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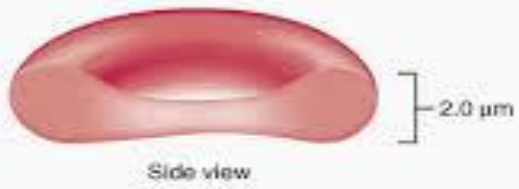
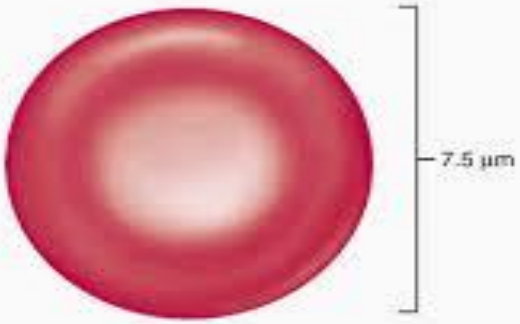
INTRODUCTION:

Anaemia is the most common blood disorder in general population. If left untreated can have many serious implications such as cardiovascular diseases and immunocompromised functions.

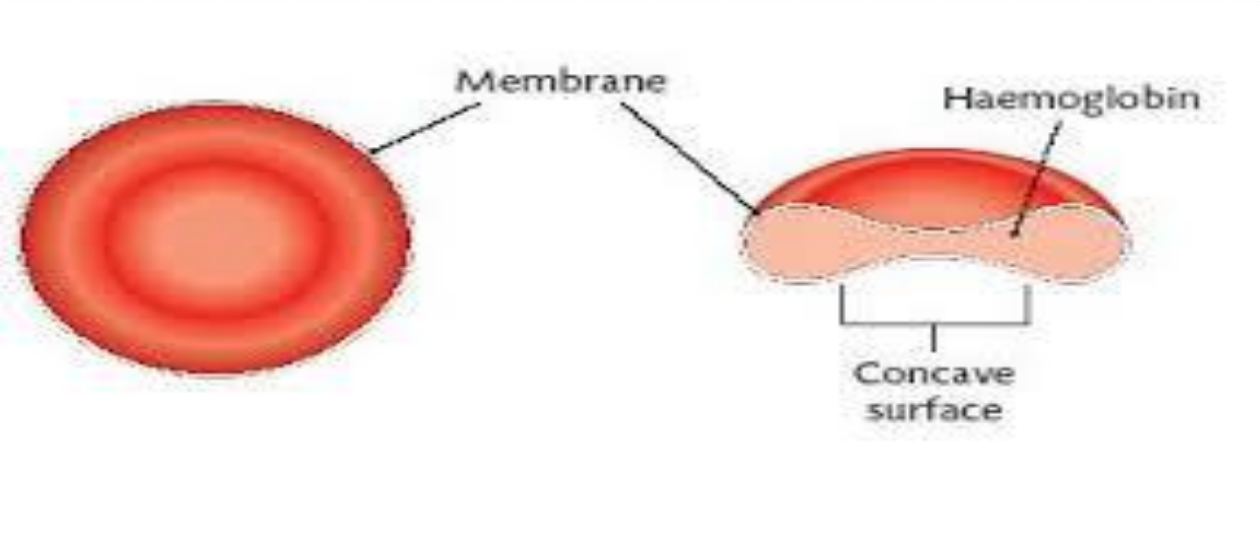
Red Blood cells (RBCs):

- Mature red blood cells are flexible biconcave disc that lack a cell nucleus.
- RBCs develop in the bone marrow under control of hormone erythropoietin and circulate for about 100 – 120 days in the blood before their components are recycled by macrophages in the spleen.



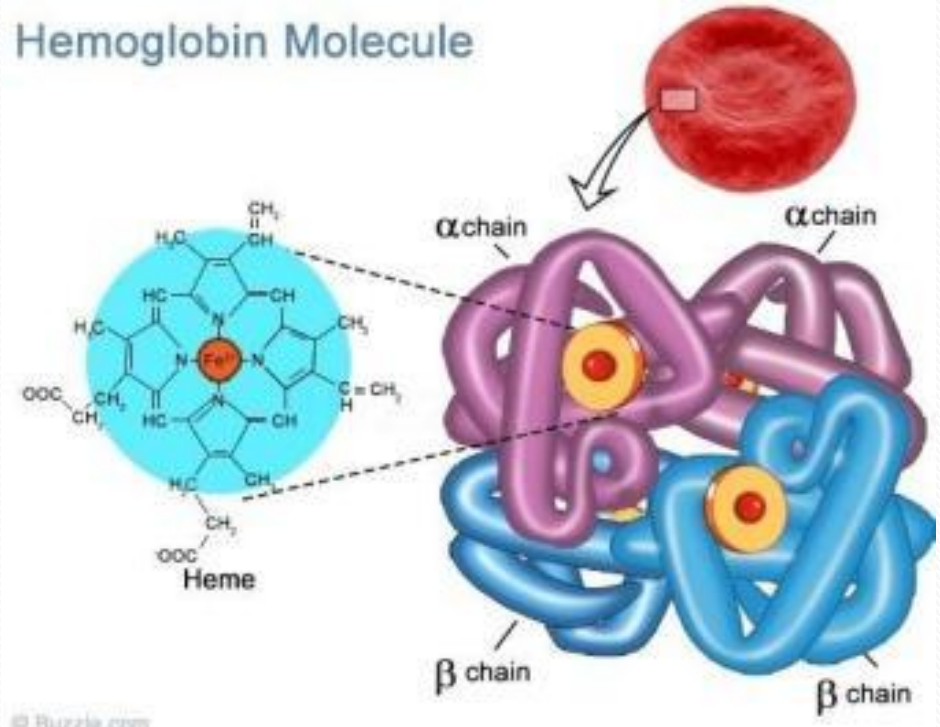


-RBCs Female normal range: 4.2 – 5.4 million cell/micro liter and male 4.7 – 6.1 million cell/micro liter. The main function of RBCs is to carry oxygen (O_2) from the lung to the tissues and to return carbon dioxide (CO_2) from the tissues to the lung. To do this they contain the specialized iron containing protein called Haemoglobin(Hb).



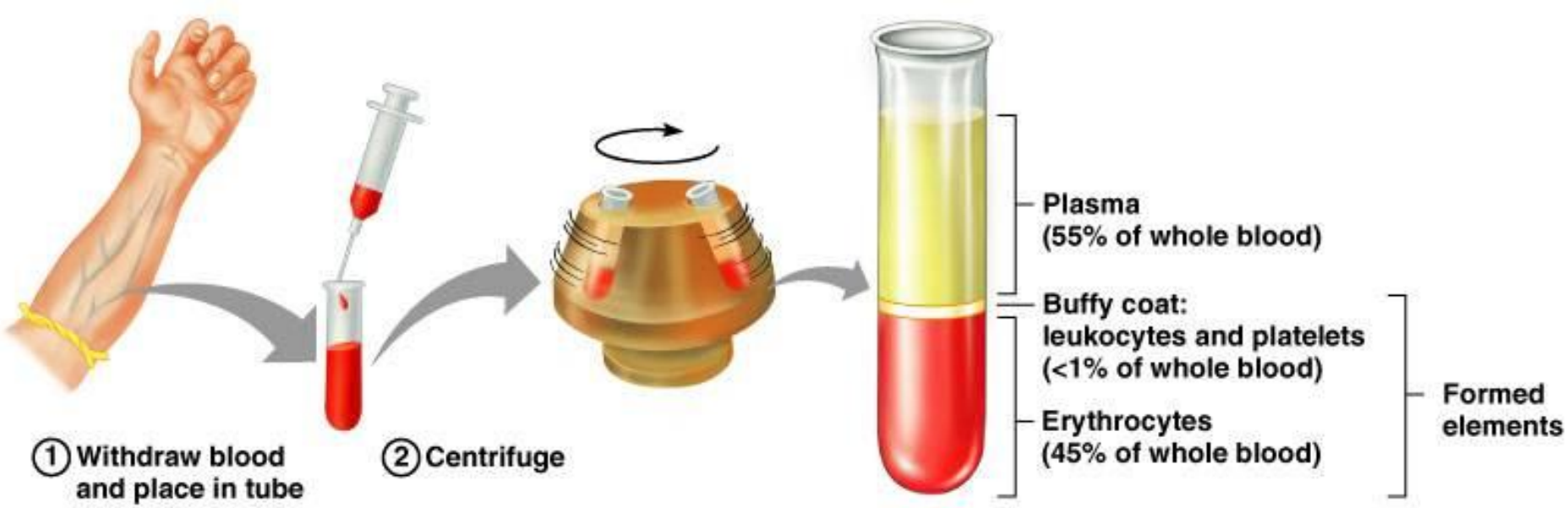
Haemoglobin (Hb):

Hb is composed of heme (iron containing protoporphyrin) and globin (4 polypeptide chains). Hb normal range in males: 13 – 18 g/dl and females 12 – 17 g/dl.



Haematocrit (HCT):

It is the volume percentage (%) of red blood cells in whole blood. HCT (packed cell volume) normal range in males: 40% - 52% and in females: 36% - 48%.

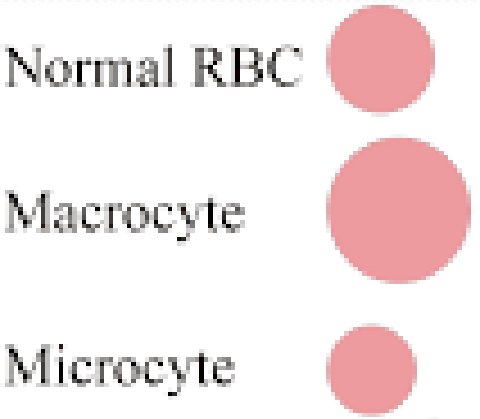


THE RED BLOOD CELLS INDICES:

1-Mean Corpuscular Volume (MCV):

Definition: It is the average volume of one RBC.

- Normal range: 80 – 95 femtoliter (fl).
- Normal MCV ⟶ Normocytic RBCs.
- MCV above 95 fl ⟶ Macrocytic RBCs
- MCV below 80 fl ⟶ Microcytic RBCs.

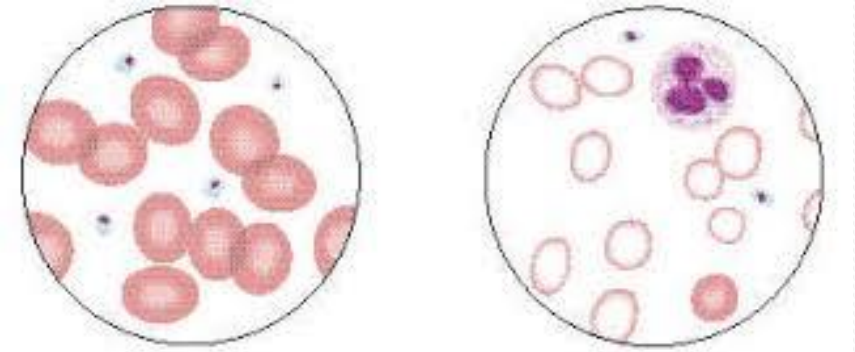


THE RED BLOOD CELLS INDICES:

2-Mean Corpuscular Haemoglobin (MCH):

Definition: It is the average mass of Hb per one RBC.

- Normal range: 27 – 34 picogram /cell.
- Normal MCH ⟶ Normochromic cells.
- MCH below 27 pg ⟶ Hypochromic cells.



Normal Peripheral Blood Smear

Microcytic, Hypochromic Anemia

THE RED BLOOD CELLS INDICES:

3-Mean Corpuscular Haemoglobin Concentration (MCHC):

Definition: It is the concentration of Hb in a given volume of packed RBCs.

Normal range: 30 – 36 g/dl.

Definition of Anaemia:

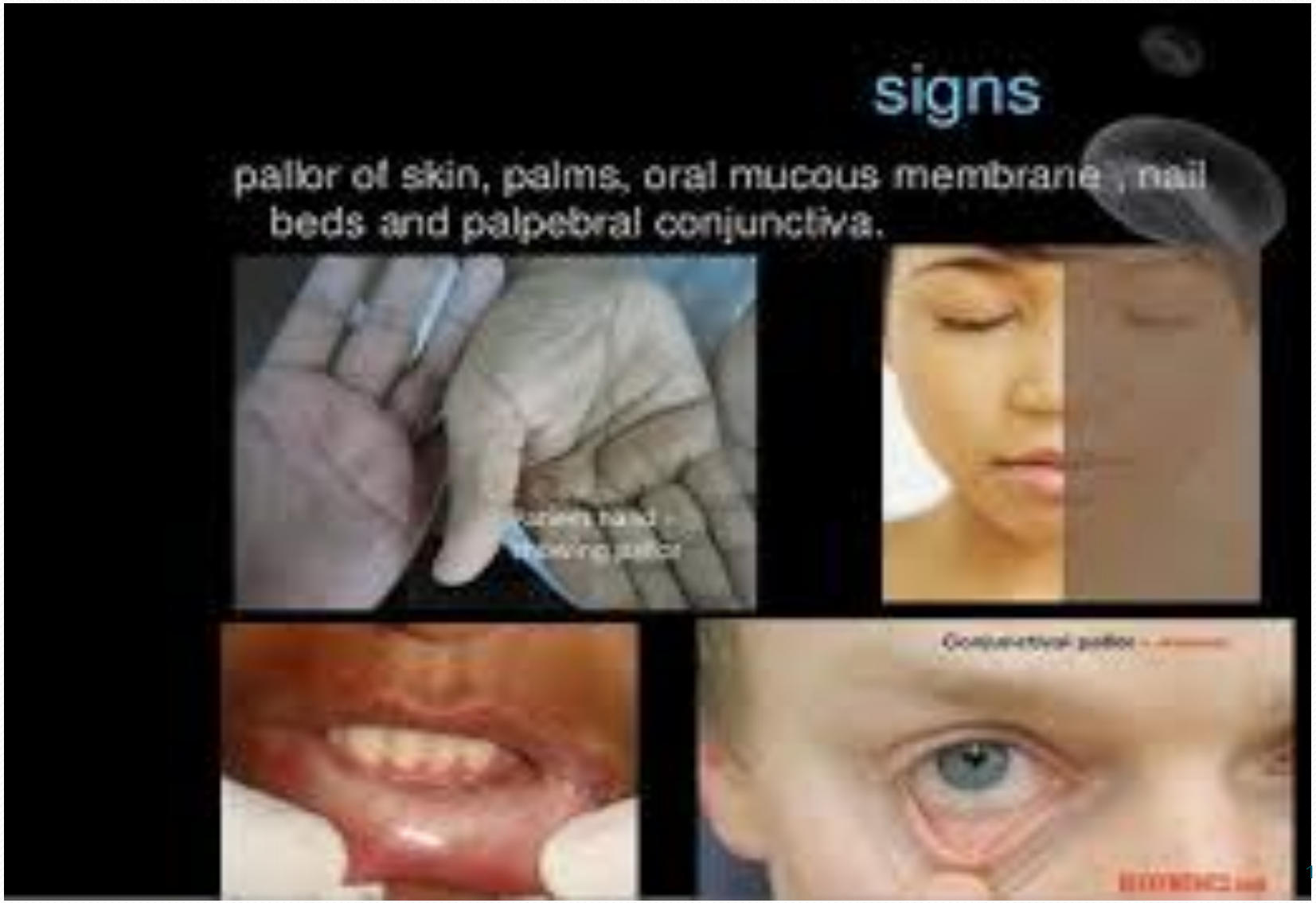
- It is the reduction in the haemoglobin concentration of the blood below normal range for age and sex resulting in decreased ability of blood to carry oxygen to body tissues (Anaemia is a symptom and not a disease; we should diagnose the underlying disease causing the anaemia and treat it).

Symptoms of anaemia:

- Shortness of breath particularly on exercise.
- Weakness.
- lethargy.
- Palpitation.
- Headache.

Signs of anaemia:

- Pallor of mucous membranes.



- Tachycardia.
- Koilonychia (spoon nails) in iron deficiency anaemia.

- Bone deformities in thalassaemia.
- Neurologic manifestations (confusion, paresthesia and sever neuropathy) in megaloblastic anaemia.
- Hepatosplenomegaly in haemolytic anaemia.
- Jaundice in haemolytic anaemia.

CLASSIFICATION OF ANAEMIA

- The most useful classification is that based on red cell indices and divides the anaemia into microcytic, macrocytic and normocytic.

I-Microcytic Hypochromic Anaemia (low MCV and MCH):

-Iron deficiency anaemia.

-Thalassaemia.

-Anaemia of chronic disease (some cases).

II-Macrocytic Anaemia (high MCV):

1-Megaloblastic:

- -Vitamin B12 deficiency.
- -Folate deficiency.

2-Non Megaloblastic:

- -Liver disease.
- -Pregnancy.
- -Alcohol intake.
- -Neonatal.
- -Aplastic anaemia.

III-Normocytic Normochromic Anaemia (normal MCV and MCH):

-Anaemia of chronic disease.

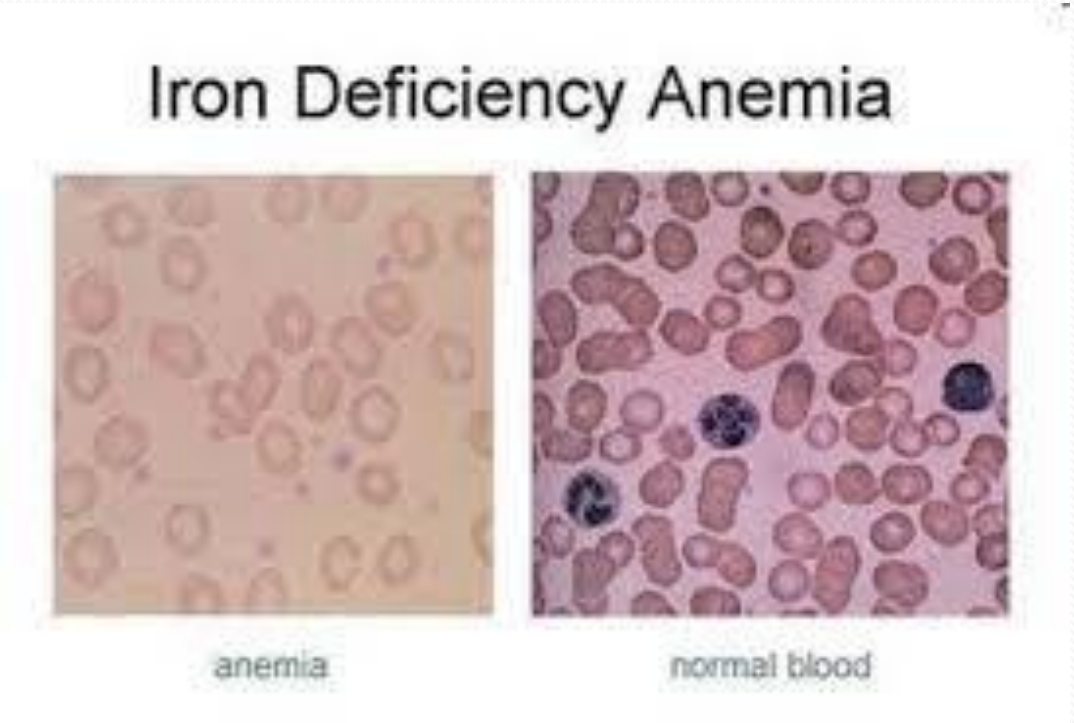
-Haemolytic anaemias.

-Anaemia of acute blood loss.

I-MICROCYTIC ANAEMIA

A-Iron Deficiency Anaemia:

It is the most common anaemia. Iron deficiency leads to decreased heme synthesis so decreases Hb synthesis and produces microcytic hypochromic anaemia.



Causes:

1-Chronic blood loss:

-Uterine blood loss.

-Gastrointestinal blood loss.

-others e.g.: haematuria.

2-Increased iron demand:

e.g.: pregnancy and lactation.

3-Decreased iron absorption:

e.g.: malabsorption syndrome.

4-Decreased dietary intake.

Investigations to diagnose anaemia:

1-Complete blood count (CBC):

-Low Hb, low RBCs count and low HCT → Anaemia.

-Low MCV, low MCH and low MCHC → Microcytic hypochromic cells.

2-Reticulocyte count (immature RBCs):

-Normal or low.

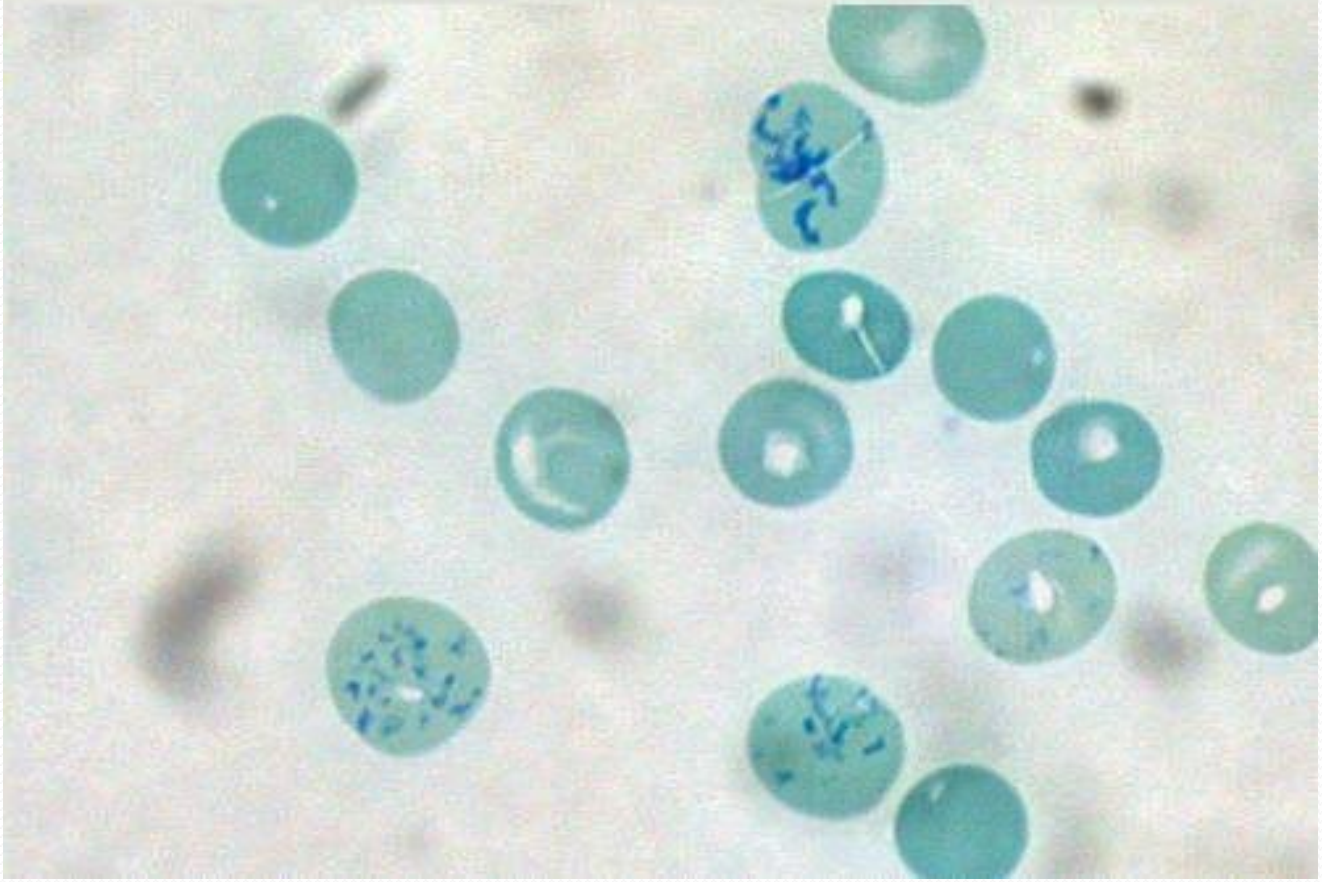
3- Iron profile:

-Serum iron: low.

-Serum ferritin (iron store): low.

-Total iron binding capacity (TIBC): high.

Reticulocyte count



Investigations to detect the cause:

1-Occult blood in stool.

2-Gastrointestinal endoscopy and radiography.

3-Urine analysis.

Treatment:

1-Identification and treatment of the cause.

2-Correction of the deficiency by inorganic iron.

B-Thalassaemia:

It is a group of hereditary disorders each resulting from defect in the rate of synthesis of one or more globin chain leading to low total haemoglobin with microcytic hypochromic anaemia. Also there is increased destruction of RBCs (haemolysis) in the spleen and bone marrow leading to anaemia, raised iron level in blood and jaundice. Decrease O_2 delivery to tissues leads to hypoxia with increased erythropoietin production which causes erythroid hyperplasia and expansion of bone marrow leading to skeletal deformity.

Investigations to diagnose anaemia:

- CBC:

  Low Hb, low RBCs count and low HCT ⟶ Anaemia.

  Low MCV and low MCH ⟶ Microcytic hypochromic RBCs.

Investigations to detect haemolysis:

1-Reticulocyte count : High.

2- Iron profile:

  -Serum iron: High.

  -Serum ferritin: High.

  - TIBC: low.

3-Total bilirubin: High.

4- Urinary urobilinogen: High.

5- Haptoglobin and hemopexin: Decreased.

6-LDH: High.

Investigations to detect the cause:

-Hb electrophoresis: Increased HbF.

Treatment:

-Chelation therapy (iron binding agent to reduce iron).

-Blood transfusion to maintain Hb above 10 g/dl.

C- Anaemia Of Chronic Disease:

Anaemia occurs in patients with a variety of chronic inflammatory diseases (e.g.: T.B, pneumonia, rheumatoid arthritis, systemic lupus erythematosus (SLE), etc…) and malignant diseases (e.g.: carcinomas, sarcomas and lymphomas).

Pathogenesis of anaemia:

1-Decrease red blood cell life span.

2-Decrease release of iron from macrophages to plasma.

3-Inadequate erythropoietin response to anaemia.

Investigations to diagnose anaemia:

1- CBC:

-Low Hb, low RBCs count and low HCT → Anaemia.

-At the beginning normal MCV and normal MCH → Normocytic normochromic RBCs.

-Later low MCV and low MCH → Microcytic hypochromic RBCs.

2- Iron profile:

-Serum iron: low.

-Serum ferritin: high.

-TIBC: low.

Investigations to detect the primary disease:

According to the disease.

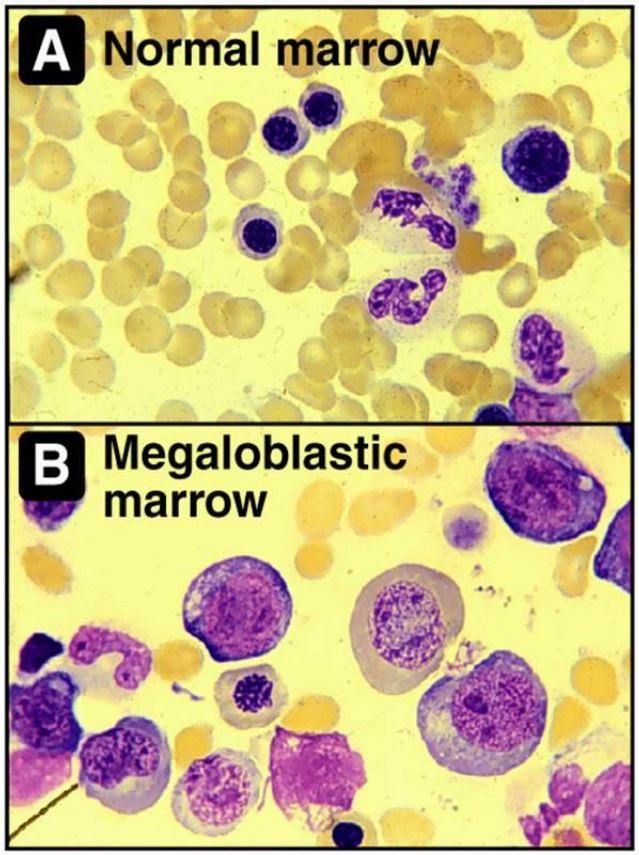
Treatment:

-Treatment of the cause.

-Erythropoietin injection improves anaemia in some cases.

II-MACROCYTIC ANAEMIA

In macrocytic anaemia the red blood cells are abnormally large (MCV >95 fl). It is subdivided into megaloblastic and non-megaloblastic, based on the appearance of developing RBCs in the bone marrow.



A-Megaloblastic anaemia:

It is caused by deficiency of vitamin B12 or folate causing impaired DNA synthesis in RBCs precursors.

1-Vitamin B12 Deficiency:

Vitamin B12 in food binds to a glycoprotein called Intrinsic factor which is secreted from the parietal cells of the gastric mucosa. Intrinsic factor-vitamin B12 complex binds specific receptor in terminal ileum. It is transported in blood bound to a protein called Transcobalamin.

Causes Of B12 Deficiency:

1-Congenital:

A-Congenital absence of transcobalamin.

B-Congenital deficiency of Intrinsic factor.

2-Decrease dietary intake.

3-Decrease absorption:

A-Absence of intrinsic factor.

-Pernicious anaemia (autoimmune disease with destruction of parietal cells of the stomach).

-Gastrectomy.

B-Intestinal causes:

-T.B of ileum.

-Lymphoma of small intestine.

-Parasitic infestation.

2-Folate Deficiency:

Causes:

1-Poor nutrition.

2-Decrease absorption.

3-Increase requirements: e.g.: pregnancy, childhood and malignancy.

Investigations to diagnose macrocytic anaemia:

1- CBC:

-Low Hb, low RBCs count and low HCT ⟶ Anaemia.

-High MCV ⟶ Macrocytic RBCs.

-Low total leucocytic count and low platelets count.

2-Reticulocyte count: low.

3-Bone marrow aspiration biopsy: show megaloblastic changes.

Investigations to detect the cause:

-Serum Vitamin B12 level (Low).

-Serum and red cell folate (Low).

Treatment:

1-Treatment of the cause.

2-Vitamin B12 injections.

3-Folic acid oral tablets.

B-Non-megaloblastic macrocytic anaemia:

Occur in:

-Liver disease.

-Pregnancy.

-Alcohol intake.

-Neonatal.

-Aplastic anaemia.

III-NORMOCYTIC ANAEMIA

Anaemia (low Hb, low RBCs and low HCT) with normal MCV and MCH.

Haemolytic Anaemias:

Definition:

They are anaemias with increase in the rate of red cell destruction.

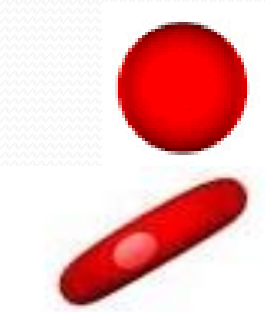
Classification Of Haemolytic Anaemia:

A-Hereditary:

1-Membrane defect:

i-Hereditary spherocytosis.

ii-Hereditary Elliptocytosis.



2-Hb defect:

i-Thalassaemia.

ii-Sickle cell anaemia.

3-Enzyme defect:

i- Glucose-6-phosphatase dehydrogenase (G6PD) deficiency.

ii-Pyruvate kinase deficiency.

B-Acquired:

1-Immunological disease:

i-Autoimmune haemolytic anaemia.

ii-Alloimmune haemolytic anaemia.

2-Mechanical (trauma to RBCs):

e.g.: prosthetic cardiac valves.

3-Infection:

e.g.:Malaria.

4-Drugs and chemicals.

5-Burn.

Investigations to diagnose anaemia:

- CBC:
  - -Low Hb, low RBCs count and low HCT → Anaemia.
  - -Normal MCV and normal MCH → Normocytic normochromic RBCs.

Investigations to detect haemolysis:

1-Reticulocyte count : High.

2- Iron profile:

- -Serum iron: High.
- -Serum ferritin: High.
- - TIBC: low.

3-Total bilirubin: High.

4- Urinary urobiliniogen: High.

5- Haptoglobin and hemopexin: Decreased.

6-LDH: High.

Investigations to detect the cause:

1-Hb electrophoresis (to diagnose Hb defects).

2-Enzyme assay (to diagnose enzyme defect).

3-Direct and indirect coombs' test (to diagnose auto and alloimmune causes).

4-Osmotic fragility test (to diagnose spherocytosis).

THANK YOU