MEDICAL LAB TECHNICIAN

Paper - III

ANOTAMY & PHISIOLOGY

INDEX

UNIT – 1

INTRODUCTION TO HUMAN ANATOMY AND PHYSIOLOGY

HUMAN ANATOMY

Human Anatomy is science that deals with the structure of human body. Study of anatomy helps in understanding the functions of body.

Types

Macroscopic anatomy – It deals with the structure of body with unaided eye

Histology - The study of normal cells and tissues, mainly using microscopes.

Various anatomical positions(Fig 1)

- Superior(Cephalic): Closer to the top of the head. For example, the nose is superior to the chin.
- Inferior (Caudal): Closer to the feet. The chin is inferior to the nose. Caudal is similar to inferior.
- Anterior (Ventral): Closer to the front of the body. For example, the abdominal muscles are anterior to the spine. Ventral is similar to anterior; it means toward the abdomen.
- Posterior (Dorsal): Closer to the back of the body. For example, the spine is posterior to the abdominal muscles.
- Median: At the midline of the body. For example, the nose is a median structure.
- Medial: Closer to the midline of the body. For example, the big toe is medial to the little toe.
- Lateral: Farther away from the middle. For example, the little toe is lateral to the big toe.
- Proximal: Closer to the trunk or closer to the point of origin. For example, the shoulder is proximal to the elbow.
- Distal: Farther from the trunk or from the point of origin. For example, the elbow is distal to the shoulder.

- Superficial: Closer to the surface. The skin is superficial to the muscles.
- Intermediate: In between. The abdominal muscles are intermediate between the skin and the small intestines.
- Deep: Farther from the surface. The abdominal muscles are deep to the skin.

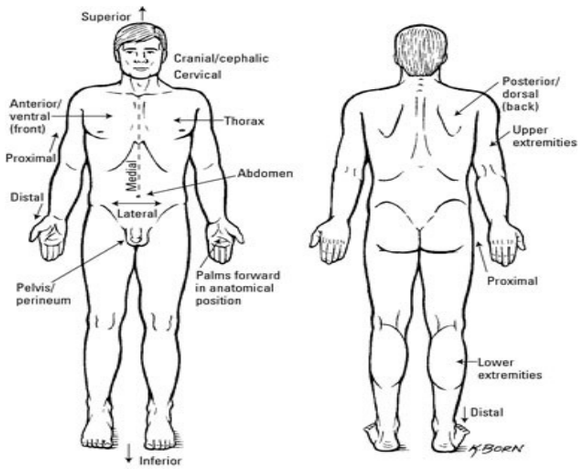


Fig1: Various anatomical positions of the human body

Planes of the human body

- Midsagittal plane: It is a vertical plane that divides the body into left and right halves.
- Sagittal planes: Vertical planes are parallel to the midsagittal plane and divide the body into unequal left and right portions.
- Frontal (coronal) planes: Vertical planes pass through the body at right angles to the midsagittal plane and divide the body into front (anterior) and back (posterior).
- Transverse (horizontal) planes: Horizontal planes pass through the body at right angles to the midsagittal and the frontal planes. They divide the body into superior and inferior portions.

Movements occurring at various joints

Flexion : It is the movement where similar surfaces come nearer to each other reducing the angle between them. eg: Bending of fore arm near elbow.

Extension: It is the movement causing similar surfaces to go apart, whic is opposite to flexion. eg : Straightening of bent fore arm.

Adduction: It is the movement bringing the limb towards mid line.

Rotation: It is the movement around central axis involving 360 degrees.

Medial rotation : Rotation towards medial direction is called medial rotation.

Lateral rotation: Rotation towards lateral direction is called lateral direction.

Circumduction: It is the movement involving flexion, abduction, extension and adduction occuring in sequence.

Important terms that deals the human body

Cell- The tiniest particle of body. It is the basic functional and structural unit of body.

Tissue- A group of cells of similarity in structure, function and origin.

Organ- A group of different kinds of tissues for performing specific functions.

System- The collection of different organs of body to work collectively to conduct some kinds of functions. Eg: Respiratory system, Digestive system, etc.

Organism –It consists of different systems.

HUMAN PHYSIOLOGY

Human physiology is the science of the mechanical, physical and biochemical functions of humans. It is closely related to anatomy as there is an intrinsic link between structure and function of the human body.

The word *physiology* is from the Ancient Greek *phusiología*, "natural philosophy" and it is the study of how organisms perform their vital functions. An example is the study of how a muscle contracts or the force contracting muscles exert on the skeleton. It was introduced by French physician Jean Fernery in 1552. Physiology is better explained by applying the principles of physics, chemistry, biology and anatomy. Anatomy helps in the study of physiology as they are inter related.

Organ systems included in Human anatomy

The following systems make up the human body.

Haemopoieticsystem:Thissystemconsistsofblood.Mainfunctionsof blood are transport of respiratory gases,nutrients,hormones,waste productsetc.

Cardiovascular system: The main organs are heart and blood vessels. The blood vessels transport oxygen, carbon dioxide, nutrients, hormones etc, to and from the cells. The heart acts as a blood pump, pushing blood in the blood vessels to be transported to and from all body tissues.

Digestive system: The organs included are the oral cavity (mouth), oesophagus, stomach, small large intestines, and rectum. The role is to break down food into absorbable molecules and to deliver these to the blood for distribution to body cells.

Endocrine system: The organs included are pituitary, thyroid, parathyroids, adrenals, thymus, pancreas, pineal gland, ovaries (in the female) and testes (in the male). These glands produce and secrete hormones that affect every cell in the body. Metabolism is regulated primarily by these hormones.

Excretory system: The urinary system is mainly involved in excretory function and is composed of the kidneys, ureters, bladder, and urethra. Its main function is to flush wastes from the body in urine, to maintain the body's water and electrolyte balance. Other organs related with excretion are lungs and skin etc.

Integumentary system: It is the external covering of the body (skin).It waterproofs the body and cushions and protects the deeper tissues from injury.

Lymphatic system:It includes lymphatic vessels, lymph nodes, and other lymphoid organs such as the spleen and tonsils. It returns fluid leaked from the blood back to the blood vessels so that blood can be kept continuously circulating through the body. These organs also hold cells involved in immunity.

Muscular system: It is made up of muscles that contract or shorten. The muscles in our body allows for movement and maintain our posture.

Nervous system: It consists of the brain, spinal cord, nerves, and sensory receptors. Central nervous system is concerned with intellectual activity, whereas automatic nervous system is concerned with involuntary functions of body and consists of sympathetic and parasympathetic nerves.

Reproductive system: The male reproductive system includes the testes, scrotum, penis, accessory glands, and the duct system. The female reproductive system includes the ovaries, uterine tubes, uterus, and vagina. The main purpose of these systems is to produce offspring.

Respiratory system : It consists of the nasal passages, pharynx, larynx, trachea, bronchi, and lungs. Its isconcerned with the constant supply of oxygen and to remove carbon dioxide.

Skeletal system: It is made up of bones, cartilages, ligaments and joints. These provide support and protection for body organs.

Special senses: Special senses of body are sight, hearing, taste, smell and touch. Organs related to these functions are eyes, ears, tongue, noseand skin.

Summary

Human Anatomy is the science dealing with the structure of human body, whereas Human Physiology is the study of functions of body. 11 organ systems make up the body like cardiovascular system, skeletal system, muscular system, respiratory system, digestive system, excretory system, endocrine system, reproductive system, nervous system, integumentary system and lymphatic system.

Questions

Anatomy

Essay - Define Anatomy. Describe and various postions of the human body.

Short Answer Questions

1.Mention the types of Anatomy.

2. Write briefly about the variousmovements of the body

3. Name various planes of the body

4. Write the definitions of a) Cell b) Tissue

5. Write the definitions of a) Organ b) system

6.Define Histology

Physiology

Essay- Define Physiology. Describe various organ systems of the body and their functions?

Short Answers

1. What are the organs involved in the excretory system?

2. Write the functions of cardiovascular system

3. Name the organs involved in endocrine system

4. Mention the functions of respiratory system

5. Define the major types of the nervous system.

6. Name the organs involved in lymphatic system.

7. Mention the sensory organs

UNIT – 2

CELL

Definition: Cell is the basic structural, functional and biological unit of all living organisms. It is the smallest unit of the body. Based on the number of cells, organisms can be classified as unicellular (consisting of a single cell eg: bacteria) or multicellular (consisting of many cells eg: plants, mammals).

Types of cells of body: They are two types of cells in body.

1) Somatic cells - Somatic cells are diverse cells which make up somatic structure of body.

2) Gonadal cells- Gonadal cells are gametes which can unite to form new individual.

Structure of cell: Humans contain more than 10 trillion (10^{13}) cells. Most plant and animal cells are visible only under a microscope, with dimensions between 1 and 100 micrometres.

Every cell comprises following parts. 1) Cell membrane2) Cytoplasm 3) Nucleus

1) Cell membrane : It is also called as plamsalemma or plasma membrane. It is a double layered, thin barrier, surrounding the cell to control the entry and exit of certain substances. It cannot be seen by light microscope. It can be seen by electron microscope. It has trilaminar structure of phospholipid bilayer. Outer surface of cell wall contains pinocytotic vesicles. Inner surface is continuous with endoplasmic reticulum (ER).

The functions of cell wall are 1) Transport of materials (main function) 2) Protection of cell 3) Reception of external stimuli 4) Ingestion of nutrients 5) Excretion of waste products of cellular metabolism.

2) Cytoplasm : It is a membrane, which protects the cell by keeping the cell organelles separate from each other. It is the site, where many vital biochemical reactions take place.Cytoplasmic organelles are Endoplasmic reticulum, Golgi apparatus, Mitochondria, Lysosomes, Ribosomes, Centrosomes etc. (Figure 2)

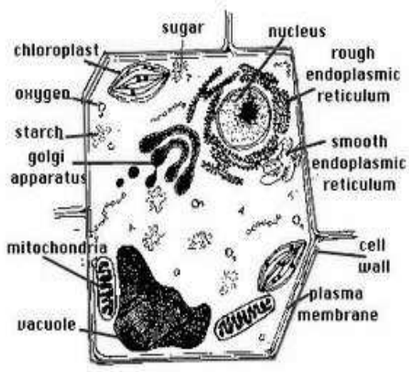


Figure 2 : Structure of cell

Endoplasmic reticulum: Endoplasmic reticulum is a system that continues with infoldings of cell membrane.

It is of two types of endoplasmic reticulum.

1.Smooth ER - It is a network of smooth tubules.

Function: It is concerned with metabolism and synthesis of steroids

2. Rough ER-It consists of ribosomes and isprominent in Adrenal cortex, liver and striated muscle.

Functions are 1) Protein synthesis2) Translation of language of nucleic acids.

Golgi apparatus : It is shaped like network of threads.

Functions: 1) synthesis of various secretions. 2) Storage of enzymes etc. 3) helps in the movement of materials within the cell.

Mitochondria: They are double membrane, rod shaped, filamentous organelles.They vary in size from 0.5 to 5 microns. Inner membrane remains folded to form partitions called cristae mitochondriales. Intramitochondrial space contains fluid called matrix. (Fig 3)

Functions: 1) play a vital role in generating, transforming the energyand supply 95% of cell's energy requirement, hence called power houses2) plays a vital role in various functions of the cell metabolisms including oxidative phosphorylation3) synthesis of RNA and DNA.

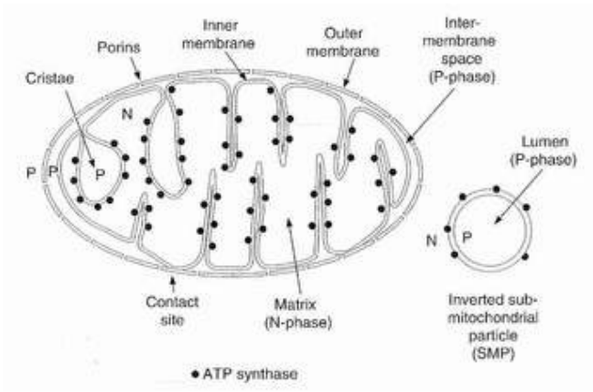


Figure 3: Structure of mitochondria

Lysosomes : They are digestive organs of cells and are also called suicide bags of cells. They contain powerful hydrolytic enzymes. Lysosomes are absent in RBC.

Functions : 1) Digestive organelles of cells and break down of particles taken hydrolytic enzymes.2) Autolysis 3) Phagocytosis 4) Killing of cells 5) Cell division.

Ribosomes : They are scattered throughout cytoplasm singly or as groups. They are ribonucleoprotein in nature.

Functions: Protein synthesis.

Centrosome : Centrosome contains centrioles.

Function : Centrioles control polarisation of spindle fibres. Centriole is closely related to spindle formation during cell division (Mitosis).

Plasmosin : It is constant constituent of cytoplasm. They formtonofibrils in epithelial cells, myofibrils in muscles and neurofibrils in nerves.

They consist of long protein molecules rich in deoxy-ribonucleoprotein.

Vacuoles : They are also cytoplasmic organelles. They are found covered by faton staining with dilute neutral red solution.

Nissl bodies: They are found in nerve cells.

Secretory granules: They store secretory products of cell and are found in- Golgi apparatus and Endoplasmic reticulum.

3) Nucleus : It is the key structure of living cell. Nucleus is covered by nuclear membrane and consists of chromatin and nucleolus. Chromatin is dense chromosomal network. Chromatin contains different genes which determine heredity of cell.Chromosomes are present as individual bodies in interphase as well as in mitosis. Predominant component in chromosome is DNA. Genes are located in chromosome. They are discrete units of transmission of hereditary characters. In female, 2X chromosomes and in males 1X and 1Y chromosomes are present. There is usually single nucleolus or 2-5 nucleoli in a cell.

Differential arrangement of cellular mass: Differentiation of cellular mass is evident when cells arrange in three layers. They are 1) Ectoderm2) Mesoderm 3) Endoderm. Ectoderm gives rise to epithelium of mouth, nose, skin, hair, some glands like sweat, mammary, pituitary, adrenal medulla, brain and nerves. Mesoderm gives rise to connective tissue including blood, bone marrow cells, cortex etc. Endoderm gives rise to epithelium of digestive and respiratory tract, thyroid, parathyroid, thymus and bladder.

Properties of cell :

Properties of cell in unicellular organisms like amoeba are - a) Irritability b) Conductivity

c) Contractility d) Absorption e) Excretion f) Growth and reproduction g) Motility h) Secretion

Questions

Essay Questions

1. Write the structure of cell with diagram.
2. Explain Properties of cell.

Short questions

1. Write the definition of a cell?
2. Mention various properties of the cell.
3. List out cytoplasmic organelles.
5. Explain the types of endoplasmic reticulum and their functions.
6. What are the functions of Golgi apparatus?
8. Draw the diagram of mitochondria.
9. What are Lysosomes ? Write briefly about their functions.
10. What are the elements arise from a) Ectoderm b) Mesoderm C) Endoderm

UNIT – 3

TISSUE

Definition: Tissue is defined as group of cells of similarity in structure,function and genesis.

Classification:

Human body contains following types of tissues.

I) Epithelial tissue II) Connective tissueIII) Muscular tissue IV) Nervous tissue

I. Epithelial tissue:

Epithelial tissues are a diverse group of tissues that include both surface epithelia and solid organs. Surface epithelia cover or line all body surfaces, cavities and tubes and forms epithelial membrane. All epithelia are supported by a basement membrane which separates the epithelium from underlying supporting tissues. Blood vesselsnever cross epithelial basement membranes, so epithelium depend on the diffusion of oxygen and metabolites from adjacent supporting tissues.

Functions of epithelial tissue are -

1) To form protective barrier (protects underlying surfaces) 2) Regulation of the exchange of molecules between compartments (selective diffusion and absorption3) Synthesis and secretion of glandular products 4) Excretion

Classifiacation of epitheilia:

Number of cell layers	**Type of cell**	**Special features**	**Example**
Simple (one layer)	Squamous		Peritoneum, vascular endothelium
	Cuboidal		Collecting tubule of kidney
		Microvilli	Proximal convoluted tubule of kidney
	Columnar	Pseudostratification	Respiratory tract
		Microvilli	Small intestine
		Goblet cells	Small and Large

			intestine
		Surface cilia	Fallopian tube
		Stereocilia	Vas deferens
			Gall bladder
Stratified(Multiple layers)	Squamous	Keratinization	Epidermis of skin
			Oral cavity
	Cuboidal		Exocrine gland ducts
	Transitional		Bladder

1. Simple epithelium: It is defined as surface epithelium consisting of a single layer of cells. Types of simple epithelial tissues are,

a) Squamous or pavement epithelium–It consists of single layer of flat cells.

Functions : - 1) Passage of liquids and gases 2) Protection

b) Cuboidal epithelium–It represents an intermediate form between simple squamous and simple columnar epithelium. It consists of single layer of cuboidal cells of samedimensions and the cells appear as square. Nucleus is round and located in the centre of the cell. Eg: Collecting tubule of kidney, salivary glands, pancreas.etc.

Functions:1) Protection 2) Secretion 3) Excretory etc.

c) Columnar epithelium– It is similar to simple cuboidal epithelium except that the cells are taller and appear columnar in sections perpendicular to the basement membrane.The nucleus is elongated and may be located towards the base; the centre or occasionally at the apex of the cytoplasm; this is known as polarity of the nucleus.

It is found on absorptive surfaces such as in the small intestine, large intestine, alveoli as well as secretory surfaces such as that of the stomach and endocervix, In alimentary canal and nephron, it is brush bordered. Goblet cells are another type of columnar epithelium found in large intestine mainly and secrete mucus.

Functions : 1) Absorption 2) Secretion

Variants: 1.Ciliated columnar and cuboidal epithelium –They have surface cilia. Cilia are much larger than microvilli and are readily visible with the light microscope. Each cell may have upto 300 cilia that beat in a wave – like manner.The waving motion of the cilia propels

fluid and particles over the epithelial surface. It is found in the female reproductive tract(fallopian tube). Ciliary action facilitates transport of the ovum from the ovary towards uterus.

2. Pseudostratified ciliated columnar epithelium (Respiratory epithelium)- It appears as it contains more than one layer of cells. The nuclei are placed at different levels, thus creating illusion of cellular stratification. In fact, this is a true simple epithelium. It is exclusively confined to respiratory tract.

2.Stratified epithelium: It is defined as epithelium consisting of two or more layers of cells.

a) Stratified squamous keratinized epithelium–It has two or more layers and horny due to deposition of keratin.It is found in skin, hairs, nails, horns, enamel of teeth.

Functions: 1) Protection from atmosphere2) Protection from mechanical pressure3) Protection from injury and friction

b) Stratified squamous nonkeratinized epithelium –It has also two or more layers, but keratin is absent. It is found in cornea, mouth, pharynx, oesophagus, anal canal, urethra, vagina and cervix etc.

c) Stratified cuboidal epithelium –It is thin, stratified epithelium that usually consists of only two or three layers of cuboidal cells. It is confined to the large excretory ducts such as the salivary glands.

d) Transitional epithelium (Urothelium)- It is a form of stratified epithelium found only in the urinary tract in mammals. It is so named because it has some features intermediate between stratified squamous and stratified cuboidal epithelium.

Functions: It is highly specialized to accommodate a great degree of stretch and to withstand the toxicity of urine.

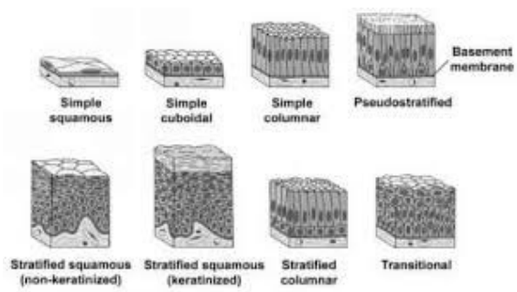


Figure 1: Types of epithelia

II.Connective Tissue: Connective tissue/supporting tissue is the term applied to tissues which provide general structure, mechanical strength, space filling and physical and metabolic support for more specialized tissues. It is also called as mesenchymal tissue. It is developed from mesoderm. Cells will be less and intercellular matrix will be abundant.

Every type of connective tissue has the following components.

1. Matrix fibres - Collagen and elastin
2. Ground substance – Glycoproteins, Glycosaminoglycans
3. Basement membrane –Type IV collagen
4. Support cells -Fibroblasts, Myofibroblasts, Adipocytes, Chondrocytes, Osteoblasts and Osteocytes and neurons.

Types of connective tissue

a) Areolar tissue b) Adipose tissuec) Fibrous tissue d) Elastic tissue e) Bloodf) Hematopoietic tissue g) Cartilaginous tissueh) Osseous tissue i) Jelly like tissue k) Reticuloendothelial tissue

a.Areolar tissue: It is loose connective tissue present in many organs. It is composed of fibres(collagenous and elastic fibres), cells, and ground substance. It acts as a biological packing and wrapping material. It is distributed between muscular, vascular and nervous tissues, subcutaneous, subserous and submucous tissues.

b) Adipose tissue : It is loose connective tissue mostly composed of adipocytes . It is found below skin in mesentery, omentum etc. It is of two types.

1. White adipose tissue- It provides structural fill which gives shape to limbs and forms part of shock absorbing padding and prevents injury to organs.
2. Brown adipose tissue- It is highly metabolically active and helps in the regulation of body temperature and body weight.

c) Fibrous tissue : It is made of white fibres formed by fibroblasts. These fibres are non branching and present in bundles. They are present in tendons and ligaments of limbs. It is made up of collagen.

d) **Elastic tissue** : It is another variety of fibrous tissue. Elastin fibres are eosinophilic, wavy. It is most resistant to many chemicals and is found in areolar tissue throughout body. It is also

present in lung, skin, urinary bladder and blood vessels etc. Elastic fibres in the dermis allow the skin to stretch and recoil, keeping it wrinkle free. In arteries elastin provides the stretch and recoil to smooth and transmit the pulse pressure generated by each heart beat.

e) Blood : Blood is fluid connective tissue of body.

f) Haemotopoietic tissue : There are two types of haematopoietic tissues. They are - a) Myeloid tissue b) Lymphatic tissue

Myeloid tissue **:** Myeloid tissue is blood forming tissue as well as phagocytic. 'Myelos' means marrow. There are two types of bone marrow

a) Red bone marrow ... Active form

b) Yellow bone marrow - Inactive form.

Red bone marrow: Red cells are produced in red bone marrow. In foetal life, most of the bones contain red bone marrow. With advancement of age, it is located only in upper ends of humerus, femur, bones of skull, thorax, vertebrae and pelvic innominate bones.

Yellow bone marrow: It is inactive in adult.

Lymphatic tissue: Lymphatic tissue is two types - It is present in lymph organs - lymph node, spleen, thymus, tonsils.

g) Cartilaginous tissue : It is connective tissue, which is intermediate between fibrous and osseous tissues in firmness and elasticity. Main components are cartilage cells, chondroblasts, inter cellular ground substance called matrix, fibres. It is divided into three types.

a) Hyaline cartilage b) Fibrocartilage c) Elastic cartilage.

a) Hyaline cartilage : It is made of cartilaginous cells and clear homogenous ground substance. Cartilage cells are also called chondrocytes. The small empty spaces in the matrix are called lacunae. Matrix is solid intercellular substance of cartilage or bone. It is distributed in the articular end of bones.

b) Fiibrocartilage: This type of cartilage has great tensile strength with flexibility and rigidity. It can stand with shearing forces. It is found in intervertebral discs, meniscus of knee joints, mandibular joints, pubis symphysis and linings of tendon.

c) Elastic cartilage : Elastic cartilage is histologically similar to hyaline cartilage. It contains elastin fibre networks and collagen type II fibres. The principal protein is elastin. It is

distributed in External ear, Epiglottis and Eustachian tube.These fibres give elastic cartilage great flexibility so that it is able to withstand repeated bending.

Jelly like connective tissue(Wharton's jelly) : It is an embryonic form of areolar tissue. It contains large fibroblasts and mucin. It is found in umbilical cord. It is called as Wharton's jelly here. Vitreous humour of eye ball is composed of this tissue in adult life.

h) Mononuclear phagocytic system (Reticuloendothelial tissue) : It is a part of immune system and consists of phagocytic cells located in reticular connective tissue. The cells are primarily monocytes and macrophages and accumulate in lymph nodes and spleen. Main functions are phagocytosis, antibody formation and formation of new RBC and destruction of old RBC.

i) Osseous tissue : Osseous tissue is specialized connective tissue andis made of bone cells and intercellular ground substance. It acts as structural support and stores minerals .It is seen in skeleton.There are three types of bone cells. They are - Osteoblasts, osteocytes and osteoclasts.

There are 2 types of bone tissues They are 1) woven bone 2) Lamellar bone

1.Woven bone : (Also known as Primary or immature bone) it has irregularly arranged bone matrix seen in bone development.

2.Lamellar bone : (Also known as Secondary or mature bone) It has well organised layers of bone matrix.

There are 2 types of bone tissue based on bony architecture

1.Compact bone : It is dense ,closely packed bony tissue . It is seen in cortical bone of long shafts of bone .

2.Spongy bone : It is also called cancellous or trabecular bone , is lighter than compact bone and is seen in parts of medullary cavity of mature bones. It is present in vertebrae, flat bones, long bones,,

Bone is covered with periosteum. Periosteum has two layers- Outer fibrous layer and inner layer called cambium. Cambium is osteogenic in its functions to produce osteoblasts and osteoclasts. Endosteum is the lining membrane of medullary cavity of all long bones .Bone cavity is the hollow space inside the bone and filled with bone marrow.

Transverse section of bone: T.S. of bone under microscope shows Haversian system consisting of 1) Central haversian canal 2) Lamellae 3) Lacunae 4) Canaliculi.

Central haversian canal contains blood vessels, nerves and lymphatic vessels.

Lamellae are layers of bone deposited in concentric circles around haversian canal.

Lacunae are interlamellar spaces.

Canaliculi are minute canals joining lamellae and communicating with central haversian canal.

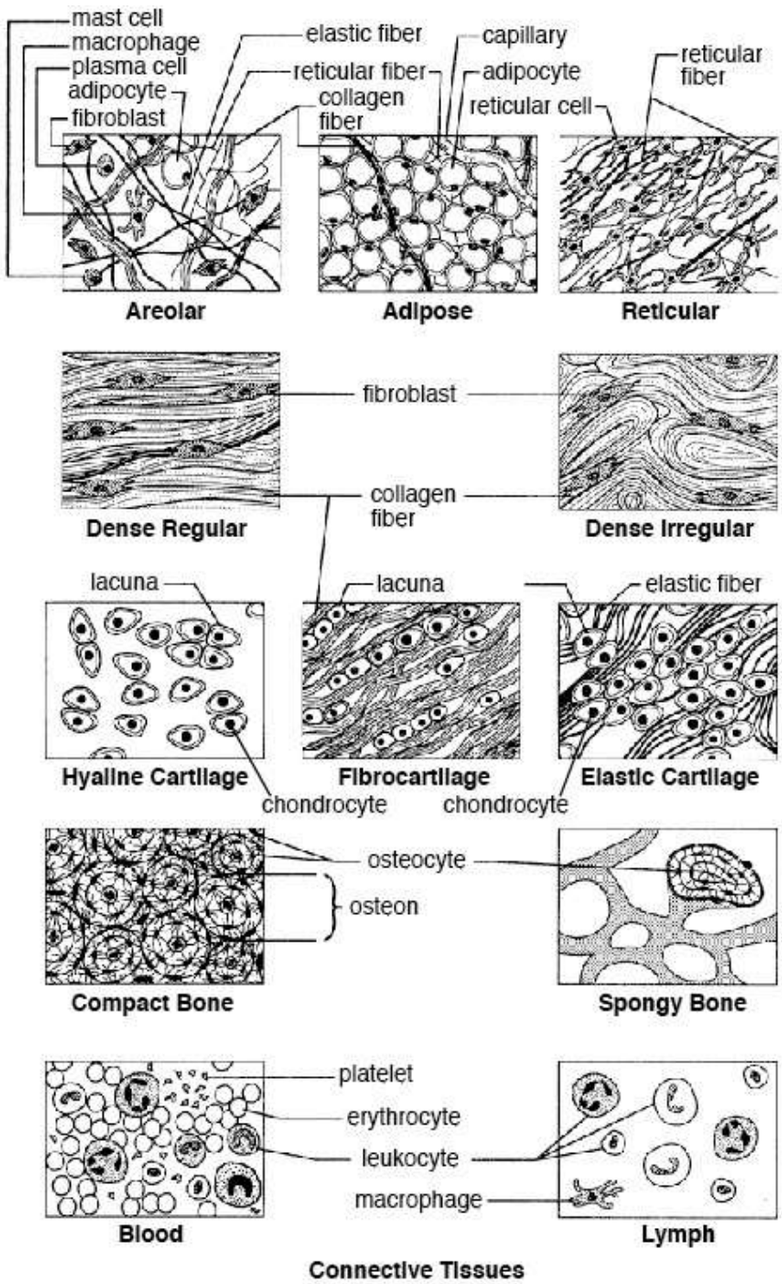


Fig 2: Types of Connective tissues

III) Muscular tissues : These tissues has contractile ability on excitation. It has also property of conductivity. There are different types of muscular tissues.

Types of muscular tissues based on striation: They are two types.

1) Striated muscles : They have cross striations Ex : Skeletal muscle and Cardiac muscle

2) Non striated muscles : They do not have cross striations Ex.Smooth muscle

Types of muscular tissues on the basis of control. They are two types,

1) Voluntary muscles Ex.Skeletal muscle

2) Involuntary muscles Ex : Cardiac and Smoothmuscle

Types of muscular tissues on the basis of distribution. They are of 3 types.

1) Skeletal muscles 2) Cardiac muscles 3) Smooth muscles.

Skeletal muscle : Skeletal muscles are attached to bones.

Epimysium is the outer covering of skeletal muscle.

Perimysium is the sheath of connective tissue surrounding a bundle of muscle fibers.

Smaller bundles into which skeletal muscle is divided are called fasciculi.

Each fasciculus contains muscle fibres. Each fibre is covered by endomysium.

Sarcolemma is the transparent cell wall of muscle fibre.

Cardiac muscle: It is involuntary, striated muscle of heart. It contracts rhythmically and automatically.

Main differences between skeletal and cardiac muscle are seen in the following table 2:

Characteritiscs	**Cardiac Muscle**	**Skeletal Muscle**
Contarctility .	Spontaneous rhythmicity and contractility	Voluntary in action
Muscle'fibers arrangement	Arranged syncytially	individually present
Nucleus	Single oval shaped at centre	Nuclei are seen peripherally

Smooth muscle: They are smooth, involuntary and muscles of viscera.

Visceral muscle fibres are smooth and elongated. They are fusiform with tapering towards periphery.. They contain one oval or rod shaped nucleus at the centre of each cell.

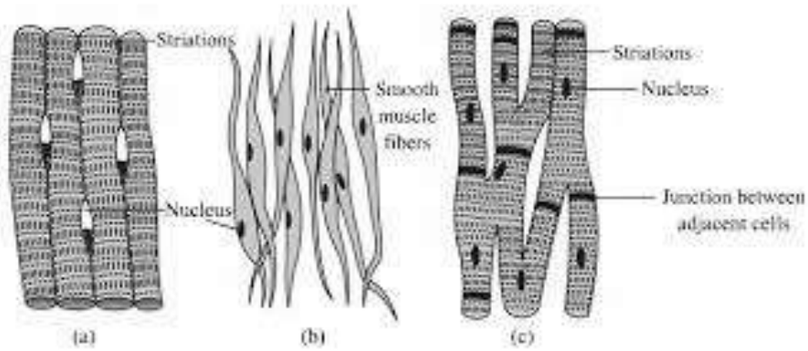


Fig : Types of Muscle tissue

IV. Nervous Tissue:

Nervous tissue is excitable type tissue receiving and transmitting messages. It is composed of neurons. Nervous system is ectodermal in origin. There are three types of matters in nervous tissue. They are -

1) Grey matter - forming nerve cells

2) White matter - forming nerve fibres

3) Neuroglia - holding nerve cells and fibres together and supporting them.

Neuron : Neuron is the basic functional and structural unit of nervous system. Parts of neuron are -

1) Nerve cell body (also called Perikaryon or Neurocyton or Soma)

2) Nerve fibres (also called processes of nerve cells)

Nerve cell body: It is the part of neuron containing cell membrane, neuroplasm and nucleus. Neuroplasm contains neurofibrils, nissl bodies, mitochondria and golgi apparatus. Neurofibrils are fine filaments passing through neuroplasm from dendrites to axon. Nissl bodies are angular granules stained with basic dyes.

Nerve fibres: There are two types of nerve fibres.

a) Dendrites- They are receptive processes (also called dendrites). Dendrites carry impulses from other neurons and carry them towards nerve cell body.

b) Axons- They are discharging processes. It carries impulses away from nerve cell. It consists of three parts - axis cylinder, myelin sheath and neurilemma.

Axis cylinder contains axoplasm, neurofibrils and mitochondria.

Myelin sheath is absent over nerve fibres within grey matter. It is present over nerve fibres after entering white matter. Function of myelin sheath is insulation of nerve fibre.

Neurilemma is the homogeneous nucleated covering over somatic and autonomic nerve fibres outside C.N.S. Myelinated fibres in brain and spinal cord do not have neurilemma.

Peripheral nerves: Fibres of peripheral nerve trunks are divided into bundles. Individual fibres are held together by loose connective tissue called endoneurium. Each bundle is covered by a sheath called perineurium. Epineurium is the tough enclosure of whole nerve trunk.

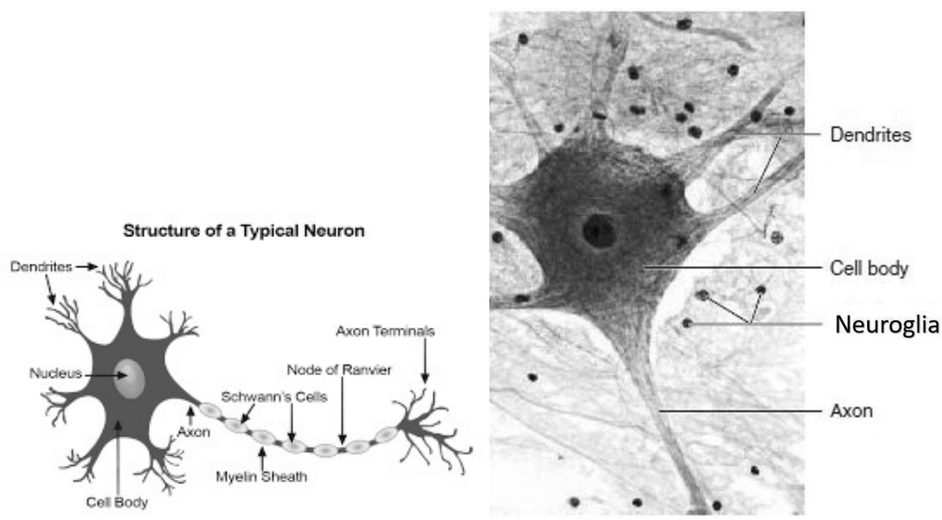


Fig 2: Structure of Neuron

Summary

Tissue is group of cells. Different types of tissues of body are Epithelial tissue, Connective tissue, Muscular tissue and Nervous tissue. Epithelial tissue is two types - simple and compound. Connective tissue is also called mesenchymal tissue. There are several types of connective tissue. Muscular tissue is three types - Skeletal muscle, cardiac muscle, smooth

muscles. Nervous tissue is made of neurons. Each neuron contains nerve cell, dendrites and axon.

Questions

1. Classify the tissues of human body and write about epithelial tissue.
2. What are different types of connective tissue? Explain myeloid tissue and osseous tissue.
3. Add note on Areolar tissue tissue.
4. Add note on nervous tissue. Draw diagram of neuron.

Short Answer Questions

1.Mention major classes of tissues of human body.

2. Define a) Simple epithelium b) Compound epithelium

3. Describe pavement epithelium.

4. Give the distribution of pavement epithelium.

5. Write the description and distribution of cuboidal epithelium.

6. Write about columnar epithelium.

7. Mention the classes of compound epithelium

8. Write the distribution of a) Transitional epitheliumb) Stratified squamous cornified epithelium.

9. Write the functions of Pseudostratified columnar epithelium.

10. What are the types of cells found in areolar tissue?

11. Write about white fibrous tissue.

12. Explain Myeloid tissue.

13. What are different types of cartilaginous tissue?

14. Write about Reticuloendothelial tissue.

15. What are types of bone tissue.

16. Give the T.S. of bone

17. Mention different types of muscular tissues
18. Explain a) Epimysium b) Perimysium c) Endomysium
19. Define a) Sarcolemma b) Sarcoplasm
20. Differentiate between skeletal and cardiac muscular tissues.
21. Write about visceral muscles.
22. What is nervous tissue?
23. Write different types of matters of nervous tissue.
24. What are parts of Neuron?
25. Explain a) Endoneurium b) Perineurium

UNIT – 4

RESPIRATORY SYSTEM

Definition : Respiratory system is defined as the system consisting of parts concerned with inhalation and exhalation. Respiration is defined as the process of gaseous exchange between body tissues and external environment.

Respiratory tumor is divided into 2 parts.

1. Upper respiratory tract extends from upper nares to the vocal cord.

2. Lower respiratory tract extends from vocal cord to the alveoli.

Parts of the respiratory system:

1. Nose

2. Pharynx

3. Larynx

4. Trachea

5. Bronchi

6. Lungs : They have following parts.

a. Bronchioles

b. Alveolar ducts

c. Alveoli

1. Nose: It is the part of respiratory system through which air is inhaled in and exhaled out.

Roof of the nose is formed by ethmoid bone at the base of the skull.Floor of the nose is formed by the hard and soft palates at the roof of the mouth.

External nose is the visible part of nose. It is formed by the two nasal bones and cartilage. It is covered by skin. There are hairs inside.

Nasal cavity is a large cavity divided by a septum. It is lined with ciliated mucous membrane. It is extremely vascular.

Anterior nares are the openings which lead in.

Posterior nares are similar openings at the back and lead into pharynx.

Paranasal sinuses are the cavities in the bones surrounding the nasal cavity, which are lined with mucous membrane and open into nasal cavity.

They are of 4 types. 1. Maxillary sinus 2. Frontal sinus 3. Ethmoidal sinuses 4. Sphenoidal sinus

2.Pharynx : It lies between Nasal cavity and larynx.

Pharynx is divided into three parts. They are.

i) Nasopharynx ii) Oropharynx iii)Laryngopharynx

i)Nasopharynx: It lies between nasal cavity and oropharynx.It is lined with ciliated mucous membrane which is continuous with lining of the nose.

ii) Oropharynx: It extends from soft palate to the level of hyoid bone. The lateral wall contains of lymphoid tissue called tonsils.

iii) Laryngopharynx (Hypopharynx): It is the lowest part of pharynx.

3. Larynx: It lies below pharynx and above trachea. It is continuous with oropharynx. It is composed of several cartilages. They are joined together by ligaments and membranes.

Cartilages of Larynx are-a) Thyroid cartilageb) Cricoid cartilage c) Arytenoid cartilages d) Epiglottis

4) Trachea: It is also called as wind pipe. It is a cylindrical tube of length about 11 cm and begins at the lower end of pharynx. It divides into two bronchi at the level of fifth thoracic vertebra. It is made of sixteen to twenty C-shaped incomplete cartilages. It is lined by ciliated epithelium and contains goblet cells which secrete mucus.

5) Bronchi: Trachea divide into right and left bronchi. Right bronchus leads into right lung and left bronchus leads into left lung. Right bronchus is shorter and wider than left bronchus. Bronchi are made up of complete rings of cartilage.

6) Lungs: Lungs are the principal spongy organs concerned with respiratory process. They are two in number and lie in the thoracic cavity on either side of heart and great vessels. Hilum is a triangular shaped depression on the concave medial surface and is formed by

pulmonary arteries, pulmonary veins, bronchial arteries, bronchial veins, bronchi and lymphatic vessels.

Lungs have apex above and base below. Each lung is divided into lobes by means of fissures. Right lung is divided into three lobes whereas left lung is divided into two lobes. Each lobe is divided into number of lobules. Each lobe contains a) bronchioles b) alveolar ducts c) alveoli.

a) Bronchioles: They are the branches of bronchi and donot have cartilage. They are lined by cuboidal epithelium. They become further smaller to form terminal bronchioles which are lined by a single layer of flattened epithelial cells.

b) Alveolarducts: Terminal bronchioles divide repeatedly to form minute passages called alveolar ducts. They open into alveolar sacs.

c) Alveoli: Alveolar ducts open into alveoli.They are surrounded by numerous capillaries. Capillary network is the site of exchange of gases between blood and air in the alveoli.

Pleura: It is a serous covering the lungs. It contains two layers, inner visceral layer andouter parietal layer. Pleural fluid lies in the space between these layers.

Respiratory muscles: Intercostal muscles and diaphram are main respiratory muscles. However, during forced respiration sternocleidomastoid, scalenie, mylohyoid, platysma and abdominal muscles also participate.

Intercostal muscles are 11 pairs and are external and internal intercostal muscles. Diaphramis a large dome shaped sheath of muscle. It separates thoracic cavity from abdominal cavity.

Mediastinum: It is a block of tissue in between the two lungs and contains heart, great vessels, trachea, oesophagus, thoracic duct and thymus gland.

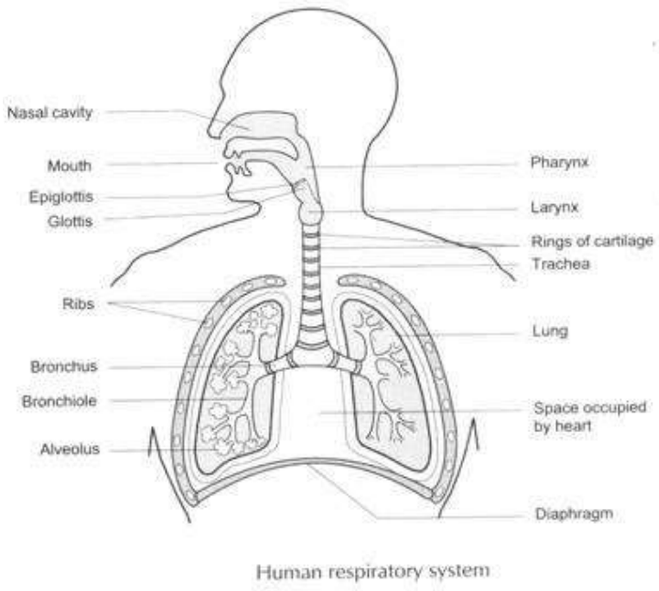


Fig 1: Parts of sRespratory system

PHYSIOLOGY OF RESPIRATION

Breathing or ventilation

1.External respiration. which is the exchange of gases (oxygen and carbon dioxide) between inhaled air and the blood.

2. Internal respiration, which is the exchange of gases between the blood and tissue fluids.

3.Cellular respiration

In addition to these main processes, the respiratory system serves for:

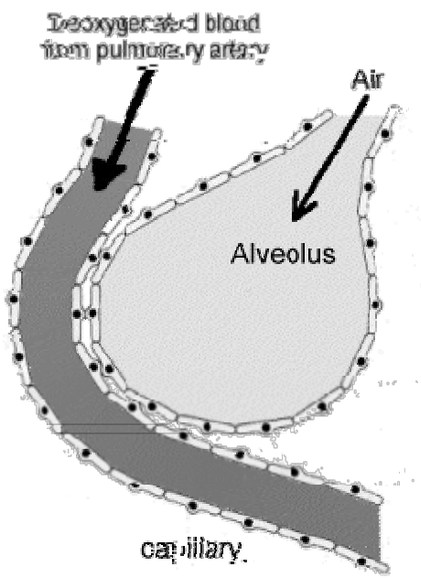
- Regulation of blood pH, which occurs in coordination with the kidneys
- Acts as a defense against microbes
- Control of body temperature due to loss of evaporate during expiration

Mechanics of Breathing

To take a breath in, the external intercostal muscles contract, moving the ribcage up and out. The diaphragm moves down at the same time, creating negative pressure within the thorax. The lungs are held to the thoracic wall by the pleural membranes, and so expand outwards as well. This creates negative pressure within the lungs, and so air rushes in through the upper and lower airways.

Expiration is mainly due to the natural elasticity of the lungs, which tend to collapse if they are not held against the thoracic wall.

Physiology of Gas Exchange



Each branch of the bronchial tree eventually sub-divides to form very narrow terminal bronchioles, which terminate in the **alveoli**. There are many millions of alveloi in each lung, and these are the areas responsible for gaseous exchange, presenting a massive surface area for exchange to occur over.

Each alveolus is very closely associated with a network of capillaries containing deoxygenated blood from the pulmonary artery. The capillary and alveolar walls are very thin, allowing rapid exchange of gases by *passive diffusion along concentration gradients*. CO_2 moves *into* the alveolus as the concentration is much lower in the alveolus than in the blood, and O_2 moves *out of* the alveolus as the continuous flow of blood through the capillaries prevents saturation of the blood wit

Summary

Respiratory system is system consisting of parts related with respiration. Parts of respiratory system are -Nose, pharynx, larynx, trachea, bronchi, bronchioles, alveolar ducts and alveoli.

Alveoli are the ultimate sites of gaseous exchange. Lungs are two in number. Right lung is divided into three lobes. Left lung is divided into two lobes. Each lobe is divided into lobules. Pleura is serous membrane covering lungs. Hilum on each lung is depression through which blood vessels, nerves, lymphatics etc. pass.

Essay Questions

1) Describe in detail about various parts of respiratory system

Short Answer Questions

1) What are the parts of respiratory system, which lead into lungs?

2) Name the parts of respiratory system which lie within lungs.

3) Mention the parts of nose.

4) What are the parts of pharynx?

5) Name the cartilages of larynx.

6) Explain trachea.

7) What are a) Bronchi b) Bronchioles?

8) Write about alveoli.

9) What are the types of respiration?

10) Desribe the mechanics of breathing.

11) Write about the process of brathing.

4. DIGESTIVE SYSTEM AND HEPATO BILIARY SYSTEM

Digestive system consists of gastrointestinal tract(Alimentary canal) and various glands attached. It starts with mouth and ends with anus.The upper gastrointestinal tract consists of the buccalcavity(Mouth), pharynx, esophagus, stomach, and duodenum.The lower gastrointestinal tract includes most of the small intestine, large intestine, rectum and anus.

Various parts of Digestive tract:

1)Mouth

2)Pharynx
4)Stomach

5)Smallintestine

8)Anus

Accesory organs of the digestive tract:

1)Teeth

2)Threepairsofsalivary glands

3)Liverandbiliarysystem

4)Pancreas

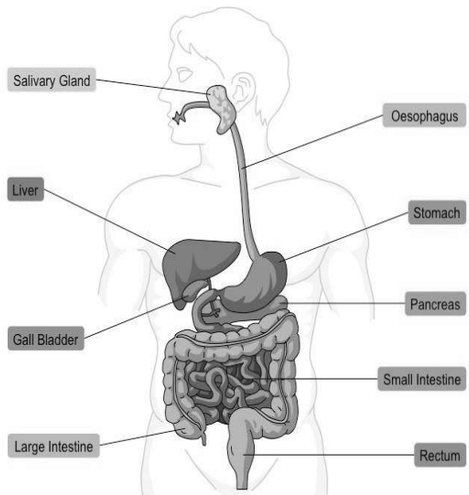


Fig 1: Parts of Digestive system

Mouth: It is the first part of the digestive tract. It opens through upper and lower lips. Roof of the mouth is called palate which is dome shaped . It is divided into hard (front part) and soft palate (back part) . Walls of the mouth are formed by muscles of cheeks. Mouh is lined by mucous membrane. This muscle keeps the mouth closed. Pharyngeal tonsils are on either side at the back of oral cavity. Uvula hangs down from lower border of soft palate.

Tongue: Tongue is at the base of the mouth. It is a musculo-membranous structure. It consists of 1)Stratified and cornified epithelium 2) Voluntary, cross striated muscle fibres and 3)Glands.Epithelium of tongue is modified into papillae and taste buds.

Teeth: Man is provided with two sets of teeth in his life. First set is called as Deciduous teeth or primary teeth. They are 10+10 in number. They eruptthrough the gums during first and second years of life. Second set strarts replacing the first set at about sixth year and process is complete by twenty fifth year.Second set remains upto old age and is called as permanant teeth.

Permanant teeth are 16+16 in number.Four types of teeth are there. They are,

1) Incisor teeth

2) Canine teeth

3) Premolar teeth

4) Molar teeth

Upper teeth and lower teeth are attached to upper Jaw and Lower jaw respectively.

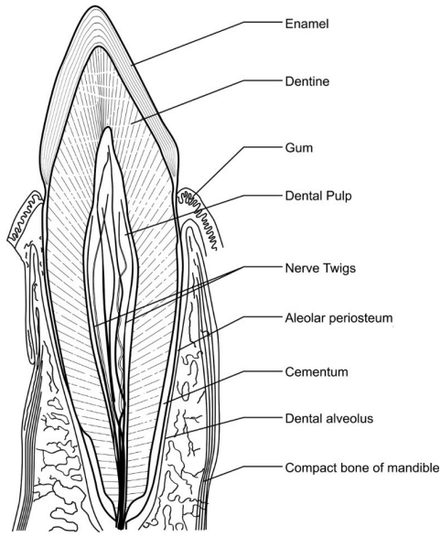


Fig 2: Structure of tooth:

Each tooth consists of three parts.They are 1) Root2) Neck3) Crown

Tooth is composed of three substances. They are 1)Dentine 2)Enamel 3)Cementum

Crowns of Incisor teeth are chisel shaped. Crowns of canine teeth are large and conical.

Crowns of premolar teeth are bicuspid and almost circular. Crowns of Molar teeth are broad and tetra or penta cuspid.

Salivary glands: There are three pairs of salivary glands in the mouth. They are

1)Parotid 2)Submandibular and 3) Sublingual glands.

1) Parotid glands: They are the largest salivary glands and present below the ears. Each gland opens on inner side of cheek opposite to the second upper molar teeth through its duct. Ducts of the parotid glands are called as Stenson's ducts.

2) Submandibular glands:They are also called as Submaxillary glands and are smaller than parotid glands. They lie on each side and lies under the angle of Jaw. Eachsubmandibular gland has a duct called wharton's gland. They open near the midline under the tongue.

3) Sublingual glands:They are the smallest salivary glands. They lie under the tongue. They pour their secretions into the mouth through several openings.

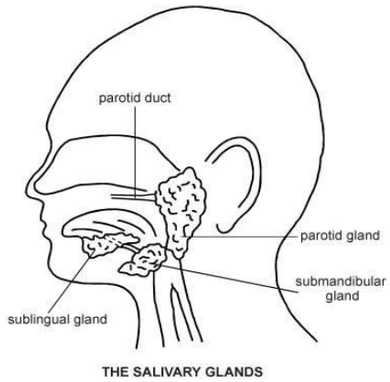


Fig 3: Salivary glands

Pharynx: Pharynx lies between mouth and oesophagus.It serves commonly forboth digestive and respiratory systems. It is divided into 3 parts.

1)Nasopharynx 2)Oropharynx and3)Laryngopharynx.

Oesophagus: It lies in both thoracic and abdominal cavities. Trachea and vertebral column lie in the front and back of oesophagus respectively.Histology of oesophagus shows similar structure as remainder of alimentary canal. It shows the following layers.

1) Mucosa 2)Submucous coat 3) Muscular coat

It is devoid of Serosa. Upper one third of oesophagus consists of smooth muscles. Lower one third contains smooth muscles and middle one third contains both types of muscles.

Stomach: Stomach is the most dilated part of digestive tract and is J shaped. It is situated between the end of the oesophagus and beginning of the small intestine. It lies below the diaphragm in the abdominal cavity.Its major part is to the left of the mid line.It distends when it is filled with food. Average capacity of stomach is 1.5 L in an adult.Stomach has two surfaces,two curvatures, two ends,three parts and two sphincters.They are as follows.

The two surfaces of stomach are-

1) Anterior surface 2) Posterior surface.

Two curvatures are- 1) Lesser curvature 2)Greater curvature.

Three parts of stomach are –

1) Fundus (upper portion) - above the cardiac sphincter

2) Body (middle portion) - between fundus and pylorus.

3) Pylorus (lower portion) - below incisura angularis.Pylorus is subdivided into pyloric antrumand pyloric canal.

Two ends of stomach are-

1) Cardiac end guarded by cardiac sphincter.

2) Pyloric end guarded by pyloric sphincter.

Two sphincters of stomach are-

1) Cardiac sphincter (at the beginning)

2) Pyloric sphincter (at the ending)

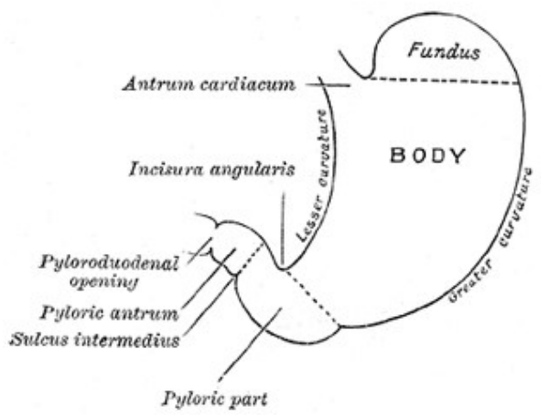


Figure 4: Parts of stomach

Histology of stomach- It has 4 layers

1) Mucousmembrane – innermost layer containing numerous folds (rugae).

2) Submucous layer

3) Muscular coat is made up of three layers consisting of longitudinal, circular and oblique smooth musclefibres.

4) Serous coat, which is the visceral layer of peritoneum.

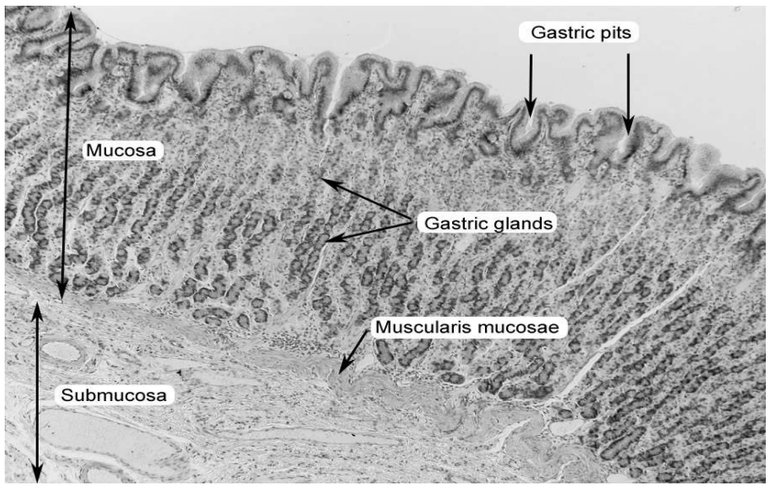


Fig5: Histology of stomach

Folds connected to the stomach are called as omenta. It is divided into,

1) Greater omentum - hangs from lower border of stomach to the front surface of small intestine.

2) Lesser omentum - extends from lower border of liver to the lesser curvature of stomach.

Small intestine:

It is a coiled tubular structure about 6 metres long. It extends from pyloricsphincter to its junction with large intestine at the ileocaecal valve.It is divided into three parts. They are- 1) Duodenum 2) Jejunum 3) Ileum

Histology of small intestine:It has 4 layers.

1) Mucousmembranne(Muscularis interna/Muscularis mucosa) – It is the innermost layer of the small intestine and contains goblet cells and villi. They produce mucus. It contains circular folds. Unlike the rugae of the stomach, they are permenant. They enhance the surface area available for absorption. The intestinal glands secrete intestinal juice.

2) Submucouscoat containing blood vessels, lymph vessels and nerves. It contains Brunner glands in duodenum.

3) Muscular coat with a thin external layer of longitudinal fibres and a thick internal layer of circular fibres.

4) Serosa- It is an outer peritoneal layer

Duodenum: It is the first part of smallintestine and is C shaped. Duct from gall bladder, bile duct and prancreatic duct open into the second part of duodenum through the hepato-panereatic ampulla.

Jejunum: This is the midsection of the small intestine, connecting the duodenum to the ileum. It is about 2.5 m long, and contains the circular folds, and villi that increase its surface area. Products of digestion (sugars, amino acids, and fatty acids) are absorbed into the bloodstream here.

Ileum:It is the distal three fifth of long and coiled part small intestine. It extends between Jejunum and caecum (beginning of large intestine). There are number of minute lymphoid structures (peyer's patches) in ileum. Ileum has similar structure as Jejunum but more villi. Ileum also contains digestive glands. But they are less than in the jejunum.

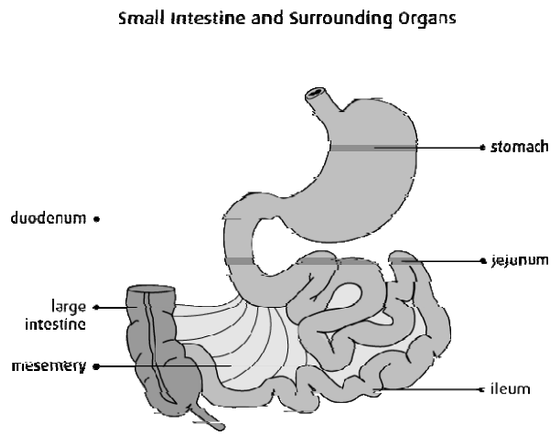


Fig 6 : Small intestine

Large intestine (colon):

Ileum of the small intestine merges into large intestine. Colonmeasures about1.5 metres in length.There is ileocaecalvalve at the junction of ileum and large intestine. Large intestine consists of following parts. They are,

1)Caecum: It is a short rounded sac and lies in the right iliac fossa. It begins at the ileoeacealvalve where ileum and caecum join. It is continuous with ascending colon.

2)Vermiform appendix: It is a vestigial organ and present about an inch from ileocaecal value. Lumen of the appendix communicates with that of caecum. It contains same four layers as intestine but the submucous layer contains lymphoid tissue.

3) Ascending colon: It ascends upwards from caecum and infront of right kidney. It turns to left below the liver. It merges with transverse colon.

4)Transverse colon:It lies transversely below the stomach. It is suspended from its own mesertery from the posterior abdominal wall. It extends to the left and merges with descending colon at the lower surface of spleen.

5)Descending colon: It is situated verticallyon the left side of abdomen. It extends from transverse colon and merges with sigmoid colon.

6)Sigmoid colon: It lies in the pelvis. Hence it is also called as pelvic colon. It is situated at the left. It forms loops. It has a mesentery of its own. It continues below with rectum.

Histology of large intestine:Large intestine has the same structure as small intestine. The difference is, longitudinal muscles are arranged in three bands. Mucous membrane does not contain villi.

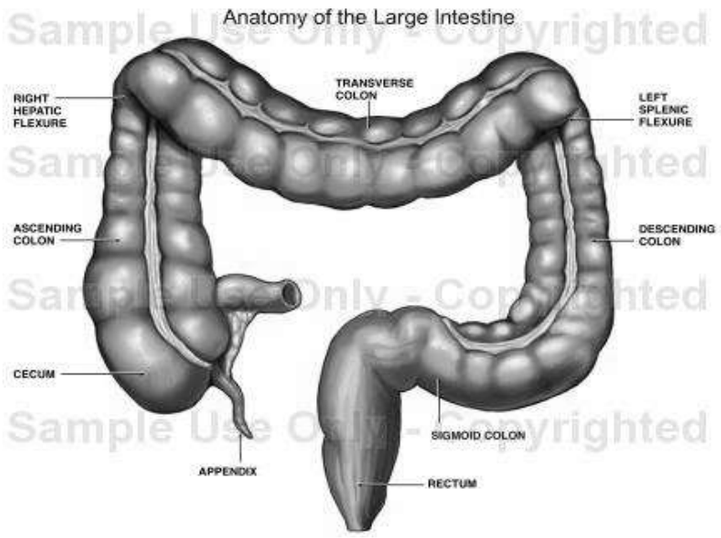


Fig 8: Parts of large intestine

Rectum: It is a straight tube lying in lower posterior part of pelvic region. It is12 cm long extends from sigmoid colon to analcanal. It is situated behind urinary bladder, prostate and seminal vesicles in male and behind uterus and vagina in females. Mucous coat of rectum has longitudinal and transverse folds. Lower portion of rectum is called as rectal ampulla.

Anus:Rectum ends in anus. It is about 1 inch long. It is a small canal guarded by two sphincters. Internal sphincter is involuntary and external sphincter is voluntary.

Mesentery:

Mesentery is the fold of peritoneum which attaches different parts of small intestine to the posterior abdominal will. Blood vessels, nerves and lymphatics enter the intestines through mesentery.

Peritoneum:

Peritoneum is a serous membrane. In males it is a closed sac lining the abdomen. In females, free ends of uterine tubes open into peritoneal cavity. It consists of two layers. They are

1) Parietal layer lining the walls of abdominal cavity.

2) Visceral layer covering the abdominal organs.

Peritonial cavity: It is the space between parietal and visceral layers of perital layers.

Pouch of Douglas: Sac of peritoneum between rectum and uterus is called as pouch of Douglas.

Regions of abdomen: Abdomen is divided into 9 regions.

1) Right hypchondrium
2) Epigastrium
3) Left hypochondrium
4) Right lumbar region
5) Umbilical region
6) Left lumbar region
7) Right iliac fossa.
8) Hypogastrium
9) Left iliac fossa.

Accessory organs of the digestive system: They are teeth, salivary glands, liver, biliary system and pancreas,Teethandsalivaryglandsarecoveredundermouth.

Liver: Liver is the largest organ in the abdomen and is the largest gland in the body. It is situated in the upper right part of abdominal cavity. It lies below the diaphragm under the cover of lower ribs. Falciform ligament divides it into two lobes. They are-

1) Right lobe – It lies over the right colic flexure and right kidney. It is bigger than left lobe.

2) Left lobe - lies over stomach

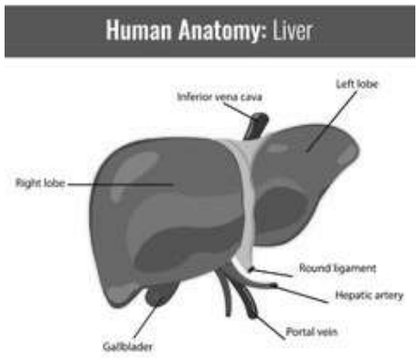


Fig 9: Lobes of liver

Histology of liver:Liver consists of large number of hepatic lobules. They are hexagonal in shape. Each lobule has a small central intra lobular vein, which is a branch of a hepaticvein.Lobules consist of liver cells which are large polygonal cells with abundant eosinophilic cytoplasm. These cells radiate from central vein. Portal triads are present inbetween the lobules. It contains 1) Inter lobular vein 2)hepatic artery 3) bile duct.

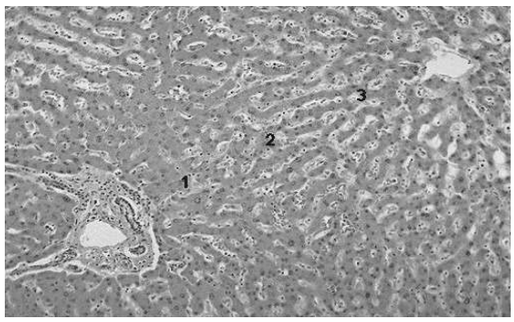


Fig 10: Histology of liver

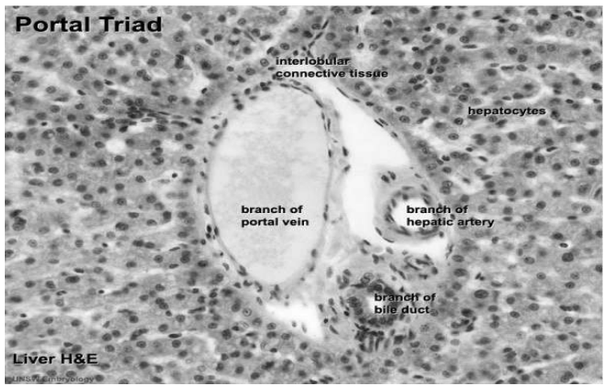


Fig 11: Portal triad

Blood supply of liver:Hepatic artery and portal vein carry blood to liver. Hepatic artery supplies oxygenated blood to liver. It is a branch of coeliac plexus. Portal vein brings blood to liver from stomach, spleen and intestines. It divides into inter lobular veins. They subdivide and finally form central veins.

Biliary system: Biliary system consists of,

1) Common hepaticduct formed by the union of right and left hepatic ducts from liver.

2) Gall bladder

3) Cystic duct from gall bladder

4) Common bile duct formed by union of common hepatic duct and cystic duct.

Gall bladder: It is a pear shaped organ situated at the under surface of right lobe of liver.It has a duct called cystic duct.

It consists of three parts, 1) Fundus 2) Body 3) Neck

Histology of gall bladder: It has three layers.

1) Inner mucous coat.

2) Middle muscular coat

3) Outer serous coat.

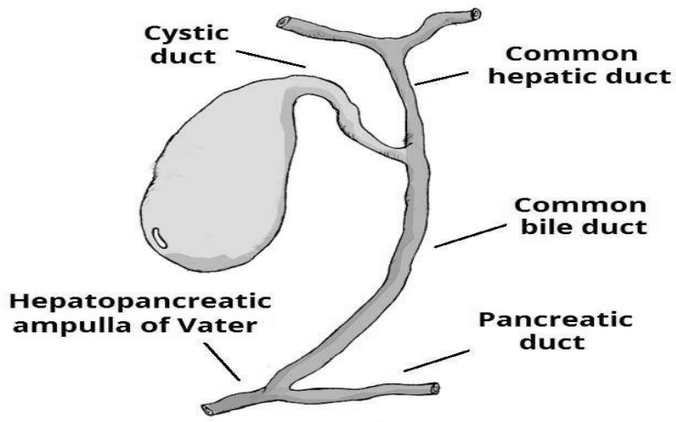


Figure 12: Biliary system

Pancreas: It is a soft greyish pink coloured gland. It is about 12 to 15 cm long. It lies transversely across the posterior abdominal wall behind the stomach.

Pancreas has three parts.1) Head 2) Body and3) Tail.

Head of the pancreas lies within the curve of duodenum. Tail extends as for as the spleen. Body lies between Head and tail. Pancreatic duct lies within the organ. Pancreatic duct joins the bile duct at the head of the pancreas and open together into duodenum at heptopancreatic ampulla.

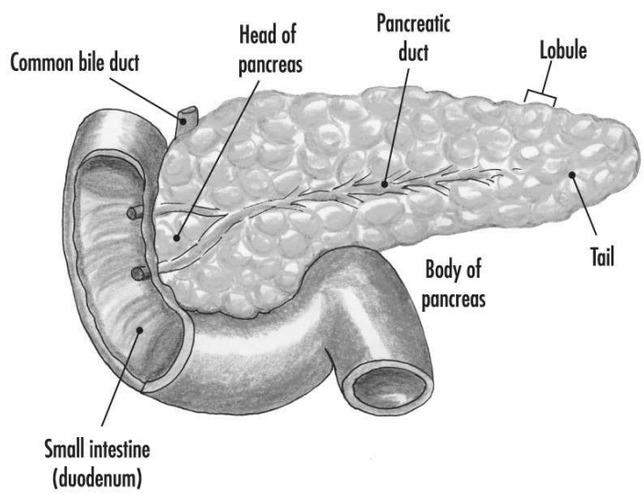


Figure 13: Parts of pancreas

Hitology of pancreas: Pancreas is composed of lobules. Each consists of tiny vessel. All these tiny vessels lead to the main duct and end in number of acini. Acini lined with cells secrete the enzymes trypsinogen, amylase and lipase. In between the acini, aggregates of cells called Islets of langerhans are present. Alpha cells constitute 25 percent of total number of Islets and beta cells constitute 75 percent of the total number of Islets.

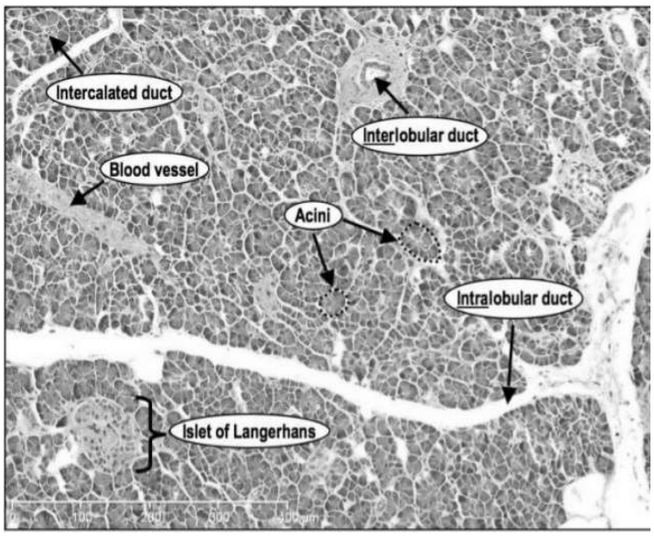


Fig 14: Hostology of pancreas

Summary

Digestive system consists of Gastrointestinal tract and various glands attached.They are mouth, pharynx, oesophagus, stomach, small intestine, large intestine, rectum and anus. These are concerned with functions like ingestion, deglutition, absorption and excretion. Accessory organs are teeth, salivary glands, liver and biliary system, pancreas etc.

Questions

Essay Questions

1) What are the various parts of digestive system? Describe anatomy of teeth

2) Describe the anatomy of pharynx and oesophagus. Draw the diagrams.

3) Write the anatomy of stomach. Draw the diagram and label.

4) What are different parts of small intestine? Desribe in detail the anatomy of each part with diagrams.

5) Write the anatomy of large intestine. Draw the digrams.

6) Desribe in detail about the anatomy and histology of liver.

7) What are the parts of pancreas? Describe the histology ofpancreas.

Short answer questions

1) List the main parts of Digestive system.

2) Mention the names of accessory organs of diagestive system.

3) What are the parts of a tooth?

4) Mention the types of permanant teeth.

5) What are the parts of a tooth?

6) Write the names of the salivary glands.

7) Name the ducts of a)parotid glands b)Submandibular glands.

8) What are different parts of pharynx?

9) What are the Histological layers of oesophagus?

10) Mention various parts of stomach.

11) Name the cuvatures of stomach.

12) List the layers of stomach.

13) Name the parts of small intestine.

14) What are the Histologiacl layers of small intestine?

15) Write about vermiform appendix.

16) What are the lobes of liver?

17) What is a portal triad and write the components of portal traid

18) Name the surfaces of liver.

19) Write the parts of Biliary system?

20) Where is Gall bladder situated? What are its parts?

21) Mention the parts of pancreas.

22) What are islets of langerhans?

UNIT – 5

CARDIO VASCULAR SYSTEM

Cardiovascular system consists of Heart and Vascular system. It is well organised blood transport system of body. Heart is the central pumping organ. Blood vessels constituting vascular system are arteries, arterioles, capillaries, venules and veins.

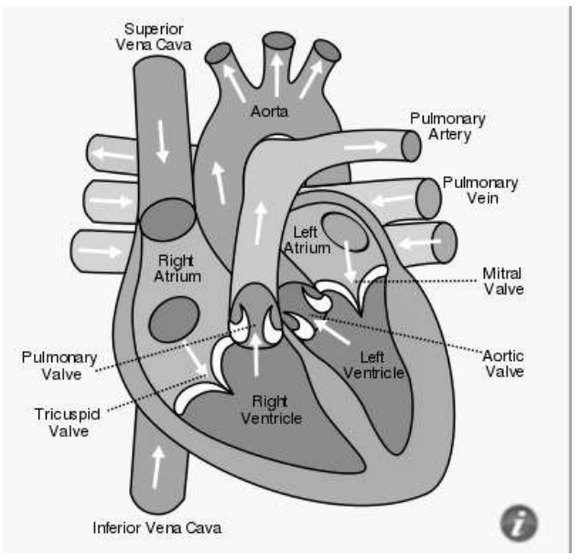
Anatomy of Heart

Heart lies on the left upper part of thoracic cavity and lies between the two lungs.

Chambers of Heart : Heart has four chambers. Two of them are upper chamberscalled atria or auricles. Lower two chambers are called ventricles.

The two atria are separated by interatrial septum.

The two ventricles are separated by interventricular septum.



Atria are filling chambers and ventricles are pumping chambers. Compared to artia, ventricles are thicker since they are pumping chambers. Of the two ventricles, wall of left ventricle is

three times thicker than that of right ventricle since left ventricle pumps oxygenated blood to all parts of body and right ventricle pumps deoxygenated blood to lungs only.

Valves of Heart :

i) Tricuspid valve: Opening between right artium and right ventricle is guarded by tricuspid valve. It prevents back entry of blood into right atrium from right ventricle at the beginning of ventricular systole.

ii) Mitral valve: Opening between left atrium and left ventricle is guarded by the mitral valve. It is also known as the bicuspid valve. It has two flaps that lies between the left atrium and the left ventricle. It prevents back flow of blood into left atrium.

The mitral valve along with the tricuspid valve are known collectively as the atrioventricular valves because they lie between the atria and the ventricles of the heart.

iii) Pulmonary valve: Pulmonary artery is guarded by tricuspid semilunar valve which prevents back flow into right ventricle. It carries deoxygenated blood from the right side of the heart to the lungs.

iv)Aortic valve: Aorta has tricuspid semilunar valve which prevents back flow of blood into left ventricle at the beginning of ventricular diastole.

Chordae tendinae and papillary muscles: Papillary muscles arise from ventricular walls. Chordaetendinae attach apical end of valves and papillary muscles. They prevent over distension of valves during diastole.

Histology of Heart: Heart consists of three layers.

1) Pericardium - outermost layer consisting of a) Visceral pericardium b) Parietal pericardium.

2) Myocardium - Middle layer made of cardiac muscle cells and interstitial cells.

3) Endocardium - Innermost layer.

Pericardium forms bag like structure between visceral and parietal layers containing pericardial fluid.

Blood vessels attached to heart:

1) Superior and inferior vena cava– They carry deoxygenated blood from parts of body to right atrium.

2) Pulmonary artery carries venous blood to lungs from right ventricle.

3) Pulmonary veins carries oxygenated blood from lungs to the left atrium of heart.

4) Aorta carries oxygenated blood to all parts of body from left ventricle of heart.

Blood vessels supplying oxygenated blood to heart: Right and left coronary arteries arising from Aorta supply oxygenated blood to heart.

Blood vessels draining heart: Coronary veins bring deoxygenated blood of heart into coronary sinus, which opens directly into right atrium.

Nerve supply to heart : Sympathetic and vagus nerves supply heart.

Conducting system of heart: System of conducting impulses of cardiac contraction consist of

1) Sinoatrial node (SA node): It is present at the opening of superior venacava into right atrium. It is called pacemaker of heart.

2) Atrioventricular node (AV node) :It is present in the right atrium at the posterior part of inter atrial septum. It is close to the opening of coronary sinus.

3) Bundle ofHis: Main trunk of bundle of His is continuous with AV node. Itpasses through interventricular septum. It is about 20 mm long.

4) Right and left branches of bundle of His :Bundle of His divides into right and left branches. Right branch is longer than left branch. Left branch bifurcates into superior and inferior divisions.

5) Purkinje fibres: They arise from branches of bundles of His. They spread from interventricular septum directly to papillary muscle and ultimately end in sub endocardial network.

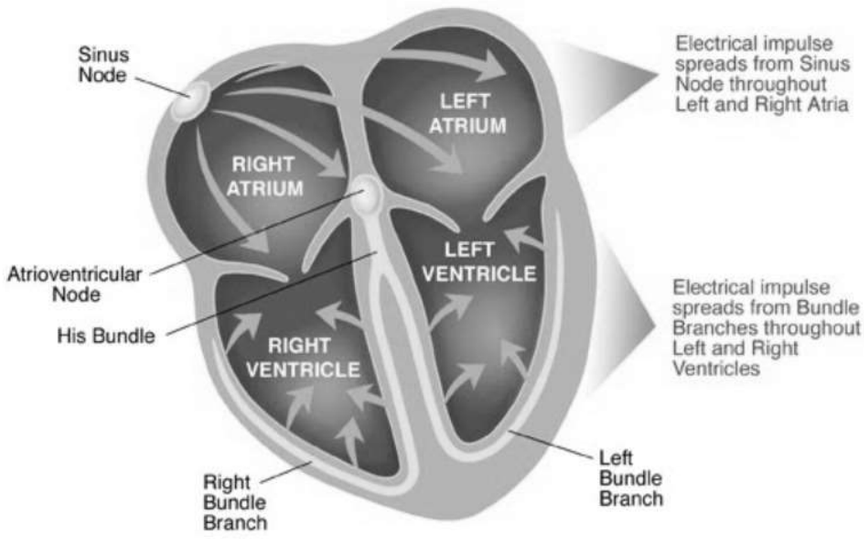


Fig: Nodes of conducting system of heart

BLOOD VESSELS:

Histology of Arteries and Veins:Arteries and veins consist of three layers.

1) Tunica externa - outer layer made of fibrous tissue and elastic tissue. It is also called as tunica adventitia.

2) Tunica media - middle layer of plain muscles and network of elastic fibres.Tunica media in arteries is thicker than in veins.

3) Tunica interna– innermost layer made of endothelial cells and also called tunica intima.

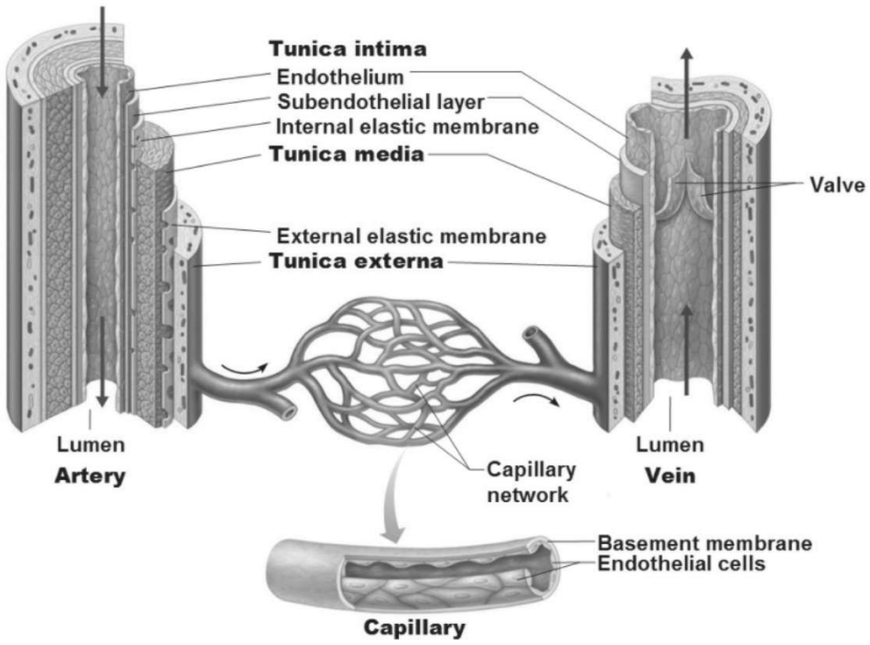


Fig : Layers of blood vessel

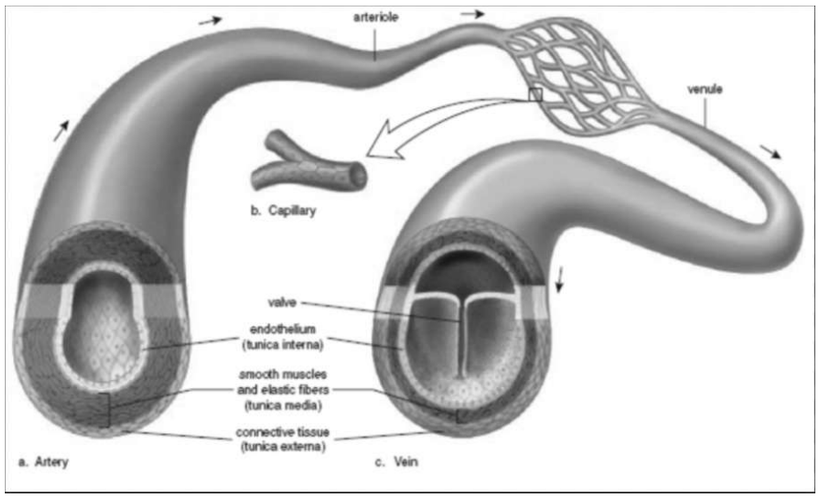


Fig: T.S. of artery and vein

Arteries of the body:

Aorta: It arises from left ventricle of heart is the main artery of body.

It consists of three parts.They are,

1) Ascending aorta:It gives off two branches i) Right coronary artery ii) Left coronary artery. Coronary arteries supply blood to heart.

2) Arch of aorta: It gives off three branches and supplying blood to head, neck and upper limb. The branches of arch of aorta are,

i) Innominate artery –It divides intocommon carotid arteryright subclavian artery

3) Descending aorta–It is divided into,

i) Thoracic aorta –It supplies blood to wall of chest cavity and viscera.

ii) Abdonminal aorta – It supplies wall of abdominal cavity and its viscera. The Branches of abdominal aorta:

i) Coeliac plexus

ii) Mesenteric arteries

iii) Renal arteries

iv) Final branches

i) Coeliac plexus divides into,

a) Hepatic artery - supplies liver

b) Gastric artery - supplies stomach

c) Splenic artery - supplies spleen.

ii) Mesenteric arteries arei) Superior mesenteric arteryii) Inferior mesenteric artery

iii) Renal arteries supply kidney. Final branches are,i) Right common iliac artery ii) Left common iliac artery.

These common iliac arteries divide into,

i) Internal iliac artery - Itsuplies pelvic organs. In females, its branch uterine artery supplies uterus.

ii) External iliac artery**-** Itcontinuousin thigh as femoral artery.Continuing in popliteal fossa as popliteal artery.

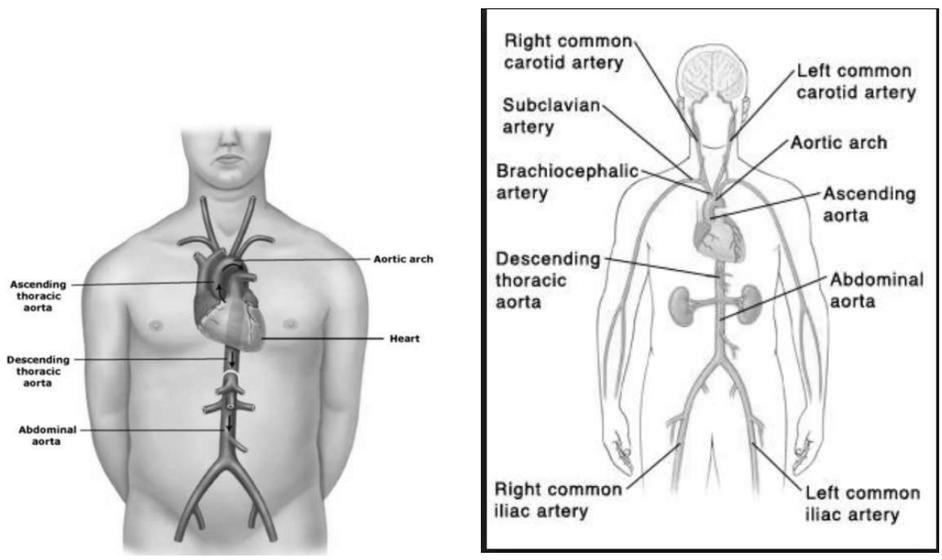


Fig:Arteries of the human body

Veins of the body

All the veins of the body join superior and inferior venacavae and drain the collected blood into right atrium of heart.

Superior venacava: Superior venacava is formed by union of right and left brachiocephalic veins collecting blood from head, neck, upper extremities and some part of thorax.

Inferior venacava: Inferior venacava is formed by union of two common iliac veins collecting blood from lower extremities and abdomen. It extends upwards through abdomen and thorax and opens into right atrium.

Veins of the head, neck and upper limbs:

Internal and external jugular veins drain head and neck.

Subclavian veins collect blood from upper limbs.

Radial veins collect blood from metacarpals. Ulnar vein collects from fingers through palmar arch.

Common iliac vein collects blood from lower extremities and abdomen. In abdominal region, renal veins from kidneys, gonadal veins from testes or ovaries, suprarenal veins from suprarenal glands, hepatic vein from liver, lumbar veins from abdominal wall and internal

iliac veins join inferior venacava. Internal iliac or hypogastric veins drain blood from gluteal muscles, medial side of thigh, urinary bladder, prostate gland, vas-deferens, uterus and vagina.

Types of circulation:

There are mainly two circulatory networks in the body. They are,

1) Systemic circulation

2) Pulmonary circulation

Systemic circulation: Oxygenated blood is circulated to all the parts of body from the left ventricle of heart through aorta. Deoxygenated blood of all parts of body reaches right artium of heart through superior and inferior venacavae. This is the major circulatory network of body and called systemiccirculation or greater circulation.

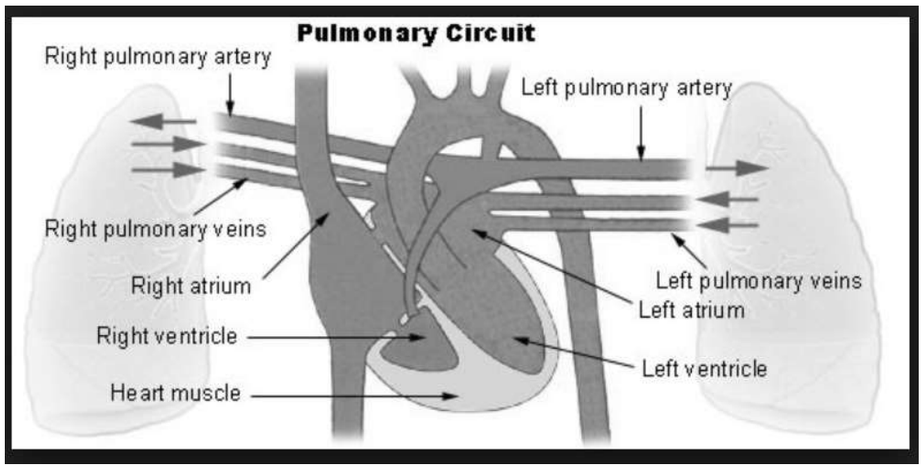


Fig. 5.4Pulmonary circulatory network

Pulmonary circulation : Deoxygenated blood reaching right atrium goes into right ventricle and from here, it reaches lungs through pulmonary artery. After losing CO2 in lungs, it gets oxygenated and reaches left atrium of heart through pulmonary artery.

Coronary circulation : It is the circulatory network, supplying oxygenated blood to heart itself and draining deoxygenated blood from it. Right and left coronary arteries arising from ascending aorta supply oxygenated blood to heart. Coronary veins collecting deoxygenated blood from heart join coronary sinus, which opens into inferior venacava.

Portal circulation : It is the circulatory network through liver. Portal vein and hepatic artery bring blood to liver. Portal vein carries blood into liver through superior mesenteric and splenic veins. Superior mesenteric vein carries blood from mesenteric bed (stomach, small intestine, part of large intestine and pancreas). Splenic vein carries from spleen. Hepatic artery carries oxygenated blood to liver. Capillaries of portal vein join with capillaries of hepatic artery. Hepatic vein carries blood circulated in liver to right atrium of heart through inferior venacava. This circulatory network of liver is called portal circulation.

Summary

Cardio vascular system consists of heart and vascular system. Heart contains four chambers. Upper two chambers are called atria or auricles and lower two chambers are called ventricles. Histology of heart shows pericardium, myocardium and endocardium. Conducting system of heart consists of S.A. node, A.V. node, bundle of His, branches of bundle of His and purkinje fibres. Vascular system consists of arteries, arterioles, capillaries, venules and veins. Arteries and veins contain three layers- tunica externa, tunica media and tunica interna. Aorta is the main artery of the body. Superior and inferior venacavae are the main veins of body. Veins of superior parts of body, upper parts of limbs and some parts of thorax join superior venacava. Veins of abdomen and lower limbs join inferior venacava. Different circulatory networks of body are - systemic circulation, pulmonary circulation, coronary circulation, portal circulation etc.

Questions

Essay Questions

1) Discussthe anatomy of heart. Draw the diagram.

2) Write about the histology of arteries and veins. Discuss arteries of head and neck.

3) Discuss Veins of body.

4)Discuss the types of circulation of body.

Short Answer Questions

1) Name the chambers of Heart.

2) What are the layers of heart?

3) Name the valves of heart.

4) What are the blood vessels that supply heart?

5) Write briefly about the conducting system of heart.

6) Write briefly about S.A. node.

7) Describe A.V. node.

8) What is bundle of His?

9) What are the parts of Aorta?

10) Write the branches of arch of aorta.

11) What are the branches of ascending aorta?

12) Name the divisions of descending aorta.

13) Name the arteries of upper limbs.

14) Mention the branches of abdominal aorta.

15) Write the divisions of coeliac plexus.

16) What are mesenteric arteries?

17) What is plantar arch?

18) What are main veins of body?

19) Name the veins of head and neck.

20) Write the veins of lower limbs.

21) Mention abdominal veins.

22) What is systemic circulation?

23) Write about pulmonary circulation.

24) Explain portal circulation.

25) Write briefly on coronary circulation.

UNIT – 6

LYMPHATIC SYSTEM

The lymphatic system is part of the circulatory system. It is an important part of the immune system, comprising a network of lymphatic vessels that carry a clear fluid called lymph directionally towards the heart

Lymphatic system is a closed system consisting of 1) Lymphatic capillaries2)Lymphatic vessels 3) Lymph nodes and 4) Lymphatic ducts.

1) Lymphatic capillaries:They are fine hair like vessels with porous walls.They arise in the tissue spaces. They unite to form lymphatic vessels. Walls of the capillaries have permeability to substances of greater molecular size than the substances permeable through walls of blood capillaries. Their walls are formed by endothelial cells and supported by fibrous connective tissues.

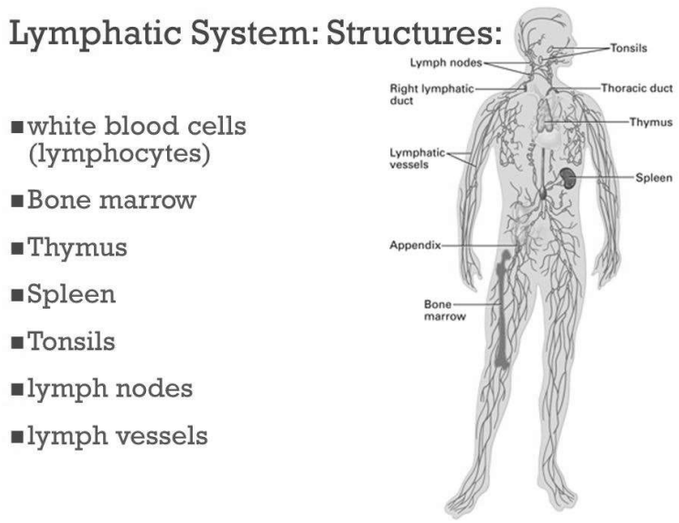


Fig. 6.1 Lymphatic system of human body

2) Lymphatic vessels: Lymphatic capillaries unite to form lymph vessels.

They have one sided valves. They are superficially and deeply located. They are found in skin, muscles and several visceral organs. Lymph vessels pass through lymph nodes. Finally lymph collected from the body pours into right lymphatic duct and left lymphatic duct. Left lymphatic duct is also called as thoracic duct.

3) Lymph nodes: Lymph nodes are small bodies made of lymphatic tissue. They are located both superficially and deeply. Lymphatic vessels bring lymph to lymph nodes.They divide within the node and discharge lymph.Lymphatic vessels entering into the lymph node are called afferent lymph vessels. Lymph vessels leaving the lymph nodes are called as efferent lymph vessels.

Naming of lymph nodes: Lymph nodes are named accordingly as they are located.They are,

a) Cubital and axillary lymph nodes -They are situated in arms.

b) Poplietal and inguinal - Lymph nodes situated in legs are named so.

c) Cervical lymph nodes- Lymph nodes present in the neck.

d) Mediastinal lymph nodes: These are present in Thorax.

e) Abdominal lymph nodes: They are present in abdomen. eg: Mesenteric lymphnodes.

f) Pelvic lymph nodes: Pelvic lymph nodes are present in pelvic organs.

4) Lymph ducts:

i) Right lymphatic duct- Efferent lymph vessels leaving lymph nodes pour lymph into right lymphatic duct and left lymphatic duct (thoracic duct). Right lymphatic duct is comparatively smaller. It is formed by joining of lymphatic vessels from right side of head, thorax and right upper limb at the root of neck.

ii)Thoracic duct – It is left lymphatic duct. It begins at cisternachyli.

iii) Cisternachyli is a small pouch at the back of the abdomen. Lymphatic vessels from lower limbs, abdominal and pelvic organs empty into cysternachyli.

iv) Thoracic duct finally empties into left subclavian vein at its junction with left internal jugular vein. It is provided with unidirectional valves to prevent lymph from flowing in wrong direction.

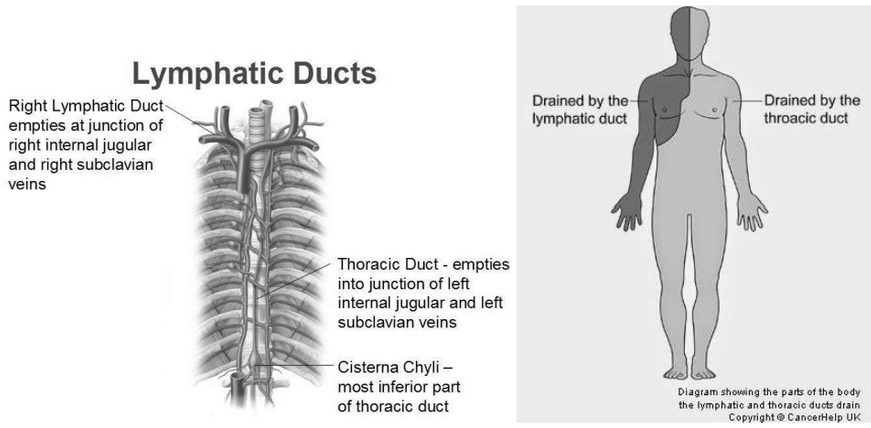


Fig. 6.2 Lymphatic Ducts and Cisterna chyli

Histology of Lymph node: Histology of lymph node shows three parts. They are cortex,medullaandhilum.

1) Cortex: Cortex is the outer part of lymph node. It contains lymphatic nodules peripherally and germinal centres in the inner zone. Germinal centres present in the lymph nodes produce lymphocytes. Lymph sinuses separate lymph nodules from capsule.

ii) Medulla : It is the inner part of lymph node. It is devoid of lymph nodules.It contains reticulo endothelial cells.

iii) Hilum : It is the depression at one side of lymphnode or lymph gland.Through

Hilum, an artery enters and there is exit to a vein and an efferent lymphatic vessel. Afferent lymph vessels enter from all sides but efferent lymph vessel leaves through hilum. Chief efferent vessel leaving lymph node carries filtered and lymphocyte enriched lymph fluid

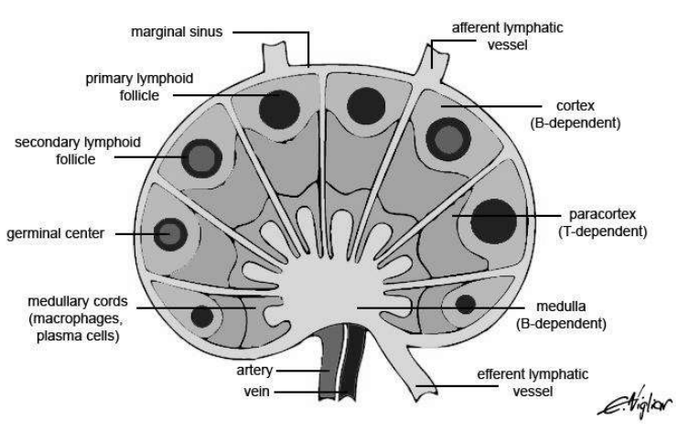


Fig :Normal histology of Lymphnode

Other lymphatic organs: They are spllen, tonsis and thymus

Spleen: Spleen is the largest lymphoid tissue in the body. It is highly vascular organ. It is located in the left hypochondrium beneath the diaphragm. It weighs about 150 g. in adult human being and does not contain afferent lymphatic vessels.It is haemopoieticconnective tissue.

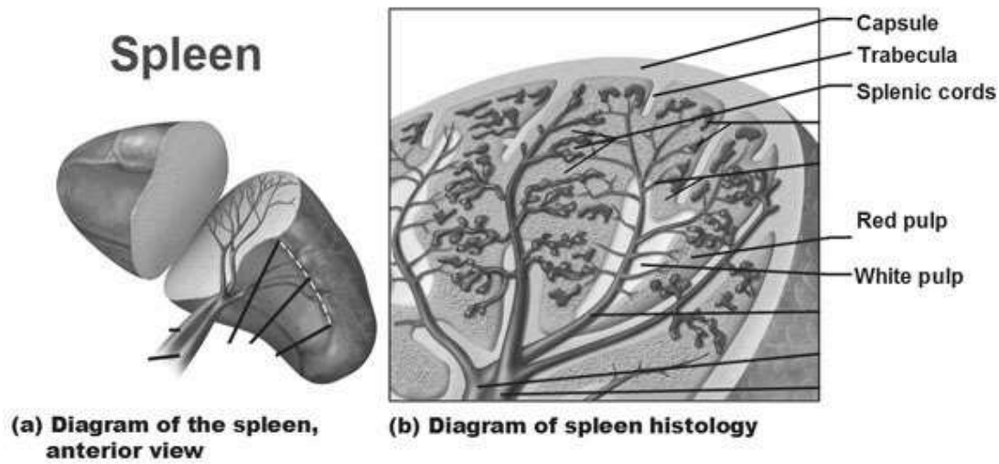


Fig: T.S. of Spleen

Histology of spleen:Histology of spleen shows,

1) Capsules 2) Trabeculae3) Hilum 4) White pulp5) Red pulp 6) Reticular mesh work

7) Blood vessels.

Splenic pulp : Splenic pulp is the parenchymal tissue within the capsule. It is two types 1) White pulp 2) Red pulp.

White pulp : It contains mostly lymphocytes.

Red Pulp : It containssinusoids the blood filled areas.It is concerned with disposing of worn out RBCs and blood borne pathogens.

Splenic sinuses: Splenic sinuses are long vascular channels.

Splenic cords: They are continuous partitions in between splenic sinuses.

3. Tonsils : Tonsils are well-defined organs of accumulated lymphoid tissue inthe mucous membrane at the root of tongue. Tonsils are present at the surrounding of pharynx, where nasal and oral passages unite. Tonsils do not possess afferent lymphatic vessels.

Tonsils can be divided into three groups.

1) Palantine tonsils -covered by stratified squamous epithelium

2) Lingual tonsil- situated at the root of tongue.

3) Pharyngeal tonsils - one on each side in the median posterior wall of nasopharynx.

4.Thymus: Thymus is partly endocrine gland and partly lymphoid structure. It is present in anterior and superior mediastinum of thorax. It extends from pericardium up into neck. It consists of two lobes.

Histology of thymus shows -

1) Capsule 2) Cortex 3) Medulla

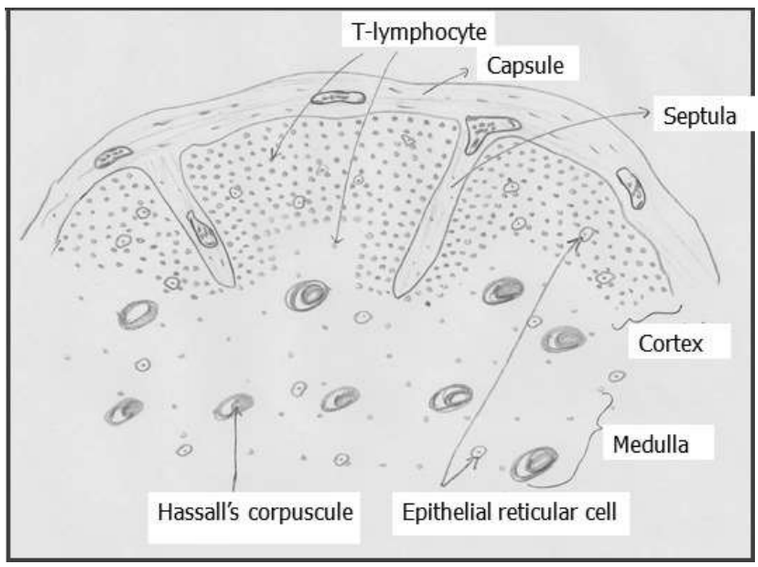


Fig : Histology of Thymus

SUMMARY

Lymphatic system is a closed system consisting of lymphatic capillaries, lymphatic vessels, lymph nodes and lymph ducts. Spleen, tonsils and thymus are also lymphatic tissues. Spleen is haemopoietic organ. Splenic pulp is parenchymal tissue within the capsule of spleen.

Essay questions

1) Write the anatomy of lymphatic system.
2) Write in detail about the anatomy and histology of spleen.

Short Answer Questions

1) Define lymphatic system.

2) Write briefly about lymphatic capillaries.

3) Name various types of lymphnodes.

4) What are a) Cubital and axillary lymph nodes b) Mediastinal lymph nodes.

5) Write about histology of lymph node.

6) Name the lymph ducts.

7) What is splenic pulp?

8) What are tonsils?

9) Write breifle about Thymus.

UNIT – 7

BONES AND JOINTS

Bones and Joints form the skeletal system of body. There are about 206 bones in human body.

Functions of skeletal system

1) Gives support and protection to soft tissues and vital organs.

2) Gives attachment to muscles and assists in body movements.

3) Formation of blood cells in the red bone marrow.

4) Storage of mineral salts like calcium and phosphorous.

Composition of bone :

Bone is structurally a complex organ and has 30% water and 70% Bone Matrix.

Structure of bone tissue : Refer to Cell and Tissues.

Functions of bone marrow :

Bone marrow performs functions of

1) Formation of blood cells(Haemopoeisis).

2) Destruction of old RBC with the help of Reticuloendothelial cells(haemolysis)

3) Protection of body against infections by microbes with the help of Reticuloendothelial cells (Defence mechanism)

Ossification : Ossification is the process of bone formation. Development of bones takes place from spindle shaped cells called osteoblasts.There are two types of ossification.

1) Intra membranous ossification.

2) Intra cartilaginous ossification.

1) Intra membranous ossification : It is the type of ossification in which, dense connective tissue is replaced by deposits of calcium and forms bone. Eg: Bones of skull are formed by this process.

2) Intra cartilaginous ossification: It is the type of ossification in which, cartilages are replaced by bone is called as intracartilaginous ossification. Most of the bones of the body are formed by this process.

Types of Bones: Bones are mainly three types.

1) Long bones.2)Short bones 3) Flat bones 4) Irregular bones 5) Seasmoid bones.

1) Long bones: Long bones are found in limbs. It has two ends called as epiphyses.These two ends are connected by shaft, which is called as diaphysis. The outer membrane covering the bone is called periosteum. It is followed by layer of compact bone. There is central medullary canal.It contains yellow bone marrow.Extremities consist of mass of spongy bone, which contains red bone marrow. Yellow bone marrow contains fat and blood cells but is not rich in blood supply or red blood cells. Arteries enter the bone through nutrient foramen

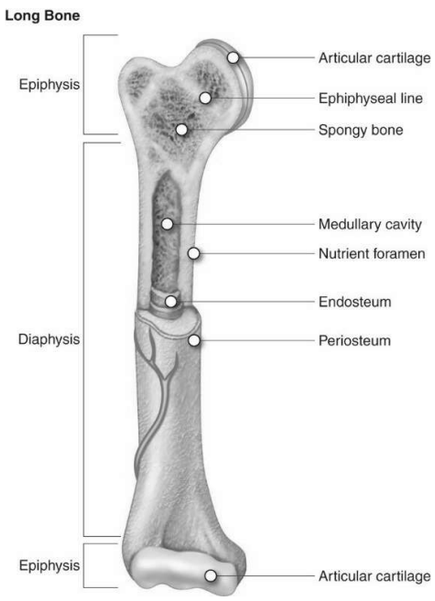


Fig. 7.1 Long bone

2)Short bones : They do not have shaft. They contain spongy substancecovered by shell of compact bone.eg: small bones of wrist and ankle.

3) Flat bones : They contain two layers of compact bone with spongy substance.

4) Irregular bones : Bones which do not fall into any category are irregular bones. ex: vertebrae and bones of face.

5) Seasmoid bones : They are small bones and develop in tendons of muscles. eg: Patella of knee joint.

Classification of bones:

Total 206 bones forming the human skeleton can be divided into

1) Bones of Axial skeleton:

i) Bones of skull: Bones of cranium and face.

ii) Bones of trunk:Sternum,Ribs,Vertebral column.

2)Bones of appendicular skeleton:

i)Bones of upper limbs

ii)Bones of lower limbs and pelvic girdle

Bones of Axial Skeleton:

I) Bones of skull

i) Bones of Cranium : Cranium is called as brain box. It is a large, hollow bony case. It is formed by fusion of various bones with zigzag edges. Cranium is formed by 8 bones.

1Frontal bone

2Parietal bone

2 Temporal bones

1 Occipital bone

1 Sphenoid bone

1 Ethmoid bone

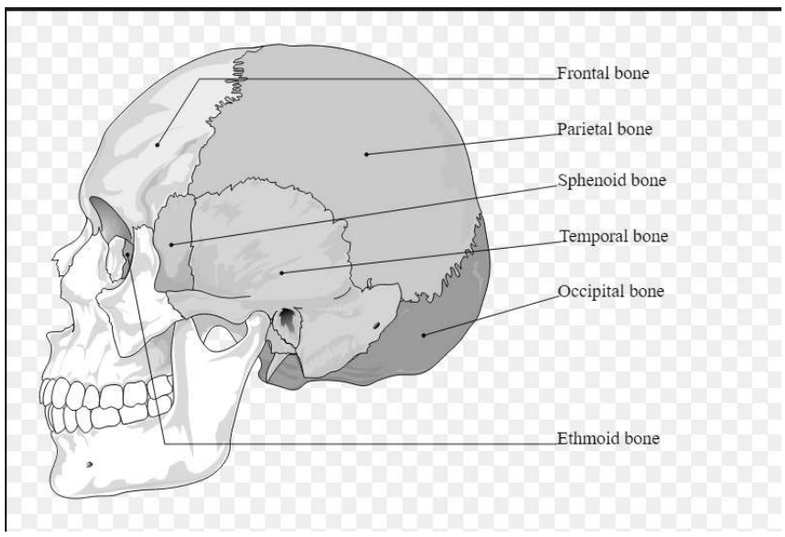


Fig 7.2 – Cranial Bones

Cranial Sutures : Immovable joints of bones of skull are called sutures. There are 3 sutures in cranium.

1. Coronal suture : It is the immovable joint between frontal bone and parietal bones
2. Sagital suture : It is the immovable joint between the two parietal bones.
3. Lambdoid suture : It is the immovable joint between occipital bone and parietal bones.

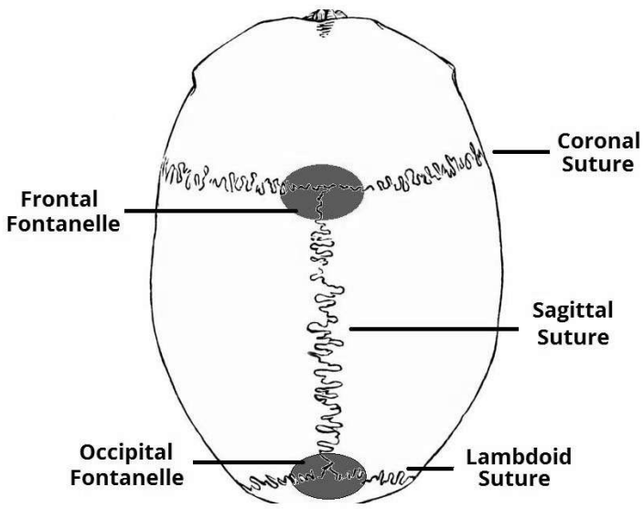


Fig 7.3 Cranial sutures .

ii) Bones of Face : Bones making the face are 14 in number.

i) Nasal bone

ii) Lacrimal bone

iii) Ethmoid bone

iv) Maxilla - 2 (upper jaw)

v) Mandible-1 (lower jaw)

vi) Mastoid process

vii) Zygomatic bones -2 (cheek bones)

viii) Palate bones -2 (roof of mouth cavity and hard palate)

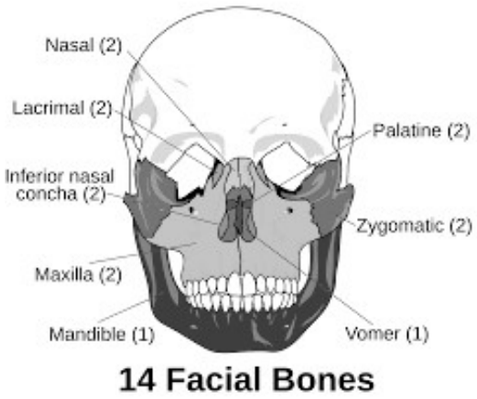


Fig 7.4 Facial bones

Sinuses : Sinuses are the cavities in the bones of skull and communicating with nose.

1) Frontal sinuses

2) Maxillary sinuses

3) Ethmoidal and

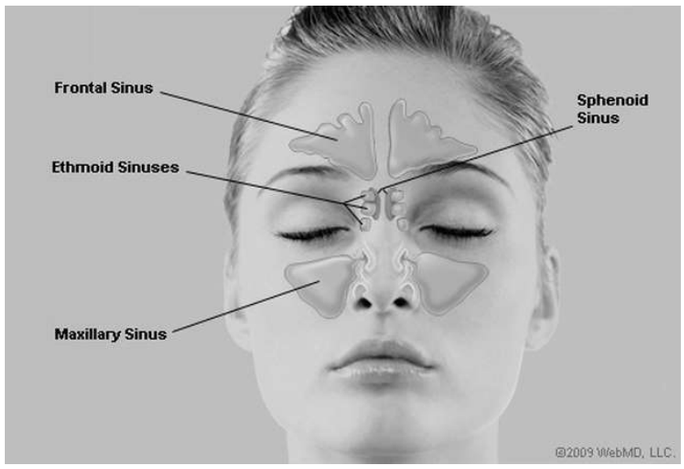
4) sphenoidal sinuses.

Functions of sinuses:

1) Lightening of bones of face and cranium.

2) Giving resonance to voice

Fig 7.5 Sinuses



Cranial fossae:

Base of the skull is divided into three fossae.

1) Anterior cranial fossa: It is is formed by horizontal plates of frontal bone..

2) Middle cranial fossa: It is formed by sphenoid bone and petrous portion of temporal bones

3) Posterior cranial fossa.: It is formed by occipital bone

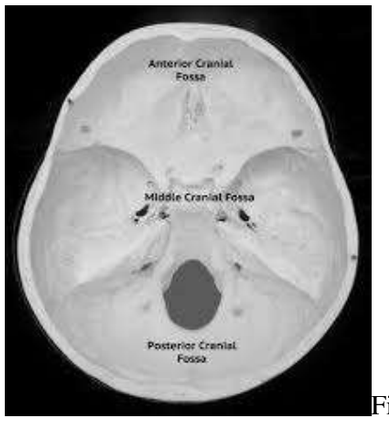


Fig. 7.6 Cranial fossa

II) Bones of trunk:

i) Sternum : It is a long flat bone. Itruns down the front of thorax. It is divided into three parts.

a) Manubrium sterni b) Body c) Xiphoid process.

ii) Ribs : They are 12 pairs of arched bones attached on back side to thoracic vertebrae.On the basis of attachment to sternum, they are classifiedas,

1) True ribs -attached to the sternum directly. First seven pairs are true ribs.

2) False ribs - attached to the sternum throughcostal cartilages.Remaining five pairs are false ribs. Of these, last two pairs are known as floating ribs.

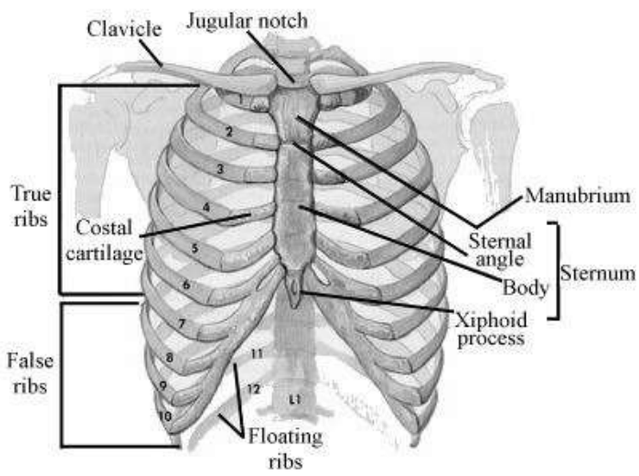


Fig 7.7 Rib Cage

iii) Vertebral column : Vertebral column made of a number of irregular bones called vertebrae. There are 33 vertebrae which are connected to one another.They are capable of limited movement. Main functions of vertebral column are,

1) Supporting spinal cord.

2) Protecting spinal cord.

3) Cushioning when jumping and landing on feet

Ligaments holding the vertebrae are,

1) Anterior and posterior ligaments

2) Ligamenta flava

3) Supraspinous ligaments

4) Intervertebral discs

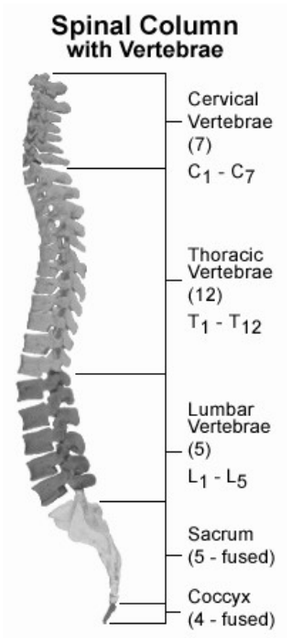


Fig. 7.8 Vertebral column

Structure of typical vertebra : Except atlas and axis, remaining vertebrae have common features. Each vertebra consists of the following parts.

a) Body - cylindrical in shape and lying to the front.

b) Vertebral arch (also called neural arch) - posterior part. It encloses vertebral foramen.

c) Vertebral foramen - Spinal cord passes through this foramen.

d) Spinous process - directed backwards and downwards.

e) Two transverse processes - projecting laterally for attachment of muscles and ligaments

f) 4 articular processes -They meet corresponding processes of adjoining vertebrae.

g) Laminae - wide parts of arch carrying spinous process.

h) Intervertebral discs - They are discs of fibrocartilage for connecting one vertebra to another. Each disc has outer ring of fibrous cartilage and inner core callednucleus pulposus.

Vertebrae are divided into five groups.

1) Cervical vertebrae- 7 in number forming the neck region.They are the smallest. First cervical vertebra iscalled atlas and the 2nd vertebra is called Axis

2) Thoracic vertebrae - 12 in number forming Thorax

3) Lumbar vertebrae - 5 in number forming lumbar region.

4) Sacral vertebrae - 5 in number forming sacrum.

5) Coccygeal vertebrae - 5 in number forming coccyx

III) Appendicular skeleton:

i) Bones of upper limb :

Upper limb consists of shoulder, upper arm, fore arm, wrist and fingers.

a) Bones of shoulder girdle - Scapula, clavicle on each side

b) Bones of upper arm-Humerus on each side.

c) Bones of fore arm -Radius and ulna on each side.

d) Bones of wrist : - 8 carpal bones arranged in two rows.

e)Bones of palm - metacarpals on each side.

f) Bones of fingers - phalanges

Functions of upper limb are locomotion, posture, giving stability to trunk.

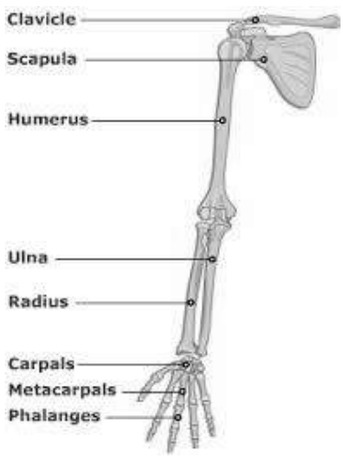


Fig 7.9 upper limb

ii) Bones of lower limbs and pelvic girdle :

Bones of pelvic girdle : Pelvic girdle forms link between trunk and lower limbs.

Differences between male and female pelvis :

Female pelvis is shorter , wider , shallower than male pelvis.

Pubic arch forms obtuse angle in females whereas it forms acute angle in males.

Bones of the lower limb:

i) Femur (thigh bone) : It is the longest and the strongest bone of the body

ii) Patella (knee cap)

iii)Tibia : It is inner bone of leg and is stronger than fibula

iv) Fibula : It is outer bone.It does not participate in weight bearing.

v) Tarsal bones(ankle bones)

vi) Metatarsal bones

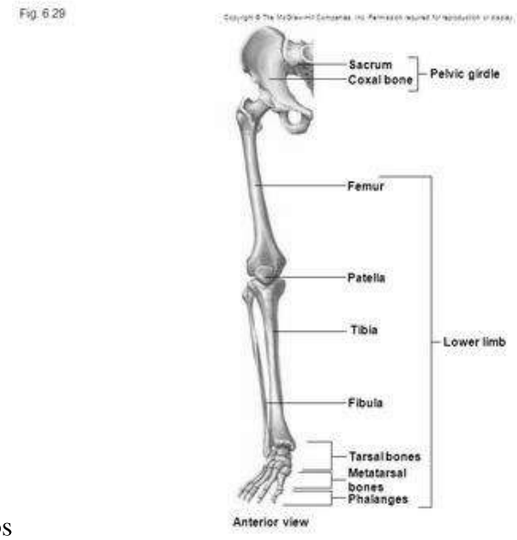


fig 7.10 lower limbs

JOINTS

Definition : Joint or articulation is a junction between two or more bones. Joint is completely surrounded by a fibrous capsule lined with synovial membrane.eg: Elbow joint

Classification of joints : Joints are classified depending on the degree of movement allowed. There are three types of joints.

1) Fibrous joints (Immovable)

2) Cartilaginous joints (Slightly movable)

3) Synovial joints (Freely movable).: It is the joint between the bones where bones are free.

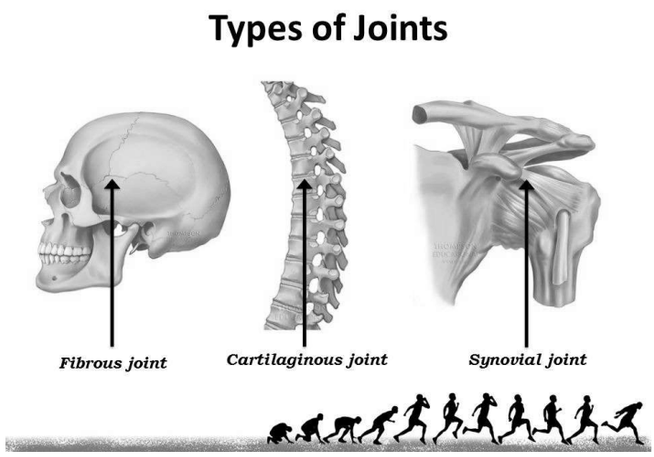


Fig 7.11 Types of joints

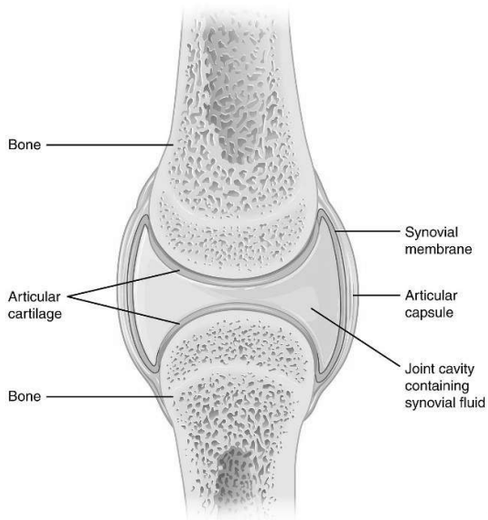


Fig 7.12 synovial jointS

Questions

Essay questions:

1) Classify bones of human skeleton and write about bones of cranium.

2) Classify bones. Write in detail about the bones of trunk.

3) Write note on bones of upper limb, lower limb and bones of wrist and hand.

4) Classify joints. What are different synovial joints?

Short Answer Questions

1) What are the functions of skeletal system?

2) Define ossification. What are the types?

3) Write the classification of bones?

4) Name the bones of skull.

5) Write the list of bones of the wrist.

6) Write the bones of upper limb.

7) Write the bones of lower limb.

8) Write the composition of bone.

9) What are sutures. What are the types?

12) What are fontanelles? Mention the types.

13) Mention the sinuses of skull.

14) What are the functions of sinuses.

15) Mention the bones of the face.

17) Name the bones of upper limb.

20) Mention bones of thorax.

21) What are different types of vertebrae?

22) Mention the number of 1) Thoracic vertebrae 2) Lumbar vertebrae

23) Write the names of pelvic girdle.

24) What are the features of pubis bone?

25) Write the parts of pelvis.

26) What are the differences between male and female pelvis.

27) Mention the bones of lower limb.

30) What are the bones of foot?

35) Mention the types of joints.

36) Write the characteristics of synovial joints.

UNIT – 8

NERVOUS SYSTEM

Nervous system controls and integrates the functions of human body. It consists of neurons, its fibres, dendrites and axons.

Nervous tissue: It is composed of 1) Neurons 2) Neuroglia

1) Neuron:

i) It is the structural and functional unit of nervous system.

ii) It is made of nerve cell body, dendrites and axons.

ii) Nerve cell body consists of large nucleus, neurofibrils and Nissl granules, which are present in the neuroplasm.

iii) Dendrites receive impulses and transmit them to the nerve cell body.

iv) Axons carry impulses away from the nerve cell body.

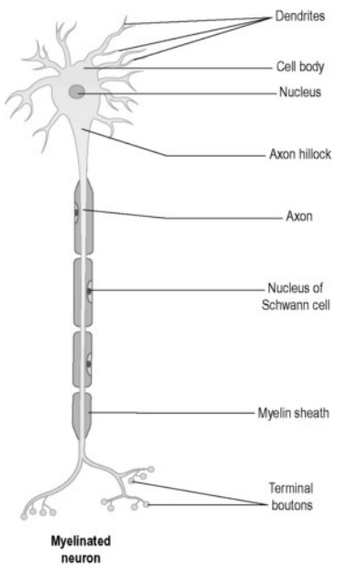


Fig 8.1 Neuron

Types of neurons: On the basis of number of processes, they are classified into,

a) Apolar neurons – Neurons having no processes (seen in fetal life)

b) Unipolar neurons – Neurons having only one process axon (seen in fetal life)

c) Bipolar neurons – Neurons having one axon at one pole and dendrite at the other pole. (Eg: Retina)

d) Pseudo unipolar neurons – Neurons, which are typically bipolar at first and spindle shaped, but later processes converge to meet at one side of the cell body. Eg: They are found in all spinal ganglia and ganglia of cranial nerves except 8th cranial nerve.

e) Multipolar neurons – Neurons having most varied form. (Eg: Cerabral cortex)

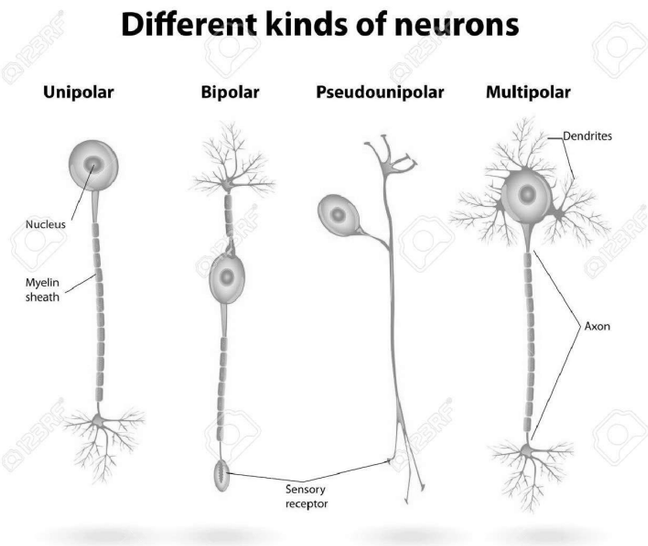


Fig 8.2 Different kinds of Neurons

Types of nerve fibres: Histologically there are two types of nerve fibres.

I) Myelinated nerve fibres - Axon is covered by myelin sheath except at the nodes of Ranvier.

2) Non myelinated nerve fibres - Axons are not covered by myelin sheath.

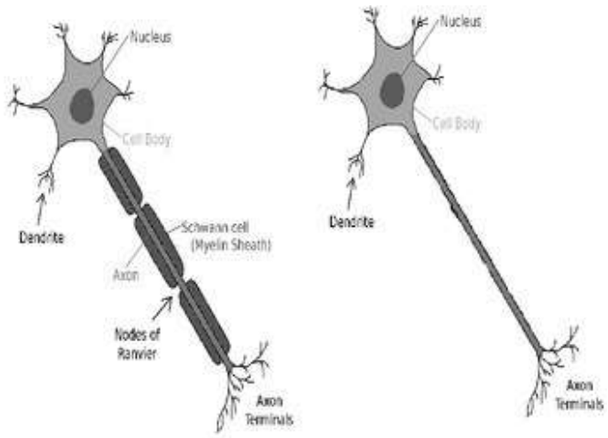


Fig 8.3 Myelinated and non myelinated neuron

2) Neuroglia: Neuroglia is a special type of interstitial tissue present both in grey and white matter. There are three types of neuroglia.

1) Astrocytes 2) Oligodendroglia 3) Microglia

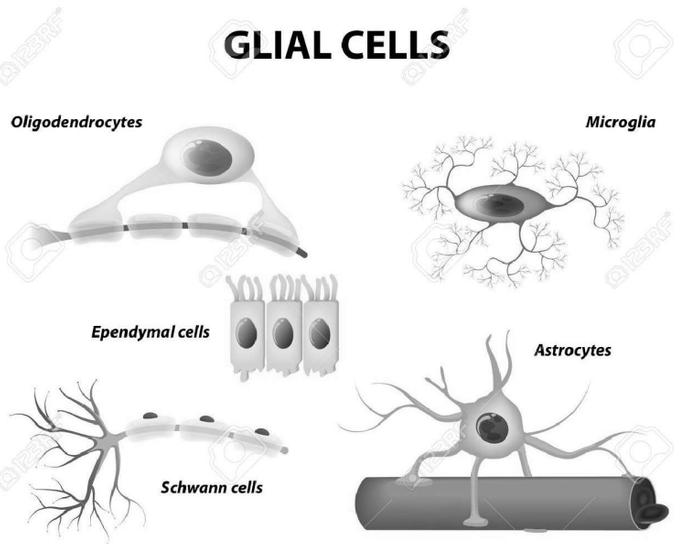


Fig : 8.4 Neuroglial cells

Synapse: Synapse is the junction where one neuron ends and another neuron begins. There are 3 types of synapses.

1) Axosomatic synapse : Presynaptic terminal of the axon ends in the cell body of neuron.

2) Axodendritic synapse : Presynaptic fibres of any axon end in the dendrites of postsynaptic cell.

3) Axo-axonic synapse. : Presynaptic fibres of any axon ends in the axon of the postsynaptic cells.

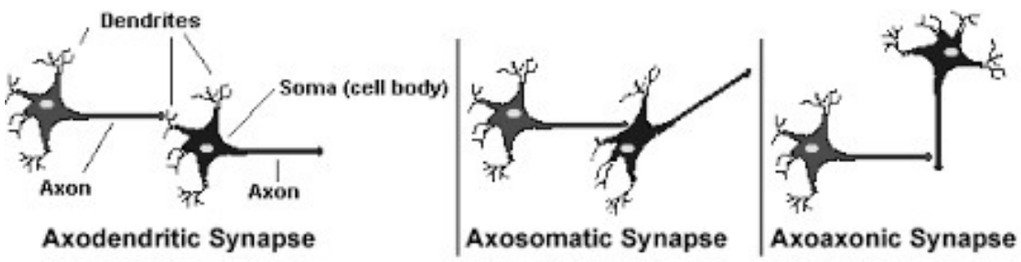


Fig 8.5 Types of synapse

Neuromuscular junction: It is the junction where motor nerve ends into muscle. It is contact between a motor neuron and a muscle fibre causing muscle contraction.

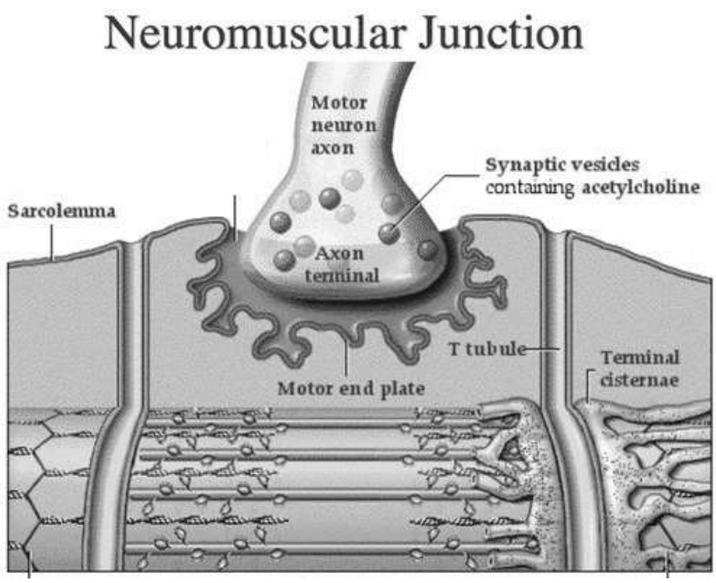


Fig 8.6 Neuromuscular junction

Functionally, the nerve endings are two types. 1) Motor nerve endings 2) Sensory endings (sensory receptors).

Receptors: Sensory receptors are a specialised structure that can be stimulated by environmental changes as well as by changes within the body. It can be defined as the terminal afferent endings that undergo depolarisation in response to specific type of physical stimuli.

Reflex arc: Reflex arc is complete pathway for a reflex action. It comprises of three parts.

1) Afferent limb- It consists of receptor and afferent nerve fibre.

2) Centre- It consists of nerve cells

3) Efferent limb- It consists of a) efferent or motor nerve fibre and its endings b) effector organ i,e, muscle.

4) Synapse – This is link between two neurones.

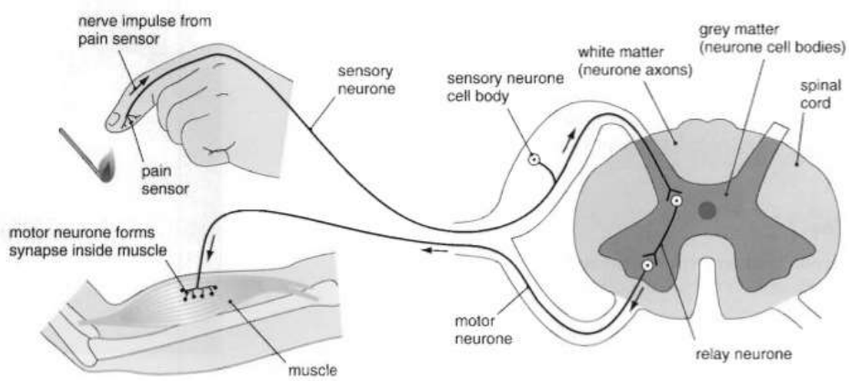


Fig 8.7 Reflex ARC

Brain: It consists of Cerebrum , Cerebellum and Brain stem.

Cerebrum: The cerebrum is the largest part of the brain and is composed of right and left hemispheres. It performs higher functions like interpreting touch, vision and hearing as well as speech, reasoning, emotions, learning, and fine control of movement. They are connected by corpus callosum which is broad band of commissural fibres. Gray matter of Cerebrum is called cortex.

Each hemisphere has five main lobes.

1) Frontal lobe → mainly consists of speech centre.

2) Parietal lobe → higher appreciation of sensation

3) Occipital lobe → consists mainly of visual cortex

4) Temporal lobe → consists of auditory cortex

5) Limbic area.

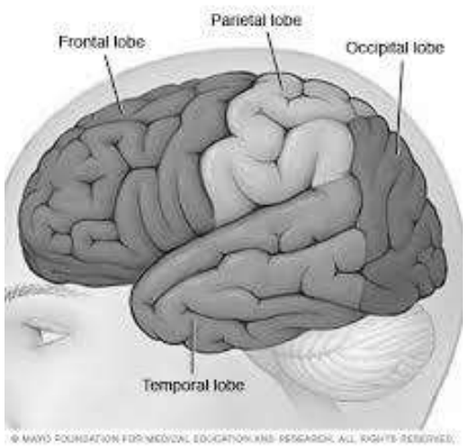


Fig 8. 8: Lobes of cerebrum

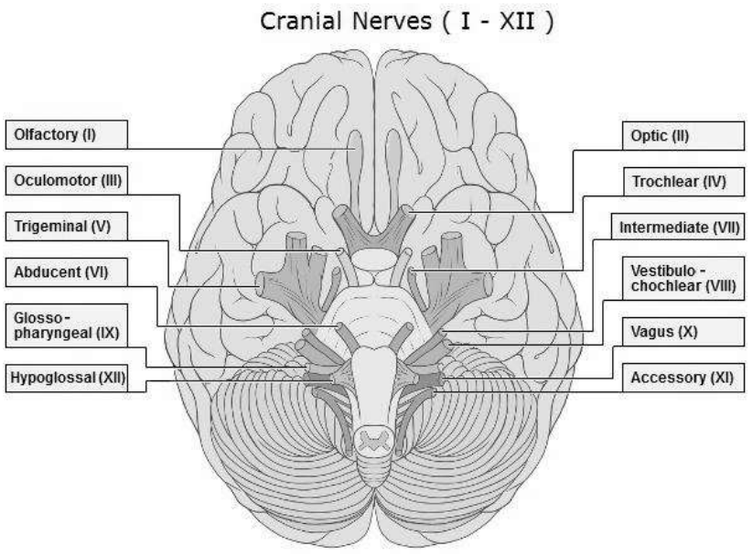


Fig 8.9 Cranial Nerves

Cerebellum: The **cerebellum** is located under the cerebrum. Its function is to coordinate muscle movements, maintain posture, and balance.

Brain stem: It includes,

1) Midbrain: It is connection between fore brain and hindbrain.

2) Medulla oblongata: It is also called spinal bulb. It is continuation of cervical part of spinal cord and is conically expanded. It extends from foramen magnum to the caudal border of pons.

3) Cerebellum: Cerebellum is the largest part of hind brain. It lies behind pons and medulla oblongata.

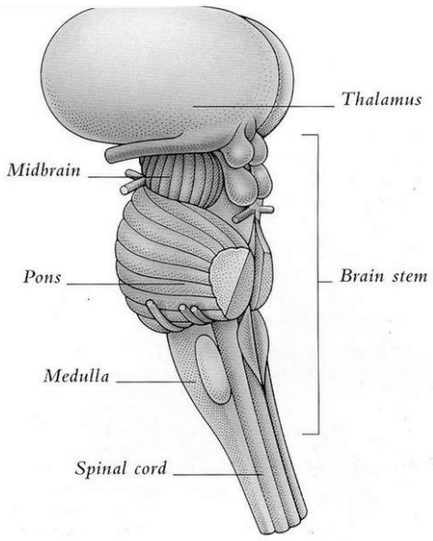


Fig 8.10 –Brain stem

Deep structures

Hypothalamus - It is located in the floor of the third ventricle and is the master control of the autonomic system. It plays a role in controlling behaviors such as hunger, thirst, sleep, and sexual response. It also regulates body temperature, blood pressure, emotions, and secretion of hormones.

Pituitary gland – It lies in a small pocket of bone at the skull base called the sella turcica. The pituitary gland is connected to the hypothalamus of the brain by the pituitary stalk. Known as the "master gland," it controls other endocrine glands in the body. It secretes hormones that control sexual development, promote bone and muscle growth, respond to stress, and fight disease.

Pineal gland – It is located behind the third ventricle. It helps regulate the body's internal clock and circadian rhythms by secreting melatonin. It has some role in sexual development.

Thalamus – It serves as a relay station for almost all information that comes and goes to the cortex (Fig. 5). It plays a role in pain sensation, attention, alertness and memory.

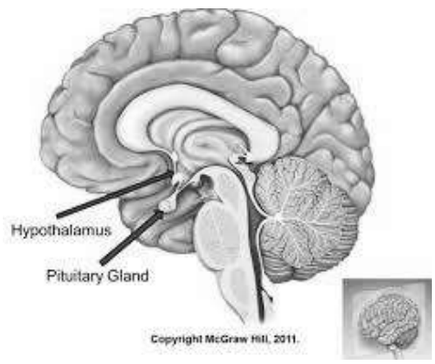


Fig 8.11 Hypothalamus

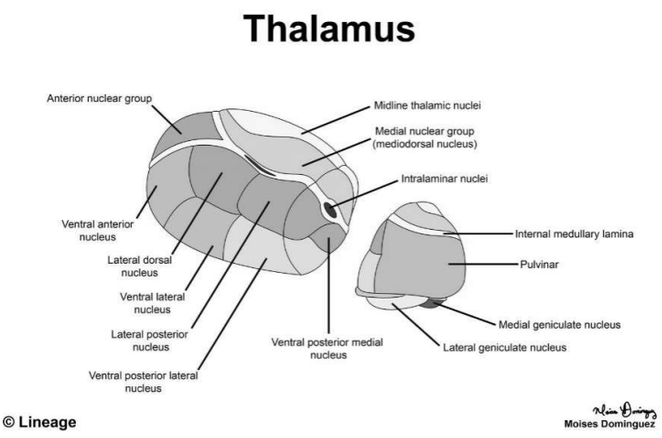


Fig. 8.12 Principal thalamic nuclei

Meninges:

The brain and spinal cord are surrounded by three coverings beneath the bones.

These layers from within outward are

1. Piamater: (closely covers the brain and spinal cord.)

2. Arachnoid mater: It is delicate layer lying between dura mater and pia mater. In between arachnoid mater and piamater there is a space called subarchnoid space. Cerebrospinal fluid fills up this space.

3. Dura mater: It is the outer most, tough fibrous membrane.

There is a space between dura mater and arachnoid mater called subdural space.

All the meninges give protection to the brain and the spinal cord.

Cerebral Ventricles: These are the cavities in the brain where CSF flows and bathes the whole brain. There are four ventricles

i) Two lateral ventricles - They present in the cerebrum

ii) Third ventricle – It lies in between two halves of the thalamus

III) Fourth ventricle - It lies in front of cerebellum and behind the medulla oblongata and pons.

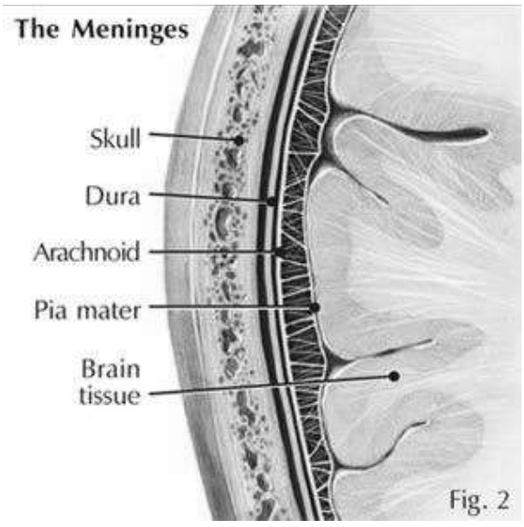


Fig 8.13 Meninges

Cranial nerves : They are twelve pairs.

Table 1: Cranial nerves

Number	Name	Function
I	Olfactory	Smell
0II	Optic	Sight
III	Oculomotor	Moves eyes, pupil
IV	Trocheal	Moves eyes
V	Trigeminal	Face sensation

VI	Abducens	Moves face
VII	Facial	Moves face
VIII	Vestibulocochlear	Salivation, hearing , balance
IX	Glassopharyngeal	Taste, Swallow
X	Vagus	Heart rate, digestion
XI	Accessory	Moves head
XII	Hypoglossal	Moves tongue

Classification of cranial nerves based on function

Sensory nerves :

I Olfactory - smell

II Optic - vision

VIII Vestibulochochlear - for hearing and balance

Motor :

III Oculomotor - eye movements

IV Trochlear - innervates Superior Oblique muscle depresses and rotates eye

VI Abducens - abducts the eye by innervating lateral rectus muscle.

XII Accessory - controls Sternocleidomastoid and Trapezius muscle.

Mixed – Both sensory and Motor

V Trigeminal - Muscles of Mastication

VII Facial - helps in facial expression and taste

IX Glossopharyngeal – Taste

X Vagus – Parasympathetic action

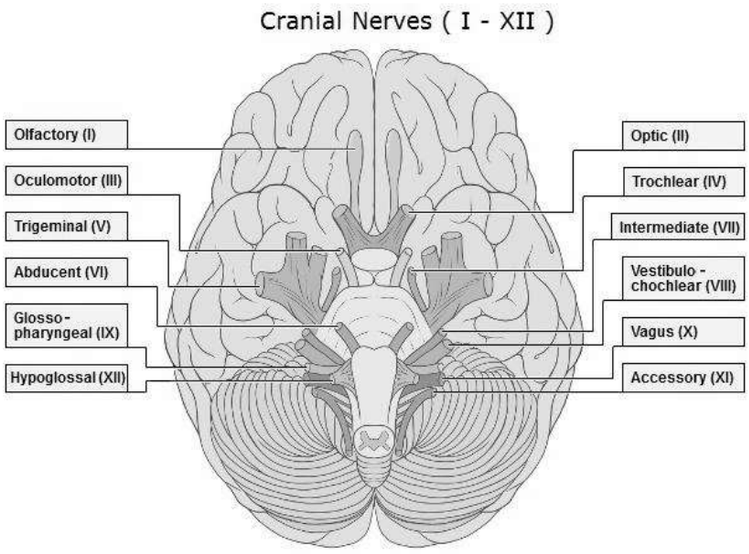


Fig 8.14 – Cranial Nerves

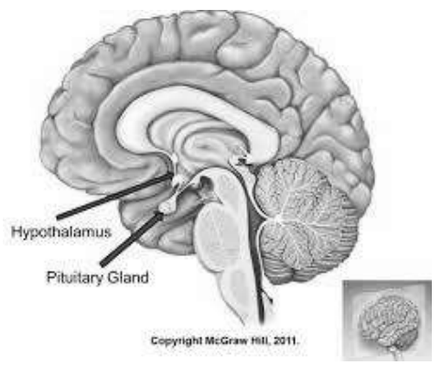


Fig 8.15 Hypothalamus

Thalamus: It is a large collection of nerve cells.

It is useful for relaying of sensory signals and motor signals.

It is helpful in regulation of consciousness, sleep and alertness.

It is located at the top of mid brain.

Basal ganglia

i) Corpus striatum (caudate nucleus and putamen)

ii) Globus pallidus

iii) Substantia nigra (contains melanin)

iv) Subthalamic nucleus

Internal capsule: It is a 'V' shaped band of fibres. It is bounded medially by thalamus and caudate nucleus. Reticular formation which play role in wakefulness.

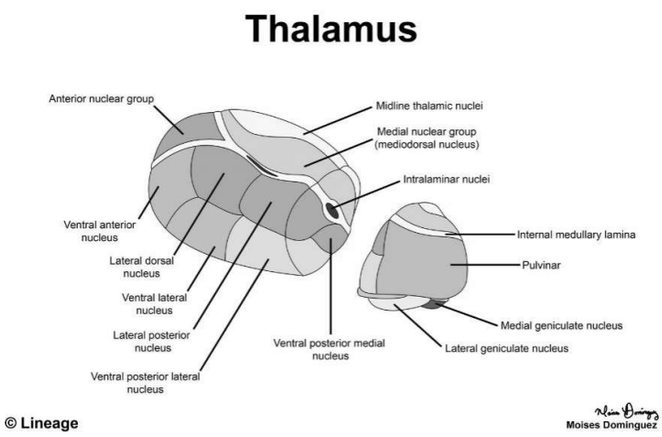


Fig. 8.16 Principal thalamic nuclei

Brain stem: It includes,

1) Midbrain: Midbrain is connection between fore brain and hindbrain.

2) Medulla oblongata: It is also called spinal bulb. It is continuation of cervical part of spinal cord and is conically expanded. It extends from foramen magnum to the caudal border of pons.

3) Cerebellum: Cerebellum is the largest part of hind brain. It lies behind pons and medulla oblongata.

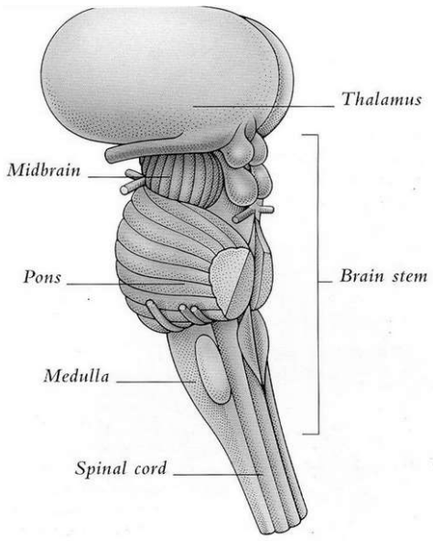


Fig 8.17 –Brain stem

Spinal cord:

It is a long cylindrical flattened nervous cord.

It is located in the vertebral column.

It extends from level of foramen magnum above to the level of the disc between 1st and 2nd lumbar vertebrae below.

Lower end of spinal cord consists of a bunch of nerves called as cauda equina.

The terminal nerve is thin and long. It is called filum terminale.

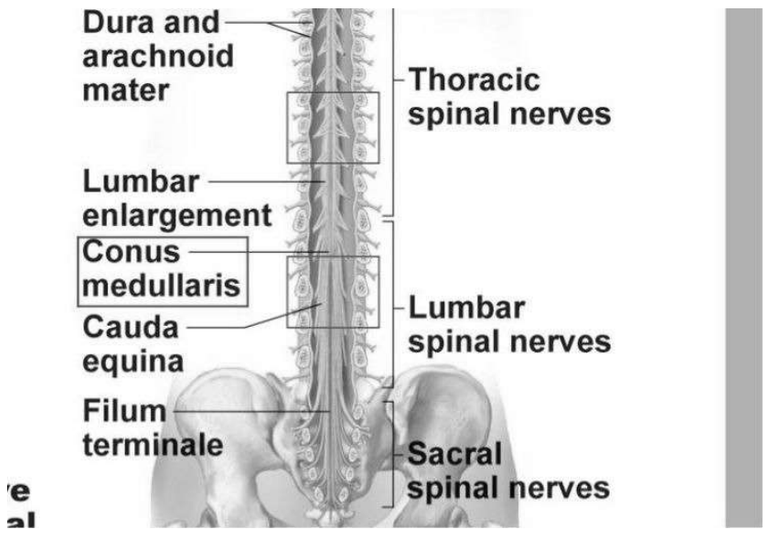


Fig 8.18 Spinal cord

T.S. of spinal cord:

T.S. of Spinal cord shows 1) Central canal 2) Gray matter 3) White matter

1) Central Canal: Central canal is in the middle of the spinal cord. It is lined by cubical ciliated epithelium. Cerebrospinal fluid (C.S.F) circulates through this canal.

2) Gray matter: It is divided into 2 parts

i) Gray matter in front of the central canal is known as anterior (ventral) gray commissure.

ii) Gray matter behind the central canal is known as posterior (dorsal) gray commissure.

It is chiefly composed of three elements a) nerve cells b) neuroglia c) nerve fibres.

3) White matter: It surrounds the gray matter and consists of myelinated and unmyelinated fibres , predominantly myelinated fibres.

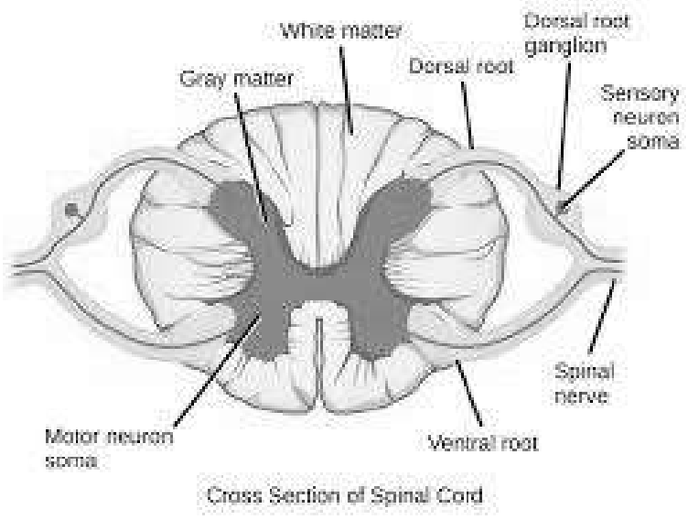


Fig 8.19 T.S of Spinal cord

Spinal nerves: There are 31 pairs spinal nerves. They are 7 cervical, 12 thoracic, 5 lumbar, 5 sacral and 2-3 coccygeal.

i) The first cervical nerve originates from the medulla oblongata and leaves the spinal canal between the occipital bone and atlas.

ii) The eighth spinal nerve emerges from the vertebral column below the seventh cervical vertebra.

iii) All the other spinal nerves emerge from the spinal cord below the vertebra whose number it bears. The coccygeal nerves pass from the lower extremity of the spinal canal.

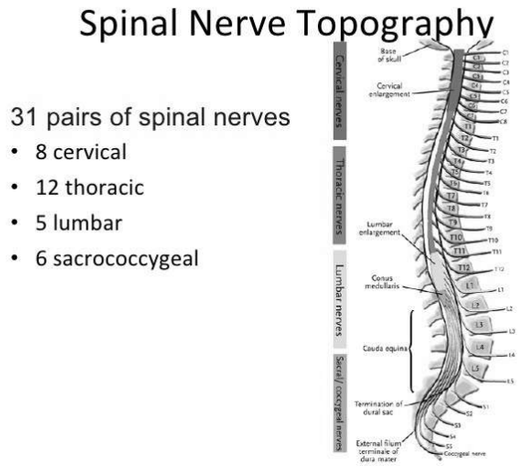


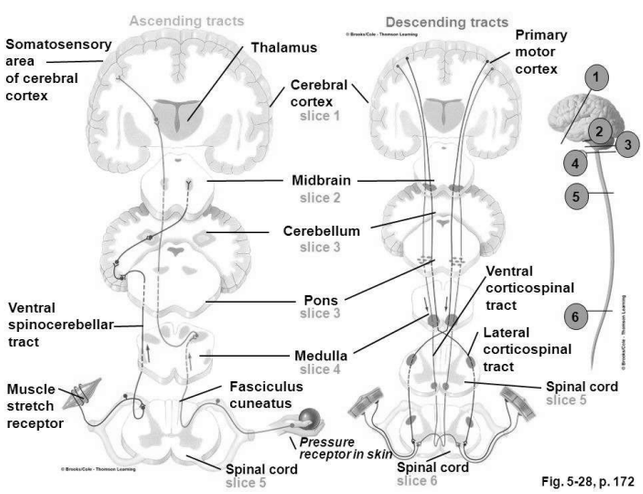
Fig 8.20 Spinal Nerves

Tracts: Fibres carrying different sensations enter the spinal cord through the posterior roots. These are divided into 3 classes.

1) Ascending tracts: Sensory tracts (carry impulses from sensory organs to Brain)

2) Descending tracts: Motor tracts (carry information from brain to voluntary organs which does the action).

3) Intersegmental fibres: Both ascending and descending.



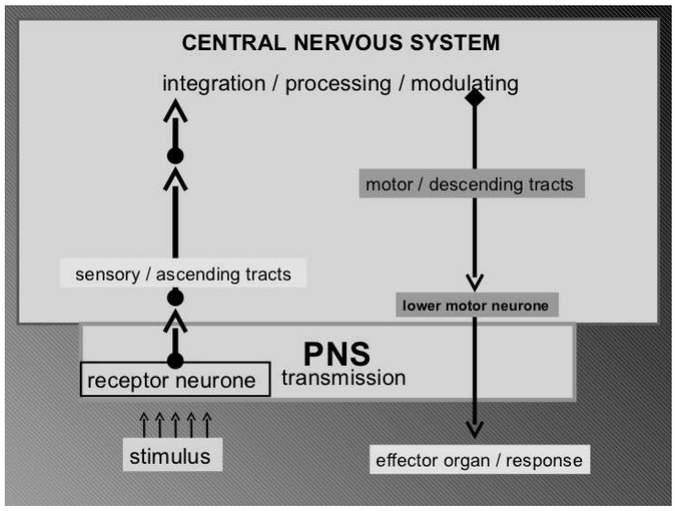


Fig 8.21 Tracts of Brain

Summary

Nervous system consists of neurons, its fibres, dendrites and axons. Nervous tissue is made of neurons and neuroglia. Neuron is the structural and functional unit of nervous system. Synapse is the junction where one neuron ends and another neuron begins. At neuromuscular junction, motor nerve fibre ends into muscle fibre. Reflex arc is complete path way for a reflex action. Cerebellum is the largest part of hind brain. Thalamus is located at the top of mid brain. Cerebrum consists of two symmetrical hemispheres. Histologically spinal cord consists of central canal, Gray matter and white matter. Spinal nerves are 31 pairs. They are 7 cervical, 12 thoracic, 5 lumbar, 5 sacral and 2-3 coccygeal. Brainstem includes mid brain, medulla oblongata and pons. Brain and spinal cord are covered by piamater, arachnoid matter and duramater. Cranial nerves are 12 pairs in number. Autonomic nervous system is divided into craniosacral and thoracolumbar systems. Diencephalon contains thalamus and hypothalamus.

Questions

Essay Questions

1) Write the anatomy of brainstem.

2) What are cranial nerves and their distribution?

3) Write in detail about the anatomy of Spinal cord.

Short Answer Questions

1) What is nervous tissue?

2) Define neuron and mention its types.

3) Write the definition and types of synapse.

4) Neuromuscular junction?

5) Receptors.

6) What are parts of reflex arc?

8) Mention types of spinal tracts.

9) What are the parts of brainstem?

10) Write about medulla oblongata.

11) Name the nuclear masses of thalamus.

12) Basal ganglia.

13) Write the lobes of each cerebral hemisphere.

14) Name the coverings of brain and spinal cord.

15) What are organs of distribution of a) Olfactory b) Facial nerves

16) Name the divisions of ANS.

17) Write the parts of Diencephalon.

18) Where is speech centre located?

UNIT - 9

ENDOCRINE SYSTEM

Endocrine system consists of endocrine glands of body.There are two types of glands in body.

I) Exocrine glands II) Endocrine glands

I) Exocrine glands : They are glands of the body with ducts.eg: mammary glands, sweat glands, lacrimal glands, salivary glands.

II) Endocrine glands: Endocrine glands are ductless glands which pour their secretions directly into blood circulation from where these secretions (hormones) reach their site of action.

I) Endocrine glands :

1) Pituitary gland (Master gland)

2) Thyroid gland

3) Parathyroid gland

4) Adrenal glands

5) Pancreas

6) Testes

7) Ovaries

8) Placenta (during pregnancy)

Thymus and pineal body are glands with probable endocrine function. Stomach, small intestine and kidneys also have endocrine activity.

Hypothalamus

Hypothalamus is a complex neurohormonal regulatory part. Diencephalon contains thalamus and hypothalamus. Hypothalamus forms lower part of lateral ventricle. It forms anterior wall of third ventricle. It is situated at the interpedencular space below the thalamus. It forms complex nuclei and fibres.

1) Pituitary gland

It is called the master gland of the body. It is reddish gray coloured and small oval shaped structure. It is located at the base of the brain in the sellaturcica of sphenoid bone. Average weight is 0.5 to 0.6 g. In females it weighs from 0.6-0.7 g. Its dimensions are 10 mm (anterio posteriorly), 6 mm (dorsoventrally) and 13 mm (laterally).

Anatomically, it has two lobes

i) Anterior lobe of pituitary gland

ii) Posterior lobe of pituitary gland

Histology of pituitary gland: It shows 6 parts.

1) Pars distalis (pars anterior) 2) Pars tuberalis3) Pars intermedia4) Pars nervosa (pars posterior or processusinfundibulis or lobusnervosus)5) Median eminence of tubercinerium. 6) Infundibulum or pituitary stalk.

Anterior lobe consists of pars distalis and pars tuberalis. Posterior lobe consists of pars intermedia and pars nervosa. Adenohypophysis consists of pars distalis, pars tuberalis and pars intermedia. Neurohypophysis consists of pars nervosa (lobusnervosus) and infundibulum (pituitary stalk or neural stalk).

Pars distalis contains acidophils, basophils and chromophobes. Pars intermedia contains basophilic polygonal or prismatic cells. Pars tuberalis contains mainly cuboidal columnar cells.

Blood Supply

Blood supply of anterior lobe : Anterior lobe of pituitary gland is supplied blood by several hypophyseal arteries. These originate from internal carotid artery and circle of willis.

Blood supply to posterior lobe : Neural lobe is supplied blood by inferior hypophyseal arteries. Vessels form capillary network while ending in pars nervosa.

Nerve supply : Few fibres from hypothalamohypophyseal tract or carotid plexus or from greater superficial petrosal nerves have control over this gland. Probably, they may be vasomotor nerves.

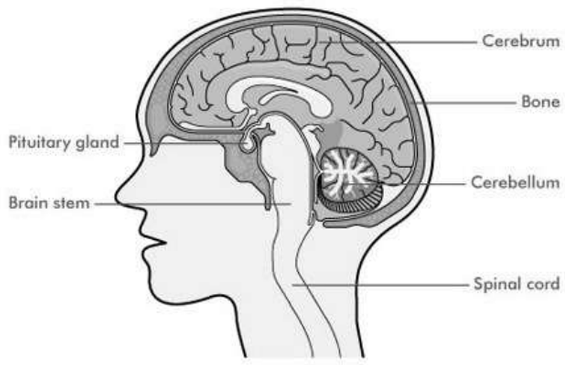


Figure :9.1 Pitutitary gland

Thyroid

This gland is situated at the root of the throat. It has two fairly lateral lobes, which are symmetrical. Each measures 5 x 2 x 2 cm3 approximately. These lobes are present one on either side of trachea. They are connected by as isthmus. Thyroid gland moves upwards during swallowing. Weight in adults is between 20-25 g. It is highly vascular gland.

Histology: It shows follicles lined by single layer of granular cuboidal cells. Bases of cells are in contact with fine basement membrane. Follicles are surrounded by highly vascular stroma. Electron microscopy reveals two types of cells, principal cells and para follicular cells.

Blood supply : Superior and inferior thyroid arteries supply thyroid gland. Internal jugular vein and innominate vein drain the gland.

Lymphatic drainage : Lateral lymph nodes of neck commonly drain lymph. Anterior mediastinal lymph nodes drain to some extent.

Nerve supply: Sympathetic fibres derive from superior, middle and inferior cervical ganglia. Parasympathetic fibres derive from superior and inferior recurrent laryngeal branches of vagus.

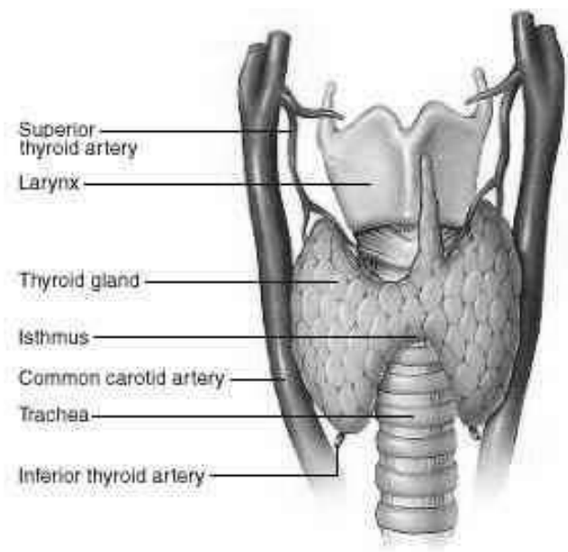


Fig. 9.2 Location and gross structure of thyroid gland

Parathyroid

It consists of four oval bodies embedded in posterior surface of thyroid. Each body measures 6 x 3 x 2 mm3. Each of the two pairs are present vertically behind each of the two lobes of thyroid. Total weight is about 140 mg. Gland is highly vascular.

Blood supply: Superior and inferior thyroid arteries supply blood.

Nerve supply:It is same as for thyroid.

Histology: There are two types of cells in parathyroid.

1) Chief cells or principal cells 2) Oxyphil cells or eosinophil cells.

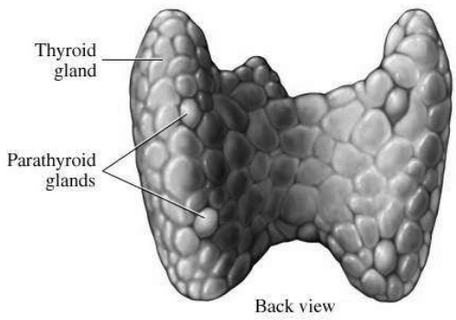


Fig. 9.3 Parathyroid glands

Adrenal glands

Adrenal glands are two in number. They are also called suprarenal glands as two glands are located on upper pole of each kidney. Right suprarenal gland is smaller than left. Dimensions of each gland are 50 x 30-40 x 10 mm3 . Average weight of each is 5-9 g. in adults.

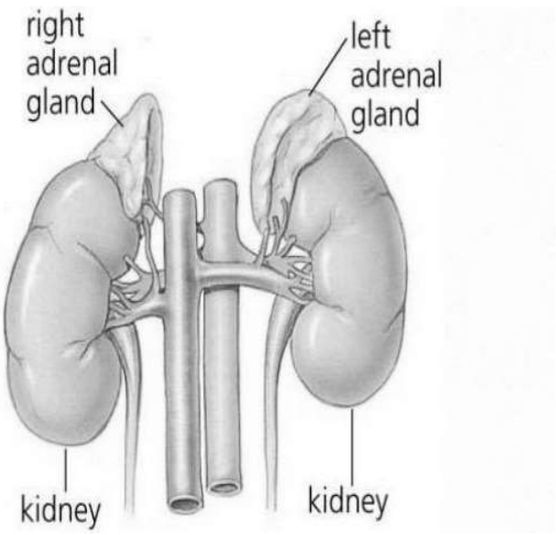


Fig. 9.4 Section of adrenal glands

Histology : There are two parts in adrenal gland.

1) Adrenal cortex - outer part consisting of,

a) Zona glomerulosa (outer) b) Zona fasciculata (middle) c) Zona reticularis (inner)

2) Adrenal medulla - Inner part consisting of irregular masses of polyhedral granular cells.

Pancreas

Human pancreas is large gland which has both exocrine and endocrine functions. It lies transversely across posterior abdominal wall behind the stomach at the level of 1st and 2nd lumbar vertebrae. It contains both exocrine cells and endocrine cells. Endocrine cells (Islets of Langerhans) are distributed all over the gland. These islets are not connected with duct system of the gland. Endocrine part constitutes about 1-2% of the gland.

There are mainly three distinct types of islet cells in human pancreas, α – cells, β – cells, δ - cells of islets of Langerhans.

Blood supply: The pancreas is supplied arterially by the pancreaticoduodenal arteries

- the superior mesenteric artery feeds the inferior pancreaticoduodenal arteries
- the gastroduodenal artery feeds the superior pancreaticoduodenal artery

Nerve supply: The pancreas receives neural innervation from the vagus (cranial X). This is part of the autonomic parasympathetic supply. The role of the vagus is to stimulate secretion of the pancreatic digestive juices.

Histology:

Darker-staining cells form clusters called acini, which are arranged in lobes separated by a thin fibrous barrier. The secretory cells of each acinus surround a small intercalated duct.The intercalated ducts drain into larger ducts within the lobule, and finally interlobular ducts. The ducts are lined by a single layer of columnar epithelium. With increasing diameter, several layers of columnar cells may be seen.

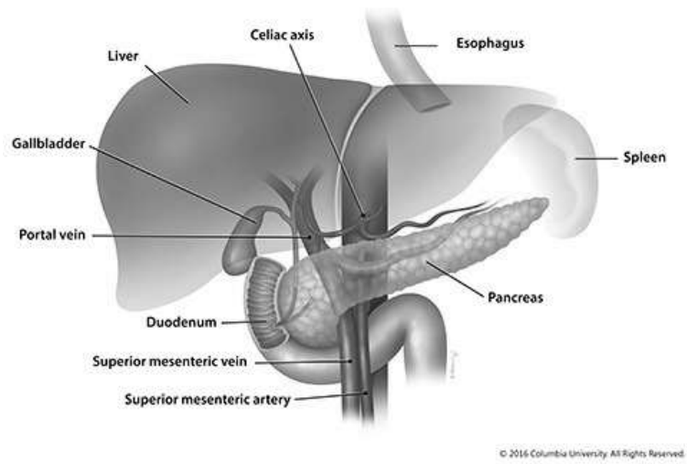


Figure :9.5 Pancreas

Testes

Testes are the male reproductive organs concerned with spermatogenesis. For anatomy refer to Anatomy of Reproductive system.

Ovaries

Ovaries Refer to Anatomy of Reproductive system.

Placenta

Placenta Refer to Anatomy of Reproductive system.

Thymus

It is both endocrine and lymphoid structure, located in the anterior and superior mediastina of thorax behind sternum. It extends from pericardium upwards upto the lower border of thyroid. There are two lobes which are fused and asymmetrical. Right lobe is bigger than left lobe. Each lobe consists of numerous lobules. Follicles of lobules have diameter of 1 mm each.

Histology: It has 3 parts

a) Capsule –It is dense connective tissue, rich in macrophages, mast cells, granulocytes and fat cells etc.

b) Cortex - which is similar to lymph tissue of ordinary lymph nodes,but deficit of primary follicles.

c) Medulla - broad, branched band of thymic tissue.

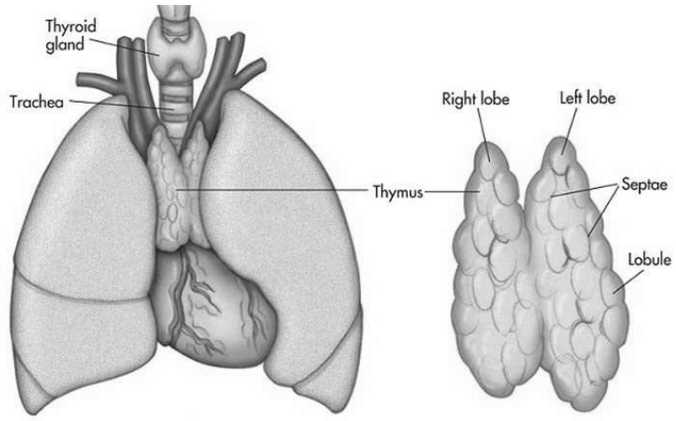


Fig. 9.6 Thymus gland

Pineal body:

Pineal body is also called epiphysis cerebri. It is flat, cone shaped and grey colored. It's length is about 5-8 mm and breadth is about 3-5 mm. Pineal body is attached to the roof of third ventricle by means of a short hollow stalk. Its histology shows two major types of cells, which are neutral in origin. They are1) Parenchymal or chief cells. 2) Interstitial or supportive cells.

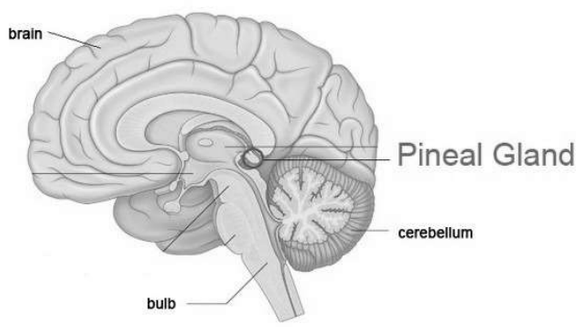


Fig. 9.7 Pineal gland

Gastro intestinal tract:

Certain localised area of GIT acts as endocrine to secrete gastro intestinal hormones. Cells responsible for endocrine activity in GIT are not known. Gastrin I and II are produced in modified epithelial cells of glandular mucosa of pyloric part of stomach. Mucosa of upper part of small intestine secretes cholecystokinin - pancreozymin hormone. Duodenal muscosa produces secretin. Wall of stomach and small intestine produce gut glucagon hormone. Human gastric muscosa contains gastrone. Mucosa of upper small intestine produces villikinin. Intestinal lumen secretes enterocrinin.

Kidneys:

Juxtaglomerular cells produce renin. Erythropoietin is largely produced by kidneys. Prostaglandins are also produced by kidneys.

Summary

Endocrines system consists of endocrine glands of body. Endocrine glands are ductless glands. Endocrine glands of human body are pituitary, thyroid, parathyroid, andrenals, pancreas, testes, ovaries and placenta (during pregnancy). Pituitary has two lobes - anterior and posterior lobes. It is located at the base of brain in sellaturica of sphenoid bone. Thyroid is located at the root of the throat. It has two lobes. Parathyroid consists of four oval bodies. Each of the two pairs are present vertically behind each of the two lobes of thyroid. Adrenal glands are present on upper pole of each kidney. Pancreas lies transversely across posterior abdominal wall behind the stomach at the level of 1st and 2nd lumbar vertebrae. Testes, ovaries and placenta have endocrine activity of producing sex hormones.

Thymus is located in the anterior and posterior mediastina of thorax behind sternum. Pineal body is attached to the roof of third ventricle.

Questions

Essay Questions

1) What are different endocrine glands of body? Write the anatomy of pituitary.

2) Discuss anatomy and histology of thyroid with diagrams.

3) Disribe the anatomy and histoly of pancreas with diagrams.

Short Answer Questions

1)What are the major types of endocrine gland.

2) What are exocrine glands.

2)Write any four endocrine glands of body.

3) Write the anatomical location of pituitary gland

4) What are the lobes of pituitary?

5)Mention the parts of adenohypophysis and neurohypophysis.

6)Where is thyroid located? Write the dimensions.

7)Write the location and dimensions of parathyroid.

8)What are the types cells in parathyroid?

9)Mention the parts in adrenal gland.

10)What are different islet cells of pancreas?

11)Mention the endocrines secreting female sex hormones.

12)Where is thymus situated?

13)Write the histological parts of thymus.

14)Write the major types of cells of pineal body.

UNIT – 10

REPRODUCTIVE SYSTEM

Reproduction is the process of producing same type of offsprings.

There are two sexes.

1. Males - masculine characters are dominant and feminine features are rudimentary.
2. Females - feminine characters dominant and masculine features are rudimentary.

Balance of male and female sex hormorones is essential for physical and mental get up of male or female.

Puberty : Puberty is onset of reproductive life. Usually, onset of puberty is between 12 and 16 years. Reproductive capacity stops in old age.

Menarche : It is the first appearance of menstruation in females.

Menopause : It is cessation of menstruation in females. It is usually between 45th and 55th years of age.

Differentiation of sex: Male spermatogonia and female oogonia contain 23 pairs of chromosomes each as in somatic cells. These are divided into,

1. Autosomes - 22 pairs do not play any role in sex determination.

2.Sex chromosomes - Last pair plays important role in sex determination. In females, there are 2 X chromosomes i.e. XX which are of homoglogous type. In males there are one X and one Y and hence called heterologous type.

In the process of fertilisation,zygote is formed by union of sperm and ovum. If X chromosome of male unites with ovum (X), two sex chromosomes will be identical and resulting offspring is female (XX). If Y sex chromosome of male unites with ovum (X), two sex chromosomes will be different and resulting offspring is male (XY).

Testes

Functions of testes: 1) Spermatogenesis takes place in seminiferous tubules.There are 2 stages.

a)Spermatocytogenesis- It is the first stage in the formation ofspermatozoa. Spermatogonia divide into spermatocytes and then into spermatids.

b) Spermiogenesis - Spermatids are converted iinto spermatozoa.

2) Secretion of testosterone by interstitial cells of Leydig -They occupy less than 10% of volume of testes. They secrete a hormone called testosterone. At puberty, pituitary interstitial cell stimulating hormone (ICSH) rises and stimulates the development of interstitial cells of Leydig.

Semen : It is suspension of spermatozoa in the fluid secreted by epiddiymis, prostate, seminal vesicle, cowper's glands (bulbo-urethral glands). Volume of semen at each emission is about 3-4 ml. Reaction ranges from 7.2 to 8.9 (alkaline). Average pH is 7.8. Normal sperm count is 40-300 millions/ ml. of semen. Count of spermatozoa less than 20 millions/ml. of semen can generally cause infertility.

Sperm count is same as WBC count using WBC pipette. Diluting fluid is different. Motility of spermatozoa is determined by counting at least 500 spermatozoa and taking average.

Ovaries

Functions of ovaries :

1) Formation of mature ova: Each ovary contains germinal epithelium, the outermost covering of ovaries. It sends down genital cords. They cut off from surface and break into small islands of cells. Of these cells, one enlarges and gets differentiated from neighbouring cells. It is called primary oocyte. Rest of the cells surround this primary oocyte and form primordial follicles. From the onset of puberty, under the influence of Follicle stimulating hormone (FSH), only one follicle matures, discharging one ovum at each menstrual cycle. During the whole sexual life of female, only 400-500 mature and ovulate. Others degenrate.

2) Secretion of hormones- Four hormones are secreted. a) Oestrogen b) Progesteronec) Androgen d) Relaxin.

With these four hormones, ovary controls whole reproductive life of female. It is responsible for 1)Puberty changes 2) Pregnancy and associated changes 3) Parturition.

Ovulation : The process of rupture causing release of ovum is called ovulation. It occurs between 13th to 17th day after first day of menstruation in human female.Maturation of follicle takes place in 10-14 days. It increases in size gradualy and migrates to the surface.

Surface layer of ovary undergoes necrosis. Enlarged follicle protrudes from the surface of ovary. Follicle ruptures due to increasing pressure. Ovum is discharged near the end of follopian tube. Ciliary movement of tubular epithelium carries the ovum released near the mouth of follopian tube along the tube. Approximately, in 72 hours after ovulation, ovum arrives at uterus. Ovum will not remain functionally active after few days.

Ovarian cycle : Adult ovary undergoes recurring cyclic process of ovulation and menstruation. It occupies about 28 days. The cycle begins on the first day of menstruation.

Ovarian cycle consists of two phases.

1) Follicular phase 2) Luteal phase

Ovulation occurs normally between 13th to 17th days of cycle, separating the two phases. Menstruation takes place 14 days after ovulation, if fertilisation does not take place.

Ejaculation : It is the act of sudden ejection of semen out of urethra at the time of orgasm. It is a sympathetic activity. At the time of ejaculation, sympathetic impulses prevent micturition by causing - a) Relaxation of detrussor muscle& b) Constriction of internal sphincter. This act also prevents reflux of semen into bladder.

Fertilisation : Fertilisation is the process of penetration of ovum by spermatozoa recently deposited in the genital tract. Fertilisation usually occurs at ampullaryisthmic junction of fallopian tube. Once fertilisation of ovum takes place, further penetration by other sperms is prevented. Blastocyst is formed after fertilisation. Blastocyst is the developing embryo, which moves down the uterine tube into uterus.

Implantation: Implantation is attachment of blastocyst to uterus.It usually occurs between seventh and ninth days ofafter ovulation.Implantation occurs by erosion of epithelial cells of uterine mucosa and penetration of blastocyst.

Menstruation: It is the process of cyclical discharge of unfertilised ovum along with blood, mucus, strips of endometrium and leukocytes. After discharge, clotting takes place due to rapid formation of fibrin.

In each ovarian cycle, endometrium proliferates to prepare suitable bed to receive and implant blastocyst. This proliferated mucosa is converted into placenta in case of conception.If conception does not take place, this hypertrophied mucosa breaks down and discharged along with unfertilised ovum, blood and leucocytes.

Endometrial changes during menstrual cycle are divided into

1)Resting phase or follicular phase of healing of endometrium.(1st-5thday)

2)Proliferative phase of maturation of graafian follicle.(6th-14th day until ovulation)

3)Premenstrual or luteal phase of growth of corpus luteum.(15th-28th day)

4)Destructive or menstrual phase of degeneration of corpus luteum.(starting on 28th day and lasting upto 4-6 days)

Pregnancy : Conception occurs if ovum is fertilised. At the end of pregnancy, parturition takes place. It is normally 280 days of gestation period in human females (10 menstrual cycles).

Physiological changes during pregnancy are Hypertrophy and thus enlargement of uterus, Development of placenta, Enlargement of birth canal and relaxation of pelvic ligaments, Proliferation and development of breasts, Formation and growth of corpus luteum, Cessation of ovulation, Raise of blood volume,blood cholesterol,plasma fibrinogen,plasma globulin etc., Lowered plasma albumin,plasma iron levels, Increased erythrocyte sedimentation rate, Increased cardiac output, Increased vital capacity,tidal volume and pulmonary ventilation, Nausea&vomiting in early months,hypochlorohydria and hypotonicity of colon often seen. Other changes are Increased glomerular filtration and some times glycosuria,Excretion of oestrogen, pregnanediol and placental gonadotrophin, Enlarged thyroid gland and increased thyroid hormones secretion, Enlarged adrenal cortex (Zona fasciculata) and increased secretion of cortisol, Enlarged parathyroid glands and increased secretion of parathormone,Lowered renal threshold of glucose causing glycosuria, Positive nitrogen balance and retention of more nitrogen in the body, Increased water retention in the later months in omniotic fluid, placenta, foetus, breast, uterus, blood and other tissues,Increased retention of sodium, Stimulated synthesis of hormone binding proteins by liver and Increased formation of renin substrate by liver.

Placenta: It is the functional connection between embryo and uterus. It is necessary in mammals as the foetus is developed in uterus. It is developed from uterus.

Functionsof Placenta -

1) Supply of nutrients from maternal blood to foetus.

2) Excretion of foetal metabolites by diffusion into maternal blood.

3) Passage of O2 from maternal blood to foetal blood and CO2 from foetal blood to maternal blood etc.

Parturition: Parturition is the process of child birth at the end of gestation. It occurs at about 280th day after last menstrual period. Periodic contraction of smooth muscles of uterus and skeletal muscles of abdomen aid parturition. Oestrogen stimulates uterine contraction.

Stages of Labour: Duration of labour varies from 12-18 hours.

1) First stage or stage of dilatation of rupture of amnion and expulsion of amniotic fluid.

2) Secondary stage or stage of descent of child through vagina and expulsion.

3) Third stage of expulsion of membranes of foetus.

Involution : It is the process of rapid decrease of size of uterus to normal. It occurs by gradual autolysis or self digestion within 6-8 weeks.

Multiple Births: Giving birth to more than one child at once is called multiple births.Giving birthto two children at a time is called twin birth.

Twins can be divided into two types - 1) Monozygotic twins 2) Dizygotic twins.

Monozygotic twins : One zygote is formed by penetration of single sperm into single ovum. Zygotic material divides into two halves and gives rise to two separate embryos. In this type, twins of same sex, same blood group and tissues, same antigenic potencies are born.

Dizygotic twins:In this case, two ova are discharged at a time and they are fertilised by two sperms. Two zygotes are formed. In such case, twins are not identical and called dizytotic twins.

Triplets, quadruplets or quintuplets may be born from any of above process or combination.

Methods of controlled reproduction

Populatin explosion is a major problem in the today world. It is necesary to follow contraceptive measures to bring the population to a balance. In a country like India, people have to be mass educated regarding population control.

1) Temporary methods

a) Natural methods b) Methods using barriers c) IUCD d) Oral contraceptives e) Spermicidal jellies, sponges, tampoons, powders, f) Implant g) Douching

a) Natural methods : These methods include1) Coitus interruptus 2) Rhythm method

Coitus interruptus: In this method, penis is withdrawn from vagina just before discharge of semen. It can cause psychic disturbance. It may fail, when it is not possible to have control.

Rhythm : Intercourse should be avoided in unsafe period of menstrual cycle. This natural method is not fool proof.

In this method , In a regular menstrual cycle of 28 days,

-1-5 are days of menstruation.-6-9 days of are safe.-10-18 days are not safe.-19-28 days are safe.

b) Methods using barriers : Barriers are condom, membrane sheath and diaphragm.

c) Use of intrauterine contraceptive device: If a foreign body is placed in uterus, implantation of blastocyst becomes difficult. Presence of IUCD in uterus interferes with chain of events in the implantation of blastocyst in uterine wall.Some of the complications are execessive bleeding, pain, expulsion of IUCD, infection and uterine perforation. Failure rate is about 5%.

d) Oral contraceptives: There are three regimes of oral contraceptives.They are1)Classical pills 2) Sequential pills 3)Luteal supplementation pills.

e) Spermicidal jellies, sponges, tampoons and powders.

f) Implants : Progestin capsules are implanted in body. Action lasts for months or years. Progestasert is such an implant.It can be taken out when pregnancy is needed.

g) Douching : It is washing vagina with irritating fluid like salt solution, lactic acid solution, lemon juice or alum solution after coitus. Tap water can also be used for douching.

Termination of pregnancy : It is also a method of contraception when conception has already occured.It should be conducted in accordance with Medical termination of pregnancy act enacted in 1971.

2) Permanant methods : Vasectomy for males, tubectomy for females and laproscopic methods for women.

In vasectomy, vasdeferens is cut on both sides and ligated. In tubectomy, fallopian tubes are ligated. In laproscopic method, fallopian tubes are viewed using laproscope and ligated or lumen is sealed.It is usually done after 5th day of menstruation. A small incision is made on abdomen for this operation near umbilicus. This procedure requires 10 to 15 minutes.

Sex hormones

I) Male sexual hormones:1) Testosterone 2) Androsterone and 3) Dehydroepiandrosterone (DHEA).Testosterone is primarily produced by Leydig cells of testes in testes in response to FSH and LH released by anterior lobe of pituitary gland. Testosterone and other androgens in turn inhibit the release of FSH and LH by negative feedback mechanism.

Levels of testesterone in plasma of men are 5 to 100 times greater than the levels in plasma of women. About 4-12 mg. is produced in young males per day where as 0.5 - 2.9 mg. is produced in young females per day. Testesterone is converted by androgen responsive tissues in the body to highly active metabolite - dihydrotestosterone. It is believed to be the active form of the hormone.

Physiological actions of male sex hormones :

They are three main functional components of male sexual hormones.

1) Androgenic functions :

In foetus:Testosterone and dihydro testosterone cause masculinising effects in male foetus. They cause development of prostate, penis and related sexual tissues.

At puberty: Secretion of testosterone by testes increases greatly at puberty. At this stage androgens are responsible for growth of male sex organs, increase in the activity of these organs, secondary sexual characters.

Growth of male sex organs:Penis,testes,seminal vesicles,prostate and epididymis develop in size by the activity of male sex hormones.

Increase in the activity of these organs:Spermatogenesis by testes begins. Secretions by epididymis, prostate, seminal vesicles and Cowper's glands start. Secretion of semen starts. Nocturnal emissions occur.

Secondary sexual characters:Secondary sexual characters develop.They are 1) growth of moustache and beard, pubic hair and hair in other parts of body likechest, axillae etc. 2) Change in voice to male type

2) Anabolic functions: There are increase in protein anabolic activity,increase in muscle mass and rapid growth of long bones etc.

3) Psychological aspect :Androgens play important role in development of male psychology and behaviour. Emotional get up of male type is developed. These hormones are responsible for libido which provides back ground for sexual functions.

Female sex hormones: Oestrogens, progesterone,relaxin, androgens.

1) Oestrogens : It is the most important member of this group. It is produced by graafian follicle of ovaries.It is excreted as such or as metabolites.

2)Progesterone : It is secreted by corpus luteum of ovaries and placenta. Pregnanediol is the metabolic product of progesterone and it is biologically inactive. It is also found in adrenal cortex.

Functions of oestrogens and progesterone:

At puberty:These hormones are responsible for,

1) Growth of female sex organs: Oestrogen stimulates development and maintains morphological and functional state of female sex organs- vagina, uterus, fallopian tubes. Oestrogen is responsible for enlargement of vagina to adult size.

2) Secondary sexual characters: Mainly oestrogens and to a lesser extent, progesterone are responsible for devolopement of secondary sexual characters in women at puberty. They are - devolopement of breast,growth of pubic hair and underarm hair,pigmentation of nipples and genital tissues.

Development of breast at puberty is caused by both oestrogens and progesterone.Oestrogens cause proliferation of ductile system of breast. Progesterone stimulates development of alveolar system. Oestrogens contribute to the shape of breast and function.Important role of oestrogens is attribution of feminity.

In menstrual cycle: Progesterone causes premenstrual changes in endometrium after proliferative changes have been made by oestrogens. Oestrogen has direct stimulatory effect on follicle growth.

In Pregnancy : Oestrogen promotes motility of fallopian tube. This plays prominant role in sperm transport.Most important activity of progesterone during pregnancy is depressed contractility of uterus. In the third trimster of pregnancy, progesterone secretion is decreased and oestrogen secretion is increased and thus uterus becomes excitable in preparation for parturition.

Progesterone has important role to play in pregnancy.Functions of progesterone in pregnancy are1) Embedding of ovum, 2) Formation of placenta, 3) Inhibition of uterine excitability before third trimster, 4) Development of breasts in synergism with oestrogens, 5) Inhibition of menstrual cycle and ovulation and 6) Enlargement of birth canal due to growth of vagina and relaxation of pelvic ligaments in synergism with oestrogens.

3) Relaxin : It is the hormone present in pregnant mammalian ovary, placenta and uterus. Its level reaches maximum at the terminal stages of pregnancy. It is useful in affecting parturition.

4)Androgens: Small amounts of testosterone present in females are responsible for development of libido.

Oestrogens and progesterone also have various other actions of which, effect of oestrogen increasing the skeletal growth, lowering of plasma cholesterol level are some.

Summary

Reproduction is the process of producing same type of offsprings. Functions of testes are 1) Spermatogenesis 2) Secretion of testosterone. Semen is suspension of spermatozoa in the fluid secreted by epididymis, prostate, seminal vesicles and Cowper's glands. Functions of ovaries are 1) formation of mature ova 2) secretion of hormones. Fertilisation is penetration of ovum by spermatozoa. Menstrual cycle consists of i) Menstrual phase ii) Follicular phase iii) Luteal phase. Pregnancy ends with child birth. Methods of family planning are i) Temporary methods ii) Permanant methods. Male sex hormones are i) Testosterone ii)Androsterone iii)Dehydro epiandrosterone.Female sex hormones are - oestrogens, progesterone and relaxin. Small quantities of androgens are also present in women and are responsible for libido.

Essay Questions

1)Write the functions of testes in detail.

2)Explain the functions of ovaries.

3)Write about pregnancy and physiological changes during pregnancy.

4)Discuss the methods of controlled reproduction.

5)What are the male sex hormones? Write note on them.

6)List out female sex hormones. Add a note on them.

Short Answer Questions

1)What is puberty?

2)Define a) Menarch b) Menopause

3)Mention the functions of testes.

4)What is spermatogenesis ?

5) What is spermiogenesis?

6)What is semen?

7)Mention the functions of interstitial cells of Leydig.

8)Mention the functions of ovaries.

9)What is ovarian cycle? Mention the phases.

10)Define a) Fertilisation b) Implantation

11) What are the types of twins Explain a) Monozygotic twins b) Dizygotic twins.

12)What is menstruation? Mention the phases of menstrual cycle.

13)Define parturition and write the stages of labour.

14)What are the temporary& natural methods of controlled reproduction?

15)Mention the permanant methods of controlled reproduction

16)Mention male sexual hormones.

17)Mention the main functional components of male sexual hormones.

18)Write the secondary sexual characters in a) Males b) Females

19)What are the androgenic functions of male sex homones at puberty?

20)What are the anabolic functions of androgens?

Stress

Definition: A state of mental or emotional strain or tension resulting from adverse or demanding circumstances.

The other similar terms are strain, pressure, tension, nervous tension, worry, anxiety, nervousness. It is your body's response to certain situations. It is subjective. Stress can affect your physical and mental health, and your behavior.

Types of stress

1. Acute stress- It is the most common type of stress.

2.Episodic acute stress- When acute stress happens frequently, it is called episodic stress.

3.Chronic stress- If acute stress isn't resolved and begins to increase or lasts for long periods of time, it becomes chronic stress.

1. Acute stress - Acute stress is the most common type of stress. It's your body's immediate reaction to a new challenge, event, or demand, and it triggers your fight-or-flight response. As the pressures of a near-miss automobile accident, an argument with a family member, or a costly mistake at work sink in, your body turns on this biological response.

Severe acute stress such as stress suffered as the victim of a crime or life-threatening situation can lead to mental health problems, such as post-traumatic stress disorder or acute stress disorder.

2. Episodic acute stress -When acute stress happens frequently, it's called episodic acute stress. People who always seem to be having a crisis tend to have episodic acute stress. They are often short-tempered, irritable, and anxious. People who are "worry warts" or pessimistic or who tend to see the negative side of everything also tend to have episodic acute stress.

Negative health effects are persistent in people with episodic acute stress. It may be hard for people with this type of stress to change their lifestyle, as they accept stress as a part of life.

3. Chronic stress - If acute stress isn't resolved and begins to increase or lasts for long periods of time, it becomes chronic stress. This stress is constant and doesn't go away. It can stem from such things as poverty, a dysfunctional family, an unhappy marriage and a bad job

Chronic stress can be detrimental to your health, as it can contribute to several serious diseases or health risks, such as heart disease, cancer, lung disease, accidents, cirrhosis of the liver and suicide.

Managing stress(Regulation of stress)

Stress affects each person differently. Some people may get headaches or stomachaches, while others may lose sleep or get depressed or angry. People under constant stress may also get sick a lot. Managing stress is important to staying healthy.

It is impossible to completely get rid of stress. The goal of stress management is to identify your stressors, which are the things that cause you the most problems or demand the most of your energy. In doing so, we can overcome the negative stress those things induce.

The Centers for Disease Control and Prevention recommend the following to help cope with stress:

- take care of ourself, by eating healthy, exercising, and getting plenty of sleep
- find support by talking to other people to get our problems off
- connect socially, as it's easy to isolate ourself after a stressful event
- take a break from whatever is causing stress
- avoid drugs and alcohol, which may seem to help with stress in the short term, but can actually cause more problems in the long term

UNIT – 11

EXCRETORY SYSTEM

Excretory system consists of organs concerned with excretion of waste products formed in the cellular metabolism of body.

Excretory organs:

Kidneys(2)

Liver

Lungs(2)

Digestive tract

Salivary glands

Urinary system: Urinary system consists of,

Kidneys(2)

Ureters (2)

Urinary bladder

Urinogental tract / Urethra

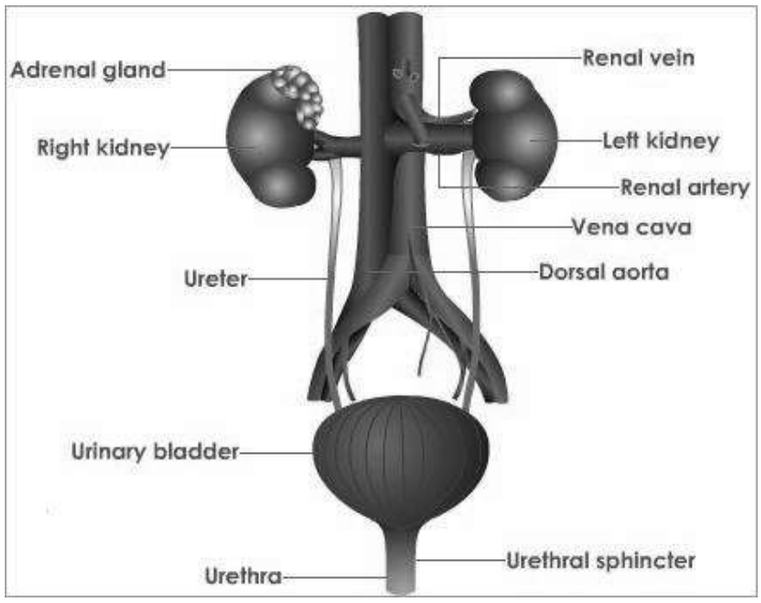


Fig.11.1 Urinarysystem

Kidneys: Kidneys are the main organs of urinary system.They are two bean shaped organs lying on the posterior wall of upper abdomen, one on each side of vertebral column.Right kidney is located slightly lower than left kidney.Each kidney measures about 11 x 5 x 3 cm and weighs 150g approximately.They are embedded by fat called perirenal fat.Each kidney is convex on its outer border and concave in the centre of its inner border (Hilus).At this point,blood vessels,nerves and ureter enter and leave kidney.On each kidney, an adrenal gland is present.

Structure of Kidney: Kidney is surrounded by a fibrous capsule. It can be stripped off easily. Portion inside this fibrous capsule can be divided into,

1. Outer cortex - Cortex is the outer reddish brown coloured portion. Medulla is the inner lighter area.
2. Inner medulla - Medulla is subdivided into 10 to 15 conical areas called renal pyramids. Pyramids have their broad base towards cortex and apex projecting into lumen of minor calyx. Columns of Bertin are the projections of cortex. They form the boundaries of the pyramids.

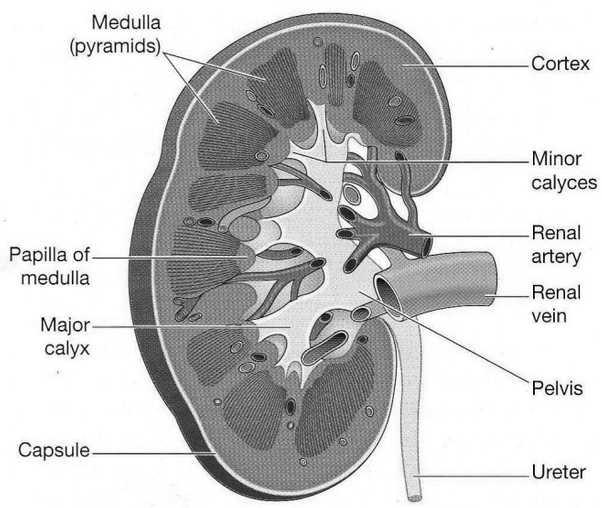


Fig.11.2 L.S. of Kidney

Histology of kidney:

Uriniferous tubules consist of two portions 1) Nephron 2) Collecting tubule.

1) Nephrons : Eachkidney consists of number of minute units called nephrons. They are basic structural and functional units of kidney. They are about one million nephrons in each kidney. Nephrons drain into pelvis of ureter and then into urinary bladder.

Parts of Nephron :

1. Malphigian body: It is also called as renal capsule. It lies in cortex of kidney. It consists of two parts.

A) Glomerulus is tuft of about 6-8 renal capillaries invaginating into the end of tubule. It has two poles 1) Vascular pole - where bloods vessels are attached 2) Tubular pole - Where renal tubule begins. Afferent arteriole brings blood to glomerular tuft. It is short and wide. This capillary tuft reunites and forms efferent arteriole. It is long and narrow. This arrangement builds up a pressure gradient of 70 mmHg and facilitates filtration.

B) Bowman's capsule is the dilated end of nephron. It is invaginated by glomerular tuft. It is made of two layers called parietal and visceral layers. It gradually continues with tubule.

2) Renal tubule: Renal tubule begins at the tubular pole of glomerulus. Renal tubule is about 3 cm long and 20-60 microns wide. Short constricted part of tubule just below the glomerulus is neck.Parts of the renal tubule after neck are, proximal convoluted tubule, loop of Henle and distal convoluted tubule.

A) Proximal convoluted tubule :It measures about 14 mm. It is lined by cubical cells arranged in single layers. Free borders of the cells are brush bordered. This portion of nephron lies in cortex of kidney.

B) Loop of Henle: It is U-shaped loop. It is anatomically divided into1) Descending limb of loop of Henle2) Thin walled ascending limb of loop of Henle 3) Thick walled ascending limb of loop of Henle.Variable length of loop of Henle lies in medulla. It is made of epithelial cells with variable shape in different portions of loop.

C) Distal convoluted tubule: Average length is about 4.9 mm. It is lined by cubical epithelium.

D) Collecting tubule: It is non-secretory portion of uriniferous tubule. It is collecting system. It is about 20mm long. It is lined by pale cuboidal cells. Several collecting tubules from

nephrons join to form duct of Bellini. Nephrons ultimately drain into pelvis of ureter. From here urine collects into urinary bladder. Urine is passed out into exterior through urethra.

Renal Circulation:

There are two circulations in kidney.1) Greater circulation 2) Lesser circulation

Greater circulation carries 85% of blood and lesser circulation carries 15% of blood. Renal arteries enter into kidneys through respective hilus. On or before entering the hilus, renal artery on each side divides into anterior and posterior divisions. They divide to form segmental arteries and drain into lobar branches one for each pyramid.

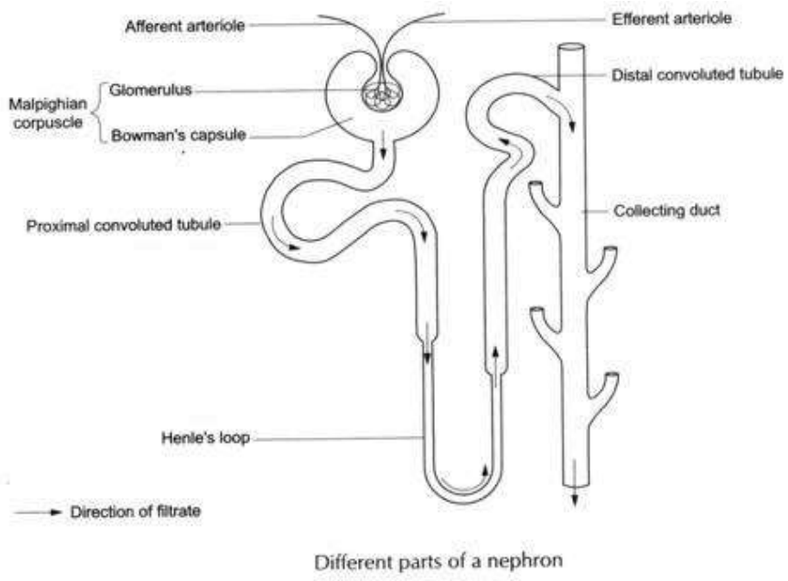


Fig.11.3 Parts of nephron

Ureters: Ureters transport urine formed in kidneys to urinary bladder.

Urinary bladder: From urinary bladder,urine is passed to the exterior through urethra.

Urethra: In males it also for passage of semen.Hence it is also called urinogenital tract in males. In females, it is independent.

UNIT – 12

BLOOD

Blood is defined as specialised fluid connective tissue of body containing blood cells suspended in plasma.

Functions of blood :

1)Transport of oxygen from lungs to tissues and carbondioxide from tissues to lungs.

2)Transport of end products of digestion absorbed from intestines to cells for utilisation.

3)Carriage of essential chemicals like hormones,vitamins and other substances to the sites of their activities.

4)Transport of waste products of cellular metabolism to the excretory organs.

5)Maintenance of acid base equilibrium.

6)Maintenance of water balance.

7)Maintenance of ionic balance.

8)Regulation of body temperature.

9)Regulation of blood pressure

10)Guarding against haemorrhage by its property of coagulation.

11)Defence mechanism by means of phagocytosis by white cells and development of antibodies.

12)Maintenance of osmotic pressure due to presence of albumin (plasma protein) etc.

Physical properties:

1) Colour : Red

2) Reaction:Slightly alkaline

3) pH:7.36-7.45(average 7.4)

4) Specific gravity : 1.048-1.066

5) Consistency :Viscous

6) Bleeding time: 2-5minutes(3.25 minutes on average) by Duke's method.

7) Clotting time:6-17 minutes

8) Prothrombin time : 11-16 secs.

9) E.S.R:0-6.5 mm/hour

Wintrobe'smethod : Average being 9.6mm/hour

Westergrenmethod :0-5mm/hour in men and 0-7mm/hour in females

10.Plasma volume:52-55%

11. Packed cell volume:45-48% { 45%in males&40% in females } .

12. R.B.C.count:Nomal average count in

Adult males -5millions/mm3

Females - 4.5millions/mm3

Infants-6-7millions/mm3 -value

Foetus -7-8millions/mm3

13. Haemoglobin:14-18g %

Males 11.5-16.5g %

Females 13.5-19.5g%

Infants 11-13g%

Children upto 1year 11.5-14.5g%

Children of 10-12years

14.Total count of white cells:

4000-1000/mm3 in adults,

1000-25000 at birth,

6000-18000 for age group of 1-3years,

6000-15000 for 4-7age group

4.5-13.5 thousand for 8-12 years age group.

Platelet count:2.5-4.5L/mm3

Composition of blood: Blood is composed of two parts.

1)Plasma - It is aqueous solution of various organic and inorganic constituents and also acting as suspending medium for blood cells.It constitutes about 55% of whole blood. It contains91-92% water and 8-9% solid components.Solid components of plasma are,

i)Inorganic constituents: They constitute 0.9%.They are sodium, potassium, calcium, magnesium, phosphorous, iron and copper etc.

ii) Organic constituents of plasma:They are Proteins, Nonproteinous nitrogen(NPN) substances, Carbohydrates, Lipids, Pigments.

2)Cells - Different types of blood cells having diverse functions are suspended in plasma.

They constitute about 45% of whole blood. There are three types of blood cells.

a) Red blood corpuscles (RBC) or erythrocytes.

b) White blood corpuscles (WBC) or leukocytes.

c) Platelets or thrombocytes.

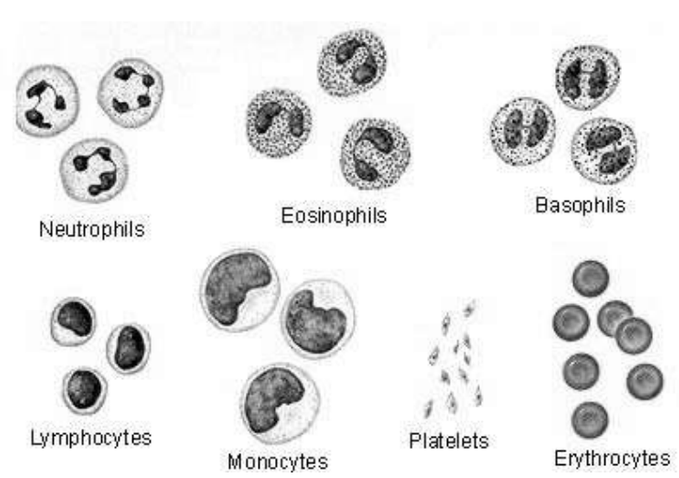


Fig 2.1 Types of blood cells.

Blood gases: They are oxygen and carbon dioxide.

Forms of Blood:

Forms of blood used as specimens in diagnostic testing procedures are,

a) Whole blood

b) Plasma

c) Serum: It is supernatant fluid collected after retraction of clotted blood

d)Cells

Plasma- It is supernatant fluid collected from blood after sedimentation of cells. It contains fibrinogen and prothrombin whereas serum does not contain fibrinogen and prothrombin.

Plasma proteins and their functions:

Plasma proteins are

1) Albumin -It is responsible for exerting 80% of total Osmotic Pressure exerted by plasma proteins.

2) Globulin - They are responsible for viscosity and blood pressure of blood and they are attributed to their higher molecular weight and asymmetry. They also play important role in body's defence mechanism(Immunoglobulins).

3) Prothrombin- It plays role in blood clotting.

4) Fibrinogen - It plays role in blood clotting. It is converted to fibrin during clotting. It is also concerned with erythrocyte sedimentation rate.

Increased fibrinogen levels raise sedimentation rate of blood cells by accelerating rouleaux formation.

Other functions of plasma proteins :

1) Acting as reservoir.

2) Helping in CO2 carriage by formation of carbamino proteins.

3) Transport of hormones, enzymes, clotting factors, iron, copper etc.

4) Protein binding of certain drugs helps their transport.

Red blood corpuscles (RBC):

Structure of RBC : Mature RBC of human being is circular biconcave disc shaped and not containing nucleus.It appears like a dumbell on viewing from side. It appears light brownish under microscope. Hemoglobin is present inside of RBC.

Size: 7.2 μ diameter and similar to the size of an RBC.

Composition of RBC:

Water : It is the major component constituting about 60-70 %,.

Solids :They constitute about 30%- 40%. They are haemoglobin,protein, phospholipid ,cholesterol,cholesterides etc.

Erythropoiesis: Erythropoiesis is the process of formation of RBC.

There are two theories of origin of RBC.

They are 1) Theory of intravascular origin 2) Theory of extravascular origin.

1) According to extravascular theory, erythropoiesis begins with haemocytoblast.

2) As per intravascular theory, erythropoiesis beings with endothelial cells.

In foetal life, sites of synthesis of RBC are liver and spleen. After birth, erythropoiesis takes place in all bones. As age advances, most of the bones except upper end of humerus and femur stop erythropoiesis.Flat bones like ribs, vertebrae, skull, sternum, pelvis etc. continue to produce blood cells.

Stages of development into normal erythrocyte as per extravascular theory are as follows Heamocytoblast ------->Proerthyroblast ------> Early normoblast -----> Intermediate normoblast --->Latenormoblast -----> reticulocyte -----> Normal erythrocyte.

Stages of development into normal erythrocyte as per intravascular theory are Endothelial cell ----->Megaloblast -----> Early erythroblast ----->Late erythroblast ---->Normoblast ----> Reticulocyte ----->Normal erythrocyte.

Requirements for erythropoiesis: 1) Vitamin B12 and Folic acid are essential.

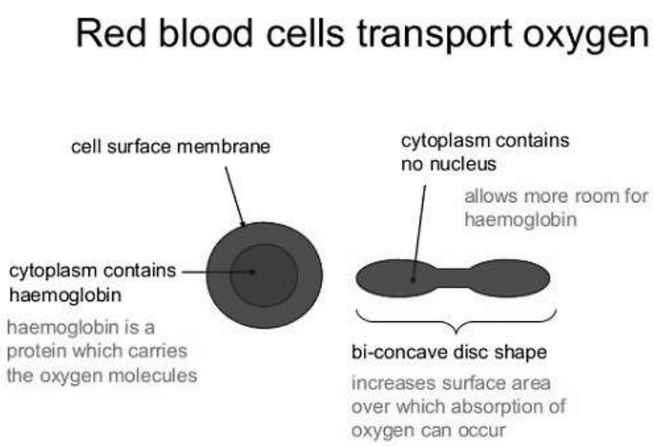


Fig. 2.2 Diagram of RBC

Life span of R.B.C:120days

Fate of R.B.C :

i) At the end of life span,erythrocytes disintegrate.

ii) RES swallows and digests the fragments.

iii) Haemoglobin is broken down into haem and globin.

iv) Globin breaks into amino acids.

v) Haem breaks into iron and non iron residue of haemoglobin i.e. protoporphyrin.

vi) Iron is stored as ferritin and haemosidrin.

vii) They are used up in haemoglobin synthesis.

viii) Green coloured biliverdin is formed from protoporphyrin and reduced to yellow coloured bilirubin or haemoglobin is formed first and oxidised to biliverdin.

Method of counting RBC:

Instruments required: Improved Neubauer's haemocytometer,diluting fluid,cover slip and microscope are required for counting RBC.Haemocytometer consists of special glass slide(counting chamber),RBC pipette and WBC pipette.

ii) Blood is sucked upto a mark on the stem of RBC pipette and diluting fluid is sucked upto mark above the central bulb.One drop of diluted blood is loaded into the counting chamber under cover slip,focussed under microscope

iii). Red cells in the 5small squares(four corners and central) of central counting area are counted.Number of cells per cu.mm can be got by multiplying the number of cells counted with dilution factor and dividing this figure with the volume of total small squares counted.

Functions of RBC :

1) RBCs involve in transport of respiratory gases - O2 and CO2 and thus help in respiration.

2)Buffering action of Hb of RBC helps in acid-base equilibrium.

3)Ionic balance is maintained by special permeability of cell membrane.

4)Maintenance of viscosity

5)Haemolysis gives raise to various pigments - bilirubin, biliveridin etc.

Haemoglobin : Haemoglobin is the red pigment of blood. It is respiratory pigment of blood. It has two parts.

1) Haem (4%) -Metalloporphyrin containing iron in ferrous form

2) Globin (96%) - Protein

Varieties of haemoglobin: There are two varieties of haemoglobin in man.

1) HbF (Foetal haemoglobin)

2) HbA (Adult haemoglobin) Foetal haemoglobin has greater affinity for oxygen. It releases CO2 more readily.

Factors favouring synthesis of haemoglobin:

1) Proteins of high biological value

2)Metals like iron, copper, manganese and cobalt

3)Hormones - Thyroxine

4)Vitamins - B12, Vitamin-C,folic acidriboflavin,nicotinic acid, pantothenic acid and pyridoxine

Estmationion of Haemoglobin :

1)Sahli'sacid hematin method

2)Cyanmethoaemoglobin method

3) Gasometric method

4) Chemical method

5)Tallqvist method

6) Specific gravity method

Functions of haemoglobin:

1)Transport of respiratory gases - O2 and CO2

2)Maintenance of pH

3)Maintenance of Ion balance

4)Formation of pigments of bile, urine and stool

Disorders related to RBC and Haemoglobin:

Anisocytosis : Variation in size of RBC is called anisocytosis.Macrocytes are red larger than normal size are called macrocytes .Microcytes are red cells smaller than normal size are called microcytes.

Poikilocytosis : It is condition in which there is deviation in shape from normal.Eg: Ovalocytes, tear drop cells, target cells and pencil cells.

Polycythemia : It is clinical condition in which erythrocyte count is above normal. In this condition there is also raised Hb content above normal and elevated haematocrit.

Anaemia : It is reduction in RBC count or Hb content or both below normal. There are different types of anaemia.

1.Anaemia caused due to blood loss:

a) Acute post haemorrhagic severe blood loss and causes iron deficiency anemia.

2. Anaemia caused by haemolysis (Haemolytic anaemia): RBC formation is abnormal making them fragile. Different types of haemolytic anaemia are,

i) Sicklecell anaemia - Red cells are sickle shaped.

ii) Hereditory spherocytosis - Red cells are small and spherical.

iii) Thalasaemia- RBCs contain HbF and thus fragile.

In haemolytic anaemia, there may be jaundice along with anaemia due to increased formation of bile pigments from lysing red cells.

3) Aplastic anaemia – It is due to failure of bone marrow itself, exposure of X-rays or γ rays, cancer of bone marrow etc. It is of normochromic, normocytic type.

4. Nutritional anaemia-

a) Pernicious anaemia - It is macrocytic anaemia and is due to Vit B12, and folic acid deficiency.It is also called megaloblastic anaemia as maturating factors converting megaloblasts (proerythroblasts) into erythrocytes are deficient.

b) Iron deficiency anaemia – It is microcytic anaemia and is due to inadequate intake of hypochromic iron or enhanced requirement of iron.

Microcytic Anemia (<76 fL)	Macrocytic Anemia (>98fL)	Normocytic Anemia (76-98 fL)
1) Iron Deficiency anemia	Vit. B12 & folate deficiency	Vit B2 & B6
2) Thalassemia	Alcoholism	Hemolytic Anemia
3) Sideroblastic Anemia	Acute Blood Loss	Post Hemorrhagic Anemia
4) Lead Poisoning Anemia	Liver disease	Sickle Cell Anemia
5) Chronic Disease Anemia	Aplastic Anemia	Anemia in Pregnancy

Fig 2.3 Causes of Anemia

Some important indices of RBC and haemoglobin:

Mean corpuscular volume(MCV)

Mean corpuscular haemoglobin(MCH)

Mean corpuscular haemoglobin concentration(MCHC) etc.

White blood Corpuscles (WBC):

They are also called leucocytes.They are nucleated and bigger than RBC. Lifespan of WBC is shorter than RBC.Origin of WBC is purely extravascular.

Classification of leucocytes:

1) Granulocytes -Granules are present in their cytoplasm. They are again three types.

i)Neutrophils or polymorphs - Nucleus is multilobed. Granules take neutral dye.

ii)Eosinophils - Nucleus is two or three lobed. Granules take eosin (acidic dye).

iii) Basophils - Nucleus is lobed.Granules take basic dye.

2)Agranulocytes- Granules are absent in the cytoplasm.They are again two types.

i) Lymphocytes a) Small lymphocytes b) Large lymphocytes

ii) Monocytes

Normal differential leucotye count-

1.Neutrophils-60-70% (3,000-6,000/mm3)

2.Eosinophils-1-4% (150-400/mm3)

3.Basophils- 0-1% (0-100/mm3)

4.Lymphocytes - 25-30% (1500-2700/mm3)

5.Monocytes-5-10% (350-800mm3)

Origin of Leucocytes: In early embryo, all blood cells originate from single primitive reticuloendothelial cell. In postnatal life, their origin is extravascular.

Granulocytes are derived exclusively from red bone marrow.

Lymphocytes and monocytes originate from spleen, lymphglands and bone marrow.

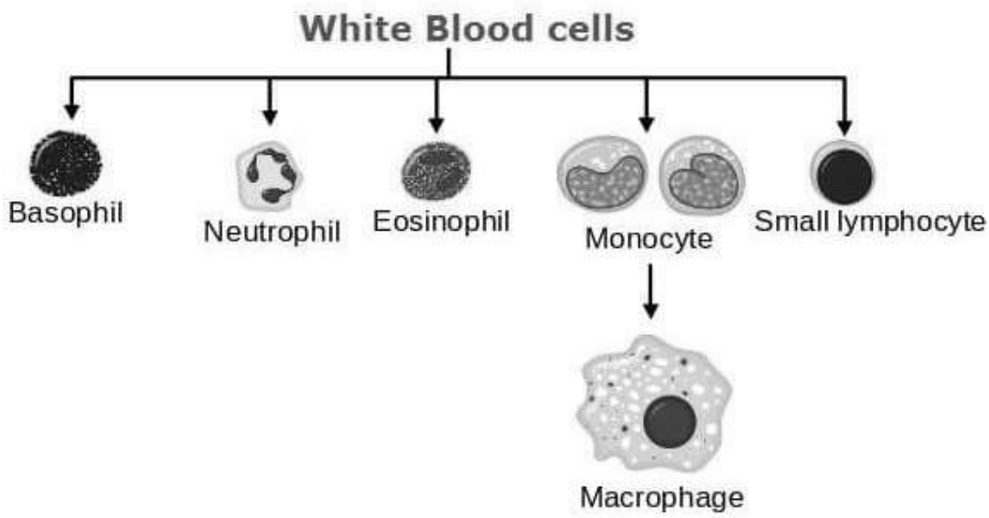


Fig. 2.4 Different types of Leukocytes

Life span of WBC:

Neutrophils 2-4 days

Eosinophils8-11 days

Basophils 12-15 days

Lymphocytes 2-3 days

Fate of WBC:

1.Granulocytes fragment in blood and subjected to monocytesphagocytic action by reticulo-endothelial cells.

2.Lymphocytes pass through intestinal and other mucosa or subjected to phagocytic action of reticulo endothelial cells

Functions of Leucocytes :

1)Phagocytosis: Engulfment of bacteria and foreign particles and their digestion by neutrophils is phagocytosis.

2)Manufacture of β and γ globulins : Important role is played by lymphocytes in body defence mechanism by manufacture of β and γ globulins.

3)Process of repair:Conversion of lymphocytes into fibroblasts in the area of inflammation helps in the process of repair.

4)Nutrition,growth and repair of tissues:Leucocytes influence nutrition, growth and repair of tissues.

5)**Prevention of intravascular clotting:**Secretion of heparin by basophils prevents intravascular clotting.

Disorders related to WBC count:

Leucopenia: Decrease in WBC count below 4,000/mm3

Leucocytosis:Raise of WBC count above 11,000/mm3

Agranulocytosis:It is great fall of circulating granulocytes. It may be due to harmful effects of certain drugs.

Leukaemia: It is malignant disease of one or more varieties of WBC.

Thrombocytes(Platelets)

i) Platelets are non-nucleated round or oval biconvex discs.

ii) Their size varies from 2-5 µ.

iii) Platelets arrange in clumps as well as discretely.

Origin of Thrombocytes: Megakaryocytes introduce pseudopodia through walls of sinusoids. They are broken in a way so that, unit membrane envelopes individual fragment. These fragments with unit membranes are washed away into blood stream. These are called as platelets.

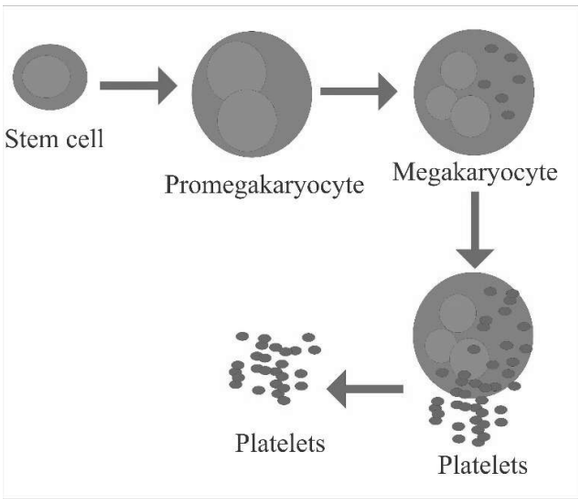


Fig. 2.5 platelet formation

Life span of thrombocytes:5-9 days

Fate of thrombocytes: They are destroyed in spleen and reticuloendothelial cells.

Functions of platelets:

1)Initiation of blood clotting by disintegration and liberation of thromboplastin.

2)Speedy repair of capillary endothelial lining.

3)Haemostatic mechanism by means of agglutination and coagulation.

4)Hastening the retraction of clot. It is dependent on thrombosthenin.

5)Liberation of 5-HT and Histamine to exert vasoconstriction which helps in haemostasis.

Thrombocytopenic purpura :

It is due to diminution of platelets in blood.There is haemorrhage beneath skin and mucous membrane.Coagulation time is normal. Bleeding time gets prolonged. Clot retraction does not take place.

Blood clotting (coagulation) and clotting factors: Coagulation of blood is important for stopping further bleeding during injuries. Clotted blood plugs the bleeding point of blood vessels thus acting as haemostat.

Mechanism of blood clotting: When bleeding starts, blood comes into contact with rough surface. Platelets disintegrate and thromboplastin is released. Damaged tissues in the area of

injury also release certain amount of thromboplastin.This thromboplastin converts prothrombin into thrombin with the help of calcium ions. Thrombin interacts with fibrinogen to form fibrin (clot).

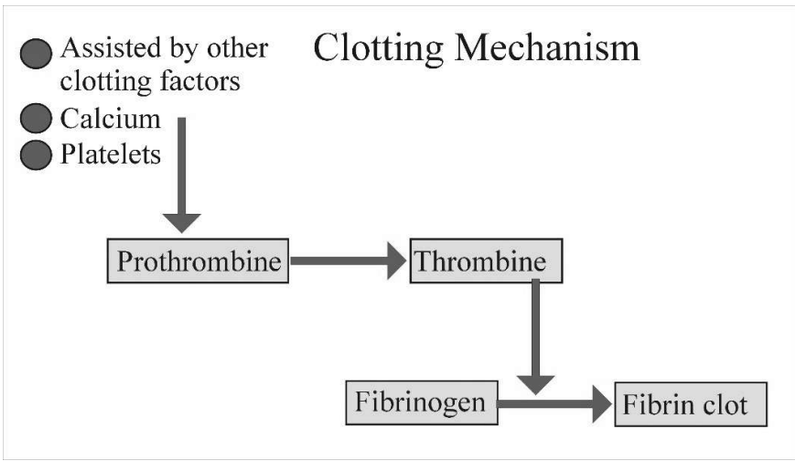


Fig 2.6 Clot Formation

Cellular elements of blood :

1) Erythrocytes (Red blood corpuscles)

2) Leukocytes (White blood corpuscles)

3) Thrombocytes (platelets)

Clotting Factors : Clotting mechanism is a complex process and several factors are involved in this process.

1)Factor–I Fibrinogen

2)Factor–II Prothrombin

3)Factor–IIITissue thromboplastin

4)Factor–IV Calcium

5)Factor–V Proaccelerin or acclerator globulin

6)Factor–VI Accelerin

7)Factor–VII Cothromboplastin

8)Factor-VIII Antihaemophilic globulin (AHG)

9)Factor-IX Christmas factor

10)Factor-X Stuart factor

11)Factor-XI Plasma thromboplastin antecedent (PTA)

12)Factor-XII Hageman factor.

13)Factor-XIII

Complete thromboplastin or thrombokinase.

Fibronogen (F-I) :It is the plasma protein converted to fibrin during clotting.

Prothrombin (F-II): It is converted into thrombin during clotting. In normal plasma, prothrombin is single compound of calcium. Prothrombin activity is measured by prothrombin time.Prothrombin is manufactured in liver. Vitamin 'K' is essential for prothromb in synthesis.

Tissue thromboplastin (F-III):Prothrombin is converted to thrombin with help ofF-III and Ca++ ion. It is also called extrinsic thromboplastin or platelet factor. It is derived from two sources.

1) Extrinsic (in tissues)

2) Intrinsic (in plasma) Calcium (F-IV) : Calcium is essential in blood clotting.

It is essential for

1) Thromboplastin formation

2) Conversion of prothrombin to thrombin.

Proaccelerin (F-IV) : Is is also called as accelerator globulin or Ac globulin or Ac G or thrombogene. It is necessary for complete conversion of prothrombin into thrombin by extrinsic or intrinsic thromboplastin.

Accelerin (F-VI) : It is hypothetical acctivation product of factor-V.

Cothrombolpastin (F-VII): It is also called stable factor or proconvertin or auto prothrombin-I. It accelerates tissue thromboplastin synthesis. It is not used up during clotting. It is converted to convertin during clotting

Antihaemophilic globulin (F-VIII) : It is also called antihaemophilic factor (AHF) or platelet cofactor-I. It helps in intrinsic thromboplastin formation and intrinsic prothrombin conversion. Absence of this factor causes haemoplilia (breeders disease). Haemophilia occurs in males. It is transmitted as sex linked recessive trait.

Christmas factor (F-IX) : It is also called plasma thromboplastin component (PTC) or platelet co factor-II. It is neccssary for intrinsic thromboplastin synthesis.It's absence causes haemophilia in males, which is transmittedas sex linked recessive trait. This factor is precipitated by 50% ammonium sulphate.

Stuart factor (F-X) : It has many properties similar to factor VII. Its absence leads to mild haemorrhagic diathesis. It is stable at R.T. It is destroyed at 560C. Plasma thromboplastin antecedent

(PTA) (F-XI) : It is activated by Hageman factor. It leads to formation of thrombin. Its deficiency causes mild bleeding tendencies of haempphiloid D type. It is transmitted as sex linked dominant to both sexes.

Hageman factor (F-XII) : It is also called surface factor. It activates enzyme kallikerin to produce plasma kinins. This results in increase of vascular permeabiliy. I also causes dilation of blood vessels.

Loki-Lorand factor F-XIII) : It is also called Fibrin stabilising factor. Its active form converts soft fibrin to hard fibrin clot with the help of Ca++. People having its congenital malformation will suffer from poor wound healing.

There are two related path ways involved in clotting.

a) Extrinsic system.

b) Intrinsic system.

Extrinsic system is initiated by damaged tissue and it is faster (1-2 minutes).

Intrinsic system is initiated by blood it self. It takes about 4-8 minutes.

Thrombus : Thrombus is a clot formed inside blood vessels. Intravascular thrombosis occurs in coronary and cerebral thrombosis.

Fibrinolysis : It is the process of breakdown of clotted blood when it is not kept sterile. It is brought about by proteolytic enzyme called plasmin. It is also called fibrinolysin.

Factors inhibiting clotting of blood:

1) Lowering of temperature.

2) Avoiding contact with rough surface

3) Removing calcium ions.

4) Precipitating fibrinogen

5) Addition of anti coagulants.

Factors accelerating clotting of blood :

1) Raising temparature (causing warmth)

2) Contact with rough surface

3) Addition of thrombin

4) Addition of thromboplastin.

5) Injection of Vitamin-K.

6) Adding CaCl2.

7) Adrenaline injection

Blood grouping: Karl Land steiner discovered fundamental principles of blood grouping in 1900.Blood grouping is important to avoid mismatching of blood groups as mismatching would cause hazards to recipient. Death also may occur in mismatched blood transfusions.

It is also needed in

i) Paternity testing,

ii)Forensic medicine,

iii) Blood diseases,

iv) Experimental purposes etc.

Blood transfusion is intravenous administration of blood to compensate blood loss in haemorrhage or otherwise.Blood transfusion corrects shock and vascular collapse.

Agglutinogens: Erythrocytes contain antigens on the surface of their cell membrane. They are chemically lipoproteins.Surface antigens of red cells are also called agglutinogens. Types of agglutinogens:They are two types - A and B

Agglutinins:Agglutinins are antibodies present in plasma or serum.

Types of agglutinins:They are two types α and β.

Haemagglutinationreactions : Reactions between agglutinogens present on cells surfaces of erythrocytes and agglutinins are called haemagglutination reactions.

These antigen - antibody reactions are made use of to detect the type of antigen.

Human blood group systems:There are nearly 300 blood group systems discovered so far.

Some of them are -1) ABO system 2) Rh system 3) MN system 4)P system Major systems are

1) ABO system of blood grouping 2) Rh system of blood grouping ABO system of blood grouping : It was discovered by Karl Land steiner in 1900. According to this system, there are four blood groups. i)A- group - containing agglutinogen 'A' on cell surfaces of erythrocytes and β agglutinin in plasma.

ii)B - group - agglutinogen B, agglutinin α.

iii) AB- group -agglutinogens 'A' and 'B', no agglutinins

iv)O- group - No agglutinogens, α and β agglutinins.

Universal donor: As O group blood can be donated to all groups, it is called universal donor. Universal recipient : As 'AB' group can receive blood from all, it is called universal recipient. Determination of blood group in ABO:Blood group can be determined using known anti A and anti B reagents. To two drops of blood taken on a slide, anti'A' is added to one drop and anti 'B' to another drop. Group is determined by aglutination in the drops.

1)A group :Agglutination takes place only in the drop of blood to which anti A is added.

2)B group: Agglutination takes place only in the drop of blood to which anti B is added.

3)AB group:Agglutination takes place in both the drops.

4)O group:Agglutination does not take place in both the drops.

Distribution pattern of blood groups in indian population.

A - 27%B - 31%AB - 8%O - 34%

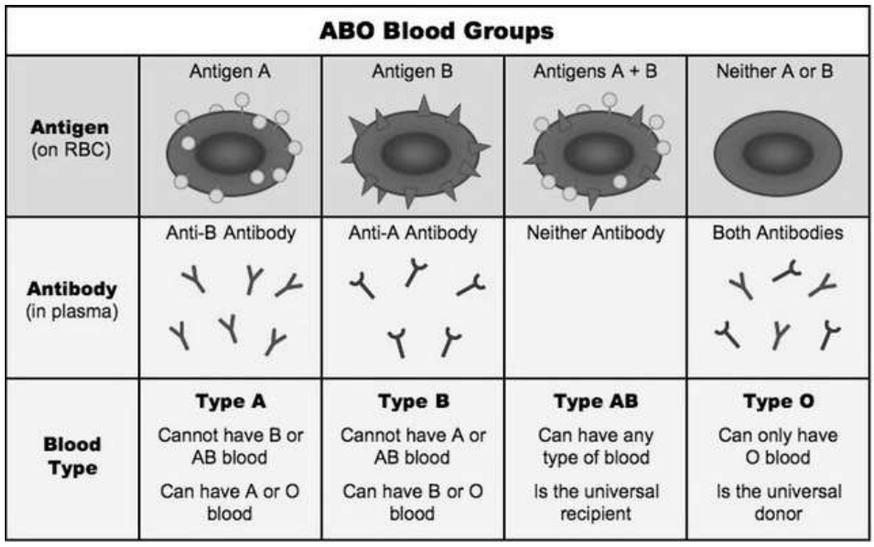


Fig 2.7 ABO blood grouping

Rh - system of blood grouping : It was discovered by Landsteiner and Wiener in 1940. Their study reveals that agglutinogen of Rhesus monkey is present in 85% of white people and 95% or even more in Indians and Ceylonese.

Rh - Agglutinogens: There are six Rh agglutinogens.They are C, c, D, d, E, e.

D and d are most common.Rh positive people contain 'D' antigen or Dd and Rh negative people contain 'd' antigen.

Rh antibodies:All the six Rh agglutinogens stimulate antibody formation,'D' antigen stimulates anti-D antibody.

Rh group determination: When anti 'D' is added to drop of blood, taken on a clean and dry side, agglutination indicates Rh +ve group and non agglutination indicates Rh -ve group.

Clinical significance of Rh grouping in blood transfusion: When Rh +ve blood (containing 'D' antigen) is given to Rh-ve recipient for the first time, anti 'Rh' antibodies develop in recipient's serum but Rh incompatibility reaction does not take place.If same

patient receives same blood for second time,incompatability reaction can take place between 'D' antigens of donor's blood and anti 'D' antibodies developed in patient's blood. Thus agglutination and haemolysis can take place in recipient's blood.

Significance of Rh factor in pregnancy : If mother is Rh -ve and Father is Rh+ve, there is strong possibility of foetus inheriting Rh+ve factor. Rh+ve cells of feotus produce anti 'Rh' antibodies in mother's blood. In the subsequent pregnancies, problem araises if the baby is again Rh +ve.

This is due to passing of anti Rh antibodies from mother's blood through plaenta into foetus, causing haemagglutination reaction. If the antibody titre is very high, foetus may die and gets expelled before end of normal gestation period. If the antibody titre is not high enough to cause death of foetus, child will be born alive and develops haemolytic jaundice. This condition is called erythroblastosis foetalis. If the case is servere, child may die if complete replacement of blood is not undertaken after birth.

Risks of blood transfusion: There is risk of transmission of Hepatitis and AIDS,if proper screening is not done prior to transfusion

Screening of blood:Donor's blood should be screened for malarial parasites,microfilariae,VDRL,HIV,hepatitis virus etc.before transfusion.

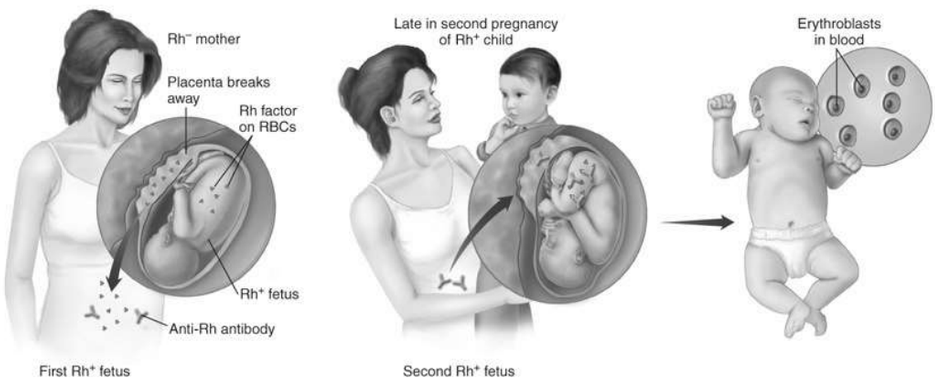


Fig 2.8 Rh incompatability

Summary

Blood is specialised fluid connective system of body. Main function of blood is transport of respiratory gases. Blood is composed of 55% plasma and 45% cells. Plasma proteins are Albumin, globulin,prothrombin and fibrinogen. Blood cells are RBC, WBC and platelets. Blood has the property of clotting when exposed to rough surface. Various clotting factors are responsible for blood clotting and they are I, II, III, IV, V, VI, VII, VIII, VIII, IX, X, XI, XII and XIII. Anticoagulants prevent blood clotting. Blood grouping is needed to present mismatching and thus hazards of incompatible blood transfusion. Different blood grouping systems are ABO, Rh, MN and P. Different goups in ABO systems are 'A', 'B', 'AB' and 'O'. According to Rh grouping Rh +ve and Rh -ve groups are there. Rh in compatibility is significant in blood transfusion and pregnancy.

Essay Questions

1)Write the functions, properties and composition of blood.

2)Discuss plasma proteins and their functions.

3)Write about coagulation, its mechanism and clotting factors.

4)Describe the structure of RBC. Write its composition, erhtyropoiesis and functions of RBC.

5)Write about Haemoglobin in detail.

6)Explain the disorders of RBC and haemoglobin.

7)What are different types of WBC? Write different aspects related to WBC.

8)Write about platelets in detail. 9)Explain blood grouping.

Short Answer Questions

1)Define blood.

2)Mention main functions of blood.

3)What are the parts of blood?

4)Write the forms of blood used as specimens in diagnosis.

5)List the protein and non-protein constituents of plasma.

6)Mention the plasma proteins.

7)Write different globlulin fractions.

8)What is the mechanism of blood clotting?

9)What are the sysnonyms of factor - IV, Factor-VIII, Factor-I and Factor XIII.

10)Write about antihaemophilic globulin.

11)Define a) Syneresis b) Thrombus

12)What are the factors inhibiting blood coagulation?

13)Mention the factors acclerating coagulation of blood?

14)What is the composition of RBC?

15)What are the stages of development of RBC according to extravascular theory?

16)Mention the functions of RBC.

17)Write the parts of haemoglobin.

18)Mention the varieties of haemoglobin.

19)What are the factors favouring synthesis of haemoglobin?

20)Mention the normal values of haemoglobin.

21)List various methods of haemoglobin determination.

22)Write functions of haemoglobin. 23)Define a) Polycythaemia b) Anaemia

24)What are different types of anaemia caused by haemolysis?

25)Write the fate of a) RBC b) WBC.

26)What is nontropical sprue? Write about size and colour of RBC in this condition.

27)Mention different types of leucocytes.

28)Write the values in total count of WBC.

29)Give any four functions of WBC.

30)Write lifespans of a) RBC b) WBC.

31)Explain structure of platelets by light microscope.

32)What are the properties of thrombocytes?

33)Give the a) lifespan &b)fate of thrombocytes.

34)What are the functions of thrombocytes?

35)Discuss thrombocytopenic purpura.

36)Mention few blood group systems.

37)What are different agglutionogens and agglutinins according to ABO system?

38)Mention different blood groups according to ABO and Rh systems.

39)How do you determine blood group by ABO system?

40)What are the antigens of Rh grouping?

41)Write the clinical significance of Rh grouping in blood transfusion.

42)What is the significance of 'Rh' factor in pregnancy?

UNIT – 13

SENSE ORGANS

The sense organsare eyes, ears, tongue, skin, and nose. Of these five organs, first four are organs of special senses. Skin is the organ of general sensations.

Theyhelp in protection of the body. The human sense organs contain receptors that relay information through sensory neurons to the appropriate places within the nervous system.

Eye: Eye is the organ of special sense of vision. It consists of i) Eyeball 2) Accessory structures.

i) Eye ball: It is almost spherical in shape. It is situated in anterior part of orbital cavity. It contains three coats and light transmitting structures.

Layers of eye ball: Layers of eye ball are,

1)Outer fibrous coat- It contains,

a) Sclera - posterior opaque part forms 5/6th of outer fibrous coat.

b) Cornea -anterior transparent forms 1/6th of outer fibrous coat.

2)Middle vascular coat - It contains,

a) Choriod is highly vascular.It forms 5/6th of middle coat. It is dark.

b) Ciliary bodyis in between choroid and iris.

c) Iris- is anterior continuation of ciliary body and is a pigmented membrane. Its central opening is called pupil. It is controlled by circular and radial muscles. Circular muscles are pupillary constrictors and radial muscles are pupillary dilators.

3)Inner nervous coat –It is also called as retina and is the innermost nervous coat of eye ball. It contains special structures called,

a) Rods -Rods are for critical vision and cones for dim vision. Each retina contains 120 million rods.

b)Cones - They are for reception of light. Each retina contains 6 million cones.

Optic disc: It is the point where optic nerve leaves eye ball. This point doesnot contain retina and thus it is photo insensitive. It is also called blind spot.

Macula: It is a small area of retina. It is also called yellow spot situated opposite to the centre of pupil lateral to the entrance of optic nerve. It is for focussing near vision.

Conjuctiva: It is the thin stratified mucous membrane covering the exposed part of eye ball

Light transmitting structures of Eye ball:

1. Aqueous humour-It is the fluid present in anterior chamber of eye.

2. Lens – It is behind iris and pupil. It is trhe organ of refraction of light onto retina.

3. Vitreous humour –It is jelly like fluid in between lens and retina. It is responsible for maintenance of shape of eye.

Accesory structures of eye:

i)Eyebrows: They are arches of thick skin present over the eyes and containing thick hairs.

ii) Eyelids: They are musculocutaneous layer like structures infront of eye. Upper eyelids are bigger than lower eyelids. Eye lashes are hairs projecting from eyelids.

iii) Lachrymal apparatus:It consists of,

a) Lacrimal gland situated in the lateral end of upper eyelid.

b) Lacrimal duct through which tears come out.

c) Lacrimal sac

d) Nasolacrimal duct through which tears flow into nasal cavity.

Extrinsic muscles of eye: There are six muscles moving the eyeball. They are,

I. Four straight muscles
   1) Superior rectus- upward movement of eye.
   2) Inferior rectus- downwards movement of eye.
   3) Medial rectus- inwards movement of eye.
   4) Lateral rectus- outwards movement of eye.

II. Two oblique muscles.

5) Inferior oblique- upward and outward movement of eye.

6) Superior oblique- Downward and out ward movement of eye.

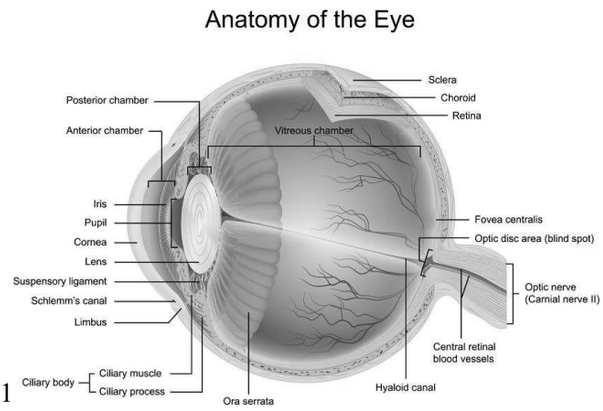


Fig 13.1

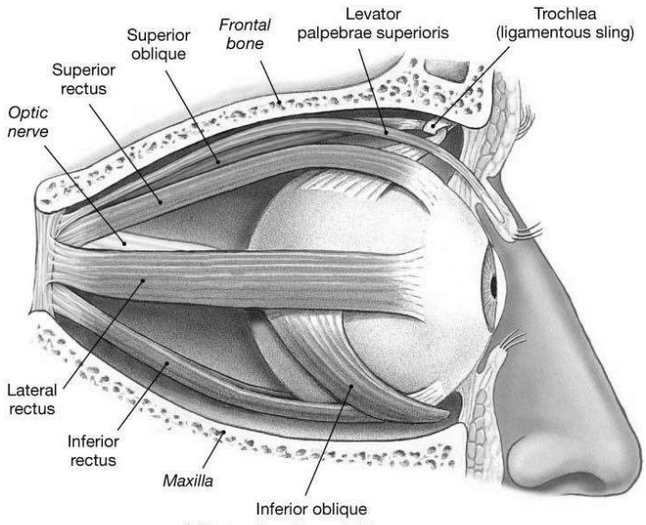


Fig 13.2Muscles of Eye

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Ear: Ear is the organ of special sense of hearing. It is also responsible for equilibrium. It is divided into three parts.

Parts of ear:

1) External ear : It lies outside the skull. It contains two parts.

i) Pinna –It is funnelshaped organ made of fibroelastic cartilage. It is the organ of collection of sound waves.

ii) External auditory meatus –It is small channel of about 3cm length.It is lined with skin and wax creating glands. Itsinner part is closed by a thin membrane called tympanic membrane or ear drum.This canal is the organ of conveyance of vibrations of sound to the tympanic membrane.

2) Middle ear: It lies inside the skull. It is a small cavity in the temporal bone,internal to tympanicmembrane. It contains air.It contains,

i. Fenestra ovalis (oval window) and fenestrarotundum (round window).

ii. Eustachian tube - It communicates with nasopharynx.It helpsin equalisation of pressure on both sides of tympanic membrane.

iii. Auditus –It is a channel connecting middle ear posteriorly with mastoid antrum of temporal bone.

iv. Auditory ossicles - Malleus, incus and stapes arranged across middle ear. These are minute bones of middle ear and are bound by ligaments.They vibrate as a single unit when sound waves impinge on tympanic membrane.

3. Internal ear: It contains,

i. Bony labyrinth –It is present in petrous portion of temporal bone.

ii. Membranous labyrinth –It lies with the bony labyrinth.

Fluids of Internal ear : Perilymph is the fluid of bony labyrinth. Endolymph is the fluid of membranous labyrinth.

Structures of bony labyrinth : Bony labyrinth contains vestibule, cochlea and 3 semicircular canals. Vestibule is present between vestibule and semicircular canals.Cochlea is the organ of hearing and semicircular canals for equilibrium.

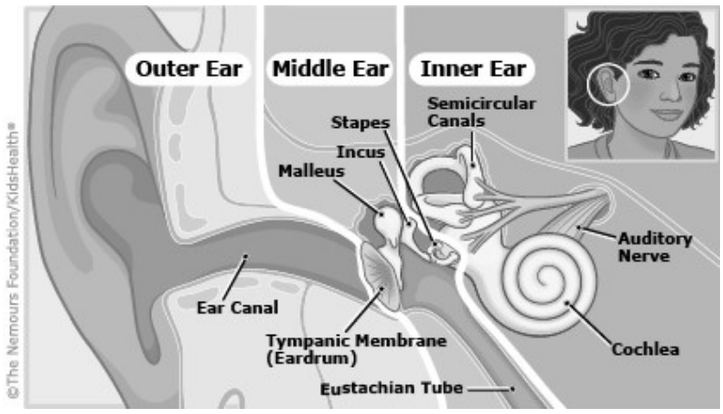


Fig. 13.3 Parts of ear

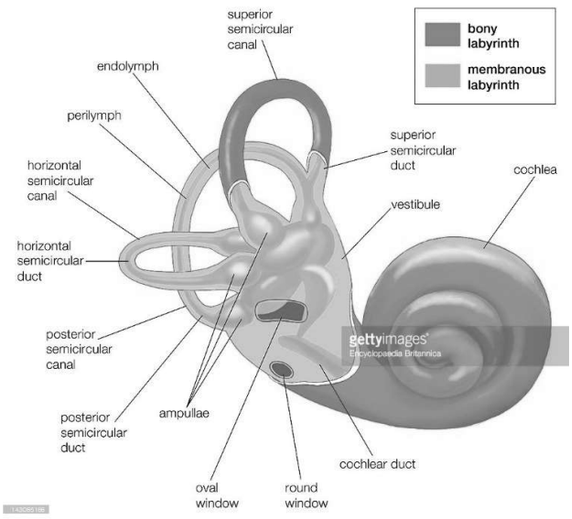


Fig. 13.4 Semi-circular canals

3. Tongue

Tongue is the organ containing taste buds.Taste buds are receptors of special sensation of taste.Epithelium of tongue is modified into papillae and taste buds.Taste buds are located on the sides of papillae.There are four types of taste buds based on sensation of taste - bitter, sour, salt and sweet.

Branch of facial nerve innervates anterior 2/3rds oftongue.Glossopharyngeal nerve innervates posterior 1/3rd of tongue.

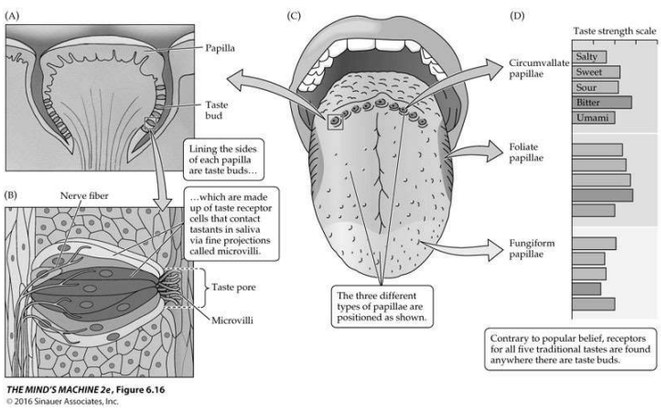
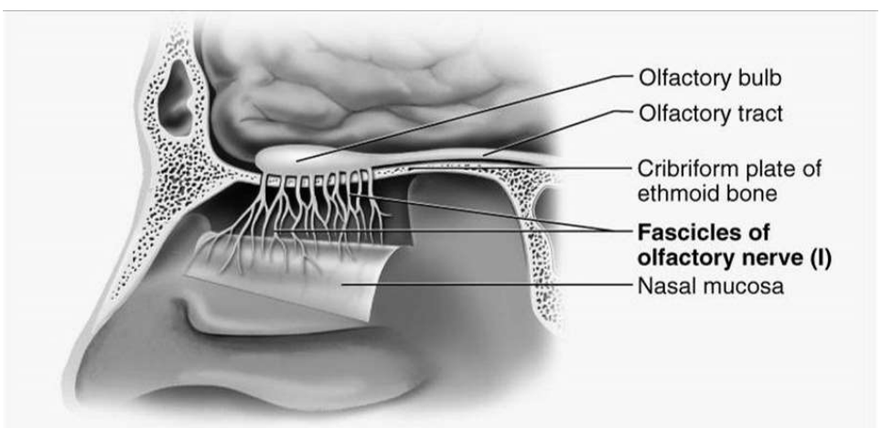


Fig. 13.5 Taste bud

4. Nose (olfactory receptors)



13.5 olfactory bulb

Olfactory receptors are specialised bipolar nerve cells present in the olfactory area of mucous membrane of upper part of nasal cavity. They are about 10-20millions in man.They receive sensation of smell. Ends of olfactory receptors join to form olfactory nerve (1stcranial nerve). Olfactory nerve passes through root of nose and ends in olfactory bulb. Olfactory bulb is connected to olfactory centre in the cerebrum through olfactory tract.

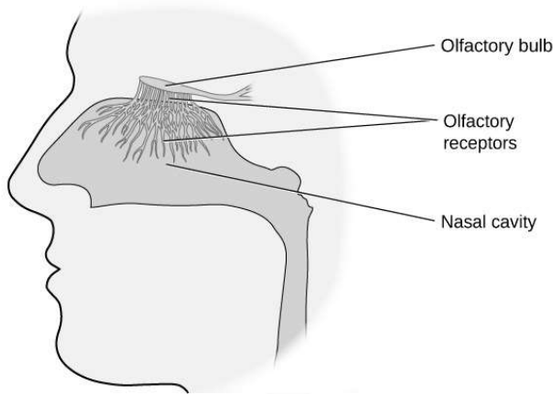


Fig. 13.6 Olfactory receptor

5. Skin

Itconsists of two layers. They are i) Superfial Epidermis ii) Deep Dermis

i) Epidermis: It is made of stratified epithelium. It has following layers,

a) Stratum corneum – It contains scale like cells. They have keratin protein and these cells are constantly replaced.

b) Stratum lucidum – It is a glistening layer.

c) Stratum granulosum – It is made of spindle shaped cells. They have granules in their cytoplasm.

d) Stratum germinatum – It is made of cuboidal cells. Multiplication of skin cells takes place in this layer.

e) Stratum basalis - Itcontains melanophorecells containing melanin pigment.

ii) Dermis: Dermis is deep layer of the skin. Itcontains arterial and venous capillaries, sensory nerve endings, sweat glands and sebaceous glands, roots of hairs, erector pili muscles (Hair straightening muscles).

Various sensory nerve endings of skin are encapsulated in connective tissue and are responsible for receiving various sensations. They are as follows.

1.Meissner's corpuscles – Mechano receptors for touch or light pressure

2.Pacinian Corpuscles – Mechanoreceptors for deep pressure

3.Krause's end bulbs - Thermoceptors for temparature

4.Some naked nerve fibres - Nociceptors for pain, itch, excess pressure etc

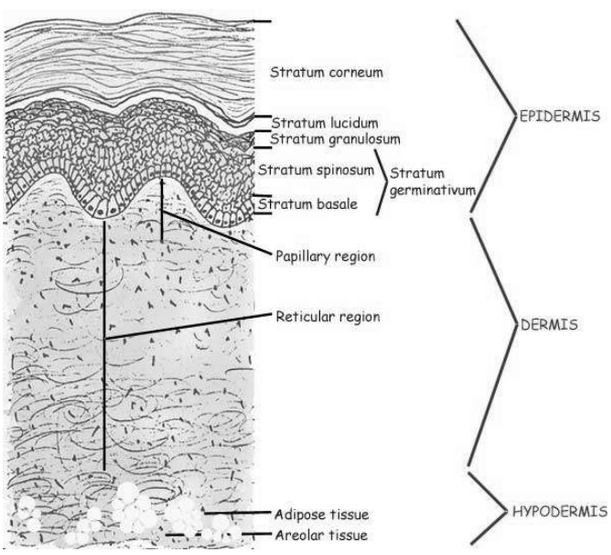


Fig 13.7 skin

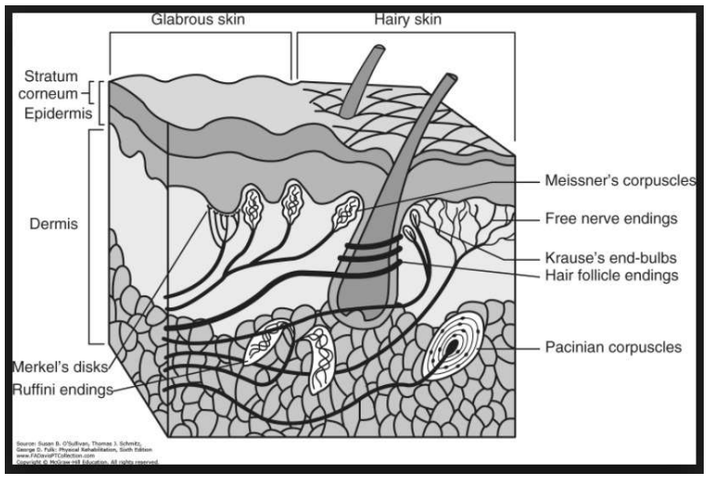


Fig. 13.6 Superficial receptors of skin

Summary

Eye,ear,tongue and nose are special sense organs. Of these five organs, first four are organs of special senses. Skin is the organ of general sensations..

Eye consists of Eye ball and accessory structures. Ear consists of external ear,middle ear and internal ear.Tongue consists of taste buds surrounded by stratified squamous epithelium and taste buds. Olfactory receptors of nose are present in the mucous membrane of upper part of nasal cavity.Skin consists of epidermis and dermis. Epidermis contains stratum corneum,stratum lucidum,stratum granulosum,stratum germinatum and stratum basalis. Several receptors of skin are mechanoceptors, thermoceptors, nosiceptors and naked nerve endings etc.

Questions

Essay questions

1. Write the structure of Eye, draw the diagram and label.

2.Discuss the Anatomy of ear with diagram.

3.Write in detail about the Anatomy of Tongue and draw diagrm .

4.Describe the layers of skin. Draw diagram.

Short answer questions

1.Mention organs of special senses ?

2.What are the layers of Eyeball ?

3.List the accessory structures of Eye ?

4. Write briefly about choroid, ciliary body and iris ?

5.Explain (a) Blindspot (b) Macula

6.What are the light transmitting structures of eyeball ?

7.Name the parts of lachrymal apparatus.

8.Mention the three main parts of ear.

9.What are the parts of external ear ?

10.What are the parts of middle ear.

11.Write the main parts of internal ear.

12.Write the auditory ossicles (bones of middle ear).

13.Mention types of taste buds.

14.Define (a) Taste buds (b) Olfactory receptors

15.What are layers of epidermis ?

16.What are components of dermis ?

17.Name different sensory receptors of skin ?