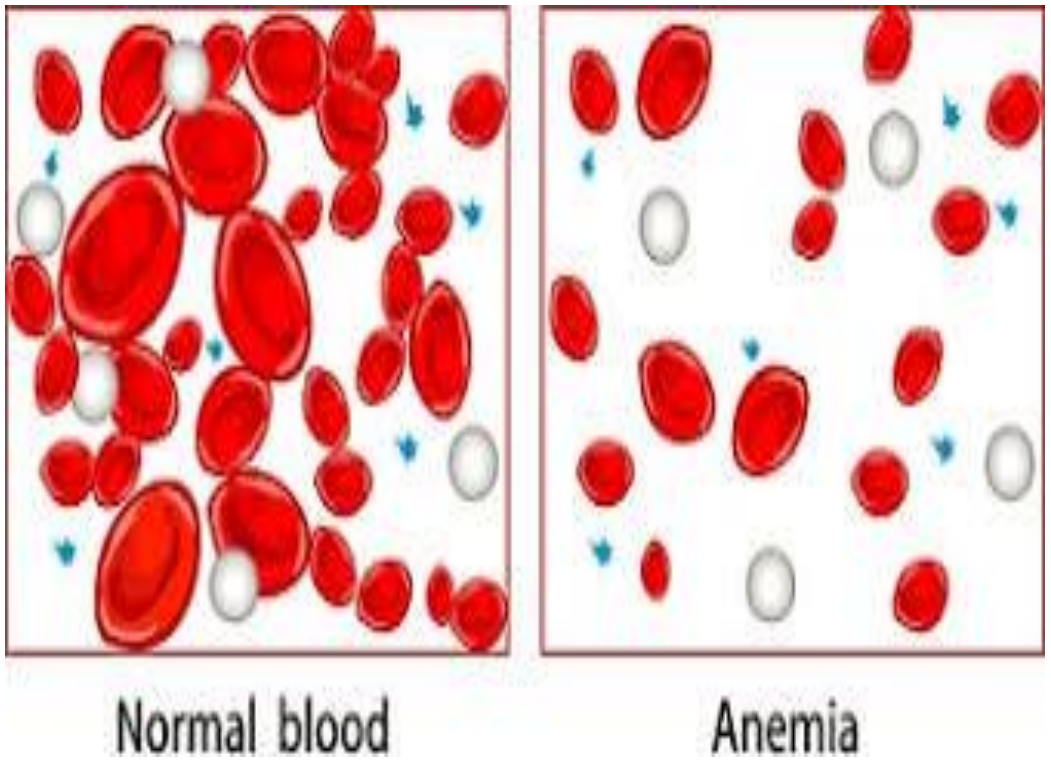
Types of anemias


Normal blood
Anemia

Objectives

- At the end of this lecture the student will be able to
- Define anemia
- Describe classification of anemia
- Explain RBC indices
- Discuss pathophysiology of anemia in general
- Differentiate different anemias on the basis of morphology

Defination

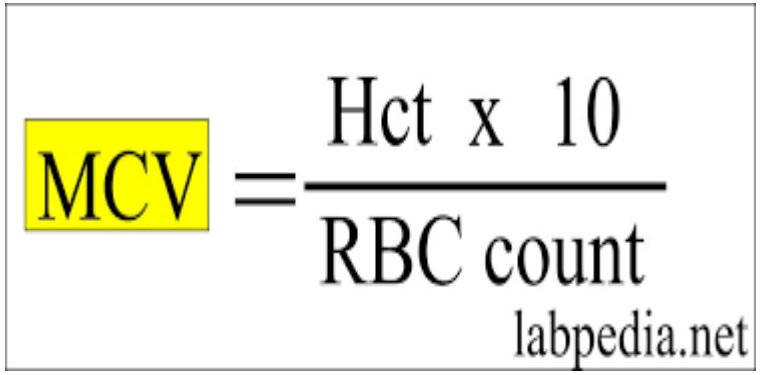
- The condition of having a lower-than-normal number of red blood cells or quantity of hemoglobin in the body.

- Red Blood Cells mature and take the shape of flexible biconcave disks.
- Resembles a soft Ball Compressed between two fingers.
- 2.4 million new erythrocytes are produced per second.
- It has a diameter about 8 micro meter.
- The membrane of RBC is very thin , so that gases such as Oxygen an Co2 can be Diffuse easily across it

- Mature erythrocytes have no nuclei immature (RBC) are called **reticulocytes**.
- Life Span of RBC – 120 Days.
- RBC production process called Erythropoiesis In Erythropoiesis , The most common important hormone is Erythropoietin , Which produced from Kidney.
- The Entire Process of Erythropoiesis typically takes 5 Days.

Red cell indices

- MCV (Mean Corpuscular Volume)



The normal range for MCV 80-99 fL(Femtoliter) 80-99 fL

- MCH (Mean Corpuscular Haemoglobin)

$$\text{MCH} = \frac{\text{Hb (g/dL)} \times 10}{\text{RBC count}}$$

labpedia.net

- The normal range for MCH 27-31 picograms/cell

.

MCHC (mean corpuscular hemoglobin cocentration)

$$MCHC = \frac{Hb\ (g/dL) \times 100}{Hct}$$

labpedia.net

The normal range is 31- 36 gm/dl

Pathophysiology

Decrease in RBCs, Hb, or Hct level

↓

Diminished O_2-carrying capacity

↓

Hypoxia and hypoxia-induced effects on organ function

↓

Signs and symptoms of anemia

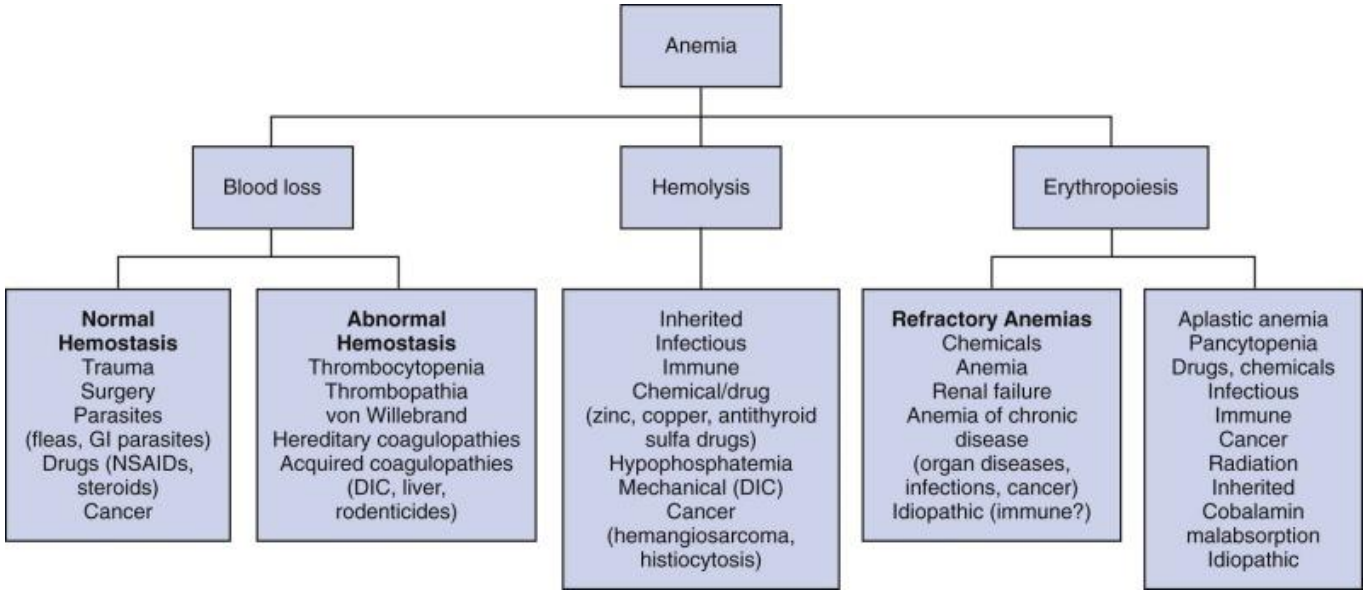
Classification

1. **On The Basis of Cause**

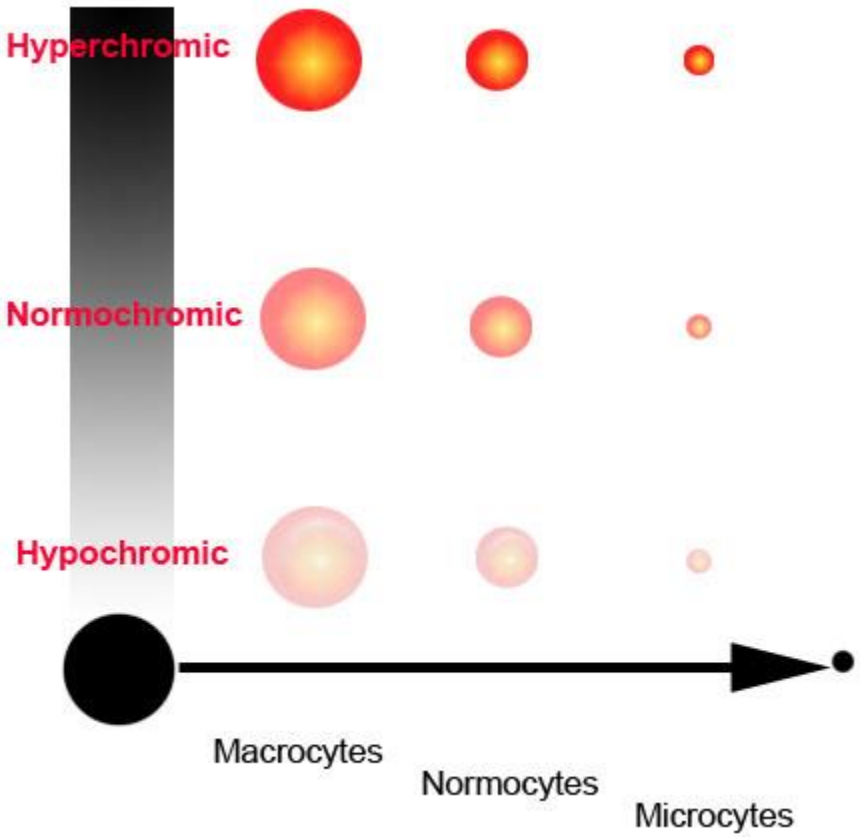
a. Hypo proliferative (Resulting From Defective RBC Production)

b. Haemorrhagic (Resulting from RBC Loss)

c. Haemolytic Anaemia (Resulting From RBC Destruction)

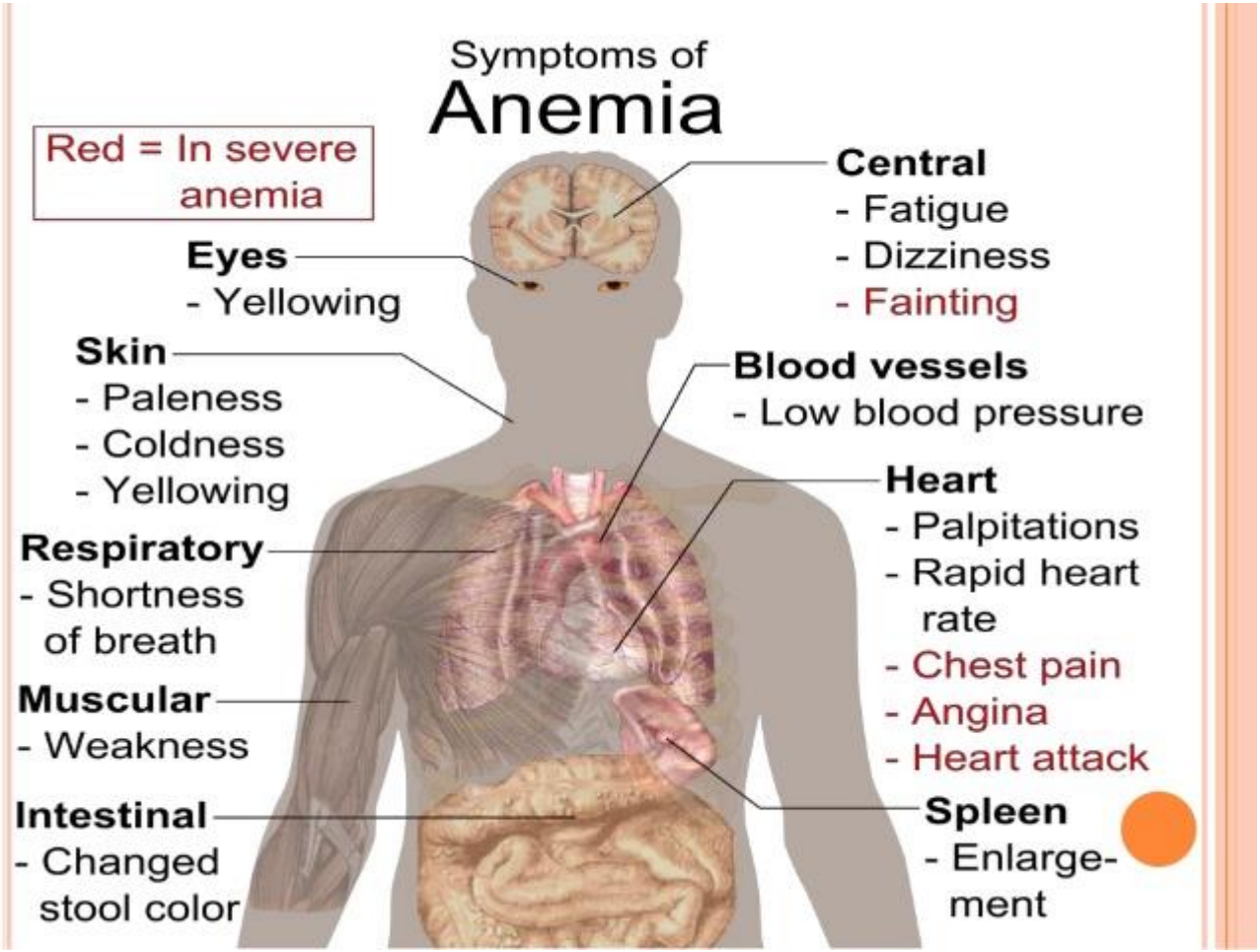

Anemia
Blood loss
Hemolysis
Erythropoiesis
Normal Hemostasis
Trauma
Surgery
Parasites
(fleas, GI parasites)
Drugs (NSAIDs, steroids)
Cancer
Abnormal Hemostasis
Thrombocytopenia
Thrombopathia
von Willebrand
Hereditary coagulopathies
Acquired coagulopathies
(DIC, liver, rodenticides)
Inherited
Infectious
Immune
Chemical/drug
(zinc, copper, antithyroid sulfa drugs)
Hypophosphatemia
Mechanical (DIC)
Cancer
(hemangiosarcoma, histiocytosis)
Refractory Anemias
Chemicals
Anemia
Renal failure
Anemia of chronic disease
(organ diseases, infections, cancer)
Idiopathic (immune?)
Aplastic anemia
Pancytopenia
Drugs, chemicals
Infectious
Immune
Cancer
Radiation
Inherited
Cobalamin malabsorption
Idiopathic

- **2. On the Basis of Morphology**
- a. Microcytic Anemia (Cells are smaller than normal under 80 fl) .
- b. Macrocytic Anaemia (cells are larger than normal over 100 fl) .
- c. Normocytic Anaemia (Cells are normal size 80–100 fl)
-


Hyperchromic
Normochromic
Hypochromic
Macrocytes
Normocytes
Microcytes

Morphological Classification of Anemias

Microcytic anaemias (MCV < 80 fl)	Macrocytic anaemias (MCV > 100 fl)	Normocytic anaemias (MCV 80–100 fl)
Iron deficiency anaemia	Megaloblastic anaemia	Reticulocyte production normal
Thalassaemias	Nonmegaloblastic anaemia	• Recent blood loss
Sideroblastic anaemia	• Liver disease	• Haemolytic anaemia
Anaemia of chronic disease	• Haemolytic anaemia	Reticulocyte production deficient
	• Alcoholism	• Aplastic anaemia
	• Myelodysplastic syndrome	• Myelophthisic anaemia
	• Hypothyroidism	• Chronic renal failure
		• Anaemia of chronic disease
		• Hypothyroidism


Symptoms of
Anemia
Red = In severe anemia
Central
- Fatigue
- Dizziness
- Fainting
Eyes
- Yellowing
Skin
- Paleness
- Coldness
- Yellowing
Blood vessels
- Low blood pressure
Heart
- Palpitations
- Rapid heart rate
- Chest pain
- Angina
- Heart attack
Respiratory
- Shortness of breath
Muscular
- Weakness
Intestinal
- Changed stool color
Spleen
- Enlarge-ment

- **Microcytic Anaemia** It Occurs in Iron Deficiency Anaemia and Ineffective RBC Production a result of Haemoglobin synthesis failure/insufficiency. Cells are smaller than normal under 80 fl.
- Heme synthesis defect - Iron Deficiency Anaemia
- Globin Deficiency Defect - Thalassemia
- **Macrocytic Anaemia** An Abnormally Large RBC cells are larger than normal over 100 fl It Occurs as Nutritional Deficiency. E.g.Vit.B12 , Folates and Protein It's also occurs due to Drug toxicity (phenytoin) & - Liver Disease & Alcolism - Hypothyrodism .
- **Normocytic Anaemia** overall Haemoglobin levels are decreased but the red blood cell size(MCV) remains normal. Cells are normal size 80–100 fl.
- Acute blood loss
- Haemolytic Anaemia
- Aplastic Anaemia

IRON DEFICIENCY ANEMIA

- Anaemia associated with either Inadequate Absorption or Excessive Loss of Iron/Blood. It is Chronic Microcytic Anaemia.
- The most common Cause of Anaemia in Children is Iron Deficiency Anaemia.
- It is also known as Microcytic Hypochromic Anaemia.

Causes

Insufficient Iron Supply at Birth

Impaired Iron Absorption

Blood Loss

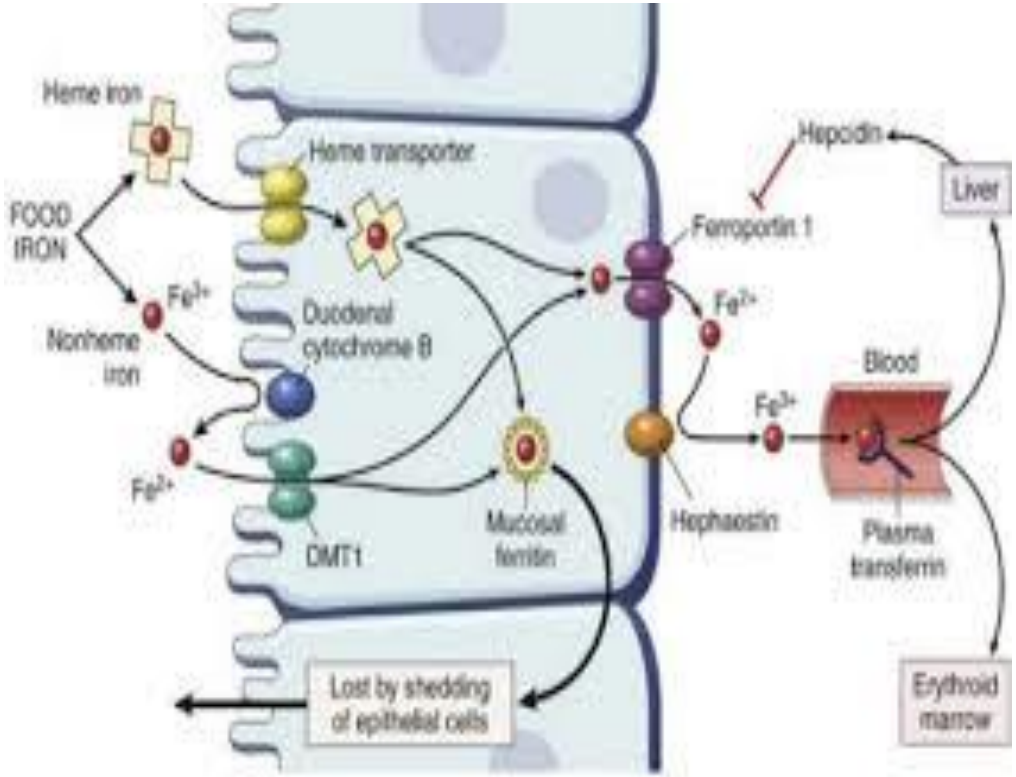
Insufficient Iron Intake in Diet

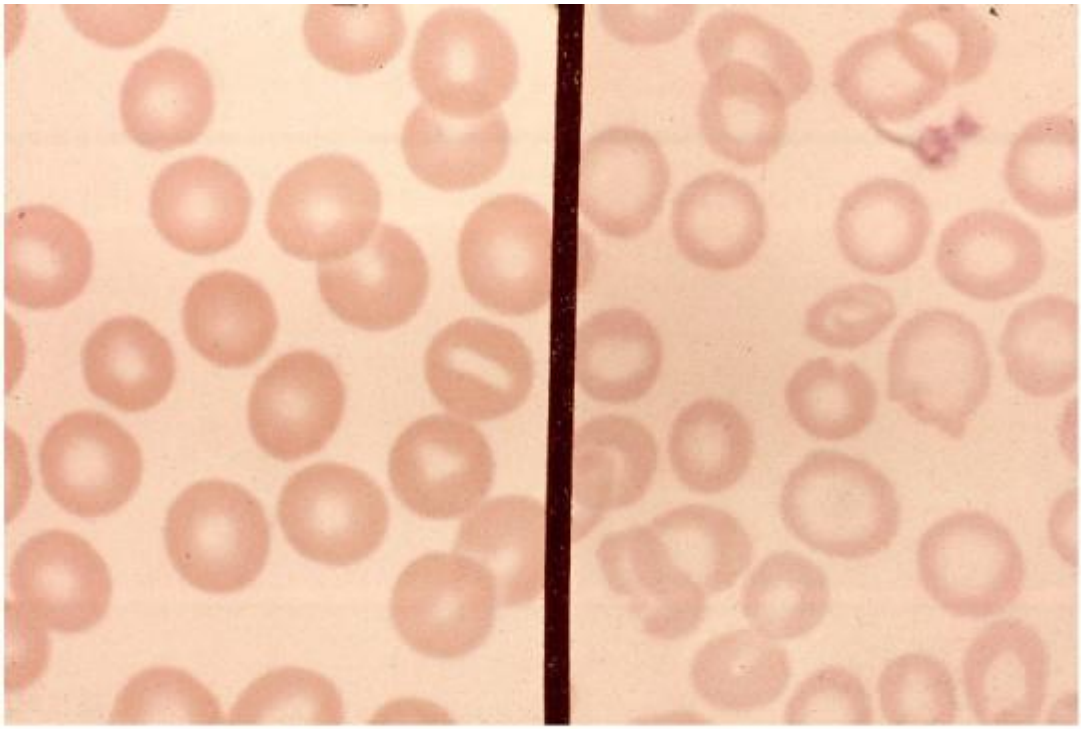
Periods of Rapid Growth.

- Decreases Serum Iron Level
- Decreased Hb Level (6 to 9 mg/dl)

Increased Requirements	• Menstruating females • Pregnancy • Lactation • Growing infants and children • Erythropoietin treatment
Increased Loss	• GI bleeding • Menorrhagia • Persistent hematuria • Intravascular hemolytic anemias • Regular blood donors • Parasitic infections
Decreased Intake	• Vegetarian diet • Socioeconomic factors
Decreased Absorption	• Upper GI pathology (eg: Celiac and Crohn's disease) • Gastrectomy • Medications (antacids, Zantac)

Iron absorbtion



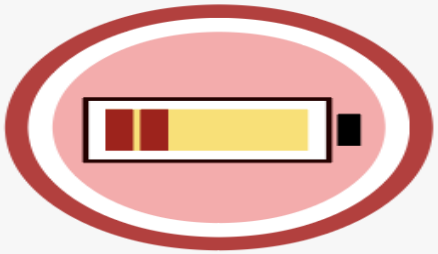


Normal red blood cells Microcytic anemia

Sign & Symptoms

- Cold Hands and Feet
- Shortness of breath
- Fatigue
- Sore Tongue
- Brittle Nails
- Irritability
- Pale Skin Colour
- Dizziness

ANEMIA SYMPTOMS



FATIGUE

HEADACHE

YELLOWISH SKIN

IRREGULAR HEARTBEATS

CHEST PAIN

COLD HANDS

DIZZINESS

LEG CRAMPS

INSOMNIA

Pregistry

.Megaloblastic Anaemia

- It is characterized by Deficiency of Vitamin B12 as well as Deficiency of Folic Acid(Folates). It is also called Macrocytic Anemia.

  I. Pernicious Anemia(Lack of Vit B12)

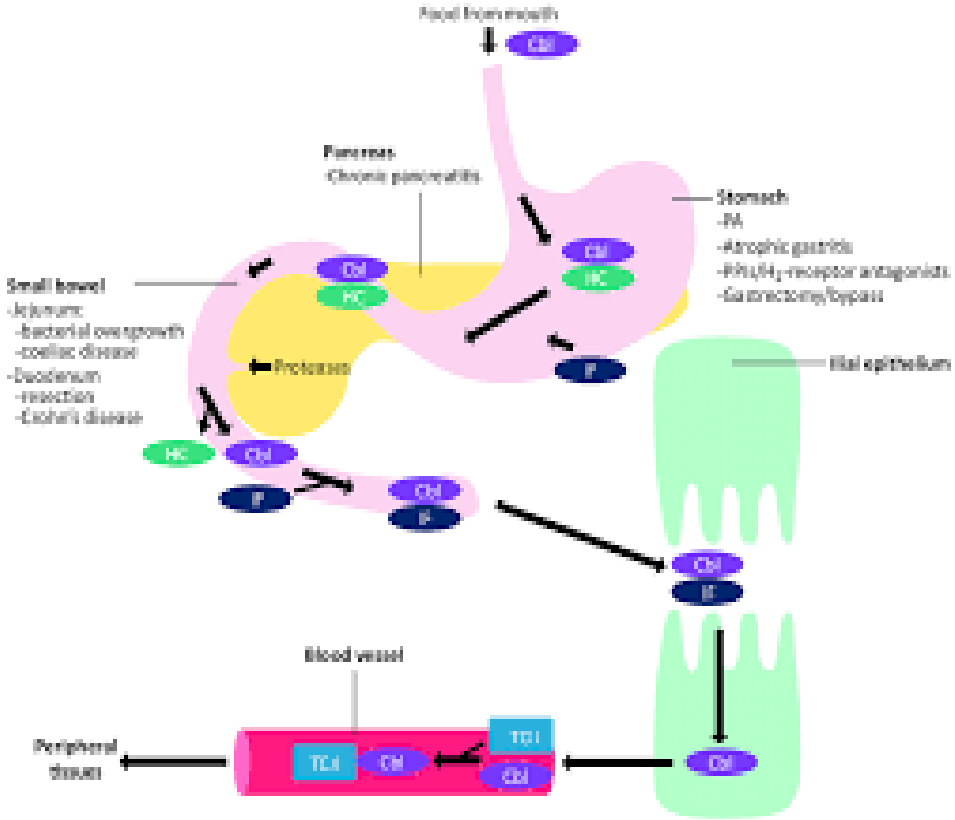
  II. Folate Deficiency Anemia(Lack of Folates)

Causes

Poor Dietary Intake

- Poor Absorption of Vit B12 in GIT
- Lack of Intrinsic Factor(Produced by Parietal cells by Stomach) in Stomach.
- Weakend Stomach Lining Digestive Disorders
- Alcohol Abuse
- Intestinal Dysfunction
- Certain Medications, Such as Phenytoin, Methotrexate etc
- Worms

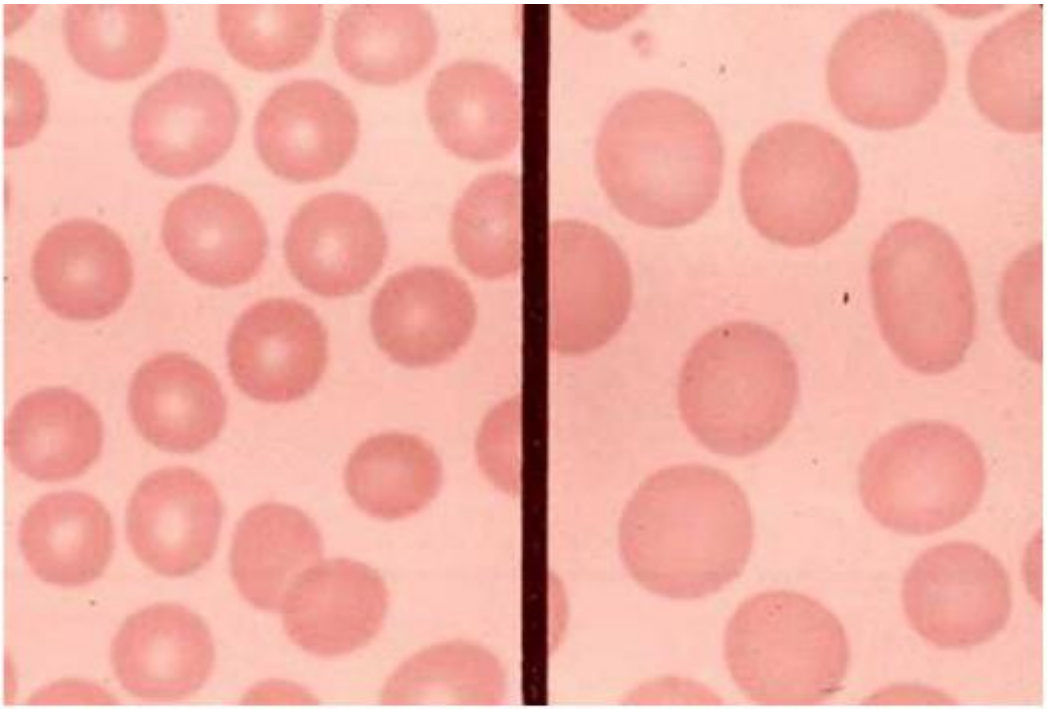
Vit B12 absrobtion



- Pernicious Anemia:
- It is due to deficiency of intrinsic factor secreted by stomach parietal cells. This intrinsic factor and B12 molecule are transported and absorbed properly. In pernicious anemia antibodies are produced against the intrinsic factor.
- Decreases in red blood cells that occurs when the body can not properly absorb Vit B12 from the GI tract. Vit B12 is necessary for the proper development of red blood cells. In this type of anemia RBC's are larger than normal and die earlier than the 120 Days. Red Blood cells can be oval shaped and larger in size.
- Vitamin B12 is also required for the conversion of folic acid to its active form that is THF(tetra hydro folate) .

- Folate Deficiency:

  Folic acid works along with Vit B12 and to help in the synthesis of proteins which are important for the formation DNA. Folic acid is a type of vitamin it is water soluble which means it can not be stored in the body for a longer period of time. So the RBCs get arrested in the cell cycle phase between G2 and M. The cells keep on growing in size but they don't have the required amount of DNA for cell division ,so they face destruction either in the bone marrow which is called intramedullary hemolysis or in the peripheral circulation they get destroyed by the spleen.



normal red cells macrocytic red cells

Sign & Symptoms

- Tingling & Numbness of Hands & Feet
- Muscles Weakness
- Neurological Problems like Dementia,Depression,Memory Loss, Headache and Forgetfulness
- Slight Jaundice
- Weight Loss
- Glossitis
- Pallor

Aplastic Anaemia

- Aplastic Anaemia is rare and serious blood disorder in which bone marrow stops making enough new blood cells. This is because the bone marrow's Stem Cells are damaged due to multiple inherited and acquired diseases. The disorder tends to get worse over time,unless it's cause is diagnosed and treated. It results in a condition calledPancytopenia (Insufficient Numbers of RBCs,WBCs and Platelets) all three lineages are effected.

Causes

Exposure to Toxic Substances such as Arsenic, Benzene

Cancer Therapy

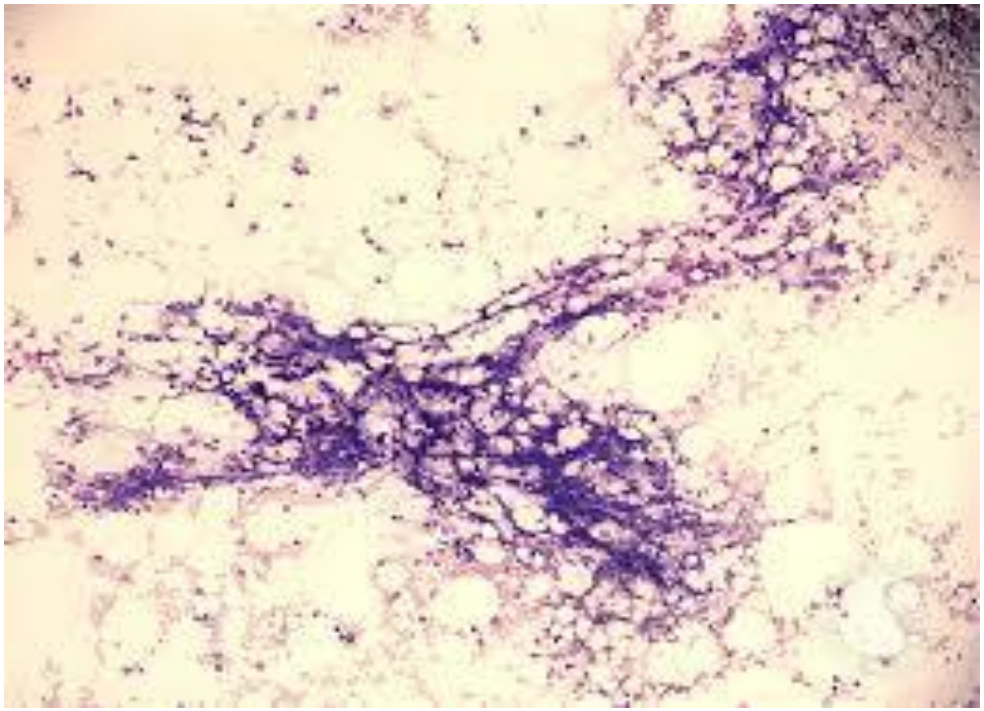
Certain Drugs used in autoimmune disorder such as Rheumatoid Arthritis

Viral Infection such as Hepatitis, HIV etc.

Damage to the Stem Cells in Bone Marrow that are Responsible for Blood Cell Production.

Weakend Bone Marrow (Hypo parathyrodism)

Autolmmunity.



Sign & Symptoms

- Pancytopenia
- Fatigue and Restlessness
- Hypoxemia
- Irregular Heartbeat (Heart Murmur)
- Pale Skin , Gums and Nail beds
- Fever and Frequent Infection due to Leukocytopenia
- Increases Bleeding Tendency and Pinpoint Red Bleeding spots on the Skin due to Thrombocytopenia
- Oral Thrush

Haemolytic Anaemia

- The Rupture OR Destruction of Red Blood Cells is called Haemolysis. Haemolytic anaemia is a condition in which RBCs are destroyed and removed from the blood stream before their normal life span.
- It's can be:
- I. Inherited (Parents passed the Gene for the condition on the Baby) e.g.-Sickle Cell Anaemia & Thalassemia
- II. Acquired (Baby are not Born with this condition , But Develop it due to another Disease , Condition or Factor)

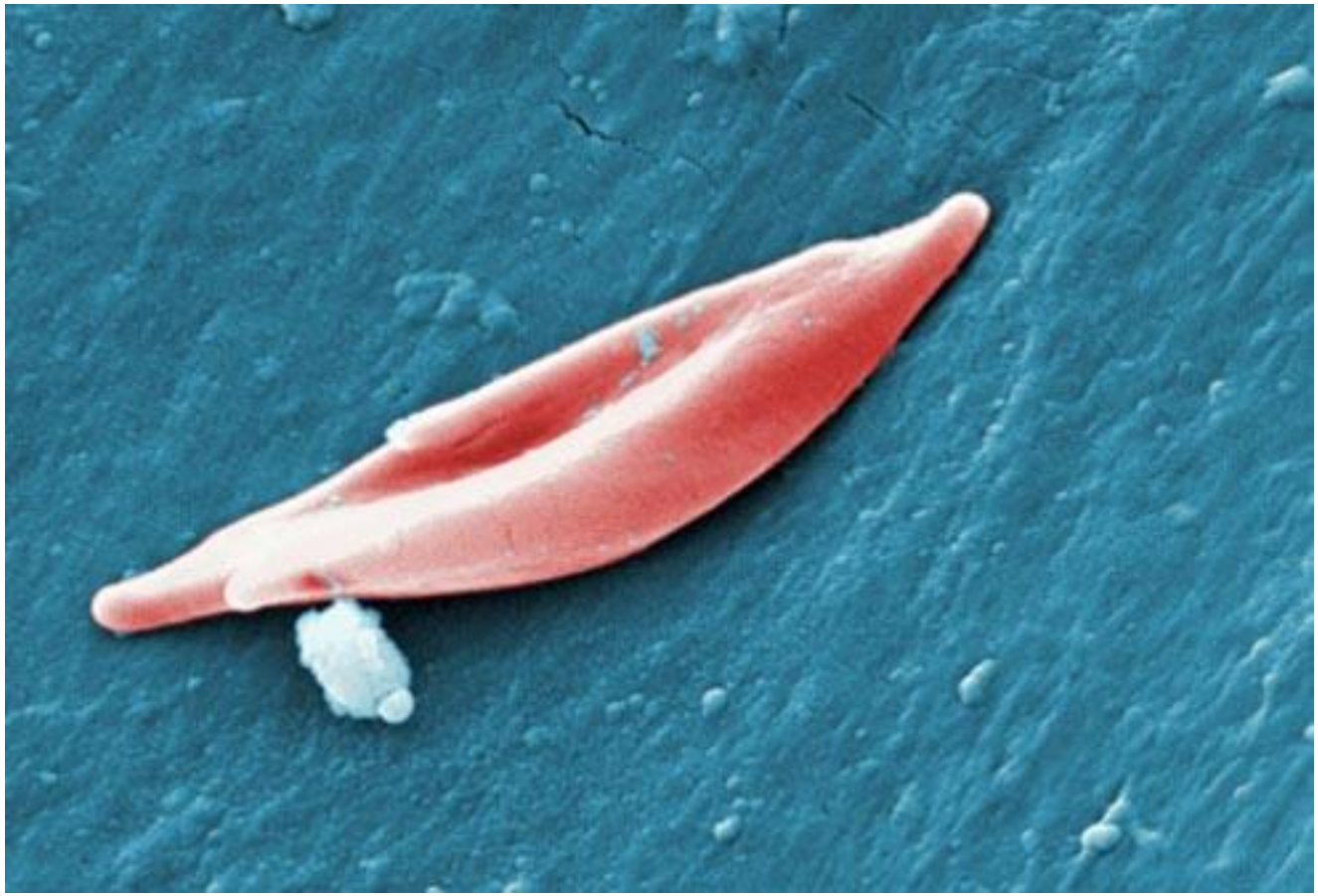
,

- Hemolytic anemias are classified further into two categories
- **Intrinsic defects and**
- **Extrinsic defects.**
- In intrinsic defects we can have further three categories
- A)Hemoglobinopathies .(Thalassemias and Sickle cell disease)
- B)Membranopathies .(Heriditary spherocytosis and heriditary elliptocytosis)
- C)Enzymopathies. (G6PD Defficiency)

- In Extrinsic defects we have
- A)Immune destructive hemolytic anemias.
- B)Microangiopathic hemolytic anemias.

Sickle cell anemia

- Sickle Cell Anaemia is Serious Inherited Disease RBC that assume an abnormal, rigid, sickle shape whenever exposed to low oxygen tension. Sickling decreases the cells' flexibility and results in a risk of various complications. The sickling occurs because of a mutation in the hemoglobin gene
- Sickle cells contain abnormal hemoglobin called sickle hemoglobin or hemoglobin S. Sickle hemoglobin causes the cells to develop a sickle, or crescent, shape. Sickle cells are stiff and sticky. They tend to block blood flow in the blood vessels of the limbs and organs. Blocked blood flow can cause pain and organ damage. It can also raise the risk for infection.



Sign & Symptoms

- The most common symptom of anemia is fatigue. Other signs and symptoms of anemia include:
- Shortness of breath
- Dizziness
- Headaches
- Coldness in the hands and feet
- Paler than normal skin or mucous membranes

Jaundice

Diagnosis

- Hb (hemoglobin) level.
- Complete blood count.
- Serum iron levels.
- Serum ferratin levels.
- Periphral blood smears.
- Specific diagnostic tests for different anemias.
- Bone marrow examination.
- Genetic testing on molecular level.

- Thanks