

HB (structure and function)

BY

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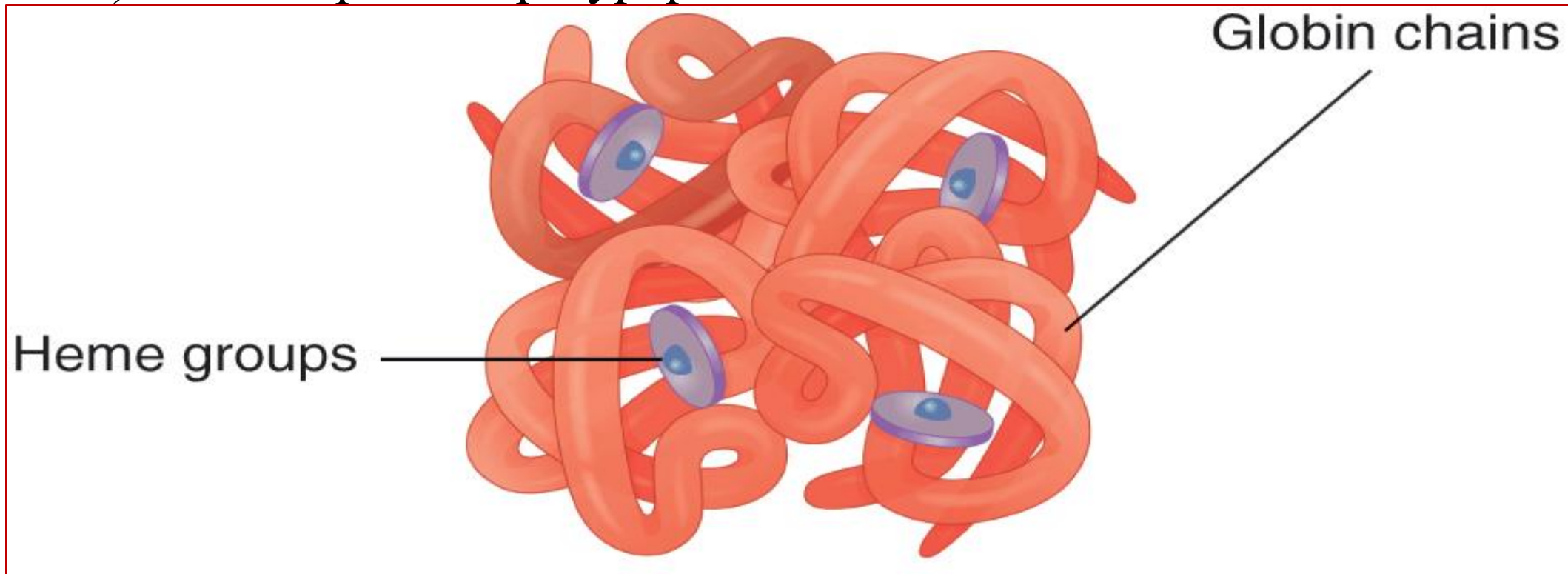
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➤ Hemoglobin:

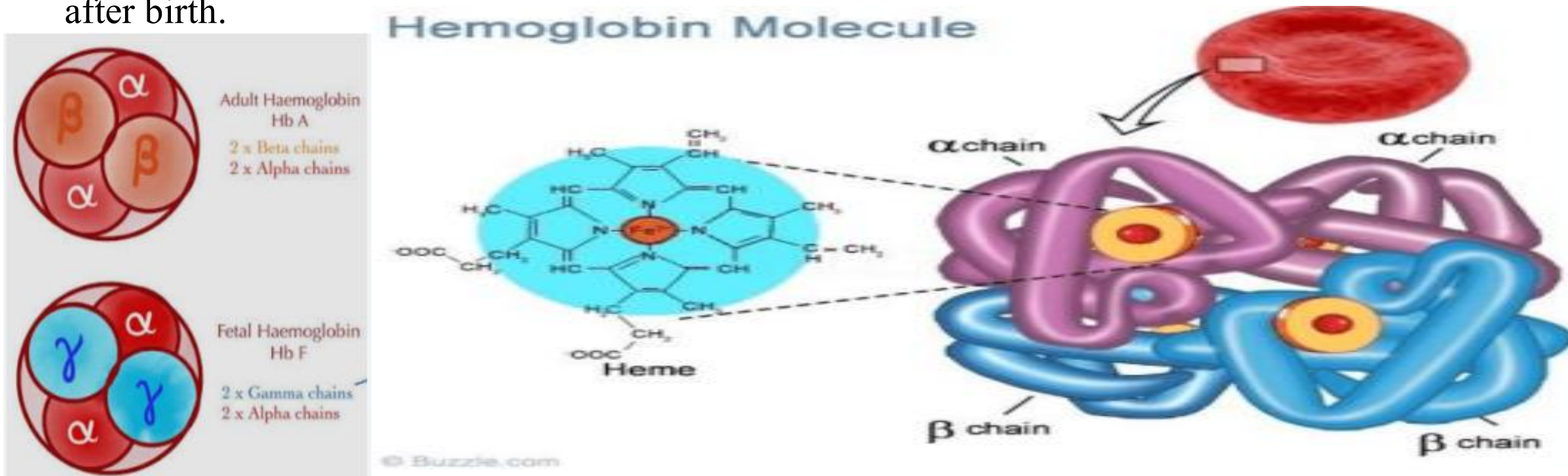
- It is the red oxygen-carrying pigment. Protein in nature, made up of four subunits. Each unit is formed of heme (Iron protoporphyrin) and globin (polypeptide chain).
- In each molecule of hemoglobin, there are four atoms of iron (ferrous state) and two pairs of polypeptides.



➤ Types of hemoglobin:

• I- Normal types of hemoglobin:

- Adult hemoglobin (Hb A): about 15.5 gm% in adult male and 13.5 gm% in adult female.
 - **Hemoglobin A**; its globin consists of 2 α chains and 2 β chains.
- Fetal hemoglobin (Hb F): (2 α & 2 γ)
- It is present in fetal blood and its affinity to oxygen is greater than Hb A to be able to take oxygen from the mother that have HbA. It is replaced by adult type within 6-8 months after birth.



Abnormal types of hemoglobin:

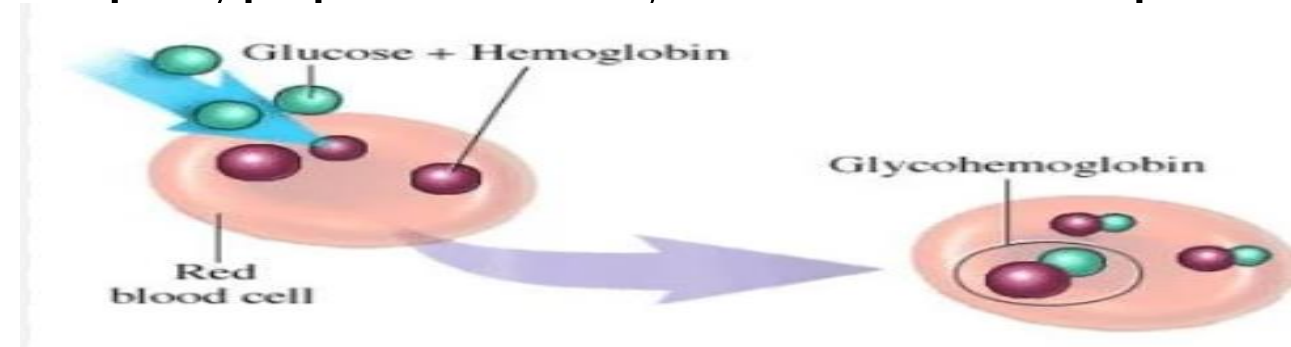
▪ Hemoglobin A_{1c}:

Hb A reacts with glucose to form glycated hemoglobin. Normally it account about 5 % of adult hemoglobin and it increases if blood glucose level increased and remain elevated for several days so it's used in diabetic persons follow up.

▪ Carboxy-hemoglobin (HbCO):

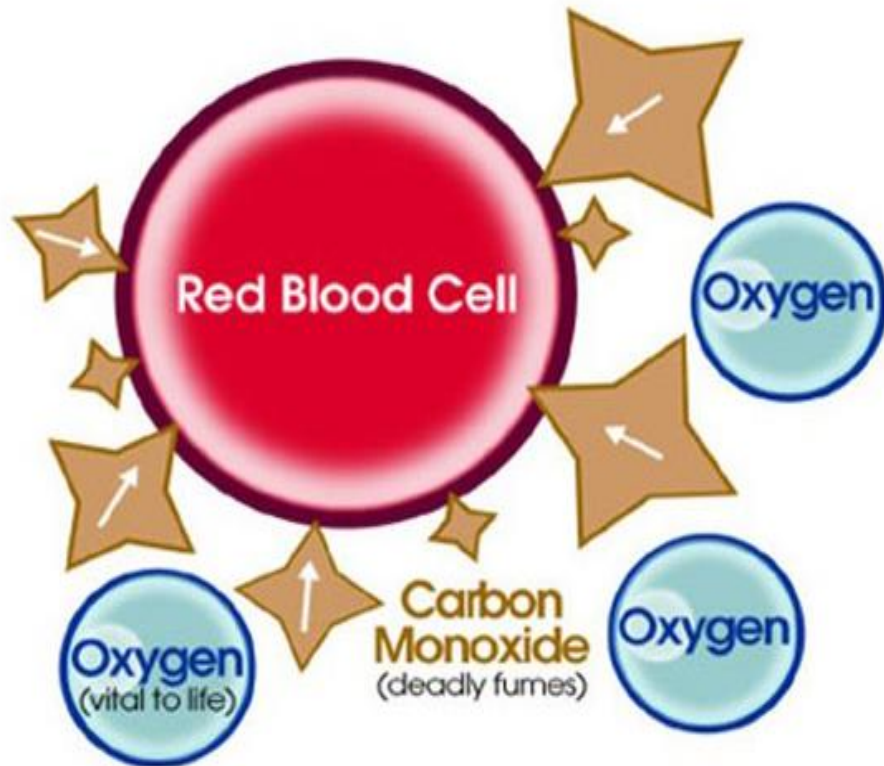
Hb reacts with carbon monoxide to form carboxy-hemoglobin. The affinity of Hb to CO is about 200 times its affinity to oxygen, it combine with the Hb iron competing with oxygen.

N.B. CO₂ combine with the a.a. of the Hb polypeptide chain, so it is not compete with O₂.

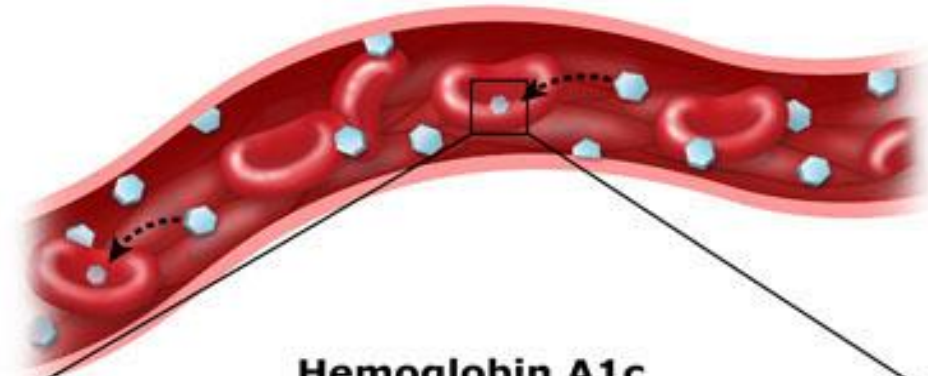


Carbon Monoxide Poisoning

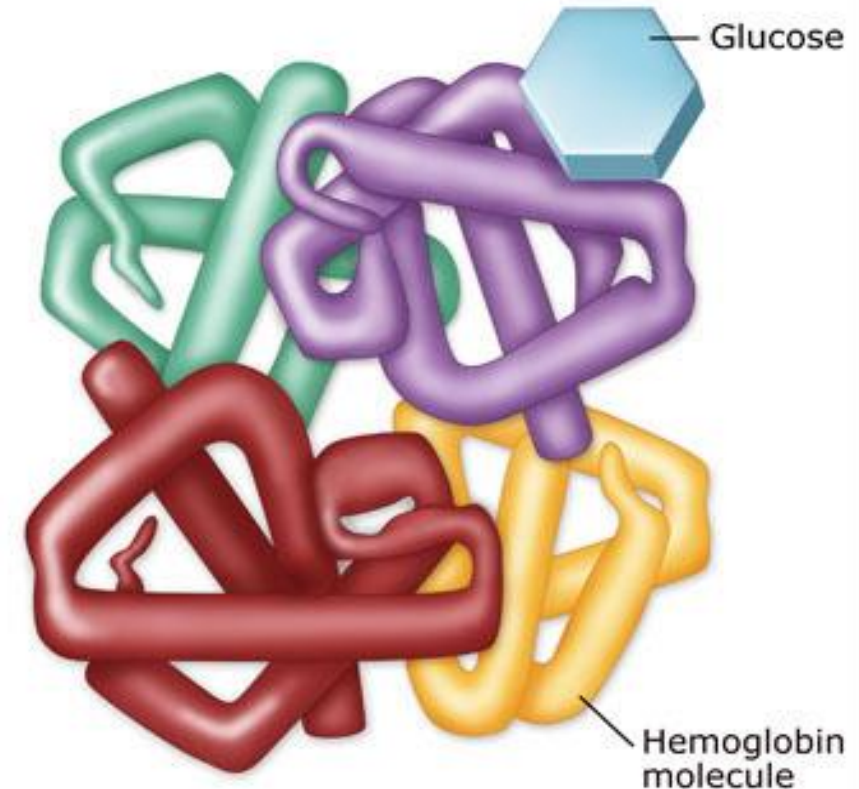
The Silent Killer



Hemoglobin A1c



Hemoglobin A1c



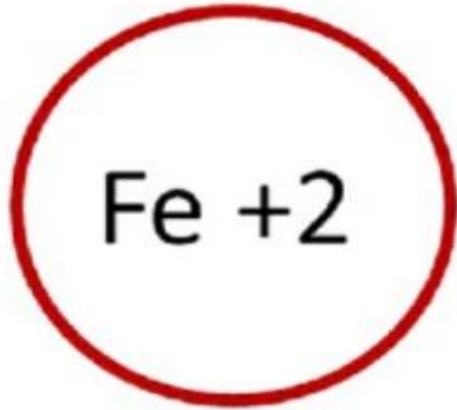
- Met-hemoglobin (MetHb)

Normally small amount of Hb are oxidized to met-hemoglobin (blue in color & can't carry O₂ due to oxidation of ferrous iron to ferric). An enzyme (Methemoglobin reductase) is present inside R.B.Cs. It changes MetHb back to Hb, congenital absence of this enzyme → increase the amount of MetHb in R.B.Cs.

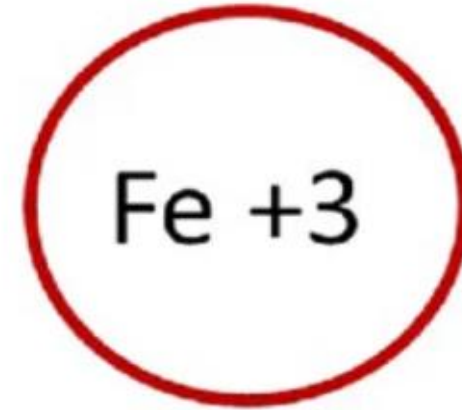
HbS:

Abnormality in β chain with normal α chain. At low oxygen tension, red cell becomes sickled shape, they break down prematurely, the result is a severe hemolytic anemia (Sickle cell anemia).

Hemoglobin



MetHb



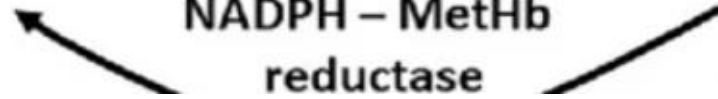
Free radicals



CYB5R (primary pathway)



NADPH – MetHb reductase



Leukomethylene

Methylene Blue

NORMAL RBC

Normal hemoglobin molecules

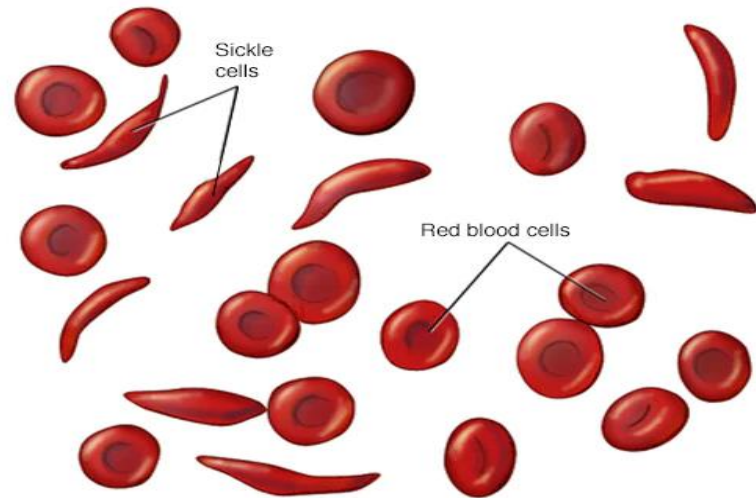


SICKLED RBC

Abnormal hemoglobin molecules



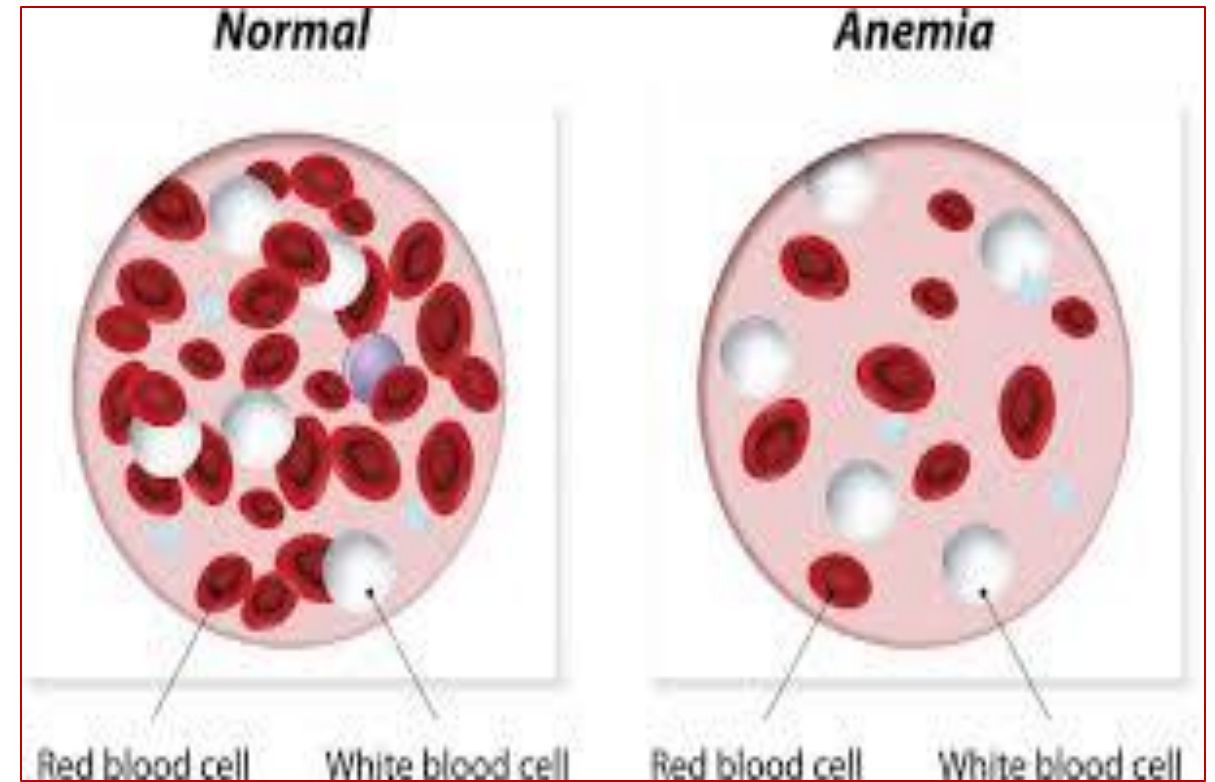
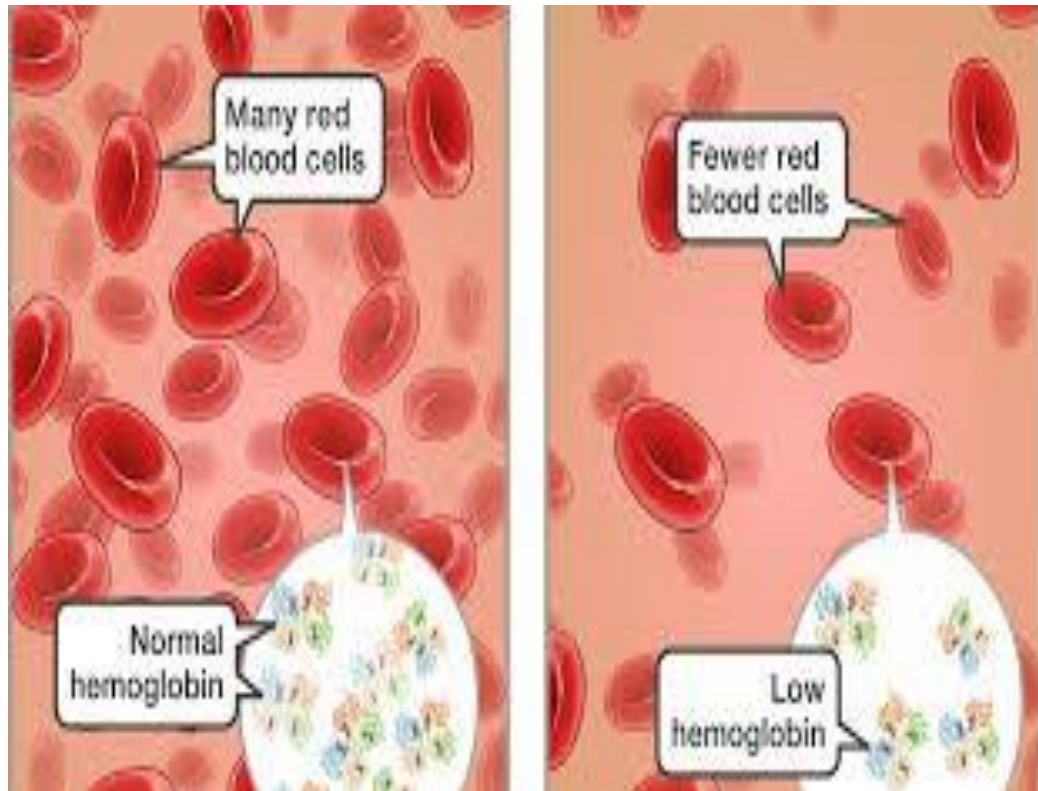
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Anemia

It means decreased RBCs number or their hemoglobin content or both.



- **Types and causes of anemia**

- I. **Normochromic Normocytic Anemia**: including;

- **A. Hemolytic anemia**; due to excessive hemolysis of RBCs. **e.g.**,

1. Incompatible blood transfusion.
2. Snake venoms.
3. Sensitivity to drugs.
4. Infections as some types of malaria.
5. Antibodies against red blood cells.
6. Increased fragility of RBCs as in spherocytosis, sickle cell anemia and thalassemia.

B. Aplastic anemia; due to **bone marrow depression**. e.g.;

1. Exposure to radiation such as X-rays.
 2. Chemotherapy.
 3. Drugs as antibiotics as chloramphenicol.
 4. Destruction of bone marrow by malignant tumors.
- **C. Hemorrhagic anemia**; due to **acute blood loss** (i.e. hemorrhage).

- **Microcytic Hypochromic Anemia:**

- **Iron deficiency anemia**, either due to: decrease iron or increase iron requirement

- I. **Decrease iron**

1. Deficiency in the diet (**commonest cause**).

2. Failure of iron absorption **due to** :

- Absence or removal of acid producing part of the stomach, **e.g.** congenital achlorohydra or partial gastrectomy
- Excess oxalates, phytic acids and phosphates in diet.
- 3. Diseases of small intestine (upper part) as duodenal ulcers.
- 4. Liver disease (site of storage of iron)
- 5. Chronic blood loss, **e.g.**, bleeding piles and menstruation in females.

- **Treatment:**

- Oral iron or injection (in case of gastric or small intestinal causes)

- **Increase iron requirement**

- 1) physiological causes:

- in infant due to poor of iron in the milk of the mother

- in puberty

- in females due to menstrual cycle.

- 2) Pathological causes:

- as in chronic bleeding e.g in piles

III. Macrocytic (Megaloblastic) Anemia:

- It occurs due to **deficiency of vitamin B12 or folic acid.**

1. Vitamin B12 deficiency (Pernicious anemia) due to:

- a) Absence of intrinsic factor from the stomach.
- b) Malabsorption due to small intestine diseases (lower part).
- c) Liver disease (site of storage).
- d) lack of vitamin in diet (**Rarely**)

• Treatment:

Vitamin B12 **injection** for life.

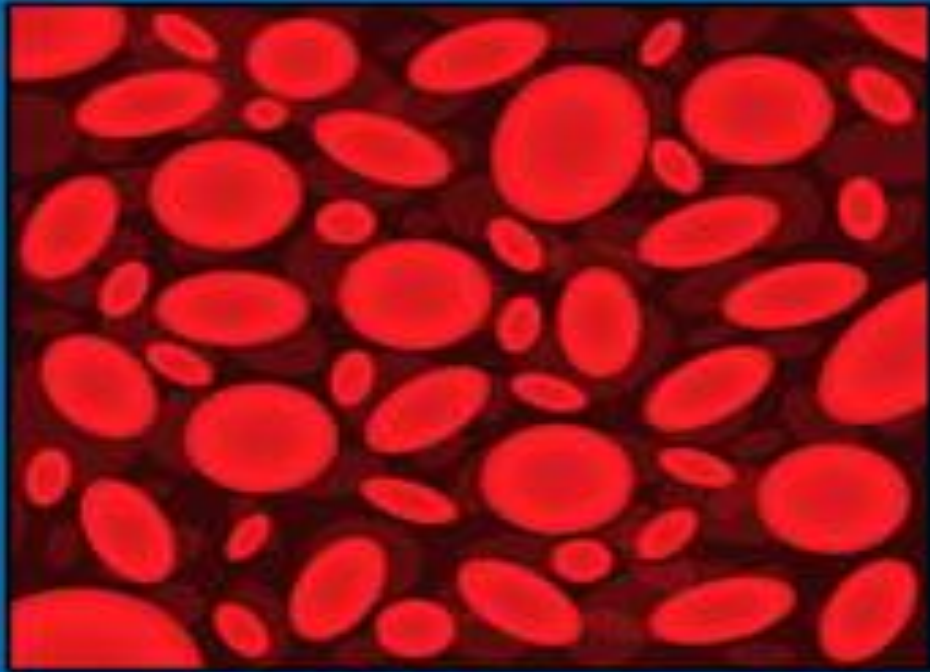
2. Folic acid deficiency due to:

- Deficiency of folic acid in diet especially during pregnancy.
- Failure of absorption due to small intestine diseases.

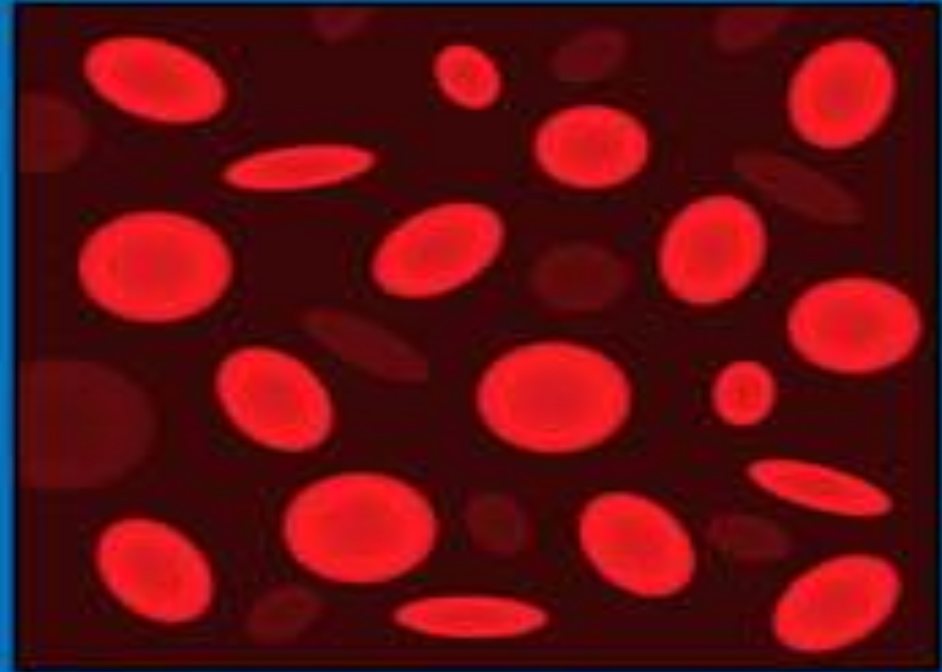
Polycythemia

Polycythemia means increased number of RBCs.

It may reach up to **6-8 million/mm³**.



Polycythemia Vera



Normal



THANK YOU

