علم الفسلجة البشري

قسم تقنيات العلاج الطبيعي

المرحلى الاولى

اعداد

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Human Physiology

Physiology is defined as the study of functions of various systems and different organs of the body. Physiology is of different types namely, Human Physiology, Animal Physiology and Plant Physiology. Human Physiology and Animal Physiology are very much inter-related. Knowledge of Human Physiology is essential to understand the other allied subjects like Biochemistry, Pharmacology, Pathology, Medicine, etc.

Cell Physiology

All the living things are composed of cells. A single cell is the smallest unit that has all the characteristics of life .

Structure of the Cell

Each cell is formed by a cell body and a membrane covering the cell body called the cell membrane. Cell body has two parts, namely nucleus and cytoplasm surrounding the nucleus. Thus, the structure of the cell is studied under three headings:

1. Cell membrane.
2. Cytoplasm.
3. Nucleus.

Cell Membrane

Cell membrane is a protective sheath, enveloping the cell body. It is also known as plasma membrane. This membrane separates the fluid outside the cell called extracellular fluid (ECF) and the fluid inside the cell called intracellular fluid (ICF). The cell membrane is a semipermeable membrane. So, there is free exchange of certain substances between ECF and ICF.

Composition of Cell Membrane

Cell membrane is composed of three types of substances:

1. Protein (55).
2. Lipids (40%).
3. Carbohydrates (5%).

Functions of Cell Membrane

1. Protective function: Cell membrane protects the cytoplasm and the organelles present in the cytoplasm
2. Selective permeability: Cell membrane acts as a semipermeable membrane, which allows only some substances to pass through it and acts as a barrier for other substances
3. Absorptive function: Nutrients are absorbed into the cell through the cell membrane
4. Excretory function: Metabolites and other waste products from the cell are excreted out through the cell membrane
5. Exchange of gases: Oxygen enters the cell from the blood and carbon dioxide leaves the cell and enters the blood through the cell membrane
6. Maintenance of shape and size of the cell: Cell membrane is responsible for the maintenance of shape and size of the cell.

Cytoplasm

Cytoplasm of the cell is the jelly-like material formed by 80% of water. It contains a clear liquid portion called cytosol and various particles of different shape and size. These particles are proteins, carbohydrates, lipids or electrolytes in nature. Cytoplasm also contains many organelles with distinct structure and function .

Cytoplasm is made up of two zones:

1. Ectoplasm: Peripheral part of cytoplasm, situated just beneath the cell membrane
2. Endoplasm: Inner part of cytoplasm, interposed between the ectoplasm and the nucleus.

Functions of cytoplasmic organelles

Rough endoplasmic reticulum	Synthesis of proteins
Smooth endoplasmic reticulum	Synthesis of lipids and steroids
Golgi apparatus	Processing, packaging, labeling and delivery of proteins and lipids
Lysosomes	Degradation of macromolecules
Centrosome	Movement of chromosomes during cell division
Ribosomes	Synthesis of proteins
Mitochondria	1. Production of energy 2. Synthesis of ATP
Cytoskeleton	1. Determination of shape of the cell 2. Stability of cell shape 3. Cellular movements

Nucleus

Nucleus is the most prominent and the largest cellular organelle. It has a diameter of 10 μ to 22 μ and occupies about 10% of total volume of the cell. Nucleus is present in all the cells in the body except the red blood cells. The cells with nucleus are called eukaryotes and those without nucleus are known as prokaryotes. Presence of nucleus is necessary for cell division .

Most of the cells have only one nucleus (uninucleated cells). Few types of cells like skeletal muscle cells have many nuclei (multinucleated cells). Generally, the nucleus is located in the center of the cell. It is mostly spherical in shape. However, the shape and situation of nucleus vary in some cells.

Structure of Nucleus

1- Nuclear membrane.
2- Nucleoplasm.
3- Chromatin.
4- Nucleolus.

المحاضرة الثانية/ منسلة نظري

Body Fluids

Body fluids are liquids originating from inside the bodies of living humans. They include fluids that are excreted or secreted from the body.

Significance of Body Fluids

1- In Homeostasis

Body cells survive in the fluid medium called **internal environment**. Internal environment contains substances such as glucose, amino acids, lipids, vitamins, ions, oxygen, etc. which are essential for growth and functioning of the cell.

2- In Transport Mechanism

Body water forms the transport medium by which nutrients and other essential substances enter the cells; and unwanted substances come out of the cells. Water forms an important medium by which various enzymes, hormones, vitamins, electrolytes and other substances are carried from one part to another part of the body.

3- In Metabolic Reactions

Water inside the cells forms the medium for various metabolic reactions, which are necessary for growth and functional activities of the cells.

4- In Texture of Tissues

Water inside the cells is necessary for characteristic form and texture of various tissues.

5- In Temperature Regulation

Water plays a vital role in the maintenance of normal body temperature.

Compartments of Body Fluids –Distribution of Body Fluids

Total water in the body is about 40 L. It is distributed into two major compartments:

1. Intracellular fluid (ICF): is the fluid found inside the cell membrane. Its volume is 22 L and it forms 55% of the total body water. The concentration of sodium is low and the concentration of potassium is high. For example, the mitochondrial matrix separates the mitochondrion into

compartments. Its composition consists mostly of water, dissolved ions, small molecules, and large, water-soluble molecules (such as proteins).

2. Extracellular fluid (ECF): is the fluid found outside cell membrane. Its volume is 18 L and it forms 45% of the total body water. The concentration of sodium is high and the concentration of potassium is low. Examples: lymph, Plasma, Fluid in bones and fluid in dense connective tissues like cartilage. It composition is mainly cations and anions. The cations include: sodium (Na+), potassium (K+) and calcium (Ca2+). Anions include: chloride and hydrogen carbonate (HCO3). These ions are important for water transport throughout the body

Composition of Body Fluids

Body fluids contain water and solids. Solids are organic and inorganic substances.

1- **Organic Substances:** are glucose, amino acids and other proteins, fatty acids and other lipids, hormones and enzymes.
2- **Inorganic Substances:** present in body fluids are sodium, potassium, calcium, magnesium, chloride, bicarbonate, phosphate and sulfate.

Measurement of body fluid

To calculate the interstitial fluid volume (fluid not in the cells and in the blood) subtract the plasma volume from the extracellular volume. To measure the volume of any fluid compartment within the body you must inject or infuse a **marker substance** that will equilibrate (diffuse freely to a uniform concentration) throughout this compartment, also not be metabolized.

Tritiated (3H) water is a good marker because it diffuses throughout the body, it is chemically identical to normal water and 3H water is radioactive.

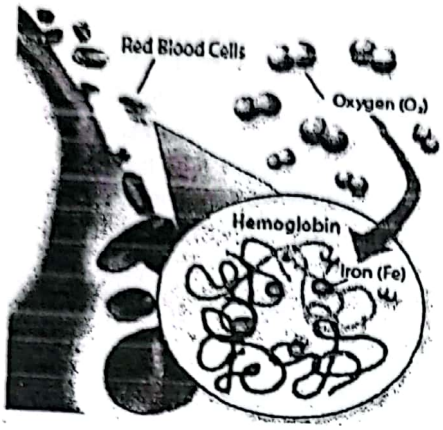
Given that concentration (C) = mass (M) / volume (V) it should be obvious that:

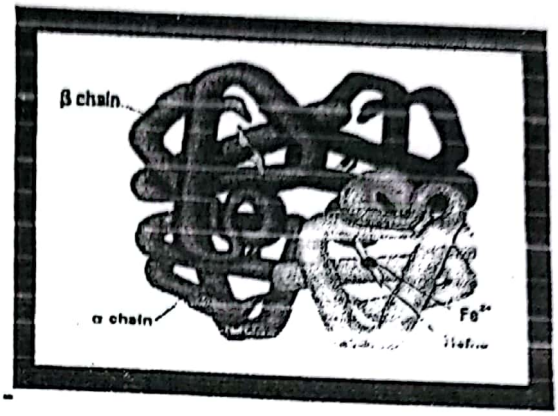
$V = M/C$

Therefore: if you know the mass of marker injected into the body and are able to measure the marker concentration once equilibration is complete, you can calculate the volume of the compartment occupied by the marker.

الفسلجة النظري

المحاضرة الخامسة





Hemoglobin

Define: (abbreviated Hgb or Hb),the hemoglobin molecular present inside RBC and is responsible for is main function which is carry O2 to the tissue and return CO2 from tissues to the lungs.

Hemoglobin is made up of four protein molecules (globin) globin chains that are connected together.

Hemoglobin = Heme + globin (protein)

-globin is considered as a protein so that it synthesized by rough endoplasm reticulum RER.

-Hemoglobin molecule consists of four polypeptide chains:

Two alpha chains α, each with 141 amino acids and Two beta chains β globin, each with 146 amino acids

in adult hemoglobin (molecule contains two alpha-globin chains and two beta-globin chains. **In fetuses and infants,** beta chains are not common and the hemoglobin molecule is made up of two alpha chains and two gamma chains. As the infant grows, the gamma chains are gradually replaced by beta chains, forming the adult hemoglobin structure (after birth and reaches adult level within 1-2 years).

-The iron contained in hemoglobin is also responsible for the red color of blood.

Normal hemoglobin types include:

- **Hemoglobin A (Hb A):** makes up about 95%-98% of hemoglobin found in adults; it contains two alpha (α) chains and two beta (β) protein chains.
- **Hemoglobin A2 (Hb A2):** makes up about 2%-3% of hemoglobin found in adults; it has two alpha (α) and two delta (δ) protein chains.
- **Hemoglobin F (Hb F, fetal hemoglobin):** makes up to 1%-2%: it has two alpha (α) and two gamma (γ) protein chains.

Normal hemoglobin values?

- Adult males: 13.5 to 17.5 gm/dL
- Adult women: 12 to 16 gm/d
- Newborns: 17 to 22 gm/dL
- Children: 11 to 13 gm/dL

IF low hemoglobin level is referred to as anemia or low red blood count. There are many reasons (causes) for anemia:-

- such as nutritional deficiency (iron, vitamin B12, folate),
- loss of blood (traumatic injury, surgery, bleeding,
- bone marrow problems....etc.

if Higher than normal hemoglobin levels referred to problem such as in people living at high altitudes , in people who smoke, Dehydration, polycythemia.....etc

hemoglobin measured?

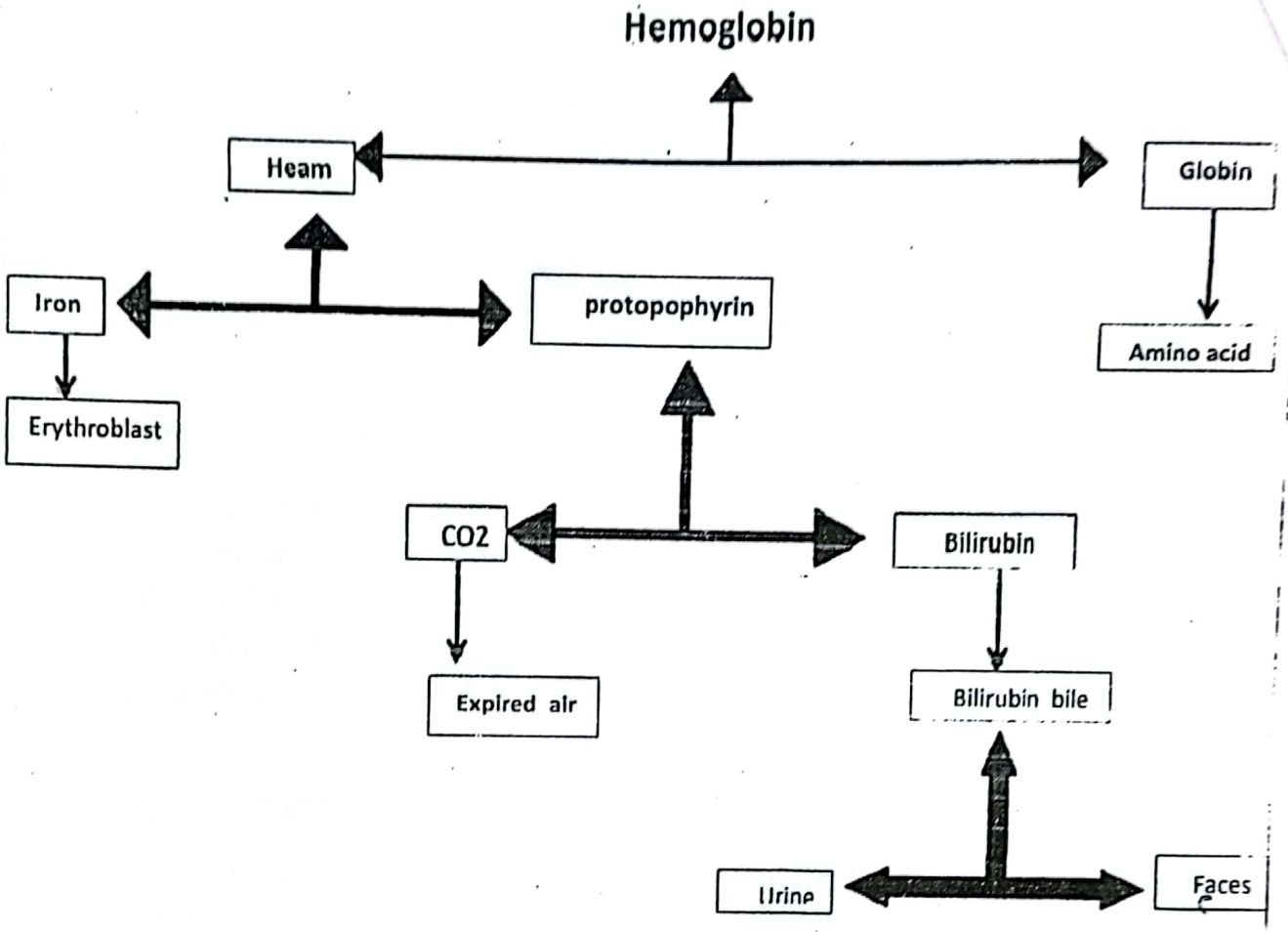
Hemoglobin is usually measured as a part of the routine complete blood count (CBC) test from a blood sample and P.C.V

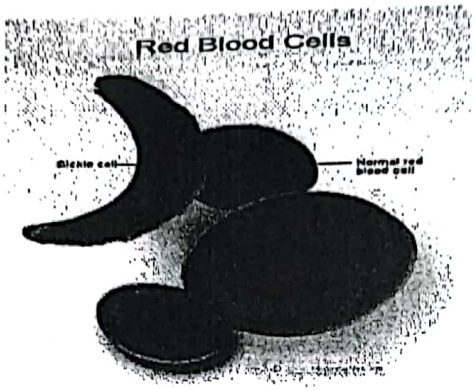
Note ..the method to know the type of Hb it is Electrophoresis technique

Abnormal type of Hb : There are thousand types of Hb some are there that are commen

1- synthesis of abnormal Hb genetic condition (e.g Sickle cell anemia)
2- reduced synthesis of normal globin chains genetic condition (e.g Thalassemia)

composition of hemoglobin :





1-Sickle cell anemia :- فقر الدم المنجلي

Define: (abbreviated HbS) is genetic disease results from a single glutamic acid to valine situation replace of beta globin poly peptide chain , it is inherited from parents' this type is more common in Africa , result in abnormally-shaped (sickled) red blood cells These abnormal red blood cells cannot easily pass through small blood vessels leading to inadequate oxygen for the tissues of the body.

Type of Sickle cell anemia:-

1-the cell like sickle ,due to abnormal Hb inside RBC ,it is inherited from two parents .

2-the cell is like leaf of tree, this type inherited from one parents'.

Laboratory features:-

The blood film shows : 1- the cell is like sickle 2-target cell 3-pokilocytosis

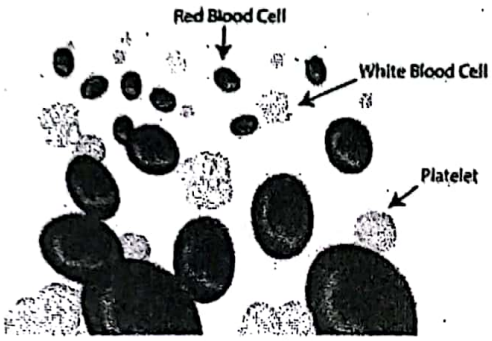
4-polychromasia .

Clinical feature :-

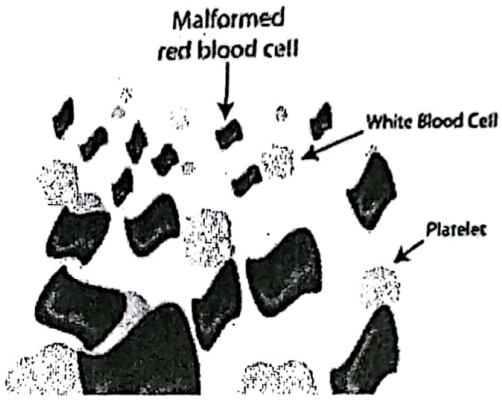
Some of Clinical feature , Sever bone pain due to affects in morrow , hypoxia , severe anemia, tachycardia etc....

Treatments might include medications and blood transfusions.

Normal



Thalassemia



2-Thalassemia :it is congenital disorder in which there is defection in hemoglobin production one or more of Hb sub unite, failure to synthesis specific type of globin chain (alpha or beta).

Type of Thalassemia:

1- In **Beta Thalassemia** failure synthesis beta chain so called (beta Thalassemia) it is more common type of Thalassemia in the Mediterranean area , it is Asymptomatic, occurs when one or both of the two genes needed for making the beta globin chain of hemoglobin are variant.
2- **Alpha Thalassemia** reduce or absent alpha chain synthesis so called (alpha Thalassemia) is common in southeast Asia.it is symptomatic ,occurs when one or more of the four genes needed for making the alpha globin chain of hemoglobin are variant or missing
3- Laboratory features:

Hypo chronic, target cell ,schisto cytosis ,polychromasia ,total iron binding capacity is normal , serum ferritin is normal , one electrophoresis we see in HbA2 and HbF

People who have alpha or beta thalassemia trait can have mild anemia. However, many people who have these types of thalassemia have **no signs or symptoms.**

Aplastic anemia (A.A) فقر دم لا تنسجي

Pancytopenia قلة الكريات الشاملة result from effect in bone morrow, decreased in WBC, Hemoglobin and Platelets.

Classification :

1) **Primary Aplastic anemia** → congenital is associated with other disease
   → Acquired , autoimmune disease

2)**Secondary Aplastic anemia** causes:

a) Treatment high-dose radiation or ionizing radiation, chemotherapy for cancer
b) Exposure chemical e.g. benzene ,hair dyes ,
c) drug e.g. chloramphenical, antibiotics cytotoxic
d) infection e.g. chronic hepatitis .

Lab. Feature :

1. Anemia (Hb)
2. Reticulopenia : decreased mature RBC
3. Leukopenia : decreased WBC
4. Thrmocytopenia :decreased platelets
5. Bone marrow finding hypocellulary with replacement of marrow by fat tissue in about 70%

Differential leucocyte count

Introduction :- the precursor of leucocyte is leucoblast , the morphology of white blood cells are differ from the red blood cells in apperance , quantity , and function these contain nucleus of varying shapes and sizes , the cells themselves are round tend to be colourless the different types of white blood cells are identified by their sizes and shapes of nucleus and the apperance of cytoplasmic granules when these cells are stained usually with :

1- **Leishman,s stain**
2- **Wright,s stain**

White blood cells are divided into **2** main groups according the presence or absence of granules in the cytoplasm :

1-**Granulocyte** (cytoplasm contain granules)
2-**Agranuelocyt** (cytoplasm with out granules)

Granulocyte

1- **Neutrophil** :- (polymorphonuclear)
this cell is **10-12** Mm in diameter has a characteristic nucleus consisting of between **2-5** lobes and a pale cytoplasm with many fine pink or violet pink granules these are capable of amoeboid movement , increase in bacterial infection (pneumonia) and also can be seen in urine in urinary tract infection
Normal value → **40- 70 %**

2-**Eosinophil** :- these cells are similar to neutrophil except that the granules are larger and more deeply red staining and there are rarely than three lobes (2-3) it is no capable of amoeboid movement the function (detoxication) remove of foreign substance from body , increase in allergic reaction & parasitic infestation
Normal value → **1- 6% or 0- 4%**

3- Basophil :- this cell is **8- 10** Mm in diameter these are occasionally seen in normal peripheral blood ,the nucleus is irregular and are coverd by the cytoplasm granules which are large and violet –blue in colour ,increase only in one condition Basophilic granulocytic leukemia , synthesis of histamine is also thought to be one of their functions suggesting arole in allergic reaction
Normal value → **0 – 1%**

Agranulocyte

1- **Monocyte** :- it is the larger leucocyte in peripheral blood **10 – 16** Mm in diameter
and have large central oval or indented nucleus abundant cytoplasm stain pale blue and contain fine vacuoles increase in some bacterial infection and malaria and in monocytic leukemia ,it is capable of amoeboid movement (ingestion of bacteria)
Normal value → **2 – 8 %**

Lymphocyte :- these concerned with antibody formation ,there are 2 form

a- small lymphocyte
b- large lymphocyte

small lymphocytes are present in peripheral blood (7 – 10) Mm with scanty cytoplasm and central nucleus they produce by bone marrow (**B- lymphocyte**) and also by the thymus gland (**T- lymphocyte**) it is increase in infant , child ren in bacterial infection , lymphocytosis increase in lymphocyte in viral disease like mump, measles , and high increase in whooping cough and chronic lymphocytic leukemia

Normal value → **20 -40 %**

Function of leucocytes :-

the most important function of WBCs is to destroy pathogenes whenever pathoger inter the tissue as through (wounds) certain WBCs (**neutrophil & monocyte**) are attracted to the area they leave the blood vessels and proceed by amoboid movement to the area of infection they engulf the invade pathogenes by process called phagocytosis if the pathogens are extremely virulent or numerous they may destroy the WBCs , the dead leucocytes are known as **pus cell** , a collection of pus localized in an area is known as **abscess** , the lymphocyte destroy foreign invade pathogens by attaching the cell directly or by producing antibodies that circulate with the blood and help destroy the pathogens

the differential leucocyte count

this is consist of the enumeration of the percentages of the various types of WBCs in the peripheral blood . a smear of film of blood must be prepared and stain with leishman,s or wright stain only well smear should be used if the smear is too thick differentiation of cells types especially monocytes from lymphocytes will be difficult
or impossible if it is too thin the majority of the neutrophil & monocyte will be located at the edges and tail of the smear.

After staining

the red cells should be pink , nuclei varying shades of purple , granules of neutrophil are pink ,of eosinophil are bright red , of basophil are deep violet

Urinary system

The kidneys are the primary organs involved in the excretion of waste products , the other organs involved being the lung, skin, intestine .

Anatomy

In the urinary system there are ٢ kidney which from excrete urine by peristalsis ,it is conveyed from each kidney through ureter to the urinary bladder ,the bladder provides temporary storage for about ٣٠٠ ml urine which is eventually voided through the urethra to the exterior .

Organs of urinary system

١- two kidney ٢- two ureter ٣- urinary bladder ٤- urethra

Structure of kidney

each kidney which is bean shap is enclosed in a capsule of fibrous tissue the kidney is divided into ٣ region

١- renal cortex : it is an outer portion of the kidney

٢- renal medulla : it is contains the tubules that collect urine, these tubes form a number of cone-shaped structures called pyramids the tip of each pointed toward the renal pelvis .

٣- renal pelvis : it is a funnel – shaped here the renal artery and nerve enter and vein and ureter leave the kidney .

Nephron

It is functional unit of kidney . it is primal a tiny coiled tube with a bulb at one end called bowman's capsule each kidney contain more than one million nephron if all these coiled tubes were separated and straightened and laid end to end , they could spain same ١٢٠ kilometer (٧٥ miles)

The nephron consist of

١- the glom ruler or bowman capsule .

٢- proximal convoluted tubule.

٣- loop of Henley :

٤- distal convoluted tubules .

Function of the kidney

1- elimination of excess body water .

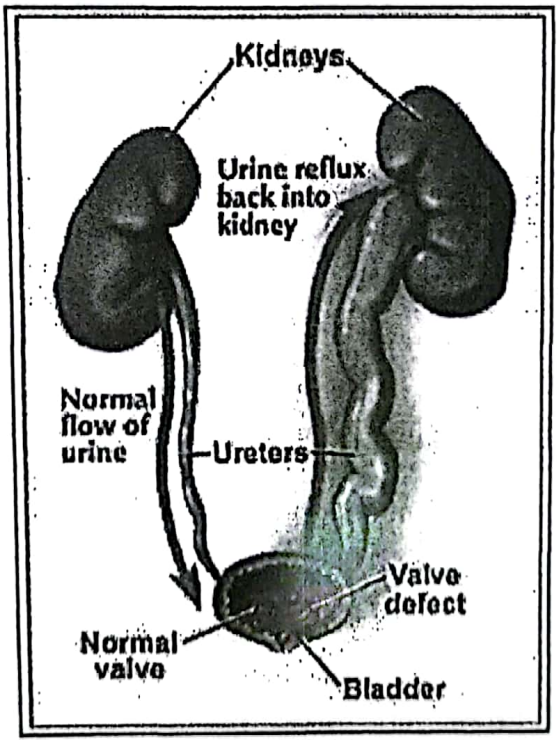
2- elimination of product of metabolism e.g. urea , creatinine .

3- elimination of foreign substance e.g. drug .

4- retention of substance necessary for normal body .

5- regulation of electrolyte balance and osmatic pressure of the body fluid

6- production of hormone e.g. Renin , erythropoietin .


Kidneys
Urine reflux back into kidney
Normal flow of urine
Ureters
Valve defect
Normal valve
Bladder

2-FORMED ELEMENT:-

A-Erythrocyte (RBC):these are tiny disc –shape bodies averaging (7.8 nm) in diameter in a central area that is thinner then edges , the mature form found in the circulating blood does not have a nucleus , on purpose of RBC is to carry O2 from the lung to the tissues and CO2 in reverse direction .

Average: 4.5- 5 million /cmm

Life span :120 days

B- leukocytes (WBC) :they (7-16 nm) contain nuclei of varying shapes and size they are colorless and its function is to destroy pathogens. 5,000 - 10,000 cells/ cmm. Life span: few hours- few days.

Platelets (thrombocytes) : these tiny (2-4 nm) fragments of cells (megakaryocyte's) 200,000-400,000/ cmm

Platelets , are essential for blood coagulation (clotting)

Life span : 5-9 days

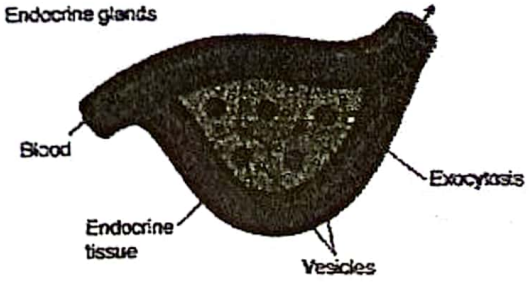
Endocrine Physiology

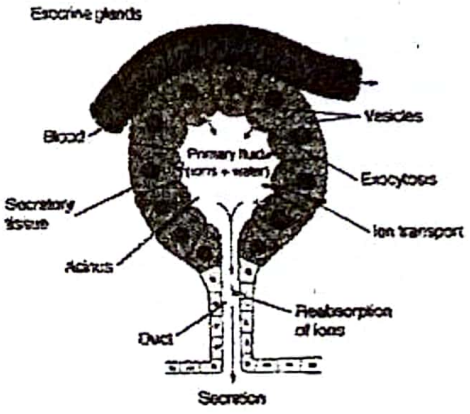
Glands are special secreting organs which pour their secretions either directly or indirectly into the bloodstream.

Kinds of Glands:

a) Duct Glands or Exocrine Glands: Have ducts or canals through which they pour out their secretions. These include lacrimal (tear) glands, sebaceous (sweat), salivary, gastric, mammary glands.

b) Ductless or Endocrine Glands: Pour their secretions called hormones directly into the bloodstream.





Endocrine glands: are glands of the endocrine system that secrete their products, hormones, directly into the blood rather than through a duct. They are also called ductless glands because they do not have ducts to secrete their hormones.

A hormone: is a chemical substance that is secreted into the internal body fluids by one cell or group of cells and has a physiological control effect on other cells of the body.

Important Functions of hormones include:

1. Growth and development of Prompting cell or tissue
2. Food metabolism
3. Initiating and maintaining sexual development and reproduction
4. Maintaining body temperature

Two classes of hormones based on solubility in aqueous medium: -

1.Hydrophilic Hormones: Hormones that are soluble in aqueous medium. They cannot cross the cell membrane. Examples: Insulin, Glucagon, Epinephrine.

2. Lipophilic Hormones: Hormones that are not soluble in aqueous medium, but soluble in lipid. They can easily cross the cell membrane. Examples: Thyroid hormones, Steroid hormones.

The main endocrine glands include:

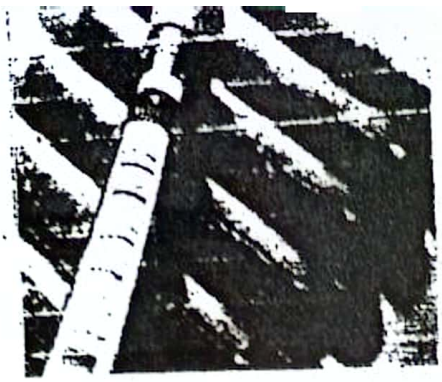
Gland	Hormone
Pituitary gland	-Growth hormones regulate body growth (height and weight) and development. -Hormones regulate the thyroid gland (Thyroid Stimulating Hormones (TSH). -Stimulate milk production in the breasts.
Thyroid Gland	-Thyroxine -Triidothyronine: increase the rates of chemical reaction in almost all cells of the body, thus increasing the general level of body metabolism. -Calcitonin: - It promotes the deposition of calcium in the bones.
Pancreas	Insulin: It controls blood sugar levels.
Adrenal gland	Adrenaline: It is the key in regulating body's stress response.
Ovaries	-Estrogen: - It stimulates the development of the female sex organs, the breasts and various secondary sexual characteristics. -Progesterone: During pregnancy, progesterone also stimulates development of the glands in the breasts that are responsible for milk production.

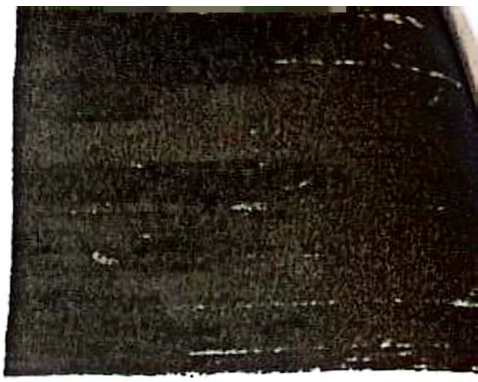
Testis	Testosterone: It stimulates growth of the male sex organs, also promotes the development of male secondary sex characteristics.

Hormones: Hormones that are

LABORATORY FEATURE

- Increased in HB, P.C.V, RBC
- Platelet increased
- Vitamin B12 increased
- Hyper cellular Bone marrow





POLYCYTHEMIA

POLYCYTHEMIA OR ERYTHROCYTOSIS

It is a pattern of blood cell changes includes increased in HB above 17.5mg\dl in male

Above 15.5 mg\dl in female

Also increased in RBC count above 6000.000mm cubic and ↑ increased in P.C.V 50%