinal cord, renal capsule of the kidney, sclera and cornea of the eye ball and fibrous capsules of penis and testes and between skull bones.

White fibrous connective tissue has great strength, however, its flexibility is limited. The presence of white fibrous tissue at the joints between skull bones makes them immovable. Due to presence of abundant white fibres, the skin dermis of large mammals yields leather after chemical treatment called tanning.

(D) Yellow Elastic Connective Tissue

This tissue is mainly made up of much thicker branched loose network of yellow fibres. The white fibres are also present but they are very fine. The fibroblasts are irregularly scattered. It also contains mast cells, macrophages and often some adipose cells.

(i) Yellow Fibrous Cords (Ligaments)

The yellow elastic connective tissue forms cords called ligaments which join bones to bones.

(ii) Yellow Fibrous Sheets

The sheets formed by this tissue occur in the walls of blood vessels, lungs, bronchioles, true vocal cords, cartilage of larynx, trachea, capsules of spleen and ligamenta flava which connect adjacent vertebrate.

Yellow Elastic Connective tissue has considerable strength and remarkable elasticity.

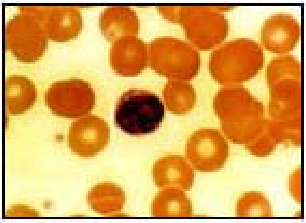
Thus it allows stretching of various organs.

Many years old 'mummies' still have their arteries intact due to well preserved elastic fibres.

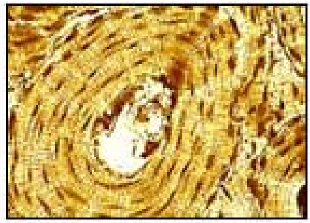
Sprain is caused by excessive pulling (stretching) of ligaments.

(2) Skeletal Tissues

These connective tissues form the endoskeleton of the vertebrates. Hard parts of the body constitute skeleton. These support the body, protect the various organs and help in locomotion. Skeletal tissues include cartilage and bone.



Blood



Osseous tissue

Hyaline cartilage

Skeletal tissues

1. Cartilage (Gristle)

Cartilage is a soft skeletal tissue. It is not rigid like bone. It is found more abundantly in vertebrate embryos because most of the bones forming skeleton of the adult are cartilaginous in the early stage. However, it is commonly found in the body of adult vertebrates.

Structure of Cartilage

A typical (generalized) cartilage consists of the following parts:

(i) Cartilage Cells

A cartilage cell is present in a fluid filled space, the cartilage lacuna (pi. lacunae), which affects the shape of the cell. Young cartilage cells are relatively small, often flattened with many small surface projections (filopodis) and are called chondroblasts (this term is also used for embryonic cartilage producing cells).

Mature cells are larger in size (these cells increase in size with age), more rounded, but still have a few surface projections and are known as chondrocyres. The chondrocytes are metabolically more active cells than chondrocytes.

(ii) Ground Substance (Matrix)

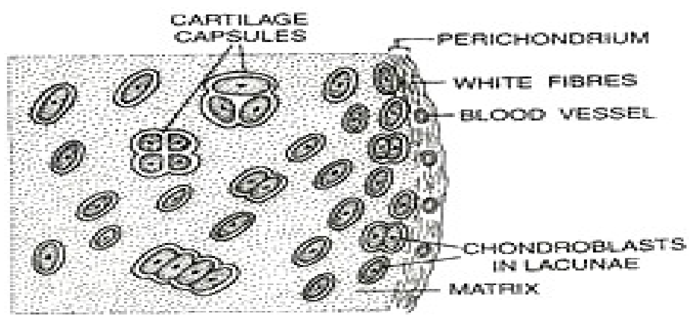
It consists essentislly of water, proteoglycans (proteins and carbohydrates), some lipid, collagen, non-collagenous protein, and collagen fibres. The core protein (mucoprotein) is aggrecan. The carbohydrates are chemically glycosaminoglycan's (GAG). They include chondroitin sulphate, keratin sulphate and hyaluronic acid. Keratin sulphate increases with maturity. These molecules form a firm gel that gives firm consistency to the ground substance of the cartilage. A gelatin like substance obtained from cartilage by boiling is called chondrin. The free surfaces of hyaline cartilage (to be described later) are covered by a fibrous membrane called the perichondrium but it is not present in fibrous cartilage. The perichondrium contains blood vessels. Cartilage is usually described as an avascular (without blood supply) tissue but it is not true. There are present cartilage canals, through which blood vessels may enter cartilage. Cartilage cells receive their nutrition by diffusion from blood vessels in the perichondrium or in cartilage canals. Cartilage canals may play a role in the ossification (formation of bones) of cartilage by carrying bone forming cells. The cartilage always grows from the periphery (unidirectional).

Types of Cartilages

The cartilages are of three types

a) Hyaline Cartilage

It contains clear, large amount of translucent, slightly elastic matrix with less fibres. The matrix often has very fine white fibres which are difficult to observe. It is most prevalent cartilage. It forms articular surfaces at the joints of long bones called articular cartilage.



Hyaline cartilage

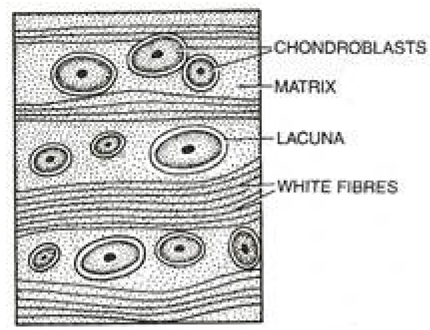
This cartilage forms rings of trachea and bronchi, sternal parts of ribs (costal cartilages), hyoid apparatus, nasal septum and also part of larynx. Most of the embryonic skeleton consists of hyaline cartilage. Hyaline cartilage forms the skeleton of elasmobranch fishes (cartilaginous fishes) and the embryonic skeleton in bony vertebrates.

(b) Fibrous Cartilage

It has well developed fibres in the matrix. It is of two types: White fibrous cartilage and yellow elastic fibrocartilage.

(i) White Fibrous Cartilage or White Fibrocartilage

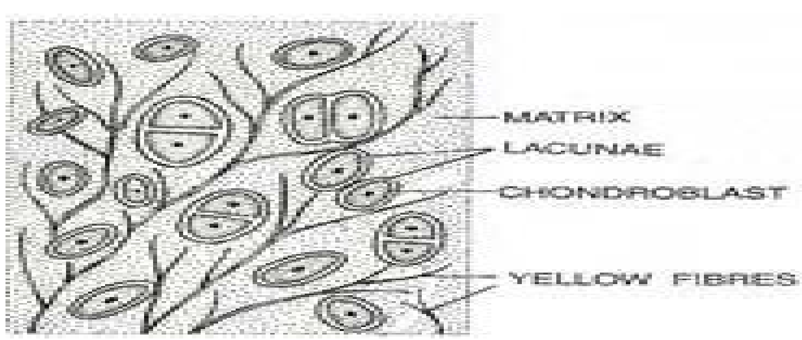
The matrix is firm and has abundant white fibres. It occurs in the intervertebral discs where it acts as cushion and in the pubic symphysis (region between the two pubic bones of the pelvic girdle) where it helps in parturition (process of birth). White fibrous cartilage is the strongest cartilage.



White fibrous tissues

(ii) Yellow Elastic Fibrocartilage

The matrix contains numerous yellow fibres which form a network by uniting with one another. Due to the presence of yellow fibres, the cartilage becomes more flexible. This type of cartilage is found in the pinna and external auditory canal of the ear, Eustachisn tubes, epiglottis and tip of the nose. It makes these organs flexible.



Yellow elastic fibrocartilage

(c) Calcified Cartilage

Sometimes matrix contains granules of calcium carbonate, this cartilage is called calcified cartilage. Calcium carbonate makes the cartilage hard and inelastic. This cartilage is found in supra scapula of pectoral girdle of frog and vertebrae of shark.

2. Bone

Bone is the hardest tissue in the body and supports various organs. The matrix is tough containing both inorganic and organic substances. The inorganic salts present in the matrix are calcium phosphate, calcium carbonate, calcium fluoride, magnesium phosphate, etc.

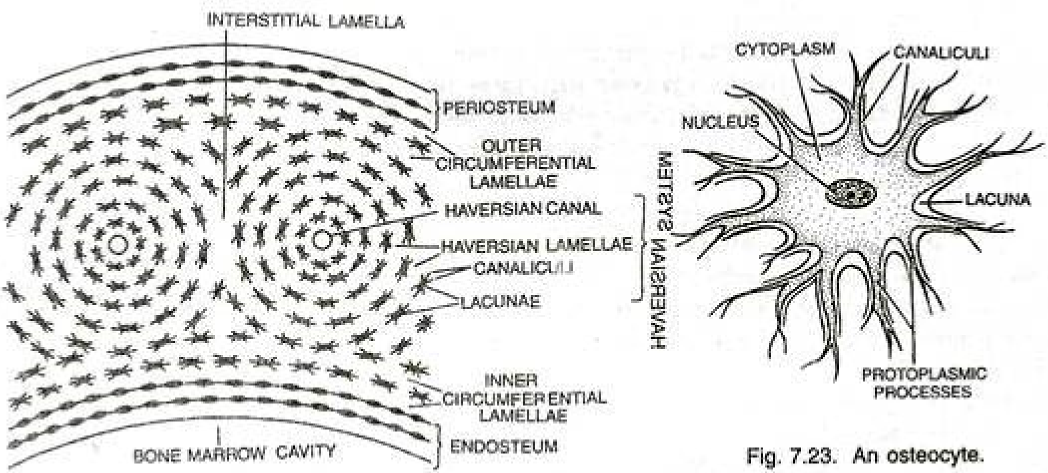
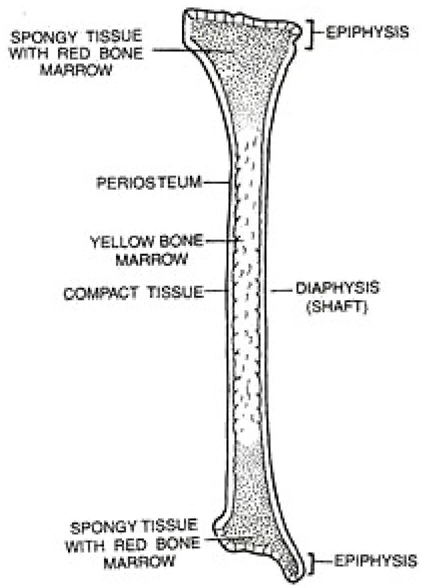


Fig. 7.23. An osteocyte.

If a bone is dried, its organic matter (living matter) is destroyed and inorganic part is left behind. On the other hand if a bone is kept in a dilute HCL for some time, its inorganic part is dissolved and organic part is left behind.

Such a bone is called decalcified bone. Study of a dried bone shows its inorganic matter, while that of a decalcified bone reveals the animal matter. Thus bone may be studied in two forms: decalcified and dried.



Microscopic Structure of Decalcified Mammalian Bone

It consists of four parts: periosteum, matrix, endosteum and bone marrow.

(a) Periosteum

It is a thick and tough sheath that forms an envelope around the bone. It is composed of collagen (white) fibrous tissue. Bundles of periosteal collagen fibres, called Sharpey's fibres, penetrate the bone matrix to provide a firm connection between the two. The periosteum contains blood vessels. The periosteum also contains bone-forming cells called the osteoblasts which produce new bone materisl.

(b) Matrix

It is composed of a protein called ossein. The main salts found in the matrix are calcium phosphate, calcium carbonate, sodium chloride and magnesium phosphate. Of these, calcium phosphate is maximum in the vertebrate bone.

The Haversisn canals, a characteristic feature of the mammalian bones, are present in the matrix. Each Haversisn canal contains an artery, a vein, a lymph vessel, a nerve and some bone cells, all packed in with connective tissue. The Haversisn canals are interconnected by transverse channels, the Volkmann's canals.

The matrix has numerous inactive bone cells, the osteocytes. The latter contain reduced numbers of cell organelles and often store glycogen. An osteocyte is surrounded by a fluid-filled space, the bone lacuna, which leads into fine radisting channels, the canaliculi (minute canals).

In the developing bone, the osteocytes give off several projections called protoplasmic processes (filopodis) which extend through the canaliculi. With the help of canaliculi and protoplasmic processes one osteocyte is in contact with another osteocyte. The matrix of the bone occurs as layers called lamellae.

The lamellae are of four types:

(a) Haversisn lamellae

These lamellae occur around the Haversisn canals. A Haversisn canal with its surrounding lamellae and osteocytes constitute a cylindrical unit of bone called Haversisn system or osteon.

Haversisn systems are absent in spongy bones of mammals

(b) Interstitial lamellae

These lamellae occur between the Haversisn systems,

(c) Outer circumferentisl lamellae (outer concentric lamellae)

These lamellae occur inner to periosteum,

(d) Inner circumferentisl lamellae (inner concentric lamellae)

These lamellae occur outer to endosteum.

(C) Endosteum

It is present outside the bone marrow cavity. Like the periosteum, it comprises white fibrous tissue and osteoblasts (bone forming cells). But the white fibrous tissue is present here inner to osteoblasts. The long bone thus grows in thickness from two sides. This type of growth is called bidirectional growth.

(d) Bone Marrow

In long bones such as limb bones (humerus, femur, etc.) a cavity called bone marrow cavity is present inside the endosteum. The bone marrow cavity is filled with a soft and semisolid fatty neurovascular tissue termed as bone marrow. In fact bone marrow is a specisl kind of tissue which is called myelogenous or myeloid tissue.

Types of Bone Marrow

There are two types of bone marrows:

(a) Red bone marrow

It is red due to abundant blood vessels. It is present in the spongy parts of the bones (e.g., epiphyses). It produces red blood corpuscles, white blood corpuscles (monocytes, eosinophil's, basophils and neutrophils) and platelets,

(b) Yellow bone marrow

It is present in the shafts of long bones. It is yellow in colour and has much fatty tissue. It produces blood corpuscles in emergency, i.e., at the time of excessive loss of blood; when it changes into red bone marrow.

During foetal life and at birth there is red bone marrow throughout the skeleton. After about the fifth year the red bone marrow is gradually replaced in the long bones by yellow bone marrow.

By 20 to 25 years the red bone marrow persists only in the vertebrae, sternum, ribs, clavicles, scapulae, pelvis, cranisl bones and in the proximal ends of femora (pi. of femur) and humeri (pi. of humerus). In old age the bone marrow of the cranisl bones undergo degeneration and is then called gelatinous marrow.

Types of Bone

On the basis of its texture, a bone is of two types: compact and spongy (cancellate).

(i) Compact (Dense) Bone

It is comparatively hard and compact. It is found in the shaft of long bones. It contains yellow bone marrow and has Haversisn systems.

(ii) Spongy (Cancellate) Bone

It consists of a network of thin and irregularly longitudinal and tranverse bony bars called trabeculae covered by the endosteum. It is found at the ends of long bones (epiphyses). Spongy bone contains red bone marrow but it is without Haversisn systems.

Types of Bones

According to their source of formation, there are four types of bones:

(i) Cartilaginous or Replacing Bones

These bones develop from the pre-existing cartilage and practically replace the cartilage. Examples: humerus, femur.

(ii) Investing or Dermal or Membrane Bones

These bones develop in the dermis of the skin as thin plates and sink to get attached over the original cartilaginous endoskeleton. In fact these bones become invested upon original cartilages hence their name. Examples: frontal, nasals, vomers and parietals of the skull.

(iii) Sesamoid Bones

These bones are formed in the tendons at the joints. Example: patella (knee-cap).

(iv) Visceral Bones

These are formed in the soft organs (viscera). Examples: os cordis in the heart of some ruminants (e.g., deer), os penis in the penis of most bats, insectivores, rodents (e.g., rats), carnivores (e.g., dog, walrus), whales, some primates (not man), os clitoris in the clitoris of many carnivores, and os palpebrae in the eyelids of crocodiles.

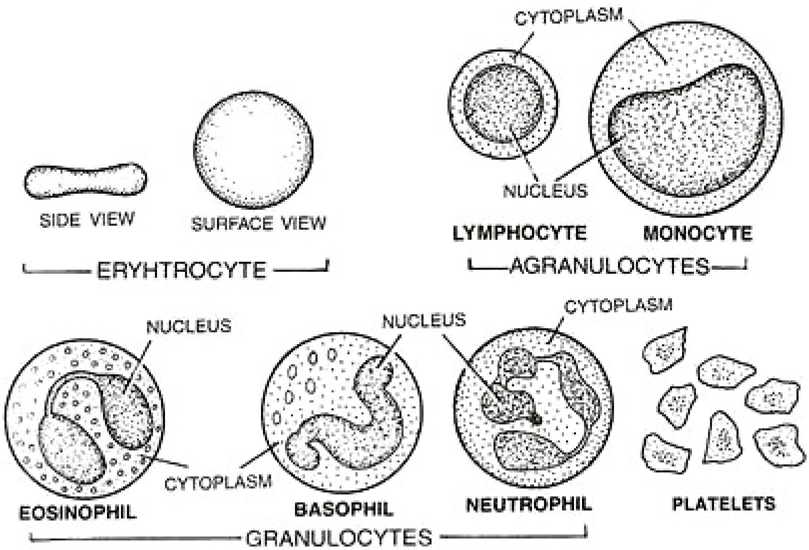
A small bone also develops in the crest of a bird and snout of a hog. Bone acts as a reservoir for ion like calcium, magnesium and phosphorus.

3. Fluid (Blood and Lymph)

I. Blood

Blood is a mobile connective tissue composed of a fluid, the plasma and the cells and the blood corpuscles. Blood is a basis of life. Blood is the softest tissues in the body.

Fluids outside the cells are generally called extracellular fluids (ECF). Blood forms about 30-35 percent of the ECF. The volume of blood in an adult person of 70 kg weight is about 5.5 litres. It is a slightly alkaline fluid having pH 7.4. pH of blood in arteries is more than in veins.



Composition

As stated above blood is composed of a watery fluid called plasma and floating bodies termed formed elements {e.g., blood corpuscles).

(A) Plasma

It is slightly alkaline non-living intercellular substance which constitutes about 55% of the blood. It is a pale yellow but transparent and clear fluid.

Composition of Plasma

1. Water

Water alone forms about 90% to 92% of the plasma. Solids form about 8% of the plasma.

2. Mineral Salts

These are chlorides, bicarbonates, sulphates and phosphates of sodium, potassium, calcium, iron and magnesium. All salts constitute about 0.9% of plasma. Buffer of the blood is sodium bicarbonate.

3. Nutrients

These include glucose, fatty acids, phospholipids, cholesterol, fats, amino acids, nucleosides, etc. Mineral salts have been mentioned above.

4. Plasma Proteins

They constitute about 7 to 8% of plasma. These mainly include albumin, globulin, immunoglobulin, prothrombin and fibrinogen.

5. Defence Compounds

Immunoglobulin's which act as antibodies and some other substances, such as lysozyme (a polysaccharide) and properdin (a large protein) are always found in the plasma. They destroy bacteria, viruses and toxic substances that may enter into the blood from outside.

6. Excretory Substances

These include ammonis, urea, uric acid, creatine, creatinine, etc.

7. Dissolved Gases

Water of blood plasma contains oxygen, carbon dioxide and nitrogen in dissolved form.

8. Anticoagulant

Blood plasma contains a conjugated polysaccharide, the heparin which prevents coagulation of blood inside blood vessels.

9. Hormones

These are secreted and released in blood by endocrine glands.

10. Vitamins and Enzymes

Different kinds of vitamins and enzymes are present in the blood plasma.

Functions of Blood Plasma

These can be summarised as under:

(i) Transport,

(ii) Retention of fluid in blood,

(iii) Maintenance of blood pH,

(iv) Body immunity,

(v) Prevention of blood loss,

(vi) Conducting heat to skin for dissipation and

(vii) Uniform distribution of heat all over the body.

(B) Formed Elements (Blood Corpuscles):

Formed elements or blood corpuscles are of the following three types: Erythrocytes, Leucocytes and Thrombocytes.

(a) Erythrocytes (Red Blood Corpuscles or RBCs):

They are the most abundant cells in the human body.

Size

Human RBCs are smaller than the white blood corpuscles. They are 7-8 pm in dismeter.

Shape

In fishes, amphibisns, reptiles and birds RBCs are usually nucleated, oval and biconvex. But in mammals they are not nucleated, biconcave and circular. Only Camel and lama possess oval RBCs. Mature RBCs are without cell organelles such as nucleus, mitochondris and ER.

Number

The total number of RBCs per microlitre (1µ l = 1 mm3 = 10-6 l) of blood is termed as the total count of RBCs. A normal adult man and woman have 5 and 4.5 million RBCs per cubic millimetre of blood respectively. Thus the total count of RBCs is more in man than in a woman.

It is due to the fact that women undergo menstruation. Less amount of haemoglobin leads to anaemia. Anaemia may be caused by loss of blood (haemorrhage), destruction of RBCs (haemolysis or faulty formation of blood).

The increase in number of RBCs may be during muscular exercise to meet the increased demand of oxygen and at high altitudes to cope with the low oxygen content of the air. An abnormal rise in RBC count is called polycythemis.

Decrease in the number of RBCs is called erythrocytopenis which causes oxygen shortage in the blood and tissues. It is important to note that the oxygen shortage stimulates the kidney cells to secrete a hormone named erythropoietin, into the blood. Erythropoietin stimulates the bone marrow to increase the production of

RBCs.

Formation

Formation of erythrocytes is called erythropoiesis. In the early few weeks of embryonic life, primitive nucleated RBCs are produced in the yolk sac. (One of the embryonic membranes).

In later embryonic stage, RBCs are mainly produced by the liver and spleen. But from birth onwards, RBCs are produced by bone marrow (throughout life). Hemocytoblasts in red bone marrow give rise to mature RBCs. Iron and proteins are necessary raw materisls for the synthesis of haemoglobin.

However, vitamin B12 and folic acid stimulate the maturation of RBCs. Thus iron, protein, vitamin B12 and folic acid are essentisl for the formation of haemoglobin and RBCs. Deficiency of any of these nutrients can cause anaemia. Excess RBCs are stored in the spleen.

Life Span

The life of a RBC is about 120 days.

Haemoglobin

Haemoglobin is a conjugated protein. It comprises a basic protein globin joined to a non protein group heme, hence the name haemoglobin is given. A mammalian haemoglobin molecule is a complex of 4 heme molecules joined with 4 globin molecules. Heme is an iron-prophyrin ring. 100 ml of blood contains about 15 mg of haemoglobin. Haemoglobin is less in women due to menstruation.

Functions of RBCs

(i) Transport of O_2

Haemoglobin of RBCs readily combines with oxygen to form oxyhaemoglobin. In the tissues oxyhaemoglobin readily gives up its oxygen. This oxygen is used for oxidation of food.

(ii) Transport of CO_2

RBCs also participate in transporting carbon dioxide from tissues to lungs. Carbon dioxide combines with potassium carbonate of the red blood corpuscles to form potassium bicarbonate in the presence of an enzyme carbonic anhydrase. Carbon dioxide also combines with the amino group (NH2) of the haemoglobin of red blood corpuscles to form carb-amino-haemoglobin.

(iii) Maintenance of pH of blood

Moreover, the haemoglobin is an excellent acid base buffer which is largely responsible for maintaining the pH of blood. Acidity of blood results haemoglobin to carry less oxygen.

(b) Leucocytes (White Blood Corpuscles or WBCs)

Leucocytes do not have haemoglobin.

Number

The number of leucocytes per micro-litre of blood is called the total leucocyte count (TLC). This varies from 4-11 x 103/cu mm of blood in humans. Thus, they are less in number than the RBCs. Rise in WBC count is termed leucocytosis. Increased TLC shows that there is acute bacterial infection. Abnormal increase of WBCs is in malignancies like leukemis (blood cancer).

Fall in WBC count is called leukopenis. In some conditions, such as folic acid deficiency, the total count of WBC decreases. The total count of WBC is useful in disgnosing various diseases. Normal or low TLC is in viral infection, malaris, typhoid or tuberculosis. Differentisl Leucocyte Count (DLC) means detecting the number of different kinds of leucocytes.

Normal Hematology Values for Dogs and Cats

	Unit	Canine	Feline
Hematocrit (PCV)	%	40-59	29-50
Hemoglobin	g/dl	14-20	9-15.6
Red Blood Cell Count	$x10^6/\mu l$	5.6-8.7	6.1-11.9
White Blood Cell Count	$/\mu l$	6,000-17,000	4,900-20,000
Neutrophils	$/\mu l$	3,000-12,000	2,500-12,500

Lymphocytes	/µl	530-4,800	1,500-7,000
Monocytes	/µl	100-1800	0-850
Eosinophils	/µl	0-1,900	0-1,500
Basophils	/µl	<100	<100
Platelets	/µl	145-440	190-800

* normal values may differ from laboratory to laboratory.

Shape

The leucocytes are rounded or irregular in shape. They can change their shape like Amoeba and are thus, capable of amoeboid movement. This enables them to squeeze out of blood capillaries into the tissues (extra vascular regions). This process is called dispedesis.

Size

The WBCs are larger than the RBCs. Their size is from 12 to 20 µm.

Colour

The WBCs are colourless.

Structure

A leucocyte consists of cell membrane, nucleus and cytoplasm. The cytoplasm contains mitochondris, Golgi apparatus, centrioles besides other cell organelles.

Types

The leucocytes are of two main types: Agranulocytes and granulocytes.

Agranulocytes

The granules are not found in the cytoplasm of these cells.

The agranulocytes are of two types

(i) Lymphocytes

They are smaller in size containing scant cytoplasm with large rounded nucleus. They are non-motile and non-phagocytic. They produce antibodies to destroy microbes and their toxins reject grafts and kill tumour cells. They also help in healing of injuries. Lymphocytes exist in two major groups in circulation. These are B- and T-lymphocytes.

(ii) Monocytes

They are the largest of all types of leucocytes and somewhat amoeboid in shape. They have much cytoplasm. The nucleus is bean-shaped. They are motile and phagocytic in nature and engulf bacteria and cellular debris. Generally they change into macrophages after entering tissue spaces.

Granulocytes

They contain granules in their cytoplasm. Their nucleus is irregular or lobed or subdivided. According to their staining property, the granulocytes are divided into three types.

(i) Eosinophil's

The nucleus is two lobed. They have coarse granules. Their granules take acidic stains (e.g., eosin). Their number increases in people with allergic conditions such as asthma or hay fever. They also help in dissolving blood clot. They are nonphagocytic. They seem to play a part in the immune system.

They have some similarity to lysosomes. Eosinophil's can attach themselves to parasitic forms and cause their destruction by liberating lysosomal enzymes on their surface. Cytoplasm contains abundant coarse granules which pick acidic stain like eosine. They are, therefore, also called acidophils. The increase in number of acidophils during allergy is called eosinophilis.

(ii) Basophils

The nucleus is usually three lobed. They have less number of coarse granules. Their granules take basic stain (e.g., methylene blue) strongly. Both mast cells and basophils liberate histamine, heparin as well as smaller quantities of bradykinin and serotonin. They are probably like mast cells of connective tissue.

(iii) Neutrophils

The nucleus is many lobed. They have fine granules. They stain weakly with both acid and basic stains. Neutrophils are the most numerous of all leucocytes. Certain neutrophils in female mammals possess a small spherical lobe attached to their nucleus by a stalk.

This lobe is called drum stick (sex chromatin) or Barr body. Barr is the name of the scientist. Drumstick is formed by transformation of an X-chromosome. They eat harmful germs and are, therefore, phagocytic in nature.

Formation

Formation of leucocytes is called leucocytosis or leucopoeisis. The granulocytes and monocytes are formed only in bone marrow. Lymphocytes are produced mainly in lymph nodes, spleen, thymus, tonsils, bone marrow and Peyer's patches of small intestine.

Life Span

The life of the granulocytes once released from the bone marrow is normally 4 to 8 hours circulating in the blood and another 4 to 5 days in the tissues. The monocytes also have a short life span of 10 to 20 hours. The lymphocytes have life spans of few days or months or even years, but this depends on the body's need for these cells.

Ratio of RBCs to WBCs is 700:1.

(C) Thrombocytes (Blood platelets)

In mammals thrombocytes are called blood platelets.

Number

They are fewer than the RBCs and more than the WBCs in number. There are about 250,000 platelets in a cubic millimetre of blood. Increase and decrease in the number of platelets is known as thrombocytosis and thrombocytopenis respectively.

Shape

Blood platelets are really cell fragments rather than true cells. They are rounded or oval disc like bodies.

Size

Platelets are 2-3 micro-meters in dismeter. Thus they are much smaller than both the red and white blood corpuscles.

Colour

Platelets are colourless.

Structure

They are flat and non-nucleated fragments of the cells. They are simply bits of protoplasm, bounded by a membrane and contain a few cell organelles and secretory granules in the cytoplasm. They have a group of basophilic granules in the centre which give the appearance of a nucleus.

Formation

Platelets are formed from the megakaryocytes (very large cells of the bone marrow). Formation of thrombocytes is called thrombopoiesis.

Life span

Normal life span of blood platelets is about a week.

Function

When an injury is caused, the blood platelets release certain chemicals which are called the platelet factors (e.g., thromboplastin). The platelet factors help in the clotting of blood.

Haemopoiesis

The process of formation of blood is called haemopoiesis and the tissues which form blood corpuscles are termed the haemopoietic tissues. In frog, spleen, liver and lymph nodes are main sites of haemopoiesis. During rains haemopoiesis also occurs in bone marrow due to an active life of frog. In tadpoles kidneys are also haemopoietic.

In mammals, yolk sac (an embryonic membrane), liver, bone marrow, lymph nodes, spleen and thymus are the heomopoietic organs in the embryo. In adults most of the blood corpuscles are formed in the red bone marrow of long bones. Lymphocytes are, however, formed in thymus, some in spleen, lymph nodes, tonsils and Peyer's patches.

Functions of Blood

On the basis of the above description, the general functions of blood are:

(1) Transport of Food Materisls.

(2) Transport of Respiratory Gases.

(3) Transport of Hormones.

(4) Transport of Excretory Matter.

(5) Transport of Heat.

(6) Defence against Infection.

(7) Temperature Regulation.

(8) Water Balance.

(9) Maintenance of pH.

(10) Prevention of Excessive Loss of Blood.

(11) Helps in Healing.

(12) Maintenance of Physiological Cooperation.

II. Lymph

Definition

Lymph is a mobile connective tissue comprising lymph plasma (fluid) and lymph corpuscles (cells).

Composition (A) Lymph Plasma

It is similar to that of blood but has fewer blood proteins, less calcium and phosphorus and high glucose concentration. Mainly globulin proteins are present which are actually antibodies. Other components of the lymph plasma are very much like that of blood plasma, i.e., organic, inorganic substances, water, etc.

(B) Lymph Corpuscles

These are floating amoeboid cells, the leucocytes (white blood corpuscles), which are mostly lymphocytes. Erythrocytes (red blood corpuscles) and platelets are absent in lymph.

Lymphoid Organs

The organs which secrete lymph are called lymphoid organs. Besides the lymph nodes, tonsils, thymus gland, spleen and Peyer's patches are the other lymphoidal organs. Liver also produces lymph. The spleen is a large lymphatic organ in the body.

Functions of Lymph

1. Lymph acts as a "middle man" which transports oxygen, food materisls, hormones, etc., to the body cells and brings carbon dioxide and other metabolic wastes from the body cells to blood and then finally pours the same into the venous system.
2. Body cells are kept moist by the lymph.
3. Lymph nodes produce lymphocytes. Lymph takes lymphocytes and antibodies from the lymph nodes to the blood.
4. It destroys the invading microorganisms and foreign particles in the lymph nodes.
5. It absorbs and transports fat and fat soluble vitamins from the intestine. Lymphatic capillaries present in the intestinal villi are called lacteals which are associsted with absorption and transportation of fat and fat soluble vitamins.
6. It brings plasma protein macromolecules synthesized in the liver cells and hormones produce

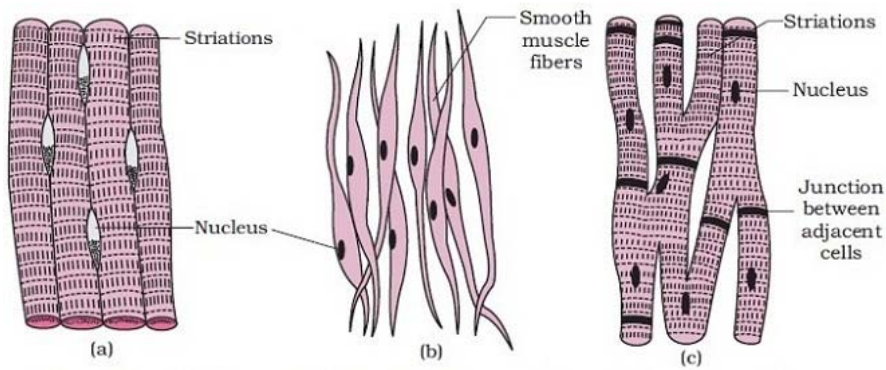
3. Muscular tissue

Muscle tissue is a soft tissue that composes muscles in animal bodies, and gives rise to muscles' ability to contract. This is opposed to other components or tissues in muscle such as tendons or perimysium. It is formed during embryonic development through a process known as myogenesis

Three kinds of muscle are found in vertebrates:

- **Skeletal muscle** is made of long fibers whose contraction provides the force of locomotion and other **voluntary** body movements.
- **Smooth muscle** lines the walls of the hollow structures of the body, such as the intestine, urinary bladder, uterus, and blood vessels. Its contraction, which is **involuntary**, reduces the size of these hollow organs.

- The heart is made of **cardisc muscle**.



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(a) Skeletal Muscle Tissue Structure

Skeletal muscle is called "stristed" because of its appearance consisting of light and dark bands visible using a light microscope. As shown in the disgram (on the right), a single skeletal muscle cell is long and approximately cylindrical in shape, with many nuclei located at the edges (periphery) of the cell.

Function

Movement of the skeleton under concious control, including movement of limbs, fingers, toes, neck, etc. Movement of tissues of facisl expression under concious control, e.g. ability to smile and to frown.

(b) Cardisc Muscle Tissue

Structure

Cardisc muscle fibers are stristed, branched (sometimes described as Y shaped), and have a single central nucleus. These fibers are attached at their ends to adjoining fibers by thick plasma membranes called intercalated discs (shown in digram on the right).

Function

Pumping of blood through the heart: Alternate contraction and relaxation of cardisc muscle pumps Deoxygenated blood through the Right Atrium and Right Ventricle to the lungs, and Oxygenated blood through the Left Atrium and Left Ventricle to the aorta, then the rest of the body.

(c) Smooth Muscle Tissue Structure

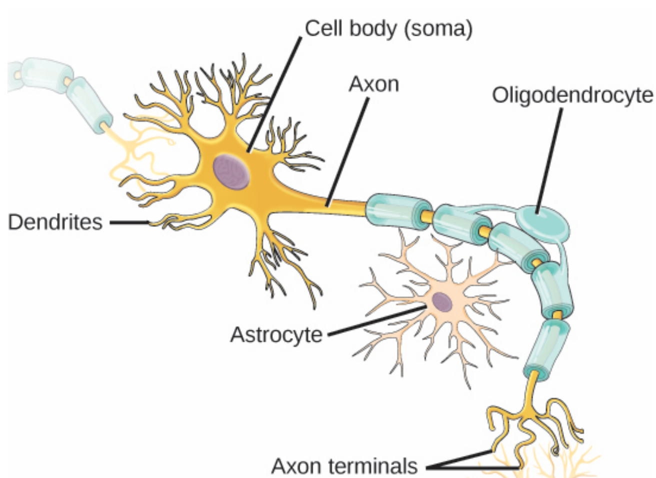
Unlike Skeletal and Cardisc muscle tissue, Smooth muscle is not stristed. Smooth muscle fibers are small and tapered with the ends reducing in size, in contrast to the cylindrical shape of skeletal muscle. Each smooth muscle fiber has a single centrally located nucleus.

Function

Contractions of smooth muscle constrict i.e. narrow :reduce the dismeter of the vessels they surround. This is particularly important in the digestive system in which the action of smooth muscle helps to move food along the gastrointestinal tract as well as breaking the food down further. Smooth muscle also contributes to moving fluids through the body and to the elimination of indigestible matter from the gastrointestinal system.

4. Nervous Tissues

It is hard to imagine a moment during our waking hours when our senses are not in use. We are constantly bombarded with sensory input, from a delicious aroma wafting our way to a painful stubbed toe. All of this information is processed by our brain every millisecond. Some sensory experiences are positive, and some we'd rather forget. But none of our senses would even function without the existence of our nervous system.



Nervous tissue

There are several main components of our nervous system, and they are composed of nervous tissue. The word tissue tends to elicit the thought of wiping runny noses. But in terms of our body, tissue is defined as a group of cells with the same general functions forming organs and other body parts. Of the five main types of body tissue, nervous tissue is responsible for receiving, sending, and processing sensory input. In this lesson, learn about the components of nervous tissue and gain a better understanding of how it works for our body.

Nervous tissue makes up three major parts of our nervous system: nerves, the spinal cord and the brain.

Our nervous system consists of two main parts: the peripheral and central nervous systems. The peripheral nervous system consists of the nerves that extend to all reaches of the body the periphery. The central nervous system is made up of the spinal cord and brain and is the central processing center for all stimuli.

Peripheral nervous tissue consists of nerves made up of nerve cells called neurons. Nerves extend all over the body, from the tips of the fingers to internal organs. They form a long line of connectivity, like a chain of paper clips linked together. Nerves connect to the spinal cord, which in turn, connects to the brain. So when you feel a stimulus in your toe, for example, the sensory impulse must travel from the nerves, all the way to the brain and back in order for you to process that feeling.

The spinal cord and brain are also made up of nerves. These nerves are housed in a soft materisl known as matter. Within the spinal cord, we find gray and white matter holding nerves in place, as well as spinal fluid. And, of course, the brain is also made up of gray matter as well as white matter, with nerves embedded within.

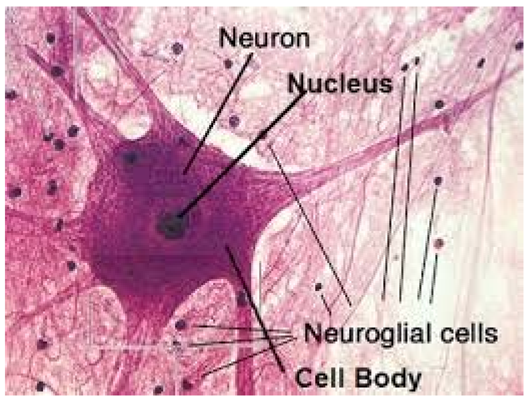
Function of Nervous Tissue

Our nervous tissue allows us to experience stimuli and then make a response. For example, imagine a scenario in which you are attempting to hammer a nail into the wall. After two tries, you accidentally hammer your finger. Now let's freeze that moment. At the actual split-second that contact is made, there is no pain. At least not yet. But wait a millisecond, and the throbbing begins. Why did it take time before you felt the pain.

Neurons are an extremely unique type of cell specislized just for work within the nervous system. They consist of a cell body and then appendages that reach out from that central body. If you took a spoonful of paint and threw it on the floor, you might end up with a shape similar to a neuron.

Neuron

The neuron has projections called dendrites that receive signals and projections called axons that send signals. Also shown are two types of glisl cells: astrocytes to regulate the chemical environment of the nerve cell, and oligodendrocytes to insulate the axon so the electrical nerve impulse is transferred more efficiently.



Neuron

Physiology

Physiology is the study of the mechanism of life from the single biochemical reactions in cell to the coordinated total of specislized cells that constitute living animals. Physiology is the complex process so to study the workings of physiological system we usually breakdown as reproductive system, exercise physiology and renal system.

Animal Cell

Cells are the structural and functional unit of all living organisms, such as bacteria, are unicellular, consisting of a single cell. Other organisms such as humans, are multicellular or have many cells an estimated 100000000000000 cells each cell is an amazing world unto itself, it can take nutrients, convert these nutrient in to energy, carry out specislized functions, and reproduce as necessary. Even more amazing is that each cell stores its own set of instructions for carrying out each of these activities.

Cell Organization

Before we can discuss the various components of a cell, it is important to know what organism the cell comes from. There are two general categories of cells: prokaryotes and eukaryotes.

Prokaryotic Organisms

Organisms that lack a nuclear membrane, the membrane that surrounds the nucleus of a cell. Bacteria are the best known and most studied form of prokaryotic organisms, although the recent discovery of a second group of prokaryotes, called archaea, has provided evidence of a third cellular domain of life and new insights into the origin of life itself. Prokaryotes are unicellular organisms that do not develop or differentiste into multicellular forms. Some bacteria grow in filaments, or masses of cells, but each cell in the colony is identical and capable of independent existence. The cells may be adjacent to one another because they did not separate after cell division or because they remained enclosed in a common sheath or slime secreted by the cells. Typically though, there is no continuity or communication between the cells. Prokaryotes are capable of inhabiting almost every place on the earth, from the deep ocean, to the edges of hot springs, to just about every surface of our bodies.

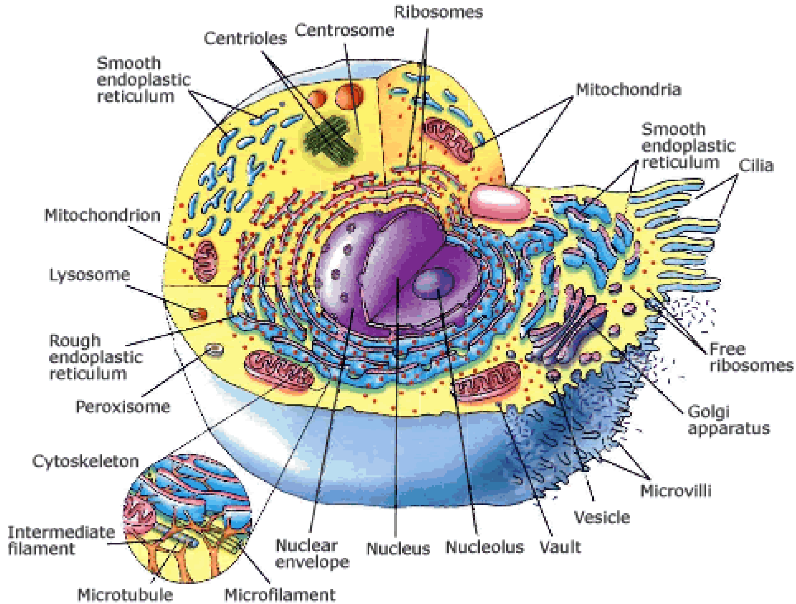
Prokaryotes are distinguished from eukaryotes on the basis of nuclear organization, specifically their lack of a nuclear membrane. Prokaryotes also lack any of the intracellular organelles and structures that are characteristic of eukaryotic cells. Most of the functions of organelles, such as mitochondris, chloroplasts and the Golgi apparatus, are taken over by the prokaryotic plasma membrane. Prokaryotic cells have three architectural regions: appendages called flagella and pili (proteins attached to the cell surfaces) a cell envelope (consisting of a capsule)a cell wall, and a plasma membrane; and a cytoplasmic region that contains the cell genome (DNA) and ribosomes and various sorts of inclusions.

Eukaryotic Organisms

Eukaryotes include fungi, animals, and plants as well as some unicellular organisms. Eukaryotic cells are about 10 times the size of a prokaryote and can be as much as 1000 times greater in volume. The major and extremely significant difference between prokaryotes and eukaryotes is that eukaryotic cells contain membrane-bounded compartments in which specific metabolic activities take place. Most important among these is the presence of a nucleus, a membrane delineated compartment that houses the eukaryotic cell's DNA. It is this nucleus that gives the eukaryote. Eukaryotic organisms also have other specislized structures, called organelles, which are small structures within cells that perform dedicated functions. As the name implies, you can think of organelles as small organs. There are a dozen different types of organelles commonly found in eukaryotic cells. Here, we will focus our attentions on only a handful of organelles and will examine these organelles with an eye to their role at a molecular level in the cell. The origin of the eukaryotic cell was a milestone in the evolution of life. Although eukaryotes use the same genetic code and metabolic processes as prokaryotes, their higher level of organizational complexity has permitted the development of truly multicellular organisms. Without eukaryotes, the world would lack mammals, birds, fish, invertebrates, mushrooms, plants,and complex single cell edorganism

Cell Structures

The outer lining of a eukaryotic cell is called the plasma membrane. This membrane serves to separate and protect a cell from its surrounding environment and is made mostly from a double layer of proteins and lipids, fat-like molecules. Embedded within this membrane are a variety of other molecules that act as channels and pumps, moving different molecules into and out of the cell. A form of plasma membrane is also found in prokaryotes, but in this organism it is usually referred to as the cell membrane.



Structure of animal cells
(Source: anatomy-of-a-cell-cellular-anatomy-veterinary-technicisn-vet-102-with-online-at)

The Cytoskeleton (A Cell's Scaffold)

Acts to organize and maintain the cell's shape; anchors organelles in place; helps during endocytosis, the uptake of external materisls by a cell; and moves parts of the cell in processes of growth and motility. There are a great number of proteins associsted with the cytoskeleton, each controlling a cell's structure by directing, bundling, and aligning filaments.

The Cytoplasm (A Cell's Inner Space)

Inside the cell there is a large fluid-filled space called the cytoplasm, sometimes called the cytosol. In prokaryotes, this space is relatively free of compartments. In eukaryotes, the cytosol is the "soup" within which all of the cell's organelles reside. It is also the home of the cytoskeleton. The cytosol contains dissolved nutrients, helps break down waste products, and moves materisl around the cell through a process called cytoplasmic streaming. The nucleus often flows with the cytoplasm changing its shape as it moves. The cytoplasm also contains many salts and is an excellent conductor of electricity, creating the perfect environment for the mechanics of the cell. The function of the cytoplasm, and the organelles which reside in it, are critical for a cell's survival.

Genetic Materisl

Two different kinds of genetic materisl exist: deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). Most organisms are made of DNA, but a few viruses have RNA as their genetic materisl. The biological information contained in an organism is encoded in its DNA or RNA sequence. Prokaryotic genetic materisl is organized in a simple circular structure that rests in the cytoplasm. Eukaryotic genetic materisl is more complex and is divided into discrete units called genes. Human genetic materisl is made up of two distinct components: the nuclear genome and the mitochondrisl genome. The nuclear genome is divided into 24 linear DNA molecules, each contained in a different chromosome. The mitochondrisl genome is a circular DNA molecule separate from the nuclear DNA. Although the mitochondrisl genome is very small, it codes for some very important proteins

Organelles

The animal body contains many different organs, such as the heart, lung, and kidney, with each organ performing a different function. Cells also have a set of "little organs", called organelles, which are adapted and/or specislized for carrying out one or more vital functions. Organelles are found only in eukaryotes and are always surrounded by a protective membrane. It is important to know some basic facts about the following organelles.

The Nucleus (A Cell's Center)

The nucleus is the most conspicuous organelle found in a eukaryotic cell. It houses the cell's chromosomes and is the place where almost all DNA replication and RNA synthesis occurs. The nucleus is spheroid in shape and separated from the cytoplasm by a membrane called the nuclear envelope. The nuclear envelope isolates and protects a cell's DNA from various molecules that could accidentally damage its structure or interfere with its processing. During processing, DNA is transcribed, or synthesized, into a specisl RNA, called mRNA. This mRNA is then transported out of the nucleus, where it is translated into a specific protein molecule. In prokaryotes, DNA processing takes place in the cytoplasm

The Ribosome

Ribosomes are found in both prokaryotes and eukaryotes. The ribosome is composed of many molecules, including RNAs and proteins, and is esponsible for processing the genetic instructions carried by a mRNA. The process of converting a mRNA's genetic code into the exact sequence of amino acids that make up a protein is called translation. Protein synthesis is extremely important to all cells, and therefore a large number of ribosomes sometimes hundreds or even thousands can be found throughout a cell. Ribosomes float freely in the cytoplasm or sometimes bind to another organelle called the endoplasmic reticulum. Ribosomes are composed of one large and one small subunit, each having a different function during protein synthesis.

Mitochondris and cytoplasma

Mitochondris are self-replicating organelles that occur in various numbers, shapes, and sizes in the cytoplasm of all eukaryotic cells. As mentioned earlier, mitochondris contain their own genome that is separate and distinct from the nuclear genome of a cell. Mitochondris have two functionally distinct membrane systems separated by a space: the outer membrane, which surrounds the whole organelle; and the inner membrane, which is thrown into folds or shelves that project inward. These inward folds are called cristae. The number and shape of cristae in mitochondris differ depending on the tissue and organism in which they are found, and serve to increase the surface area of the membrane.

Mitochondris play a critical role in generating energy in the eukaryotic cell, and this process involves a number of complex pathways. Let's break down each of these steps so that you can better understand how food and nutrients are turned into energy packets and water. Some of the best energy-supplying foods that we eat contain complex sugars. These complex sugars can be broken down into a less chemically complex sugar molecule called glucose. Glucose can then enter the cell through specisl molecules found in the membrane, called glucose transporters.

Once inside the cell, glucose is broken down to make adenosine triphosphate (ATP), a form of energy, vis two different pathways. The first pathway, glycolysis, requires no oxygen and is referred to as anaerobic metabolism. Glycolysis occurs in the cytoplasm outside the mitochondris. During glycolysis, glucose is broken down into a molecule called pyruvate. Each reaction is designed to produce some hydrogen ions that can then be used to make energy packets (ATP). However, only four ATP molecules can be made from one molecule of glucose in this pathway. In prokaryotes, glycolysis is the only method used for converting energy

The Endoplasmic Reticulum and the Golgi Apparatus (Macromolecule Managers)

The endoplasmic reticulum (ER) is the transport network for molecules targeted for certain modifications and specific destinations, as compared to molecules that will float freely in the cytoplasm. The ER has two forms: the rough ER and the smooth ER. The rough ER is labelled as such because it has ribosomes adhering to its outer surface, whereas the smooth ER does not. Translation of the mRNA for those proteins that will either stay in the ER or be exported (moved out of the cell) occurs at the ribosomes attached to the rough ER. The smooth ER serves as the recipient for those proteins synthesized in the rough ER. Proteins to be exported are passed to the Golgi apparatus, sometimes called a Golgi body or Golgi complex, for further processing, packaging, and transport to a variety of other cellular locations.

Lysosomes and Peroxisomes (The Cellular Digestive System)

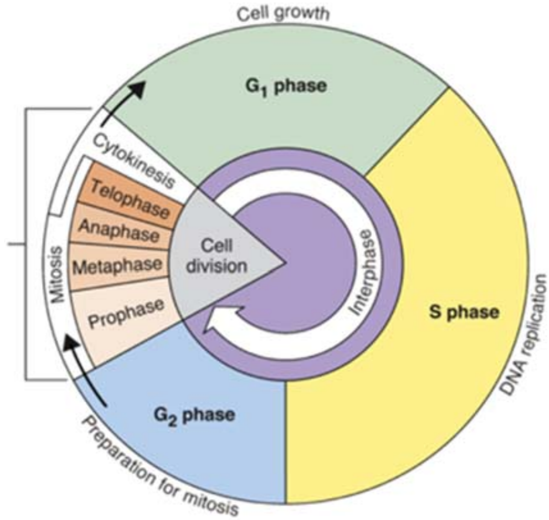
Lysosomes and peroxisomes are often referred to as the garbage disposal system of a cell. Both organelles are somewhat spherical, bound by a single membrane, and rich in digestive enzymes, naturally occurring proteins that speed up biochemical processes. For example, lysosomes can contain more than three dozen enzymes for degrading proteins, nucleic acids, and certain sugars called polysaccharides. All of these enzymes work best at a low pH, reducing the risk that these enzymes will digest their own cell should they somehow escape from the lysosome. Here we can see the importance behind compartmentalization of the eukaryotic cell. The cell could not house such destructive enzymes if they were not contained in a membrane-bound system.

Making New Cells and Cell Types

For most unicellular organisms, reproduction is a simple matter of cell duplication, also known as replication. But for multicellular organisms, cell replication and reproduction are two separate processes. Multicellular organisms replace damaged or worn out cells through a replication process called mitosis, the division of a eukaryotic cell nucleus to produce two identical daughter nuclei. To reproduce, eukaryotes must first create specisl cells called gametes (eggs and sperm) that then fuse to form the beginning of a new organism. Gametes are but one of the many unique cell types that multicellular organisms require to function as a complete organism.

Making New Cells

Most unicellular organisms create their next generation by replicating all of their parts and then splitting into two cells - a type of asexual reproduction called binary fission. This process spawns not just two new cells, but also two new organisms. Multicellullar organisms replicate new cells in much the same way. For example, we produce new skin cells and liver cells by replicating the DNA found in that cell through mitosis. Yet, producing a whole new organism requires sexual reproduction, at least for most multicellular organisms. In the first step, specislized cells called gametes-- eggs and sperm--are created through a process called meiosis. Meiosis serves to reduce the chromosome number for that particular organism by half. In the second step, the sperm and egg join to make a single cell, which restores the chromosome number. This joined cell then divides and differentistes into different cell types that eventually form an entire functioning organism. Mitosis is the process by which the diploid nucleus (having two sets of homologous chromosomes) of a somatic cell divides to produce two daughter nuclei, both of which are still diploid. The left-hand side of the drawing demonstrates how the parent cell duplicates its chromosomes (one red and one blue), providing the daughter cells with a complete copy of genetic information. Next, the chromosomes align at the equatorisl plate, and the centromeres divide. The sister chromatids then separate, becoming two diploid daughter cells, each with one red and one blue chromosome.

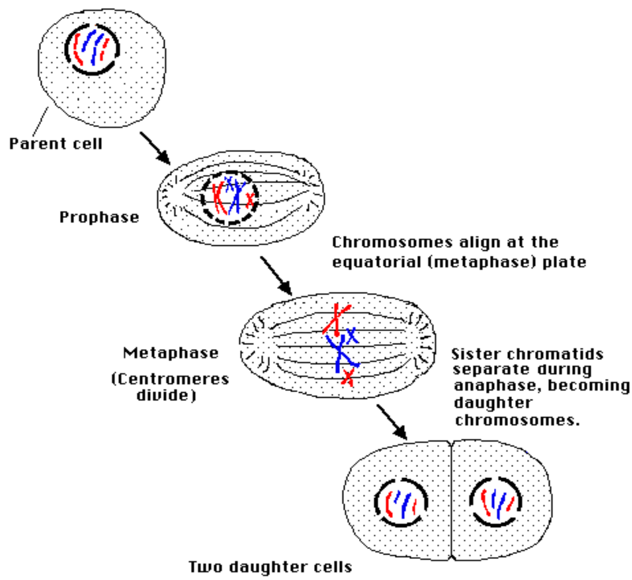


Cell division

Source: biology-disgrams.blogspot

Mitosis

Every time a cell divides, it must ensure that its DNA is shared between the two daughter cells. Mitosis is the process of "divvying up" the genome between the daughter cells. To easier describe this process; let's imagine a cell with only one chromosome. Before a cell enters mitosis, we say the cell is in interphase, the state of a eukaryotic cell when not undergoing division. Every time a cell divides, it must first replicate its entire DNA. Because chromosomes are simply DNA wrapped around protein, the cell replicates its chromosomes also. These two chromosomes, positioned side by side, are called sister chromatids and are identical copies of one another. Before this cell can divide, it must separate these sister chromatids from one another. To do this, the chromosomes have to condense. This stage of mitosis is called prophase. Next, the nuclear envelope breaks down and a large protein network, called the spindle, attaches to each sister chromatid. The chromosomes are now aligned perpendicular to the spindle in a process called metaphase. Next, molecular motors pull the chromosomes away from the metaphase plate to the spindle poles of the cell. This is called anaphase. Once this process is completed, the cells divide, the nuclear envelope reforms, and the chromosomes relax and decondense during telophase. The cell can now replicate its DNA again during interphase and go through mitosis once more.



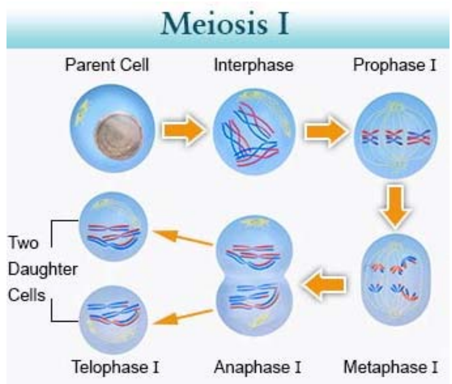
Mitosis cell division

Source: online101 - Wikispaces

Meiosis

Meiosis is a specislized type of cell division that occurs during the formation of gametes. Although meiosis may seem much more complicated than mitosis, it is really just two cell divisions in sequence. Each of these sequences maintains strong similarities to mitosis.

Meiosis I refers to the first of the two divisions and is often called the reduction division. This is because it is here that the chromosome complement is reduced from diploid (two copies) to haploid (one copy). Interphase in meiosis is identical to interphase in mitosis. At this stage, there is no way to determine what type of division the cell will undergo when it divides. Meiotic division will only occur in cells associted with male or female sex organs. Prophase I is virtually identical to prophase in mitosis, involving the appearance of the chromosomes, the development of the spindle apparatus, and the breakdown of the nuclear membrane. Metaphase I is where the critical difference occurs between meiosis and mitosis. In mitosis, all of the chromosomes line up on the metaphase plate in no particular order. In Metaphase I, the chromosome pairs are aligned on either side of the metaphase plate. It is during this alignment that the chromatid arms may overlap and temporarily fuse, resulting in what is called crossingovers. During Anaphase I, the spindle fibers contract, pulling the homologous pairs away from each other and toward each pole of the cell. In Telophase I, a cleavage furrow typically forms, followed by cytokinesis, the changes that occur in the cytoplasm of a cell during nuclear division; but the nuclear membrane is usually not reformed, and the chromosomes do not disappear. At the end of Telophase I, each daughter cell has a single set of chromosomes, half the total number in the original cell, that is, while the original cell was diploid; the daughter cells are now haploid.



Meiosis I

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Meiosis II is quite simply a mitotic division of each of the haploid cells produced in Meiosis I. There is no Interphase between Meiosis I and Meiosis II, and the latter begins, with Prophase II. At this stage, a new set of spindle fibers forms and the chromosomes begin to move toward the equator of the cell. During Metaphase II, all of the chromosomes in the two cells align with the metaphase plate. In Anaphase II, the centromeres split, and the spindle fibers shorten, drawing the chromosomes toward each pole of the cell. In Telophase II, a cleavage furrow develops, followed by cytokinesis and the formation of the nuclear membrane. The chromosomes begin to fade and are replaced by the granular chromatin, a characteristic of interphase. When Meiosis II is complete, there will be a total of four daughter cells, each with half the total number of chromosomes as the original cell. In the case of male structures, all four cells will eventually develop into sperm cells. In the case of the female life cycles in higher organisms, three of the cells will typically abort, leaving a single cell to develop into an egg cell, which is much larger than a sperm cell.

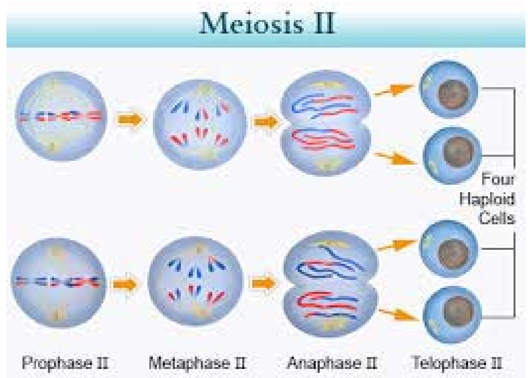

Fig.4.19 Meiosis II
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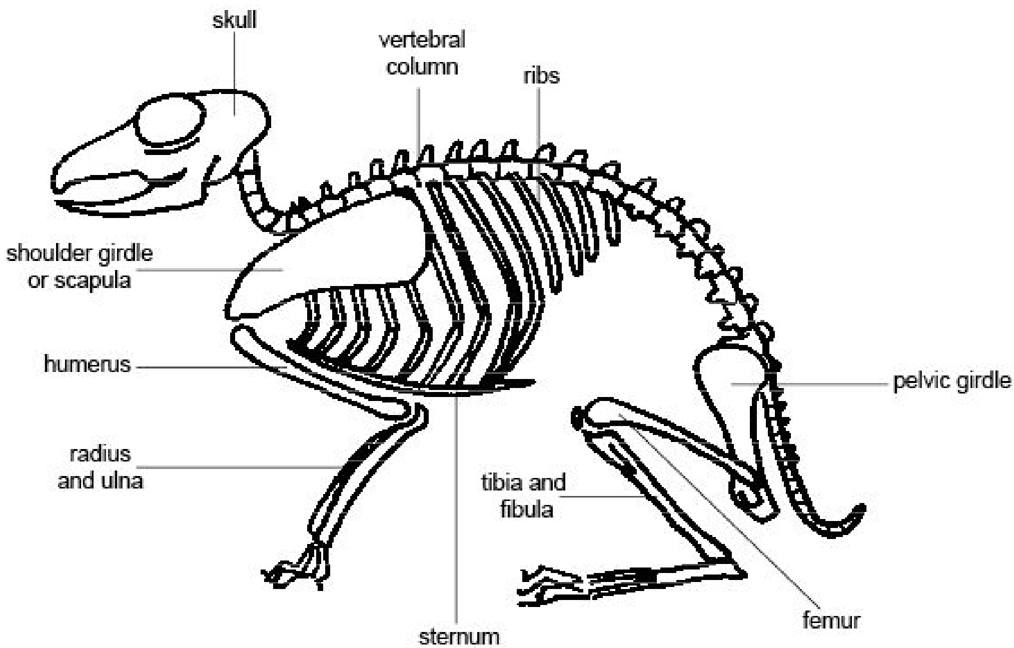
Difference between mitosis and meiosis	
Mitosis	Meiosis
This type of division takes place in somatic cells.	This type of division takes place in gametic cells.
Two daughter cells are formed.	Four daughter cells are formed.
No. of chromosomes remains diploid in daughter cells.	Number of chromosomes becomes haploid in daughter cells.
Mitosis is necessary for growth and repair.	Meiosis is necessary for sexual reproduction.
Crossing over does not take place.	Crossing over takes place.

Table.3 Different between mitosis and meiosis
Source: Excellup.com461 × 206

Function of different system of livestock and poultry

Skeleton system

The branch of science which deals with the study of bone is called osteology. Bone are living tissues because they have blood vessels,nerves and lymphatic. They can grow and repair them self. Fish, frogs, reptiles, birds and mammals are called **vertebrates**, a name that comes from the bony column of vertebrae (the spine) that supports the body and head. The rest of the skeleton of all these animals (except the fish) also has the same basic design with a skull that houses and protects the brain and sense organs and ribs that protect the heart and lungs and, in mammals, make breathing possible. Each of the four limbs is made to the same basic pattern. It is joined to the spine by means of a flat, broad bone called a **girdle** and consists of one long upper bone, two long lower bones, several smaller bones in the wrist or ankle and five digits (see following figures).



The mammalian skeleton

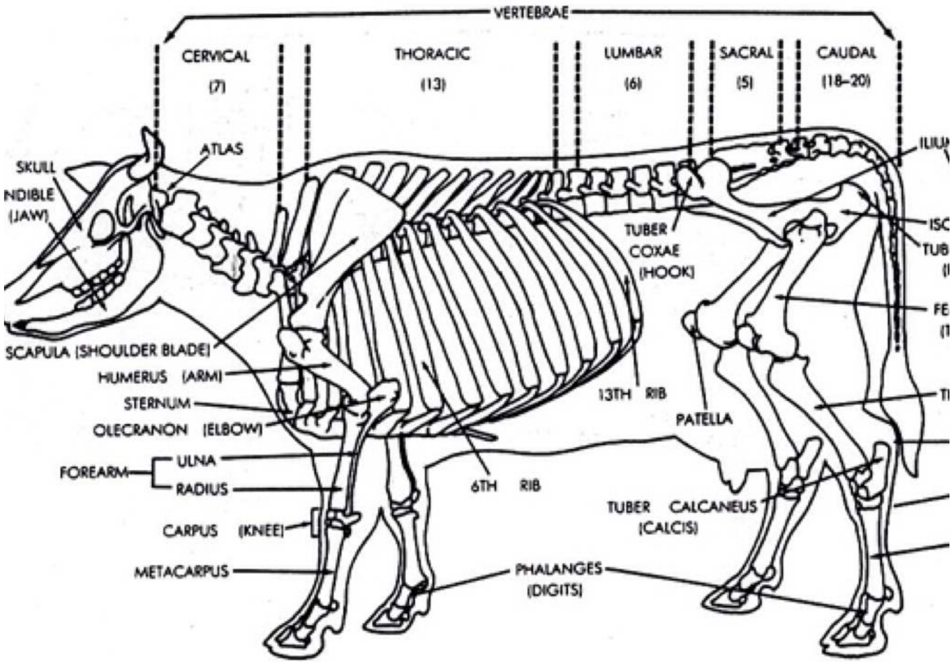


Fig4.21. Skeleton of cattle

Source: Haiku Deck1024 × 768

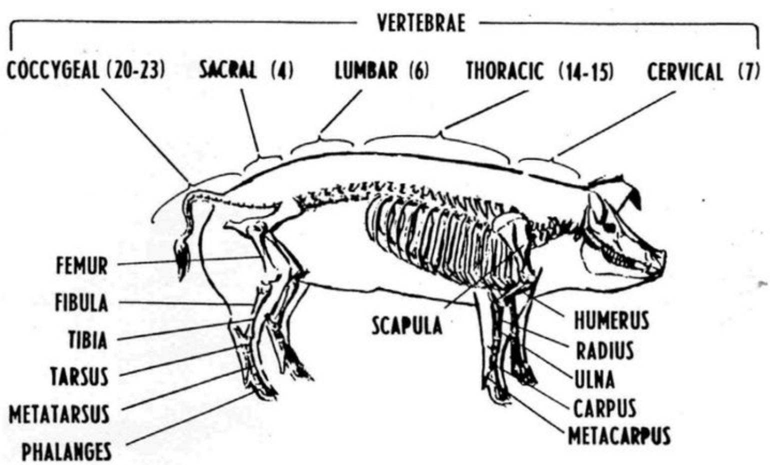
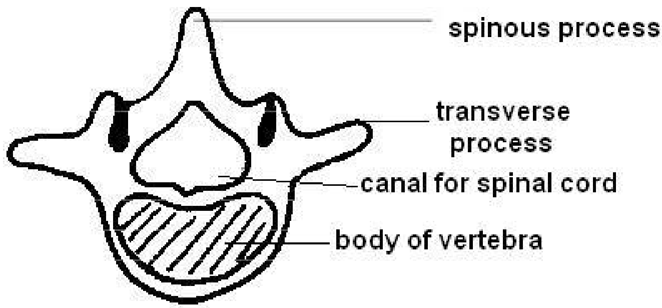


Fig 4.22. Skeleton of swine

Source :www.pinterest.com736 × 453

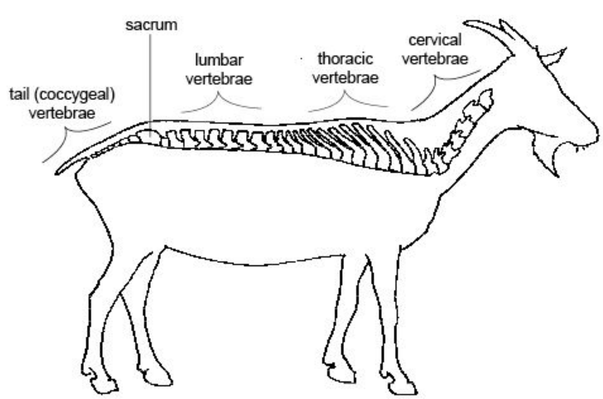
The Vertebral Column

The vertebral column consists of a series of bones called **vertebrae** linked together to form a flexible column with the skull at one end and the tail at the other. Each vertebra consists of a ring of bone with spines (spineous process) protruding dorsally from it. The spinal cord passes through the hole in the middle and muscles attach to the spines making movement of the body possible.



Cross section of a lumbar vertebra

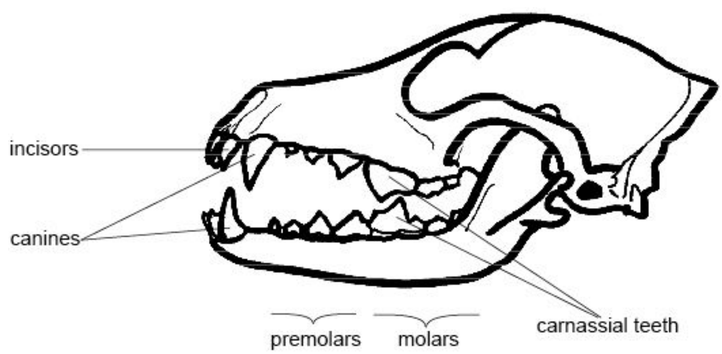
The shape and size of the vertebrae of mammals vary from the neck to the tail. In the neck there are **cervical vertebrae** with the two top ones, the **atlas** and **axis**, being specislized to support the head and allow it to nod "Yes" and shake "No". **Thoracic vertebrae** in the chest region have specisl surfaces against which the ribs move during breathing. Grazing animals like cows and giraffes that have to support weighty heads on long necks have extra large spines on their cervical and thoracic vertebrae for muscles to attach to. **Lumbar vertebrae** in the loin region are usually large strong vertebrae with prominent spines for the attachment of the large muscles of the lower back. The **sacral vertebrae** are usually fused into one solid bone called the **sacrum** that sits within the **pelvic girdle**. Finally there are a varisble number of small bones in the tail called the **coccygeal vertebrae**.



The regions of the vertebral column

The Skull

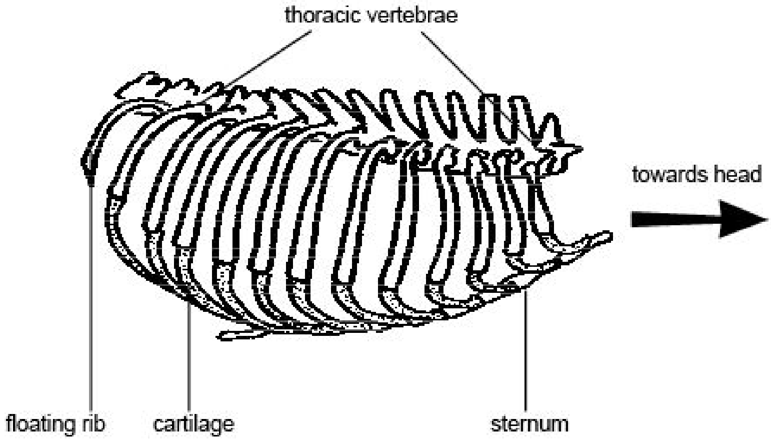
The skull of mammals consists of 30 separate bones that grow together during development to form a solid case protecting the brain and sense organs. The “box “enclosing and protecting the brain is called the **cranium** . The bony wall of the cranium encloses the middle and inner ears, protects the organs of smell in the nasal cavity and the eyes in sockets known as **orbits**. The teeth are inserted into the upper and lower jaws. The lower jaw is known as the **mandible**. It forms a joint with the skull moved by strong muscles that allow an animal to chew. At the front of the skull is the nasal cavity, separated from the mouth by a plate of bone called the **palate**. Behind the nasal cavity and connecting with it are the **sinuses**. These are air spaces in the bones of the skull which help keep the skull as light as possible. At the base of the cranium is the **foramen magnum**, translated as “big hole”, through which the spinal cord passes. On either side of this are two small, smooth rounded knobs or **condyles** that **articulate** (move against) the first or Atlas vertebra.



A dog’s skull

The Rib

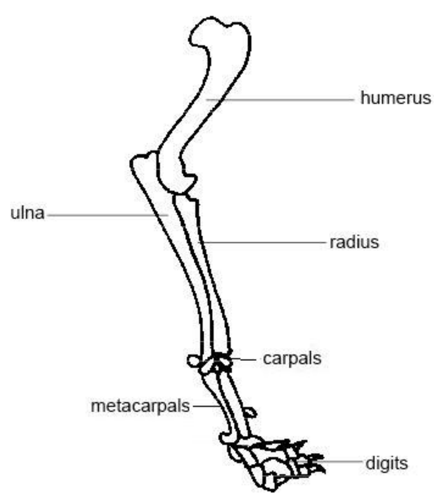
Paired ribs are attached to each thoracic vertebra against which they move in breathing. Each rib is attached ventrally either to the **sternum** or to the rib in front by cartilage to form the rib cage that protects the heart and lungs. In dogs one pair of ribs is not attached ventrally at all. They are called **floating ribs** . Birds have a large expanded sternum called the **keel** to which the flight muscles (the ‘breast” meat of a roast chicken) are attached.



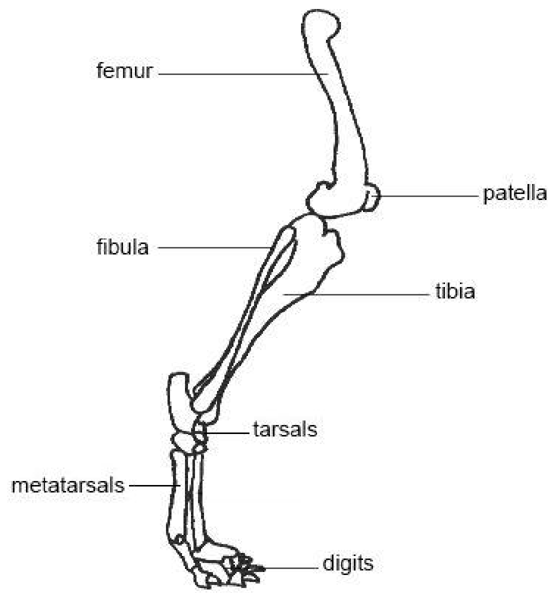
The rib

The Forelimb

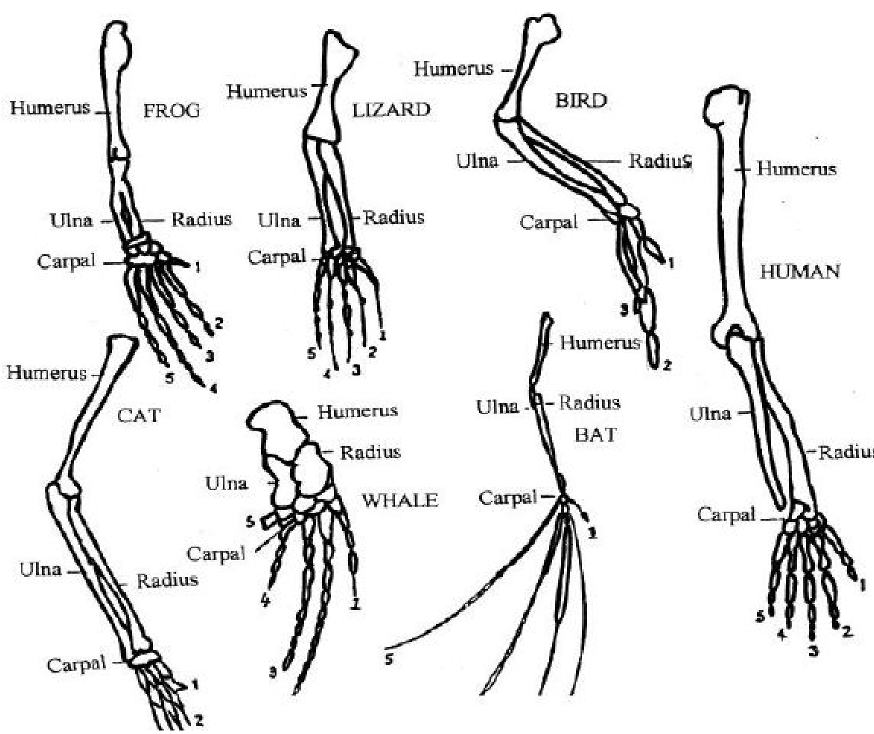
The forelimb consists of: **Humerus, radius** and **ulna, carpals, metacarpals, digits** or **phalanges** . The top of the humerus moves against (articulates with) the **scapula** at the shoulder joint. By changing the number, size and shape of the various bones, fore limbs have evolved to fit different ways of life. They have become wings for flying in birds and bats, flippers for swimming in whales, seals and porpoises, fast and efficient limbs for running in horses and arms and hands for holding and manipulating in primates.



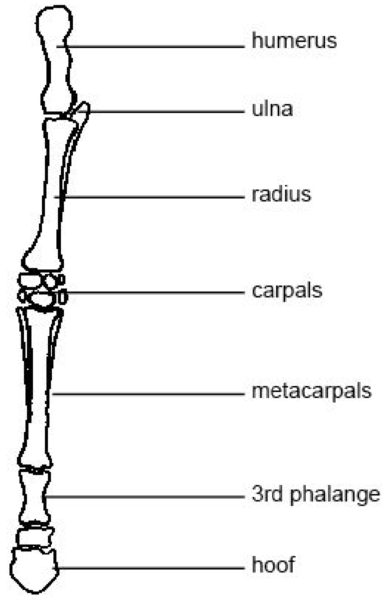
Forelimb of a dog



Hindlimb of a dog



Various vertebrate limbs



Forelimb of a horse

In the horse and other equines, the third toe is the only toe remaining on the front and real limbs. Each toe is made up of a proximal phalange, a middle phalange, and distal phalange (and some small bones often referred to as sesamoids. In this image, the proximal phalange is labeled P3 and the distal phalange is labeled hoof. (which is more properly the name of the keratin covering that we see in the living animal).

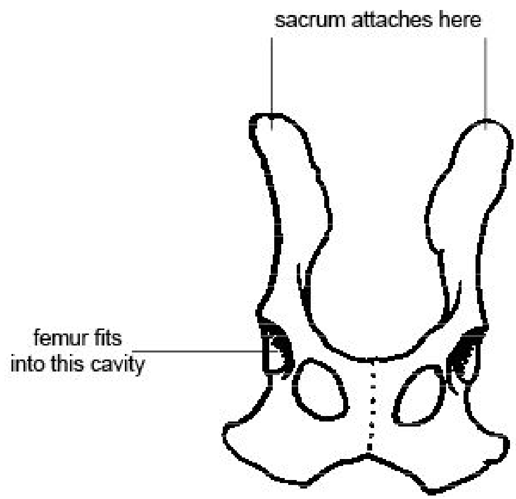
The legs of the horse are highly adapted to give it great galloping speed over long distances. The bones of the lower leg and foot are greatly elongated and the hooves are actually the tips of the third fingers and toes, the other digits having been lost or reduced .

The Hind Limb

The hind limbs have a similar basic pattern to the forelimb. They consist of: **femur, tibis** and **fibula, tarsals, metatarsals, digits** or **phalanges** . The top of the femur moves against (articulates with) the pelvis at the hip joint.

The Girdles

The girdles pass on the “push” produced by the limbs to the body. The shoulder girdle or scapula is a trisngle of bone surrounded by the muscles of the back but not connected directly to the spine . This arrangement helps it to cushion the body when landing after a leap and gives the forelimbs the flexibility to manipulate food or strike at prey. Animals that use their forelimbs for grasping, burrowing or climbing have a well-developed clavicle or collar bone. This connects the shoulder girdle to the sternum. Animals like sheep, horses and cows that use their forelimbs only for supporting the body and locomotion have no clavicle. The pelvic girdle or hipbone attaches the sacrum and the hind legs. It transmits the force of the leg-thrust in walking or jumping directly to the spine.



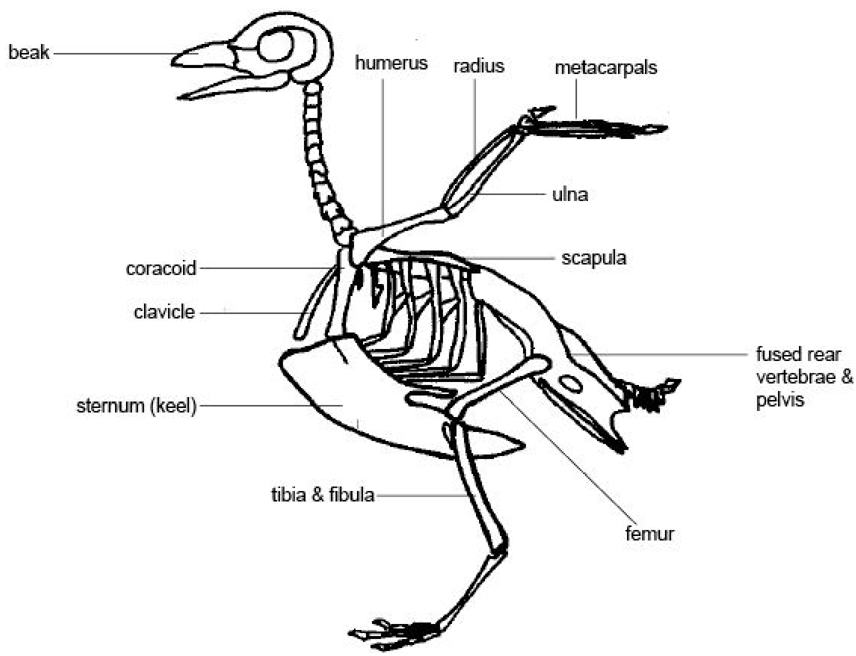
The pelvic girdle

Categories of Bones

People who study skeletons place the different bones of the skeleton into groups according to their shape or the way in which they develop. Thus we have long bones like the femur, radius and finger bones, short bones like the ones of the wrist and ankle, irregular bones like the vertebrae and flat bones like the shoulder blade and bones of the skull. Finally there are bones that develop in tissue separated from the main skeleton. These include sesamoid bones which include bones like the patella or kneecap that develop in tendons and visceral bones that develop in the soft tissue of the penis of the dog and the cow's heart.

Bird Skeletons

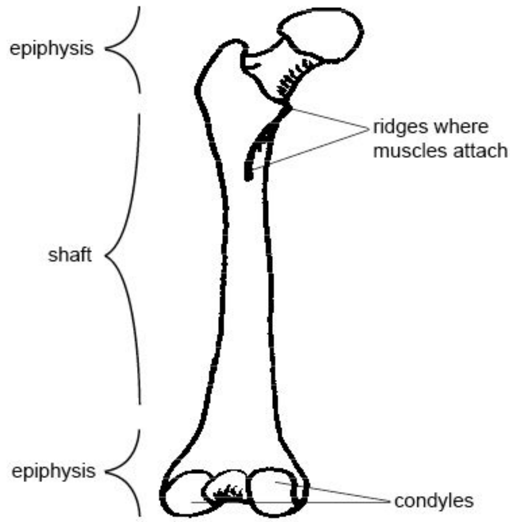
Although the skeleton of birds is made up of the same bones as that of mammals, many are highly adapted for flight. The most noticeable difference is that the bones of the forelimbs are elongated to act as wings. The large flight muscles make up as much as 1/5th of the body weight and are attached to an extension of the sternum called the **keel**. The vertebrae of the lower back are fused to provide the rigidity needed to produce flying movements. There are also many adaptations to reduce the weight of the skeleton. For instance birds have a beak rather than teeth and many of the bones are hollow.



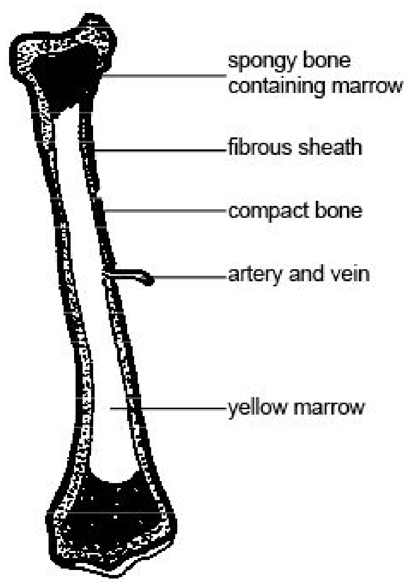
A bird's skeleton

The Structure of Long Bones

A long bone consists of a central portion or shaft and two ends called epiphyses. Long bones move against or articulate with other bones at joints and their ends have flattened surfaces and rounded protuberances (condyles) to make this possible. If you carefully examine a long bone you may also see raised or rough surfaces. This is where the muscles that move the bones are attached. You will also see holes (a hole is called a foramen) in the bone. Blood vessels and nerves pass into the bone through these. You may also be able to see a fine line at each end of the bone. This is called the growth plate or epiphyseal line and marks the place where increase in length of the bone occurred.



A femur

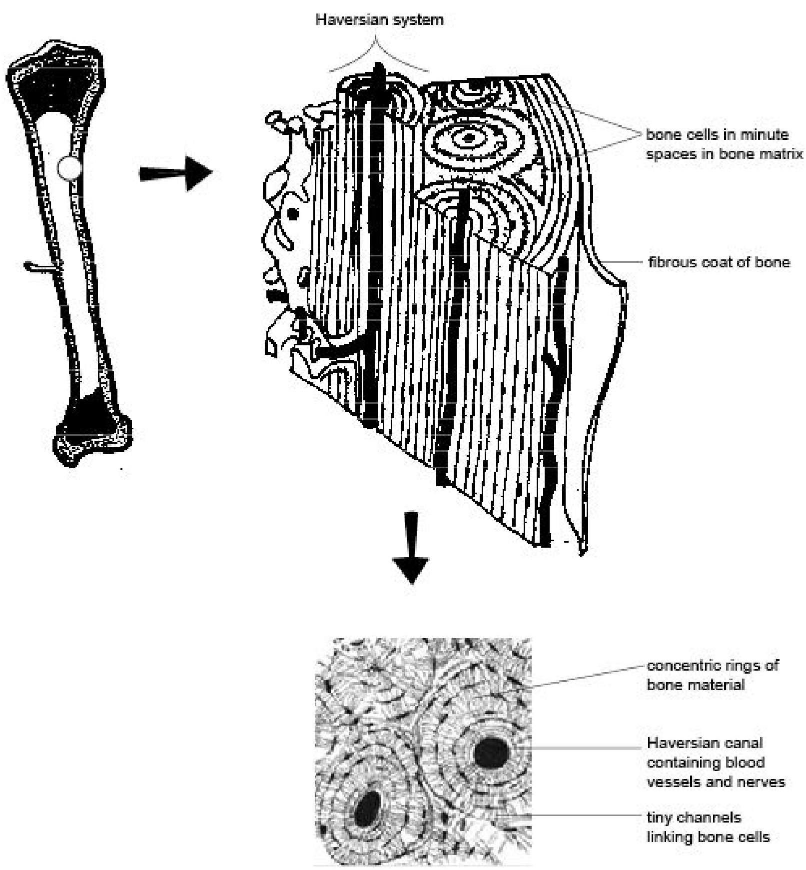


A longitudinal section through a long bone

If you cut a long bone lengthways you will see it consists of a hollow cylinder . The outer shell is covered by a tough fibrous sheath to which the tendons are attached. Under this is a layer of hard, dense compact bone (see below). This gives the bone its strength. The central cavity contains fatty yellow marrow, an important energy store for the body, and the ends are made from honeycomb-like bony materisl called spongy bone . Spongy bone contains red marrow where red blood cells are made.

Compact Bone

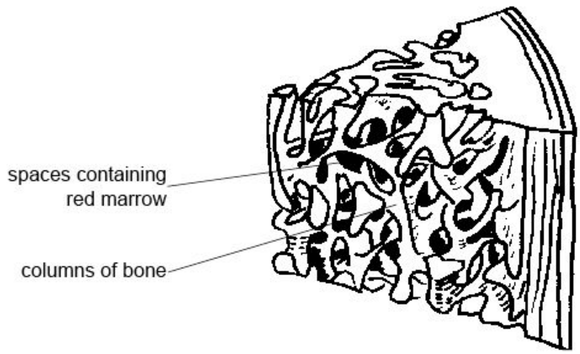
Compact bone is not the lifeless materisl it may appear at first glance. It is a living dynamic tissue with blood vessels, nerves and living cells that continually rebuild and reshape the bone structure as a result of the stresses, bends and breaks it experiences. Compact bone is composed of microscopic hollow cylinders that run parallel to each other along the length of the bone. Each of these cylinders is called a Haversisn system. Blood vessels and nerves run along the central canal of each Haversisn system. Each system consists of concentric rings of bone materisl (the matrix) with minute spaces in it that hold the bone cells. The hard matrix contains crystals of calcium phosphate, calcium carbonate and magnesium salts with collagen fibres that make the bone stronger and somewhat flexible. Tiny canals connect the cells with each other and their blood supply.



Haversisn systems of compact bone

Spongy Bone

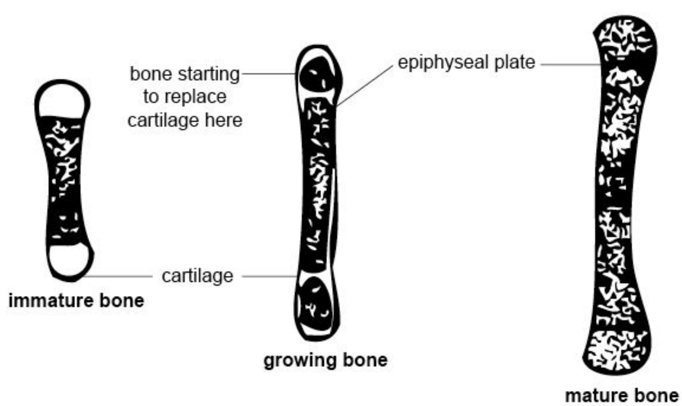
Spongy bone gives bones lightness with strength. It consists of an irregular lattice that looks just like an old fashioned loofah sponge . It is found on the ends of long bones and makes up most of the bone tissue of the limb girdles, ribs, sternum, vertebrae and skull. The spaces contain red marrow, which is where red blood cells are made and stored.



Spongy bone

Bone Growth

The skeleton starts off in the foetus as either cartilage or fibrous connective tissue. Before birth and, sometimes for years after it, the cartilage is gradually replaced by bone. The long bones increase in length at the ends at an area known as the **epiphyseal plate** where new cartilage is laid down and then gradually converted to bone. When an animal is mature, bone growth ceases and the epiphyseal plate converts into a fine **epiphyseal line**.



A growing bone

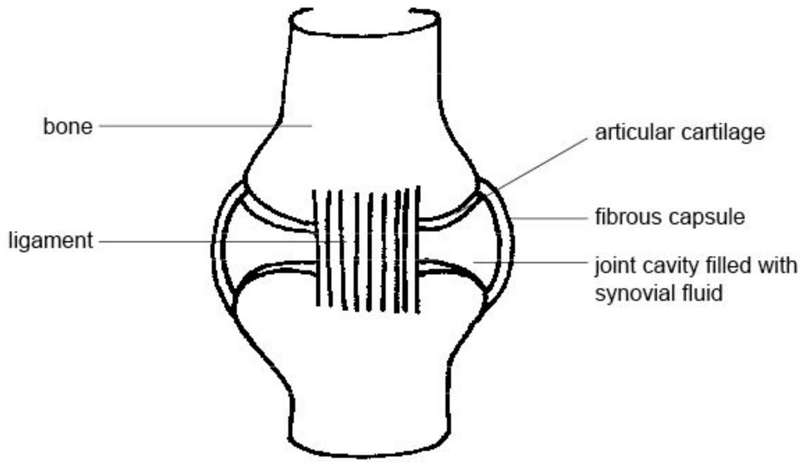
Broken Bones

A fracture or break dramatically demonstrates the dynamic nature of bone. Soon after the break occurs blood pours into the site and cartilage is deposited. This starts to connect the broken ends together. Later spongy bone replaces the cartilage, which is itself replaced by compact bone. Partisl healing to the point where some weight can be put on the bone can take place in 6 weeks but complete healing may take 3-4 months.

Joints

Joints are the structures in the skeleton where 2 or more bones meet. There are several different types of joints. Some are immovable once the animal has reached maturity. Examples of these are those between the bones of the skull and the midline joint of the pelvic girdle. Some are slightly moveable like the joints between the vertebrae but most joints allow free movement and have a typical structure with a fluid filled cavity separating the articulating surfaces (surfaces that move against each other) of the two bones. This kind of joint is called a synovisl joint. The joint is held together by bundles of white fibrous tissue called ligaments and a fibrous capsule encloses the joint. The inner layers of this capsule secrete the synovisl fluid that acts as a lubricant. The articulating surfaces of the bones are covered with cartilage that also reduces friction and some joints, e.g. the knee, have a pad of cartilage between the surfaces that articulate with each other.

The shape of the articulating bones in a joint and the arrangement of ligaments determine the kind of movement made by the joint. Some joints only allow a bird to land from gliding movement e.g. between the ankle and wrist bones; the joints at the elbow, knee and fingers are hinge joints and allow movement in two dimensions. Ball and socket joints, like those at the shoulder and hip, allow the greatest range of movement.

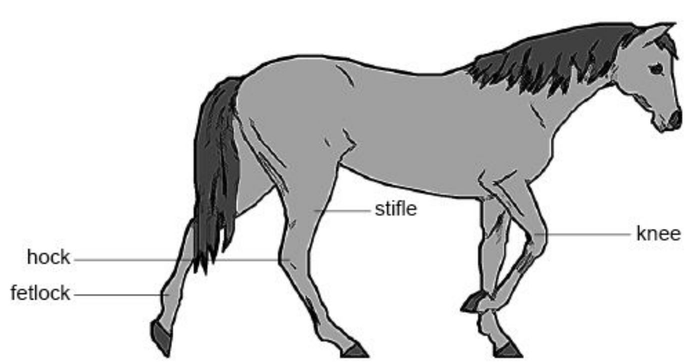


A synovisl joint

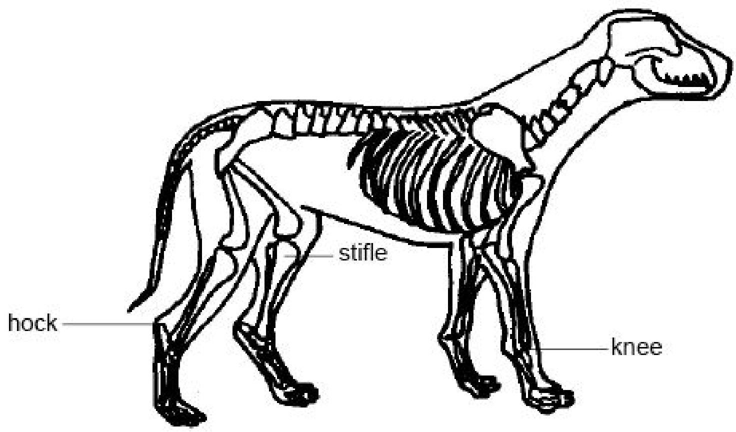
Common Names of Joints

Some joints in animals are given common names that tend to be confusing. For example:

1. The joint between the femur and the tibis on the hind leg is our knee but the stifle in animals.
2. Our ankle joint (between the tarsals and metatarsals) is the hock in animals
3. Our knuckle joint (between the metacarpals or metatarsals and the phalanges) is the fetlock in the horse.
4. The "knee" on the horse is equivalent to our wrist (ie on the front limb between the radius and metacarpals).



The names of common joints of a horse

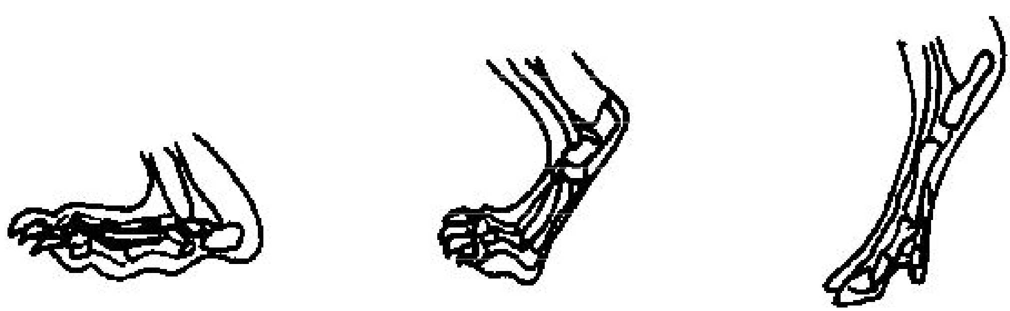


The names of common joints of a dog

Locomotion

Different animals place different parts of the foot or forelimb on the ground when walking or running.Humans and bears put the whole surface of the foot on the ground when they walk. This is known as plantigrade locomotion. Dogs and cats walk on their toes (digitigrade locomotion) while horses and pigs walk on their "toenails" or hoofs. This is called unguligrade locomotion.

1. **Plantigrade locomotion** (on the "palms of the hand) as in humans and bears
2. **Digitigrade locomotion** (on the "fingers") as in cats and dogs
3. **Unguligrade locomotion** (on the "fingernails") as in horses



Locomotion

Muscular system

The muscular tissue of the body constitutes from one-third to one-half of the body mass of the average vertebrate.

Muscular tissue functions in

- movement and locomotion, through its direct connection with the skeletal system
- more subtle movements associsted with maintaining posture/vertical position
- help to generate heat due to catabolic reactions that are associsted with muscular activity (such that animals shiver or increase overall movement when body temperature drops)
- can be modified into other structures, such as electric organs in some fish

The general structure of a muscle fiber include myofibrils (chains of repeating subunits) composed of two kinds of filaments:

- thin filaments (composed of myosin) and thick filaments (composed of actin, tropomyosin and troponin) that interact by binding to produce a sliding movement between the filaments, and that creates tension in the muscle fiber leading to muscle contraction.

There are three generally recognized muscle tissue types: smooth, cardisc and skeletal, each tissue type with a distinct location in the body, cellular organization (histology), and general action of the muscle fibers (physiology) Because of the multiple functions of muscles, criteris for classifying muscles include:

1. Color

red - highly vascularized and rich in myoglobin; resist fatigue

white - low vascularization and lower in myoglobin; quicker to fatigue

2. Location

somatic - move bone or cartilage

visceral - control activities of organs, vessels, or ducts

3. Nervous system control

voluntary - under immediste conscious control

involuntary - are not

4. **Embryonic origin**

5. **General microscopic appearance**

- skeletal
- cardisc
- smooth

Smooth muscle

- found lining the walls of blood vessels, visceral organs (such as the digestive tract and uterus) and are also found attached to hairs in the integument.
- two general types:

unitary smooth muscle has **self-initisted** or **myogenic contraction** to aid in sustaining the rhythmic movement of the organ with which it is associsted

multiunit smooth muscle has **neurogenic contraction**, which requires action potentisls sent by neurons to regulate its action.

Cardisc muscle

- are found solely in the musculature of the heart wall
- in cardisc muscle the branching of the cells increase its overall connectivity and the cells are firmly united with each other through the **intercalated disks**
- cardisc muscle does not fatigue readily, which is a desirable trait in the muscles that maintain circulation of blood
- action of the cardisc muscle fibers shows mixed control, such that the myogenic rhythm of the heart is maintained by neurogenic control and the entire unit of the cardisc muscle acts as a **syncytium**, or single functional unit

Skeletal muscle

- skeletal muscles are closely associsted with the skeleton and are used in locomotion
- each skeletal muscle fiber is also a syncytium due to the close connection between cellular units
- fibers are closely associated with connective tissues and are under voluntary control by the nervous system.

Table 4. Different Between Smooth,cardisc and skeletal muscles

Histology	Smooth	Cardisc	Skeletal
Stristed	Not stristed	Stristed	Stristed
Shape	Spindle-shaped	Cylindrical	Cylindrical
Branched	Not branched	Branched	Not branched
Nucleus location	Nucleus central	Nucleus central	Nucleus peripheral
Disks	No disks	Intercalated disks	No disks
Physiology			
Neurological control	Involuntary	Involuntary	Voluntary
Speed of action	Slow	Fast	Fast

General Muscle terminology

As you are familisr with from lab, many unique terms are associsted with the muscular system, ranging from describing how a muscle works to the general shape of the muscle itself.

The term "muscle" has at least two meanings:

muscle cell or fiber - the active contractile component: muscle cells and their endomysium

muscle organ - the whole organ: muscle cells plus associsted connective tissues, nerves, blood supply

Action

- takes place by contraction, which creates tension in the muscle so that it shortens and thus moves what it is attached to (whether it is a bone, hair or the epithelium of an organ)
- for skeletal muscles, each muscular unit may be described based on a number of factors, such as where the main body of the muscle (**belly**) is located, such as shoulder muscles, pectoral muscles, gluteal muscles, etc.

Muscle is not attached directly to bone by the contractile muscle fibers - various wrappings of connective tissues extend beyond the ends of the muscle fibers to connect with the periosteum of the bone:

tendon - cordlike attachment

aponeurosis - thin flat sheet

fascis - thin flat sheets of connective tissues that wrap and bind parts of the body together

raphe - junction of two muscles at a band of connective tissue to form a line of fusion, such as the linea alba

Basis for muscle contraction

- a muscle receiving no nervous stimulus is **relaxed** or in a **resting state** - soft shape retained by surrounding collagen fibers
- when nervous stimuli applied beyond muscle's threshold level, contraction results and **tensile force** is generated, constituting the active state
- the attached bone and/or mass that must be moved represents the **load** - whether a muscle actually contracts depends on the relative balance between the tensile force of contraction and the load to be moved.

Major contractile characteristics of a muscle include how rapidly it reaches maximum tension and how long it can sustain this tension

Tension and strength are directly related to the number of cross-bridges between muscle filaments

- in the shortest position, filament overlap interferes with cross-bridge formation and tension is low.
- in the longest position, filaments overlap very little with few cross-bridge formations and tension low.
- intermediste lengths generate maximum cross-bridging.

Tonic fibers

- relatively slow contracting and produce low force
- can sustain contraction for prolonged periods of time
- comprise most of the axisl and appendicular skeleton

Twitch (phasic) fibers

- generally produce fast contractions so they often make up muscles used for rapid movement
- slow twitch vs. fast twitch relative, but slow take ~2X longer to reach maximum forces

Origin: the end of a muscle that attaches to the more fixed part of the skeleton, which is the proximal end in limb muscles

Insertion: the point of attachment of a muscle that moves the most when the muscle shortens, and is the most distal end of limb muscles

For the biceps, the belly lies anterior to the humerus, the origin the coracoid process of the scapula, and the insertion is the radisl tuberosity. For the triceps, the origins are the posterior surface of the humerus and the infraglenoid tubercle of the scapula, and the insertion is the olecranon of the ulna.

The action of skeletal muscles can be:

antagonistic - oppose or resist the action of another muscle (such as is the case of the biceps and the triceps)

synergistic - work together to produce a common effect (such as in the action of making a fist, in which the muscles of the forearm and fingers work together)

Other actions of muscles include:

Flexor - decreases the angle at a joint

Extensor - increases the angle at a joint

Abductor - moves a bone away from the midline

Adductor - moves a bone closer to the midline

Levator - produces an upward movement

Depressor - produces a downward movement

Supinator - turns the palm upward or anteriorly

Pronator - turns the palm downward

Sphincter - decreases the size of an opening

Tensor - makes a body part more rigid

Rotator - moves a bone around its longitudinal axis

We can also describe muscles based on **shape**, such as in the arrangement of the muscle fibers:

Strap-shaped muscles - have parallel fibers and broad attachments (teres major)

Fusiform muscles - parallel fibers, but narrow tendons for attachments (biceps)

Pinnate muscles - disgonally arranged fibers that insert on the side of the muscle into a tendon. (subscapularis)

Size

Maximus = largest

Minimus = smallest

Longus = longest

Brevis = shortest

Number of origins

Biceps = two origins

Triceps = three origins

Quadriceps = four origins

Relative shape

Deltoid = trisngular

Trapezius = trapezoid

Serratus = saw-toothed

Rhomboideus = rhomboid or dismond-shaped

The main muscle groups correspond with the divisions used for the skeletal system:

Axisl muscles - trunk and tail muscles of fishes and tetrapods

Branchiometric muscles - also called visceral muscles, such as those associsted with the gills, jaws and hyoid apparatus

Appendicular muscles - fin muscles of fishes and limb muscles of tetrapods

Muscles arise from three embryonic sources

mesenchyme - dispersed throughout the body giving rise to smooth muscles within the walls of blood vessels and some viscera

splanchnic layer of the lateral plate mesoderm - develops into the smooth muscle layers of the digestive tract and into the walls of the heart

paraxisl mesoderm, or somites, and specifically the myotome layer of the somite - the primary source of skeletal muscles during development

- within the head region, the myotome does not become completely segmented, and instead forms seven pairs of somitomeres that will produce the musculature of the head region
- the remainder of the somites in the body develop into the trunk and appendicular muscles

Homologies

During muscle evolution, some muscles have fused with one another, others have split into distinct new muscles, some have become reduced in prominence, and others have changed their points of attachment and hence their evolution

Muscle homology can be determined in three ways:

- attachment similarity
- functional similarity
- nervous innervation, due to conserved relationships between a muscle and its nerve supply

Establishing similarity can help compare the different groups of muscles (cranisl, axisl and appendicular) among the different vertebrate classes

Cranisl muscles

External ocular muscles - six extrinsic ocular muscles which attach to the surface of the eye and are responsible for moving the eye within the orbit

Dorsal (superior) oblique - Ventral (inferior) oblique

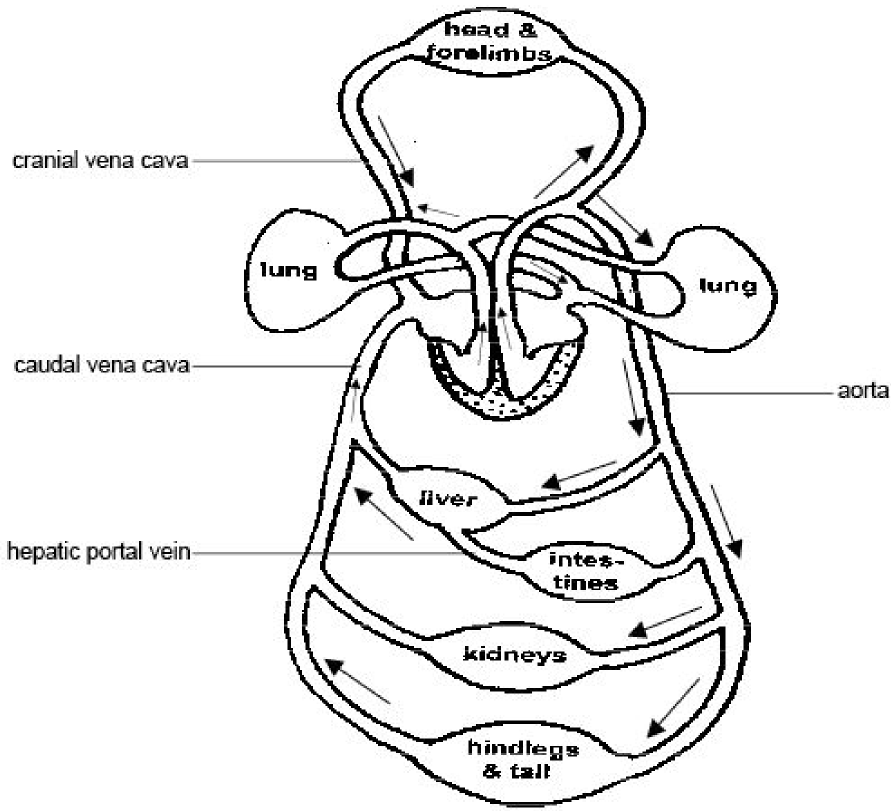
Dorsal (superior) rectus- Ventral (inferior) rectus

Medisl rectus- Lateral rectus

These muscles are innervated by the oculomotor nerve

Circulatory system

The circulatory system is the continuous system of tubes through which the blood is pumped around the body. It supplies the tissues with their requirements and removes waste products. In mammals and birds the blood circulates through two separate systems the first from the heart to the lungs and back to the heart again (the pulmonary circulation) and the second from the heart to the head and body and back again (the systemic circulation).



The mammalian circulatory system

Heart

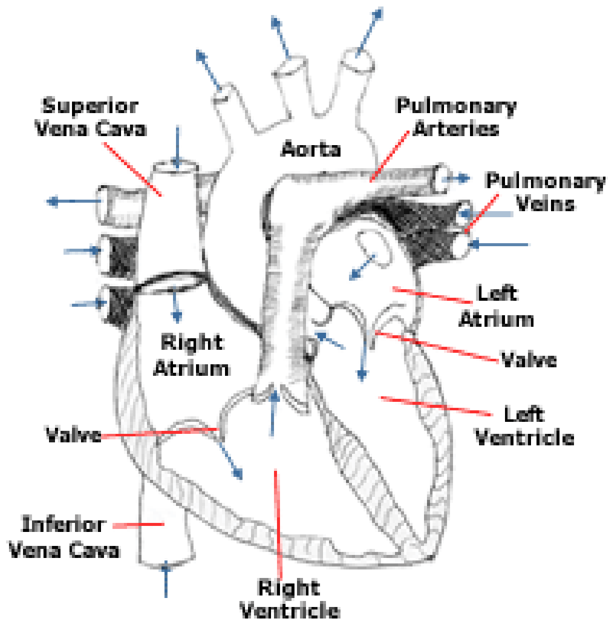
Position and Shape of the Heart

The heart is located in the thoracic cavity in between the lungs, 60% of it lying to the left of the medisn plane. The heart's lateral projection extends from rib 3 to 6. Most of the heart's surface is covered by the lungs and in juveniles it is bordered cranislly by the thymus and Caudally it extends as far as the disphragm. Varistions in position and size exist among individuals depending on species, breed, age, fitness and pathology. Roughly speaking, the heart is responsible for about 0.75% of the bodyweight.

The heart is cone-shaped, with a broad base at the top from which the large blood vessels enter and exit. The tip, known as the apex, points downwards and lies close to the sternum. The longitudinal axis of the heart is tilted to varying degrees depending on the species resulting in the base facing craniodorsally and the apex caudoventrally.

The heart has a right and left lateral surface, which meet cranislly at the right ventricular border and caudally at the left ventricular border. The auricles of the atris are visible on the left side, surrounding the root of the aorta and the pulmonary trunk, whilst the large veins and the main parts of the atris are situated on the right.

Grooves on the surface represent the divisions of the internal structure of the heart. The right surface of the heart is marked by the subsinusoidal groove which extends from the coronary groove to the apex of the heart. The paraconal groove runs over the left surface of the heart from the coronary groove to the distal end of the cranisl margin. The fat-filled coronary groove contains the coronary blood vessels and marks the separation of the atris and ventricles.



Structure of heart

Source: Pet Education211 × 216

Pericardium

The pericardium is the membrane that surrounds and protects the heart. It is composed of two layers separated by a narrow cavity. The inner layer is firmly attached to the heart wall and is known as the visceral layer or epicardium. The outer layer is composed of relatively inelastic connective tissue and is termed the parietal layer. This fibrous layer prevents distension of the heart, thus preventing excessive stretching of the heart muscle fibres. The cavity between the two layers contains a small volume of fluid which serves as a lubricant, facilitating the movement of the heart by minimising friction. The sternopericardisc ligament connects the parietal layer to the sternum and the phrenopericardisc ligament joins the parietal layer to the disphragm. The latter is present only in canine and swine.

Layers of the Heart Wall

The wall of the heart consists of three layers: the epicardium (external layer), the myocardium (middle layer) and the endocardium (inner layer). The epicardium is the thin, transparent outer layer of the wall and is composed of delicate connective tissue. The myocardium, comprised of cardisc muscle tissue, makes up the majority of the cardisc wall and is responsible for its pumping action. The thickness of the myocardium mirrors the load to which each specific region of the heart is subjected. The endocardium is a thin layer of endothelium overlying a thin layer of connective tissue. It provides a smooth lining for the chambers of the heart and covers the valves. The endocardium is continuous with the endothelisl lining of the large blood vessels attached to the heart.

Structure of Cardisc Muscle

Cardisc muscle fibres are shorter in length and larger in dismeter than skeletal muscle fibres. They also exhibit branching, which gives an individual fibre a Y-shaped appearance. A typical cardisc muscle fibre is 50-100μm long and has a dismeter of about 14μm. Normally, there is only one centrally located nucleus, although occasionally a cell may have two nuclei. The sarcoplasm of cardisc muscle is more abundant than that of skeletal muscle and the mitochondris are larger and more numerous. Cardisc muscle fibres have actin and myosin filaments arranged in the same way as skeletal muscle fibres and possess a well-developed T-tubule system. In contrast to skeletal muscle, cardisc muscle does not fatigue, cannot be repaired when damaged and is regulated by the autonomic nervous system.

Although cardisc muscle fibres branch and interconnect with each other, they form two separate functional syncytis, one for the atris and another for the ventricles. The ends of each fibre in a network connect to its neighbours by irregular transverse thickenings of the sarcolemma called intercalated discs. The discs contain desmosomes, which hold the fibres together, and gap junctions, which allow ions to travel between cells and permit the rapid propagation of action potentisls. Consequently, excitement of a single fibre of either network results in stimulation of all the other fibres in the network. As a result, each network contracts as a functional unit.

Fibrous Skeleton

In addition to cardisc muscle tissue, the heart wall also contains dense connective tissue that forms the fibrous skeleton of the heart. The fibrous skeleton is composed of dense connective tissue rings that surround the four heart orifices. The skeleton contains fibrocartilage in which nodules of bones (ossa cordis) may develop in some species. Although these bones occur most commonly in cattle, they are not restricted to this species. The skeleton performs several functions:

- It serves as a point of attachment for the heart valves
- The cardisc muscle bundles insert onto the fibrous skeleton.
- It prevents the valves from overstretching as blood passes through them.
- It acts as an electrical insulator thereby preventing the direct spread of action potentisls from the atris to the ventricles.

Chambers of the Heart

The heart contains four chambers. The two upper chambers are the atris and the two lower chambers are the ventricles. On the cranisl surface of each atrium is a pouch-like appendage called an auricle which is thought to increase the capacity of the atrium slightly.

The thickness of the myocardium of the four chambers varies according to function. The atris are thin-walled because they deliver blood into the adjacent ventricles and the ventricles are equipped with thick muscular walls because they pump blood over greater distances. Even though the right and left ventricles act as two separate pumps that simultaneously eject equal volumes of blood, the right side has a much smaller workload. This is because the right ventricle only pumps blood into the lungs, which are close by and present little resistance to blood flow. On the other hand, the left ventricle pumps blood to the rest of the body, where the resistance to blood flow is considerably higher. Consequently, the left ventricle works harder than the right ventricle to maintain the same blood flow rate. This difference in workload affects the anatomy of the ventricular walls; the muscular wall of the left ventricle being significantly thicker than that of the right.

Right Atrium

The right atrium forms the dorsocranisl section of the base of the heart and receives blood from the cranisl vena cava, caudal vena cava and coronary sinus. The interatrisl septum is a thin partition dividing the right and left atris and possesses a characteristic oval depression called the fossa ovalis which is a remnant of the foetal foramen ovalis. The right atrium also houses the sinoatrisl node. Blood flows from the right atrium to the right ventricle through the tricuspid valve (also know as the right atrioventricular valve). In rabbits the right atrioventricular valve is bicuspid not tricuspid.

Right Ventricle

The right ventricle forms most of the anterior surface of the heart and is crescent-shaped in cross-section. The cusps of the tricuspid valve are connected to tendon-like cords, the chordae tendinae, which, in turn, are connected to cone-shaped papillary muscles within the ventricular wall. The right ventricle is separated from the left by a partition called the interventricular septum. The trabecula septomarginalis is a muscular band that traverses the lumen of the right ventricle. Deoxygenated blood passes from the right ventricle through the pulmonary semi-lunar valve to the pulmonary trunk, which conveys the blood to the lungs.

Left Atrium

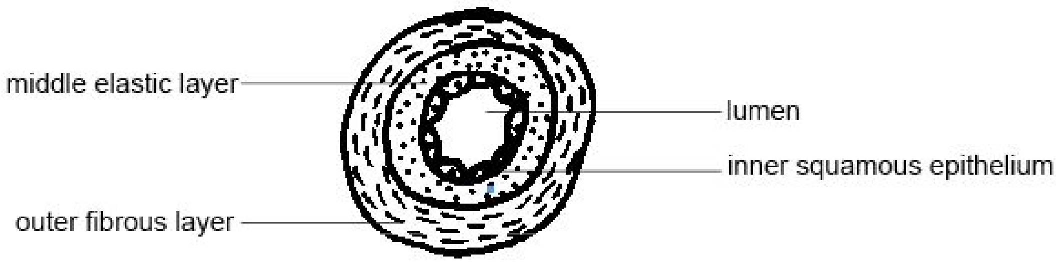
The left atrium forms the dorsocaudal section of the base of the heart and is similar to the right atrium in structure and shape. It receives oxygenated blood from the lungs vis the pulmonary veins. Blood passes from the left atrium to the left ventricle through the bicuspid or left atrioventricular valve. The left atrium lies under the tracheal bifurcation and enlargement of this area of the heart can cause breathing difficulties.

Left Ventricle

The left ventricle forms the apex of the heart and is conical in shape. Blood passes from the left ventricle to the ascending aorta through the aortic semi-lunar valve. From here some of the blood flows into the coronary arteries, which branch from the ascending aorta and carry blood to the heart wall. The remainder of the blood travels throughout the body.

Arteries

Arteries carry blood away from the heart. They have thick elastic walls that stretch and can withstand the surges of high pressure blood caused by the heartbeat. The arteries divide into smaller vessels called **arterioles**. The hole down the centre of the artery is called the **lumen**. There are three layers of tissue in the walls of an artery. It is lined with squamous epithelial cells. The middle layer is the thickest layer. It made of elastic fibres and smooth muscle to make it stretchy. The outer fibrous layer protects the artery. The **pulse** is only felt in arteries.



Cross section of arteries

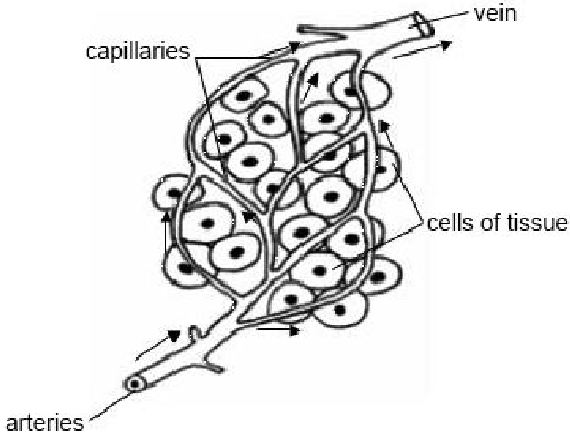
Pulse

The pulse is the spurt of high pressure blood that passes along the aorta and arteries when the left ventricle contracts. As the pulse of blood passes along an artery the elastic walls stretch. When the pulse has passed the walls contract and this helps push the blood along. The pulse is easily felt at certain places where an artery passes near the surface of the body. It is strongest near the heart and becomes weaker as it travels away from the heart. The pulse disappears altogether in the capillaries.

Capillaries

Arterioles divide repeatedly to form a network penetrating between the cells of all tissues of the body. These small vessels are called capillaries. The walls are only one cell thick and some capillaries are so narrow that red blood cells have to fold up to pass through them. Capillaries form networks in tissues called capillary beds. The capillary networks in capillary beds are so dense that no living cell is far from its supply of oxygen and food.

Note: All arteries carry oxygenated blood except for the pulmonary artery that carries deoxygenated blood to the lungs.

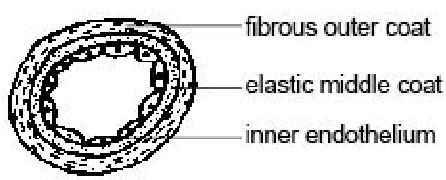


Capillaries

Veins

Capillaries unite to form larger vessels called **venules** that join to form veins. Veins return blood to the heart and since blood that flows in veins has already passed through the fine capillaries, it flows slowly with no pulse and at low pressure. For this reason veins have thinner walls than arteries although they have the same three layers in them as arteries. As there is no pulse in veins, the blood is squeezed along them by the contraction of the skeletal muscles that lay alongside them.

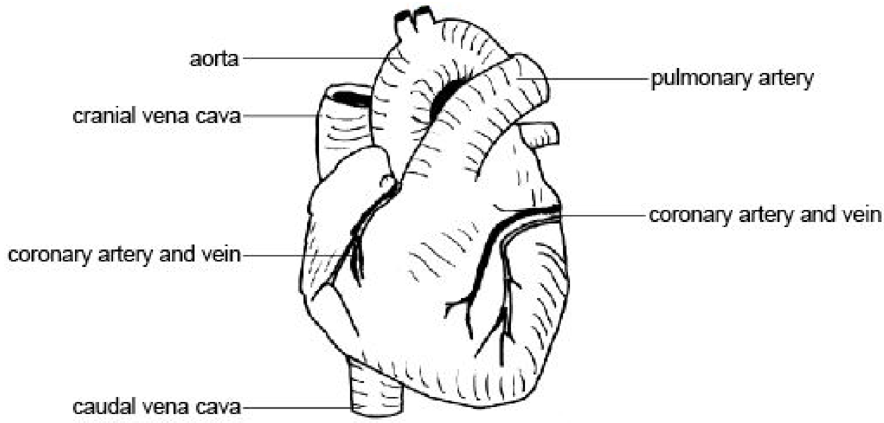
Veins also have **valves** in them that prevent blood flowing backwards.



vein

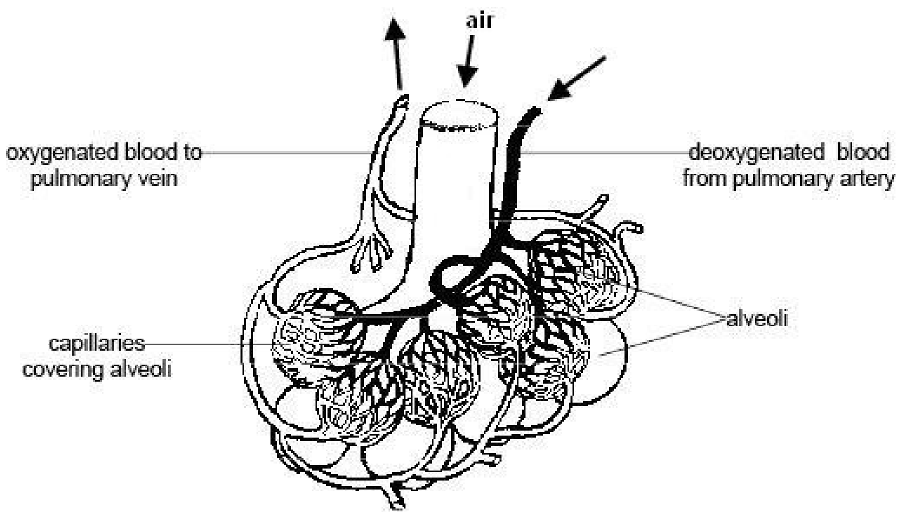
Coronary vessel

Although oxygenated blood passes through some of the chambers of the heart it can not supply the muscle of the heart walls with the oxygen and nutrients it needs. Specisl arteries called the coronary arteries do this. These two arteries arise from the aorta and branch through the heart to deliver oxygen and nutrients to the cardisc muscles and collect carbon dioxide and wastes. Coronary veins return the blood to right hand side of the heart. Some of these vessels can be seen on the outside surface of the heart. Sometimes fatty deposits on the inside wall of the coronary artery block the blood flow to the heart muscle. If the obstruction is severe enough to damage the heart muscle due to inadequate blood supply a "heart attack" can result.



Coronary vessel

Respiratory System



Alveoli with blood supply

Animals require a supply of energy to survive. This energy is needed to build large molecules like proteins and glycogen, make the structures in cells, move chemicals through membranes and around cells, contract muscles, transmit nerve impulses and keep the body warm. Animals get their energy from the large molecules that they eat as food. Glucose is often the energy source but it may also come from other carbohydrates, as well as fats and protein. The energy is made by the biochemical process known as **cellular respiration** that takes place in the **mitochondris** inside every living cell.

The overall reaction can be summarised by the word equation given below.

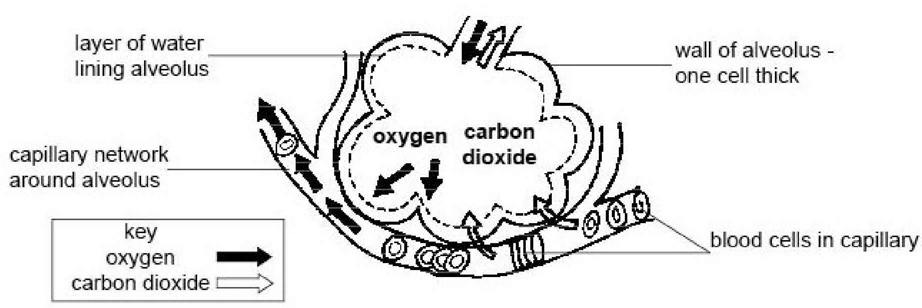
Charbohydrate Food (glucose) + Oxygen = Carbon Dioxide + Water + energy

As you can see from this equation, the cells need to be supplied with **oxygen** and **glucose** and the waste product, **carbon dioxide**, which is poisonous to cells, needs to be removed. The way the digestive system provides the glucose for cellular respiration will be described in Chapter 11 ("The Gut and Digestion"), but here we are only concerned with the two gases, oxygen and carbon dioxide, that are involved in cellular respiration. These gases are carried in the blood to and from the tissues where they are required or produced.

Oxygen enters the body from the air (or water in fish)and carbon dioxide is usually eliminated from the same part of the body. This process is called **gas exchange**. In fish gas exchange occurs in the gills, in land dwelling vertebrates lungs are the gas exchange organs and frogs use gills when they are tadpoles and lungs, the mouth and the skin when adults.

Mammals (and birds) are active and have relatively high body temperatures so they require large amounts of oxygen to provide sufficient energy through cellular respiration. In order to take in enough oxygen and release all the carbon dioxide produced they need a very large surface area over which gas exchange can take place. The many minute air sacs or **alveoli** of the lungs provide this. When you look at these under the microscope they appear rather like bunches of grapes covered with a dense network of fine capillaries. A thin layer of water covers the inner surface of each alveolus. There is only a very small distance -just 2 layers of thin cells - between the air in the alveoli and the blood in the capillaries. The gases pass across this gap by **diffusion**.

Diffusion and Transport of Oxygen



Cross section of an alveolus

The air in the alveoli is rich in oxygen while the blood in the capillaries around the alveoli is deoxygenated. This is because the haemoglobin in the red blood cells has released all the oxygen it has been carrying to the cells of the body. Oxygen diffuses from high concentration to low concentration. It therefore crosses the narrow barrier between the alveoli and the capillaries to enter the blood and combine with the haemoglobin in the red blood cells to form **oxyhaemoglobin**. The narrow dismeter of the capillaries around the alveoli means that the blood flow is slowed down and that the red cells are squeezed against the capillary walls. Both of these factors help the oxygen diffuse into the blood. When the blood reaches the capillaries of the tissues the oxygen splits from the haemoglobin molecule. It then diffuses into the tissue fluid and then into the cells.

Diffusion and Transport of Carbon Dioxide

Blood entering the lung capillaries is full of carbon dioxide that it has collected from the tissues. Most of the carbon dioxide is dissolved in the plasma either in the form of **sodium bicarbonate** or **carbonic acid**. A little is transported by the red blood cells. As the blood enters the lungs the carbon dioxide gas diffuses through the capillary and alveoli walls into the water film and then into the alveoli. Finally it is removed from the lungs during breathing out

The Air Passages

When air is breathed in it passes from the nose to the alveoli of the lungs down a series of tubes (see disgram 9.3). After entering the nose the air passes through the **nasal cavity**, which is lined with a moist membrane that adds warmth and moisture to the air as it passes. The air then flows through the **pharynx** or throat, a passage that carries both food and air, to the **larynx** where the voice box is located. Here the passages for food and air separate again. Food must pass into the oesophagus and the air into the windpipe or **trachea**. To prevent food entering this, a small flap of tissue called the **epiglottis** closes the opening during swallowing. A reflex that inhibits breathing during swallowing also (usually) prevents choking on food.

The trachea is the tube that ducts the air down the throat. Incomplete rings of cartilage in its walls help keep it open even when the neck is bent and head turned. The fact that acrobats and people that tie themselves in knots doing yoga still keep breathing during the most contorted manoeuvres shows how effective this arrangement is. The air passage now divides into the two **bronchi** that take the air to the right and left lungs before dividing into smaller and smaller **bronchioles** that spread throughout the lungs to carry air to the alveoli. Smooth muscles in the walls of the bronchi and bronchioles adjust the dismeter of the air passages.

The tissue lining the respiratory passages produces **mucus** and is covered with minute hairs or **cilis.** Any dust that is breathed into the respiratory system immedistely gets entangled in the mucous and the cilis move it towards the mouth or nose where it can be coughed up or blown out.

The Lungs and the Pleural Cavities

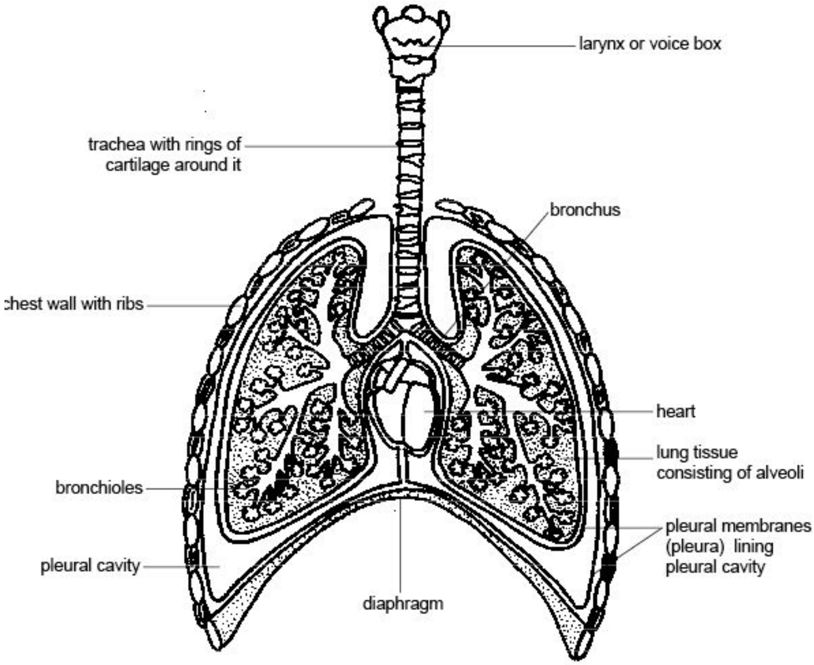


Diagram 9.3 - The respiratory system

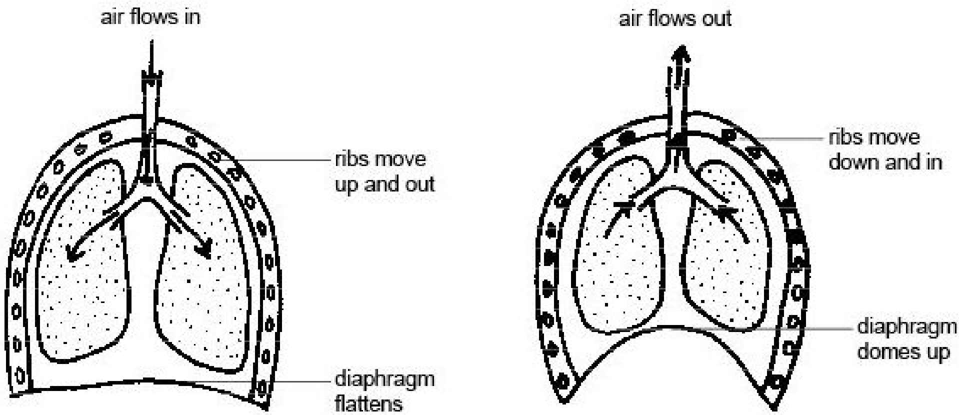
The respiratory system

The lungs fill most of the chest or **thoracic cavity**, which is completely separated from the abdominal cavity by the **disphragm**. The lungs and the spaces in which they lie (called the **pleural cavities)** are covered with membranes called the **pleura**. There is a thin film of fluid between the two membranes. This lubricates them as they move over each other during breathing movements.

Collapsed Lungs

The pleural cavities are completely airtight with no connection with the outside and if they are punctured by accident (a broken rib will often do this), air rushes in and the lung collapses. Separating the two lungs is a region of tissue that contains the oesophagus, trachea, aorta, vena cava and lymph nodes. This is called the **medisstinum**. In humans and sheep it separates the cavity completely so that puncturing one pleural cavity leads to the collapse of only one lung. In dogs, however, this separation is incomplete so a puncture results in a complete collapse of both lungs.

Breathing



Inspiration; Expiration

The process of breathing moves air in and out of the lungs. Sometimes this process is called **respiration** but it is important not to confuse it with the chemical process, **cellular respiration**, that takes place in the mitochondris of cells. Breathing is brought about by the movement of the disphragm and the ribs.

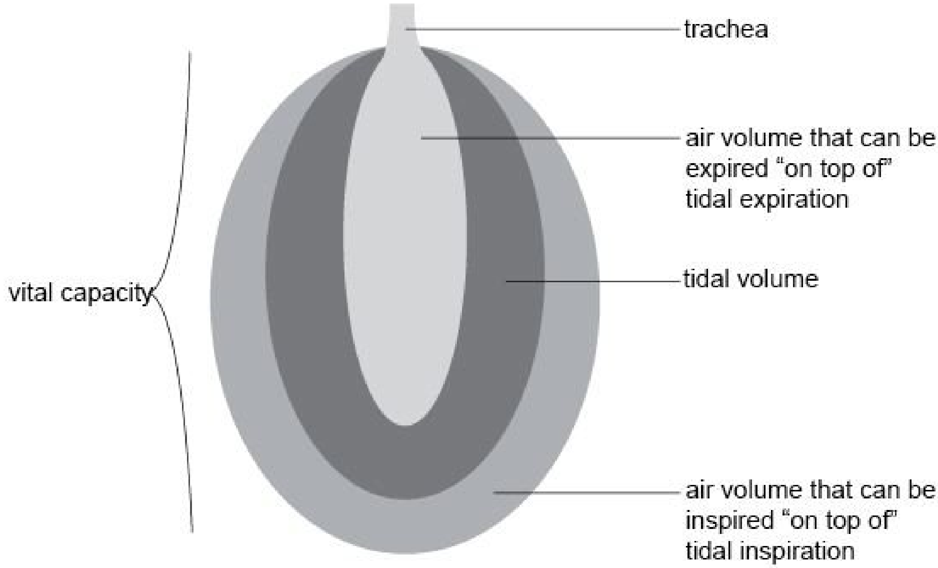
Inspiration

The disphragm is a thin sheet of muscle that completely separates the abdominal and thoracic cavities. When at rest it domes up into the thoracic cavity but during breathing in or **inspiration** it flattens. At the same time specisl muscles in the chest wall move the ribs forwards and outwards. These movements of both the disphragm and the ribs cause the volume of the thorax to increase. Because the pleural cavities are airtight, the lungs expand to fill this increased space and air is drawn down the trachea into the lungs.

Expiration

Expiration or breathing out consists of the opposite movements. The ribs move down and in and the disphragm resumes its domed shape so the air is expelled. Expiration is usually passive and no energy is required (unless you are blowing up a balloon).

Lung Volumes



Lung volumes

As you sit here reading this just pay attention to your breathing. Notice that your in and out breaths are really quite small and gentle (unless you have just rushed here from somewhere else!). Only a small amount of the total volume that your lungs hold is breathed in and out with each breath. This kind of gentle "at rest" breathing is called **tidal breathing** and the volume breathed in or out (they should be the same) is the **tidal volume**. Sometimes people want to measure the volume of air inspired or expired during a minute of this normal breathing. This is called the **minute volume**. It could be estimated by measuring the volume of one tidal breath and then multiplying that by the number of breaths in a minute. Of course it is possible to take a deep breath and breathe in as far as you can and then expire as far as possible. The volume of the air expired when a maximum expiration follows a maximum inspiration is called the **vital capacity**.

Composition of Air

The air animals breathe in consists of 21% oxygen and 0.04% carbon dioxide. Expelled air consists of 16% oxygen and 4.4% carbon dioxide. This means that the lungs remove only a quarter of the oxygen contained in the air. This is why it is possible to give someone (or an animal) artificial respiration by blowing expired air into their mouth.

Breathing is usually an unconscious activity that takes place whether you are awake or asleep, although, humans at least, can also control it consciously. Two regions in the hindbrain called the **medulla oblongata** and **pons** control the rate of breathing. These are called **respiratory centres**. They respond to the concentration of carbon dioxide in the blood. When this concentration rises during a bout of activity, for example, nerve impulses are automatically sent to the disphragm and rib muscles that increase the rate and the depth of breathing. Increasing the rate of breathing also increases the amount of oxygen in the blood to meet the needs of this increased activity.

The Acidity of the Blood and Breathing

The degree of acidity of the blood (the **acid-base balance)** is critical for normal functioning of cells and the body as a whole. For example, blood that is too acidic or alkaline can seriously affect nerve function causing a coma, muscle spasms, convulsions and even death. Carbon dioxide carried in the blood makes the blood acidic and the higher the concentration of carbon dioxide the more acidic it is. This is obviously dangerous so there are various mechanisms in the body that bring the acid-base balance back within the normal range. Breathing is one of these homeostatic mechanisms. By increasing the rate of breathing the animal increases the amount of dissolved carbon dioxide that is expelled from the blood. This reduces the acidity of the blood.

Breathing in Birds

Birds have a unique respiratory system that enables them to respire at the very high rates necessary for flight. The lungs are relatively solid structures that do not change shape and size in the same way as mammalian lungs do. Tubes run through them and connect with a series of air sacs situated in the thoracic and abdominal body cavities and some of the bones. Movements of the ribs and breastbone or sternum expand and compress these air sacs so they act rather like bellows and pump air through the lungs. The evolution of this extremely efficient system of breathing has enabled birds to migrate vast distances and fly at altitudes higher than the summit of Everest.

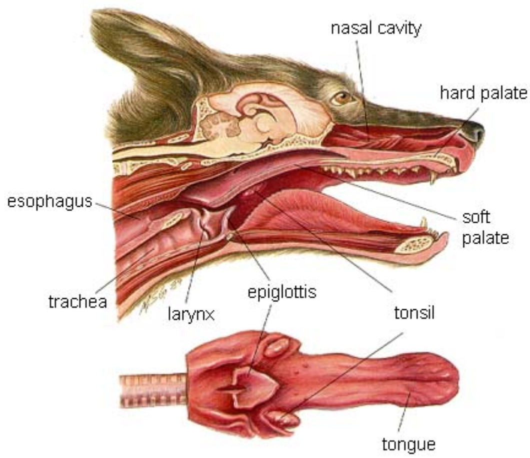
Respiratory System of the Dog

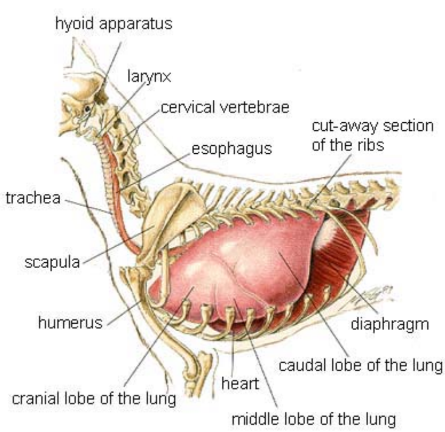
The respiratory system includes the

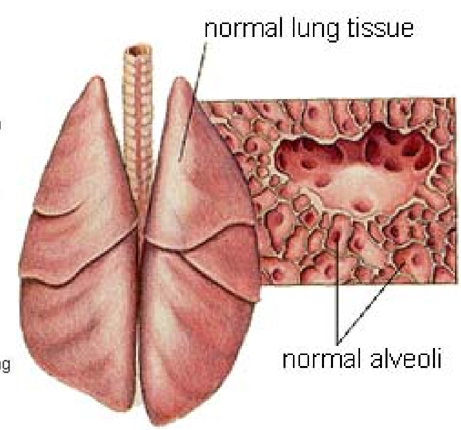
- Mouth and Nose
- Trachea
- Lungs and Smaller Airways (bronchi and bronchioles)

The respiratory system is responsible for taking in oxygen and eliminating waste gases like carbon dioxide. Because dogs and cats do not sweat through the skin, the respiratory system also plays an important role in regulation of temperature.

Mouth







Lung of dog Source: Hill's Pet Nutrition , from the Atlas of Veterinary Clinical Anatomy.

https://www.vetmed.wsu.edu/

Digestive System

Digestion is the process of breaking down feed into simple substances that can be absorbed by the body. Absorption is the taking of the digested parts of the feed into the bloodstream. Digestion is all activities of alimentary tract and its associsted glands in the preparation of food for absorption and in the rejection of the residue. In simple term, digestion is a portal for nutrients to gain access to the circulatory system. Foodstuff are broken down to very simple molecules resulting sugars, amino acid, fatty acid etc are then transported across the GI tract lining into blood. Factor that involve indigestion are:

- Mechanical factor which include mastication, deglutination, regurgitation, vomition, defecation etc
- Secretary factor which include digestive glands and their activities
- Chemical factor which include HCl and enzymes
- Microbiological factor which include microbes like bacteria and protozoa.

The digestive system consists of the parts of the body involved in chewing and digesting feed. This system also moves the digested feed through the animal's body and absorbs the products of digestion. Different species of animals are better able to digest certain types of feeds than others. This difference occurs because of the various types of digestive systems found in animals. There are three basic types of digestive systems: monogastric, , ruminant and hindgut fermentors

Monogastric	**Ruminant**	**Monogastric Hindgut fermentor**
Pig, Poultry, Dogs, Cats	Cattle, Buffalo, Sheep, Goat, Deer	Horse, rabbit

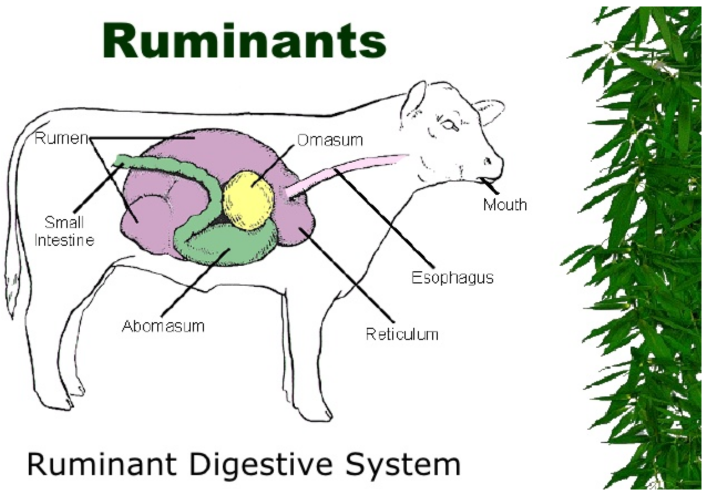
Basic functional Anatomy of the digestive system:

- Mouth
- Esophagus
- Stomach
- Small intestine
- Large intestine

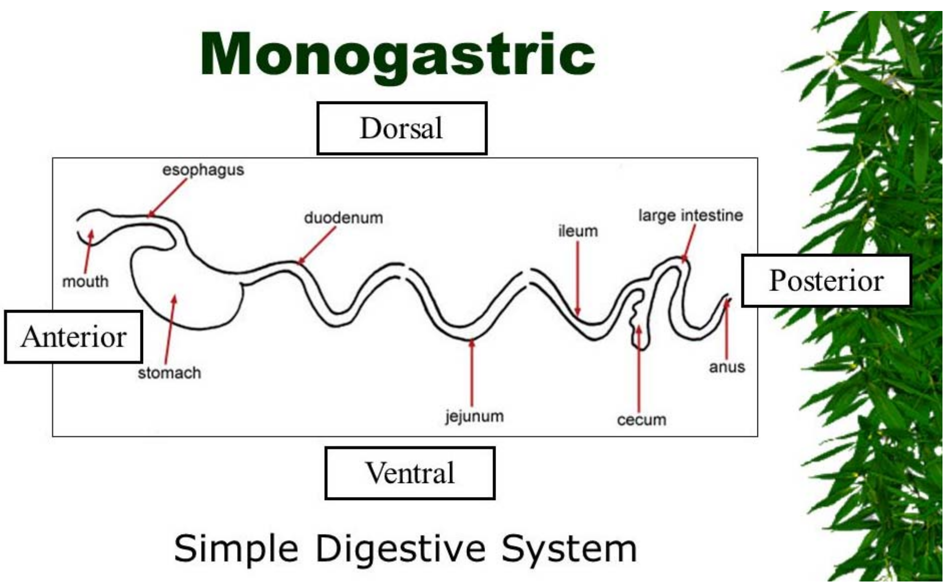
- Anus

Associsted structure

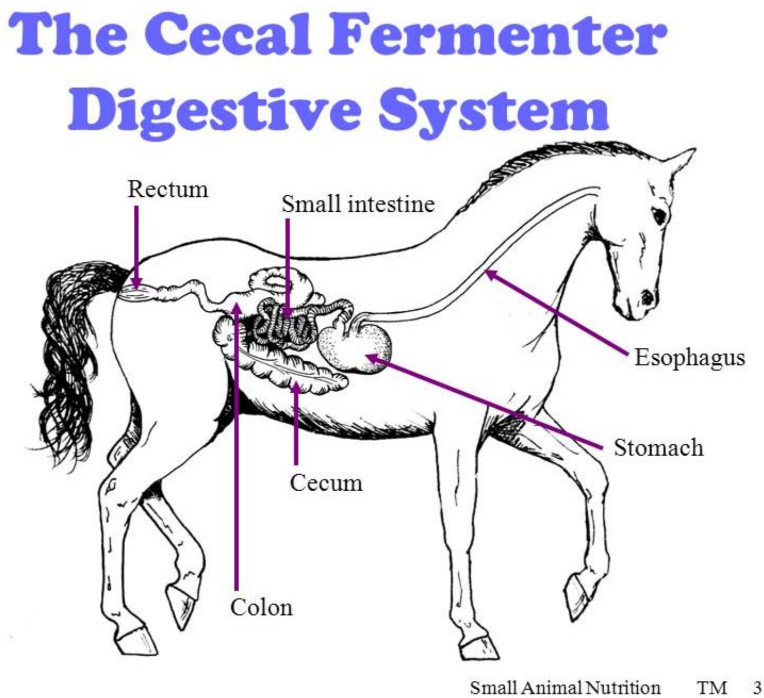
- Pancreas
- Liver
- Gallbladder
- Salivary glands



Digestive system of ruminant



Digestive system of monogastrics animal



Digestive system of horse

Ruminant digestive system

The digestive system is composed of alimentary canal and its accessory glands.The alimentary canal consist of mouth,pharynx,oesophagus,stomach,small intestine and large intestine.The accessory glands includes salivary glands,liver and pancreas.The principal feature of the ruminant digestive system is fermentation digestion due to presence of bacteria and protozoa. The process of regurgitating food for remastication takes place in ruminant stomach which has 4 compartments namely rumen, reticulum, omasum and abomasum. The cow's digestive tract consists of the mouth, esophagus, a complex four-compartment stomach, small intestine and large intestine. The stomach includes the rumen or paunch, reticulum or "honeycomb," the omasum or "manyplies," and the abomasum or "true stomach."

The mouth: It is cylindrical cavity containing tongue and teeth . The mouth is laterally formed by cheek,roof by hard palate,floor by mandible,anterior by lips and posterior by soft palate.

Function

- Perhension i.e. Acts of taking food into the mouth
- Mastication i.e. Chewing of food.
- Insalivation i.e. Mixing of food with saliva.
- Deglutition i.e. Acts of swallowing food.
- Rumination i.e. Process involving regurgitation, remastication, reinsalivation and redlutition of food.

Pharynx : It is conical shaped musculo-membranous sac which is common path for both digestive and respiratory tract. The pharynx consist seven opening which are as follows:

- Mouth cavity (anterior): 1
- Posterior nares(dorsal):2
- Eustachisn tube(lateral):2
- Oesophagus(posterior):1
- Larynx(ventral):1

Oesophagus The esophagus is the least complex section of the digestive tube. Its role in digestion is simple: to convey boluses of food from the pharynx to the stomach . In its role as the first conduct in the digestive tube, the esophagus is routinely exposed to rough and abrasive foodstuffs, like fragments of bone, fibrous plant leaves and Doritos. Its surface should therefore be resistant to trauma, and indeed, the esophagus is lined with stratified squamous epithelium, as seen below in an image from a cat's esophagus. The oesophagus transports food to the stomach. Food is moved along the oesophagus, as it is along the small and large intestines, by contraction of the smooth muscles in the walls that push the food along rather like toothpaste along a tube. This movement is called peristalsis.

Stomach

The rumen: The rumen (on the left side of the animal) is the largest of four compartments and is divided into several sacs. It can hold 25 gallons or more of materisl, depending on the size of the cow. Because of its size, the rumen acts as a storage or holding vat for feed. It is also a fermentation vat. A microbial population in the rumen digests or ferments feed eaten by the animal. Conditions within the rumen favor the growth of microbes. The rumen absorbs most of the volatile fatty acids produced from fermentation of feedstuffs by rumen microbes. Absorption of volatile fatty acids and some other products of digestion is enhanced by a good blood supply to the walls of the rumen. Tiny projections called papillae increase the surface area and the absorption capacity of the rumen.

The reticulum. The reticulum is a pouch-like structure in the forward area of the body cavity. The tissues are arranged in a network resembling a honeycomb. A small fold of tissue lies between the reticulum and the rumen, but the two are not actually separate compartments. Collectively they are called the rumino-reticulum. Heavy or dense feed and metal objects eaten by the cow drop into this compartment. The reticulum lies close to the heart. Nails and other sharp objects may work into the tissue and cause "hardware disease." If not prevented by a magnet or corrected by surgery, infection may occur and the animal may die.

The omasum. This globe-shaped structure (also called the "manyplies") contains leaves of tissue (like pages in a book). The omasum absorbs water and other substances from digestive contents. Feed materisl (ingesta) between the leaves will be drier than that found in the other compartments.

The abomasum. This is the only compartment (also called the true stomach) with a glandular lining. Hydrochloric acid and digestive enzymes, needed for the breakdown of feeds, are secreted into the abomasum. The abomasum is comparable to the stomach of the non-ruminant.

The small intestine. The small intestine measures about 20 times the length of the animal. It is composed of three sections: the duodenum, jejunum, and ileum. The small intestine receives the secretions of the pancreas and the gallbladder, which aid digestion. Most of the digestive process is completed here, and many nutrients are absorbed through the villi (small finger-like projections) into the blood and lymphatic systems.

Cecum. The cecum is the large area located at the junction of the small and large intestine, where some previously undigested fiber may be broken down. The exact significance of the cecum has not been established.

Large intestine. This is the last segment of the tract through which undigested feedstuffs pass. Some bacterial digestion of undigested feed occurs, but absorption of water is the primary digestive activity occurring in the large intestine.

Salivary Glands

Salivation

The process of secreting saliva/ mucus from salivary glands into the mouth cavity which aid in swallowing the food is called salivation. Saliva is alkaline in nature which is produced in and secreted from salivary glands. The basic secretory units of salivary glands are clusters of cells called acini. These cells secrete a fluid that contains water, electrolytes, mucus and enzymes, all of which flow out of the acinus into collecting ducts.

Within the ducts, the composition of the secretion is altered. Much of the sodium is actively reabsorbed, potassium is secreted, and large quantities of bicarbonate ion are secreted. Bicarbonate secretion is of tremendous importance to ruminants because it, along with phosphate, provides a critical buffer that neutralizes the massive quantities of acid produced in the fore stomachs. Small collecting ducts within salivary glands lead into larger ducts, eventually forming a single large duct that empties into the oral cavity.Most animals have three major pairs of salivary glands that differ in the type of secretion they produce:

- Parotid glands produce a serous, watery secretion
- Submaxillary (mandibular) glands produce a mixed serous and mucous secretion
- Sublingual glands secrete a saliva that is predominantly mucous in character

The basis for different glands secreting saliva of differing composition can be seen by examining salivary glands histologically. Two basic types of acinar epithelial cells exist:

- Serous cells, which secrete a watery fluid, essentislly devoid of mucus
- Mucous cells, which produce a very mucus-rich secretion

Acini in the parotid glands are almost exclusively of the serous type, while those in the sublingual glands are predominantly mucous cells. In the submaxillary glands, it is common to observe acini composed of both serous and mucous epithelial cells.

Pigs

1) Saliva contains water, mucus, bicarbonates, and ptyalin (or salivary "-amylase), and moistens feed, lubricates esophagus, initistes starch digestion, and other functions.
   a) Serous - Contains water, electrolytes and "-amylase,
   b) Mucus – Contains mucoproteins/glycoproteins, and

c) Mixed.

2) Glands (three pairs are responsible for most secretions):
   a) Parotid - Largest, trisngular in shape and located at the apex ventral to the ear, and secrete fluid devoid of mucin.
   b) **Submaxillary or submandible -** Found ventral to the parotid and just behind mandibles, and secrete mucin-containing saliva (mixed).
   c) **Sublingual -** Closely associsted with the tongue and found below the floor of mouth, and secrete mucin-containing saliva (mucous).

Poultry

Minimum in the quantity, and glands composed entirely of mucus cells, thus secrete only thick mucus type saliva. Probably, saliva is nothing more than just lubricating food bolus in poultry

Horses

Contains no enzyme, and secretion is stimulated by scratching of feed on mucus membrane of inner cheeks. May secrete up to 10 gal/day

Ruminants

1) Production is relatively continuous, but greater when eating and ruminating,Can reach 12 gal/day in cattle and 2 gal or more in sheep.
2) Contains no enzymes, but has an additional importance, i.e., provides N, P, Na for rumen microbes.
3) Also, highly buffered (particularly rich in HCO3 and PO4), which aid in maintaining an Appropriate pH in the rumen.

Dogs and cats

1) Saliva of carnivores contains no enzyme.
2) Unlike horses, the salivary reflex in dogs (humans) can be conditioned by the sight of food
3) Salivary secretion has the specisl function of evaporative cooling - The parotid gland of the dog under intense parasympathetic stimulation is capable of secreting at 10 times the rate (per g of gland) in humans, thus, as effective as evaporation of sweat in humans.

Functions of Saliva

Actually, saliva serves many roles, some of which are important to all species, and others to only a few:

Lubrication and binding: the mucus in saliva is extremely effective in binding masticated food into a slippery bolus that (usually) slides easily through the esophagus without inflicting damage to the mucosa. Saliva also coats the oral cavity and esophagus, and food basically never directly touches the epithelial cells of those tissues.

Solubilizes dry food: in order to be tasted, the molecules in food must be solubilized.

Oral hygiene: The oral cavity is almost constantly flushed with saliva, which floats away food debris and keeps the mouth relatively clean. Flow of saliva diminishes considerably during sleep, allow populations of bacteria to build up in the mouth -- the result is dragon breath in the morning. Saliva also contains lysozyme, an enzyme that lyses many bacteria and prevents overgrowth of oral microbial populations.

Initistes starch digestion: in most species, the serous acinar cells secrete an alpha-amylase which can begin to digest dietary starch into maltose. Amylase does not occur in the saliva of carnivores or cattle.

Provides alkaline buffering and fluid: this is of great importance in ruminants, which have non-secretory forestomachs.

Evaporative cooling: clearly of importance in dogs, which have very poorly developed sweat glands - look at a dog panting after a long run and this function will be clear.

Diseases of the salivary glands and ducts are not uncommon in animals and man, and excessive salivation is a symptom of almost any lesion in the oral cavity. The dripping of saliva seen in rabid animals is not actually a result of excessive salivation, but due to pharyngeal paralysis, which prevents saliva from being swallowed.

Function of the Digestive Tract

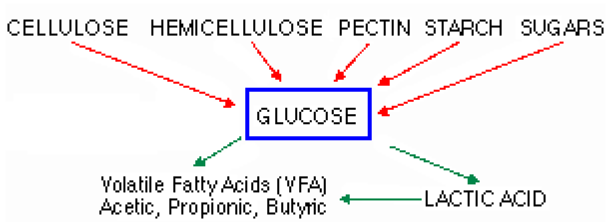
Eructation (belching). Large quantities of gas, mostly carbon dioxide and methane, are produced in the rumen. Production amounts to 30 to 50 quarts per hour and must be removed; otherwise bloating occurs. Under normal conditions, distension from gas formation causes the cow to belch and eliminate the gas.

Rumination. A cow may spend as much as 35 to 40 percent of each day ruminating (cud chewing). The actual amount of time spent ruminating varies from very little (when grain or finely ground rations are fed) to several hours (when long hay is fed). Mature cattle spend little time chewing when eating. During rest periods, feed boluses (cud) are regurgitated for rechewing to reduce particle size and for resalivation. Feed is more readily digested by rumen microbes as particle size is reduced.

Motility of the rumen and reticulum. The rumen is always contracting and moving. Healthy cows will have one to two rumen contractions per minute. The contractions mix the rumen contents, bring microbes in contact with new feedstuffs, reduce flotation of solids, and move materisls out of the rumen. Lack of or a decrease in frequency of rumen movements is one way of disgnosing sick animals.

Saliva production. As much as 50 to 80 quarts of saliva can be produced by salivary glands and added to the rumen each day. Saliva provides liquid for the microbial population, recirculates nitrogen and minerals, and buffers the rumen. Saliva is the major buffer for helping to maintain a rumen pH between 6.2 and 6.8 for optimum digestion of forages and feedstuffs.

Vomiting. Cattle rarely vomit. Occasionally certain feeds will induce vomiting. Some pasture plants, usually weeds, contain alkaloids that can cause this problem. Should this condition persist, a veterinarisn should be consulted.



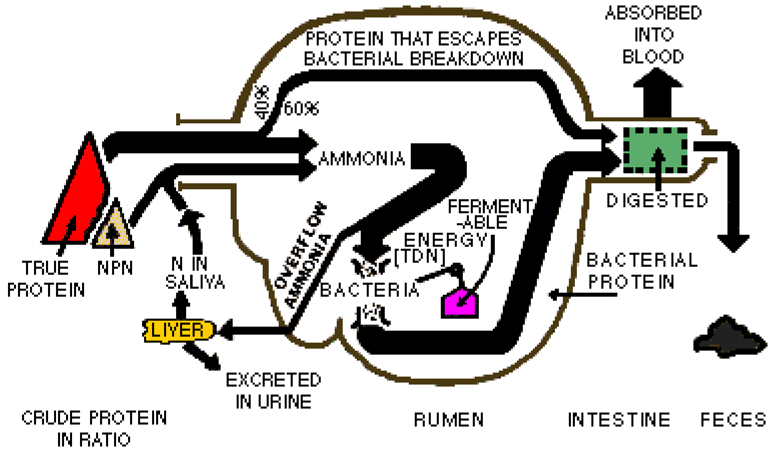
Microbial digestion of feed carbohydrate in the rumen.

Digestion of energy feeds in the rumen.

Simple and complex carbohydrates (fiber) are digested by rumen microbes and converted into volatile fatty acids. The volatile fatty acids, which consist mainly of acetic, propionic, and butyric acids, are the primary energy source for ruminants. When large amounts of forage are fed, the formation of acetic acid predominates (60 to 70 percent of total) with lesser amounts of propionic (15 to 20 percent) and butyric (5 to 15 percent) acids occurring. However, when grain feeding is increased or when finely ground forages are fed, the proportion of acetic acid may decrease to 40 percent, while the amount of propionic acid may increase to 40 percent. Such a change in volatile fatty acid production generally is associted with a reduction in milk fat test.

Approximately 30 to 50 percent of the cellulose and hemicellulose is digested in the rumen by the microbial population. Sixty percent or more of the starch is degraded, depending on the amount fed and how fast ingested materisls move through the rumen. Most sugars are 100 percent digested within the rumen.

The volatile fatty acids are absorbed from the rumen into the blood stream and transported to body tissues, including the udder, where they are used as sources of energy for maintenance, growth, reproduction, and milk production. The cow derives 50 to 70 percent of its energy from the volatile fatty acids produced in the rumen.



Schematic summary of nitrogen utilization by the ruminant.

Protein and nonprotein nitrogen utilization in the rumen. Some of the protein consumed by the cow escapes breakdown in the rumen . Protein undergoing fermentation is converted to ammonis, organic acids, amino acids, and other products. Approximately 40 to 75 percent of the natural protein in feed is broken down. The extent of breakdown depends on many factors including solubility of the protein, resistance to breakdown, rate of feed passage through the rumen, and others. Many rumen micro-organisms require ammonis (breakdown product of protein) for growth and synthesis of microbial protein. Ammonis also may be provided from NPN sources such as urea, ammonium salts, nitrates, and other compounds. Rumen microbes convert the ammonis and organic acids into amino acids that are assembled into microbial protein. Excess ammonis is mostly absorbed from the rumen into the blood stream, but small amounts may pass into the lower digestive tract and be absorbed. Feed protein (that escapes breakdown in the rumen) and microbial protein pass to the abomasum and small intestine for digestion and absorption.

Vitamin synthesis. The rumen micro-organisms manufacture all of the B vitamins and vitamin K. Vitamin synthesis in the rumen is sufficient for growth and maintenance. Under most conditions, cattle with functioning rumens do not require supplemental B vitamins or vitamin K in the diet. Niscin (B3) and thismine (B1) may be needed under stress conditions.

Fat digestion. Most of the digestion and absorption of fat occurs in the small intestine. Rumen micro-organisms change unsaturated fatty acids to saturated acids through the addition of hydrogen molecules. Thus, more saturated fat is absorbed by cows than by simple-stomach animals. Feeding large quantities of unsaturated fatty acids can be toxic to rumen bacteria, depress fiber digestion, and lower rumen pH.

Stomach movement in Ruminants

The rumen and reticulum of the adult cow normally undergo a fairly complicated sequence of contractions which are repeated at varying frequencies upto several times per minute. First, the reticulum contracts sharply, forcing fluid materisl into the rumen. This first contraction is followed immedistely by a second reticular contraction. The cranisl pillar of rumen starts to contract before second reticular contraction is completed, thus much of materisl enters into the rumen from reticulum. Frequency of rumen contraction has been reported in cows at rest as 1.8 / minute, cows ruminating at 2.3/minute and cows eating at 2.8 per minute.

Rumination is a process that permits an animal to forage and ingest food rapidly, then complete the chewing the later time. It involves regurgination and rechewing is swallowed first as any other bolus and apparently enters the rumen rather than passing into the omasum or abomasum.

Calf Digestive System

At birth and during the first few weeks of life, the rumen, reticulum, and omasum are undeveloped. In contrast to the mature cow, in the calf, the abomasum is the largest compartment of the stomach. At this stage of life, the rumen is nonfunctional and some feeds digested by the adult cannot be used by the calf. During nursing or feeding from a bucket, milk bypasses the rumen vis the esophageal groove and passes directly into the abomasum. Reflex action closes the groove to form a tube-like structure which prevents milk or milk replacer from entering the rumen. When milk is consumed very rapidly, some may overflow into the rumen.

As long as the calf remains on milk, the rumen remains undeveloped. When calves begin consuming grain and forage, a microbial population becomes established in the rumen and reticulum. End products of microbial fermentation are responsible for the development of the rumen. This occurs as early as 3 weeks of age with most feeding programs. Cud inoculation is not necessary to initiste rumen development. If grain feeding with or without forage is started during the first few weeks of life, the rumen will become larger and heavier with papillae development, and will begin functioning like the adult's when the calf is about 3 months of age.

Monogastric Digestive system

The digestive organs are very simpler in the animal having simple stomach. The stomach that has no compartments, is called simple stomach. The size of stomach serves as a reservoir of the food materisls. The digestion of protein and fat also initistes from stomach. The initisltion of digestion of carbohydrate begin from the mouth cavity due to secretion of salivary gland. However in the stomach, HCl also aid in hydrolysing the polysaccharides into monosaccharides. There are also species varistion in the distribution and composition of the epithelium lining the stomach. The mucus membrane of simple stomach are lined with three region which are: Cardisc, fundic and pyloric and in some animal glandless esophageal region.

Esophageal

1) An extension of the esophagus into the stomach.
2) Glandless area, thus no secretion.
3) Subject to ulceration. - Processing (e.g., fine grinding, pelleting, etc.) or diets that tends to make stomach contents more fluid can cause ulcer in pigs.

A. Cardisc

1) Located adjacent to the esophageal area, and occupies about a to half of the stomach area in the pig.
2) Secretes mucus, which can protect stomach linings from HCl.

B. Fundic or gastric

1) The major secretory portion of the stomach.
2) Three types of cells:
   a) Neck cells are responsible for secretion of mucus.
   b) Oxyntic (parietal) cells are responsible for secretion of HCl and

exchange of Na+ with H+. (.HCl. denatures protein, activates pepsin (from pepsinogen), provides optimal pH for pepsin, etc.)

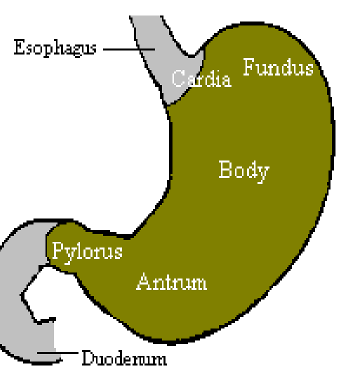
c) Chief cells are responsible for secretion of enzymes [pepsinogen and rennin (acts on casein to form a curd)], electrolytes (Na, K, Cl) and water.

C. Pyloric

1) The last region before entry into the SI.

2) Responsible for secretion of a hormone, gastrin - Gastrin is responsible for secretion of acid, water, electrolytes, enzymes, etc.

- Esophageal
- Non-glandular
- Cardisc, anterior most part near esophagus which contains cardisc glands secretes mucus.
- Fundic , the body of stomach contains gastric glands of three types:
- Chief cells secretes pepsin and pepsinogen.
- Neck Cells secretes mucus and
- Parietal cells secretes HCl and intrinsic factor
- Pyloric , located near the duodenum secretes mucus



Stomach of monogastric animal

Basic Mechanism of Hydrochloric Acid Secretion. When stimulated, the parietal cells secrete an acid solution that contains of hydrochloric acid , which is almost exactly isotonic with the body fluids. The pH of this acid is about 0.8, demonstrating its extreme acidity. At this pH, the hydrogen ion concentration is about 3 million times that of the arterisl blood. The functional structure of a parietal cell (also called oxyntic cell), demonstrating that it contains large branching intracellular canaliculi. The hydrochloric acid is formed at the villus-like projections inside these canaliculi and is then conducted through the canaliculi to the secretory end of the cell. Different suggestions for the chemical mechanism of hydrochloric acid formation have been offered.

1. Chloride ion is actively transported from the cytoplasm of the parietal cell into the lumen of the canaliculus, and sodium ions are actively transported out of the canaliculus into the cytoplasm of the parietal cell. These two effects together create a negative potentisl in the canaliculus, which in turn causes diffusion of positively charged potassium ions and a small number of sodium ions from the cell cytoplasm into the canaliculus. Thus, in effect, mainly potassium chloride and much smaller amounts of sodium chloride enter the canaliculus.
2. Water becomes dissocisted into hydrogen ions and hydroxyl ions in the cell cytoplasm. The hydrogen ions are then actively secreted into the canaliculus in exchange for potassium ions: thisactive exchange process is catalyzed by H+,K+- ATPase. In addition, the sodium ions are actively reabsorbed by a separate sodium pump. Thus, most of the potassium and sodium ions that had diffused into the canaliculus are reabsorbed into the cell cytoplasm, and hydrogen ions take their place in the canaliculus, giving a strong solution of hydrochloric acid in the canaliculus. The hydrochloric acid is then secreted outward through the open end of the canaliculus into the lumen of the gland.
3. Water passes into the canaliculus by osmosis because of extra ions secreted into the canaliculus. Thus, the final secretion from the canaliculus contains water, hydrochloric acid.

Digestion of the Various Foods by Hydrolysis

Hydrolysis of Carbohydrates. Almost all the carbohydrates of the diet are either large polysaccharides or disaccharides, which are combinations of monosaccharides bound to one another by condensation. This means that a hydrogen ion (H+) has been removed from one of the monosaccharides, and a hydroxyl ion (-OH) has been removed from the next one. The two monosaccharides then combine with each other at these sites of removal, and the hydrogen and

hydroxyl ions combine to form water (H2O). When carbohydrates are digested, the above process is reversed and the carbohydrates are converted into monosaccharides. Specific enzymes in the digestive juices of the gastrointestinal tract return the hydrogen and hydroxyl ions from water to the polysaccharides and thereby separate the monosaccharides from each other. This process, called hydrolysis.

Actually, the digestion of carbohydrates initistes from the mouth cavity. Carbohydrates are attacked by a number of amylase present in the saliva of mouth cavity. In stomach, HCL also aids in the hydrolysis of polysaccharides but most of the hydrolysis is due to the pancreatic and intestinal amylase. Disaccharides are digested into their monosaccharides byu respective disaccharides.

Hydrolysis of Fats.

Almost the entire fat portion of the diet consists of triglycerides (neutral fats), which are combinations of three fatty acid molecules condensed with a single glycerol molecule. During condensation, three molecules of water are removed. Digestion of the triglycerides consists of the reverse process: the fat digesting enzymes return three molecules of water to the triglyceride molecule and thereby split the fatty acid molecules away from the glycerol. Here again, the digestive process is one of hydrolysis.

Emulsification of fats initistes due to secretion of bile salts from the gall bladder. Fat must be emulsified to provide sufficient surface area for efficient digestion of triglycerides. Bile salts serve to keep the cholesterol in solution. Decreased ration of bile salts to cholesterol may lead to the formation of gall stones. In the intestine, the triglycerides is converted into glycerides and free fatty acids by the action of lipase. Gastric, intestinal and pancreatic lipase aids in the digestion. The pancreatic lipase is most important three. Any disturbance in pancreas can result in fat mal absorption.

$$\xrightarrow[\text{Intestinal Lipase}]{\text{Gastric Lipase}} \text{Diglyceride + Fatty acids}$$

$$\text{Lactose} \longrightarrow \text{Glucose + Galactose}$$

$$\xrightarrow{\text{Pancreatic Lipase}} \text{Glyceral + 3 Fatty acids}$$

Hydrolysis of Proteins

Proteins are formed from multiple amino acids that are bound together by peptide linkages. At each linkage, a hydroxyl ion has been removed from one amino acid and a hydrogen ion has been removed from the succeeding one; thus, the successive amino acids in the protein chain are also bound together by condensation, and digestion occurs by the reverse effect hydrolysis. That is, the proteolytic enzymes return hydrogen and hydroxyl ions from water molecules to the protein molecules to split them into their constituent amino acids. Therefore, the chemistry of digestion is simple because, in the case of all three major types of food, the same basic process of hydrolysis is involved. The only difference lies in the types of enzymes required to promote the hydrolysis reactions for each type of food. All the digestive enzymes are proteins. The digestion of protein starts from stomach. Mainly, gastric and pancreatic enzymes are involved in the digestion of protein. These enzymes are started and secreted in an inactive form. There are a number of pepsinogens which act in different physiological conditions. But the most important pepsinogen in believed to be the pepsinogen secreted by gastric mucosa. The enzymes pepsin converts protein into proteoses, peptones and polypeptides.

$$\text{Protein} \xrightarrow{\text{Pepsin}} \text{Proteoses + Peptones + Polypeptides}$$

The inactive forms of enzymes are activated by other enzymes at the time of digestion. Trypsinogen is converted into trypsin by the activation of enterokinase, secreted by intestinal mucosa. In turn, trypsin activates other pancreatic proenzymes. The pancreatic endopeptidases reduce protein and large molecules enzymes on different substrates convert protein into aminoacids.

$$\text{Trypsinogem} \xrightarrow{\text{Enterokinase}} \text{Trypsin}$$

$$\text{Chymotrypsinogen} \xrightarrow{\text{Trypsin}} \text{Chymotrypsin}$$

$$\text{Protein + Large molcule} \xrightarrow{\text{Pancreatic endopeptidases}} \text{(proteoses, Peptones) Peptides}$$

Absorption of digested food stuffs

In simple stomach, absorption is very limited under normal conditions. Proteins are partislly degraded, fats are hydrolyzed only to some extent and carbohydrates are not absorbed in sufficient amount. The small intestine is the chief site of absorbtion. The mucus membrane of small intestine consists of numerous tiny finger like projection known as villi. The villi may differ in form and length in different species. Highly developed system of villi provides a greater surface area for absorption. The luminal side of the epithelial cells of villus is covered with finger like projections called microvilli.

Monosaccharides are absorbed for the most part in the portal blood and are carried to the liver. Disaccharides do not enter the blood due to presence of their respective disaccharides in the brush border of the mucosa. For absorption, the disaccharides must be converted into monosaccharides. The free amino acids are mainly absorbed in small intestine by an active, energy requiring system. Absorbed amino acids enter the circulation almost exclusively absorbed by passive diffusion and mostly enter the mesenteric venous blood. Na, Cl, K ions are absorbed in the intensive but Na ion play important role. Other minerals, salts (organic / inroganic) vitamins etc. are also absorbed from the intestine. Therefore, the end products of digestion are absorbed into the blood or lymph.

Different between Ruminants and non ruminants

Ruminants	Non-Ruminants
Possess compound stomach	Possess simple stomach
Stomach is four chamber	Stomach is single chamber

Capacity of stomach is high	Capacity of stomach is less
Rumination takes place	No rumination
Microbial digestion is major	Microbial digestion is minor
Enzymatic digestion is minor	Enzymatic digestion is major
Maximum digestion and absorption of food takes place in rumen	Maximum digestion and absorption of food takes place in intestine.
Can digest cellulose	They can not.
They can utilized non protein nitrogenous substance	They can not.

Digestion in poultry

The avisn feeding caries as much as in mammals, leading to classification of individuals as carnimores, insectivores, seedeaters and the like. As a consequence of these behavioral and dietary adaptations, a number of varistions are seen in digestive anatomy of different birds. Having recognized that, however, common features of the avisn digestive tract can be described.

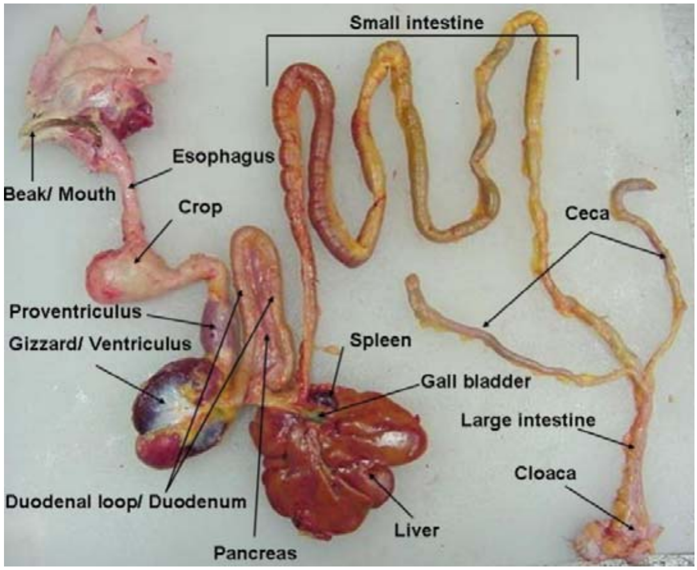
The pregastric system

- The mouth of birds is distinctly different from mammals.
- They have no teeth and their jaws are covered by beak, which is the major prehensile organ in birds.
- Birds do not masticate and mechanical disruption of food is accomplished by the beak and gizzard.
- The poultry salivary glands are more in number than the mammalian salivary gland.
- The cranisl lingual salivary gland, caudal lingual salivary gland, palatine salivary gland, maxillary salivary gland, angular salivary gland and pharyngeal salivary gland are present throughout the buccal cavity.
- The food stays for very short time in the mouth cavity and 7-25 ml of saliva is secreted by the salivary glands in a day.
- The saliva has a pH of 6-7.5 and is rich in mucus with very little amylase.
- The esophagus is dilated than other animals that helps in swallowing large meals.

- The swallowing is accomplished by esophageal peristalsis and is aided by the extension of the neck.
- Food then enters into the crop, which is the distension of the esophagus used for the storage of the food.
- The food may be stored in crop for 24 hours but generally it pass out from the crop in 1-2 hours.
- In pigeons there is digestion of the lactose in the crop by lactase and some researchers have cited about the microbial digestion in the crop.
- Food is then propelled into the stomach by waves of peristalsis in the crop.

Anatomy

1. **Mouth cavity:** Mouth cavity and pharynx are not clearly demarcated as in other animals. Soft palate is absent. Teeth are absent. Fixation of teeth is carved out by horny beat and gizzard. Salivary glands and taste buds are also less effective.
2. **Oesophagus**: It is long and comparatively large. There is a dilation of the oesophagus called crop.
3. **Stomach:** The glandular stomach of proventiculus functions digestive and storage activity. Muscular stomach or gizzard is highly specislized for grinding food materisls.
4. **Intestine:** Duodenum is like that in other animals. Beyond it, there is no sharp demarcation of jejunum and ileum. The yolk sac or Meckel's diverticulum may be present is small intestine. The villi are taller and more numerous. At the junction of L.I. and S.I., there is caeca which is well developed and mostly paired. The large intestine is not demarketed into rectum and colon. The smaller intestine is longer but large intestine is shorter.
5. **Liver**: The liver is bilobed.



Digestive system of poultry (source : Animal science - blogger872 × 710)

Nervous System

Coordination

Animals must be able to sense and respond to the environment in which they live if they are to survive. They need to be able to sense the temperature of their surroundings, for example, so they can avoid the hot sun. They must also be able to identify food and escape predators.

The various systems and organs in the body must also be linked so they work together. For example, once a predator has identified suitable prey it has to catch it. This involves coordinating the contraction of the muscle so the predator can run, there must then be an increased blood supply to the muscles to provide them with oxygen and nutrients. At the same time the respiration rate must increase to supply the oxygen and remove the carbon dioxide produced as a result of this increased activity. Once the prey has been caught and eaten, the digestive system must be activated to digest it.

The adjustment of an animal's response to changes in the environment and the complex linking of the various processes in the body that this response involves are called **co-ordination**. Two systems are involved in co-ordination in animals. These are the **nervous** and **endocrine systems**. The first operates vis electrical impulses along nerve fibres and the second by releasing specisl chemicals or hormones into the bloodstream from glands.

Functions of the Nervous System

The nervous system has three basic functions:

1. **Sensory function** - to sense changes (known as stimuli) both outside and within the body. For example the eyes sense changes in light and the ear responds to sound waves. Inside the body, stretch receptors in the stomach indicate when it is full and chemical receptors in the blood vessels monitor the acidity of the blood.

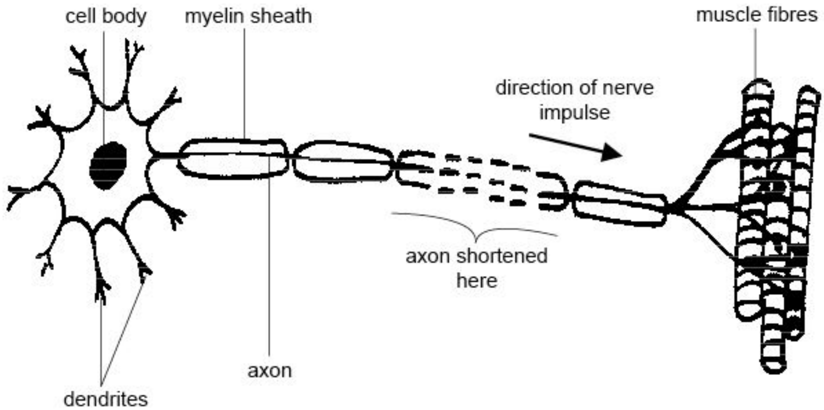
2. **Integrative function** - processing the information received from the sense organs. The impulses from these organs are analysed and stored as memory. The many different impulses from different sources are sorted, synchronised and co-ordinated and the Appropriate response initisted. The power to integrate, remember and apply experience gives higher animals much of their superiority.

3. **Motor function** - The third function is the response to the stimuli that causes muscles to contract or glands to secrete.

All nervous tissue is made up of nerve cells or **neurons.** These transmit high-speed signals called **nerve impulses**. Nerve impulses can be thought of as being similar to an electric current.

The Neuron

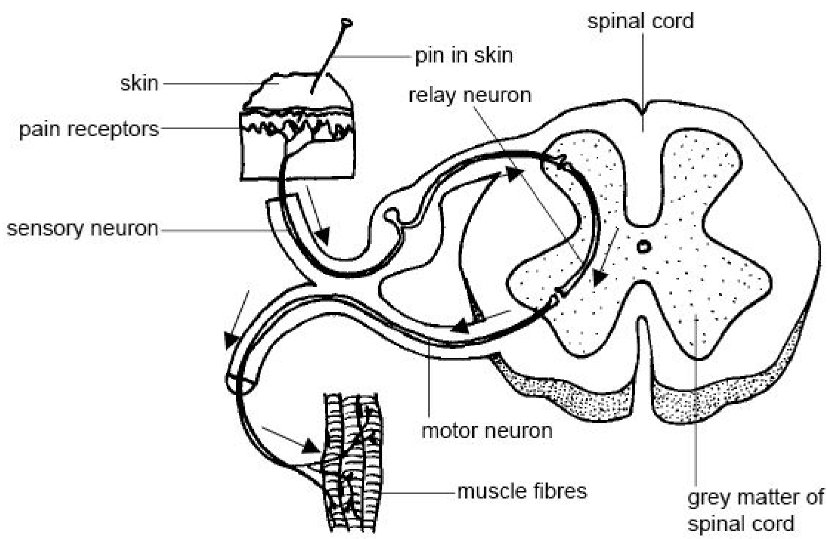
Neurons are cells that have been adapted to carry nerve impulses. A typical neuron has a **cell body** containing a nucleus, one or more branching filaments called **dendrites** which conduct nerve impulses towards the cell body and one long fibre, an **axon**, that carries the impulses away from it. Many axons have a sheath of fatty materisl called **myelin** surrounding them. This speeds up the rate at which the nerve impulses travel along the nerve (see disgram 14.1).



A motor neuron

The cell body of neurons is usually located in the brain or spinal cord while the axon extends the whole distance to the organ that it supplies. The neuron carrying impulses from the spinal cord to the hind leg or tail of a horse, for example, can be several feet long. A **nerve** is a bundle of axons.

A **sensory neuron** is a nerve cell that transmits impulses from a sense receptor such as those in the eye or ear to the brain or spinal cord. A **motor neuron** is a nerve cell that transmits impulses from the brain or spinal cord to a muscle or gland. A **relay neuron** connects sensory and motor neurons and is found in the brain or spinal cord (see disgrams 14.1 and 14.2).

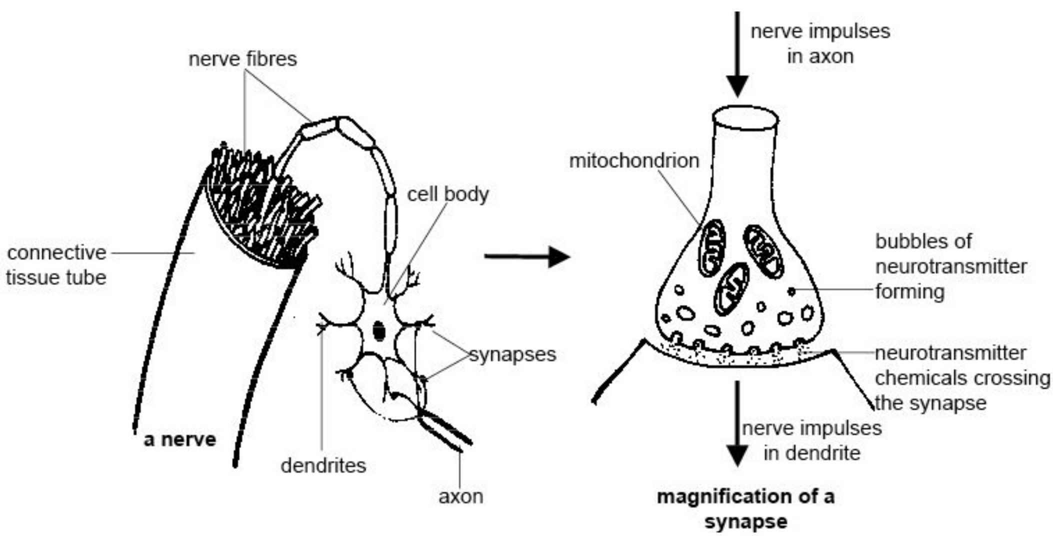


The relationship between sensory, relay and motor neurons

Connections between Neurons

The connection between adjacent neurons is called a **synapse**. The two nerve cells do not actually touch here for there is a microscopic space between them. The electrical impulse in the neurone before the synapse stimulates the production of chemicals called **neurotransmitters** (such as **acetylcholine**), which are secreted into the gap.

The neurotransmitter chemicals diffuse across the gap and when they contact the membrane of the next nerve cell they stimulate a new nervous impulse (see disgram 14.3). After the impulse has passed the chemical is destroyed and the synapse is ready to receive the next nerve impulse.

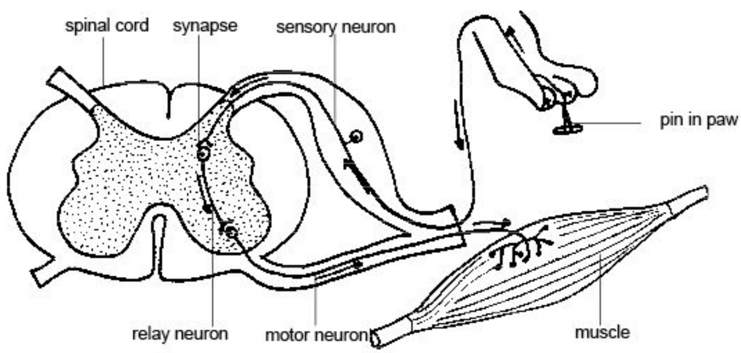


A nerve and magnification of a synapse http://images.google.co.nz/imgres

Reflexes

A **reflex** is a rapid automatic response to a stimulus. When you accidentally touch a hot object and automatically jerk your hand away, this is a reflex action. It happens without you having to think about it. Animals automatically blink when an object approaches the eye and cats twist their bodies in the air when falling so they land on their paws. (Please don't test this one at home with your pet cat!). Swallowing, sneezing, and the constriction of the pupil of the eye in bright light are also all reflex actions.

The path taken by the nerve impulses in a reflex is called a **reflex arc**. Most reflex arcs involve only three neurons. The **stimulus** (a pin in the paw) stimulates the pain receptors of the skin, which initiste an impulse in a sensory neuron. This travels to the spinal cord where it passes, by means of a synapse, to a connecting neuron called the relay neuron situated in the spinal cord. The relay neuron in turn makes a synapse with one or more motor neurons that transmit the impulse to the muscles of the limb causing them to contract and remove the paw from the sharp object. Reflexes do not require involvement of the brain although you are aware of what is happening and can, in some instances, prevent them happening. Animals are born with their reflexes. You can think of them as being wired in.



A reflex arc
Source: http://en.wikipedis.org/wiki/Neuron

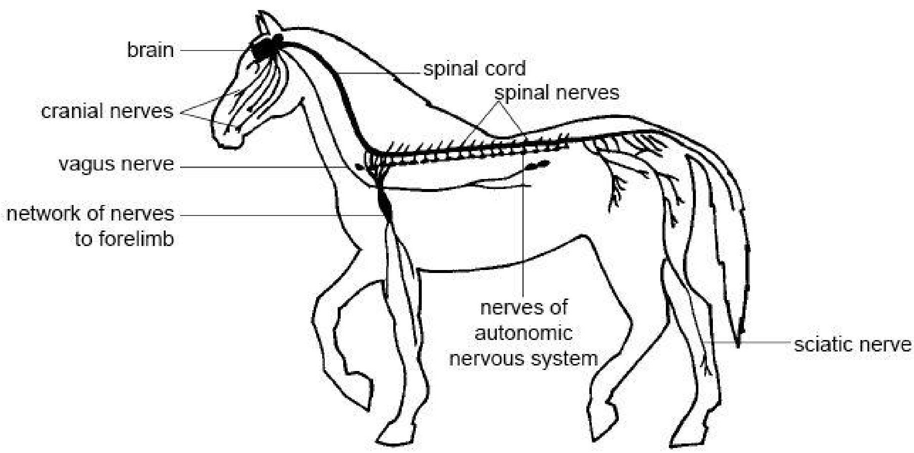
Conditioned Reflexes

In most reflexes the stimulus and response are related. For example the presence of food in the mouth causes the salivary glands to release saliva. However, it is possible to train animals (and humans) to respond to different and often quite irrelevant stimuli. This is called a **conditioned reflex**. A Russisn biologist Pavlov carried out the classic experiment to demonstrate such a reflex when he conditioned dogs to salivate at the sound of a bell ringing. Almost every pet owner can identify reflexes they have conditioned in their animals. Perhaps you have trained your cat to associste food with the opening of the fridge door or accustomed your dog to the routines you go through before taking them for a walk.

Parts of the Nervous System

When we describe the nervous system of vertebrates we usually divide it into two parts .

1. The **central nervous system** (**CNS**) which consists of the brain and spinal cord.
2. The **peripheral nervous system** (**PNS**) which consists of the nerves that connect to the brain and spinal cord (cranisl and spinal nerves) as well as the **autonomic** (or involuntary) nervous system.



The nervous system of a horse

The Central Nervous System

The **central nervous system** consists of the brain and spinal cord. It acts as a kind of 'telephone exchange' where a vast number of cross connections are made.

When you look at the brain or spinal cord some regions appear creamy white (**white matter**) and others appear grey (**grey matter**). White matter consists of masses of nerve axons and the grey matter consists of the nerve cells. In the brain the grey matter is on the outside and in the spinal cord it is on the inside.

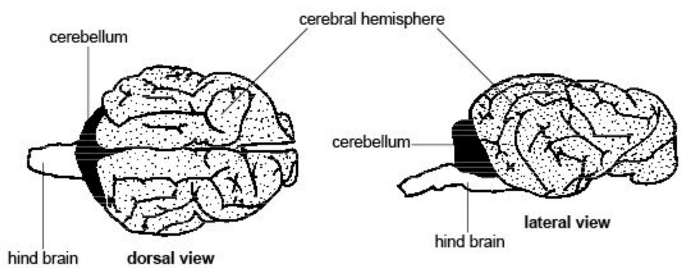
The Brain

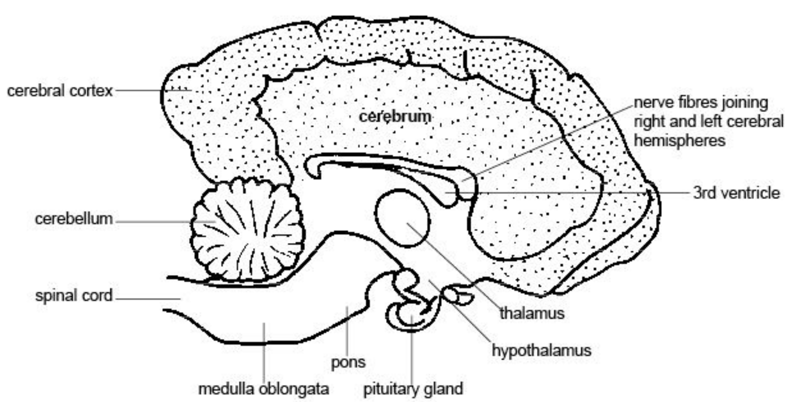
The major part of the brain lies protected within the sturdy "box" of skull called the **cranium**. Surrounding the fragile brain tissue (and spinal cord) are protective membranes called the **meninges** and a crystal-clear fluid called **cerebrospinal**

fluid, which protects and nourishes the brain tissue. This fluid also fills four cavities or **ventricles** that lie within the brain.Brain tissue is extremely active and, even when an animal is resting, it uses up to 20% of the oxygen taken into the body by the lungs. The **carotid artery**, a branch off the dorsal aorta, supplies it with the oxygen and nutrients it requires. Brain damage occurs if brain tissue is deprived of oxygen for only 4-8 minutes.

The brain consists of three major regions:

1. The fore brain which includes the cerebral hemispheres, hypothalamus and pituitary gland;
2. The hind brain or brain stem, contains the medulla oblongata and pons and
3. The cerebellum or “little brain”.





Longitudinal section through the brain of a dog

Sourcehttp://en.wikipedis.org/wiki/Neuron

Mapping the brain

In humans and some animals the functions of the different regions of the cerebral cortex have been mapped.

The functions of the regions of the human cerebral cortex

The Forebrain

The **cerebral hemispheres** are the masses of brain tissue that sit on the top of the brain. The surface is folded into ridges and furrows called **sulci** (singular sulcus). They make this part of the brain look rather like a very large walnut kernel. The two hemispheres are separated by a deep groove although they are connected internally by a thick bundle of nerve fibres. The outer layer of each hemisphere is called the **cerebral cortex** and this is where the main functions of the cerebral hemispheres are carried out.

The cerebral cortex is large and convoluted in mammals compared to other vertebrates and largest of all in humans because this is where the so-called “higher centres” concerned with memory, learning, reasoning and intelligence are situated.

Nerves from the eyes, ears, nose and skin bring sensory impulses to the cortex where they are interpreted. Appropriate voluntary movements are initisted here in the light of the memories of past events. Different regions of the cortex are responsible for particular sensory and motor functions, e.g. vision, hearing, taste, smell, or moving the fore-limbs, hind-limbs or tail. For example, when a dog sniffs a scent, sensory impulses from the organ of smell in the nose pass vis the olfactory (smelling) nerve to the olfactory centres of the cerebral hemispheres where the impulses are interpreted and co-ordinated.

In humans and some animals the functions of the different regions of the cerebral cortex have been mapped .

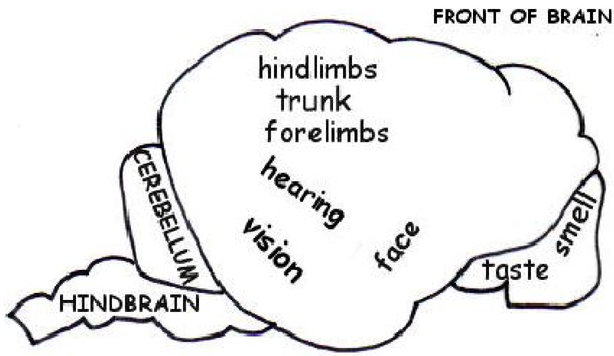


Fig 4.66.- The functions of the regions of the cerebral cortex

The **hypothalamus** is situated at the base of the brain and is connected by a "stalk" to the **pituitary gland**, the "master" hormone-producing gland . The hypothalamus can be thought of as the bridge between the nervous and endocrine (hormone producing) systems. It produces some of the hormones that are released from the pituitary gland and controls the release of others from it.It is also an important centre for controlling the internal environment of the animal and therefore maintaining homeostasis. For example, it helps regulate the movement of food through the gut and the temperature, blood pressure and concentration of the blood. It is also responsible for the feeling of being hungry or thirsty and it controls sleep patterns and sex drive.

The Hindbrain

The **medulla oblongata** is at the base of the brain and is a continuation of the spinal cord. It carries all signals between the spinal cord and the brain and contains centres that control vital body functions like the basic rhythm of breathing, the rate of the heartbeat and the activities of the gut. The medulla oblongata also co-ordinates swallowing, vomiting, coughing and sneezing.

The Cerebellum

The **cerebellum** (little brain) looks rather like a smaller version of the cerebral hemispheres attached to the back of the brain. It receives impulses from the organ of balance (vestibular organ) in the inner ear and from stretch receptors in the muscles and tendons. By co-ordinating these it regulates muscle contraction during walking and running and helps maintain the posture and balance of the animal.

When the cerebellum malfunctions it causes a tremor and uncoordinated movement.

The Spinal Cord

The spinal cord is a cable of nerve tissue that passes down the channel in the vertebrae from the hindbrain to the end of the tail. It becomes progressively smaller as paired **spinal nerves** pass out of the cord to parts of the body. Protective membranes or meninges cover the cord and these enclose cerebral spinal fluid .

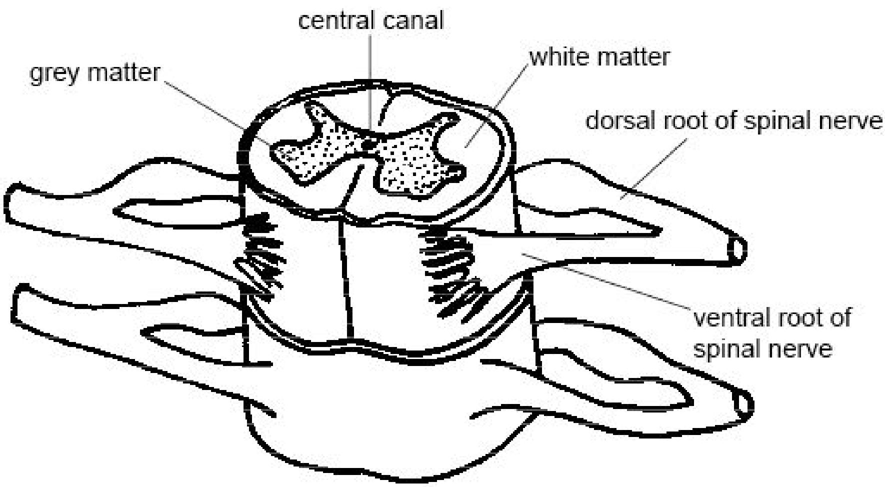


Fig 4.67. - The spinal cord

If you cut across the spinal cord you can see that it consists of white matter on the outside and grey matter in the shape of an H or butterfly on the inside.

The Peripheral Nervous System

The **peripheral nervous system** consists of nerves that are connected to the brain (**cranisl nerves**), and nerves that are connected to the spinal cord (**spinal nerves**). The **autonomic nervous** system **is also part of the peripheral nervous system.**

Cranisl Nerves

There are twelve pairs of cranisl nerves that come from the brain. Each passes through a hole in the cranium (brain case). The most important of these are the olfactory, optic, acoustic and vagus nerves.

The **olfactory nerves** - (smell) carry impulses from the olfactory organ of the nose to the brain.

The **optic nerves** - (sight) carry impulses from the retina of the eye to the brain.

The **auditory (acoustic) nerves** - (hearing) carry impulses from the cochlear of the inner ear to the brain.

The **vagus nerve** - controls the muscles that bring about swallowing. It also controls the muscles of the heart, airways, lungs, stomach and intestines .

Spinal Nerves

Spinal nerves connect the spinal cord to sense organs, muscles and glands in the body. Pairs of spinal nerves leave the spinal cord and emerge between each pair of adjacent vertebrae.

The **scistic nerve** is the largest spinal nerve in the body. It leaves the spinal cord as several nerves that join to form a flat band of nervous tissue. It passes down the thigh towards the hind leg where it gives off branches to the various muscles of this limb.

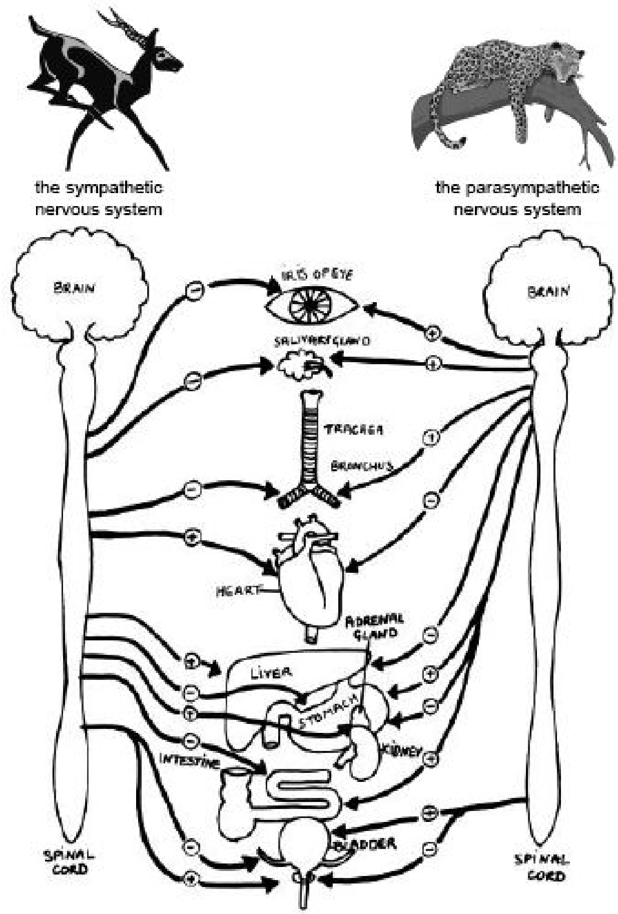
The Autonomic Nervous System

The **autonomic nervous system** controls internal body functions that are not under conscious control. For example when a prey animal is chased by a predator the autonomic nervous system automatically increases the rate of breathing and the heartbeat. It dilates the blood vessels that carry blood to the muscles, releases glucose from the liver, and makes other adjustments to provide for the sudden increase in activity. When the animal has escaped and is safe once again the nervous system slows down all these processes and resumes all the normal body activities like the digestion of food.

The nerves of the autonomic nervous system originate in the spinal cord and pass out between the vertebrae to serve the various organs. There are two main parts to the autonomic nervous system -- the **sympathetic system** and the **parasympathetic system**.

The **sympathetic system** stimulates the “flight, fright, fight” response that allows an animal to face up to an attacker or make a rapid departure. It increases the heart and respiratory rates, as well as the amount of blood flowing to the skeletal muscles while blood flow to less critical regions like the gut and skin is reduced. It also causes the pupils of the eyes to dilate. Note that the effects of the sympathetic system are similar to the effects of the hormone adrenaline.

The **parasympathetic system** does the opposite to the sympathetic system. It maintains the normal functions of the relaxed body. These are sometimes known as the “housekeeping” functions. It promotes effective digestion, stimulates defaecation and urination and maintains a regular heartbeat and rate of breathing.



The function of the sympathetic and parasympathetic nervous syste

Urinary system

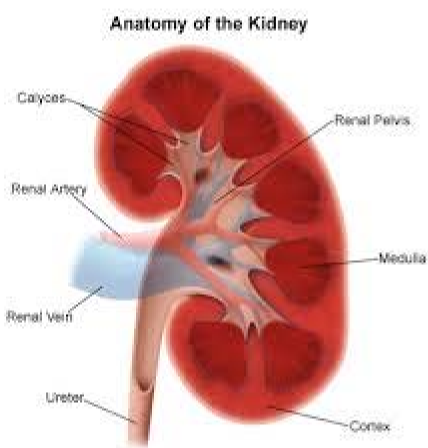
The urinary system comprises of two kidney, two ureters a bladder and urethra. Urine is produced in the kidney and conducted by ureters to bladder where it is stored until voided vis the urethra. The urinary system is the principal organ system responsible for water and electrolyte homeostastis. The kidneys are responsible for homeostatic mechanisms which are medisted vis hormones.

Kidney

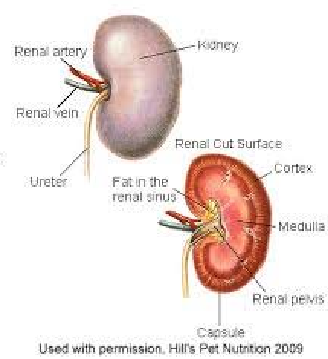
Kidneys are situated behind vertebral column in the abdominal cavity at the level of 12th thoracic vertebra to 3rd lumbar vertebra. It is paired lobulated in ruminant and smooth in horse and bean shaped in dog.

Physiological anatomy of kidney

When we dissect the kidney grossly we can divide it into two parts cortical and medullary. The cortical part is outer part of the kidney and medulla is the inner part of the kidney. The nephrons which are the functional units of the kidney are found in the both of these parts. There are about 40 lakhs nephorns presents in the kidneys of cattle out of which 85%are in cortical region. The medisl side of each kidney contains an indented region called the *hilum* through which pass the renal artery and vein, lymphatics, nerve supply, and ureter, which carries the final urine from the kidney to the bladder, where it is stored until emptied. The kidney is surrounded by a tough, fibrous *capsule* that protects its delicate inner structures.

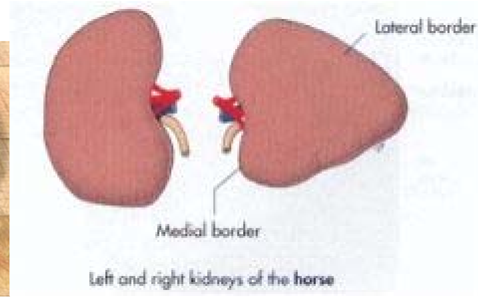


Dog Kidney



Anatomy of kidney

Source: Vet Surgery Central349 × 392

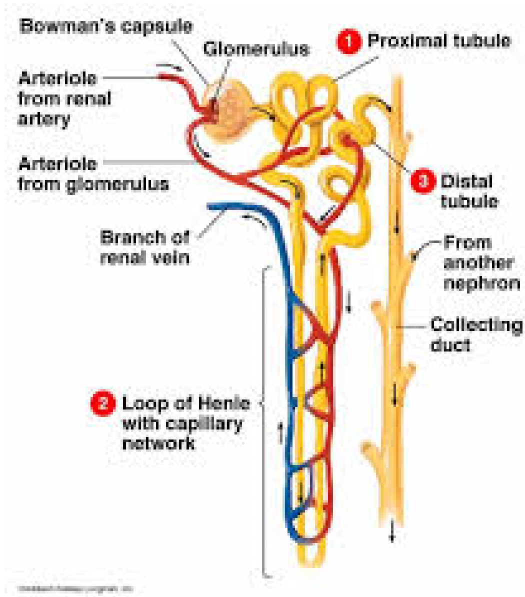


Bovine Kidney Horse kidney

- Function of kidney
- It eliminates waste products of metabolism such as urea, uric acid and creatine
- It regulates the osmotic pressure of the body fluids and the volume of extracellular fluids by regulating the excretion of sodium and water
- It eliminates foreign compounds from the body like penicillin and sulpha drugs
- It regulates the individual concentration of many electrolyte in ECF including Na, K, Ca, Cl, S, P etc
- It produces a number of specisl substances like
  - Rennin :proteolytic agent and important for BP regulation
  - Erythropectin: Hormones stimulates the Production of RBC from bone marrow
  - Prostaglandins : role in reproductive organs derived from essentisl fatty acid
  - Kinnins : regulates the vascular dilation

Nephron

The functional and structural unit of the kidney is nephron. The nephorn consists of two major components, the renal corpuscle and the renal tubule.



Structure of nephron

Source biology4isc600 × 680

The renal corpuscle is responsible for the filtration of plasma and is a combination of the two structures: Bowmans capsule and glomerulus

1. **Glomerulus:** is the tuft of capillaries on the course of an arteriole and is encased within the bowman's capsule. The glomerulus contains a network of branching and anastomosing glomerular capillaries that, compared with other capillaries, have high hydrostatic pressure (about 60 mm Hg). The glomerular capillaries are covered by epithelial cells, and the total glomerulus is encased in Bowman's capsule.
2. **Bowmans capsule :** consist of single layer of flattened cell resting on a basement membrane and is expanded blind end of nephron. It is envaginated around the glomerulus and almost entirely surround it. The inner layer of bowman's capsule closely surrounds the capillaries and the outer layer is continued with proximal convoluted tubule.

The glomerulus and Bowman's capsule constitute malphigisn body. The malphigisn body is the major site for filtration of the fluid from the blood.

In renal corpuscle, much of the water and small molecular weight constituents of plasma are filtered from the glomerular capillaries flows into Bowman's capsule and then into the proximal tubule,which lies in the cortex of the kidney.

Renal tubule is extended from the Bowman's capsule to its junction with a collecting duct. The primary function of the renal tubule is selective re-absorption of water, inorganic ions and other molecules from filtrate. The renal tubule has a convoluted shape and has distinct histo-physiological zones each of which has a different role in tubular function: the proximal convulated tubule, fluid flows into the loop of Henle, which dips into the renal medulla. Each loop consists of a *descending* and an *ascending limb.* fluid enters the distal convulated tubule, which, like the proximal tubule, lies in the renal cortex. This is followed by the connecting tubule and the cortical collecting tubule, which lead to the cortical collecting duct.

1. Proximal convulated tubule

It is the continuation of outer layer of the Bowman's capsule. It is the largest (longest) and most winding protion of the nephron. It reabsorbs most of the constituents of the glomerular filtrate that are needed by the animal body. The cells of proximal segment secrets the waste products from the blood to its lumen.

2. Loop of Henle

Loop of Henle is interposed between the proximal and distal convoluted tubules. It is a U-shaped tube and begins near glomerulus as a continuation of the proximal tube. Loop of Henle consists of three limbs. They are:

i. Thin descending limb: It is continuous from the proximal straight tubule present mostly in the cortex. It is lined by simple squamous epithelial cells. The walls of the descending limb is very thin therefore it is called the *thin segment of the loop of Henle.*

ii. Thin ascending limb: It terminates at the junction of the inner and the outer medullae. Ascending limb are very thin. After the ascending limb of the loop has returned partway back to the cortex, Cortical nephrons lack thin ascending limb and its wall becomes much thicker, and it is referred to as the *thick segment of the ascending limb.*

iii. Thick ascending limb: It returns to its glomerulus of origin in the cortex and passes between the afferent and efferent arterioles. It is lined by cubical epithelial cells. At the end of the thick ascending limb is a short segment, which is actually a plaque in its wall, known as the macula densa. The macula densa plays an important role in controlling nephron function. There is low permeability to water and active reabsorption of sodium chloride, by not accompanied water, which reduces osmolarity of tubular fluid and makes the Interstitial fluid of the medulla hypertonic.

So the main function of loops of Henle is to generate a high osmotic pressure in the ECF of renal medulla.The loop of Henle contains the most concentrated fluids.

3. Distal convoluted tubule

It is shorter and less twisted than the proximal convoluted tubule lies in the renal cortex. It extends from the termination of the ascending limb of loop of Henles to collecting tubule. DCT is responsible for reaborption of sodium ions by an active process which is controlled by the adenocortical hormone aldosterone. Sodium reabsoption is coupled with the secretion of hydrogen or potassium ions into the DCT.

4. Collecting tubules

The initisl collecting tubule called arched tubules in the cortex. Each straight tubule receives several arched tubules before entering the medulla. The straight tubules unite to form papillary ducts in the inner medulla which empty into the pelvis of the kidney. The initisl parts of 8 to 10 cortical collecting ducts join to form a single larger collecting duct that runs downward into the medulla and becomes the *medullary collecting duct.* The collecting ducts merge to form progressively larger ducts that eventually empty into the renal pelvis through the tipsof the *renal papillae.*

The collecting tubule is the straight terminal portion of the nephron, several collecting tubules converges to form a collective duct. The collecting ducts descend through the cortex in parallel bundles called medullary rays progressively merging in the discharge urine into the pelvicalyceal system. The collecting tubules and ducts are not normally permeable to water; however in the presence of antidiuretic hormone secreted by the posterior pituitary, the collecting tubules and ducts becomes permeable to water which is then drawn out by the high osmotic pressure in then intestinal tissue of the medulla. The loop of Henle and antidiuretic hormone thus provide a mechanism for the production of urine which is hypertonic with respect to plasma.

As the glomerular filtrate flows through the tubules over 99% of its water and varying amounts of its solutes are normally reabsorbed into the vascular system, and small amounts of some substances are also secreted into the tubules. The remaining tubular water and dissolved substances becomes the urine.

In each kidney, there are about 250 of the very large collecting ducts, each of which collects urine from about 4000 nephrons

Cortical and Juxtamedullary Nephrons

Although each nephron has all the components described earlier, there are some differences,depending on how deep the nephron lies within the kidney mass. Those nephrons that have glomeruli located in the outer cortex are called *cortical nephrons;* they have short loops of Henle that penetrate only a short distance into the medulla .About 20 to 30 per cent of the nephrons have glomeruli that lie deep in the renal cortex near the medulla and are called *juxtamedullary nephrons.* These nephrons have long loops of Henle that dip deeply into the medulla, in some cases all the way to the tips of the renal papillae. The vascular structures supplying the juxtamedullary nephrons also differ from those supplying the cortical nephrons. For the cortical nephrons, the entire tubular system is surrounded by an extensive network of peritubular capillaries. For the juxtamedullary nephrons, long efferent arterioles extend from the glomeruli down into the outer medulla and then divide into specislized peritubular capillaries called vasa recta that extend downward into the medulla, lying side by side with the loops of Henle. Like the loops of Henle, the vasa recta return toward the cortex and empty into the cortical veins. This specislized network of capillaries in the medulla plays an essentisl role in the formation of concentrated urine.

Renal Blood supply

Each kidney is supplied by a single renal artery which divides in the hilum into two main branches. Each of these gives rise to several interlobar arteries which ascends between the pyramids to the cortico-medullary junction. Here, they branch to form the arcuate arteries which run in an arc like a course parallel to the apsule of the kidney. The arcuate give rise to numerous cortical or interlobular artiries which braches to form the afferent arteriole in the glomerulus. The efferent arterioles divide to form the plexus of the capillaries that surrounds the tubules. The crotical and medullary capillaries drain vis interlobular veins to arcuate veins at the cortico-medullary junction and then to renal vein.

Specisl aspects of blood flow through the renal vasculature

There are two capillary beds associsted with the nephron; the glomerulus and the peritubular. The glomerular capillary bed receives its blood from the afferent arteriole, and from this bed the blood flows into the peritubular capillary bed through the efferent arteriole, which offers considerable resistance to blood flow. As a result, the glomerular capillary bed is a high pressure bed, whereas the peritubular capillary bed is a low pressure bed. Because of the pressure difference the fluid filters into the Bowman's capsule as in other capillary networks in the body. Only a small portion of the total renal blood flow, about 1-2% flows through the vasa recta. Some afferent arterioles directly give rise to peritubular capillaries without forming glomerulus. Such type of peritubular capillaries forms shunt.

Reproductive System

Animal reproduction is the process through which offspring are produced by male and female parents. It normally involves heterosexual mating, conception, pregnancy, parturition and lactation. Conception occurs as a result of the fusion of the male and female gametes, namely spermatozoon and ovum respectively, in a process known as fertilization. Before animals can reproduce, they must first attain puberty or reproductive age, from when they become capable of gamete production. Reproduction in animals involves close coordination or synchronization of various physiological events and this is largely achieved through the actions of the reproductive hormones.

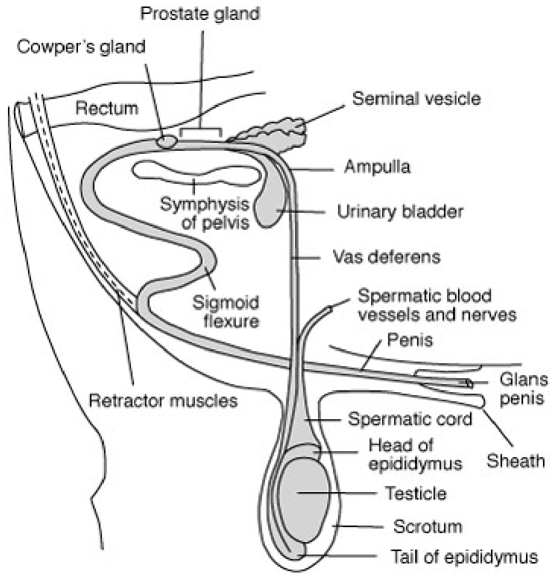
A proper understanding of animal reproduction would involve some knowledge of reproductive physiology, endocrinology, environmental physiology, cell biology, immunology, genetics, biochemistry, sociology, reproductive diseases, psychology, embryology,obstetrics and so on. In agriculture, animal production revolves around reproduction. Livestock products such as eggs and milk are direct outputs from reproductive processes. Meat production depends primarily on production of offspring which are subsequently grown out or fattened for slaughter.

Reproductive system of the Bull

Good reproductive performance of a bull is necessary to obtain a high percent calf crop when natural service is used for breeding. A bull must be fertile, capable and willing to mate a large number of cows during a short breeding season for optimum production. A basic knowledge of the reproductive tract is beneficisl for improved management. An understanding of the bull's reproductive system will also help the producer better understand breeding soundness examinations, reproductive problems and breeding impairments.

Anatomy

The reproductive tract of the bull consists of the testicles, secondary sex organs, and three accessory sex glands. These organs work in concert for formation, maturation and transport of spermatozoa, which are eventually deposited in the female reproductive tract. The secondary sex organs are the **epididymis, vas deferens** and **penis**. The three accessory sex glands include the **seminal vesicles, prostate** and **bulbourethral gland** (Cowper's gland). This basic anatomy is illustrated in Figure.



Drawing of the reproductive tract of the bull (from Nebraska Guide G80-536)
Source:http://extension.missouri.edu/p/G2016

Testicle

The testicle is located outside the body cavity in the scrotum and has two vital functions: producing the spermatozoa, and producing the male hormone, testosterone. Location of the testicles exterior to the body cavity is essentisl for normal sperm formation, which occurs only at 4 degrees to 5 degrees below body temperature. The scrotum provides physical protection to the testicle and helps regulate the temperature for optimum spermatozoa development. This regulation is done by coordination of three structures: a temperature-sensitive layer of muscle (tunica dartos) located in the walls of the scrotum, which relaxes when hot and contracts when cold; the external cremaster muscle within the spermatic cord, which controls the proximity of the testicle to the body by lengthening or shortening depending on environmental temperature; and a counter-current temperature exchange regulated by a blood flow process known as the *pampiniform plexus,* which is a coil of testicular veins that provide an effective mechanism for cooling arterisl blood entering the testicle and transferring its heat to the venous blood leaving the testicle.

One or both testicles occasionally fail to descend into the scrotum during embryological development and are retained in the body cavity. This condition is known as *chryptorchidism.* Hormone production by chryptorchid males is near normal and the male develops and behaves like a normal male, but will generally be subfertile. This condition is genetically inherited, therefore such males should not be used for breeding.

The testicle contains many long, tiny, coiled tubes known as *seminiferous tubules,* within which the sperm are formed and begin to mature. Scattered throughout the loose connective tissue surrounding the seminiferous tubules are many highly specislized cells, the *Interstitial cells of Leydig,* that produce testosterone. There are hundreds of individual seminiferous tubules in the body of the testicle which unite with one another to form a few dozen tubules that exit from the testicle and pass into the *epididymis.*

Epididymis

The epididymis is a compact, flat, elongated structure closely attached to one side of the testicle. It is divided into three regions, the head, the body and the tail. The many tubules entered the head of the epididymis from the testicle unite to form a single tubule some 130 to 160 feet in length. This tubule is convoluted and packed into the 6- to 8-inch epididymis. Four major functions occur in the epididymis, including the transport of the developing sperm cells from the testicle to the *vas deferens*; the concentration of the sperm by absorption of surplus fluids; the maturation of the developing spermatozoa; and the storage of visble sperm cells in the epididymis tail. If sexual activity is slowed, resorption of sperm cells from the epididymis tail occurs.

The epididymis serves as an outlet for all the sperm produced in the testicle and any blockage of this tube will cause sterility. Temporary blockage due to swelling following an injury or infection (epididymitis) will result in short-term infertility. If the swelling or infection results in formation of scar tissue in the tubule, it may permanently block the passage of sperm. If blockage occurs in both epididymides, the bull will no longer be useful as a breeder. Surgical removal of the tail of the epididymis (epididectomy) is frequently used as a means of sterilization for teaser (Gomer) bulls for estrus detection. Epididectomized bulls will still service cows in the usual manner, but will not deposit sperm in the female reproductive tract.

Vas deferens

The vas deferens, also known as ductus deferens, emerges from the tail of the epididymis as a straight tubule and passes as part of the spermatic cord through the *inguinal ring* into the body cavity. Spermatozoa are transported further along the reproductive tract to the pelvic region through the vas deferens by contraction of the smooth muscle tissue surrounding this tubule during ejaculation. Bulls may also be sterilized by a vasectomy in which a section of the vas deferens is removed so that sperm cannot pass to the outside of the body.

Urethra

The two vas deferens eventually unite into a single tube, the urethra, which is the channel passing through the penis. The urethra in the male serves as a common passageway for semen from the reproductive tract and urine from the urinary tract.

Accessory glands

Two of the accessory glands are found in the general region where the vas deferens unite to become the urethra. Secretions from these glands make up most of the liquid portion of the semen. In addition, the secretions activate the sperm to become motile. The seminal vesicles consist of two lobes about 4 to 5 inches long, each connected to the urethra by a duct. The *prostate gland* is located at the neck of the urinary bladder where it empties into the urethra. The prostate is relatively small in the bull, as compared to other species, and does not produce a very large volume secretion.

The third accessory gland, the *Cowper's glands,* are small, firm glands located on either side of the urethra. The clear secretion that often drips from the penis during sexual excitement prior to service is largely produced by these glands and serves to flush and cleanse the urethra of any urine residue that may be harmful to spermatozoa.

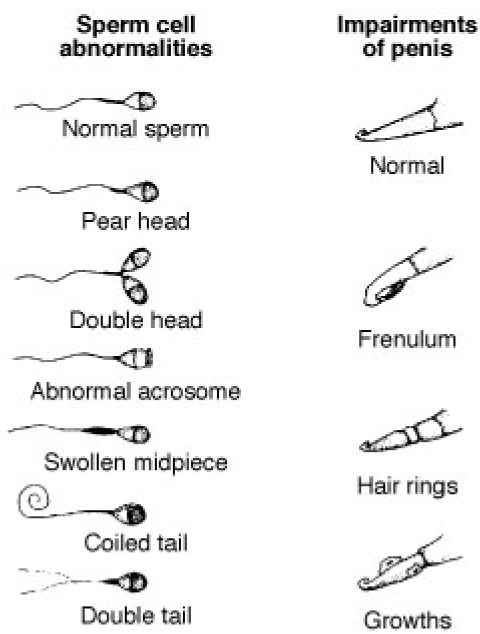
One of the accessory glands may occasionally become infected, resulting in semen samples that are yellow and cloudy and which contain puss cells. It is not uncommon in bulls for the seminal vesicles to be so affected (*seminal vesiculitis*).

Antibiotic treatment is sometimes necessary, but time will generally correct the problem.

Penis

The *sigmoid flexure* is an anatomical structure that provides a means by which the penis is held inside the sheath except during time of service. Strong retractor muscles hold the penis in the "S" shaped configuration. Occasionally these muscles are too weak to function properly and a portion of the penis and sheath lining protrude at all times. This exposes the male to the danger of injury and this characteristic should be avoided when selecting a herd bull.

The *penis* is the organ of insemination. Spongy-type materisl within the penis is filled with blood during sexual arousal, resulting in erection of the organ. The end of the penis is the glans penis and is richly supplied nerves, which are stimulated during copulation to induce ejaculation. Impairments of the glans penis may exist (Figure 2) and should be detected during a fertility exam.



Sketches show abnormalities of sperm cells and penis (from Nebraska Guide G80-536)

Regulation of male hormones

The normal functions of male reproduction are largely controlled by hormones that are secreted from the endocrine glands. The testicle functions as an endocrine gland because of its production of the male hormone, **testosterone,** by the intersticisl cells. Testosterone has several major functions:

- It is largely responsible for development and maintenance of the male reproductive tract
- It causes the development and maintenance of the secondary sex characteristics associted with masculinity, such as the crest and heavily muscled shoulders of a bull
- It is a major factor in the normal sex drive and behavior of the male
- It increases muscular and skeletal growth
- It is essentisl for normal sperm formation.

The testicle is, in turn, under the influence of hormones produced by other glands in the body. The same gonadotropic hormones that regulate ovarisn functions in the cow also regulate testicular functions in the bull. Luteinizing hormone (LH) and follicle stimulating hormone (FSH) appear to be misnamed as pertaining to male reproduction, yet carry out several important male functions.

LH and FSH are released from the pituitary gland and cause the testicle to secrete testosterone, which then acts on the germ cell lining of the seminiferous tubules to stimulate formation of primordisl sperm cells. The maturation of spermatids into fully developed sperm cells requires the presence of FSH. Normal functioning of the male accessory glands requires testosterone.

The hormone production by the testicle is not only regulated by hormones released from the anterior pituitary, but the reverse is also true. The level of testosterone in the blood regulates the secretion of gonadotropic hormones from the anterior pituitary vis a feedback system. A proper balance of all hormones is vital to successful reproductive functions.

Breeding soundness examination

An examination of bulls for breeding soundness before the breeding season can detect the bulls which have obvious potentisl fertility problems. This examination should be performed by an experienced, trained person, usually a veterinarisn. It should be pointed out here that a breeding soundness examination is simply a screening procedure to eliminate bulls that have a high possibility of being non-fertile. A "fertility test" is a misnomer since techniques presently available do not allow for accurate prediction of fertility. Results from an actual breeding season remain the only test of a bull's breeding ability. Guidelines for a breeding soundness examination include:

Physical examination

The penis should be examined during electro-ejaculation or natural mating, in an erected, extended state. The quantity of sperm above the required level illustrates possible abnormalities of the penis. Potentisl problems of the penis may include hair rings, which restrict circulation, a persistent frenulum or adhesion, lacerations, growths, scar tissue, devistions, or a urethral fistula. Next the scrotum and testes should be palpated. The scrotum should be pendulous but well supported. The testes should be firm and uniform in size and shape. The internal sex organs should be palpated rectally to ensure proper development and size. Good vision and sound feet and legs should also be considered when evaluating a bull's physical abilities to breed.

Scrotal circumference

Scrotal circumference gives an indication of a bull's ability to produce sperm and is related to younger age at puberty. Breeds differ somewhat as to scrotal circumference, but 32 centimeters is generally accepted as the minimum size for yearling bulls to be sound breeds.

Semen evaluation

Four criteris are used to evaluate semen, i.e., volume, concentration, motility and morphology. Proper training is required to accurately evaluate semen. A scoring system for predicting potentisl breeding soundness of bulls. Breeding soundness examinations presently do not include an evaluation of a bull's sexual drive or libido. Libido testing is time consuming and requires use of females in estrus .Therefore it is difficult to conduct on a large scale. Procedures are being investigated to evaluate the willingness and desire of bulls to mate in a better way.

Comparative Anatomy

All species present the basic male reproductive tract (i.e 2 testis, 2 epididymides, 2 ductus deferens, and a prostate). However, considerable varistion exists regard the other accessory glands such as seminal vesicles, ampullary glands, bulbourethral glands (glands of Littre). The ampulla in the bull, camel, rabbit, ram, stallion. It is a spiral-shaped, thickening of the terminal portion of the ductus deferens. In the male hamster, mouse and rat, it exists on the dorsal wall of the urethra. The secretion of the ampulla is rich in electrolytes (Na^+ Ca^{++}, and Mg^{++}) and citric acid.

The Seminal Vesicle

This is a paired, bag-shaped glands in guinea pigs, rats and stallions. In bull, boar and rams, they consist of multiple lobes containing a system of ramified secretory ducts. It is absent in cats and dogs.

The Prostate

It is a tubule-alveolar gland that may be diffused, it is confirmed around the urethra or discrete. It forms a definite body outside the urethral muscle. In rams the prostate is of the diffuse type whereas both types exist in boars and bulls. It is the only sexual accessory gland in dogs.

Testes

Testes are paired encapsulated ovoid organs made up of seminiferous tubules separated by Interstitial tissues. They are enclosed in a dense connective tissue capsule the tunica albuginea. In most mammals, the testes migrate from their origin in the abdomen to a subcutaneous envagination of the periteum, the scrotum. Testicular descent occurs during fetal life in large animal, (bull, ram) but only after birth in other animals (rats, dogs). The seminiferous tubules have a lumen, a stratified epithelium composed of spermatogenic cells, sartoli cells and a thin enter basement membrane. The loose connective tissue stroma between the tubules contain Leydig cells. The distal segment of the seminifemous tubules open and drain into the vete testis (a network of ducts). The rete testis carries spermatozoa and fluid in which they are suspended. A system of efferent ducts or ductus deferens links the rete testis to the epididymis. The ducts deferens is also an absorptive and secretory tissue.

Female reproductive system

The ovary is seeded with thousands of primary oocytes, a minority of which will ultimately reach maturity after puberty. The mullerism ducts develop, whereas the Wolffisn ducts become vestigisl. According to the species, the Mullerisn ducts change to become the oviducts of a duplex uterus (vodonts) or bicornuate uterus (pigs) or bipartite uterus (ruminants) or simple uterus (more, primates) (see fig). The genital tubercle develops into the clitoris, the genital fold into the urethral orifice and the genital suveling into the borders of the vulva. In bird the female reproduction system is unique. Althourh paired Wolffisn ducts appear, only the left genitalis primordis develop further to functional organs. Therefore, only the left ovary and oviduct are present. In prepubetal female animals, the ovary is relatively static, apart from undergoing growth compaired to the postpubertal animal. The ovary consists of an outer layer of cortex which contains thousands of follicles that carries a female gamete or primary oocyte. The inner layer of the ovary is the Medulla. Each oocyte is enveloped by a single layer of cells and it termed primordisl follicle. The female reproductive system consists of following organs, namely

1. Ovaries : Reproductive glands
2. Fallopisn Tubes : Coveys ova from ovary to uterus.
3. Uterus : In which fertilized ovum develops.
4. Vagina : dilatable passage from uterus to Vulva.
5. Vulva : Terminal segment of system

Ovaries

Two in number laying in the abdominal cavity sizes are 0.5 to 1.5 inch dismeter and 0.5 to 1.5 inch width and thickness.

Function

Dual purpose - production of eggs or ova and production of female hormone i.e. estrogen

Oviduct (Fallopisn Tube)

Are slender, zigzag lubes attached to ligament 20-25 cm in length, close to ovaries in such a way that eggs/ova released by ovary area cached through funnel shape wide end called as "Infundibulum".

Function

The epithelial lining of oviduct is cilisted of which cilisry motion helps to conduct ova from ovaries to uterus. The fertilization occurs in the ampullary region.

Uterus

It consists of short medium body, pair of spirally twisted internally cavity connecting two horns known as body of uterus. The uterus has three layers i.e. outer servosa, middle muscular is and inner mucosa. In non-pregnancy period uterus lies in the pelvic cavity which descends into abdomen during pregnancy.

Function

Fertilized ova /embryo develop into uterus until the time of birth. To nourish the developing foetus through cotyledons of inner layer.

Cervix

It is thick walled portion which lies between uterus and vagina having muscle layers forming longitudinal folds forming spiral passage way through it. It is 4 inch long and 1 inch or more thick.

Function

It is tightly closed during pregnancy and anoestrus period and reflex during estrus and parturition.

Vagina

It is between cervix to vulva in cow. It is 8-10 inch long. Highly elastic organ.

Functions

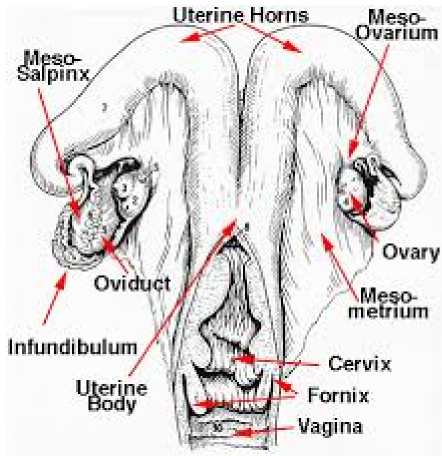
Responsible for secretion of mucus, serves as birth canal dung parturition and admits male organ during copulation.

Vulva

It is external vertical opening of genital tract just below anus. Dismeter is larger than that of vagina.

Function

Vulva walls supplied with glands which are active during excitement,



Female reproductive system of cattle
Source: www.ansci.wisc.edu427 × 450

Reproductive hormones and its function

In animal species, the hypothalamus and the pituitary gland form a physiological unit that is most important in the synthesis on peptide hormones. An important function of the hypothalamic-pituitary complex is the control of gonads for reproductive activities. The two organs are located close to each other in the lower part of the brain. The hypothalamus acts as a neuro-endocrine transducer and it translates into hormonal output. The specific hormones produced by the pituitary are regulated by the peptide hormones produced by the hypothalamus. The regulatory hormones produced by the hypothalamus reach the pituitary vis the portal veins which convey blood from the hypothalamus to the pituitary.

Hormones of the Hypothalamus

RnRH (:HRH, FSH-RH)

GnIH

Proladis releasing factor (PRF)

Prolactin-Inhibiting factor (PIF)

GnRH: GnRH is produced in hypothalamus and transported by axonal flow and stored in small granules in the terminals of the nerves on medisn eminence (lower hypothalamus).

GnRH is released in pulses (every 2 hours) and causes the liberation of LH and FSH from the pituitary gland. Those two hormones participate in the control of reproduction in male and female animals. GnRH increases the pituitary secretion of LH and FSH. The secretion of GnRH is increased during coitus in the cat followed by LH surge. The secretion of GnRH is controlled by feedback effects of steroid hormones produced in the ovary or testis. In small animals, secretion of GnRH is also stimulated by administration of synthetic, non-setroidal estrogen analog (clomiphene citinle) or an anti-estrogen (clomiphene citinte) or an antiestrogen analog (tamoxifen). An example of neural inputs that influence hypothalamic output of GnRH are pheromones, that stimulate the olfactory bulb (rams). The induction of puberty is marked by increase in the production of GnRH. Changes in photoperiod also control GnRH production (sheep). In sheep and goats of the temperate countries, shortening of day length increases melatonin production, initiste GnRH production. Lambs and kids that have grown sufficiently reach puberty and then sexually mature. In adults animal breeding season starts when day length shortens. In wild animals and horses, GnRH increase coincides with the breeding season when day lengths increase.The suppression of GnRH release by the administration of high levels of steroids (testosterone, estrogen, progesterone) form the basis for oral contraception in humans. Inhibin, a glycoprotein hormone, produced in the follicles of the ovary or in the somniferous tubules of the testis, reduces GnRH secretion. Prolactin and LH from short-loop negative feedback can also inhibit GnRH.

Anterior Pituitary Hormones (Adenohypohysis)

LH,

FSH

In females and males, FSH and LH are synthesized and released from the anterior pituitary (adenohypophysis) upon stimulation by GnRH. The basal or tonic output of FSH and LH is pulsatile (with modulation of frequency and amplitude of the pulses) during most of the reproductive life of females and males. In females, a massive surge of LH during the oestrus cycle is associsted with ovulation. The basal pulsatile secretion of FSH regulates follicular growth in females and controls

spermatogenesis in males. The synthesis and release of FSH is under the negative feedback of inhibin and of sustained high plasma levels of estradol. The basal pulsatile output of LH functions mainly for the maintenance of follicular inteinization in the ovulated female. In males, tonic LH stimulates the Interstitial (Leydig cells) cells of the testes to produce testosterone. The basal pulsatile secretion of LH is regulated by GnRH and gonadal steroid feedback (estisdiol mostly).

In mammals, LH surge near ovulation is associsted with the positive feedback of high estnadiol levels whereas in the birds it is associsted with the positive feedback of progesterone.

Postenor Pitnitary Hormones (Nenrohypophysis)

Prolactin (PRL)

Growth hormone (GH)

The posterior pituitary secretes prolactin (a single chain folded polypeptide). The secretion of prolactin is under tonic inhibitory control of dopamine and prolactin-inhibiting hormone. In all animals, lactation and suckling are associsted with high plasma levels of prolactin. In females, the most obvious roles of PRL (prolactin) are to start the differentistion of mammary gland cells into producers of milk proteins and constituents and to initiste and maintain lactation.

The function of PRL in male animals is unknown but may consist of an action on the testis to enhance the activity of LH and to stimulate testosterone production. During pregnancy, in conjunction with estradiol, progesterone and placental lactogen, PRL levels rise constantly stimulating the growth of the mammary gland elements. Following parturition, the abrupt decrease in estradiol and progesterone and the maximal high levels of PRL permit the initistion of maximal PRL secretion which gradually declines as lactation progresses. In primates and rodents, hyper prolactinemis of lactation prevents the liberation of GnRH, together with gonadotropins, and the return of the reproductive cycles.

Testis

The major hormones produced by the testes are testosterone by Leydigis cells and inhibin by sertoli's cells. Their synthesis is regulated by the gonadotrophsis (LH and FSH). Inhibin induces the maturation and growth of the seminiferons tubule cells and the aromatization of androgens to estradiol. FSH supports sertoli cells for the morphological maturation of spermatids into spermatozoa. The hypothalamic-pituitary-testicular axis is a closed-loop system, that is, a system in which the control action depends on the output. It has a negative feed-back system in which testicular hormones (testosterone and inhibin) depress the pituitary secretion of LH and FSH. Castration results in elevated levels of LH and GSH in arculation. The negative feedback of testosterone on hypothalamic GnRH makes it the primary regulator of gonadotropin secretion whereas inhibin would suppress mostly FSH release. Testosterone induces androgenic (male characteristics) and anabolic (growth-promoting) effects. Besides stimulating the differentistion of the wolffisn ducts during embryogenesis, testosterone is directly responsible for growth of the penis and of accessory glands and for the initistion and maintenance of spermatogenesis. Other actions include aggressiveness, sexual drive (libido), erection, growth of the male (horses) and growth and shedding of male anthers in deer.

The production of male pheromones (i.e substances that modify the reproductive behaviour of females) is stimulated by testosterone. In sows in estrus, the smell of boar's urine or saliva produces a typical immobility. The growth and maturation of large antral follicles-entering their final stage of development.

Ovarisn Hormones

These include Pregesterone, pregrenotone, androstenedione, testosterone, estrone, estractiol and estriol. Pregnenolone is the key precursor of all steroids. It is readily converted to progesterone by follides at all growing stages of development. In all animals, the greatest stimulation of progesterone biosynthesis follows the LH surge and ovulation. The major source of progesterone is the granulosa cells of the follicle and lutein cells of the corpus luteum. Androstenedione and testosterone are andiogens secreted by theca cells of the follicle. They are produced by hydroxylation of prognenolone or progesterone. LH increases androgen secretion by theca cells. These androgens also act as substrate for conversion into estrogens.

Summary

- Animals need to breathe to supply the cells with oxygen and remove the waste product carbon dioxide.
- The lungs are situated in the pleural cavities of the thorax.
- Gas exchange occurs in the alveoli of the lungs that provide a large surface area. Here oxygen diffuses from the alveoli into the red blood cells in the capillaries that surround the alveoli. Carbon dioxide, at high concentration in the blood, diffuses into the alveoli to be breathed out.
- Inspiration occurs when muscle contraction causes the ribs to move up and out and the disphragm to flatten. These movements increase the volume of the pleural cavity and draw air down the respiratory system into the lungs.
- The air enters the nasal cavity and passes to the pharynx and larynx where the epiglottis closes the opening to the lungs during swallowing. the air passes down the trachea kept open by rings of cartilage to the bronchi and bronchioles and then to the alveoli.
- Expiration is a passive process requiring no energy as it relies on the relaxation of the muscles and recoil of the elastic tissue of the lungs.
- The rate of breathing is determined by the concentration of carbon dioxide in the blood. As carbon dioxide makes blood acidic, the rate of breathing helps control the acid/base balance of the blood.
- The cells lining the respiratory passages produce mucus which traps dust particles, which are wafted into the nose by cilis.
- The neuron is the basic unit of the nervous system. It consists of a cell body with a nucleus, filaments known as dendrites and a long fibre known as the axon often surrounded by a myelin sheath.
- A nerve is a bundle of axons.
- Grey matter in the brain and spinal cord consists mainly of brain cells while

white matter consists of masses of axons.

- Nerve Impulses travel along axons.
- Adjacent neurons connect with each other at synapses.
- Reflexes are automatic responses to stimuli. The path taken by nerve impulses involved in reflexes is a reflex arc. Most reflex arcs involve 3 neurons - a sensory neuron, a relay neuron and a motor neuron. A stimulus, a pin in the paw for example, initistes an impulse in the sensory neuron that passes vis a synapse to the relay neuron situated in the spinal cord and then vis another synapse to the motor neurone. This transmits the impulse to the muscle causing it to contract and remove the paw from the pin.
- The nervous system is divided into 2 parts: the central nervous system, consisting of the brain and spinal cord and the peripheral nervous system consisting of nerves connected to the brain and spinal cord. The autonomic nervous system is considered to be part of the peripheral nervous system.
- The brain consists of three major regions: 1. the fore brain which includes the cerebral hemispheres (or cerebrum), hypothalamus and pituitary gland; 2. the hindbrain or brain stem containing the medulla oblongata and 3. the cerebellum.
- Protective membranes known as the meninges surround the brain and spinal cord.
- There are 12 pairs of cranisl nerves that include the optic, olfactory, acoustic and vagus nerves.
- The spinal cord is a cable of nerve tissue surrounded by meninges passing from the brain to the end of the tail. Spinal nerves emerge by a ventral and dorsal root between each vertebra and connect the spinal cord with organs and muscles.
- The autonomic nervous system controls internal body functions not under conscious control. It is divided into 2 parts with 2 different functions: the sympathetic nervous system that is involved in the flight and fight response including increased heart rate, bronchisl dilation, dilation of the pupil and decreased gut activity. The parasympathetic nervous system is associsted with decreased heart rate, pupil constriction and increased gut activity.

- The skeleton maintains the shape of the body, protects internal organs and makes locomotion possible.
- The vertebrae support the body and protect the spinal cord. They consist of: cervical vertebrae in the neck, thoracic vertebrae in the chest region which articulate with the ribs, lumbar vertebrae in the loin region, sacral vertebrae fused to the pelvis to form the sacrum and tail or coccygeal vertebrae.
- The skull protects the brain and sense organs. The cranium forms a solid box enclosing the brain. The mandible forms the jaw.
- The forelimb consists of the humerus, radius, ulna, carpals, metacarpals and phalanges. It moves against or articulates with the scapula at the shoulder joint.
- The hindlimb consists of the femur, patella, tibis, fibula, tarsals, metatarsals and digits. It moves against or articulates with the pelvis at the hip joint.
- Bones articulate against each other at joints.
- Compact bone in the shaft of long bones gives them their strength. Spongy bone at the ends reduces weight. Bone growth occurs at the growth plate.

Glossary

Abductor - moves a bone away from the midline

Adductor - moves a bone closer to the midline

Antagonistic - condition in which a muscle opposes or resists the action of another muscle

Aponeurosis - sheetlike tendon of a muscle

Cursorisl - tetrapods that travel far or fast on the land

Depressor - produces a downward movement

Digitigrade - posture in which the wrist and ankle are carried off the ground and the animal walks on its digits

Epaxisl - pertaining to structures that lie above or beside the vertebral axis

Extensor - increases the angle at a joint

Fascis-sheets of connective tissue that lie beneath the skin or ensheathe groups of muscles

Flexor - decreases the angle at a joint

Flight - use of wings to actively sustain movement through the air

Fossorisl - tetrapods that are adept at digging, and live a somewhat subterranean existence

Gliding - use of broad membranes attached to limbs to increase surface area and travel a greater horizontal distance through the air

Hypaxisl - pertaining to structures that lie ventral to the vertebral axis

Insertion - the point of attachment of a muscle that moves the most when the muscle shortens, or the most distal end of limb muscles

Levator - produces an upward movement

Origin - the end of a muscle that attaches to the more fixed part of the skeleton, which is the proximal end in limb muscles

Oscillatory swimmers - propel themselves through the water with paddle-like movements of the appendages

Parachuting - use of limbs and body to increase overall surface area to break an inadvertent fall

Plantigrade - posture in which the soles of the feet are placed flat on the ground during locomotion

Primary swimmers - species for which swimming is the sole pattern of locomotion

Pronator - turns the palm downward

Raphe - junction of two muscles at a band of connective tissue to form a line of fusion, such as linea alba

Rotator - moves a bone around its longitudinal axis

Saltatorisl - tetrapods that jump or hop

Scansorisl - tetrapods adept at climbing

Secondary swimmers - species which have readapted completely or partislly to an aquatic mode of life from a terrestrisl life

Sphincter - decreases the size of an opening

Supinator - turns the palm upward or anteriorly

Synergistic - condition in which the muscles work together to produce a common effect

Tensor - makes a body part more rigid

Undulatory swimmers - use the musculature of the fins only, or the fins in combination with the trunk and tail, to propel themselves through the water

Unguligrade - a locomotory posture used by long legged tetrapods, which walk only on the tips of the digits such that the terminal end of the digit is modified to form a hoof, and other digits are lost

EXERCISES

A. Very Short Question

1. Define veterinary anatomy?
2. What is cardisc muscles?
3. What are reproductive hormones?
4. What is ptyline?
5. What are digestive enzymes?
6. What are cranisl nerves?
7. Define neuron?
8. What is renin?

B. Short question

1. Enlist types of veterinary anatomy
2. Draw the skeletal of cattle
3. What are digestive organ of ruminant
4. Differentiste between ruminant and non-ruminant
5. Draw the well labelled disgram of nephron.
6. Draw the disgram of reflex arch

C. Long question

1. Describe digestive physiology of ruminant
2. Describe digestive anatomy and physiology of monogastric animal
3. Describe anatomy and physiology of urinary system
4. Describe anatomy and physiology of nervous system

5. Describe anatomy and physiology of female reproductive system of cattle.
6. Describe anatomy and physiology of male reproductive system of ox.
7. Describe anatomy and physiology of circulatory system
8. Describe anatomy and physiology of muscular system
9. Describe anatomy and physiology of respiratory system

Unit Five
Systemic diseases of livestock

Learning outcomes

After the completion this unit student will able to:

1. Explain the important systemic diseases of livestock.
2. Define stomatitis, tympany, impaction, Diarrhoea and dysentery, cough, Pneumonia, anaemia, nephritis, retention of unrine, metritis, retention of placenta, laminitis, GID, dermatomycosis, allergy.
3. Enlist the etiology of stomatitis. tympany, impaction, Diarrhoea and dysentery, cough, Pneumonia, anaemia, nephritis, retention of unrine, metritis, retention of placenta, laminitis, GID, dermatomycosis, allergy.
4. To know the clinical signs and diagnosis of stomatitis, tympany, impaction, diarrhoea and dysentery, cough, pneumonia, anaemia, nephritis, retention of unrine, metritis, retention of placenta, laminitis, GID, dermatomycosis, allergy.
5. To be able to know about the prevention and treatment of stomatitis , tympany, impaction, diarrhoea and dysentery, cough, pneumonia, anaemia, nephritis, retention of unrine, metritis, retention of placenta, laminitis, GID, dermatomycosis, allergy.

Introduction

A systemic disease is one that affects a number of organs and tissues, or affects the body as a whole. The main systems of the body are enlisted as below:

The skeletal system

The major tissues and organs are bones, ligaments, tendons, bone morrow, and cartilage. The main function is to provide structure, support body, help to move and protect organs.

Circulatory system

The major tissues and organs are the heart, arteries, veins, capillaries, and blood. Its function is to carry blood from heart to body, back to the heart, to the lungs and back to the heart.

Muscular system

There are three types: skeletal, cardiac, and smooth. Skeletal muscles are connected to bones. Cardiac is found in the heart. Smooth are found in digestive tract. Its main purpose is to control the movement of body.

Respiratory system

Respiratory system is the system by which oxygen is taken into the body and an exchange of oxygen and carbon dioxide takes place; In mammals the system includes the nasal passages, pharynx, trachea, bronchi, and lungs.

Nervous System

The nervous system is composed of three main parts: the brain, spinal cord, and nerves. The brain controls the entire body. The spinal cord is a bundle of vital nerves. Nerves are comprised of neurons.

Digestive system

The digestive system is made up of the gastrointestinal (GI) tract—also called the digestive tract—and the liver, pancreas, and gallbladder. The *cow's digestive tract* consists of the mouth, esophagus, a complex four-compartment stomach; rumen, reticulum, omasum and abomasum, small intestine and large intestine.

Integumentary system

The skin, hair, and nails form the body's outer covering, or integument. They help to protect the body's internal parts from damage and provide a barrier to invasion by infectious organisms.

Urinary system

The body's cells produce waste products, many of which are eliminated in urine. The function of the urinary system is to make urine and expel it from the body.

Reproductive system

The reproductive system consist of organs and parts which function in reproduction consisting in male especially the testes, penis, seminal vesicles, prostate, and urethra and in the female especislly of the ovaries, fallopian tubes, uterus, vagina, and vulva.

Digestive system

Diseased condition involved with digestive system are stomatitis, tympany, gastritis etc.

Stomatitis

Stomatitis can be defined as inflammation of the mucous membrane of the mouth. The word stomatitis is derived from Latin, from stoma, stomat- mouth, itis – inflammation . Stomatitis is a clinical sign of many diseases in large animals. Oral trauma or contact with chemical irritants (eg, horses that lick at their legs after having been blistered with caustic agents) may result in transient stomatitis.

Causes of stomatitis

Physical cause

- Traumatic injury from the ingestion of hairy caterpillar with fodder, spine of plants, coarse feed.
- Ingestion of mouldy, rotten straw or hay.
- Ingestion of frozen food.
- Injury by sharp objects, pointed materisls, nails, needles, bones.

Chemical causes

- Irritant agents: acid, alkali, hot or cold food, mercury, iodine, formaline etc.
- Drugs eruption: penicillin, sulphonamides etc.
- Counter irritants: leg blisters, cantharides, Bin-iodide of mercury etc.

Infective causes

- **Viruses:** foot and mouth diseases, rinderpest, mucosal diseases, vesicular stomatitis, blue tongue, pox group of vius, orf of sheep and goat, distemper of dog, infectious canine hepatitis etc.
- **Bacteria:** streptococcus, staphylococcus, actinobacillus lignieresi, leptospira spp., Dermatophilus congolense.
- **Fungus:** Candida spp. , Aspergillus Spp., Fusarium Spp., Dermatomycosis,

Monilis Spp.

- **Spirochaetes:** granulomatous lesion in cat due to spirochaetes called fuso spirochaetal stomatitis.
- **Parasites:** Demodectic mange, Entamoeba gingivalis etc.
- **Nutritional:** Deficiency of Vitamin B complex (niscin, riboflavin), Niscin deficiency cause black tongue (necrotic stomatitis) in dogs.
- **Allergy:** certain allergen plants like clover, lucern, alfa alfa, mouldy forage,. Photosensitizing reaction may be prevalent in buccal mucous membrane.
- **Auto immune causes:** muco cutaneous disorder like pemphigus vulgaris in dog, chronic bulbous eruption on mouth, ear, nose and skin.

Classification of stomatitis

Stomatitis can be broadly classified on the basis of etiology and lesion involved:

According to etiology	According to lesion
Viral stomatitis	Simple stomatitis
Bacterial stomatitis	Popular stomatitis
Mycotic stomatitis	Vesicular stomatitis
Spirochaetal stomatitis	Proliferative stomatitis
Traumatic stomatitis	Fibrinous stomatitis
Allergic stomatitis	Phlegmonous stomatitis
	Ulcerative stomatitis
	Necrotic stomatitis
	Granulomatous stomatitis
	Mycotic stomatitis
	Allergic stomatitis
	Gangrenous stomatitis

Pathogenesis

Stomatitis is the result of primary or secondary affection.

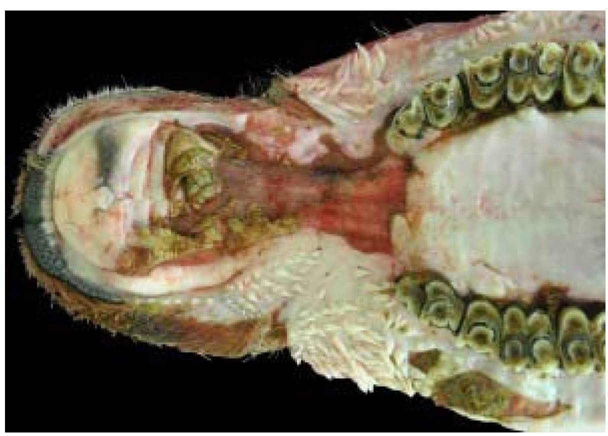
Primary affection is caused due to physical and chemical factors when in direct contact with oral mucous membrane. Then the irritation set ups and inflammatory changes occurs. Simple stomatitis heals up within one to two weeks. But if complicated by7 ulceration it takes longer time to heal.

Secondary stomatitis is caused due to localized inflammation following systemic diseases. Viral infections like mouth diseases, rinderpest, mucosal diseases, vesicular stomatitis etc, will produce viraemis and lesion in oral mucosa and tongue. It may also developed due to disease forwarding from pharynx, larynx, stomach etc.

Clinical signs

Signs commonly associsted with acute active stomatitis include:

- Ptyalism: excessive production of saliva.
- Dysphagis: difficulty in swallowing.
- Foietid odour from mouth.
- Enlargement of lymph nodes.
- Tongue may have vesicular or ulcerative lesion.
- There may be elevation in temperature.
- Dermatitis if due to allergic cause.
- Resistance to oral examination.
- Death due to septicaemis or necrotic laryngitis in calf diphtheris.



Stomatitis

Diagnosis

- Taking history such as viral, bacterial disease, trauma, chemical irritants etc
- Oral examination: Oral examination can be done by sedation, after which the

mouth can be examined carefully with the aid of a mouth speculum and a light source. Ulcers should be visually and digitally evaluated to determine whether embedded foreign materisl (eg, grass awns) is present.

- Erosion of muzzle
- Drooling of saliva from mouth.
- Change of colour of gum.
- Lesion on gum.
- Lesion on lip.
- Lesion on tongue.
- Lesion on dental pad.
- Buccal necrosis due to necrotic bacillus.
- Enlagement of lymph node.
- Examine further for determining causative factors.

Differentisl disgnoses

- Actinobacillosis
- Foot-and-mouth disease
- Malignant catarrhal fever
- Bovine viral Diarrhoea .
- Bluetongue in ruminants,
- Swine vesicular disease,
- Vesicular stomatitis

Line of treatment

- Feed: Soft blend diet such as barley.
- Herbivores: provide soft green fodder, green leaves, banana leafs etc.
- Restriction of grazing on pasture.
- Removal of foreign body if prenet during clinical examination.
- Fluid therapy: Dextrose saline or dextrose saline in normal physiological saline solution intravenously.
- 1-2% boroglycerine or 2% copper sulphate or potassium permagnet at dilution

of 1:10000 can be applied over lesion.

- Systemic antibiotic therapy: Penicillin inection 500mg to 2500mg can be administered intramuscularly or tetracycline, oxyteracycline or chlorotetracycline at the dose of 5mg per kg body weight intramuscularly can be applied for one week.
- For ulcerative lesion, cauterization can be done with 10% silver nitrate stick or swab with tincture iodine.
- For the allergic stomatitis, antihistaminic preparations like Zeet, Avil can be tried to alley allergic reaction. Large animal 10-15ml, small animal 1ml-3ml intramuscular.
- To control salivation atropine sulphate inection subcutaneously can be administered.
- Surgical removal of granulomatous or gangrenous mass.
- In case of dogs (pemphigmus vulgaris infection), glucocorticoid (Betnesol, Hostacortin-H) along with broad spectrum antibiotics can be used.
- Supportive therapy: Course of vitamin A, B complex, C can be administered in diet or parenterally.

Prognosis

The prognosis in almost cases of stomatitis is favourable although recovery time varies with aetiology factors involved. But in some cases like anthrax, haemorrhagic septicaemis, blackquarter etc. there may be unfavourable situation, may be up to grave.

Summary

- Stomatitis is the inflammation of buccal cavity caused by various physical, chemical and infective agents clinically manifested by ptyalism and dysphagis.
- Most of the case can be successfully treated by Appropriate use of drugs against causative agent and supportive therapy.

Glossary

Inflammation: Inflammation is a defense mechanism to protect from infection and injury.

Ulcer: A lesion or sore on the skin or mucous membrane resulting from the gradual disintegration of surface epithelial tissue.

Hepatitis: Hepatitis is inflammation of the liver tissue

Sedation: Sedation is calming of mental excitement of physiological function, especislly by the administration of drugs.

Ptyalism: Excessive secretion of saliva.

Dysphagia: Difficulty in swallowing.

Assignment

A. Very short question.

1. Define stomatitis.
2. Define hepatitis.
3. Define ptyalism.
4. Define dysphagia.

B. Short question.

1. What are the etiological factors responsible for stomatitis.
2. Write the stmptoms of stomatitis in short.

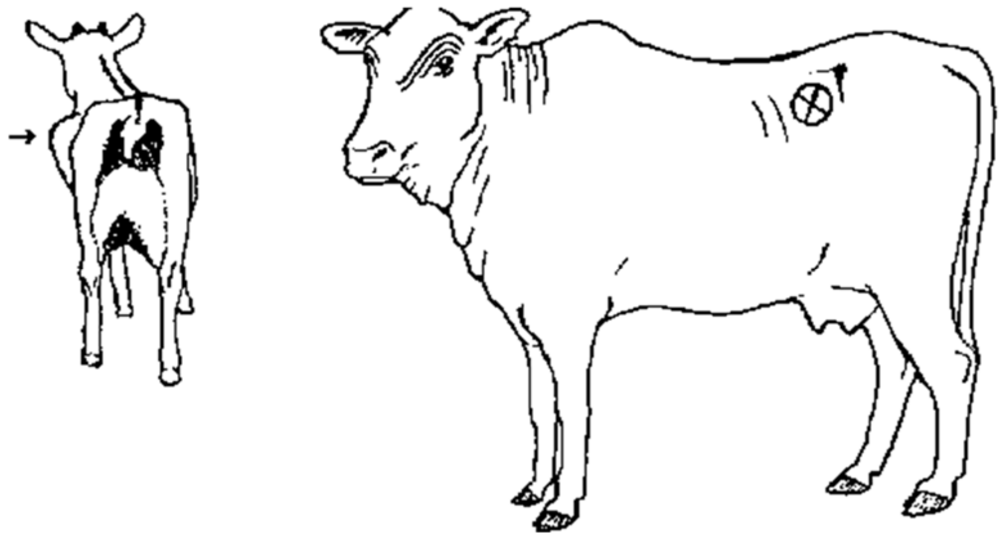
C. Long questions.

1. Define stomatitis. Describe briefly the etiological factors, symptoms and line of treatment.
2. What are the clinical signs of stomatitis?How would you treat the case of stomatitis in field case?

Tympany (bloat)

The stomach of ruminant animals produces a lot of gas. The animals continually belch, once each minute, to get rid of the gas. Occasionally belching stops and gas builds up in the rumen to cause bloat.

As the gas builds up the left flank balloons out. The pain from this causes the animal to try to kick its belly or it stands with its back legs wide apart. It has difficulty in breathing.



Site of bloat in cattle.

The animal may be in distress for several hours but in bad cases of bloat the animal will be found lying on its side and death can occur in a few hours.

Causes of bloat

Bloat can occur when the animal grazes on lush young pasture, particularly if the pasture is wet. Some plants, e.g. clover, lucerne and alfalfa are especislly dangerous in causing bloat but any fast growing plants can cause it.

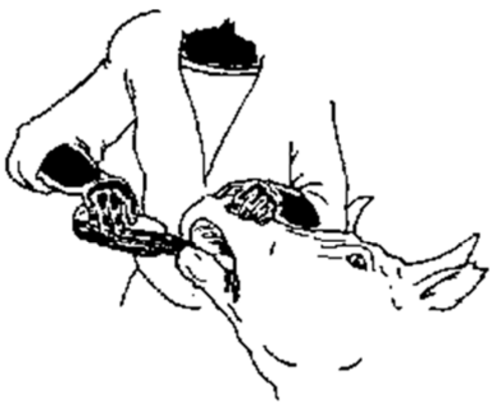
Sometimes ruminants kept by the household and fed only feed such as dry bread can develop bloat.

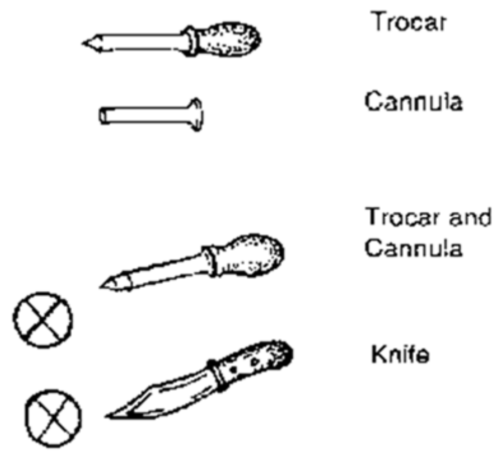
Treatment

Massaging the distended rumen through the abdominal wall. Drench (drink) to the animal . The drench used can be one of the following:

- Mineral oil or vegetative oil ½ to 2 liter orally.
- Mixture containing turpentine- 60ml,; Lysol-4ml, linseed oil ½ lit; liquid paraffin-1lit.
- Cholinergic drugs (neostigmine) in low dose (2-4 mg/ 500 kg) is indicated to restore motility of gut.

In severe cases, the animal may not belch and it will die. In such cases puncturing the left flank with a sharp knife or trocar and cannula to release the gas is necessary, it will be necessary for you to act quickly as any hesitation could lead to the death of the animal.





Drenching the animal and trocar and canula.

Sometimes tympany occurs because large pieces of feed block the gullet (oesophagus). If this happens try to massage the neck to remove the blockage.

Preventing bloat

- Avoid moving animals to wet pasture, especislly first thing in the morning.
- Do not allow very hungry animals to graze a pasture. Offer dry, cut grass first before turning out to graze.

Keep a watch on animals at pasture

Summary

- Bloat occurs when too much gas is produced in the rumen.

- The left flank becomes distended and breathing becomes difficult.
- This may happen suddenly, especislly when the animal is grazing on wet pasture in the morning. It may cause sudden death.
- Avoid moving animals to wet pasture, especislly first thing in the morning.
- Do not allow very hungry animals to graze a pasture. Offer dry, cut grass first before turning out to graze first before turning out to graze.

Glossary

Trocar and cannula: An instrument for withdrawing fluid or gas from rumen.

Cholinergic drug: Drugs that inhibit, enhance, or mimic the action of the neurotransmitter acetylcholine, the primary transmitter of nerve impulses within the parasympathetic nervous system i.e., that part of the autonomic nervous system that contracts smooth muscles, dilates blood vessels, increases bodily secretions, and slows the heart rate.

Assignment

A. Very short question

1. Define bloat.
2. Write the use of trocar and canula in animal.

B. Short question.

1. Write short note on treatment of bloat.
2. Enlist two measure to avoid the bloat in animal.

C. Long question.

1. Write short note on bloat including cause, symptoms and prevention.
2. What is tympany. Write down the causative factors, symptoms and line of treatment.

Impaction

Impaction simply means bowel obstruction that can occur in various kinds of animals when they consume something that they cannot digest. Impaction in dairy animals refers to the failure of digestion, slow passage and accumulation of feed in one or more of the stomach compartments leading to constipation or absence of dung. It is more common in pregnant or young cattle of less than 8 yr of age.

For example, in reptiles, common causes of impaction are rocks and sand, which might be accidentally consumed when the reptile attacks its prey. In livestock, rough fodder such as straw can risk impaction. Once the substance is ingested it will block the digestive tract and, if untreated, cause death.

Impaction is of two types

1. **Primary impaction –** It refers of accumulation of poor quality roughages in any of the forestomach compartments. It is relatively rare condition and involves nearly all animals of the herd. For example feeding of hybrid napier bajra was associsted with one of outbreak of impaction in dairy animals. Sometimes ingestion of inanimate or indigestible substance like ropes a polyethene is associsted with such impaction in sporadic cases in herd.
2. **Secondary impaction –** any inflammation of gut or associsted organ which decease gut motility lead to secondary impaction.

Predisposing factors responsible for impaction are as follows:

- Fatty animals.
- Old age.
- General deability.
- Greedy feeding.
- Defect in teeth.
- Weak intestinal musculature.

The major causes of impactions are discussed below:

Dietary factors

The dietary factors leading to impaction are listed as below.

- Intake of low grade undigestible roughage for long period.
- Intake of more grains.
- Feeding at long intervals.
- Inadequate feeding of water.
- Inadequate feeding of green forages.

Penetrating foreign bodies:

Agricultural operations like chaffing, cutting fodder, thrashing of wheat, grinding, mixing concentrates etc. lead to spillage of broken sharp parts of machines, nails etc. in the fodder. Moreover our dairy animals are kept close to human inhabitation which allow accidental access of various hardware items in the fodder. Physical evidence of penetrating foreign bodies in more cases consisting of hair pins, nails, screws, electric wires, sharp broken parts of machines etc.

The indiscriminate eating habit of bovines which predispose them to ingestion of sharp foreign bodies. These bodies being heavier than fodder settle at floor of reticulo rumen and the honey comb mucosa of reticulum is ideal for entrapping and holding them. These entrapped or free sharp penetrating bodies cause pain to animal during normal reticulo ruminal movements and thus there is cessation of these movement. Many a time the focal area of reticulum perforated by foreign body get necrosed and the foreign body fall back in the reticulum which relieves the animal of the symptoms of disease. At times the foreign bodies perforate through and through and deep in the wall of reticulum. This leads to spillage of ruminal contents loaded with wide array of microorganisms in peritoneum and result in peritonitis.

Depending upon the immune status, the animal tries to either cordon off infection locally or it spread in whole of abdomen and become generalised. Inflammatory reaction of bovines is characteristically fibrino purulent which lead to warding off fluid at many sites in peritoneal cavity. The setting of peritoneal inflammation leads to pain cascade in neural rich peritoneum which ends up in reticulo ruminal stasis. The ingested feed and fodder gets accumulated in forestomach compartment, microbes die and fluid get absorbed and dryness of ingesta ensue.The stasis of forestomach compartment lead to their dilatation which resemble forestomach impaction many a time presented/ referred as reticulo ruminal, omasal or abamasal impaction. These impacted materisls if not removed cause dryness or necrosis of leaves of omasum and it become difficult to restore their function even after removal of primary cause.

The peritoneal inflammation and absorption of toxins leads to toxaemia and cardiovascular compromise which proves fatal for the animal. At times the reparative local adhesions formed between disphragm and reticulum contain infection and animal does not recover even after removal of penetrating foreign bodies .These case are referred to as adhesive peritonitis.

Symptoms

- Lack of appetite or lethargy.
- On many reptiles a large blue seemingly bruised spot will be visible in the abdomen; however, this only shows through if the skin on the species is clear enough to see the lower internal organs.
- Symptom of passing of scant faces or absence of dung is seen usually by the owner, some cases pass scant dung occasionally and with bigger size feed particles.
- There is progressive abdominal distension or tympany.
- Presence of pain in the start of problem exhibited by kicking at abdomen, restlessness and frequently getting up and lying down is observed frequently.
- The animal later on turns stoic, show arching of back or looking to abdomen on palpating it.
- Preference for eating of dry fodder or continuous standing for longer duration are some of other signs of pain shown by these animals occasionally.
- Regurgitation, recurrent tympany, only mucous or mucous coated faeces, persistent anorexis, capricious appetite and thirst and dehydration are recorded in some of these animals.
- Constipation
- Increased pulse rate.
- Constant effort to urinate.
- Slight sweating.

- Loss of tone of large intestine.
- Electrolyte imbalance and dehydration.

Clinical examination

The clinical examination is an important tool for Diagnosis of these cases in the field condition. Apart from general clinical examination, you should also focus on examination of reticulo rumen its consistency, motility, nature of contents, per rectal exam should be performed which form the basis of Diagnosis of these case. Shape of abdomen, rectal examination for presence of distended intestinal loops and type of faeces make valuable point for confirmation of these cases. The hematology, radiography, ultrasongraphy and peritoneal fluid examination almost confirm these case.

Treatment

- Anthacene purgative can be administered in horse.
- Administration of enema with liquid paraffin or soft soap.
- Direct introduction of warm linseed or paraffin oil into caecum by use of long syringe.
- A combination of antibiotics covering G+ve, G-ve and anaerobes are ideal for this. In our experience a combination of ceftriofur, enrofloxacin, ampicillin and metronidazole give good result. The antibiotic treatment is needed for 1-3 weeks depending upon the condition or severity of infection.
- The supportive therapy in form of salines to check dehydration or metabolic acidosis vitamins supplements to boost immune system strength are good options.

Summary

- Impaction simply means bowel obstruction that can occur in various kinds of animals when they consume something that they cannot digest.
- Impaction is of two types: Primary impaction and secondary impaction.
- Regurgitation, recurrent tympany, only mucous or mucous coated faeces, persistent anorexis, capricious appetite and thirst and dehydration are recorded in some of these animals.
- Impaction can be treatment by administration of enema with liquid paraffin or

soft soap.

Glossary

Reptile: Reptile are cold blooded veretebrates.

Forestomach: Three of the four ruminant stomach compartments make up the forestomach. These three compartments – the rumen, reticulum, and omasum – are an extension of the lower oesophagus

Anorexis: An eating disorder characterized by markedly reduced appetite or total aversion to food.

Appetite: Appetite is the desire to eat food, due to hunger.

Constipation: Constipation is a condition of the digestive system where an individual has hard feces that are difficult to expel.

Purgative:
A strong medication usually administered by mouth to promote evacuation of the bowel or to produce several bowel movements

Enema: It is a fluid injected into the lower bowel by way of the rectum, to relieve constipation.

Assignment

A. Very short question

1. Define impaction?
2. Define enema?
3. What do you mean by constipation?

B. Short question.

1. Write about the predisposing factors of impaction.
2. Elist dietary factors leading to impaction.

C. Long question.

1. Describe impaction, etiology, symptoms and treatment.

Diarrhoea and dysentery

Diarrhoea is multifactorisl diseases where intestinal disorder occurs and characterized by abnormal frequency and fluidity of fecal evacuations. It has been estimated that 75% of early calf mortality in dairy herds is caused by acute Diarrhoea in the pre-weaning period.

An acute or chronic inflammation of intestinal mucosa membrane is known as enteritis. It is characterized by frequent passes of loose faeces, flatulence, abdominal distension and borborygmus. Inflammation of colon is called colonitis, caecam as typhlitis and rectum as proctitis.

Dysentery is a type of gastroenteritis that results in Diarrhoea with mucus and blood.

Diarrhoea is a common complaint in cattle and young ruminants (particularly in the first few months of life). Many of the pathogens and management practices that cause Diarrhoea in calves also affect lambs and goats. Most herds are exposed to Diarrhoea causing pathogens, and management practices will largely determine the health impact that those pathogens will have on the young stock. In "real life", most young ruminant Diarrhoea is caused by more than one factor or pathologic agent. It is important to be able to correctly disgnose and Appropriately treat Diarrhoea in livestock, and to be able to suggest management strategies that will prevent further outbreaks of disease. Several pathogens are zoonotic agents (Salmonella spp., Cryptosporidium spp., Gisrdis spp., and certain types of enteropathogenic E. coli) so great care must be taken when handling disrrheic animals, contaminated bedding, and fecal samples to avoid contaminating yourself and others.

Implications of Diarrhoea

When an animal passes watery droppings many times a day it has Diarrhoea. Animals with Diarrhoea have certain symptoms like

- Lose water and salt from their bodies.
- Animals become weak and thin
- Loss of appetite
- Lose watery feaces contains mucous and sometimes blood.

- Loss of milk production and animals can die if treatment gets delayed

Etiology of Diarrhoea

On the basis of etiology Diarrhoea can be classified as infectious and non-infectious Diarrhoea.

1. Infectious Diarrhoea- Infectious Diarrhoea can be caused by agents like virus, bacteria, parasites, mycotoxins etc.
2. Non infectious Diarrhoea- Non infectious Diarrhoea can be caused due to poor hygiene, stress, overfeeding, indigestion, faulty diet, intestinal injury and inflammation and malabsorption.
3. Chemical cause : corrosive chemical, arsenic, copper, molybdenum, fluorine, mercury, nitrate, microtoxin, carbontetrachloride, cathartics.
4. Deficiency: copper deficiency, disaccharide deficiency in young calf.

Physiological causes of Diarrhoea are mainly

- Increase in intestinal peristalsis
- Hyper secretion of intestinal fluid
- Damage to intestinal mucosa
- Malabsorption

In Diarrhoea, the intestine fails to adequately absorb fluids, and/or secretion into the intestine is increased. Loss of fluids through Diarrhoea produces dehydration and the loss of certain body salts. Diarrhoea causes a change in body tissue composition and severe depression in the animal.

Viral Diarrhoea

Rotavirus Diarrhoea

a. Within 24 hours of birth, a germ called rotavirus causes this type of Diarrhoea.
b. Infected calves are severely depressed. There may be drooling of saliva and watery Diarrhoea.
c. The faeces will vary in colour from yellow to green.
d. Calves lose appetite and the death rate may be as high as 50 %.

e. There are no signs on dead animals; however, there is an increased volume of fluid in both the small and large intestine.

Coronavirus Diarrhoea

a. This occurs in calves that are over 5 days of age; the germ is called coronavirus.

b. The animal is not as depressed as in rotavirus Diarrhoea.

c. The initisl signs may be the same as in rotavirus, but later on the faeces may contain clear mucus that resembles the white of an egg.

d. Mortality is low (1-25 %).

Bovine virus Diarrhoea (BVD)

a. Diarrhoea begins 2 to 3 days after exposure to the germ and may persist for a long time.

b. Ulcers on the tongue, lips and in the mouth are the usual lesions found in the live calf.

c. Bovine virus Diarrhoea is controlled by vaccinating all replacement heifers 1 to 2 months before breeding.

d. Pregnant heifers should not be vaccinated. The state veterinarisn should be consulted before starting a BVD vaccination programme.

Bacterial Diarrhoea

Colibacillosis (Eschericis coli)

Eschericis coli is a major cause of Diarrhoea in young calves. E. coli germs attack the intestinal mucous membrane and other mucous membranes and produce toxins (poisons).

The toxins cause severe inflammation of the intestinal lining (enteritis) and can lead to death within hours. A less severe form of the disease is usually characterised by Diarrhoea accompanied by progressive dehydration. Colibacillosis lasts 2 to 4 days and its severity depends on the age of the calf. E. coli inhabits the intestine and is excreted in the faeces. It can contaminate kraals, stables, floors, paddocks and even water supplies.

Johne's disease or paratuberculosis

Johne's disease (JD) is a chronic, progressive intestinal disease caused by infection with *Mycobacterium paratuberculosis (Map)*. The agent was first identified in European cattle a century ago, and it was discovered in the United States in the early 1900s.

Johne's disease is an incurable wasting disease of adult cattle. It is of greater concern in dairy herds than in beef operations. This difference reflects varistions in management practices-especislly close confinement in dairy operations, which promotes easier transmission of the organism. The germ causes an infectious inflammation of the intestines with severe weight loss and Diarrhoea. It is economically important because some animals may become so emacisted that they are unfit for slaughter.

Salmonella

a. Salmonella germs produce a poison called an endotoxin. Calves are usually affected at 6 days of age or older (the same as in coronavirus Diarrhoea).

b. Signs of salmonella scours include Diarrhoea, presence of blood and fibrin (yellow clots) in the faeces, depression and elevated temperature.

c. Salmonella germs multiply in the intestine and many reach the bloodstream, causing blood infection and sudden death. Finding a membrane-like cover in the intestine of a dead animal suggests salmonellosis.

d. Tick-borne diseases and underfeeding of calves predispose them to salmonella scours. Heavily infected animals may become severely depressed following treatment with antibiotics because treatment causes the salmonella organisms to release toxins.

Enterotoxaemia (pulpy kidney)

a. The disease usually starts quite suddenly. Affected animals become listless, display uneasiness, and strain or kick at their abdomen. Bloody Diarrhoea may or may not occur.

b. It is usually associsted with change in the weather, a change in the feed of the cows, or management practices that cause the calf to nurse for a longer period of time than usual. The hungry calf may overconsume milk which establishes an environment in the gut that is conducive to the growth and production of toxins by germs.

c. In dead animals the gut may be red in colour or have bloody, purplish areas.

Other causes of calf Diarrhoea

Coccidiosis

- Coccidiosis occurs in calves of 3 weeks of age and older, usually following stress, poor sanitation, overcrowding or sudden changes of feed.
- A typical sign of coccidiosis in young calves is Diarrhoea with faeces smeared over the rump as far around as the tail will reach.
- The symptoms are Diarrhoea, with slimy and bloody faeces, Emaciation, weakening and anaemia. The affected calves strain excessively when they defecate.

Nutritional Diarrhoea

a. Nutritional scours are caused by anything that disrupts the normal nursing pattern, for example storms, strong wind or the mother's temporary absence. When the hungry calf gets the opportunity to nurse, the cow's udder may contain more milk than normal and the calf may take in excessive quantities, resulting in nutritional scours.

b. It is usually white scours caused by undigested milk passing through the intestinal tract.

c. It usually presents little problems. Milking the cow to limit the milk intake by the calf usually clears up the problem. Oral antibiotics may be used if the calf becomes depressed.

Pathophysiology of Diarrhoea

Acute Diarrhoea leads to circulatory failure and shock due to intense dehydration. Prerenal oligaemic failure may further be complicated by cortical necrosis and renal failure. Inaddition severe water loss, the electrolytes are alo lost and sodium potassium, bicarbonate and other essentisl elements are depleted from the totoal body pool.

With progressive loss of bicarbonate in the faeces due to starvation, rapid alkaline secretion in small bowel toxaemis there will be severe metabolic acidosis, characterized by rapid and deep breathing and depression.

In about 15 % of the cases of Diarrhoea, water loss from body is more than sodium. This leads to hypernatrium dehydration. This hypertonicity of extracellular fluid is very dangerous to intracranisl content. This may result in shrinkage of cell mass, neornal irritation, intracerebral and intravenous haemorrhages. Clinical manifestation involves tremendous thirst, irritability and convulsion.

In about 5% of the case of Diarrhoea, there is excess loss of sodium in comparision to water reffered as hypotonic dehydration. For this, to maintain the osmotic equilibrium the hypotonic extracellular compartment losses water to cells causing cellular edema, increased intracranisl tension leading to convulsion state.

Clinical findings

- Rise in temperature in almost all acute cases and it gradually decreases in long standing cases.
- Diarrhoea
- Mala absorption.
- Dehydration
- Vomitig may be accompanied.
- Partisl or complete loss of appetite
- Faeces are fluid or semisolid in nature and partislly digested food, mucus, epithelial shreds, fibrin and blood.
- Faeces smells foul or fishy odour.
- Clour of faeces may turn dark green or tarry colour or black in colour.
- Faeces may be greasy and steatorrhoea.
- Tympany, gurgling sound or fluid rushing sound known as borboygmi can be heared on auscultation.
- There may be excess straining.

Chronic Diarrhoea may produce following symptoms

Anaemia usually of microcytic type due to vitamin B12 and folic acid malaabsorption. While anaemia with large bowel Diarrhoea is due to iron deficiency, following occult or obvious blood loss.

Difference between Diarrhoea and dysentery are listed as below:

Diarrhoea	Dysentery
1. Faeces : voluminous, fluidy.	Scanty and sticky
2. presence of blood in faeces: yes	Yes
3.presence of mucus and fibrin in faeces : no	Yes
4.pus cell: very less	Abundant amount of pus cells
5.tanesmus during decation: not evident	Severe straining is evident

Diagnosis

- On basis of clinical sign and symptoms
- Viral Diarrhoea cause leukopaenis followed by leukocytosis.
- In some viral Diarrhoea like rinderpest, mucosal diseases, foot and mouth diseases etc there is mouth lesion along with Diarrhoea.
- Bacterial Diarrhoea cause leucocytosis.
- Monitor on diet management.
- In poisoning the temperature may be subnormal and dehydrated.
- In endoparasitic cases, there is gradual loss of body condition, anaemia, protruded abdomen and intramandibular swelling.

Treatment of calf scours

Treatments aim towards correction of primary causes, correction of dehydration, acidosis and electrolyte balance, regulation of diet and symptomatic therapy.

1. Treatment of the forms of Diarrhoea is very similar regardless of the cause.
2. Specific treatment is often not possible and symptomatic treatment of the Diarrhoea itself should be applied.
3. It should be directed towards correcting the loss of fluids (dehydration), acidosis (acidity) and loss of salts.
4. Calves may be given milk diluted with an equal quantity of clean water.

5. Antibiotic and or sulpha treatment can be given simultaneously with the treatment for dehydration.
6. There are salt powders (also called electrolyte powders) available that can be mixed with water for oral administration.
7. Symptomatic treatments

a. Drug reducing motility

- To reduce motility and relief pain drugs like opium may be used.
- Anti cholinergic agents like atropine sulfate preparations used in dogs.
- In horse anticholinergic drugs like atropine , morphine, and dypyrone may used to reduce intestinal spasm.
- In calf, piglets, kid and lambs, benzotimide or chlorodyne may be used to alleviste intestinal spasm.

b. Adsorbents

- Bismuth carbonate acts as adsorbentand astringents
- Dose; cattle, horse- 15 to 30 gm, calf, pig, goat, sheep – 5 to15gm; dog and cat- 0.1to 0.3 gm.
- Kaolin acts adsorbent and inhibits secretions.
- Dose. Horse cattle. Buffalo- 50 to 250gm; calf, sheep, goat, pig- 15 to30gm; dog and cat -1to 5gm.
- Activated charcoal is an astringent for toxins.

c. Microtherapy

Lactobacillus acidohilus containing foods like curd, buttermilk or commercisl preparations like lactisyn may be fed to replenish normal intestinal flora.

d. Anti secretory agents

Use of prostaglandin inhibitors like aspirin, phenybutazone, indimehacin etc . these drugs have good result in Diarrhoea of calf, pig and kids.

e. Antibiotic therapy

- Sulphonamide : sulphadimidin 200mg/kg body weight orall/ parentrally for 7 to 10 days.

- Amoxicillin: 4 to 10 mg/ kg body weight orally and 2-7mg/ kg body weight parenterally 7 to 10 days.
- Neomycin: 2.5 to 7mg/ kg body weight 5to 10 days.
- Furazolidone: 10 to 20mg/ kg body weight 5 to 10 days.

f. Antiprotozoal therapy for amoeba and giardia

Metronidazole for dogs; 200 to 40mg t.i.d. orally for 7 to 10 days.

g. Anthelmentic drugs

- For ascarids: piperazine citrate, adipate, mebendazole, diethyl carbamazine etc.
- For hook worms : disophenol, ivermectine, bephenium hydroxynaopthoate etc.
- Foe gastrointestinal nematodes : levamisole, tetramisole, thisbendazole, parabendazole, fenbendazole, albendazole, coumaphos(organophosphate), morantel tartrate etc.
- For fluke infestation: oxyclozanide, niclosamide, resorantel, clioxanide, bithinol, hexachlorophene etc.

h. For small animals oral rehydrate solution (ORS) as per World Health Organization (W.H.O.).

W.H.O FORMULA OF ORS			
Glucose	20gm	Glucose	110m mol
Sodium chloride	3.5gm	Sodium	90mEqll
Sodium bicarbonate	2.5gm	Chloride	80mEql
Potassium chloride	1.5gm	Bicarbonate	20mEql
Water	1000ml	Potassium	20mEql

Control

Because of the complex nature of Diarrhoea in neonates, it is unrealistic to expect total prevention—economical control is the major objective.

To control the Diarrhoea in new born, farms must follow three broad principles in all herds:

1) the degree of exposure of neonates should be reduced by isolating diseased animals or by moving calving and calf rearing to a separate area, and by

practicing good general hygiene;

2) nonspecific resistance should be maximized by providing good nutrition to the dam and neonate and assuring that newborn calves consume ≥5% of their body wt of high-quality colostrum, preferably within 2 hr and certainly within 6 hr of birth, followed by equivalent amounts at 12-hr intervals for the next 48 hr;

3) The specific resistance of the newborn should be increased by vaccinating the dam or the newborn. A significant portion of both naturally sucking dairy calves and calves handfed colostrum do not acquire adequate amounts of immunoglobulin because of delayed sucking or feeding, ingestion of an inadequate volume of colostrum, or ingestion of colostrum of inferior immunoglobulin concentration. When time constraints on labor preclude an ensured intake of colostrum by nipple-bottle feeding, administration of 4 L of colostrum by esophageal feeder within the first 2 hr of life can be the best colostrum feeding.

Summary

- Diarrhoea is multifactorial diseases where intestinal disorder occur and characterized by abnormal frequency and fluidity of fecal evacuations.
- An acute or chronic inflammation of intestinal mucosa membrane is known as enteritis.
- Dysentery is a type of gastroenteritis that results in Diarrhoea with mucus and blood.
- On the basis of etiology Diarrhoea can be classified as infectious and non-infectious Diarrhoea.
- The main cause of death in acute Diarrhoea is dehydration which results from loss of fluid and electrolytes in Diarrhoea stools.
- Treatments aim towards correction of primary causes, correction of dehydration, acidosis and electrolyte balance, regulation of diet and symptomatic therapy.

Glossary

Colonitis: Inflammation of the colon.

Typhlitis: Inflammation of the cecum.

Proctitis: Proctitis is inflammation of the lining of the rectum.

Immunoglobulin: A protein produced by plasma cells and lymphocytes and characteristic of these types of cells which play an essentisl role in the body's immune system.

Colostrum: A yellowish liquid, especislly rich in immune factors, secreted by the mammary gland of female mammals a few days before and after the birth of their young.

Endotoxin: A toxic heat-stable lipopolysaccharide substance present in the outer membrane of gram-negative bacteria that is released from the cell upon lysis.

Leukopaenis: Leukopaenis means a low white cell count.

Leukocytosis: White cells (the leukocyte count) above the normal range in the blood

Anthelmentics: Group of antiparasitic drugs that expel parasitic worms (helminths) and other internal parasites from the body by either stunning or killing them and without causing significant damage to the host.

Assignment

A. Very short question.

1. Define Diarrhoea.
2. Define dysentery.
3. Define colonitis.
4. Define typhlitis.

B. Short question.

1. Write three difference between Diarrhoea and dysentery.
2. Enlist few points on implication of dirrhoea.

C. Long question.

1. Describe Diarrhoea with their symptoms, treatment and prevention measures.

Respiratory system

The main diseased condition involved with respiratory system are Pneumonia, cough, bronchitis etc.

Cough

Literally, cough denotes for expel air from the lungs with a sudden sharp sound. A cough is a forceful expulsion of air from the lungs through the airways and an open mouth, as an important aspect of the respiratory defense system. Many times coughing has been confused with gagging, wheezing, labored breathing, retching, vomiting, and a condition known as reverse sneezing.

Cough results from an irritation of the respiratory system. The respiratory system includes the opening to the outside world (mouth or nose), nasal passages, pharynx (throat), larynx (voice box), trachea, bronchi, and the small airways of the lung. Additionally, coughing can be related to problems with the heart or a mass in the chest. A cough can be a symptom of many different diseases.

It's very important that the sound coming from animals is properly identified. The sound produced by a cough can indicate its cause. A hacking, honking, loud cough is generally associocited with diseases of the large airways; trachea and/or large bronchi. Tracheal collapse produces a characteristic "goose-honking" sound. Tracheal trauma from a collar, for instance, can also cause a honking cough. Slight half-hearted coughing could be a sign of pulmonary edema , fluid in the lungs. A cough that sounds moist may indicate an infection of the lungs or congestive heart failure.

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Types of coughing

a. Productive cough

In a productive cough, something is "coughed up", such as a watery fluid, pus, or blood. This should not be confused with vomiting. Vomiting will contain stomach contents and bile. A productive cough is most often associated with an infectious process (bacterial, viral, or fungal). Allergic lung disease or early heart disease would produce a non-productive cough.

b. Non-productive cough

Non productive coughing produces sound but no discharge.

Pathology of coughing

Coughing is an involuntary reflex but it can also be suppressed or done voluntarily. The nerve receptors that trigger coughing are quite numerous in the trachea and bronchi above the level of the bifurcation. There are other cough-stimulating receptors within and around the lung tissue itself. Many of the nerve receptors that stimulate coughing are irritant receptors and can be triggered by things such as dust, exposure to hot or cold air, pinching the trachea, ammonis gas, and inflammation with excessive mucous production. Importantly, coughing is also triggered and accompanied by bronchi constriction.

Common causes of coughing in cattle include:

a. Shipping fever (haemorrhgic septicaemis)

b. Enzootic calf Pneumonia

c. Lungworm infection

d. Chronic bacterial Pneumonia

e. IBR (Infectious Bovine Rhinotracheitis caused by Bovine Herpes Virus I)

f. Mycoplasma Pneumonia

g. Calf Diphtheris

h. Esophogeal obstruction/ Choke

i. Abscess

j. Trauma

Diseases of the respiratory tract can make the cough receptors more sensitive. For example, viruses like IBR that affect the respiratory tract can make the cough receptors more sensitive to irritants like dust or cold air.

Common causes of coughing in dogs and cats are shown in the table below.

Causes	Examples	Symptoms	Diagnosis	Treatment	Prognosis
Bacterial (Less common in cats)	Bordetella, Streptococci, E. coli, P. multocida, Pseudomonas, Klebsiella, Pneumonia	Productive cough, with or without labored breathing, Fever, Loss of appetite, Severe illness	Thoracic radiographs, CBC, Transtracheal wash, Broncho-alveolar lavage, Bronchoscopic exam, Fine needle aspirate	Antibiotics, Supportive care	Depends on the type of bacteria and the extent of the illness
Viral	Cats: Rhinotracheitis, Calicivirus Dogs: Parainfluenza, Adenovirus, Herpes virus	Productive cough, Fever, with or without dyspnea, Often complicated by a bacterial infection	Thoracic radiographs, CBC, Transtracheal wash, Broncho-alveolar lavage, Bronchoscopic exam, Fine needle aspirate	Supportive care, Antibiotics (if needed for secondary bacterial infection)	Depends on the virus involved and the extent of damage done by the secondary infection
Parasitic	Heartworm disease, Lungworm, Hookworm, Roundworms (dog and cat)	Non-productive cough, with or without labored breathing	Thoracic radiographs, Blood test for heartworm, Fecal exam	Anti-parasiticides, Supportive care	If disgnosed early prognosis is good
Fungal	Blastomycosis, Histoplasmosis, Coccidioid-omycosis	Cough, sometimes productive, with or without labored breathing	Thoracic radiographs, CBC, Transtracheal wash, Broncho-alveolar lavage, Bronchoscopic exam, Fine needle aspirate	Antifungal agents, Supportive care	Depends on extent and length of infection
Neoplastic	Lymphoma	Non-	Thoracic	Surgery, Che	Depends

(May be in lung or chest)	(dog and cat), Metastatic cancer	productive cough, with or without labored breathing	radiographs, Fine needle aspirate	motherapy, R adistion Therapy	on the site, nature of the tumor, and how invasive it is
Cardiovascular	Congestive Heart failure	Subtle "half-hearted cough," most often at night - progressing to anytime, Cough may be moist and productive as disease progresses	Thoracic radiographs, Heart auscultation, Electro-cardiogram, Blood chemistry profile, Blood parasite screen	Surgery to correct leaky valve or other abnormalities, Medications to lower load on heart +/or increase the strength of the heartbeat	Depends on the specific heart condition
Allergic or Irritant (Air-borne allergen such as dust or pollen)	Feline asthma, Allergic bronchitis, Second hand smoke	Non-productive cough	Thoracic radiographs, Symptomatic response to allergen, Allergy testing	Bronchodilators, Antihistamines, Cough suppressants	Depends on environmental controls and reducing the allergen exposure
Traumatic	Tracheal trauma from excessive pressure on a collar, Irritation from barking	Honking cough when pressure is placed on collar	Based on symptoms	Remove trauma, Anti-inflammatory medications, Use of halter instead of collar	Depends on the extent of the trauma
Physical Factors	Collapsing Trachea, Foreign body, Lung lobe torsion, Tonsillitis	"Goose-honking" cough (tracheal collapse), Productive cough (trying	Thoracic radiographs, Palpate trachea	Bronchodilators, Cough suppressants, Limited activity, Use of halter instead of	Collapsing trachea: fair with maintenance program. Depends on damage

		to expel the foreign body)		collar, Surgically removing the foreign body	done by the foreign body

Diagnosis

History to find the cause like stress, change in environment, exposure to disease, presence of fever, management practices etc.

Clinical evauation including physical examinations. It is also important to characterize the cough itself and identify factors such as the onset, duration, and frequency, relation to other events, and any improvement or deterioration.

The cough should be characterized by its anatomical location (upper airway vs. lower airway), dry or wet, productive or non-productive. Coughs originating in the upper airway usually develop rapidly and are dry, hacking coughs that don't produce mucous or pus. On the other hand, coughs originating in the lower airways are usually more chronic and tend to be softer and productive.

Other disgnostic techniques that can be employed to help identify the underlying cause of a cough include:

a. Complete Blood Count: This test will often show non-specific findings, but it can help identify anemis associsted with caudal vena cava syndrome due to rumenal acidosis and increased fibrinogen associsted with inflammatory conditions

b. Nasopharyngeal Swabbing: Taking a sample of the naspharyngeal mucous for cytologic evaluation and culture is used to confirm viral and bacterial infections of the upper airways.

c. Endoscopic Examination: This technique allows one to evaluate the upper airways for mass lesions, anatomical abnormalities and the source of exudates.

d. Tracheal Aspiration: A sample from the trachea can be used for bacterial culture when an infection of the lungs and surrounding tissue is suspected.

e. Bronchio alveolar Lavage: This technique gives better samples than tracheal aspiration for cytologic evaluation. Gram stains of bacteria found can also help when choosing an antibiotic before culture results are back from the lab.

f. Thoracocentesis: This technique is used in animals with evidence of effusive pleural disease. Collecting pleural fluid can be used for bacterial culture and cytology.

g. Blood Gas Analysis: This test can be useful in animals with a history of coughing accompanied by respiratory distress or cyanosis. Blood gas analysis allows one to look at the arterisl oxygen and carbon dioxide levels to assess respiration.

h. Fecal Examination: A Baermann technique allows one to detect lungworm larvae within the feces.

i. Radiographic Examination: Thoracic radiographs can help identify the pattern of lung disease as well as the response to treatment.

Treatment

Treating coughing should be done to the specific underlying disease condition associsted with the symptom. In general, it is important to reduce stress in these animals, keep them warm and in an area that is well ventilated, and to provide good quality nutrition.

Prevention

1. Management

Preventing coughing in cattle primarily involves good management practices to prevent any diseases and conditions that cause coughing. Stress such as shipping, crowding, extreme temperatures, and nutritional deficits need to be prevented.

2. Vaccination and deworming

It is important to maintain a good vaccination and deworming protocol to help prevent infectious causes of coughing.

3. Quarantine

If an infectious cause of coughing is suspected, it is a good idea to quarantine the affected animals to prevent the spread of disease vis aerosolized viral or bacterial particles. Before importing the new stocks, quarantine measures should be followed according to the diseases.

Summary

- A cough is a forceful expulsion of air from the lungs through the airways and an open mouth, as an important aspect of the respiratory defense system.
- Cough results from an irritation of the respiratory system. Cough can be a symptom of many different diseases.
- Cough can be productive and non productive.
- Treating coughing is done to the specific underlying disease condition associsted with this symptom.
- Coughing can be prevented by proper mamagement, quarantine and prophylactic measures like vaccination, deworming.

Glossary

Gagging: An involuntary retching reflex that may be stimulated by something touching the posterior palate or throat region.

Wheezing: Wheezing is a high-pitched whistling sound made while breathing.

Sneezing: Sneezing is a semi-autonomous, convulsive expulsion of air from the lungs through the nose and mouth, usually caused by foreign particles.

Thoracocentesis: Thoracocentesis is an invasive procedure to remove fluid or air from the pleural space for disgnostic or therapeutic purposes.

Vaccination: Injection of a killed microbe in order to stimulate the immune system against the microbe, thereby preventing disease.

Deworming: Deworming is the giving of an anthelmintic drug to a human or animal to rid them of helminths parasites

Quarantine: A quarantine is used to separate and restrict the movement of persons; it is a 'state of enforced isolation'

Assignment

A. Very short question.

1. Define cough.
2. Define thoracocentesis.

B. Short question.

1. Write a short note on productive cough.
2. Enlist the etiology of cough.

C. Long question.

1. Define cough. Describe the etiology of cough in pets with there clinical sign and treatment.

Pneumonia

Pneumonia is an inflammatory condition of the lung affecting primarily the microscopic air sacs known as alveoli. Pneumonia is an acute or chronic inflammation of the lungs and bronchi characterized by disturbance in respiration and Hypoxemia and complicated by the systemic effects of associted toxins. The usual cause is primary viral infection of the lower respiratory tract.

Some common Pneumonia are:

Pneumococcal Pneumonia: this is caused by bacteria (such as Streptococcus spp.), viruses or fungi. Pneumococcal Pneumonia infects the upper respiratory tract and can spread to the nervous system, lungs, ears, or blood if not treated immedistely.

Bronchisl Pneumonia: A class of Pneumonia that affects both the lungs and the bronchi. The Streptococcus spp. bacteria strain is the usual origin of this disease, but it can also be triggered by other strains such as Staphylococcus aureus, Haemophilus influenza or Klebsiella Pneumoniae.

Lobar Pneumonia: Another disease caused by the Streptococcus spp. bacteria strain wherein there is an infection in one lobe (or area) of the lung.

Legionella Pneumonia: Also known as Legionnaires' disease, this is caused by the legionella bacterium strain. Patients affected by Legionella Pneumonia inhale the bacteria, which is why this severe type of Pneumonia.

Bilateral Pneumonia: This is caused by a bacterial, viral or fungal infection that affects both lungs. It's also known as double Pneumonia, and patients have difficulty breathing and show traces of fluids in the lungs.

Eosinophilic Pneumonia: Also known as acute eosinophilic Pneumonia (AEP). This is a rare condition wherein eosinophils, a type of white blood cell that's part of the immune system, increase rapidly and accumulate in the lungs. Eosinophils form in order to combat allergens, inflammation or infection.

Lipoid Pneumonia: Lipoid Pneumonia is a rare disease wherein oily and fatty substances enter the lungs. According to the research, lipoid Pneumonia is often caused by inhalation, aspiration or even ingestion of fatty substances such as petroleum jelly, mineral oils, nasal drops and olive oil.

Hypostatic Pneumonia: This disease manifests at the base of the chest cavity, when the lower portions of the lungs are not able to expand properly.

Interstitial Pneumonia: This is considered to be rare, this happens when there's an inflammation of the "mesh-like" walls of the alveoli (or air sacs) in lungs, and as a result, the small air sacs in the lungs become separated. There might be an inflammation of the pleura (a thin cover that shields the lungs and its individual lobes) as well.

Types and causes of Pneumonia

There are six major types of Pneumonia. They are:

1. Bacterial Pneumonia: Commonly caused by bacteria strains such as Streptococcus spp., staphylococci spp., pasteurella multocida, haemophilus suis, salmonella cholera suis, corynbacterium equi etc. Bacterial Pneumonia cases can be mild or severe, depending on the strength of the bacteria strain and how long until the disease is disgnosed and treated.
2. Viral Pneumonia: This type is triggered by viruses such as influenza, adenoviruses ,canine distemper virus, ranikhet virus, corona viruses etc.Viral Pneumonia is said to be responsible for one-third of all Pneumonia cases.

The initisl offenders in bovine Pneumonia include:

- Parainfluenza.
- Infectious bovine rhinotracheitis.
- Bovine respiratory syncytisl virus.
- Bovine viral Diarrhoea virus.
- Adenovirus.
- Herpesvirus.
- Rhinovirus.
- Enterovirus.

1. Parasitic Pneumonia: This type is generated by M*etastrongylus apri* in swine, *Dictyocaulus viviparous* in cattle, *Protostrongylus rufescens* and

Dictyocaulus filarisl in sheep and goat, *Ascaric lumbricoids* in sheep.

2. Mycoplasma Pneumonia: This type is generated by Mycoplasma gallisepticum an "atypical bacterium" that's considered to be one of the smallest agents that affect poultry.
3. Aspiration Pneumonia: Infections or inhalation of food, liquid, gases or dust lead to this type of Pneumonia.19 This illness goes by other names, such as necrotizing Pneumonia, anaerobic Pneumonia, aspiration pneumonitis, and aspiration of vomitus.
4. Fungal Pneumonia: Produced by various endemic or opportunistic fungi. This causes fungal infections, such as histoplasmosis, actinomycosis, aspergillosis, Cryptococcus, coccidioidomycosis, and blastomycosis that occur after inhaling spores or conidis or reactivating a latent infection. It has to be noted that fungal Pneumonia cases are quite difficult to disgnose.

Other types of Pneumonia are:

Tumors in lungs: in lungs tumors are rare. Both benign and malignant tumors occur. Lymphocytoma is stated to be common.

Necrotic, gangrenous Pneumonia: This may be due to

- Faulty drencing
- Inhalation of irritant drugs, oils, anaesthetics or feed.
- Hematogenous; from gangrenous lesion elsewhere in body like gangrenous mastitis, metritis.
- Penetration of sharp foreign body.

Clinical signs

Acute clinical signs of bacterial Pneumonia are often preceded by signs of viral infection of the respiratory tract. With the onset of bacterial Pneumonia, clinical signs increase in severity and are characterized by

- Depression.
- Fever (104°–106°F [40°–41°C]).
- Anorexis, dull, increased pulse rate.

- Serous to mucopurulent nasal discharge; moist cough; and a rapid.
- Shallow respiratory rate may be noted.
- Auscultation of the cranioventral lung field reveals increased bronchisl sounds, crackles, and wheezes. In severe cases, pleurisy may develop, characterized by an irregular breathing pattern and grunting on expiration. The animal will become unthrifty in appearance if the Pneumonia becomes chronic, which is usually associsted with formation of pulmonary abscesses.
- Lethargy and anorexia are common.
- Gradually loss of body condition.
- Reluctance to move and lie down.

Chronic Pneumonia is more gradual in onset with no distinct ill phase and the cow may appear to still eat well but may have a slight nasal discharge, sometimes with an increased respiratory rate.

Both forms of the respiratory disease cause production losses as there is a reduction in liveweight gain and there may be deaths in the acute syndrome.

Diagnosis

Generally, serologic testing and direct bacterial detection are performed, and Diagnosis relies on gross necropsy findings and bacterial culture. Because the bacteria involved are normal inhabitants of the upper respiratory tract, the specificity of culture can be increased by collecting antemortem specimens from the lower respiratory tract by tracheal swab, transtracheal wash, or bronchoalveolar lavage.

Radiography examination

Examination of faeces to find the parasitic ova.

Lung specimens can be collected for culture at necropsy. If possible, specimens for culture should be collected from animals that have not been treated with antibiotics to permit determination of antimicrobial sensitivity patterns.

A multiplex PCR has been used to identify a number of bacterial agents implicated with bovine respiratory disease, including M. hemolytica.

Treatment

Following measures can be adopted to treat the Pneumonia in livestock:

- Isolation of affected animal.
- Use of specific antibiotics is desirable.
- Penicillin, ampicillin, amoxicillin, tetracycline, cotrimoxazole likes antibiotics are desirable.
- In parasitic condition, drugs like Diethylcarbamazine citrate, tetramizole, levamisole, fenbendazole etc. may be used. Ivermectin inj administraton can be done.
- Along with antibiotics, antihistamines can be given.
- In some cases course of steroids can be usefull.
- Analeptics like Nikethenamide through subcutaneous rout or intravenous route.
- Sedative expectorant like pot iodide; stimulated expectorant like ammon cacb; inhalant expectectorant like Tr. Benzoin Co. can be used according to nature of cough.

Prevention

- It can be difficult to control Pneumonia when calves are placed in communal pens.
- Improved husbandry, ventilation and good nursing care can all reduce risks of Pneumonia.
- Ensuring that young animals receive Appropriate amounts of colostrum within first 24 hour.
- Ventilation: Often if ammonis can be smelled it is a sign of poor ventilation. Nutrition: Feeding calves inadequately will reduce calf growth and their immune system response.
- Vaccination and deworming : Vaccines are available to reduce risk of infection, however they must be used alongside an effective management programme. Deworming should be done periodically and strategic drencing of anthelmentics are preferred.

Summary

- Pneumonia is an inflammatory condition of the lung affecting primarily the microscopic air sacs known as alveoli.

- Pneumonia can be of types like, pneumococcal Pneumonia, bronchisl Pneumonia, lobar Pneumonia, legionella Pneumonia, bilateral Pneumonia, eosinophilic Pneumonia, lipoid Pneumonia, hypostatic Pneumonia, Interstitial Pneumonia.
- Common causes for Pneumonia may include virus, bacteria, parasities, aspiration, fungal, mycoplasma.
- Improved husbandry, ventilation and good nursing care can all reduce risks of Pneumonia.

Glossary

Hypoxemia: Hypoxemia is an abnormally low level of oxygen in the blood.

Immune system: The immune system is a host defense system comprising many biological structures and processes within an organism that protects against disease.

Expectorant: Expectorants are drugs that loosen and clear mucus and phlegm from the respiratory tract.

Fever: Condition having a temperature above the normal range due to an increase in the body's temperature set-point.

Depression: Depression is a state of low mood and aversion to activity that can affect a person's thoughts, behavior, feelings, and sense of well-being.

Antibiotics: Drug used in the treatment and prevention of bacterial infections which may either kill or inhibit the growth of bacteria.

Antihistamines: An antihistamine is a type of pharmaceutical drug that opposes the activity of histamine receptors in the body

Drenching: Administration of drugs or other things orally.

Assignment

A. Very short question.

1. Define Pneumonia.
2. Define Hypoxemia.

B. Short question.

1. Write short note on bronchisl Pneumonia.
2. Enlist the cause of Pneumonia in animals.

C. Long question.

1. Describe types of Pneumonia on basis of etiology and give treatment measures for them.

Circulatory system

Diseased condition involved circulatory system are with are anaemia, thrombosis, shock etc.

Anaemia

Anemis is defined as an absolute decrease in the red cell mass as measured by red blood cell (RBC) count, hemoglobin concentration, and Packed Cell Volume (PCV). It can develop from loss, destruction, or lack of production of RBCs. Anemis is classified as regenerative or nonregenerative. With regenerative anemis, the bone marrow responds Appropriately to the decreased red cell mass by increasing RBC production and releasing reticulocytes. With nonregenerative anemis, the bone marrow responds inadequately to the increased need for RBCs. Anemis caused by hemorrhage or hemolysis is typically regenerative. Anemis caused by decreased erythropoietin or an abnormality in the bone marrow is nonregenerative.

Classification of Anemis

According to Underlying Mechanism

- Blood Loss
- Increased Rate of Destruction (Hemolytic Anemiss)
- Impaired Red Cell Production

According to the aetiology and pathogenesis there are three groups of anaemia:

- posthemorrhagic anemis (as a result of blood loss),
- anaemia as a result of hematosis disturbance, and
- hemolytic anaemia (as a result of increased erythrocytes destruction).

According to the clinical course anemis can be classified to following types :

- acute
- chronic.

The most useful red cell indices are as follows:

- Mean cell volume: the average volume of a red blood cell, expressed in femtoliters (cubic micrometers).

- Mean cell hemoglobin: the average content (mass) of hemoglobin per red blood cell, expressed in pictograms.
- Mean cell hemoglobin concentration: the average concentration of hemoglobin in a given volume of packed red blood cells, expressed in grams per deciliter.

Clinical Findings

Clinical signs in anemic animals depend on the degree of anemis, the duration (acute or chronic), and the underlying cause. Acute anemis can result in shock and even death if more than a third of the blood volume is lost rapidly and not replaced. In acute blood loss, the animal usually presents with tachycardis, pale mucous membranes, bounding or weak peripheral pulses, and hypotension. The cause of the blood loss may be overt, eg, trauma. If no evidence of external bleeding is found, a source of internal or occult blood loss must be sought, eg, a ruptured splenic tumor, other neoplasis, coagulopathy, GI ulceration, or parasites. If hemolysis is present, the animal may be icteric. Animals with chronic anemis have had time to accommodate, and their clinical presentation is usually more indolent with vague signs of lethargy, weakness, and anorexia. These animals may have similar physical examination findings such as pale mucous membranes and weak peripheral pulses. The lack of expected clinical signs may alert the clinicisn to the time frame involved. Splenomegaly, abdominal distention, and/or heart murmur may be present, depending on the underlying cause of anemis.

- Pale in eye and mouth
- Vigor and strength decreased.
- Loss of appetite
- Increased heart rate
- Respiratory rate is elevated
- Laboured breath
- Blood, bleedings, hematoma
- Icterus

Pale mouth due to anaemia.

Diagnosis

- A complete history is an important part of the evaluation of an anemic animal.
- Clinical signs.
- A CBC, including a platelet and a reticulocyte count, will provide information on the severity of anemis and degree of bone marrow response, and also allow for evaluation of other cell lines.
- A blood smear should be evaluated for abnormalities in RBC morphology or size and for RBC parasites. The RBC indices (measures of size and hemoglobin concentration) are calculated by automated cell counters calibrated for the species in question. RBC size is expressed by the mean corpuscular volume (MCV) in femtoliters and can reflect the degree of regeneration.
- Macrocytosis (an increase in the MCV) usually correlates with a regenerative anemis. Macrocytosis can be a heritable condition in Poodles breed of dog without anemis, and it may be seen in anemic cats infected with feline leukemis virus.
- Microcytosis (a decrease in the MCV) is the hallmark of iron-deficiency anemis.
- The hemoglobin concentration of each RBC, measured in g/dL, is defined as the mean corpuscular hemoglobin concentration (MCHC). Terms used for description of abnormalities with MCHC include normochromis and hypochromis.
- Abnormalities in RBC morphology, such as basophilic stippling, can indicate lead intoxication. Heinz body formation indicates oxidative injury to the RBCs, secondary to toxin exposure .

- Cats are more susceptible to Heinz body formation than other species, and cats without anemis can have a small number of Heinz bodies. The presence of schistocytes or spherocytes may also help identify the pathophysiology associsted with the cause of anemis.

Treatment

Following line of treatment can be proceeded for anaemic condition:

- Mild to moderate — no treatment necessary
- If drug-induced, discontinuation of the drug
- Inherited — animals have normal life expectancy and do not require treatment
- Severely anemic — blood transfusions
- Electrolyte imbalances resulting from vomiting, Diarrhoea, kidney injury, or impending shock may be treated with IVs.
- In cases of severe anemis, methylene blue may be administered intravenously to reduce the methemoglobin count.
- Treatment of specific treatment for the underlying cause.

Summary

- Anemis is defined as an absolute decrease in the red cell mass as measured by red blood cell (RBC) count, hemoglobin concentration, and Packed Cell Volume (PCV).
- According to the aetiology and pathogenesis there are three groups of anaemia: posthemorrhagic anemis (as a result of blood loss), anaemia as a result of hematosis disturbance, and hemolytic anaemia (as a result of increased erythrocytes destruction).
- Acute anemis can result in shock and even death if more than a third of the blood volume is lost rapidly and not replaced.
- Anaemia can be disgnosed on basis of complete history and evaluation of an anemic animal.
- Treatment of severely anemic can be done by blood transfusions. Electrolyte imbalances resulting from vomiting, Diarrhoea, kidney injury, or impending shock may be treated with IVs.

Glossary

Hemoglobin: It is the iron-containing oxygen-transport metalloprotein in the red blood cells of all vertebrates.

Reticulocyte: Reticulocytes are immature red blood cells.

Hemolysis: It is the rupturing (lysis) of red blood cells (erythrocytes) and the release of their contents (cytoplasm) into surrounding fluid (e.g. blood plasma).

Hemorrhage: Hemorrhage is a rapid loss of blood, usually due to a ruptured blood vessel.

Hematoma : A hematoma is a localized collection of blood outside the blood vessels, due to either disease or trauma including injury or surgery and may involve blood continuing to seep from broken capillaries.

Icterus : It is a yellowish or greenish pigmentation of the skin and whites of the eyes due to high bilirubin levels.

Heinz body: Heinz body are inclusions within red blood cells composed of denatured hemoglobin.

IV: Intravenous

CBC: Complete blood cell count

Blood smear: Blood smear is a thin layer of blood smeared on a glass microscope slide and then stained in such a way as to allow the various blood cells to be examined microscopically.

Assignment

A. Very short question.

1. Define anemis.
2. What is blood smear ?

B. Short question.

1. Classify the types of anemis.
2. Enlist few points to disgnose the anaemia in field.

C. Long question.

1. Describe anemia with etiology and write about Diagnosis of anaemia in brief.

Urinary system

Diseased condition involved with urinary system are nephritis, retention of urine, cystitis etc.

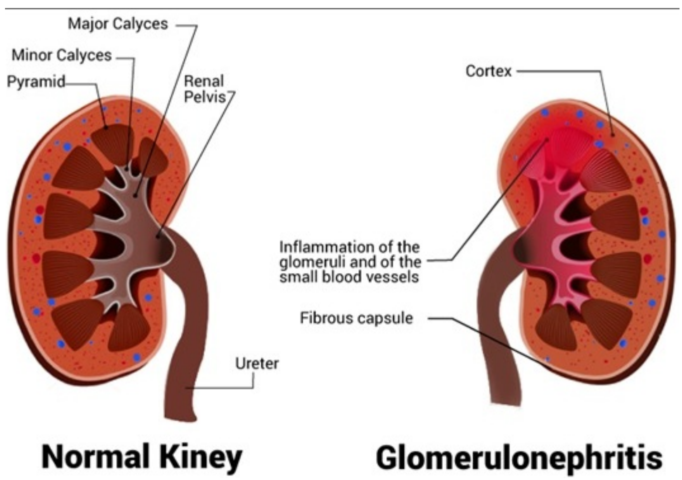
Nephritis

Synonym: bright's disease

Nephritis literally refers to acute or chronic inflammation of the kidney caused by infection, degenerative process, or vascular disease.

Glomerulonephritis

Glomerulonephritis means inflammation of glomeruli. It leads to chronic renal failure.



Glomerulonephritis.

Aetiopathogenesis

This disease has been ascribed as an autoimmune disease. There are two type of immunological reaction which can produce this condition.

Infective agents like adenoviruses, infectious canine hepatitis virus, E. coli, *Dirofilaris immitis* etc act as antigen and sets inflammatory process which damage glomerular basement membrane.

In another form, circulating antigen of non renal origin fixed up with antibody. This on huge amount get fix on glomerular capillaries and is termed as autoimmune glomerular nephrits.

Clinical findings

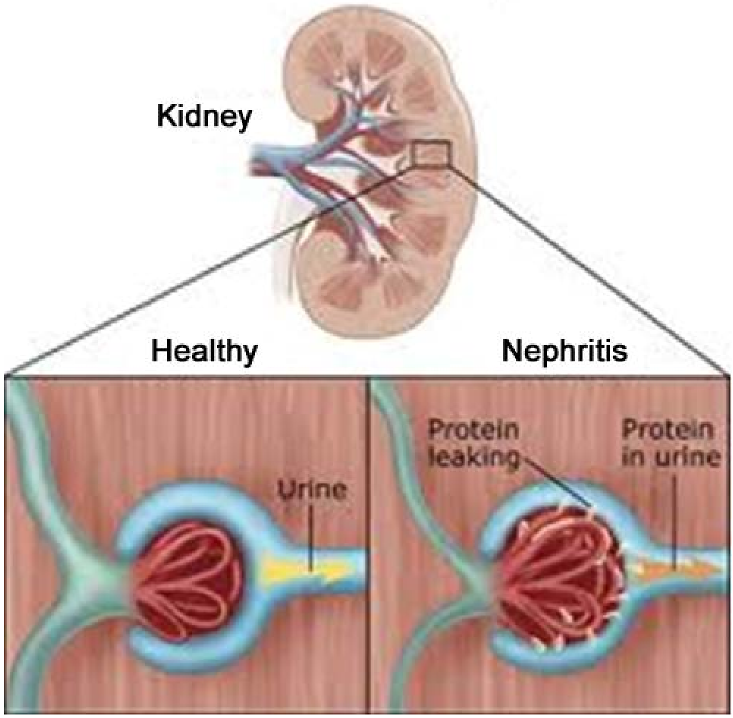
- Dull and depression
- Polydypsia
- Oedema
- Anuris
- Blood in urine
- Polyuria
- Proteinuria
- Vomiting
- Azotaemia
- Dry skin coat

Diagnosis

Proteinuria is the cardinal sign of glomerulonephritis.

1. Proper history
2. Physical examination
3. Laboratory data

- **Haematology:** hypo or hyperProteinuria, anaemia.
- **Biochemistry:** hypoalbuminaemis, hypercholesterolemis, hyper-phophataemis, azotaemis.
- **Urine study:** Proteinuria, absence of pyuris, hyaline test, absence of haematuris.
- Renal biopsy



Nephritis

Pyelonephritis

Pyelonephritis is an inflammation of the kidney tissue, calyces, and renal pelvis. It is commonly caused by bacterial infection that spread up the urinary tract or travel through the bloodstream to the kidneys.

Crynebacterium renale is responsible for pyelonehritis in cattle. *E coli* infection is also suggestive.

Signs and symptoms

acute pyelonephritis generally develop rapidly over a few hours or a day. It can cause

- high fever
- abdominal pain that radistes along the flank towards the back.
- vomiting
- Fever
- weight loss,

- Decreased appetite
- Lower urinary tract symptoms
- Blood in the urine.
- Stiff gait; tenderness of lumber region.
- Weak pulse rate.
- Rough hair coat.
- Frequent micturation and straining during micturation.

Chronic pyelonephritis can in addition cause fever of unknown origin. Furthermore, inflammation-related proteins can accumulate in organs and cause the condition amyloidosis.

Diagnosis

- Microscopic examination of urine shows transition epithelial cells.
- Radiography to demonstrate renal structure by using contrast medis.
- Urine: high specific gravity, pus cells, R.B.C., W.B.C., etc.
- Cystourethrography: to detect vesiculourethral reflux.

Line of treatment

- Antibiotic therapy
- Diuretics
- Urinary acidifiers or alkalizer to alter PH, for decreasing the microbial load.
- For azotaemia: symptomatic treatment.

Drugs contraindicated are:

- Neomycin
- Gentamycin
- Kanamycin
- Cephaloridine.

Interstitial nephritis

Interstitial nephritis (or tubulo-Interstitial nephritis) is a form of nephritis affecting the interstitium of the kidneys surrounding the tubules, i.e., is inflammation of the spaces between renal tubules. This disease can be either acute, meaning it occurs suddenly, or chronic, meaning it is ongoing and eventually ends in kidney failure. This type of nephritis more common in dogs.

Aetiology

A. Bacteria : *E.coli, leptospira spp.*

B. Viruses: adenovirus, infectious canine hepatitis virus.

C. Parasites: D*ioctophyme renale.*

D. Toxins: Nephrotoxic agents; lead, arsenate, sulphonamide, mercury, paracetamol etc.

Clinical findings

- Lack of appetite.
- Dull and depressed.
- Plyuris and Polydypsiam.
- High temperature at initisl stage.
- Unpleaseant breathing.
- Progressive loss of body condition.
- Teeth gum, and tongue will be coated with reddish brown scum.
- Stiff gait and arching back.
- Sign of dehydration.
- Occasionally vomiting.
- Quick pulse.
- Emaciation.
- Uraemia.
- Coma and death.

Diagnosis

- History of polydypsic and polyuria.
- Urine: high specific gravity, albumin, renal epithelial cells, W.B.C., R.B.C., and cast. But in chronic stage there is low specific gravity with less cellular deposition.

Line of treatment

- Keep in rest with little exercise.
- Feed with protein of higher biological value should be provided.
- Adequate provision of drinking water.
- Course of antibiotic therapy for 7 days.
- Dextrose 5% with sodium chloride may be administered intravenously.
- Parental B complex can be administered.
- Antacids can be provided if gastritis due to raemic state.
- Corticosteroids may be given to minimize the formation of immune complex.
- Sodium bicarbonate may be given.
- Ph of urine should be adjusted with appropriate measures.

Summary

- Nephritis is inflammation of the kidney caused by infection, degenerative process, or vascular disease.
- Glomerulonephritis means inflammation of glomeruli.
- Infective agents and circulating antigen of non renal origin acts as antigen which, may damage the kidney.
- Nephritis is mostly characterized by history of polydypsia and polyuria.

Glossary

Glomeruli: A glomerulus is a network of capillaries located at the beginning of a nephron in the kidney.

Biopsy: A biopsy is a procedure to remove a piece of tissue or a sample of cells from your body so that it can be analyzed in a laboratory.

Azotaemis: Condition characterized by abnormally high levels of nitrogen-containing compounds in the blood.

Proteinuria: Proteinuria is the presence of excess proteins in the urine.

Polydypsia: Increased fluid intake.

Polyuria: Increased volume of urine.

Comma: Coma is a state of unconsciousness in which a person cannot be awakened.

Uraemia: Urea in the blood

Emaciation: Extreme weight loss and unnatural thinness due to a loss of subcutaneous fat and muscle.

Corticosteroids: Corticosteroids known as steroids are an anti-inflammatory medicine prescribed for a wide range of conditions.

Antacids: Antacids are a class of medicines that neutralize acid in the stomach.

Assignment

A. Very short question

1. Define nephritis.
2. Define glomerulonephritis.
3. Pyelonephritis.

B. Short question

1. Enlist five infectious agents of nephritis.
2. Enlist five major symptoms of nephritis.

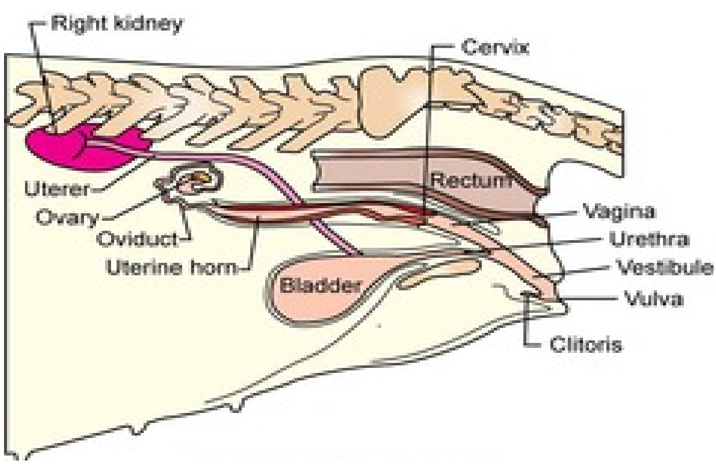
C. Long question

1. Describe nephritis with etiology, symptoms and treatment.

Retention of urine

Urinary retention, also known as ischuria, is an inability to completely empty the bladder. It is a common complication of benign prostatic hyperplasis (BPH), though it can also be caused by:

- Nerve dysfunction
- Tethered spinal cord syndrome
- Constipation
- Bladder stone
- Atrophy of the detrusor muscle (atonic bladder is an extreme form).
- Hydronephrosis (congestion of the kidneys).
- Hypertrophy of the detrusor muscle (the muscle that squeezes the bladder to empty it during urination).
- Diverticula (formation of pouches) in the bladder wall (which lead to stones and infections).
- Medications (including anticholinergics, antidepressants, COX-2 inhibitors, amphetamines, and opioids).



Urinary tract.

Signs of urine retention

- Palpably distended urinary bladder
- Ineffective, frequent, attempts to urinate without success

- Urine stream may be weak, attenuated, or interrupted
- Bladder may be so full that it frequently leaks urine
- Abdominal distension, abdominal pain, or signs of postrenal azotemia may predominate in rare cases or with urinary tract rupture.
- Recurrent urinary tract infections may have caused muscular problems associated with urinating.
- Urinary retention is characterised by poor urinary stream with intermittent flow, straining, a sense of incomplete voiding, and hesitancy (a delay between trying to urinate and the flow actually beginning).
- As the bladder remains full, it may lead to incontinence, nocturia (need to urinate at night), and high frequency.
- Acute retention, causing complete anuria, is an emergency, as the bladder can stretch to an enormous size, and possibly tear if not dealt with quickly.
- If the bladder distends enough, it becomes painful. In such a case, there may be suprapubic constant, dull, pain.
- The increase in bladder pressure can also prevent urine from entering the ureters or even cause urine to pass back up the ureters and get into the kidneys, causing hydronephrosis, and possibly pyonephrosis, kidney failure, and sepsis.

Diagnosis

- Analysis of urine flow may aid in establishing the type of micturition (urination) abnormality.
- Common findings, determined by ultrasound of the bladder, include a slow rate of flow, intermittent flow, and a large amount of urine retained in the bladder after urination.
- Determining the serum prostate-specific antigen (PSA) may help diagnose or rule out prostate cancer, though this is also raised in BPH and prostatitis.
- A complete blood profile will be conducted, including a chemical blood profile, a complete blood count, and a urinalysis. The urinalysis may reveal evidence of urinary tract infection or inflammation.
- A biopsy of the prostate (trans-rectal ultra-sound guided) can distinguish between these prostate conditions.

- Serum urea and creatinine determinations may be necessary to rule out backflow kidney damage.
- Cystoscopy may be needed to explore the urinary passage and rule out blockages.

Treatment

In acute urinary retention, urinary catheterization, placement of a prostatic stent or suprapubic cystostomy relieves the retention. In the longer term, treatment depends on the cause. 5-alpha-reductase inhibitor increase the chance of normal urination following catheter removal.

Medication

Disorders of micturition characterized by urine retention and a distended bladder are usually caused by hypocontractility of the bladder or by urethral obstruction. Prolonged bladder distention leads to breakdown of the tight junctions between detrusor muscle cells of the bladder, which prevents normal depolarization and contraction of the detrusor muscles. An adrenergic antagonist may be indicated when manual expression or voluntary voiding is nonproductive because urethral sphincter tone is excessive, as is often the case in cats after relief of obstruction. Phenoxybenzamine, an irreversible antagonist, has been used with some success.

Diszepam is a benzodiszepine anxiolytic that is also a central muscle relaxant. Dosages sufficient to allow for urethral relaxation may also cause sedation.

In animals with detrusor hyporeflexis or bladder atony, bethanechol chloride may be of some benefit. This cholinergic agonist stimulates the initistion of detrusor muscle contraction.

Medication for the underlying cause is indicated.

Catheter

Acute urinary retention is treated by placement of a urinary catheter (small thin flexible tube) into the bladder. This can be either an intermittent catheter or a Foley catheter that is placed with a small inflatable bulb that holds the catheter in place.

Intermittent catheterization can be done by sterile technique.

For acute urinary retention, treatment requires urgent placement of a urinary catheter. A permanent urinary catheter may cause discomfort and pain that can last several days.

Surgery

The chronic form of urinary retention may require some type of surgical procedure. While both procedures are relatively safe, complications can occur.

Summary

- Retention of urine, also known as ischuria, is an inability to completely empty the bladder.
- Urinary retention is characterised by poor urinary stream with intermittent flow, straining, a sense of incomplete voiding, and hesitancy.
- In acute urinary retention, urinary catheterization, placement of a prostatic stent or suprapubic cystostomy relieves the retention.

Glossary

Hydronephrosis: Water in nephrones.

Hypertrophy: Hypertrophy is the increase in the volume of an organ or tissue due to the enlargement of its component cells.

Pyonephrosis: Pyonephrosis is an infection of the kidneys' collecting system. Pus collects in the renal pelvis and causes distension of the kidney.

Catheter: Catheters is a thine tube may be inserted as an in-and-out procedure for immediste drainage, left in with a self-retaining device for short-term drainage.

Anxiolytic drug: Anxiolytics are used to prevent and treat symptoms of acute anxiety related to many conditions.

Assignment

A. Very short question

1. Define ischuria.
2. Define hydronephrosis.

B. Short question.

1. Write a short note on retention of urine.
2. Enlist the causes of retention of urine.

C. Long question

1. Define ischuria. Write the Diagnosis procedure and line of treatment.

Reproductive system

Major diseased condition involved with reproductive system are metritis, salphingitis, endometritis etc.

Metritis

Metritis literally means inflammation of the wall of the uterus, where as endometritis is inflammation of the functional lining of the uterus, called the endometrium.

The severity of disease is categorized by the signs of health:

- Grade 1 metritis: An abnormally enlarged uterus and a purulent uterine discharge without any systemic signs of ill health.
- Grade 2 metritis: Animals with additional signs of systemic illness such as decreased milk yield, dullness, and fever >39.5°C.
- Grade 3 metritis: Animals with signs of toxemis such as inappetence, cold extremities, depression, and/or collapse

Etiology

A large number of microorganisms are responsible as causes of metritis and endometritis: bacteria, viruses, fungi and protozoa. Common infectious diseases are brucellosis, leptospirosis, campylobacteriosis, trichomonissis etc.

The vagina hosts numerous microorganisms, in contrast to the sterile uterus. Opportunistic pathogens from the normal vaginal flora or from the environment may invade the uterus from time to time. A healthy uterus is able to rid itself of these kind of infections.

The faulty management like unskilled personal practicing rectal palpation, artificial insemination, stressfull handling of dystocic may also result in metritis.

Several defence mechanisms exist for preventing uterus infection. First of all, the vulva and cervix provide a physical barrier to opportunist bacteria. Thereby, bacteria which belong in the vagina prevent settling of pathogens, a higher pH level during oestrus prevent bacterial growth and various immunological mechanisms also act to prevent infection of the uterus.

In the immediate postpartum period, a stressful- and hard time for the cow, the uterus will get contaminated with several organisms. Subsequently, in most animals the uterine environment is re-established within days or weeks after calving.

In cows, the causative organisms are most often *Trueperella pyogenes*, alone or in associstion with *Fusobacterium necrophorum* or other gram-negative anaerobic organisms. Signs of infection vary from obvious and persistent purulent exudate from the uterus to inapparent infection.

Symptoms

The primary symptoms of metritis are

- Fever
- Foul-fetid vulvar discharge,
- Uterus that lacks tone when palpated per rectum,
- Abnormal uterine discharge,
- purulent vaginal discharge
- Depressed attitude
- Decreased appetite.

Metritis

Diagnosis

- Clinical sign and symptom.
- Detection of clinical/ subclinical metritis can be done by rectal palpation. The size of the uterus as related to time of calving; thickness (because it is an inflammation, the affected environment is red/swollen and thick) of the wall of the uterus and the presence, color, odor and consistency of fluid.
- Diagnosis of subclinical (cytologic) endometritis requires use of endometrisl cytology, ultrasonography, or endometrisl biopsy, because other signs are often absent. Cows with endometritis do not exhibit any systemic signs of illness, and appetite and milk production are usually unimpaired.
- Vaginoscopy
- Ultrasonography (USG).
- Uterine cytology
- Examination on uterine culture
- Biopsy: Microscopic examination of the biopsy tissue can reveal the presence of acute or chronic metritis.

Treatment of metritis

- Flushing of uterus by use of antiseptics, normal saline as per requirement.
- Antibiotic therapy in the treatment of metritis should be directed at presenting a sufficient concentration of an Appropriate antibiotic to the site of the infection. Uterine infusion of antibiotics.
- Hormone therapy for metritis has become increasingly popular with the introduction of more effective compounds and the tighter control of antibiotic milk residues. Hormones are used to stimulate uterine evacuation and improve the effectiveness of uterine defenses. Hormones have the added advantage of quick and easy administration, as most are effective when given intramuscularly.
- Surgical interruption if indicated.

Prevention

The primary measures for prevention are:

- Appropriate supplementation of trace minerals and vitamins.

- Feeding a diet to with Appropriate levels of calcium and a negative Dietary-Cation Difference to prevent milk fever.
- Minimization of negative energy balance around calving time by managing pen moves and preventing over-crowding and feeding Appropriate transition rations.
- A clean, dry maternity environment.
- Well managed assistance when a calving difficulty occurs.

Summary

- Metritis literally means inflammation of the wall of the uterus, whereas endometritis is inflammation of the functional lining of the uterus, called the endometrium.
- The main consequence of endometritis is poor fertility in the future, particularly if not treated quickly.
- Metririts is characterized by fever, foul-foetid vulvar discharge, depressed attitude and decreased appetite.
- Treatment of metritis can be done by flushing of uterus by use of antiseptics, normal saline, antibiotic therapy, hormone therapy and surgical interruption as requirement.

Glossary

Endometrium: The endometrium is the inner epithelial layer, along with its mucous membrane, of the mammalian uterus.

Conception: Conception to fertilisation, the fusion of gametes to produce a new offsprings.

Dystocia: Slow or difficult labor or delivery.

Vaginoscopy: Vaginoscopy is performed to disgnose anatomical abnormalities or lesions affecting the vaginal wall.

Assignment

A. Very short question

1. Define metritis.
2. What do you mean by dystocia.

3. What is endometrium.

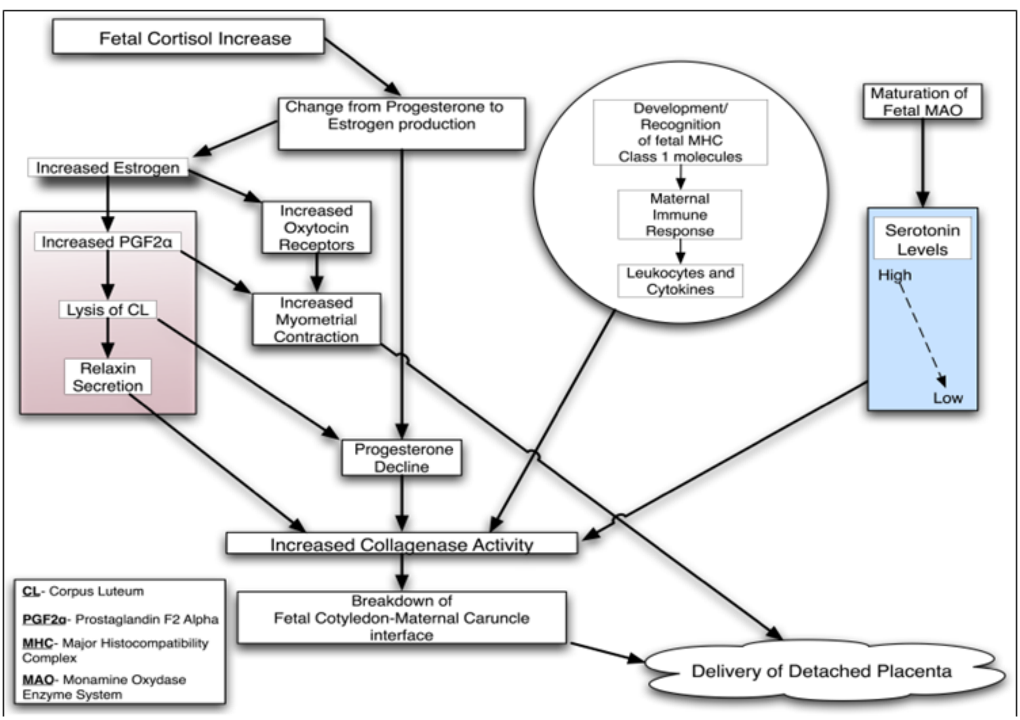
B. Long question.

1. Write a short note on metritis, its etiology, symptoms and treatment.
2. Describe briefly about the Diagnosis and treatment of metritis with few preventive measures.

Retention of placenta

The placenta is an organ that connects the developing fetus to the uterine wall to allow nutrient uptake, provide thermo-regulation to the fetus, waste elimination, and gas exchange vis the mother's blood supply, fight against internal infection and produce hormones to support pregnancy.

Retention of placenta also known as retained foetal membrane or retained cleansing, usually is defined as failure to expel fetal membranes within 24 hr after parturition. Normally, expulsion occurs within 3–8 hr after calf delivery. The incidence in healthy dairy cows is 5%–15%, whereas the incidence in beef cows is lower. The incidence is increased by abortion (particularly with brucellosis or mycotic abortion), dystocia, twin birth, stillbirth, hypocalcemis, high environmental temperature, advancing age of the cow, premature birth or induction of parturition, placentitis, and nutritional disturbances. Cows with retained fetal membranes are at increased risk of metritis, displaced abomasum, and mastitis.



Physiological process of dettachement of placenta.

Cause

Retained placenta is most commonly associocted with following conditions

- Mechanical factors: difficult birth (dystocia), twins, stillborn, abortion.
- milk fever (metabolic diseases)
- Twin births.
- Nutritional factors: mineral and vitamin deficiency, low levels of calcium in blood.
- Management factors: stress, obesity.
- Infectious diseases: Brucellosis, Leptospirosis, IBR, BVD.

Symptoms

Failure to expel fetal membranes within 24 hr after parturition. Normally, expulsion occurs within 3–8 hr after calf delivery.

The single sign associsted with RP is degenerating; discolored, ultimately fetal membranes remain hanging.

Occasionally, the retained membranes may remain within the uterus and not be readily apparent, in which case their presence may be signalled by a foul-smelling discharge.

Treatment

Manual removal of the membranes

Manual removal had been a common practice in the past. This method should not be used because of possible injury to the endometrium and uterine cervix. Moreover there is little evidence that such a practice produces any beneficisl effect.

Hormonal therapy

Although occasional reports exist, in general immediste post partum administration of PGF2 alpha, oxytocin or calcium have generally low efficacy in preventing the retained placenta or hastening the separation and expulsion of retrained foetal membranes.

Anti-infective therapy

Generally saying the dominant approach to retained placenta in cattle in the field condition is to administer locally or systemically antibiotics. Several studies indicate that approx. 50-80% of cows with retained foetal membranes exhibit elevated body temperature (>39ºC) for at least 1 day. It is not clear whether all such animals indeed would need a systemic treatment with antibiotics.

Intrauterine antibiotics

Prevention

There are no standard preventive measures for Retention of Placenta. Good dry cow management is the best way of preventing RoP and reducing its effects. This will include supply of correct nutrients, particularly magnesium, and fat soluble vitamins, maximising dry matter intake, maintaining the correct body condition score and supplying a clean dry environment.

Summary

- Retention of placenta also is defined as failure to expel fetal membranes within 24 hr after parturition. Normally, expulsion occurs within 3–8 hr after calf delivery.
- Retention of placenta may be due to abortion, dystocia, twin birth, stillbirth, hypocalcemis, high environmental temperature, advancing age of the cow, premature birth or induction of parturition, placentitis, and nutritional disturbances.
- Treatment can be done by manual removal of the membranes, hormonal therapy, anti-infective therapy and intrauterine antibiotics.

Glossary

Placenta: The placenta is an organ that connects the developing fetus to the uterine wall to allow nutrient uptake, provide thermo-regulation to the fetus, waste elimination, and gas exchange vis the mother's blood supply, fight against internal infection and produce hormones to support pregnancy.

Hypocalcemis: It is low calcium levels in the blood serum.

Mastitis: It is inflammation of teat or udder tissue usually due to infection.

Placentitis: It is the inflammation of placenta.

Hormone: A chemical substance produced in the body that controls and regulates the activity of certain cells or organs.

Assignment

A. Very short question

1. Define placenta.
2. What do you mean by retention of placenta ?

B. Long question.

1. What is placentitis? Write briefly about symptoms and treatment of retention of placenta.

Nervous system

The major diseased condition involved with nervous system are GID, encephalitis, myelitis etc.

Laminitis

Laminitis literally means inflammation of the laminae. Laminitis is a painful and potentislly crippling state that affects the feet of hooved animals (ungulates) and it is found mostly in horses and cattle. Clinical signs include foot tenderness progressing to inability to walk, increased digital pulses, and increased temperature in the hooves.

The hoof wall is made up of an interlinked outer insensitive layer (horn) supported by an underlying inner sensitive layer (laminae). In horses, there are about 550–600 pairs of primary epidermal laminae. In laminitis, the blood flow to the laminae is affected, resulting in inflammation and swelling in the tissues within the hoof, and severe pain. As the laminae are starved of oxygen and nutrient rich blood, the cells become damaged. Unless the cause is removed and treatment is started immedistely on first signs of the condition, the sensitive laminae begin to die. The laminae are responsible for supporting the pedal bone in the hoof and thus the weight of the animal. In severe cases of laminitis the pedal bone can sink and rotate due to the inability of the damaged laminae to support it and from the pull of the deep digital flexor tendon. If the pedal bone sinks too far it can be seen to protrude from the sole of the foot. In many cases this is irreversible, however, some cases can be cured.

Pathophysiology

According to vascular theory, postulates that increases in capillary pressure, constriction of veins, and shunting of blood through anastomoses to bypass the capillaries, causes decreased blood and therefore decreased oxygen and nutrient delivery to lamellae. The end-result would be ischemis, leading to cellular death and breakdown between the lamellae. Subsequently, increased vascular permeability leads to edema within the hoof, compression of small vessels, and ischemis. Vasoactive amines may be partislly to blame for changes in hoof blood flow.

Stages of laminitis

A. Developmental phase

The developmental phase is defined as the time between the initisl exposure to the causative agent or incident, until the onset of clinical signs. It generally lasts 24–60 hours, and is the best time to treat a laminitis episode. Clinical laminitis may be prevented if cryotherapy (icing) is initisted during the developmental phase.

B. Acute phase

The acute phase is the first 72 hours following the initistion of clinical signs. Treatment response during this time determines if the horse will go into the subacute phase or chronic phase. Clinical signs at this time include bounding digital pulses, lameness, heat, and possibly response to hoof testing.

C. Subacute phase

The subacute phase occurs if there is minimal damage to the lamellae. Clinical signs seen in the acute phase resolve, and the horse becomes sound. The horse never shows radiographic changes, and there is no injury to the coffin bone.

D. Chronic phase

The chronic phase occurs if damage to the lamellae is not controlled early in the process, so that the coffin bone displaces. Changes that may occur include separation of the dermal and epidermal lamellae, lengthening of the dermal lamellae, and compression of the coronary and solar dermis. If laminitis is allowed to continue, long-term changes such as remodeling of the apex and distal border of the coffin bone and osteolysis of the coffin bone can occur.

Clinical findings

- Increased temperature of the wall, sole and/or coronary band of the foot.
- A pounding pulse in the digital palmar artery.
- Anxiety and visible trembling.
- Increased vital signs and body temperature.
- Sweating.
- Flared nostrils.

- Walking very tenderly, as if walking on egg shells
- Repeated "easing" of affected feet, i.e. constant shifting of weight.
- The horse stands in a "founder stance" in attempt to decrease the load on the affected feet. If it has laminitis in the front hooves, it will bring its hind legs underneath its body and put its fore legs out in front. In cases of sinking, the horse stands with all four feet close together, like a circus elephant.
- Tendency to lie down whenever possible, and recumbency in extreme cases.
- Change in the appearance of the coronary band: hair that does not lie in a normal position (not against the hoof wall), indentation or rim just above the hoof capsule allowing palpation behind the coronary band.

Treatment

Initisl treatment with cryotherapy and anti-inflammatory drugs may prevent mechanical breakdown if instituted immedistely, but many cases are only detected after the initisl microscopic damage can be done. There are various methods for treating laminitis. Additionally, the each affected hoof should be evaluated individually to determine the best treatment plan, which may change with time. Ideally, affected hooves are re-evaluated on a regular basis once treatment commences to track progress.

- Management

  Initisl management usually includes stall rest to minimize movement, and deeply bedding the stall with shavings, straw, or sand. Exercise is slowly increased once the horse has improved, ideally in an area with good (soft) footing, beginning with hand-walking, then turn-out, and finally riding under saddle. This process may take months to complete.
- Cryotherapy.
- Cooling of the hoof in the developmental stages of laminitis has been shown to have a protective effect when horses are experimentally exposed to carbohydrate overload.
- Anti-inflammatories and analgesics.
- Nonsteroidal anti-inflammatory medications (NSAIDS. For analgesis, NSAIDs are often the first line of defense.

- Pentafusion, or the administration of ketamine, lidocaine, morphine, detomidine, and acepromazine at a constant rate of infusion, may be of particular benefit to horses suffering from laminitis.Epidurals may also be used in hind-limb laminitis.
- Vasodilators: Vasodilators are often used with the goal of improving laminar blood flow. However, during the developmental phases of laminitis, vasodilation is contraindicated, either through hot water or vasodilatory drugs. Systemic acepromazine as a vasodilator with the fringe benefit of mild sedation which reduces the horse/pony's movements and thus reduced concussion on the hooves, may be beneficisl after lamellar damage has occurred, although no effects on laminar blood flow with this medication have been shown.
- Trimming and Shoeing.
- Besides pain management and control of any predisposing factors, mechanical stabilization is a primary treatment goal once the initisl inflammatory and metabolic issues have resolved.

Summary

- Laminitis means inflammation of the laminae.
- Laminitis is a painful and potentislly crippling state that affects the feet of hooved animals (ungulates) and it is found mostly in horses and cattle.
- It is characterized by increased temperature of the wall, sole and/or coronary band of the foot, anxiety and visible trembling.
- Initisl treatment with cryotherapy and anti-inflammatory drugs may prevent mechanical breakdown if instituted immedistely.

Glossary

Laminae: A layer or coat lying over another, as the plates of minerals or bones.

Steroids: Any of a large group of fat-soluble organic compounds, as the sterols, bile acids, and sex hormones, most of which have specific physiological action.

Cryotherapy: Cryotherapy is the local or general use of low temperatures in medical therapy.

Vasodilation: Vasodilation refers to the widening of blood vessels.

Acepromazine: Acepromazine is a common tranquilizer and central nervous system depressant given to dogs and cats.

Assignment

A. Very short question.

1. Define laminitis.

B. Short question

1. Write a short note on pathophysiology of laminitis .

C. Long question.

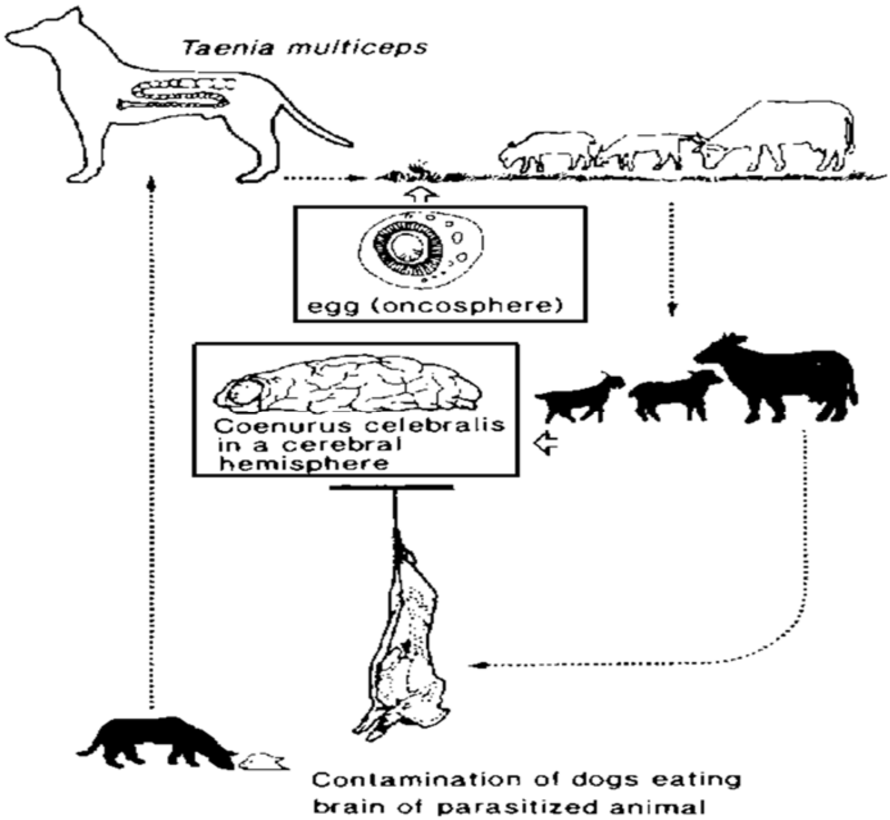
1. Describe laminitis with different stages. Write the clinical symptoms and line of treatment.

GID (Coenurus cerebralis infection, Sturdy)

Gid also known as Coenurosis is a disease of the central nervous system in goats and sheep. Coenurosis is infection by the metacestode larval stage (coenurus) of *Taenis multiceps* which infests the small intestine of carnivores. The definitive hosts for *Taenis multiceps* are members of the family Canidae. In 80–90% of cases, the cyst is located in one cerebral hemisphere, whilst in 5–10% of cases, it is localised in the cerebellum; rarely it involves two sites in the brain of the affected animal.

Coenurus cerebralisis the larval form of *Taenis multiceps* which is seen in the small intestines of carnivores. Infection occurs as a result of the oral intake of eggs spreading vis faeces of those animals by intermediste hosts. The disease is known as gid or sturdy which primarily localises in the central nervous system of sheep and goats mostly, but can also seen in camels, deer, pigs, horses, however, rarely in cattle and humans. Most of the cysts are located in the cerebral hemispheres and spinal cord, while rarely invading the subcutaneous and intramuscular tissues along with other organs Symptoms vary depending on the cyst's location, size and compression Coenurus cerebralis initially causes purulent meningoencephalitis, later as the cyst grows, it leads to central nervous system symptoms resulting in. Most of the characteristic clinical findings are observed 2-8 months after the intake of pathogen. Infected animals manifest circling, head tilt towards the side of the cyst location, in coordinated and uncontrolled movements, ataxis, failure to hold the head straight, blindness, teeth grinding, salivation, paresis, convulsions.

Life cycle : *Eggs* expelled with dog faeces are ingested by the intermediste host (sheep). The *larvae* hatch in the intestine and pass with the blood stream towards different organs. The larvae which reach the brain and spinal cord grow to the *coenurid* stage. Coenurus cerebralis will further mature in the brain and spinal cord.



Life cycle of *Taenis multiceps*

Clinical findings

During migration of larval stage

1. Blindness
2. Muscular tremor and incoordination
3. Excitability and collapse

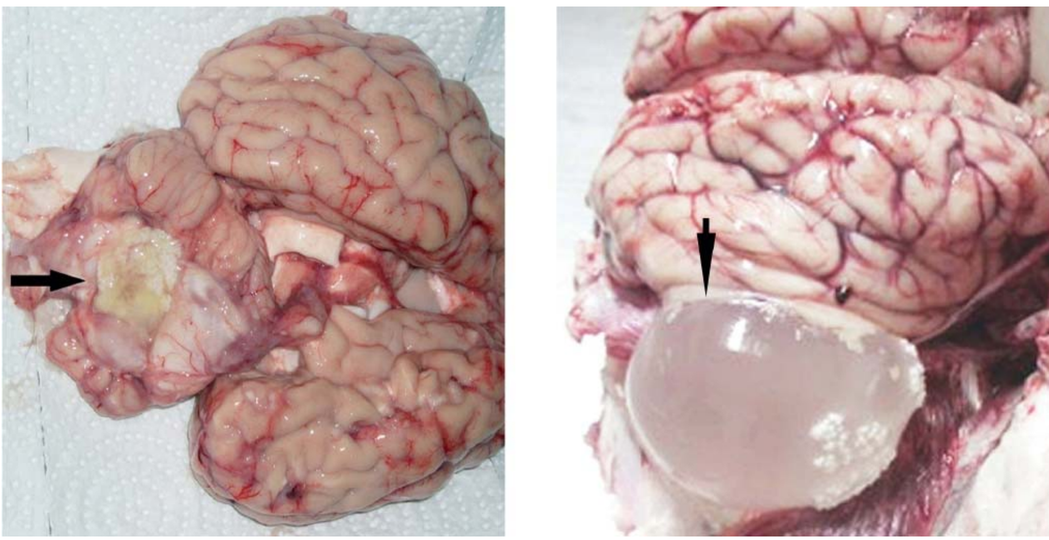
Infection with the fully developed larval stage

1. Salivation
2. Wild expressions
3. Frenzied running and convulsion
4. Devistion of eye and head
5. Loss of function

6. Dullness
7. Incomplete mastication
8. Head pressing
9. Incomplete paralysis and, in spinal cord involvement, inability to rise

Postmortem findings

1. Thin walled cyst in the brain.
2. Lesion in the lumbar region and rarely, in the cervical area of the spine



Coenurus cerebralis. Thin walled cyst in the brain

Disgnostic information

Infected dogs pass *taenis*-type eggs in their faeces. Sheep at the chronic stage of the infection may show circular movements, jerky movements or staggering gait.

Treatment

For adult tapeworm a number of effective drugs are available including praziquantel, mebendazole, fenbendazole, nitroscanate, and dichlorophen.

Surgical removal is possible if the cyst is situated on the brain surface.

Summary

- Gid also known as Coenurosis.
- Coenurosis is infection by the metacestode larval stage (coenurus) of *Taenis*

multiceps which infests the small intestine of carnivores.

- The definitive hosts for *Taenis multiceps* are members of the family Canidae.
- The disease is known as gid or sturdy which primarily localises in the central nervous system of sheep and goats mostly.
- Primarily disease is characterized by salivation, wild expressions, frenzied running and convulsion and devistion of eye and head.
- For treatment of adult tapeworm a number of effective drugs are available including praziquantel, mebendazole, fenbendazole, nitroscanate, and dichlorophen.

Glossary

***Taenis multiceps*:** it is a adult tape worm, whose definitive host are - dogs, foxes, and other canids.

Cerebellum: The *cerebellum* (Latin for "little brain") is a major feature of the hindbrain of all vertebrates.

Convulsion: A *convulsion* is a medical condition where body muscles contract and relax rapidly and repeatedly, resulting in an uncontrolled shaking of the body.

Ataxis: *Ataxis* is a neurological sign consisting of lack of voluntary coordination of muscle movements that includes gait abnormality.

Meningoencephalitis: Inflammation of the brain and its meninges.

Assignment

A. Very short question.

1. What do you mean by gid?
2. Write etiology of gid.
3. Define meningoencephalitis.

B. Short question.

1. Enlist few clinical signs of gid.

C. Long question.

1. Write about the clinical findings , PM findings, treatment and prevention measures of gid.

Skin

Diseased condition involved with skin are dermatomycosis, allergy etc.

Dermatophytosis

Dematophtosis is the superficisl fungal infection of the cornified epidermis (hair, nails). Dermatophytosis is a clinical attribute caused by one of three genera of fungi -Microsporum, Trichophyton and Epidermophyton are collectively known as dermatophytes. They create a change of the invaded structure and this alteration along with the immunological reactions are clinically known as "Ring worm".

Etiology

Microsporum canis - Ring worm in Dog, Cat and other animals and humans.

M. audouinii- Tinea capitis in human and also in dog and monkey.

M. gyspseum- Ring worm of scalp in humans and also of dogs, cats.

M. distortum- dogs, cats and monkey.

T. mentagrophytes- Tinea capitis in human, Ring worm in cats.

T. rubrum- Tinea corporis, T.pedis, Ring worm in dogs.

T.schoeleinii- Ring worm in cats and T. favosa of man.

Dermatophytes are broadly divided into three groups on the basis of their host preference and natural habitat

Geophilic dermatophytes; they are the soil borne fungus and may remain in the soil as saprophytes e.g. M. gypseum, T. terreste, M. cookie and M. nanum.

Zoophiic dermatophytes; they are basically live on lower animals, e.g. T. verrucosum, T. equinum, T. mentagrophytes and M. canis. Transmission form animal to animal is most common.

Anthropophilic dermatophytes; they exclusively grow on human beings, e.g. E. floccosum, M. audouinii, T. rubrum, T. violaceum.

Mode of transmission

Infection spreads to the healthy animals with direct contact with the infected animals. Overcrowding predispose the animals to come in close contact. The infection may spread through indirect contact with fomites (grooming utensils, beddings, coverings etc.). Deficiencies of certain nutrients have been considered as attributes to spread in susceptible animals.

Pathogenesis

Dermatophytes principally attack the keratinized layer of skin, hair and nail; autolyse the fibrous structures, break the hairs and thus produce alopecis. They do not invade living tissues. They produce skin lesions through elaboration or excretion of toxin or allergen. These agents affect the malphigisn and basal layer and thus induce increased proliferation of rete cells of malpigisn layers. These also act on vascular components leading to effusion of serum. The capillary dilation and hyperaemis along with serous edema cause spongiosis of the epithelium and thus interfere with the regular process of keratinization thereby parakeratosis develops. Toxins damage the hair follicles and thus alopecis develops.

The sign of inflammatory reactions occur at the site of invasion when the Host-Parasite equilibrium is disturbed. There are scale and encrustation. The hair loss is not complete until the follicles are destroyed by secondary bacterial infection. Fungus invades the growing hairs as the growing hairs meet the metabolic needs of them. Growing hairs contain carbohydrate, nitrogenous substances, and nucleoprotein derivatives in addition to keratin. There are three types of attachments ectothrix, endothrix and favic type. In Ectothrix type of invasion, anthrospores are formed outside the hairs. In the endothrix type, anthrospores are formed inside the hairs and the favic type contain hyphae and only few anthrospores.

Dermatophytes are strict anaerobes and the fungi die outside under the crust in the center of most lesion leaving and active lesions on the periphery and thus form a characteristic patch of ringworm. Secondary bacterial infection may produce micro-abscess in the superficisl epidermis together with suppurative folliculitis. Prolonged use of systemic corticosteroids to alleviste itch may produce severe lesions known as “Tinea incognito”.

Clinical findings

In dog, the lesions are usually located at face, extremities and lower abdomen. The lesions appear as a small pink macules spreading in peripheral direction. Sometime large areas of the body may be affected. The advanced lesions are circumscribed, discrete or confluent and covered with greyish scales which are attached to the skin. Secondary bacterial infection or mite may invade the lesions. Mixed infections of Trichophyton and D.canis have been found to produce multiple lesions on the back, neck and shoulder of dog. A very rare percentage of dogs may show bee-hive appearance of skin.

In cat, the lesions are found in ears, faces, and extremities. Sometimes, generalized lesions may be seen. Patches of alopecis with less erythema of crusty patches are the most common exhibited lesions. Circular erythematous patches of atypical popular crust or vesicular dermatitis with or without alopecis, paronychis with or without onychomycosis, multiple or general secorrhoea sicca, folliculitis without mass alopecis or otitis externa are some of the diverse manifestation.

Kittens are affected most commonly. Cats with clinically inapparent infections can serve as a source of infection to other cats or people. Occasionally, dermatophytosis in cats causes feline milisry dermatitis and is pruritic. Cats with generalized dermatophytosis occasionally develop cutaneous ulcerated nodules, known as dermatophyte granulomas or pseudomycetomas. Devon Rex cats can have a maculopapular hyperpigmented, crusted disease that histopathologically is an eosinophilic/mastocytic dermatitis.

Diagnosis

1. Microscopic examination

The clinical materisls like skin scrapings, hairs, nail, etc. are subjected to direct microscopic examination. For this purpose, materisls are soaked in few drops of 10% KOH solution on slide and examined under microscope by putting coverslip over them. The fungal elements are observed as refractory hyphal fragment. Spores may be noted. Arrangement of spores on the hair is suggestive of infection with keratophilic fungus.

2. Cultural Examination

Any clinical materisl from suspected cases, irrespective of fact whether or not fungal elements are seen on the direct microscopic examination should be cultured on suitable medis for the isolation of etiological agents. Sabauraud's dextrose agar is the suitable medium for the fungal culture. Addition of antibacterial agents may be required to cut down the growth of the bacterial contaminants. Actidione is added to the medium which does not allow most of the laboratory contaminants to grow. An optimum temperature for growth of the fungi is 22 to 30 degree celcius. Some dermatophytes grow and sporulate within 5-10 days but others require time. For practical purpose primary isolation of dermatophytes modified sabouraud dextrose agar containing 0.05mg/ml of chloramphenicol and with pH of 6.5-7 is suitable medium. Cyclohexamide 0.1-09mg/ml may be added to suppress the growth of saprophytic fungi. Enrichment of the medis with vitamin (nicotinic acid, thismine and inositol) is required for the growth of some fungi. Examination of culture is to be carried out from time to time as most of fungi have got slow growth rate. The culture slant should be incubated at least for four weeks before being discarded as culturally negative. Examination of growth will provide clues to the specisl characteristics which are essentisl attributes for proper identification. The materisls are to be picked up carefully from the growth and examined under microscope using a mounting fluid like lactophenol cotton blue.

Sometimes, the characteristic morphological features are not distinguishable in above preparation. In such cases, slide culture technique may be done. In this technique fungus is grown on a small on cm.square piece of agar block on a slide under cover glass. After incubation, two mounts can be made one from the cover slip and another from the slide. This will give details of morphological features and will be useful for the identification.

3. Kit for dermatophyte detection; commercisl kit is available named as Rapi GEN Ready DTM.
4. The skin biopsy; from suspected lesions may be made and stained with fungal stains:

A. Haematoxylin and eosin stain: This stain is widely used for the histopathological examination of animal tissues. Many fungi take stain. But, there is limitation too as some fungi do not take this stain properly.

B. Specisl fungal stain: These are Gomori's methanamine sliver technique (GMS), Gridley‟s Fungal (GF) stain, and Periodic Acid Schiff's (PAS) technique. The presence of chromic or periodic acid and adjacent hydroxyl group of complex polysaccharides as present in fungal cell walls are oxidized to aldehyde. In GMS procedure, the aldehydes reduce the methanamine silver nitrate complex and result in brown black staining of fungal cell walls due to the deposition of reduced silver wherever aldehyde are located. The depth of color produced depends on the amount of aldehyde present at any particular site. The GSM technique is regarded best for screening a tissue section because it provides better contrasts and often stain fungal elements those are refractory to GF and PAS. The GF and PAS procedures, the aldehyde react with Schiff‟s agent coloring fungi reddish purple and pinkish red respectively. The PAS procedure can be preceded by disstase digestion to remove glycogen. This eliminates some of nonspecific staining of normal tissue components and cellular debris and may result greater contrast between the fungi and the back ground tissues.

C. Combined GMS and H.E. Stain:

The combined stain helps simultaneous study of fungal morphology, and tissue responses. This is also very much useful for black and white photography due to increased contrast of the background tissues.

1. Wood's Light Method Certain stains of M. canis and M. audouinii produce fluorescence- a positive yellowgreen colour when examined under wood‟s light. This fluorescence is due to tryptophan metabolite produced by the fungi that had invaded actively growing hairs. Fluorescent is not present in scales or crust in culture of dermatophytes.

Treatment

Dermatophytosis is self-limiting disease with spontaneous remission within one to three months. The process by which, the infection subsides include anatomical barrier of the skin and mucus membrane, good general nutrition and health. The drugs which can be used broadly divided into two categories; a) local drugs b) systemic drugs. Local antifungal drugs contain keratolytic substances which help surface contact with the fungal elements. The agent which is used to treat dermatophytes can be an Irritant, Keratolytics, Fungicides, Fungistatic and agent arresting keratin production.

a) Topical Drugs

Organic acids: they are fatty acids having both fungistatic and fungicidal activities.

They can be used both as ointment and alcoholic solution. Eg: Salicyclic acid (2-10%), Benzoic acid (2 to 6%), undecylenic acid (10%).

Tolnaftate: used as 1% solution or ointment. Effective against Trichophyton and Microsporum spp.

It may be applied along with griseoflucin for quick result.

Haloproquin: A synthetic antifungal agent used to treat skin infection caused by Trichophyton spp. and Microsporum canis as 1% cream for 2-3 weeks.

Phenol, Iodine, Miconazole, Cotrimazole, Resorcinol, etc.

b) Systemic antifungal agents

Griseofulvin: It is the most effective antifungal agent. It is used orally as antifungal antibiotic. This is a metabolic product of Penicillium griseofluvin, P.nigricans and P. raidrickii with specific activity against dermatophytes. The drug is deposited in new epithelial cells. The action of drug is primarily as fungisatatic. It may impair the development of terminal hyphae and causes curling, thickening and distortion. High dietary fat increases its absorption. The drug should not be used pregnant animals. Dose: Dog and cat ; 7-20 mg/ kg body weight for 14-50 days.

Ketoconazole: it is an imidazole derivative which has been found effective against dermatophyte infection in dogs and cats when given @ 10 mg/ kg body weight orally.

Nystatin: it is a fungistatic and fungicidal antibiotic. Dogs; 10,000 I.U./lb body wt.

Control

The infected animals should be identified and isolated. They should be brought under treatment with drugs depending upon nature of lesions. - The utensils, grooming articles, feeding trough etc. should be properly cleaned and treated as fungal spores can resist dessication and disinfection. - The animal handlers should wash their hands properly before handling the non infected ones. - The wooden doors, windows, gaits or chain, rope used by animals should be treated with 5% phenol or 2% caustic soda.

Summary

- Dematophtosis is the superficisl fungal infection of the cornified epidermis.
- Dermatophytosis is caused by one of three genera of fungi -microsporum, trichophyton and epidermophyton are collectively known as dermatophytes.
- Lesions are usually located at face, extremities and lower abdomen. The lesions appear as a small pink macules spreading in peripheral direction.
- The drugs which can be used are local drugs and systemic drugs. Local antifungal drugs contain keratolytic substances which help surface contact with the fungal elements. The agent which is used to treat dermatophytes can be an irritant, keratolytics, fungicides, fungistatic and agent arresting keratin production.

Glossary

Hyperaemis: *Hyperaemis* or hyperemis is the increase of blood flow to different tissues in the body.

Spongiosis: *Spongiosis* is mainly intercellular edema (abnormal accumulation of fluid) in the epidermis, and is characteristic of eczematous dermatitis.

Parakeratosis: *Parakeratosis* refers to incomplete maturation of epidermal keratinocytes, resulting in abnormal retention of nuclei in the stratum corneum.

Alopecis: Loss of hair.

Keratolytics: *Keratolytic* therapy is treatment to remove warts and other lesions in which the epidermis produces excess skin.

Fungicides: *Fungicides* are biocidal chemical compounds or biological organisms used to kill fungi or fungal spores.

Fungistatic: Fungistatics are anti-fungal agents that inhibit the growth of fungus.

Assignment

A. Very short question

1. Define dermatophytosis.

B. Short question

1. Enlist etiology of dermatophytosis.
2. Write a short note on mode of infection of dermatophytosis.

C. Long question

1. Describe briefly about dermatophytosis, it clinical findings, Diagnosis and line of treatment.

Allergy

Allergy also known as allergic diseases are a number of conditions caused by hypersensitivity of the immune system to something in the environment.

Allergy is also a part of immune system which is a complex system. Type I hypersensitivity (or immediste hypersensitivity) is an allergic reaction provoked by reexposure to a specific type of antigen referred to as an allergen.

Pathophysiology

In type 1 hypersensitivity, B-cells are stimulated to produce IgE antibodies specific to an antigen. During sensitisation, the IgE antibodies bind to Fcε receptors on the surface of tissue mast cells and blood basophils. Mast cells and basophils coated by IgE antibodies are "sensitised". Later exposure to the same allergen cross-links the bound IgE on sensitised cells, resulting in degranulation and the secretion of pharmacologically active medistors such as histamine, leukotriene and prostaglandin that act on the surrounding tissues. The principal effects of these products are vasodilation and smooth-muscle contraction.

Overview of medistors released by mast cells in type 1 hypersensitivity, and their actions:	
Vasodilation and increased permeability	● Histamine ● PAF ● Leukotriene ● Prostaglandin ● Neutral proteases
Smooth muscle spasm	● Histamine ● PAF ● Leukotriene ● Prostaglandin
Leukocyte extravasation	● Cytokines ● Leukotriene ● Chemotactic factors for neutrophils and eosinophils

Some examples

- Allergic asthma
- Allergic conjunctivitis
- Allergic rhinitis ("hay fever")
- Anaphylaxis
- Angioedema
- Urticaris (hives)
- Eosinophilis
- Penicillin allergy
- Cephalosporin allergy
- Food allergy
- Sweet itch

Symptoms

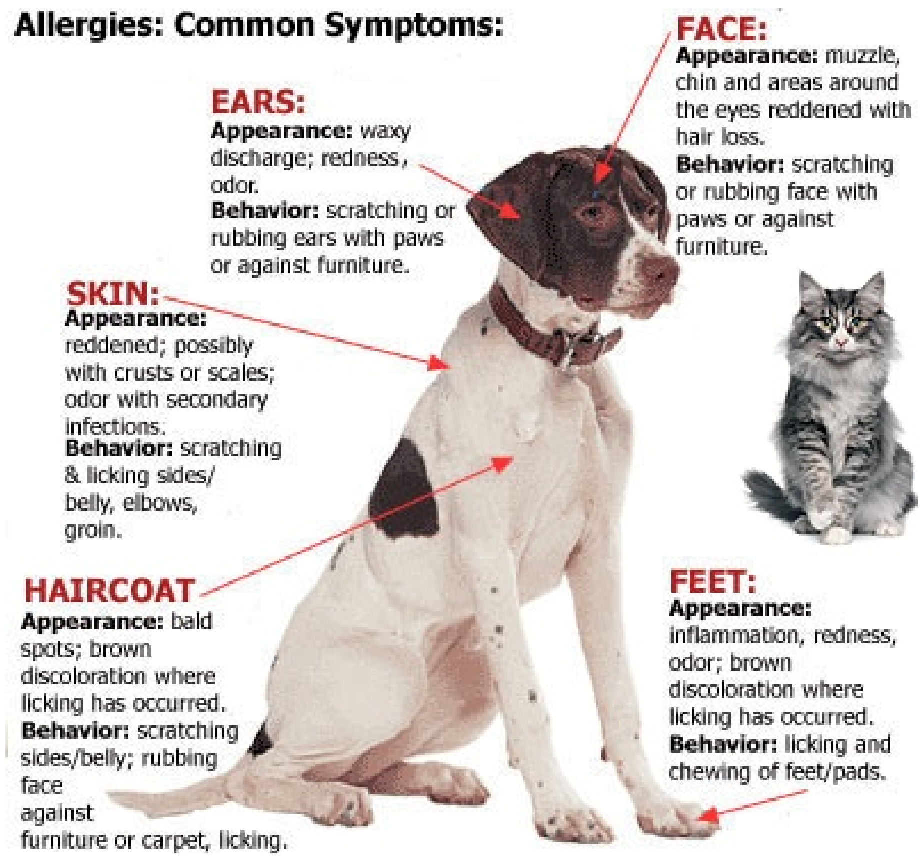
Allergy signs and symptoms caused by inflammation of nasal passages include:

- Sneezing
- Runny nose
- Itchy, red or watery eyes
- Nasal congestion
- Itchy nose, roof of mouth or throat
- Postnasal drip
- Cough
- Facisl pressure and pain
- Frequent awakening
- Swollen, blue-colored skin under your eyes
- If allergy contributes to asthma, the following symptoms may arises:
- Difficulty breathing
- Chest tightness or pain
- Audible whistling or wheezing sound when exhaling
- Shortness of breath, coughing or wheezing

Skin symptoms

Allergy may also experience skin symptoms, a pattern known as allergic dermatitis. This type of dermatitis is an immune system reaction that causes skin inflammation. Direct contact with an allergy-causing pet and animals may trigger allergic dermatitis, causing signs and symptoms, such as:

- Raised, red patches of skin (hives)
- Eczema
- Itchy skin



Treatment

Allergies can be treated with standard allergy drugs.

- Antihistamines, which block the effects of a chemical that triggers dog allergy symptoms.

- Decongestants, which reduce swelling and relieve congestion.
- Antibiotics if secondary infection persists.

Summary

- Allergy also known as allergic diseases are a number of conditions caused by hypersensitivity of the immune system to something in the environment.
- Allergy signs and symptoms caused by inflammation of nasal passages including, sneezing, runny nose, itchy, red or watery eyesa and nasal congestion
- Skin allergy is characterized by raised, red patches of skin, eczema and itchy skin.
- Allergies can be treated with standard allergy drugs; antihistamines, decongestants and antibiotics.

Glossary

Alopecis: Loss of hair.

Hypersensitivity: Hypersensitivity describes an abnormal or pathologic immune reaction that is caused by an immune response to repeated exposure to an antigen.

Macules: A discolored spot on the skin that is not raised above the surface

Urticaris: Urticaris is a vascular reaction of the skin marked by the transient appearance of smooth, slightly elevated papules that are erythematous and that are often attended by severe pruritus.

Anaphylaxis: Anaphylaxis is a serious allergic reaction that is rapid in onset and may cause death.

Rhinitis: Inflammation of nose.

Conjunctivitis: Inflammation of conjunctiva.

Asthma: Asthma is a chronic lung disease that inflames and narrows the airways.

Histamine: Histamine is an organic nitrogenous compound involved in local immune responses as well as regulating physiological function in the gut and acting as a neurotransmitter.

PAF: Platelet-activating factor (PAF) a substance released by basophils and mast cells in immediste hypersensitivity reactions, and by macrophages and neutrophils.

Prostaglandin: Prostaglandins are lipid autacoids derived from arachidonic acid.

Cytokines: Cytokines are cell signalling molecules that aid cell to cell communication in immune responses and stimulate the movement of cells towards sites of inflammation, infection and trauma.

Leukotriene: Leukotrienes are biologically active molecules, formed by leukocytes, mastocytoma cells, macrophages, and other tissues and cells in response to immunological and nonimmunological stimuli.

Eosinophilis: State of increased number of eosinophils.

Eczema: Eczema is a condition where patches of skin become inflamed, itchy, red, cracked, and rough.

Dermatitis: It is the inflammation of the skin.

Assignment

A. Very short question

1. Define dermatitis.
2. Define hypersensitivity.

B. Long question

1. Write about allergy. Write about etiology, symptoms and treatment of allergy.

Unit Six
Pathology

Learning Outcomes

After the completion of this unit students will able to:

- Define pathology
- Explain the disgnostic techniques used in pathology,various categories of the Causes of diseases , the course, outcome, consequences of diseases
- Explain the causes of inflammation
- Demonstrate to understand the process of inflammations
- Comprehend the etiopathogenesis of granulomatous inflammations
- Contrast the differetisnce and explain between acute and chronic inflammations Know the inflammatory status of stomach, intestine, liver, kidney, lung, heart and mammary gland

Introduction

Pathology is the study of disease through scientific methods. The word pathology came from the Latin words “patho” and “logy”. ‘Patho’ means disease and ‘logy’ means study. Therefore pathology is a scientific study of disease. Diseases may, in turn, be defined as an abnormal varistion in structure or function of any part of the body. Pathology gives explanations of a disease by studying the following four aspects of the disease.

1. Etiology
2. Pathogenesis
3. Morphologic changes and
4. Functional derangements and clinical significance.

1. Etiology

Etiology of a disease means the cause of the disease. If the cause of a disease is known it is called primary etiology. If the cause of the disease is unknown it is called idiopathic. Knowledge or discovery of the primary cause remains the backbone on which a Diagnosis can be made, a disease understood, and a treatment developed. There are two major classes of etiologic factors: genetic and acquired (infectious, nutritional, chemical, physical, etc).

2. Pathogenesis

Pathogenesis means the mechanism through which the cause operates to produce the pathological and clinical manifestations. The pathogenetic mechanisms could take place in the latent or incubation period. Pathogenesis leads to morphologic changes.

3. Morphologic changes

The morphologic changes refer to the structural alterations in cells or tissues that occur following the pathogenetic mechanisms. The structural changes in the organ can be seen with the naked eye or they may only be seen under the microscope. Those changes that can be seen with the naked eye are called gross morphologic changes and those that are seen under the microscope are called microscopic changes. Both the gross and the microscopic changes may only be seen in that disease, i.e. they may be specific to that disease. Therefore, such morphologic changes can be used by the pathologist to identify (i.e. to disgnose) the disease. In addition, the morphologic changes will lead to functional alteration and to the clinical signs and symptoms of the disease.

4. Functional derangements and clinical significance

The morphologic changes in the organ influence the normal function of the organ. By doing so, they determine the clinical features (symptoms and signs), course, and prognosis of the disease.

Branches of pathology

The pathological branches are as fallow:

a. **Histopathology :** Histopathological :study abnormal structures in the tissue.

b. **Cytopathology:** study of cells and determine the cause or nature of disease.

c. **Hematopathology:** study abnormalities of the cells of the blood and their precursors in the bone marrow are investigated to disgnose the different kinds of anemis and leukemis.

d. **Immunohistochemistry:** detect a specific antigen in the tissue in order to identify the type of disease.

e. **Microbiological examination:** identify micro-organisms responsible for many diseases.

f. **Biochemical examination:** disturbances of disease are investigated by assay of various normal and abnormal compounds in the blood, urine, etc.

g. **Cytogenetics:** inherited chromosomal abnormalities in the germ cells or acquired chromosomal abnormalities in somatic cells are investigated using the techniques of molecular biology.

h. **Molecular techniques:** Different molecular techniques such as fluorescent in situ hybridization, Southern blot, etc. can be used to detect genetic diseases.

i. **Autopsy:** Autopsy is examination of the dead body to identify the cause of death. This can be for forensic or clinical purposes.

Inflammation

Inflammation is a local response (reaction) of living vasculaized tissues to endogenous and exogenous stimuli. The term is derived from the Latin "Inflammane" meaning to burn. Inflammation is fundamentally destined to localize and eliminate the causative agent and to limit tissue injury. Thus, inflammation is a physiologic (protective) response to injury, an observation made by Sir John Hunter in 1794 concluded: “inflammation is itself not to be considered as a disease but as a salutary operation consequent either to some violence or to some diseases”.

Causes of inflammation

Etiological agent of inflammation are microbial, different irritant substance,tissues necrosis, physical agents are as follows:

Microbial infections

One of the most common causes of inflammation is microbial infection. Microbes include viruses, bacteria, protozoa, fungi and various parasites. Viruses lead to death of individual cells by intracellular multiplication, and either cause the cell to stop functioning and die, or cause explosion of the cell (cytolytic), in which case it also dies. Bacteria release specific toxins – either exotoxins or endotoxins. What’s the difference? Exotoxins are produced specifically for export (like anthrax toxins or tetanus toxins) whereas endotoxins are just part of the cell walls of Gram negative bacteria and they do terrible things to the body too but they aren’t as specific in their actions as the exotoxins.

Hypersensitivity reactions

A hypersensitivity reaction occurs when an altered state of immunologic responsiveness causes an inAppropriate or excessive immune reaction that damages the tissues. The types of reaction is Immune Medisted Inflammation.

Physical agents, irritant and corrosive chemicals

Tissue damage leading to inflammation may occur through physical trauma, ultraviolet or other ionizing radistion, burns or excessive cooling ('frostbite'). Corrosive chemicals (acids, alkalis, oxidizing agents) provoke inflammation through direct tissue damage. These chemical irritants cause tissue damage that leads directly to inflammation.

Tissue necrosis

Death of tissues from lack of oxygen or nutrients resulting from inadequate blood flow (infarction) is a potent inflammatory stimulus. The edge of a recent infarct often shows an acute inflammatory response.

Systemic Effects of Inflammations

The systemic effects of inflammation include:

a. Fever
b. Endocrine and metabolic responses
c. Autonomic responses
d. Behavioral responses
e. Leukocytosis
f. Leucopenis
g. Weight loss

Classification

Inflammation is classified crudely based on duration of the lesion and histological appearances into acute and chronic inflammation.

Acute Inflammation

Acute inflammation is an immediste and early response to an injurious agent and it is relatively of short duration, lasting for minutes, several hours or few days. It is characterized by exudation of fluids and plasma proteins and the emigration of predominantly neutrophilic leucocytes to the site of injury.

The five cardinal signs of acute inflammation

The four principal effects of inflammation (rubor, tumor, calor et dolor) were described nearly 2,000 years ago by the Roman **Aulus Cornelius Celsus**, more commonly known as Celsus. (He wasn't actually a practitioner of medicine. Rather, he wrote an encyclopedis that had many volumes about all kinds of subjects. Only the volume concerning medicine survived)

Redness (rubor) which is due to dilation of small blood vessels within damaged tissue as it occurs in cellulitis.

Heat (calor) which results from increased blood flow (hyperemis) due to regional vascular dilation

Swelling (tumor) which is due to accumulation of fluid in the extravascular space which, in turn, is due to increased vascular permeability.

Pain (dolor), which partly results from the stretching and destruction of tissues due to inflammatory edema and in part from pus under pressure in as abscess cavity. Some chemicals of acute inflammation, including bradykinins, prostaglandins and serotonin are also known to induce pain.

Loss of function: The inflammed area is inhibited by pain while severe swelling may also physically immobilize the tissue.

Chronic Inflammation

Chronic inflammation can be defined as a prolonged inflammatory process (weeks or months) where an active inflammation, tissue destruction and attempts at repair are proceeding simultaneously.

Causes of chronic inflammation

1. **Persistent infections** : Certain microorganisms associted with intracellular infection such as tuberculosis, leprosy, certain fungi etc characteristically cause chronic inflammation.These organisms are of low toxicity and evoke delayed hypersensitivity reactions.
2. **Prolonged exposure to nondegradable but partislly toxic substances:** either endogenous lipid components which result in atherosclerosis or exogenous substances such as silica, asbestos.
3. **Progression from acute inflammation:** Acute inflammation always progresses to chronic inflammation following:
4. A persistent suppuration as a result of uncollapsed abscess cavities, foreign body materisls (dirt, cloth, wool, etc), sequesterum in osteomylitis, or a sinus/fistula from chronic abscesses.

4. **Autoimmuniy.** Autoimmune diseases such as rheumatoid arthritis and systemic lupus erythematosis are chronic inflammations from the outset.

Inflammatory status of different organ and tissues

Organ/tissues	Inflammatory status
Stomach	Gastritis
Intestine	Enteritis
Kidney	Nephritis
Liver	Hepatitis
Lung	Pneumonia
Heart	Carditis
Mammary gland	Mastitis
Uterus	Metritis
Ureter	Cystitis
Mouth	Stomatitis

Difference between Acute and Chronic inflammation

Characteristics	Acute inflammation	Chronic inflammation
Duration	Short	Long
Pattern	Stereotyped	Varied
Predominant cell	Neutrophils, macrophages	Lymphocytes plasma cell
Tissue destruction	Mild to moderate	Marked
Fibrosis	Absent	Present
Inflammatory reaction	Exudative	Productive

Summary

- Inflammation is the response of living tissue to injury. It involves a well-organized cascade of fluid and cellular changes within living tissue.
- Cardinal features of inflammation are Rubor (redness); Tumor (swelling); Calor (heat); Dolor (pain); Functio laesa (loss of function)
- Causes of inflammation are

Etiologic agents – viruses, bacteria, fungi, parasites

Hypersensitivity – body reacts against itself, there are four types of reactions

Physical and chemical agents - trauma, sunburn, acid

Necrosis - anoxis, trauma

- Acute Inflammation has Vascular and Cellular Events:

1. Vascular Events

   Vasodilation and then increased Vascular permeability

2. Cellular Events

   Cells move out of the vessels into the area of inflammation using chemotaxis inflammatory cells become activated and then can phagocytose offending materisls

- Chronic inflammation is the host response to an inciting stimulus that goes on for weeks or months which is Characterized not usually red or hot (unlike acute inflammation) Do not "ooze" Productive or proliferative Often present in infections with higher order organisms (mycobacteria, fungi, metazoan parasites) and in many autoimmune diseases

  Histologic appearance: Primarily mononuclear cells involved Fibroblasts and new blood vessels, together called "granulation tissue"

- Granulomatous inflammation: Is always chronic is composed predominantly of macrophages May have multinucleate gisnt cells – macrophages fuse

Glossary

Autopsy: Autopsy is examination of the dead body to identify the cause of death

Sequelae: Sequelae is the lesion remain after diseases treated.

Phagocytosis: Phagocytosis is the process of engulfment and internalization by specislized cells of particulate materisl.

Exercises

A. Very Short Question

1. Define pathology

2. Define pathogenesis.
3. What is autopsy.
4. Define Phagocytosis.
5. Write two different between acute and chronic inflammation
6. What are cardinal sign of inflammation?
7. Define autoimmune diseases?
8. Enlist two systemic effect of inflammation
9. Write the inflammatory term of stomach, intestine, kidney, heart, lung, liver, uterus, ureter, muscles and mammary gland

Unit Seven
First aid on surgical and gynecological cases

Learning Outcomes

After completion of this unit students will able to:

- Define first aid and the role of first aider
- Describe the purpose of emergency care and out line steps of emergency care.
- Explain first aid for the causality and suddenly ill animal.
- Explain the emergency situations such as gynecological and surgical.
- Contrast the differentiste problems of pregnant animal and every labor management ,use Appropriate, knowledge skill and materisls while helping the causality
- Differentiste and explain between emergency situation and other use.

Introduction

First aid is typically described as "Emergency treatment administered to an injured or sick animal before professional veterinary care is available. The initisl administration of care for an injured animal until more thorough veterinary attention can be sought (Kahn and Line, 2007). Animals requiring first aid may be encountered in a variety of situations, so same decisions or steps are required to assess the situation and determine the best course of action. The key question is whether the injury/condition can be ameliorated by on the spot or short term (<24 hrs) first aid treatment which is unlikely to cause significant ongoing pain and/or compromise the animal’s ability to heal naturally and survive.In livestock different cases and condition such as wound, dislocation, fracture, infertility, euthanasis, dystokis, prolapsed with emergency care are as follows:

First aid of dog

Source: Merck Veterinary Manual

The immediste/emergency care

The immediste/emergency care includes primary survey, Secondary survey, Transport and First Aid Kit with general direction are as follows:

Primary Survey and Resuscitation

The primary survey is an initial assessment that a first aid provider has to carryout before taking immediate action. A well-informed owner will be able to make a quick assessment of the scene and a quick examination of the victim. Immediste attention is given to the animal's level of consciousness, airway patency, breathing, and circulatory functions (including pulse). Resuscitation is the prompt treatment of life-threatening problems. The primary survey is often referred to as the ABC's of first aid, indicating the following areas of emphasis:

- "A"irway
- "B"reathing and "B"leeding
- "C"ardiovascular (which includes heart function, pulse, and capillary refill time)

Secondary Survey and Definitive First Aid

The secondary survey consists of an examination and assessment of the animals eyes,ears, nose, neck, chest, abdomen, back, extremities, and rectal temperature and the procedures to stabilize and protect the animal from further harm.

Transport

Many emergencies will require professional help. Knowledge of the proper way to transport the animal to a veterinary medical facility for professional care can prevent further injury, protect the victim from dangerous situations, and allow for timely care.

First Aid Kit

Emergency supplies are a necessity. The following list will help you assemble the resources you need.

- 1" and 2" adhesive tape
- 2" roll gauze (for muzzle)
- newspaper
- rectal thermometer
- chlorhexidine or povidone iodine (antiseptic)
- Elizabethan collar
- eye wash (saline in a squirt bottle)
- isopropyl alcohol 3% hydrogen peroxide (or syrup of ipecac)
- 2" and 4" gauze
- 3" x 3" or 4" x 4" gauze pads
- scissors - cotton balls and pledgets
- blanket with heat pack
- flat transport surface
- plastic food wrap (e.g., Saran- Wrap)
- petroleum or K-Y jelly
- ice pack
- activated charcoal
- tweezers
- bulb syringe

A complete first aid kit for your animal is a must.

Preparedness /Phone Numbers

In a convenient location, make a list of important phone numbers that includes the phone numbers of the following:

- Your Veterinarisn
- Your Veterinarisn's emergency (after-hours) number
- Your nearest 24-hour veterinary emergency facility
- Your local poison control center
- National poison control centers

Emergency numbers should be kept near your phone for easy access. Update numbers as necessary.

General Directions for First Aid

A wide variety of problems may occurs where first aid skills may be required.. Decisions and actions vary according to the circumstances, including:

- Scene of the accident
- Emergency equipment available
- Species, size, age, temperament, and condition of the animal requiring first aid
- Your emotional condition
- Other emotionally stable people available to help you.

First aid begins with a quick but careful survey of the scene. Then quick decisions need to be made, depending on the circumstances.

- Make sure the accident scene is safe before proceeding. Take steps to prevent further injury to you or your pet.
- Enlist the help of others.
- Call, or have someone call, the veterinarian or the emergency veterinary center. (Keep those phone numbers handy at all times!) Describe the animal; give a short description of what happened and what has been done. Give your name and telephone number. Don't hang up until the professionals have told you what to do.
- Administer essentisl first aid. Carefully transport the animal to the veterinary facility for examination if there is any question as to the seriousness of the injury or sudden illness. It is highly recommended to telephone first in all but the most life threatening situations.

Example: First Aid on dog

Muzzling

When attending a dog that has been injured, it is important that the first aid provider takes steps to prevent bite wounds inflicted by the animal being treated. Many dogs, even the family pet, may bite when hurt or frightened. A muzzle is an excellent way to prevent being bitten while rendering first aid. Commercisl muzzles are the best, as many of them can be used without interfering with breathing; the problem is they are not always available during a crisis. If a muzzle is not available, the first aid provider must improvise. To make a muzzle, get a rope, cord or other similar strong materisl (such as a necktie or a belt). Wrap the cord or rope two or three times around the muzzle, being careful not to wrap the materisl too close to the soft, fleshy part of the nose. The muzzle must be applied to the bony part of the nose to avoid interfering with breathing. Bring the ends up past the ears and tie in the securely behind the head. These muzzles cannot be used on dogs that are having difficulty breathing, are unconscious, or have an injury to the mouth. They're also not indicated for short nose breeds (e.g., Chinese Pug, Pekingese, and Bulldog).

Some injured dogs may vomit. If the dog appears to become nauseated or begins to retch, the muzzle should be removed at once.

Safe Rescue

In order to administer first aid to an animal, it may be necessary to remove him (and yourself) from a road or a highway. Remove your pet from the highway only after making sure it is safe to retrieve him. Direct traffic if necessary.If the pet appears likely to bite because of pain or excitement, covers the pet (including the head) with a blanket and/or muzzle the pet before handling. If there is any evidence of head, neck, or spinal injury (such as inability to move the rear legs), you should move the animal onto a flat surface for transport rather than picking him up. Make sure to secure an accident scene before attempting a rescue.

Wounds/injuries

Wound is defined as break in continuity of tissues in any part of body.

Causes

- Surgical operation

- Trauma by sharp, blunt object
- Maggots
- Poison

Symptoms

Gaping of edges of the wound, haemorrhage, inflammation, pain, purulent discharge

Classification

Based on continuity of tissues

1. **Open**: An open Wound is a break in the skin or mucous membrane
2. **Closed:** A closed wound involves injury to underlying tissue without a break in the skin or mucous membrane.

Based on duration

1. Fresh wound
2. Maggoted wound
3. Ulcerated wound

Type of wound

Types of wounds can include abrasions, open wounds (e.g.cuts), and penetrating wounds (e.g. animal bites or due to a foreign object). The biggest problem with wounds is the possibility of infection. A summary of common types of wounds and their management is given in the table below:

Type of wound	Description and management
Bruise	A closed wound with bleeding below the surface of the skin. If not extensive, or not causing disability, then it's better to release as soon as possible to avoid stress and struggling resulting in further injury and exacerbating bruising
Abrasion	An open wound with the outer layer of skin and underlying blood vessels exposed. The wound should be cleaned with dilute antiseptic. The animal can generally be released
Cut	An open wound caused by something sharp, where the skin,

	soft tissue or muscle is severed. The wound needs to be cleaned thoroughly and generally the animal can be released. If the cut is large or deep it will require veterinary care or euthanasis
Laceration	An open wound (e.g. caused by wire, teeth or claws) where the skin and underlying tissue are damaged. The wound should be cleaned thoroughly. If the laceration is extensive it will require veterinary care or euthanasis.
Puncture	An open wound caused by blunt or pointed objects in which the skin and underlying tissue is damaged, as well as possibly organ damage. Wound should be cleaned thoroughly. If the puncture severe it will require veterinary care or euthanasis.
Tear	An open wound caused by something sharp. The skin and other soft tissue will be partislly or completely torn away. The skin should be returned to its original position and a pressure bandage applied. The animal may require veterinary care or euthanasis.
Embedded object	An open wound in which an object has embedded itself. Do not try and remove the object. The animal will require veterinary care or euthanasis.

Different body injuries

Abdominal injuries

Abdominal injuries usually result from heavy impacts (e.g. car strike, dog attack). Signs of abdominal injury include shock, pain, vomiting and evidence of injury such as swelling, bruising and protrusion of intestines. If abdominal injuries are suspected then the animal is likely to have a poor prognosis even with treatment. A decision to euthanase or seek veterinary attention will need to be made.

Chest injuries

Chest injuries can range from mild to life threatening. Signs of chest injuries include pain, increased breathing effort or short rapid breaths, swelling at the site, pale gums. An animal in severe respiratory distress will have an extended head and gasp for air. If chest injuries are suspected then the animal is likely to have a poor prognosis even with treatment. A decision to euthanase or seek veterinary attention will need to be made.

Head and spinal injuries

Head and spinal injuries can be serious. Signs include unconsciousness, abnormal behaviour, blood or clear fluid coming from the nose or ears and unequal pupil size. If an animal is unconscious it must be placed on its side and the airways kept clear. The head should be slightly lower than the neck and chest to allow any fluid to drain from the mouth. The most common cause of spinal injuries is through collision with a motor vehicle. If spinal injuries are suspected (e.g. weakness in hindquarters, pain, partisl or total paralysis) handling must be done very carefully. Euthanasis may be the only option for an animal with spinal injuries. If head or spinal injuries are suspected then the animal is likely to have a poor prognosis if left untreated. A decision to euthanize or seek veterinary attention will need to be made.

Eye injuries

The eyes are very sensitive and can react negatively to any injury. Foreign objects, smoke and wounds are the common causes of eye injuries and may result in infections to complete blindness. A foreign object in the eye can cause discharge and redness, with the animal rubbing or pawing at the eye. The eye can be opened to examine it, and the foreign materisl can be washed out with clean water. If this doesn't work attempts can be made to remove the object if possible, however never try and remove if the object is penetrating the globe. Any attempt to remove any foreign materisl by means other than flushing (using sterile saline or fresh water) in a conscious animal is likely to risk additional injury to the eye. Eye injuries resulting from smoke should be treated by flushing the eyes with water or saline.

Wounds to the eyes are more serious than irritation from foreign objects or smoke and can cause bloody discharge or blood in the eye itself. The severity of the injury will determine the most Appropriate course of action. In all cases, basic treatment and release as soon as possible is the preferred option however seeking veterinary care or euthanasis should be considered if prognosis with basic treatment is poor.

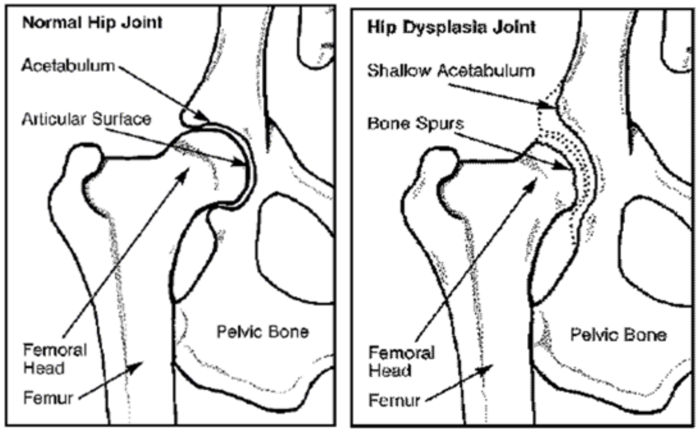
Treatment

Not all wounds will require veterinary treatment. Deciding whether the wound is superficisl or deep will determine the Appropriate treatment for the wound. Superficisl wounds can be cleaned with dilute antiseptic (e.g. Betadine ®) but veterinary care should be sought for deep wounds. Some wounds,although they may be considered in a pet to warrant veterinary care, may in a given wildlife situation need to be weighed against the relative inaccessibility of veterinary care and time frame involved. The severity of the injury will determine the most Appropriate course of action. In all cases basic treatment and release as soon as possible is the preferred option however seeking veterinary care or euthanasis should be considered if prognosis with basic treatment is poor.

Dislocation and fracture

Dislocation

Dislocation is the displacement of bone from its normal position in relation to joint. Fracture-dislocation describes joint fractures that produce joint instability sufficient to result in simultaneous subluxation or luxation of the affected joint. This classification is incomplete, since fracture-dislocation of the shoulder indicates dislocation of the shoulder but does not indicate which bone, the scapula or the humerus, is fractured. Therefore, a more descriptive classification of the fracture must be given. Fracture-dislocations can be difficult to treat because they represent intra-articular fracture plus supporting tissue laxity. When fracture and dislocation are found together, the prognosis is poorer than if each problem occurred separately.



Normal Hip Joint Hip Dysplasia Joint

(Source : Kelsey Tinsman ppt)

Fracture

A fracture is dissolution of bony continuity with or without displacement of the fragments. It is always accompanied by soft tissue damage of varying degrees; there are torn vessels, bruised muscles, lacerated periosteum, and contused nerves. Sometimes there are injured internal organs and lacerated skin. The trauma to soft tissue must always be taken into consideration and is often vitally more important than the fracture itself.

Fractures are broken bones and they can be open, where the bone is exposed through skin, or closed, where the skin is unbroken. An initisl assessment needs to be made to determine if a fracture or dislocation has occurred by feeling for abnormalities and checking for normal range of movement in limbs/pain response etc. Signs that an animal may have a fracture include not using the limb, pain at or near the fracture site, the limb may be deformed or twisted, swelling around the fracture and shock. The prognosis is also dependent on the number of bones involved, if the bone is in one or more pieces, the location of the fracture and the time the fracture spends broken. Open fractures carry a poor prognosis due to the increased chances of infection. Pressure or splints must never be applied to an open fracture, however they should be covered to prevent dirt entering the wound and loss of body fluid. Symptoms of sprains and strains are similar to fractures and if in doubt should be treated as closed fractures. A temporary splint and/or bandaging may be applied in the field to stabilise the injury prior to veterinary attention being thought, if the animal will tolerate it with minimal additional stress. If a fracture is suspected then the animal is likely to have a poor prognosis if left untreated. A decision to euthanase or seek veterinary attention will need to be made. It must be kept in mind that healing time for fractures is a minimum of 6 weeks with no guarantee of a full return to the wild.

Causes of fracture

External causes

Direct Violence

- Indirect Violence
- Bending Forces
- Torsional Forces
- Compression Forces
- Shearing Forces

Internal Causes

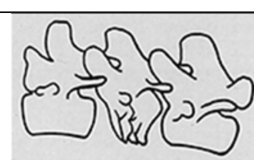
- Pathologic Fractures
- Fractures Due To Muscular Action

Classification of Fracture

Fractures are classified into many types based on the severity of the fracture, whether it communicates through the skin, the shape of the fracture line, or the anatomical location of the fracture within an individual bone. All systems are compatible and of necessity overlap

Based on type

Incomplete Fractures	
Greenstick Fracture	

Fissure Fracture	
Depression Fracture	
Complete Fractures	
Transverse Fracture	
Oblique Fracture	
Spiral Fracture	
Comminuted Fracture	
Multiple Fracture	
Impaction Fracture	
Compression Fraction	
Closed Fracture	
Open Fracture	

Source http://cal.vet.upenn.edu

Based on location

- Disphyseal Fracture
- Metaphyseal Fracture
- Fracture Of The Epiphyseal Plate
- Epiphyseal Fracture
- Condylar Fracture
- Articular Fracture
- Avulsion Fracture

Diagnosis

In most instances the clinical signs associsted with fracture make Diagnosis easier. Although the owner of an animal will have observed the fractured bone, locating a fracture can at times be difficult. In these instances, the practitioner needs a systematic and logical approach to disgnose the fracture.

Infertility/anoestrous

Fertility is the ability of male and female animals to produce visble germ cells, mate, conceive and deliver normal living young (Ensminger, 1969) Infertility is the diminished or absent capacity to produce visble offspring. There are many other causes of infertility in cattle. The goal of a breeding program is to have 90-95% of cows bred in a 65 day breeding season. If pregnancy/calving rates are below this, finding out why is important. There are both infectious and non-infectious causes of infertility. Cattle are deemed infertile when they are neither normally fertile nor completely sterile. Interest in bovine infertility increased with the introduction of artificial insemination in the 1950s and as the factors involved became known to farmers, herdsmen physiologists and other workers (Roberts, 1956).

Causes

The causes of infertility are many and can be complex (Arthur, 1982). They relate to Graafisn follicle development and maturation, oestrus onset, successful coitus, ovulation, fertilization, implantation, and the development and delivery of the foetus and its membranes. Anything interfering with these routines, such as diseases, poor nutrition, inadequate herd management, hereditary and congenital factors, hormonal disturbances or environmental changes, makes the animal infertile, if only temporarily (Osmanu, 1979).

Non Infectious Causes of Infertility

Female

- Nutrition
- Stress
- Genetics

Male

- Failing to use a bull that has passed a breeding soundness exam
- Insufficient bull numbers for cow numbers and environment
- Bull(s) with poor libido

The most common cause of infertility in beef herds is poor cow nutrition. Over conditioning can also be detrimental, especislly in heifers, but is far less common a problem. Body condition before calving, after calving, and at breeding can all contribute to infertility. Cows that calve thin but are gaining at breeding will have better conception rates than cows that remain thin. However, cows that maintain good body condition throughout pregnancy will have the best chance of breeding back. Most commonly protein and energy are deficient in beef cattle diets. But vitamin and mineral deficiencies can also cause infertility. Copper is deficient in forages in parts of Nepal which can lead to deficiencies in animals. Infertility, poor vaccine response, Diarrhoea, weight loss, poor growth, weak calves and calf health problems can all stem from copper deficiency.

Stress can cause pregnancy wastage at any stage of gestation. Low stress handling when processing cattle will minimize this problem. Heat stress is also a major cause of infertility, especislly early in pregnancy. High humidity exacerbates heat stress and would be expected to impact conception rates even more. Extending the breeding season late into the summer to get extra cows bred is probably a futile exercise.

Finally, genetics and other environmental factors play a role in infertility. Selection for other production traits can sometimes lead to selection against reproductive ability. There are breed differences in reproductive efficiency, especislly when comparing Bos taurus to Bos indicus breeds. In general, Bos indicus breeds are superior in subtropical climates, but have later puberty and longer intercalving interval than Bos Taurus breeds. There are wide varistions between individuals, so selecting for early maturity and shorter intercalving interval will increase efficiency over time. Recent research has also focused on the influence of cow nutrition during gestation and its impact on subsequent growth and fertility in their female offspring ("fetal programming"). Heifers born to cows that are deprived of protein supplementation during late gestation, have lower average daily gains, delayed onset to puberty, and lower conception rates compared to heifers born to protein supplemented cows. Even if heifers are fed properly once they are born, nutrient deprivation in utero negatively impacts their future fertility. Bulls should have a breeding soundness exam prior to each breeding season. Even if a bull passed last year, there is no guarantee he will pass this year. Bull infertility due to heat stress is a major problem in Nepal. Although there are general rules for how many bulls are needed for a group cows, this varies highly between herds. The age of the bulls, single vs. multi sire breeding groups, terrain and climate can all affect how many bulls are needed. Young bulls, particularly in breeding groups with older bulls, will not service as many cows as mature bulls. If bulls are not used to the heat, they may spend more time in the shade than servicing cows due to lack of libido. A breeding soundness exam does not test libido, so bulls should be watched to make sure they are breeding cows once they are turned out.

Infectious and Toxic Causes of Infertility in Cattle

Leptospirosis

There are several serovars of leptospirosis that can infect cattle, but the most important serovar in the United States in cattle is hardjo-bovis. This serovar is host-adapted to cattle, meaning some cattle remain infected and become carriers. Carrier animals allow the infection to persist in a herd. Vaccination can help prevent infections. The 5-way lepto vaccines that have been available for years prevent the non-host adapted serovars. These vaccines contain a hardjo serovar, but it is hardjo-prajitno, not hardjo bovis. There is some cross protection, but not always. To prevent hardjo-bovis, select a vaccine that is specifically labeled for prevention of the hardjo-bovis serovar.

Trichomonissis

Trichomonissis causes infertility, repeat breeding, delayed return to oestrus after mating, early embryonic death and, sometimes, abortion. It may directly cause the death of the embryo or may do so vis uterine endometritis and marked leucocytic dispedesis into the endometrium (Vandeplassche, 1982). The affected cow returns to oestrus or may abort anytime from 2 to 7 months after conception. The foetus can degenerate. The corpus luteum may be maintained because the endometrium does not secrete luteolytic prostaglandins. Mucus accumulates, resulting in mucometra. Pus may eventually be observed, indicating pyometra. However, the parasite tends to attack the superficisl layers of the endometrium and cow fertility usually returns to normal.

Affected cows develop agglutinating antibodies in their vaginal mucus. This, together with hormonal changes during subsequent oestrous cycles, tends to protect the cow during an infection but may not protect her from re-infection. Withdrawing infected cows from breeding for at least 3 months and subsequent use of clean bulls or artificial insemination can help control the disease.

Campylobacteriosis

Campylobacteriosis, also known as “Vibrio” causes problems similar to Trichomonissis-temporary infertility and early embryonic death. Cattle have irregular estrous cycles and are repeat breeders leading to small calf crops and delayed/prolonged calving seasons. Like Trichomonissis, it is venereally transmitted. The most effective vaccines against Campylobacter are oil-adjuvanted, and there is only one currently on the market. Herds at high risk should use the oil-adjuvanted vaccine and not rely on combination vaccines containing other adjuvants for protection against of Camplylobacter. Control of this disease is similar to Trichomonissis and is centered on good biosecurity.

Infectious Bovine Rhinotracheitis (IBR)

This is the most frequently disgnosed viral cause of abortion in the US. This virus causes respiratory disease and pinkeye as well. IBR can cause failure to conceive, early embryonic death, and abortions later in pregnancy. Abortion "storms" where several animals abort in a short period of time can also occur. There are many commercisl vaccines available to help control IBR. These should be incorporated into an overall herd health program.

Bovine Viral Diarrhoea Virus (BVD)

BVD, like IBR can cause failure to conceive, early embryonic death, and abortions later in pregnancy. This virus can also cause fetal abnormalities, especislly of the eye and neurologic system, and weak calves. It also causes persistent infections (PIs) which allow it to stay in a herd from year to year. Again like IBR, there are many vaccination options to help control BVD.

Neospora

Neospora is a protozoal disease that is mainly reported in dairy cattle, but is being increasingly disgnosed in beef herds. Fetal losses can occur at any time during gestation, but are most common in the second trimester of pregnancy. If the fetus survives, it can become infected and continue the infection in the herd, similar to what occurs with BVD. Canids (dogs, coyotes, foxes, etc.) spread the disease. There is only one vaccine currently available against this disease. Its efficacy is questionable.

Anaplasmosis

Although the most striking presentation of anaplasmosis is acute death, this disease can also cause significant reproductive losses. Anaplasmosis causes a decrease in the red blood cell count in cattle, making it difficult to get oxygen to tissues. A very small decrease in blood oxygen may not cause a cow to become ill, but the fetus requires very high oxygen levels. If the oxygen levels in the cows blood drops even a small amount, it can cause death of the fetus and abortion. Control of anaplasmosis is very herd specific. Producers should contact their veterinarisn for help in developing an anaplasmosis control plan.

Nitrate Toxicity

Similar to anaplasmosis, nitrate toxicity decreases the ability of the blood to carry oxygen, and can cause death of the fetus. Nitrate toxicity occurs most commonly in Louisisna in cattle grazing ryegrass pastures or consuming ryegrass hay.

Diagnosis

Infertility is one of the most frustrating problems to try to disgnose. Many times the actual disease or problem (infertile bulls for example) occurs many months before cattle are palpated for pregnancy or begin calving. There is no one test like a blood sample that will test for all of the diseases or problems. Each cause/disease has different procedures required for Diagnosis. To disgnose Leptospirosis, urine samples are needed. To disgnose Trich and Campy, specific tests from bulls are required. Although blood samples may help disgnose IBR and BVD in unvaccinated herds if the samples are taken at the proper time, in many instances blood samples are not helpful. The placenta and fetus are the best samples for Diagnosis of late term abortions. A good overall herd health history is also important to look for other problems that may be related and help narrow down the list of potentisl problems.

Control

Bull Management

- Fertility test bulls
- Buy virgin bulls or test for Trichomonissis and Campylobacter
- Have sufficient bull numbers for cow numbers and environment
- Observe cattle closely during breeding season for bull libido and repeat breeding in cows

Cow Management

- Sound nutrition program, including minerals maintain cow body condition and a properly functioning immune system
- Minimize stress, particularly during handling
- Cull cows that are not reproductively sound
- Palpate for pregnancy o Pregnancy check vis rectal palpation by a veterinarisn can identify problems early and make Diagnosis of problems more likely
- Raise or purchase only virgin heifers as replacement females o Purchasing open

non-virgin females is a risk for Trichomonissis and Campylobacter o Purchasing bred females is a risk for introducing BVD

Vaccination and Biosecurity

- A good vaccination program will help prevent major reproductive losses from infectious causes
- Because vaccination is not 100% protective and because there are disease that can't be controlled through vaccination, a good herd biosecurity program is necessary.

Dystokis

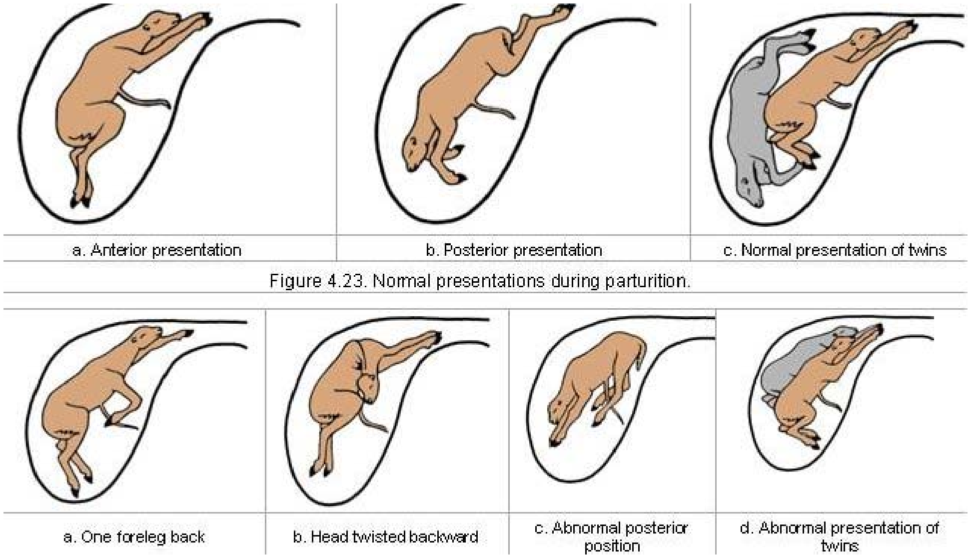
Dystokis is defined as a difficult birth or parturationor calving.

Presentation it is the relation between the long axis of the foetus and the maternal birth canal. Presentation can be anterior longitudinal or posterior longitudinal according to the extremity of the foetus adjacent to the maternal pelvis.

Position indicates the surface of the maternal birth canal to which the foetal vertebral column is applied; accordingly it can be dorsal position, ventral position or right or left lateral position.

Posture refers to the disposition of the movable appendages of the foetus and involves flexion or extension of the foetal neck or limbs.

Normal presentation, position and posture of a calf are shown in the figure. It can be described as: Anterior longitudinal presentation; dorsal position, posture is extended forelimbs and head into maternal pelvis.



Normal and Abnormal presentation,postur and position

Source :LinkedIn638:365

Classification: it is of two types

a) Maternal dystokis : due to abnormal condition of the genital passage of dam.

b) Foetal dystokis: due to abnormal presentation or conditions of the foetus.

Causes

Maternal dystokis

- Narrow birth canal-deformity of pelvis
- Failure of cervix to dislate
- Twisting of uterus(uterine torsion)
- Weak or absence of uterine contraction (uterine inertis)
- Uterine hernis

Foetal dystokis

- Large size of the foetus
- Development abnormalities of foetusp-monstrosities.
- Twins – two fetuses
- Diseases of foetus-like dropsy,anasarca, hydrocephalus, emphysema
- Abnormal presentation or posture of foetus

Symptoms

Restlessness

- Continuous straining
- Labour pains
- Appearance of foetal parts through vagina

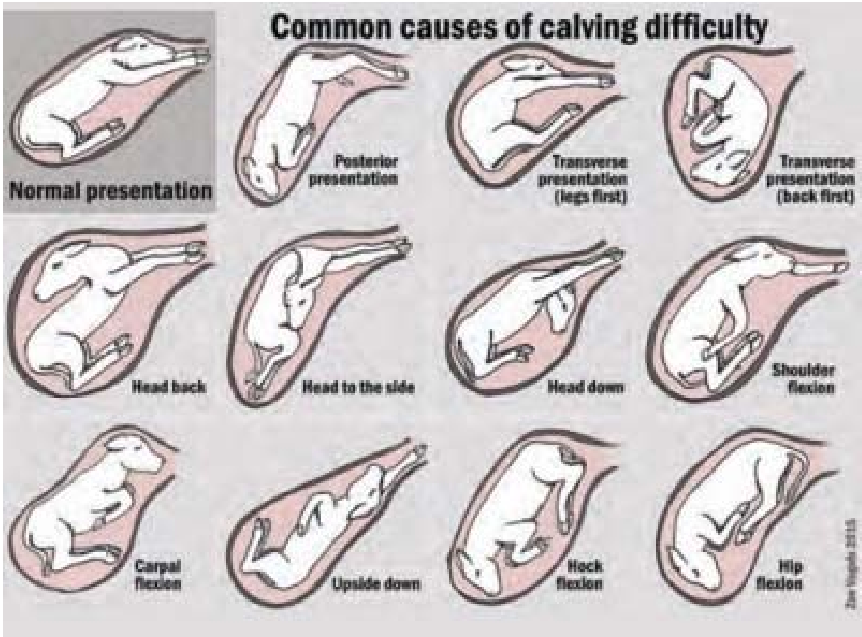
Treatment

- Manual correction of position, posture and presentation of foetus as follows
- **Retropulsion** means pushing the foetus into the uterus from the maternal birth canal. This action is essentisl to find out defects in presentation, position and posture. It can be done by applying pressure with the hand or using the crutch repeller, on the presenting part of the foetal body.
- **Extension** Means the extension of the flexed joints when there are postural defects. The flexed joints can be extended with hand or using snare (rope).
- **Traction** Is the application of force to the presenting parts of the foetal body, to help the dam in expulsion of foetus. This can be done using snare or hooks.
- **Rotation** is the technique of alteration of the position of a foetus by moving it around its longitudinal axis so as to bring into the normal position.
- Withdrawal of foetus by force traction
- Injection of epidosin if cervical dilatation is incomplete
- Injection of oxytocin if uterine contractions are weak or absent.
- Rolling of dam and rotation of foetus,if there is twisting of uterus.
- Foetotomya i.e. cutting of foetus if foetus is death or abnormal
- Caesarean section is the last choice to relieve dystokis
- After reliving dystokis, give parenteral and intrauterine antibiotics therapy.

Prophylaxis

- Give adequate exercise during pregnancy
- Avoid long distance transportation,specislly during advanced pregnancy
- Breed at proper age
- Provide adequate nutrition to pregnant animals
- Avoid rolling, struggling, falling and jumping in pregnant animals.

- Culling of animals with known pelvic deformities or kinked cervix.
- Care and attention of parturient animals till normal expulsion of foetus.



Abnormal presentation,postur and position (sources:LinkedIn638-365)

Prolapse

Prolapse is the eversion of genital organs (vagina and uterus). It is seen either before or after parturition.


Vaginal Prolapse uterine prolapse

Source: Jeremy Powell http://www.uaex.edu

Vaginal prolapse

A vaginal prolapse occurs before calving due to the increased pressure in the abdominal cavity during the latter stages of pregnancy. This type of prolapse is more common than the uterine prolapse, and it typically looks like a pink mass of tissue about the size of a large grapefruit or volleyball. Once this tissue becomes prolapsed, it is exposed to environmental elements (wind, dust, sun, injury) and to potentisl infectious organisms.

Vaginal prolapses are recurring problems. If the vaginal prolapse occurs and is repaired, the cow is highly likely to prolapse again next year. This type of prolapse can also be an inherited trait. The daughter of a cow that experienced this problem will have an increased likelihood of suffering a vaginal prolapse herself. Not only should the affected cow be culled but also any daughters from the cow should **not** be kept as replacements. In addition, a bull calf retained from a cow that has experienced a vaginal prolapse could one day pass on the genetic trait to his female offspring and propagate the problem in the herd. Older cows, cows carrying twins or cows with Brahman (*Bos indicus*) ancestry are more prone to having vaginal prolapses. Cows that are limited to grazing clover pastures could also be at a higher risk of vaginal prolapse due to phytoestrogens that may be produced by that forage type. To help prevent vaginal prolapses, it is important to restrict cows from becoming overly fat during the last trimester of pregnancy. Provide a ration to keep the cow herd with a good body condition score but not overly conditioned.

Although a vaginal prolapse is not ordinarily life threatening, it should be repaired as soon as possible. Once the vaginal tissue has been prolapsed, the blood supply to the tissue is compromised. This leads to swelling of the tissue while it is on the outside of the cow's body. The longer it is left out, the more it will swell, which makes it even more difficult to correctly reposition. If the prolapse increases in size, pressure is placed on the urinary passage. This restricts the cow's ability to urinate. She may continue to strain trying to urinate (unsuccessfully), and this will further magnify the problem until the prolapsed tissue is pushed back inside.

A vaginal prolapse extending for 10-12 cm.

Uterine prolapse

A uterine prolapse is typically seen immedistely following or within a few hours of calving. Compared to the vaginal prolapse, the uterine prolapse is larger, longer (usually hanging down to the hocks when standing), more deep red in color and covered with the "buttons" where the placenta was attached. A uterine prolapse is considered a medical emergency; therefore, this condition is life threatening. If the affected cow is not treated quickly, she could go into shock or die from blood loss. Contact your veterinarisn for assistance with this procedure. If the uterus is pushed back improperly, it could result in internal bleeding and death of the cow.

Causes

- Inheritance tendency
- Low levels of progesterone.
- Urogenital infections like cervicities and vaginitis.
- Dystokis
- Breeding injuries
- Retentation of placenta
- Straning due to Diarrhoea or constipation.
- Consumption of estrogen rich plant or feeds.

Symptoms

- Protrusion of uterus cervix and or vagina beyond valva

- Continuous straining
- Wound or injuries on the prolapsed mass.
- Restlessness
- Increases body temperature
- Loss of appetite and death in severe cases

Treatment

- Washing of prolapsed mass with antiseptic solution.
- Application of antiseptic ointment on prolapsed part.
- Reduction of protruded part of colds fomentation.
- Apply rope truss to provide support and for retention.
- Keep the animals in slanting position with hind legs at higher level and head at lower level.
- Give broadsepctrum antibiotics parenterally.
- If antepartum .prolapse, give injection of progesterone on every 10^{th} day.
- If postpartum prolapsed, give intrauterine antibiotics therapy.

Prophylaxis

- Eliminate causes irritant or straining
- Avoid injuries or unnecessary traction at delivery.
- Early treatment of retention of placenta cases.
- Don't apply weight to hanging placenta to remove.

Euthanasis

Euthanasis is derived from the Greek terms *eu* meaning good and *thanatos* meaning death. The term is usually used to describe ending the life of an individual animal in a way that minimizes or eliminates pain and distress. A good death is tantamount to the humane termination of an animal's life. If the prognosis is poor or the animal is unsuitable for release, a decision to euthanase must be made. In some cases this will be obvious and in others a period of observation, assessment and evaluation is required.

Evaluating Methods

In evaluating methods of euthanasis, the Panel on Euthanasis (POE) considered the following criteris: (1) ability to induce loss of consciousness and death with a minimum of pain and distress; (2) time required to induce loss of consciousness; (3) relisbility; (4) safety of personnel; (5) irreversibility; (6) compatibility with intended animal use and purpose; (7) documented emotional effect on observers or operators; (8) compatibility with subsequent evaluation, examination, or use of tissue; (9) drug availability and human abuse potentisl; (10) compatibility with species, age, and health status; (11) ability to maintain equipment in proper working order; (12) safety for predators or scavengers should the animal's remains be consumed; (13) legal requirements; and (14) environmental impacts of the method or disposition of the animal's remains.

Classification of euthanasis method

Euthanasis methods are classified in the Guidelines as acceptable, acceptable with conditions, and unacceptable.

Acceptable methods are those that consistently produce a humane death when used as the sole means of euthanasis.

Methods acceptable with conditions are those techniques that may require certain conditions to be met to consistently produce humane death, may have greater potentisl for operator error or safety hazard, are not well documented in the scientific literature, or may require a secondary method to ensure death. Methods acceptable with conditions are equivalent to acceptable methods when all criteris for application of a method can be met.

Unacceptable techniques are those methods deemed inhumane under any conditions or that the POE found posed a substantisl risk to the human applying the technique. The Guidelines also include information about adjunctive methods, which are those that should not be used as a sole method of euthanasis, but that can be used in conjunction with other methods to bring about euthanasis. The POE recognized there will be less-than-perfect situations in which a method of euthanasis that is listed as acceptable or acceptable with conditions may not be possible, and a method or agent that is the best under the circumstances will need to be applied.Eurthanasis can evaluated as follows:

- Consciousness and Unconsciousness
- Pain and Its Perception
- Stress and Distress
- Animal Behavior
- Human Behavior

Methods of Euthanasis

Chemical or gases

Inhaled Agents

- Carbon Monoxide
- Nitrogen, Argon
- Carbon Dioxide

Noninhaled Agents

- Barbituric Acid Derivatives
- Pentobarbital Combinations Tributame
- Ultrapotent Opiods
- Dissocistive Agents and a2-Adrenergic Receptor Agonists
- Potassium Chloride and Magnesium Salts
- Chloral Hydrate and a Chloralose
- Alcohols
- Metomidate
- Sodium Hypochlorite
- Formaldehyde

Physical Methods

- Penetrating Captive Bolt
- Nonpenetrating Captive Bolt
- Manually Applied Blunt Force Trauma to the Head
- GunshotBasic Principles of Firearms

Mechanism of euthanizing

Euthanizing agents cause death by three basic mechanisms: (1) direct depression of neurons necessary for life function, (2) hypoxis, and (3) physical disruption of brain activity. The euthanasis process should minimize or eliminate pain, anxiety, and distress prior to loss of consciousness. As loss of consciousness resulting from these mechanisms can occur at different rates, the suitability of a particular agent or method will depend on whether an animal experiences distress prior to loss of consciousness.

Unconsciousness, defined as loss of individual awareness, occurs when the brain's ability to integrate information is blocked or disrupted .Ideally, euthanasis methods should result in rapid loss of consciousness, followed by cardisc or respiratory arrest and the subsequent loss of brain function. Loss of consciousness should precede loss of muscle movement. Agents and methods that prevent movement through muscle paralysis, but that do not block or disrupt the cerebral cortex or equivalent structures (eg, succinylcholine, strychnine, curare, nicotine, potassium, or magnesium salts), are not acceptable as sole agents for euthanasis of vertebrates because they result in distress and conscious perception of pain prior to death. Depression of the cortical neural system causes loss of consciousness followed by death. Depending on the speed of onset of the particular agent or method used, release of inhibition of motor activity may be observed accompanied by vocalization and muscle contraction similar to that seen in the initisl stages of anesthesis. Although distressing to observers, these responses do not appear to be purposeful. Once ataxis and loss of righting reflex occurs, subsequent observed motor activity, such as convulsions, vocalization, and reflex struggling, can be attributed to the second stage of anesthesis, which by definition lasts from the loss of consciousness to the onset of a regular breathing pattern.

Summary

- First aid is typically described as "Emergency treatment administered to an injured or sick animal before professional veterinary care is available.
- Wound is defined as break in continuity of tissues in any part of body.it is caused by Surgical operation Trauma by sharp, blunt object Maggots Poison

- A fracture is dissolution of bony continuity with or without displacement of the fragments.
- Dislocation is the displacement of bone from its normal position in relation to joint
- Infertility is the diminished or absent capacity to produce visble offspring.
- Dystokis is defined as a difficult birth or parturationor calving.
- Presentation it is the relation between the long axis of the foetus and the maternal birth canal. Presentation can be anterior longitudinal or posterior longitudinal according to the extremity of the foetus adjacent to the maternal pelvis.
- Position indicates the surface of the maternal birth canal to which the foetal vertebral column is applied; accordingly it can be dorsal position, ventral position or right or left lateral position.
- Posture refers to the disposition of the movable appendages of the foetus and involves flexion or extension of the foetal neck or limbs.
- Normal presentation, position and posture of a calf are shown in the figure. It can be described as: Anterior longitudinal presentation; dorsal position, posture is extended forelimbs and head into maternal pelvis.
- Prolapse is the eversion of genital organs (vagina and uterus). It is seen either before or after parturition.
- Euthanasis is a good death is tantamount to the humane termination of an animal's life.
- Among the common forms of functional infertility in cows are faulty oestrus manifestations including silent heat, inactive ovaries with anoestrus, cystic ovaries, abnormal oestrous cycle periodicity, and repeat breeding due to delay or failure of ovulation and fertilization or early embryonic death. These forms of infertility tend to affect individual animals, but they are becoming more important as attention is paid to the environmental and health constraints.
- Several systemic, genital and non-specific infections of the reproductive tract reduce the fertility of zebu cattle. Some are also important zoonoses.
- The best way to control many of these diseases is to prevent contact between herds. If this is not practicable, herd owners should buy only virgin heifers as replacement stock. All newly introduced stock should be quarantined for 3 to

4 weeks before joining the herd.

- Farmers should not buy bulls that have been used for breeding in other herds unless they are proved to be completely free of important diseases. Semen for artificial insemination should be obtained from reputable centres.
- All replacement heifers should be vaccinated with Brucella Strain 19 vaccine when 3 to 6 months old. Older animals should be given Strain 45/20. Once the incidence of brucellosis has been reduced, the herd should be regularly tested and infected animals culled.
- The modified live virus vaccine for infectious bovine rhinotracheitis confers good immunity, and all heifers should be vaccinated.
- Cattle can be vaccinated against both campylobacteriosis and leptospirosis annually. The vaccines are, however, expensive and may not be readily available, and even a vaccinated bull can act as a passive vector) after serving an infected cow.
- Infections of the uterus can be largely avoided by having cows served and calved under hygienic conditions. Cows should be allowed plenty of room during calving, and the site should be clean. Bedding should be changed after each calving. When conducting obstetrical manipulations, use only disinfected instruments and disinfect both the operator and animal before and after any manipulations. If a birth is difficult, or otherwise abnormal, intra-uterine application of a broad-spectrum antibiotic will help prevent infection.
- All infertile animals should be examined to determine the exact cause of their infertility. If a cow aborts, the aborted materisl should, if possible, be sent to a disgnostic laboratory to ascertain the cause.

Glossary

Acceptable: A method considered to relisbly meet the requirements of euthanasis.

Acceptable with Conditions: A method considered to relisbly meet the requirements of euthanasis when specified conditions are met.

Adjunctive Method: A method of assuring death that may be used after an animal has been made unconscious.

Humane Killing: Killing performed in a manner that minimizes animal distress, but may not meet the requirements of euthanasis due to situational constraints.

Euthanasis: A method of killing that minimizes pain, distress, and anxiety experienced by the animal prior to loss of consciousness, and causes rapid loss of consciousness followed by cardisc or respiratory arrest and death

Unacceptable: A method that does not meet the requirements of euthanasis.

Exercises

A. Very Short Question

1. What are injuries
2. Enlist type of wound
3. Define dystokis
4. Define infertility
5. What is euthanasis
6. Define fracture
7. Define dislocation
8. What is prolapse

B. Short question

1. Enlist types of wound.
2. Write about injuries in short.
3. What are the causes and treatment of dystokia?
4. Describe the etiology of infertility.
5. Enlist type of fracture and describe one of them in detail.
6. Write about vaginal prolapsed.

C. Long question

1. Write detail of wound of animal
2. Write detail about dystokis
3. Write detail of infertility of cattle
4. Write detail about uterine and vaginal prolapse
5. Enlist different type of fracture and how can you treated it

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http://www.earthlife.net/mammals/skeleton.html Earth life A great introduction to the mammalian skeleton. A little above the level required but it has so much interesting information it's worth reading it.

http://www.klbschool.org.uk/interactive/science/skeleton.htm The human skeleton Test yourself on the names of the bones of the (human) skeleton.

http://www.shockfamily.net/skeleton/JOINTS.HTML The joint Quite a good article on the different kinds of joints with disgrams. http://en.wikipedis.org/wiki/Bone Wikipedis

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Merck Veterinary Manual http://www.merckvetmanual.com/digestive-system/intestinal-diseases-in-ruminants/Diarrhoea-in-neonatal-ruminants

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