

# **BLOOD PHYSIOLOGY**

**TEXTBOOK OF MEDICAL PHYSIOLOGY**  
**GUYTON & HALL 12<sup>TH</sup> EDITION**  
**UNIT VI CHAPTERS 32-36**

# **L2Topic: Hemoglobin, Iron,)**

- 1. Essential elements for RBC formation**
- 2. Vitamin B12**
- 3. Structure & functions of Hb**
- 4. Iron Metabolism.**
- 5. Anemia**
- 6. Polycythemia**

# Essential elements for RBCs formation and Maturation

**Certain elements are essential for RBC formation and maturation:**

- 1. Amino acid: formation of globin in Hb, sever protein deficiency leads to anaemia**
- 2. Iron: formation of Hb, iron deficiency results in small cells (microcytic) anaemia**

# Essential elements for RBCs formation and Maturation *cont*

## 3. Vitamins

- **Vit B12 and Folic acid**
  - **Synthesis of nucleoprotein**
  - **Deficiency of both causes anemia**
- **Vit B6, Riboflavin, nicotinic acid, biotin, Vit C, Vit E**

## 4. Essential elements

- **Copper, Cobalt, zinc, manganese**

## 5. Hormones

- **Androgens, Thyroid, cortisol & growth hormones**
- **Deficiencies of any one results in anaemia**

# Vitamin B12 & Folic acid

- **Important for DNA synthesis and final maturation of RBC**
- **Dietary source: meat, milk, liver, fat, green vegetables**
- **Deficiency of VIT B12 & folic acid leads to:**
  - **Failure of nuclear maturation & division**
  - **Abnormally large & oval shape RBC**
  - **Short life span**
  - **reduced RBC count & Hb content**
  - **Macrocytic (megaloblastic) anemia**

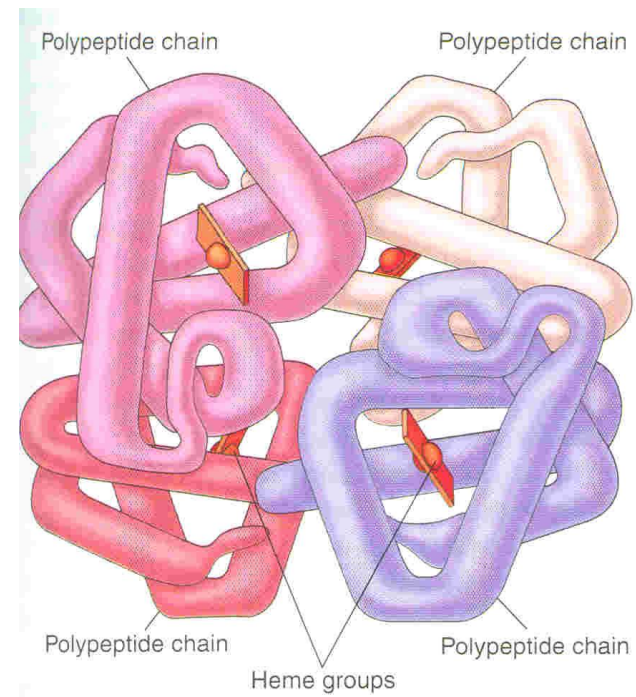
# **Malabsorption of Vit. B12**

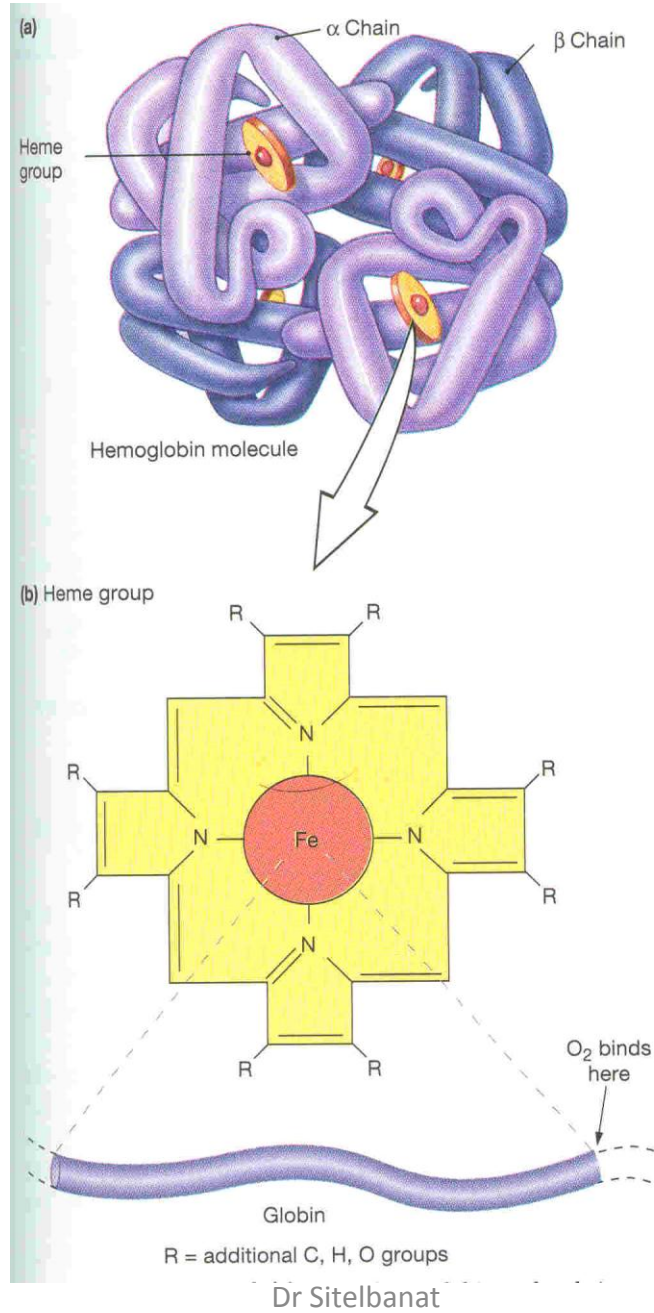
## **Pernicious Anemia**

- **VB12 absorption needs intrinsic factor secreted by parietal cells of stomach**
- **VB12 + intrinsic factor is absorbed in the terminal Ileum**
- **Causes of deficiencies**
  - **Inadequate intake**
  - **Poor absorption due to Intestinal disease**
- **Give rise to megaloblastic anaemia**

# HAEMOGLOBIN

- Hb molecules consist 4 chains each formed of heme & polypeptide chain (globin)
- Heme consist of protoporphyrin ring + iron
- Abnormality in the polypeptide chain - abnormal Hb (hemoglobinopathies) e.g thalassemias, sickle cell







# Functions of Hemoglobin

- **Carriage of O<sub>2</sub>**
  - Hb reversibly bind O<sub>2</sub> to form oxyhemoglobin, affect by pH, temperatre, H<sup>+</sup>
- **Carriage of CO<sub>2</sub>**
  - Hb bind CO<sub>2</sub> = carboxyhemaglobin
- **Buffer**

# Iron metabolism

**Iron is needed for the synthesis of Hb, myoglobin, cytochrome oxidase, peroxidase & catalase**

- **Total Iron in the body = 4-5g**
  - **65% Haemoglobin**
  - **5% other hems**
  - **1% bound to transferrin (betaglobulin) in blood**
  - **15-30% stored iron in the form of ferritin in the liver, spleen and bone marrow.**

# Iron absorption

- Iron in food mostly in oxidized form (Ferric)
- Better absorbed in reduced form (Ferrous)
- Iron in stomach is reduced by gastric acid, Vit. C.
- Rate of iron absorption depend on the amount of iron stored

# Transport and storage of iron

- **Iron is transport in plasma in the form of Transferrin (apotransferrin+iron)**
- **Iron is stored in two forms**
  - **Ferritin (apoferritin+iron)**
  - **Haemosiderin (insoluble complex molecule)**
- **Daily loss of iron is 0.6 mgm in male & 1.3mgm/day in females**

# **Destruction of RBC**

- **RBC life span in circulation = 120 days**
- **Metabolic active cells**
- **Old cell has a fragile cell membrane, cell will rupture as it pass in narrow capillaries (spleen)**
- **Released Hb is taken up by macrophages in liver, spleen & bone marrow**
- **Hb is broken into its component:**
  - **Polypeptide broken to aminoacids to storage**
  - **Iron degraded to ferritin and stored**
  - **Porphyrin ring transfer to bilirubin, secreted by the liver into bile**

# **ANAEMIAS**

## **– Definiation**

- Decrease number of RBC**
- Decrease Hb**

## **– Symptoms: Tired, Fatigue, short of breath, heart failure**

# **Causes of anaemia**

## **1. Blood Loss**

- acute → accident (RBC return to normal 3-6w)**
- Chronic → microcytic hypochromic anaemia (ulcer, worms)**

## **2. Decrease RBC production**

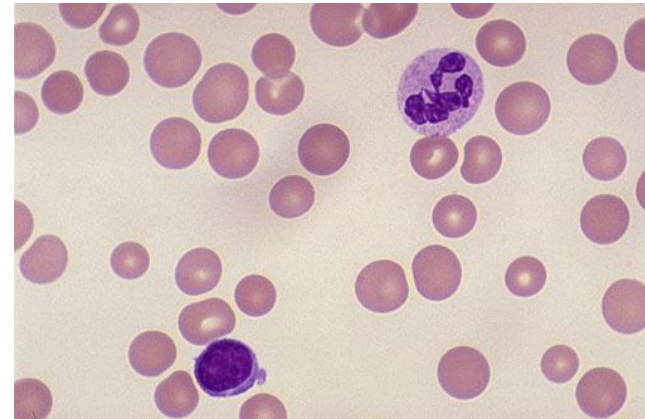
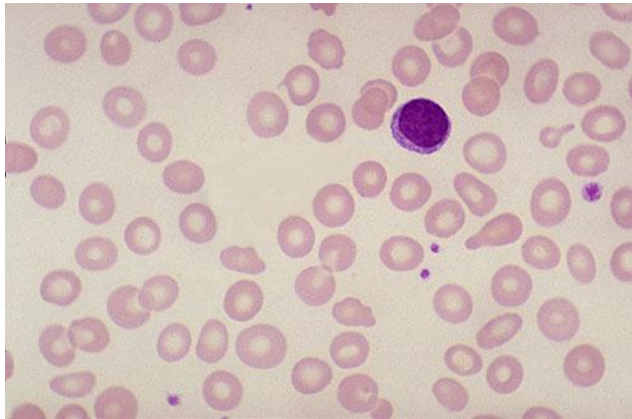
- Nutritional causes**
  - Iron → microcytic anaemia**
  - VB12 & Folic acid → megaloblastic anaemia**
- Bone marrow destruction by cancer, radiation, drugs → Aplastic anaemia.**

# Causes of anaemia

- 3. Haemolytic → excessive destruction**
  - **Abnormal cells or Hb**
    - **Spherocytosis**
    - **sickle cells**
  - **Incompatible blood transfusion**
  - **Erythroblastosis fetalis**



# Types of Anemia's



- **Microcytic anemia    Macrocytic anemia**

# Polycythemia

**Increased number of RBC**

**Types:**

- 1. Primary (polycythemia rubra vera): uncontrolled RBC production**
- 2. Secondary to hypoxia: high altitude (physiological), chronic respiratory or cardiac disease**

# Objectives

**At the end of this lecture student should be able to:**

- 1. Describe essential elements needed for RBC formation.**
- 2. Describe the process of VB12 absorption and its malabsorption**
- 3. Recognise haemoglobin structure and its functions.**
- 4. Discuss iron metabolism (absorption, storage and transport)**

# Objectives

**At the end of this lecture student should be able to:**

- 5. Describe the fate of old RBC .**
- 6. Describe anemia and its causes .**
- 7. Recognise causes of polycythemia.**