Anatomy

Anatomy: Anatomy is the study of the structure of the body and the physical relationship between its constituent parts.
Classification of the anatomy:
1. Gross Anatomy: It is the branch of anatomy that has a large-scale focus on organs and body structure.
2. Microscopic anatomy: It is the study of the microscopic structure of organs, tissue, and cells.
3. Human anatomy: It is the study of the anatomical structure of the human body.
4. Phytotomy anatomy: It is the study of the anatomical structure of plants.
5. Zootomy anatomy: Anatomical study of animals.
6. Comparative anatomy: It is the study of the anatomy of different organisms.

Physiology: It refers to the study of the functions of the structure.
Anatomical Terms in anatomy :
***Anatomical Position:**
-The position is used in all anatomical descriptions to ensure accuracy and consistency.
-The body is in the upright position then the head facing forward, the arms at the sides with the palm of the hands facing forward at the feet together.
***Directional term:**
-These terms are used to describe the location of body parts in the relation to other.
***Regional term:**
-These are used to describe parts of the body.

Types of direction terms:
1. **Medial:** Nearer to the midline.
2. **Lateral:** Farther from the midline or at the side of the body.
3. **Proximal:** Nearer to the point of attachment of a limb, or origin of a body part.
4. **Distal:** Farther from the point of attachment of a limb.
5. **Anterior or Ventral:** Nearer to the front of the body.
6. **Posterior:** Nearer to the back of the body
7. **Superior:** Nearer to the head.
8. **Inferior:** Farther from the Neck.

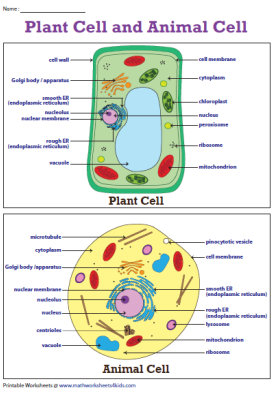
 # Body planes of the body:

-They divided the body into sections and are used to visualize the internal arrangement of the body.
1. **Median plane:** When the body is divided longitudinally through mid-line into the right and left half, it has been divided into the median plane.
2. **Frontal plane:** Frontal section divides the body longitudinally into its internal and posterior sections.
3. **Transverse plane:** Horizontal section provides a cross-section dividing the body into upper and lower parts.

 # Cavities of the body:
-The cavities and space of the body contain internal organs or viscera.
-There are two types of cavities:-
1. **Ventral cavity:** This is the larger cavity of the body.
    a. **Thoracic cavity:** It consists of the heart, lungs, trachea, oesophagus etc.
    b. **Abdominopelvic cavity:** It consists of GI-tract rectum, pelvis etc.
2. **Dorsal cavity:** It is the smaller cavity of the body consisting of the cranial cavity.

 # Scope of Anatomy and physiology:
1. **In Embryology:** It is the study of the foetus in the mother's womb, anatomy and physiology help out medical practitioners to understand the foetus's activity.
2. **In Biochemistry:** It is the study of biochemical changes in thermodynamics and the activities of cells.
3. **Biophysics:** It is the study of physical reactions and moments of different types of cells in the body.
4. **Neurophysiology:** Anatomy and physiology help the neuro physicians to understand the functional properties of nerve cells.
5. **Endocrinology:** Anatomy and physiology help to understand hormones and how they control the body's function.
6. **Cardiovascular physiology (CVP):** It has to understand the function of the heart and blood vessels.
7. **Immunology:** It helps out the body's defence mechanism against disease-causing microorganisms.
8. **Respiratory physiology:** It helps to understand the functions of air passage and lungs.

Structure of cell, its components and their functions.



 # Cell:
-Cell is the fundamental structural and functional unit of all living organisms.
 # Cell theory gives the following postulates:
1. All living organisms are composed of cells and products of cells.
2. All cells arise from preexisting cells.

 # Difference between Eukaryotic and Prokaryotic Cell:
 # Eukaryotic Cell:
1. Any cell that contains a clearly defined nucleus and nuclear membrane.
2. Ex. animal, plant, fungi, etc.
3. NUcleolus is present.
4. Cell size is large.
5. DNA replication is highly regulated with selective origin and sequence.
6. A type of organism is multicellular.
7. The quantity of chromosomes is more than one.
8. Ribosomes are large.
9. The growth rate is slow.
10. Organelles are present.
11. They have the ability to store heredity information.
12. The simple cell wall is present in plants and fungi.
13. The cytoplasm is present.

 # Prokaryotic Cell:
1. Any unicellular organism that does not contain a membrane-bound nuclear or nuclear membrane.
2. Ex. Bacteria, Archaebacteria.
3. The nucleolus is absent.
4. Cell size is small.
5. DNA replication is done for the entire genome at once.
6. The type of organism is unicellular.
7. In prokaryotic cells one long single loop of DNA and plasma.
8. Ribosomes are small.
9. The growth rate is fast.
10. Organelles are absent.
11. They don't have the ability to store hereditary information.
12. The complex cell wall is present in all prokaryotes.
13. The cytoplasm is present.

 # Cell Envelope (Plasma membrane):
- Bacteria can be classified into two groups on the basis of the differences in the cell envelope.
- The cell membrane provides protection for a cell.
- It is mainly composed of lipids and proteins.
- Measure lipids and phospholipids arranged in a bilayer.
- Lipids are arranged with the membrane with the polar head outside and the non-polar head inside.
- The hydrophobic portion ensures that the non-polar tail of saturated hydrocarbon is protected from the aqueous environment.
- The most important function of the plasma membrane is to transport the molecule inside and outside of the cell.
- This membrane is selective.

 # The movement of molecules is done by:
1. Active transport
2. Passive diffusion

3. Osmosis
4. Facilitated diffusion

 # Cell Wall:
- The cell wall is a non-living rigid structure.
- Cell walls provide a shape to the cell.
- It protects the cell from mechanical damage and infection.
- It provides a barrier to undesirable macro-molecules, it also helps in cell-to-cell interaction.

 # Mesosome:
- It is a special structure formed by the extension of the plasma membrane into the cell.
- These extensions are in the form of vesicles, tubules and lamellae.
- Mesosomes help in cell wall formation and locomotion.
- It also helps in DNA replication and distribution to daughter cells.
- Mesosomes help in respiration, and secretion, and increase the surface area of the plasma membrane.

 # Ribosome and Inclusion body:
- Ribosomes are associated with the plasma membrane of the cell.
- They are made up of two sub-unit 50s and 30s which when present together form the 70s of the ribosome.
- Ribosomes are the site of protein synthesis.
- Several ribosomes may attach to a single mRNA and form a chain called polyribosome or polysomes.

 # Inclusion body:
- Inclusion bodies are reserve material in prokaryotic cells and are stored in the cytoplasm.
- They lie free in the cytoplasm. E.g., Phosphate granules.

 # The Endoplasmic reticulum:
- The endoplasmic reticulum is a divider of intracellular space into two parts:-
    - Luminal compartment.
    - Extra luminal compartment.
- The E.R. bearing ribosomes on their surface is called Rough E.R.
- In the absence of ribosomes, E.R. is called smooth E.R. (S.E.R.).
- The S.E.R. is a measure site for lipid synthesis.

 # Golgi Apparatus (Golgi body):
- Golgi bodies perform the function of packaging that is to be delivered either to the intracellular target or secreted outside the cell.
- Golgi bodies are the important site for the formation of glycoprotein and glycolipids.

 # Lysosomes:
- Lysosomes are membrane-bound vascular structures formed by the process of packaging in the Golgi body.
- They contain all types of hydrolytic enzymes.

 # Hydrolytic enzyme:
- Hydrolases, lipases, proteases, and carbohydrases are active at acidic pH.

 # Vacuoles:
- The vacuole is the membrane-bound space present in the cytoplasm.
- It contains water, excretory product and other material which are not useful for cells.

 # Mitochondria:
- It is a membrane-bound structure with an outer membrane and an inner membrane, it also divides the lumen into 2 aqueous compartments which are the inner compartment and the outer compartment.
- The inner compartment is filled with homogenous material which is called a matrix.
- The inner membrane forms a number of infoldings called cristae. The cristae increase the surface area.
- Mitochondria are the site of aerobic respiration.
- Mitochondria produce cellular energy in the form of ATP hence they are called as powerhouse of the cell.

 # Plastids:
- Plastids are found in all plant cells.
- They bear specific pigments which are responsible for a specific colour.

 # Cytoskeleton:
- It is an elaborate network of proteinaceous structures consisting of microtubules, Microfilaments and intermediate filaments present in the cytoplasm called the cytoskeleton.

 # Cilia and Flagella:
- Cilia and Flagella are hair-like the growth of the cell membrane.
- Cilia are small structure cause movement of the cell.
- Flagella is lo0nger and it is also responsible for cell movement.

 # Centrosome and Centrioles:
- The centrosome is an organelle containing two cylindrical structures called centrioles.

 # Nucleus:
- The nucleus is a double membrane structure containing genetic materials.
- It contains cell chromosomes.
- DNA is present in the chromosomes that provide genetic information.
- It contains cell hereditary information and controlled cell growth and reproduction.
- The nucleus is the site of transcription.

 # Mitochondria:
- Many membrane-bound minute vesicles called microbodies contain various enzyme and it is present in both animal and plant.

Elementary Tissue

1. Tissue is a group of cells that have a similar structure and specific function.
2. They are four types of tissues in animals.
    a. Epithelial tissue
    b. Connective tissue
    c. Muscular tissue
    d. Nervous tissue

 # Epithelial tissue
- Epithelial tissue is spread throughout the body
- They form the covering of all body surfaces, body line cavities and hollow organs.
- They perform a variety of functions that include protection, secretion, absorption, excretion, filtration, diffusion and sensory reception.
- The cells of epithelial tissue are tightly packed because the cells have a one-time surface that is not in contact with another cell.
- Epithelial tissue is made up of carbohydrates and proteins.
- Epithelial cells are of three types
    - Squamous
    - Cuboidal
    - Columnar

 # Simple squamous
- These cells are flat in shape and arranged in a single layer.
- This is found in the wall of capillaries linings of the pericardium and the lining of alveoli of the lungs.

 # Simple cuboidal
- This epithelium consists of single-layer cells that are as tall as they are wide.
- The important function is secretion and absorption.
- They are found in the kidney, pancreas and salivary glands.

 # Simple Columnar
- It is a single row of tall, closely packed cells aligned in a row.
- These cells are found in areas with high secretory function or absorptive areas.
- They have cellular extensions like cilia and microvilli.

 # Pseudostratified
- There is simpler columnar epithelium whose nuclei appear at different heights giving misleading information.
- It contains cilia and is found in the nose, bronchi, uterus and fallopian tube.

 # Keratinized epithelium
- It is the most apical layer of cells which are dead.
- They contain tough, resistant proteins called keratin.
- Keratin makes epithelium waterproof.

 # Muscular tissue
- It is a special tissue found in animals that functions contractive and applies forces to different parts of the body.

 # Funciton of muscular tissue

- It helps to contract different body organs by nerve impulses travelling from the brain to the different body organs.
- It contains the contracting protein actin and myosin.
- Muscle tissue can be used to move bones, compress chambers, and squeeze various organs.

 # Types of muscle tissue

1. Skeletal muscle tissue
2. Cardiac muscle tissue
3. Smooth muscle tissue

 # 1. Skeletal Muscle Tissue

- These are organized bundles that allow muscles to contract quickly and relax quickly.
- Muscle tissue is attached to bones through tendons.
- This tissue is composed of the somatic nervous system (SNS).

 # 2. Cardiac Muscle Tissue

- Cardiac muscles are even parallel complex, branching found in cardiac muscles is connected via intercalated discs.
- Intercalated discs help cardiac muscles contract and move blood.

 # 3. Smooth Muscle Tissue

- In smooth muscle, the contractions are not quick and rapid.
- Smooth muscle can contract to apply a force on organs.

 # Connective Tissue

- Connective tissue was to support and connect different tissue and organ of the body.
- They are made of protein fibres secreted by the cells, called collagen or elastin.

 # Types of connective tissue

1. **Loose connective tissue**
2. **Dense connective tissue**
3. **Specialised connective tissue**

 # 1. Loose connective tissue

- These are present all over the body where support and elasticity are required.
- Blood vessels, nerves and muscles all have a loose connective tissue wrapping.

 # Types of loose connective tissue

1. **Areolar tissue:** It is present under the skin.
2. **Adipose tissue:** It is present under the skin and store fat.
3. **White adipose tissue:** It protects the kidney and is found in the back of the eye.
4. **Brown adipose tissue:** It is found in infant polar bears, penguins and other animals of cold regions.
5. **Reticular tissue:** It is made up of reticular fibre. It supports the internal framework of organs such as the liver, lymph nodes, and spleen.

 # 2. Dense Connective Tissue

- In this connective tissue fibroblast cells and fibres are compactly packed.
- The function of dense connective tissue is to support and transmit mechanical forces.

 # 3. Specialized connective tissue

- They are supportive connective tissue.
- It helps in maintaining correct posture and supports internal organs. E.g. Cartilage and bones.

 # Cartilage

- Cartilage is mostly present in the embryonic stage and works as a supporting skeleton.
- In humans, cartilage is present between the bones of the vertebral column, in the external ear, nose and hands.

 # Bones

- Bone is the hardest connective tissue and helps in maintaining the shape and posture of the body.

 # Blood

- Blood is made up of various cells present in the plasma.
- The blood contains red blood cells, white blood cells and platelets.

 # Lymph

- Lymph drains into the blood and transports absorbed fat to the blood.
- Lymph has white blood cells in the liquid matrix.

 # Nervous tissue

- Nervous tissue is the term for groups of organised cells in the nervous system, which is the organ system that controls the body's movement sends and carries signals to and from the different parts of the body.
- Nervous tissue is grouped into two main categories:
  - Neurons
  - Neuroglia

 # Function of nervous tissue

- Nervous tissues make up the nervous system.
- The CNS is composed of the brain and spinal cord.
- CNS coordinates information from all areas of the body and send nerve impulse that controls all body movement.
- PNS consist of peripheral nerves that branch all throughout the body. It connects CNS to the rest of the body part.
- **Nervous Tissue**
  - **CNS**
    - **Brain**
    - **Spinal Cord**
  - **PNS**
    - **ANS**
    - **SNS**

 # Types of Nervous system

 # Neurons

- Neurons are cells that transmit signals called nerve impulses.
- There are three types of neurons.
  - **Sensory neurons:** They transmit information from PNS to CNS.
  - **Motor neurons:** They send signals from CNS to PNS.
  - **Interneurons:** They connect sensory and motor neurons to the brain and spinal cord.

 # Neuroglia

- Neuroglia is cells that support neurons supply nutrients and get out of dead cells and pathogens.
- There are five types of neuroglia.
  - **Astroglial cells:** They provide nutrients to neurons and maintain ion balance.
  - **Ependymal cells:** They help cerebrospinal fluid (CSF) circulation.
  - **Oligodendrocytes cells:** They are found in CNS, and provide physical support to neurons.
  - **Schwann cells:** It forms myclin sheath.
  - **Microglial cells:** They engulf pathogens and protect CNS against disease.

Osseous System

- The osseous system or skeletal system or musculoskeletal system is the system which works as a support structure for our body. It gives the body its shape, allows movement, makes blood cells, provides protection for organs and stores minerals.
- **Osteology:** It is the branch of science that deals with the study of the skeletal system, its structure and functions.
- **The Skeletal system parts:**
  - **Bones**
  - **Joints**
  - **Cartilages**
  - **Ligaments**
- **Divided into two divisions:**
  - **Axial skeleton (80 bones)**
  - **Appendicular skeleton (126 bones)**
- **Functions:**
  - Support of the body
  - Protection of soft organs
  - Movement due to attached skeletal muscle
  - Storage of minerals and fats
  - Blood cell formation

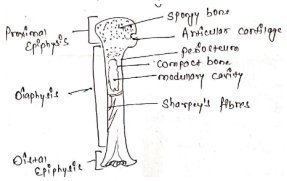
 # Classification of bones based on shape:

- **Long**
- **Short**
- **Flat**
- **Irregular**

 # Long bones:

- Typically longer than wide
- Have a shaft with heads at both ends.
- Contains mostly compact (homogeneous) bone. Ex. Femur, humerus.

- Cross Anatomy of a long bone:



- **Diaphysis:**
  - Shaft and composed of compact bones.
- **Epiphysis:**
  - Ends of the bones and composed mostly of spongy bones.
- **Periosteum:**
  - Outside covering it is diaphysis and composed of fibrous connective tissues membrane.
- **Short Bones:**
  - Generally cube-shape
  - Contains mostly spongy bone. Ex. carpals, tarsals
- **Flat bones:**
  - Thin and flattened
  - Usually curved
  - Thin layers of compact bones around a layer of spongy bones. Example: Skull ribs, sternum.
- **Irregular bones:**
  - Irregular shape
  - Do not fit into other bone classification categories. Ex. Vertebrae and hip.

 # Types of bone cells:

- **Osteocytes:**
  - Matured bone cells
- **Osteoblasts:**
  - Bone forming cells
- **Osteoclasts:**
  - Bone destroying cells and remodelling, the release of calcium.

 # Composition of the skeleton:

- Bone contains an abundant extracellular matrix that surrounds widely separated cells.

- The extracellular matrix is about 15% water, 25% collagen fibres and 50% of crystallized mineral salts.
- The most abundant mineral salt is calcium phosphate [$Ca_3(PO_4)_2$]. It forms crystals of salt.
- They combine other crystal salts to form calcium carbonates $CaCO_3$ and ions like magnesium, fluoride, potassium and sulphate.
- As these mineral salts are deposited in a framework formed by collagen fibre of the extracellular matrix, they crystallize and tissue hardens. This process is called calcification.

 # Appendicular skeleton calculation

- No. of total bones = 126

 # Upper limbs (Two hands):

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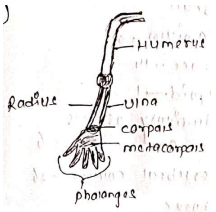
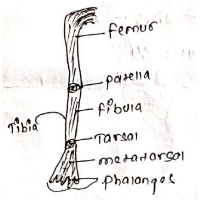


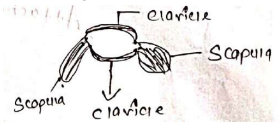
- Humerus - 1*2 = 2
- Ulna - 1*2 = 2
- Radius - 1*2 = 2
- Carpals - 8*2 = 16
- Metacarpals - 2*5 = 10
- Phalanges - 14*2 = 28

 # Lower limbs (Two legs):



- Femur - 1*2 = 2
- Patella - 1*2 = 2
- Fibula - 1*2 = 2
- Tibia - 1*2 = 2
- Tarsals - 7*2 = 14
- Metatarsals - 5*2 = 10
- Phalanges - 14*2 = 28

 # Pectorial girdles (shoulder):



- Clavicle - 1*2 = 2
- Scapula - 1*2 = 2

 # Pelvic girdle (Hip):

- Coxal bone - 1*2 = 2

 # Axial skeleton:

- No. of bones = 80

 # Skull

- Cranium - 8
- Face - 14

 # Hyoid -1

#Auditory ossicles

- Ears - 3*2 = 6

 # Vertebral column - 26

 # Thorax

- Sternum - 1
- Ribs - 24

Total = 80

Total no. of bones in body = 126 + 80 = 206

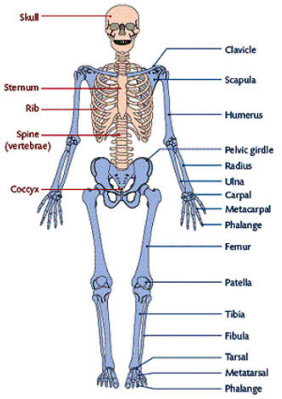


Fig:- Anatomy of Appendicular skeleton

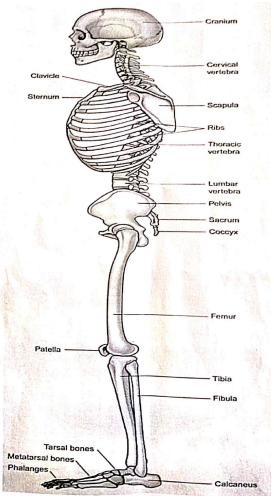


Fig:- Anatomy of Axial skeleton.

 # Joints

- A joint is a site at which any two or more bones articulate or come together, meaning the ends or edges of the bones are held together by connective tissues.
- Joints may allow flexibility and the movement of the skeleton. In some joints, however, the participating bones are contacted together due to which movement does not occur.

 # Classification of Joints:

- JOints have been classified into three main forms. They follow below:
  a. Fibrous joints
  b. Cartilaginous joints
  c. Synovial joints

 # Fibrous joints

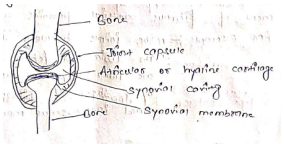
- Bones forming these joints are linked with tough, fibrous material such an arrangement of fibrous material permits no movement.
- For Example:
  - The joints between the skull bones.
  - The Tibia and Fibula in the legs are joined together along their shaft by a sheet of fibrous tissues called an interosseous membrane.

 # Cartilaginous Joints:

- These joints are formed by a pod of tough fibrocartilage between the bones that acts as a shock absorber. The joint may be immovable and somewhere slightly movable. Some cartilaginous joints permit limited movement.
- Example:
  - Vertebral columns are separated by intervertebral discs.
  - Symphysis pubis, which is softened by circulating hormones during pregnancy to allow for expansion during childbirth.

 # Synovial Joints:

- Synovial joints are characterised by the presence of a space or capsule between the articulating bones. The ends of the bones are closed together by a sleeve of fibrous tissue and lubricated with a small amount of fluid. Synovial joints are the most movable of the body.



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 # Capsule or Joint capsule:

- The joint capsule is capped in bunches of fibrous tissues that hold the bone together. It allows freedom of movement and also prevents injury.

 # Articular cartilage:

- The parts of bones in contact with each other are coated with hyaline cartilage which provides a smooth surface reduces friction and prevents damage from bone-to-bone contact.

 # Synovial cavity:

- A synovial cavity is such cavity in which synovial fluids are filled. Synovial fluids are thick, sticky fluids of egg white type.
  - It nourishes the synovial cavity.
  - Contains pathogens, and removes microbes and cellular bodies.
  - Lubricates the moving part of joints.
  - Maintains joint stability.
  - Etc.

 # Movements at synovial joints:

- Movement at any given joint depends on various factors, such as the tightness of ligaments holding the joint together, and how will the bones fit. Generally more stable bones, the less mobile it is.

 # Types of synovial joints:

- Synovial joints are classified according to the range of movement possible or the shape of the articulating parts of the bones involved.

 # 1. Ball and Socket Joints:

- The head of one bone is ball-shaped and articulates with a cup-shaped, socket of another. These joints allow a wide range of movement, including.
  - **Flexion** (Bending forward occasionally backwards) e.g. Hand knee joints/elbow.
  - **Extension -** Straightening or bending backwards. E.g. Leg knee.
  - **Abduction -** Movement away from the middle line of the body. E.g. movement of the whole hand up and down from the shoulder.
  - **Rotation -** Movement around the long axis of the bone. E.g. Left and right movement of the head.
  - **Circumduction -** Movement of a limb so that it describes the shape of a cone. E.g. rotation of the hand in a circular motion.

 # 2. Hinge Joints

- The articulating ends of the bones fit together like a hinge on a door, and the movement is therefore restricted to flexion and extension. E.g. Elbow, knee, ankle, joints between the phalanges of the fingers and toe which are also called interphalangeal joints.

 # 3. Gliding Joints

- The articulating surfaces are flat or very slightly curved and glide over one another but the amount of movement possible is very restricted.
- Example:
  - Joints between the carpals bones in the wrist.
  - The tarsal bones in the foot etc.

 # 4. Pivot joints

- These joints allow a bone or a limb to rotate. One bone fits into a hoop-shaped ligament that holds it close to another bone and allows it to rotate in the ring thus formed. E.g. The head rotates.

 # 5. Condyloid joints

- A condyle is smooth, rounded protection on a bone. One bone sits within a cup-shaped depression on another bone or ova, convex within the ellipsoid cavity.
- Example:
  - Movement of the mandible and temporal bone.
  - Movement between metatarsal and phalanges.
  - Movement between metacarpals and phalanges.

 # 6. Saddle joints

- The articulating bones fit together like a person sitting on a saddle.
- Example: Base of thumb, Trapezium of the wrist, first metacarpal bone, range of the movement is similar to condyloid joints but additional flexibility is the ability to touch each fingertip.

 # Disorders of joints:

- Disorders of joints occur mainly because synovial membrane, hyaline cartilage and bone get more affected.
- Some of the disorders are as follows below:

 # Rheumatoid arthritis:

- Rheumatoid arthritis is a chronic progressive inflammatory autoimmune disease mainly affecting synovial joints. Rheumatoid arthritis is an autoimmune disorder in which the immune system identifies the synovial membrane as “foreign and begins attacking it”.

 # Risk factor:

-Age: Increases with age
-Gender:- In premenopausal women more than men (3:1).
-Genetic risk:- Link familial history
-Vitamin o deficiency
-Smoking

 # Swelling of hand:

 # Osteoarthritis (osteoarthrosis)

- Osteoarthritis is a degenerative non-inflammatory disease that results in pain and restricted movement of affected joints. In this, the articular/hyaline cartilage gradually becomes thinner and bones begin to degenerate. When hyaline gets thinner, the synovial membrane gets thinner and lacks synovial fluid due to this phagocytes don’t destroy tissue debris and because of over-accumulation of tissue debris joint mobility is restricted and causes pain in the hip or knees etc.

 # Gout:

- This condition is caused by the deposition of sodium urate crystals in joints and tendons, provoking an acute inflammatory response. In short, increase uric acid.
- **Risk Factor:**
  - Male gender, obesity, heredity, hyperuricaemia and high alcohol intake.
- **Sites Affected:**
  - Meta-nasopharyngeal joint, knee, wrist etc.
- **Primary gout:**
  - Reduced or Increased urinate production.
- **Secondary gout:**
  - Reduced urination and kidney failure.

 # Ankylosing spondylitis:

- It is a kind of polyarthritis which means inflammation of more than one joint.
- This tends to occur in young adults and affects the joints of the vertebral column.
- Calcification of the intervertebral joints and laying down of new bone lead to reduced spinal flexibility and permanent deformity.

 # Carpel tunnel syndrome:

- This occurs when the median nerve is compressed in the wrist as it passes through the carpal tunnel. It is common, especially in women, between the ages of 30 and 60 years.
- There is pain and numbness in the hand and wrist affecting the thumb, index and middle fingers and half of the ring fingers.
- Cause: prolonged playing games and using the keyboard.

Lymph and Lymphatic system

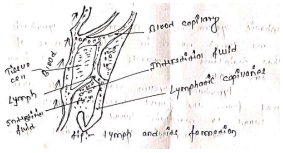
- The lymphatic system is a network of lymphatic vessels and lymph nodes in different areas of the body that maintains homeostasis as well as immunity of our body.
- The lymphatic system returns fluids that have leaked from the blood vascular system back to the blood to maintain blood volume.
- The lymphatic system consists of
  - Lymph
  - Lymphatic vessels
  - Lymph nodes
  - Lymphoid organs and tissues

 # Lymph:

- Lymph is a clear watery fluid that circulates through the lymphatic vessels on the interstitial fluid and drains into lymphatic vessels, it is called lymph. So lymph is identical in composition to interstitial fluid.

 # Formation of lymph:

- As blood vessels circulate through the body, most components of blood plasma such as nutrients, gases, and hormones filter through the blood capillary walls to form an interstitial fluid and are reabsorbed back by various capillaries. The excess filtered fluid (about 3 L per day) drains into the lymphatic vessels and becomes lymph i.e interstitial fluid enters into the lymphatic vessels and is called fluid.



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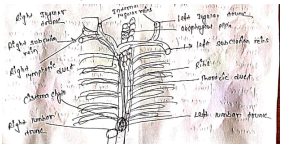
 # Lymphatic vessels:

- Lymph vessels are thin-walled, valved structures that carry lymph.
- Lymphatic vessels begin as lymphatic vessels.
- Larger lymphatic vessels unite to form a lymphatic trunk.
- The lymphatic trunk opens into two large lymphatic dust.
  - Right lymphatic duct
  - Left lymphatic (Thoracic duct)



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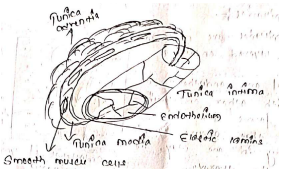
 # structure:

 # Lymph capillaries:

- Lymph capillaries are made up of single-layered endothelial cells.
- The edge of one endothelial cell with other endothelial cells forms flap line mini valves that ensure lymph flow in one way, i.e. towards the thorax.
- Lymphatic capillaries are attached to the surrounding tissue by anchoring filaments, which contain collagen filaments and elastic fibres.

 # Lymphatic vessel:

- Structure similar to veins.
- Thin walls and more valves
- 3 tunica layers - intima, media and adventitia
  - **Tunica intima:** Inner layer, made up of single flattened simple squamous epithelium composed of epithelium called endothelium and cells are called endothelial cells.
  - **Middle Tunica media:** Smooth muscle and elastic tissue that are arranged in a circular fashion around endothelium.
  - The outermost adventitia consists of fibrous tissue.
- **Afferent lymphatic vessels:** The vessels that enter the lymph nodes.
- **Efferent lymphatic vessels:** The vessels that Soares lymph node.



- Fig: Tiny portion of lymphatic vessels.

 # Lymphatic Trunk:

- Lymphatic vessels exist as lymph nodes and unite to form lymphatic trunks.
- The major trunks are:-
  - Lumbar trunks (Right and left)
  - Intestinal trunks
  - Bronchomediastinal trunks (Right and left)
  - Subclavian trunks (Right and left)
  - Jugular trunks (Right and left)

- The lumbar trunks drain lymph from the lower limbs, the adrenal glands and the abdominal wall.
- The intestinal trunk drains lymph from the stomach, intestines, pancreas, spleen and part liver.
- The bronchomediastinal trunk drains from the thoracic wall, heart and lungs.
- The subclavian trunks drain the upper limbs.
- The jugular trunks drain the head and neck.

 # Lymphatic duct:

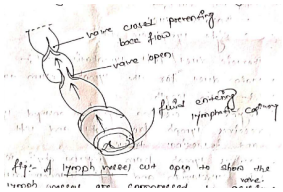
- Thoracic duct
- Right lymphatic duct

 # Thoracic duct / Left lymphatic duct:

- Main duct for the lymph return to the blood.
- 38-45cm in length.
- Begins at cisterna chyli (an enlarged lymph sac which receives lymph from the right and left lumbar trunk and intestinal trunk).
- Receives lymph from cisterna chyli left jugular, left subclavian and left branchomediastinal trunks.
- The thoracic duct drains lymph into various blood at the junction of the left internal jugular and left subclavian veins.
- Right lymphatic duct:
  - About 1.2cm in height
  - Receives lymph from the right jugular, right subclavian and right bronchomediastinal trunks.
  - Drains into various blood at the junction of the right internal jugular and right subclavian veins.

 # Circulation of lymph:

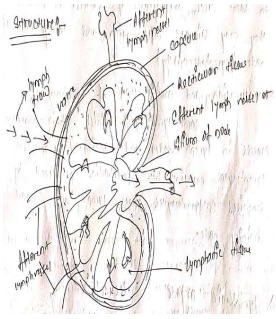
- There is no pump like the heart, involved in the onward movement of lymph, but the muscle, layer in the walls of the large lymph vessels have an intrinsic ability to contract rhythmically.



- In addition, lymph vessels are compressed by activity in adjacent structures, such as the contraction of the muscle and regular pulsation of large arteries. This milking action on the lymph vessel wall helps to push lymph along.
- Changes in the thoracic pressure associated with the respiratory cycle also assist lymph movement.
- At the peak of inspiration, when the pressure in the chest is at its lowest, lymph is 'succeed' along the right lymphatic duct and so increases lymph flow into the subclavian vein.

 # Lymp node:

- Lymph nodes are oval or bean-shaped organs that lie along the length of lymph vessels, often in groups the lymph drains through a number of nodes, usually 8-10, before returning to the various circulation. These nodes are small in size and some largest nodes are about the size of almonds.



- Lymph nodes have an outer capsule of fibrous tissue. The main substance of the node consists of reticular and lymphatic tissue. The lymphatic tissue is packed with immune and defence cells, including lymphocytes and macrophages.
- As many as four or five lymph-afferent vessels may enter a lymph node. But anyone efferent lymph vessels that carry lymph away from the node. Each node has a concave surface called helium.

 # Function:

 # Defence:

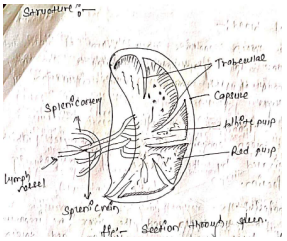
- Lymph flows slowly through lymph nodes and is filtered by the reticular and lymphatic tissue as it passes particulate matter may include bacteria, dead and alive phagocytosis of bacteria is incomplete, they may stimulate inflammation and enlargement of node (lymphadenopathy).

 # Maturation and proliferation of lymphocytes:

- Some lymphocytes finish their maturation process in lymph nodes and activated T and B lymphocytes multiply here. Antibodies produced by sensitised B-lymphocytes enter lymph and blood-draining node.

 # Lymphatic organs and Tissues:

- **Spleen:** The spleen contains the reticular and is the largest lymph organ. It lies between the fundus of the stomach and the diaphragm. It is purplish in colour usually about 12cm long, 7cm wide and 2.5cm thick. It weighs about 200g.
- **Organs associated with the spleen:**
  - Superiorly - diaphragm
  - Inferiorly - large intestine
  - Anteriorly - stomach
  - Mediary - pancreas, left kidney
  - Laterally - diaphragm - intercoastal muscle.



 # Structure:

- Oval in shape, Anterior surface covered with capsule, deep into organ forming trabeculae. While the pulp is an area of lymphatic tissue, the red pulp is suffused with blood.
- The Structure consists of
  - Splenic artery, a branch of the coeliac artery
  - Splenic vein, a branch of the portal vein
  - Lymph vessel (efferent only)
  - Nerves.

 # Functions:

- **Phagocytosis:** Old and abnormal erythrocytes are destroyed mainly in the spleen, and transported through the liver via splenic and portal veins. The transportation of leukocyte, platelets and bacteria are phagocytosis in the spleen.

 # Storage of blood:

- The spleen contains up to 350ml of blood, and in response to sympathetic stimulation can rapidly return most of this volume to circulation. E.g. haemorrhage.

 # Immune response:

- The spleen contains T and B lymphocytes which are activated by the presence of antigens. E.g. in infection.

 # Erythropoiesis:

- The spleen and the liver are important sites of fetal blood cell production, and the spleen can also fulfil this function in adults at times of great need.

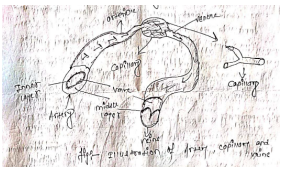
 # Disorders:

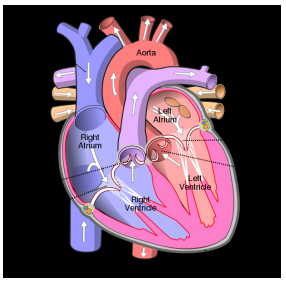
- **Lymphangitis:** Inflammation of lymph vessels.
- **Lymphadenitis:** Infection of lymph nodes.
- **Lymphadenopathy:** Enlargement of lymph nodes.
- **Splenomegaly:** Enlargement of the spleen.
- **Lymphoedema:** Swelling in tissues whose lymphatic drainage has been obstructed in some way.

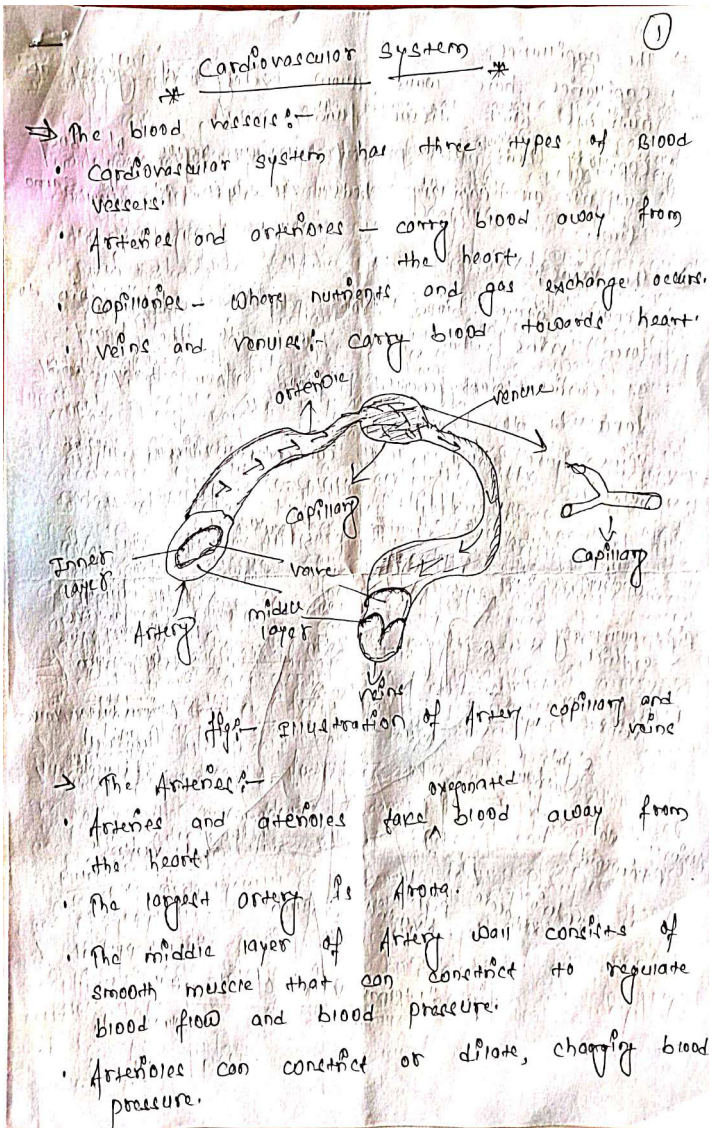
Cardiovascular System

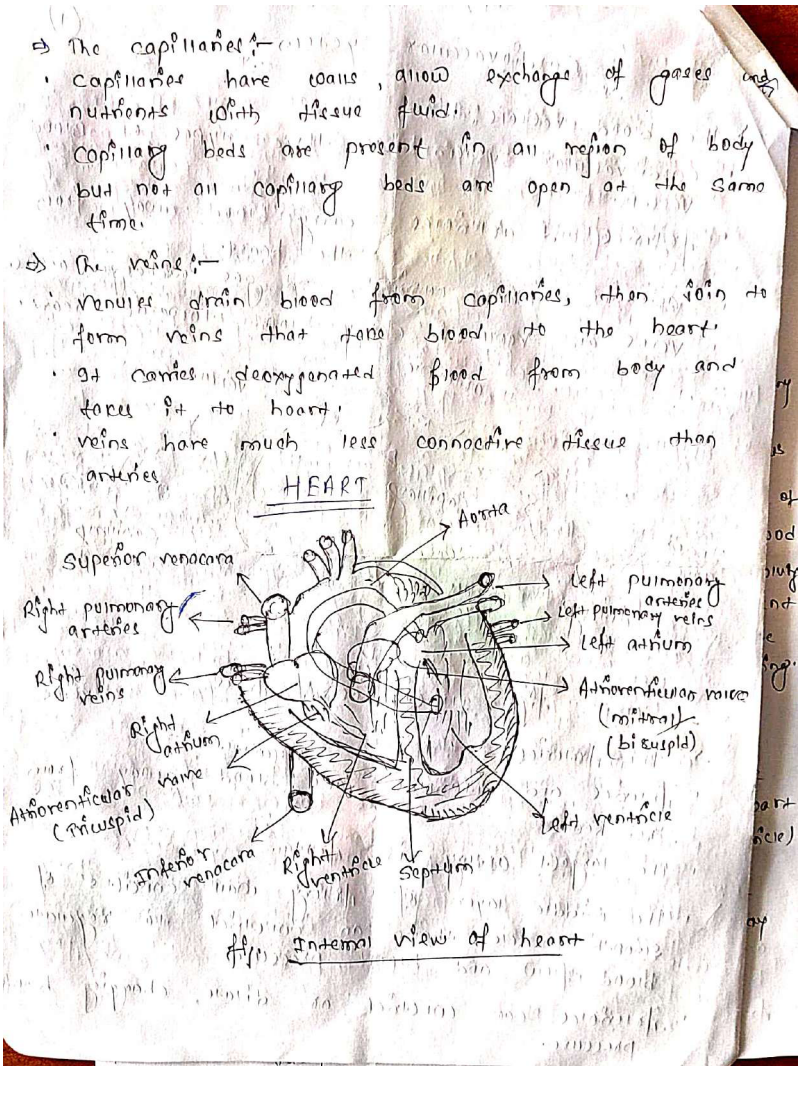
 # The blood vessels:

- The cardiovascular system has three types of blood vessels.
- **Arteries and arterioles -** carry blood away from the heart.
- **Capillaries -** where nutrients and gas exchange occurs.
- **Veins and venules -** carry blood towards the heart.









Cardiovascular system is also called circulatory system of body. This system has many blood vessels [Artery and veins]

Cardio — Heart
vascular — veins & vessels

Heart is a muscular hollow organ that pump a blood. It lies between lungs, above diaphragm.

Length — 10 cm - 12 cm, 9 cm wide, 6 cm thick
weight in male — 310 gram
weight in female — 225 gram

⇒ Layers of heart :—

① Pericardium :— It is uppermost layer of heart, pericardium has two parts parietal pericardium and visceral pericardium.

② Myocardium :— myocardia is a middle layer of it is made up cardiac muscle fibris. It is responsible for pumping of heart.

③ Endocardium :— Endocardium is a innermost layer of the heart.

⇒ chambers of heart :—

- Heart has 4 chambers — 2 Atrium, 2 ventricle
- Two atrium present upper side of heart (left & right)
- Two ventricle present lower part of heart. (left & right)

⇒ Superior venacava :—

- It is important vein which is connected with right atrium.
- Its main function is that it carry deoxygenated blood from upper part of body. e.g. brain, eye, mouth, ears etc.

⇒ Inferior venacava :—

- It is important vein which connects to right atrium.
- Its main function is to carry impure blood from lower parts of body to right atrium.

⇒ pulmonary Artery :—

- This is a special Artery which is attached to right ventricle and it's upper end is divided into two way which is connected to lungs.
- It is one of the arteries which carries deoxygenated blood (unique artery)

⇒ pulmonary veins :—

- This vein start from the lungs and lower end is connected to left atrium. (unique)
- It is one of the veins which carries oxygenated blood.

⇒ Aorta Artery :—

- This is largest artery of body which is connected to left atrium.
- It carry a oxygenated blood from the heart and send to all body.

Atrioventricular valves :—

Atrioventricular valves occur between the atria and ventricles — The tricuspid valve on the right and the bicuspid valve on the left: both valves are reenforced by chordae tendinae attached to muscular projections with in the ventricles.

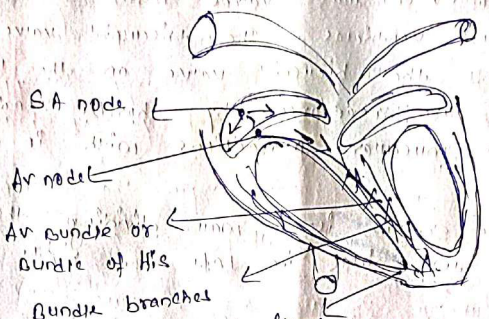
* Septum :— The septum is a wall dividing the heart into two sides ie left and right.

⇒ Passage of Blood through the heart :—

Superior and inferior vena cava → right atrium → Tricuspid valve → Right ventricle → pulmonary semilunar valve → pulmonary trunk and arteries to the lungs → Left atrium → Bicuspid valve → Left ventricle → Aortic semilunar valve → Aorta → Different part of body.

cycle of Blood Circulation

⇒ conducting system of heart :—



- A special system is available in the heart responsible for the rhythmic contraction and conduction of impulses in the heart. divided into 5 parts :—

- SA Node or Sinoatrial node :—
  - It is located in the right atrial wall just below opening of Superior vena cava.
  - Cardiac excitation begins in the SA node.
  - Impulse travels throughout heart via conductionsys- (pacemaker of heart)
- Av node or Atrioventricular node :—
  - It is located into the Septum between two atria.
  - cardiac impulses spreads from SA node to Av node. (Secondary pacemaker)
- Bundle of His :— Impulses reaches from A.V node to Bundle of His and then divided into two parts Bundle branches & purkinje fibres.

Cardiac cycle :-

- Cardiac cycle is defined as the succession of coordinated events taking place in the heart during each beat.
- Each beats consists of two major periods called Systole and diastole.
- During systole heart contracts and pumps the blood through arteries.
- During diastole, heart relaxes and blood is filled in the heart through veins.
- All these events are repeated in cyclic manner

Events of cardiac cycle :-

- Atrial events :-

When the heart beats at normal rate of 72/min duration of each cardiac cycle is about 0.8 seconds.

- Atrial systole - 0.1 (0.1) sec.
- Atrial Diastole - 0.63 (0.7) sec.

- ventricular events :-
  - ventricular systole - 0.27 (0.3) sec.
  - ventricular diastole - 0.53 (0.5) sec.

Heart Sound :-

Heart sounds are the sounds produced by the heart during a cardiac cycle, specially when heart valves snap shut. 'LUB-DUB'

It can detected by stethoscope and phonocardiogram

Types of heart sound :-

- First heart sound :-

It is dull and prolonged as 'LUB'

Duration :- 0.08s to 0.16 sec, average - 0.14s.

- Second heart sound :-

It is sharp and short as 'DUB'

Duration - 0.11s

- Third heart sound :-

Heard occasionally and weak

Duration - 0.04 sec

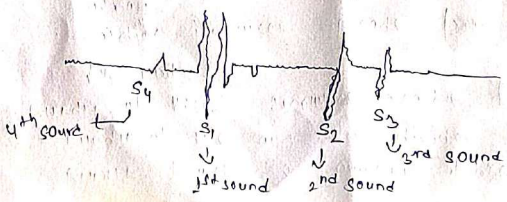
Beings :- youth, athletes, pregnancy

- Fourth heart sound :-

It is weak and rumbling in nature.

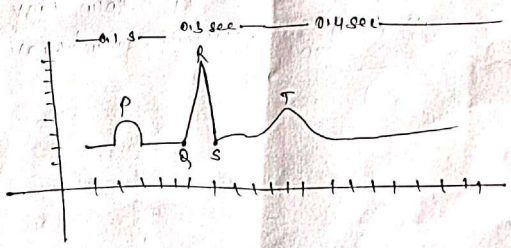
cannot be heard from stethoscope but recorded on phonocardiogram.

Phonocardiogram



Electrocardiogram :-

- Conduction of action potential through electric impulse
- An electrocardiogram is a recording of the electrical changes that occur in the myocardium during a cardiac cycle.
- Electrocardiogram shows the spread of the electrical signal generated by the SA node as it travels through the atria, the AV node and the ventricles.
- The normal ECG tracing shows five waves, which have been named P, Q, R, S and T.
- The P wave represents the impulses from the SA node sweeping over the atria (atrial depolarisation)
- The QRS complex represents the very rapid speed of spread of impulse from the AV node through the AV bundle and the purkinje fibres, and the electrical activity of the ventricular muscle (ventricular depolarisation)
- The T wave represents the relaxation of the ventricular muscle (ventricular repolarisation).
- Normally, the heart rate falls somewhere between 60 to 90 b.p.m. A heartrate over 100 b.p.m is called tachycardia and below 60 b.p.m is bradycardia.



Cardiac output :-

The cardiac output is the amount of blood ejected from each ventricle every minute. The amount expelled by each contraction of each ventricles is the blood volume/stroke volume.

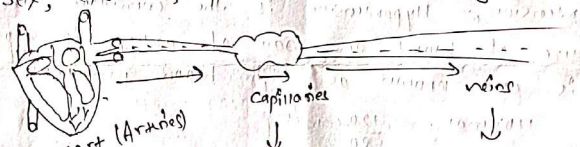
$$\text{Cardiac output} = \text{Stroke volume} \times \text{heartrate}$$
$$\text{l/min}$$

Stroke volume :- The stroke volume is determined by the volume of blood in the ventricles immediately before they contract i.e preload and preload is depends on the amount of blood returning into the heart through superior and inferior vanacava

Thrombosis :- Thrombosis is the formation of blood clot inside the blood vessels, interrupting blood supply to the tissues.

Blood pressure

- The pressure exerted by blood on the wall of artries is known as blood pressure.
  - Systolic blood pressure — ventricular contraction
  - Diastolic blood pressure — ventricles relaxation
- Normal B.P — 120/80 mm Hg
- pressure in blood vessels decreases as the distance from heart increases.
- It is essential to record both B.P's as it gives information regarding the status of working heart.
- B.P varies from physiological parameters like age, sex, exercise, posture, sleep during emotions etc



Heart (Arteries)	Capillaries	veins
Speed – high	Speed – medium	Speed – low
width – modium	width – narrow	width – wide
pressure – high	pressure – modium	pressure – low

Factors affecting blood pressure :– (Risk factors)

- Age
- Race – (Black people)
- obesity
- Hormonal changes
- Use of Tobacco
- use of drinking alcohol
- low potassium level
- Genetic factor
- unwanted pills & pregnancy

Cardiovascular diseases

Cardiovascular diseases (CVDs) are a group of disorders of the heart and blood vessels. They include:

* Hypertension
* Hypotension
* Arteriosclerosis
* Angina pectoris
* myocardial infraction
* congestive heart failure
* cardiac arrhythmias

etc.

⇒ Hypertension :– Hypertension is the condition in which pressure of blood on wall of artery is too high. It is also known as high blood pressure.

Normal — 120/80 mm Hg

Here, Systolic — ↑ 140 mmHg
Diastolic — ↑ = 90 mmHg

Also known as Silent killer disease.

Symptoms :–

* Severe headche, Blurred vission, dizziness, nausea, vomiting, confusion, Irregular heartbeat

Treatment / management :–

Two ways :–

- Life style modification :– Weight reduction, Exercise, Stress mgm
- pharmacological therapy :– using long term anti-hypertension drugs like diuretics, etc

Hypotension :–

- Hypotension is a condition where pressure of blood on wall of arteries is low. It is also known as low blood pressure.

Normal — 120/80 mm Hg

Here, Systolic B.P — < 90 mm Hg
Diastolic B.P — < 60 mm Hg

Symptoms :–

* Chest pain, shortness of breath, Irregular heartbeat, headche, stiff neck, painful urination, Black tarry stool.

Treatment :–

* Some hypotension which is not chronic that can be treated easily with proper lifestyle modification.
* Some needs to be treated by using antihypotensive drugs – Noradrenaline etc.
* In lifestyle, Adding electrolytes to the diet, morning dose of caffeine can also help etc.

Arteriosclerosis :–

- Arteriosclerosis is also known as Arteriosclerosis vascular disease (ASVD).
- It is the condition in which an artery wall thickens as a result of a build-up of a fatty materials such as cholesterol.
- Accumulation of cholesterol leads to hardening of arteries and which restrict the blood flow and cause blood clot.
- Artherosclerosis is preventable and treatable condition

⇒ Angina pectoris :–

Angina also known as angina pectoris is a medical condition characterised by chest pain usually left sided due to inadequate blood supply to the heart muscle due to obstruction (like presence of blood clot), Narrowing or contraction (vasospasm) of the supply coronary arteries.

⇒ Myocardial Infarction :–

The myocardial infarction (MI), commonly known as a heart attack, occurs when blood flow decreases or stops to a part of heart by an embolus or thrombus.

Heart attack is the irreversible damage of myocardial tissue. Speedy restoration of blood flow through the blocked artery using clot-dissolving (thrombolytic) drugs can greatly reduced the extent of permanent damage but treatment must be started within few hours of infarction occuring.

⇒ congestive heart failure :–

congestive heart failure is chronic progressive condition effects pumping power of heart muscle and results in heart failure (Right ventricle)

⇒ Cardiac arrhythmias :– Abnormality of the cardiac rhythm is called a cardiac arrhythmia. It may cause sudden death, HF, etc.

bradycardia :– < 60 b.p.m heart rate
tachycardia – > 100 b.p.m heart rate