

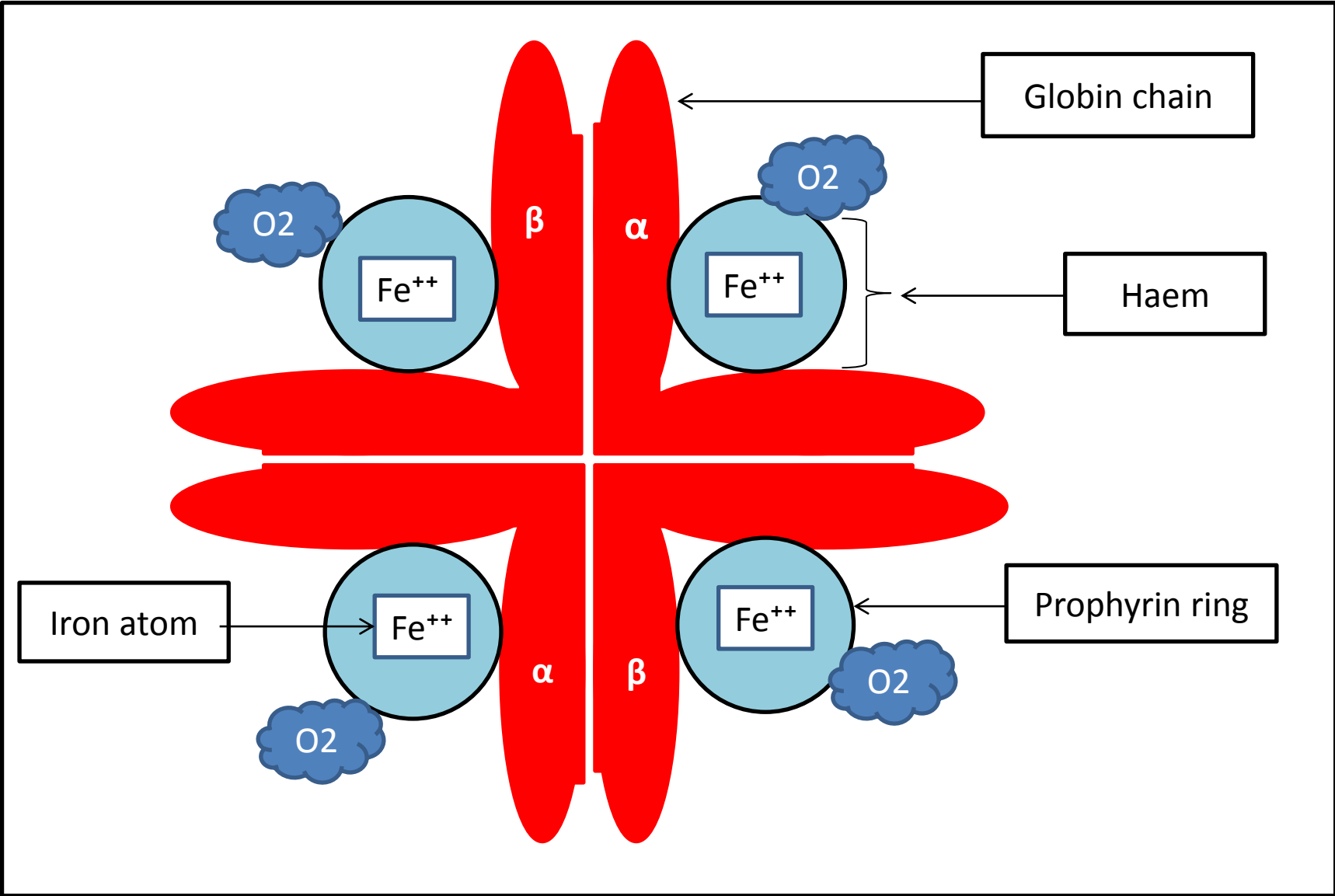
ANAEMIA

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**Head of Haematology Unit
Associate Professor & Consultant
Hematopathologists**

Hemoglobin??

Hemoglobin structure



Hemoglobin

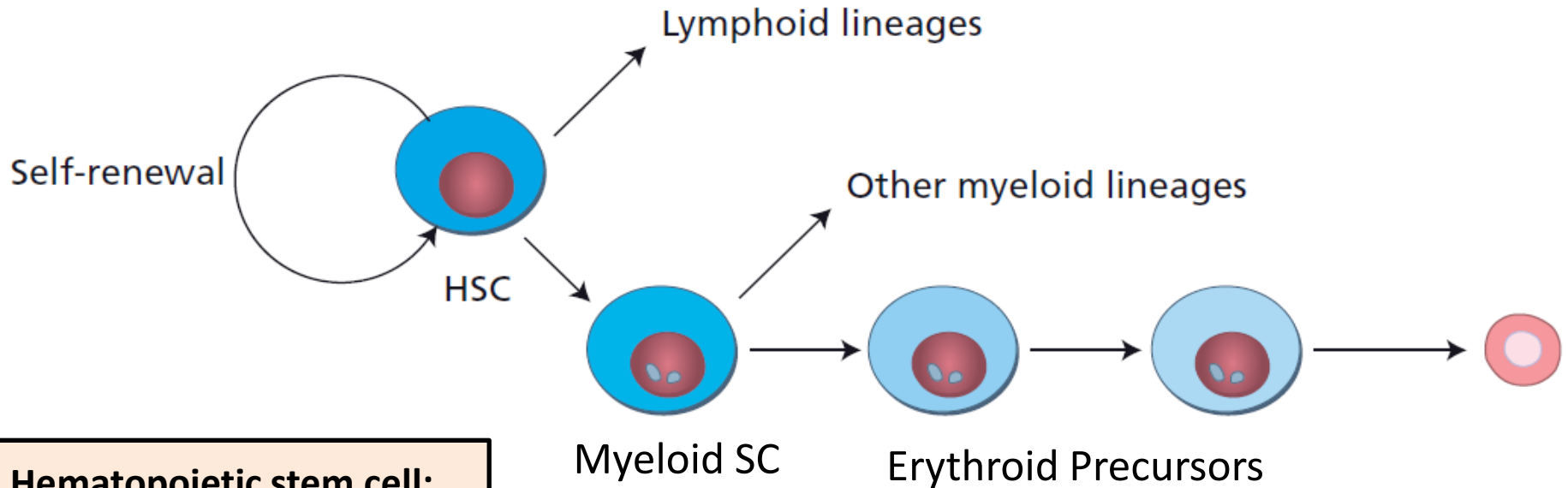
- Hemoglobin is the protein molecule in RBC that carries O₂ from the lungs to the body's tissues and returns carbon CO₂ from the tissues back to the lungs.
- Hemoglobin maintains the shape of RBC also.

Red Blood Cells



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Hematopoiesis



Hematopoietic stem cell:

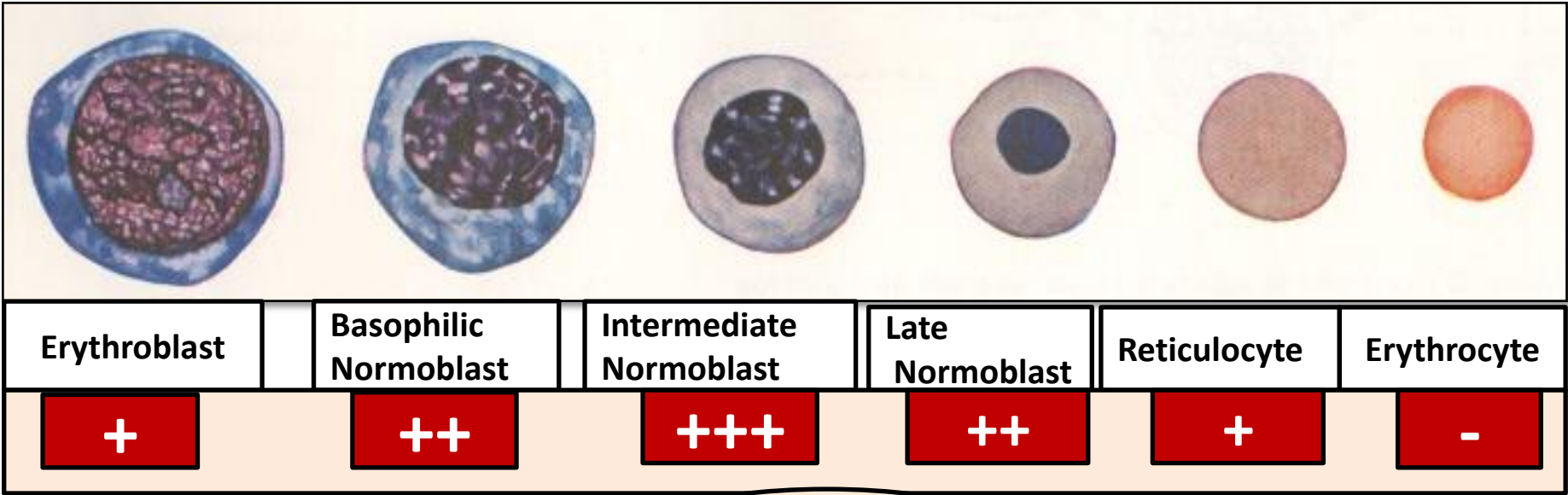
- 1- Self renewal
- 2- Cell differentiation

Transcriptional
Factor

Erythropoietin
GATA1

Erythropoiesis

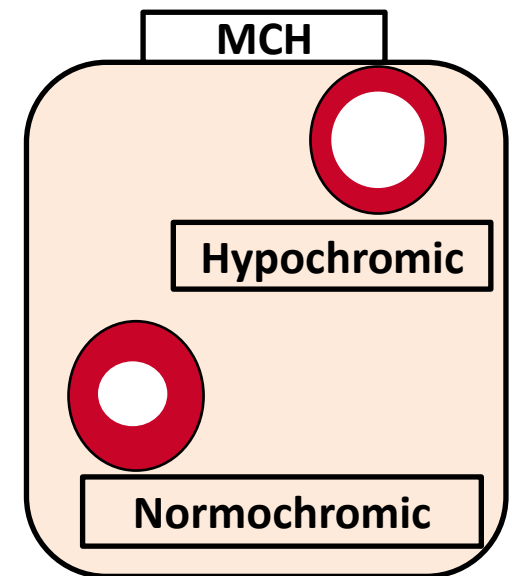
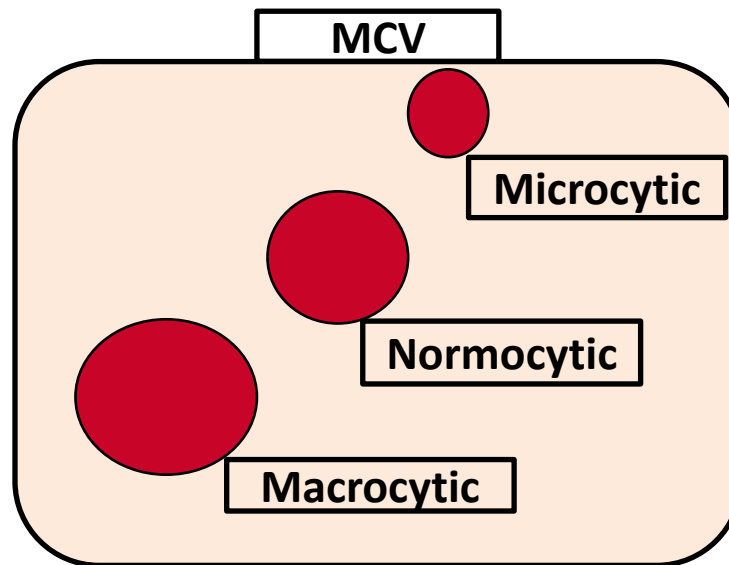
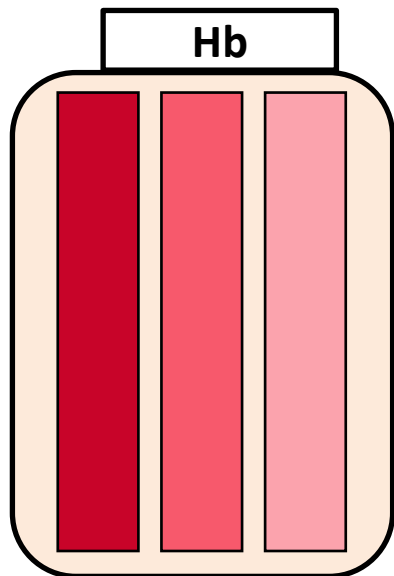
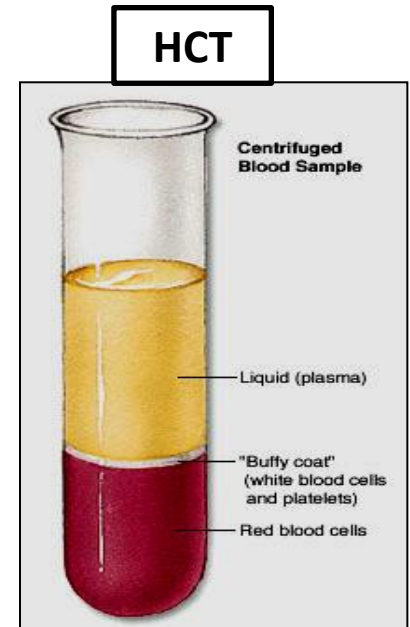
The “Bone Marrow” is the major site with the need of:
Folic acid – Iron “Ferrous” – Vit B12 – Erythropoietin -Amino acids
minerals - other regulatory factors



Synthesis of Hemoglobin

Normal Ranges

Indices	Male	Female
Hemoglobin(g/dL)	13.5-17.5	11.5-15.5
Hematocrit (PCV) (%)	40-52	36-48
Red Cell Count ($\times 10^{12}$)	4.5-6.5	3.9-5.6
Mean Cell Volume (MCV) (fL)	80-95	
Mean Cell Hemoglobin (MCH) (pg)	30-35	



ANEMIA

- ***An* (without) -*aemia* (blood)**
- **Reduction of Hb concentration below the normal range for the age and gender**
- **Leading to decreased O₂ carrying capacity of blood and thus O₂ availability to tissues (hypoxia)**

Clinical Features

Presence or absence of clinical feature depends on:

1-Speed of onset :

**Rapidly progressive anemia causes more symptoms than slow onset anemia due to lack of compensatory mechanisms:
(cardiovascular system, BM & O₂ dissociation curve**

2-Severity:

- **Mild anemia :no symptoms usually**
- **Symptoms appear if Hb less than 9g/dL**

3- Age:

- **Elderly tolerate anemia less than young patients**

Clinical Features

1-General features of anemia

- Weakness
- Headache
- Pallor
- Lethargy
- Dizziness
- Palpitation (tachycardia)
- Angina
- Cardiac failure

Related to anemia

Related to compensatory mechanism

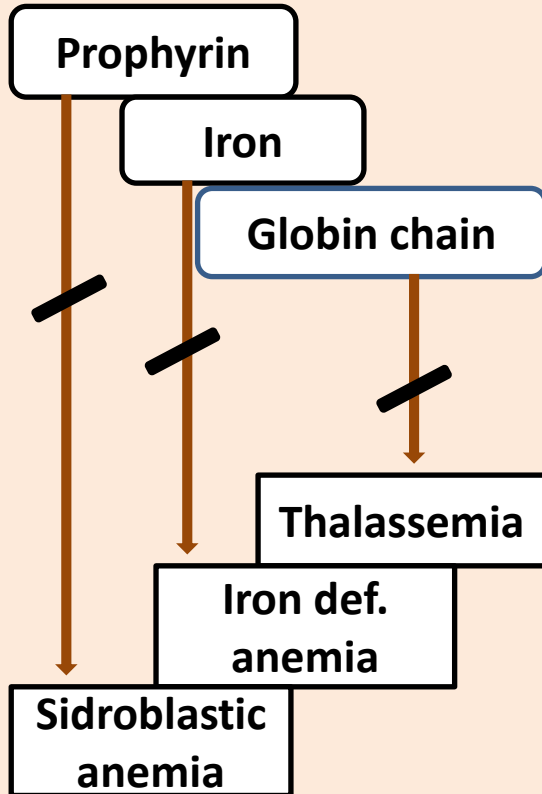
2-Specific features

Specific signs are associated with particular types of anemia :

- ❖ Spoon nail with iron deficiency,
- ❖ Leg ulcers with sickle cell anemia
- ❖ Jaundice with hemolytic anemia
- ❖ bone deformities in thalassemia major

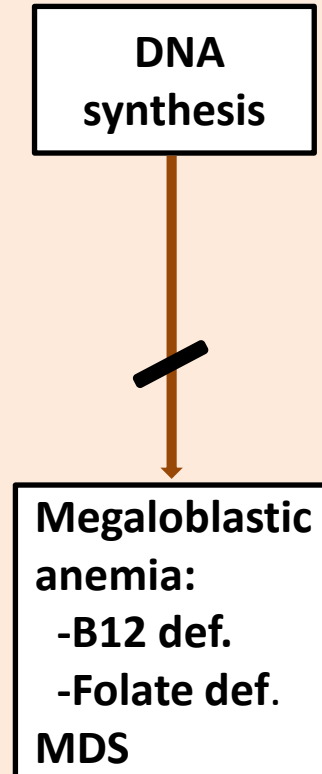
Classification of Anemia

Hemoglobin



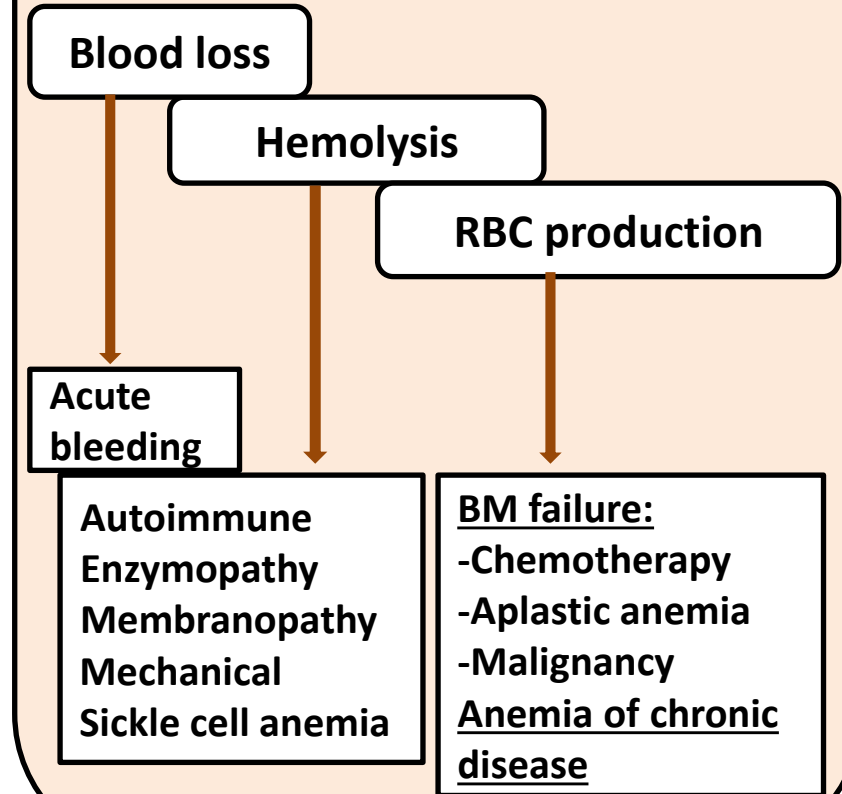
Hypochromic
microcytic
anemia

DNA



Macrocytic
anemia

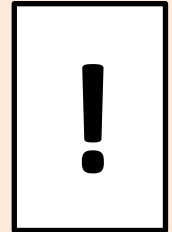
RBC count

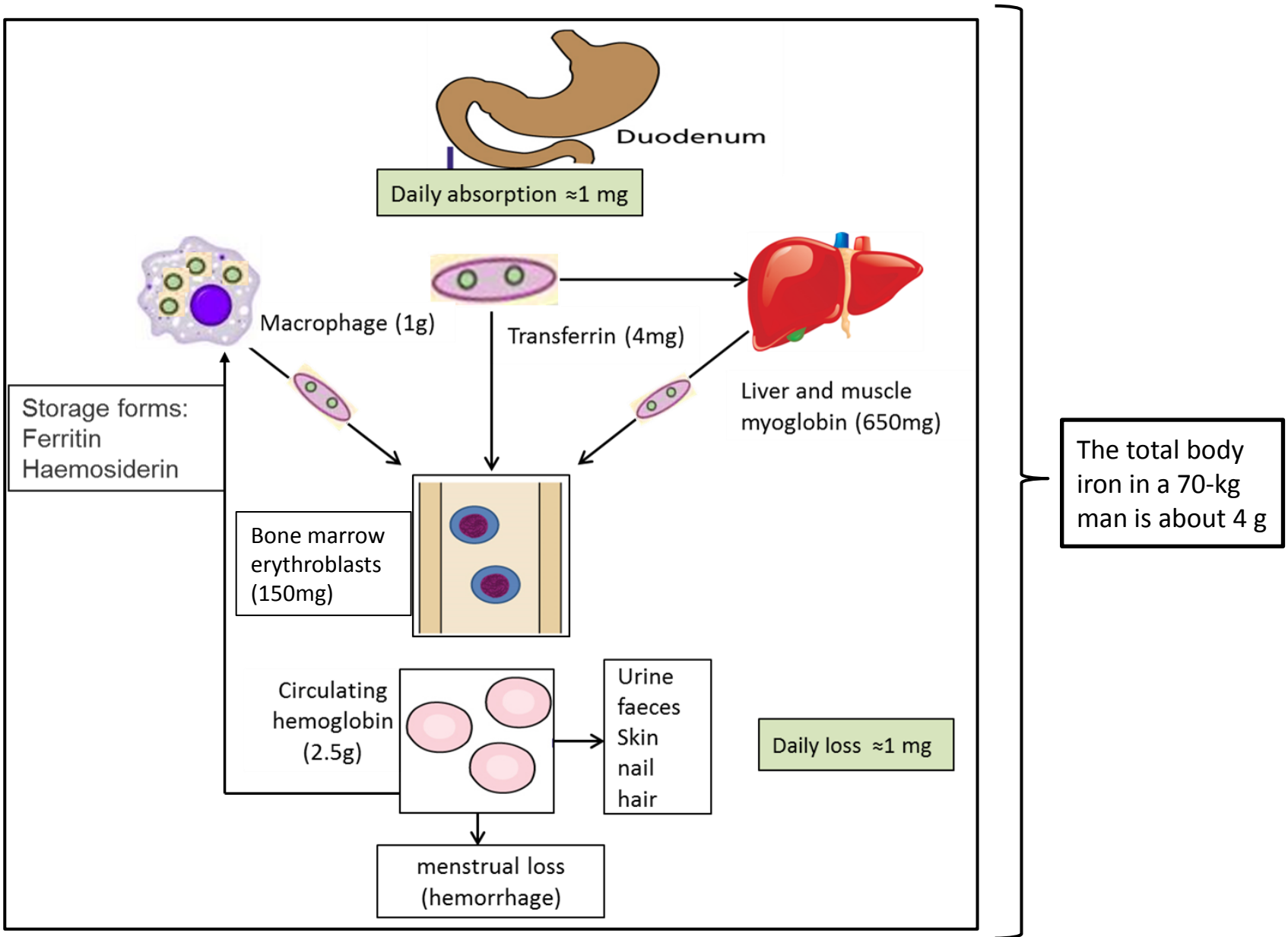


Normocytic
normochromic
anemia

Iron Deficiency Anemia

- **Iron is among the abundant minerals on earth (6%).**
- **Iron deficiency is the most common disorder(24%).**
- **Limited absorption ability :**
 - 1-Only 5-10% of taken iron will be absorbed**
 - 2- Inorganic iron can not be absorbed easily.**
- **Excess loss due to hemorrhage**





Daily absorption ≈ 1 mg

Duodenum

Macrophage (1g)

Transferrin (4mg)

Liver and muscle myoglobin (650mg)

Storage forms:
Ferritin
Haemosiderin

Bone marrow erythroblasts (150mg)

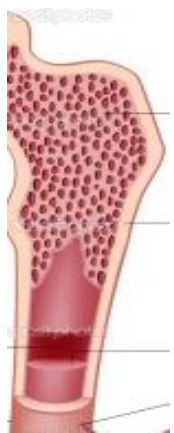
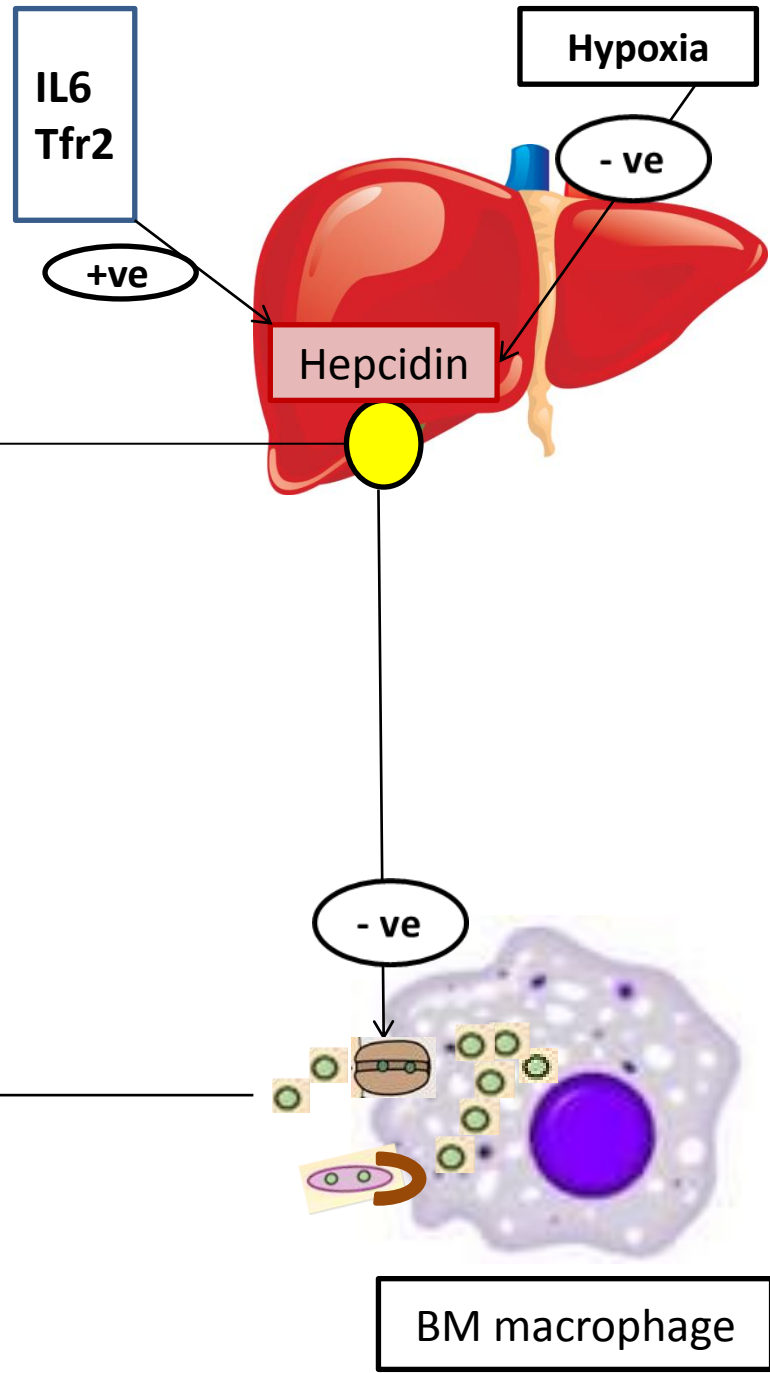
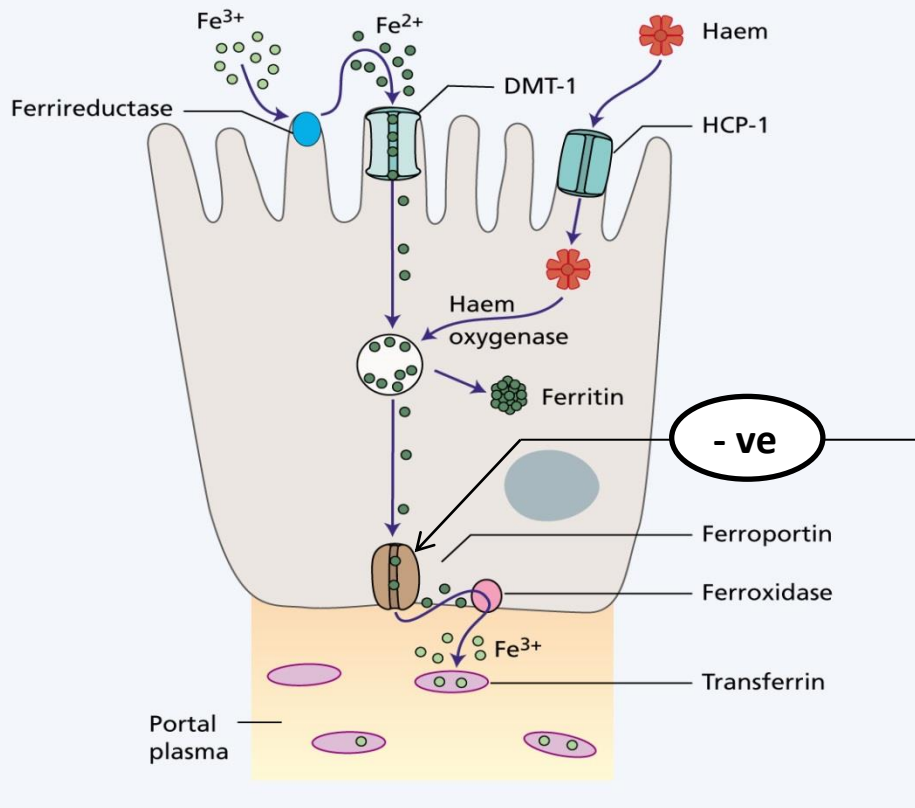
Circulating hemoglobin (2.5g)

Urine
faeces
Skin
nail
hair

Daily loss ≈ 1 mg

menstrual loss (hemorrhage)

The total body iron in a 70-kg man is about 4 g

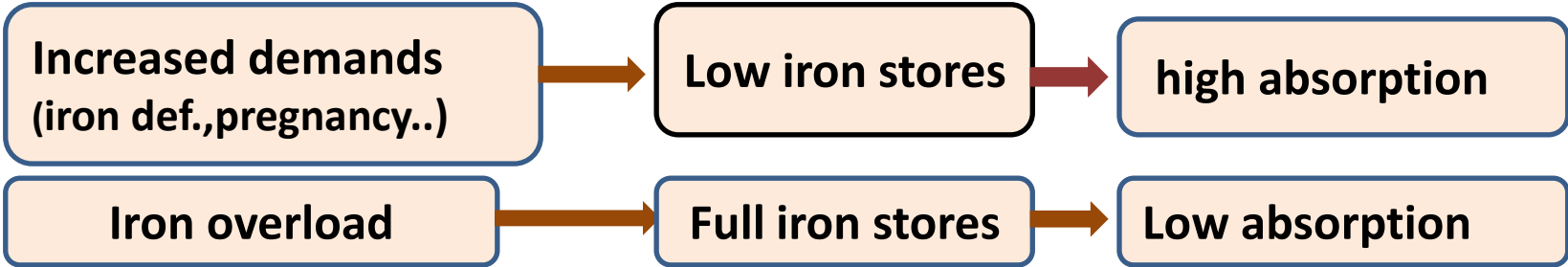


Iron Absorption

Factors favoring absorption	Factor reducing absorption
Haem iron	Inorganic iron
Ferrous Iron (Fe⁺⁺)	Ferric iron Fe⁺⁺⁺
Acid	Alkalines
Iron def	Iron overload
Pregnancy	Tea
Hemochromatosis	Increased hepcidin
Solubilizing agent (Sugar)	Precipitating agent(phenol)

Iron Absorption

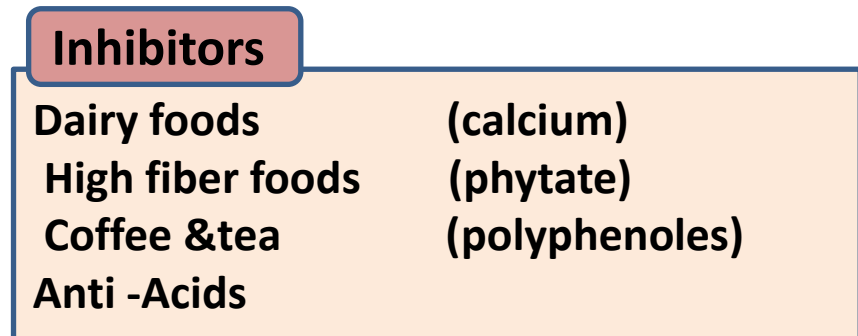
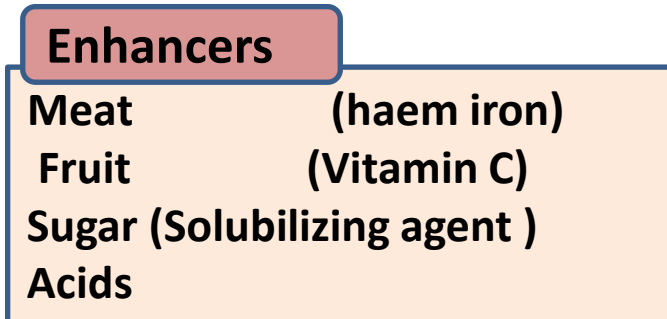
1-Body Iron status:



2- Content and form of dietary iron



3- Balance between dietary enhancers & Inhibitory factors:



Causes of IDA

1-Chronic blood loss:

- GIT Bleeding: peptic ulcer, esophageal varices , hookworm & cancer
- Uterine bleeding
- Hematuria

2- Increased demands:

- Immaturity
- Growth
- Pregnancy
- EPO therapy

3-Malabsorption:

- Enteropathy
- Gastrectomy

4-Poor diet: Rare as the only cause (rule out other causes)

Development of IDA

	1 Normal	2 Pre-latent	3 Latent	4 Iron def. anemia
Stores	Normal	Low	Low	Low
MCV/MCH	Normal	Normal	Low	Low
Hemoglobin	Normal	Normal	Normal	Low

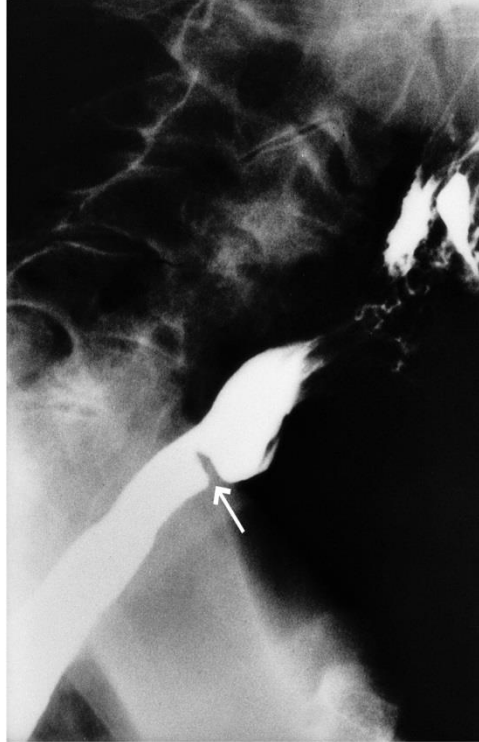


Signs of
anemia

Signs and symptoms of IDA



a



c



b



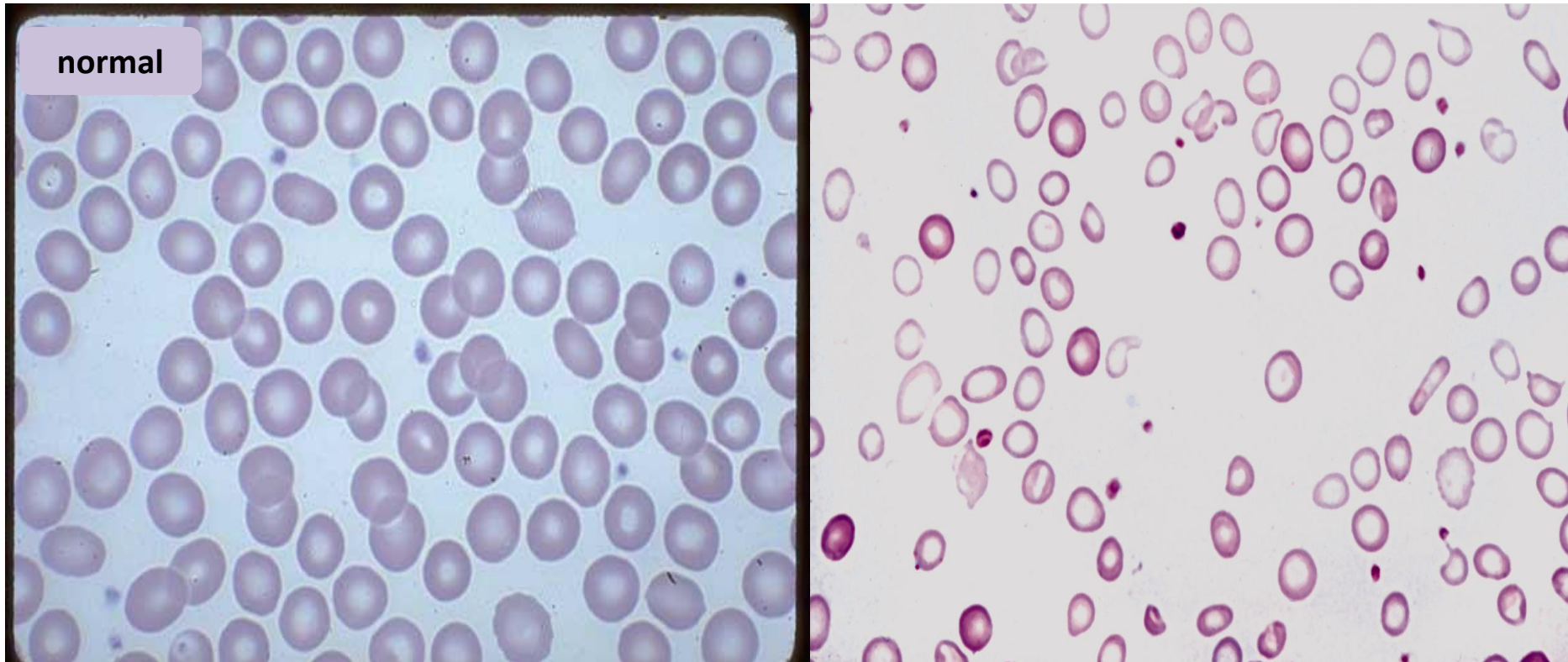
Beside symptoms and signs of anaemia +/- bleeding patients present with:

(a): Koilonychia (spoon-shaped nails)

(b): Angular stomatitis and/or glossitis

(c): Dysphagia due to pharyngeal web (Plummer-Vinson syndrome)

Investigation



Microcytic hypochromic anemia with:

- **Anisocytosis(variation in size)**
- **Pokiliocytosis (variation in shape)**

Iron Studies

Normal

IDA

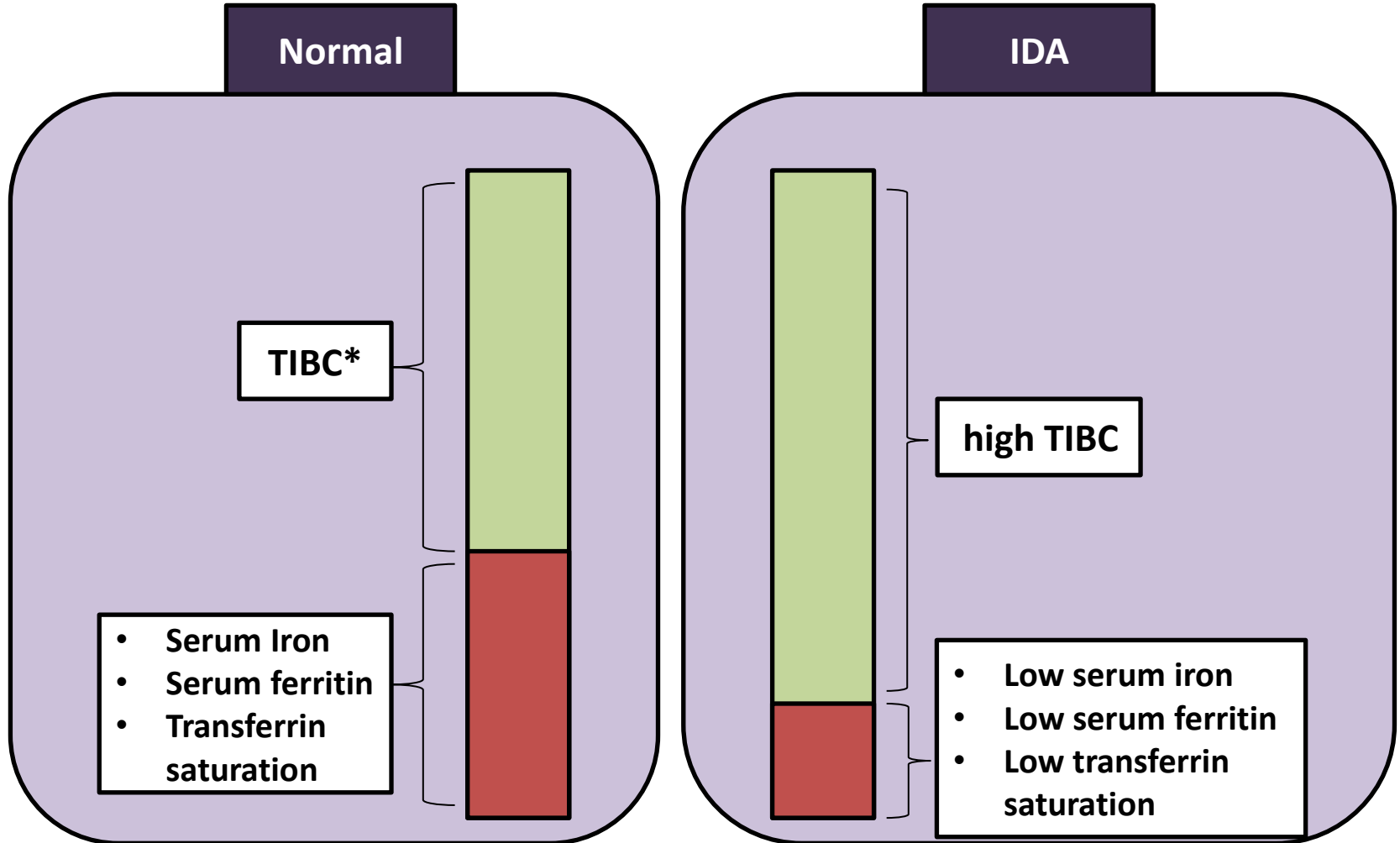
TIBC*

high TIBC

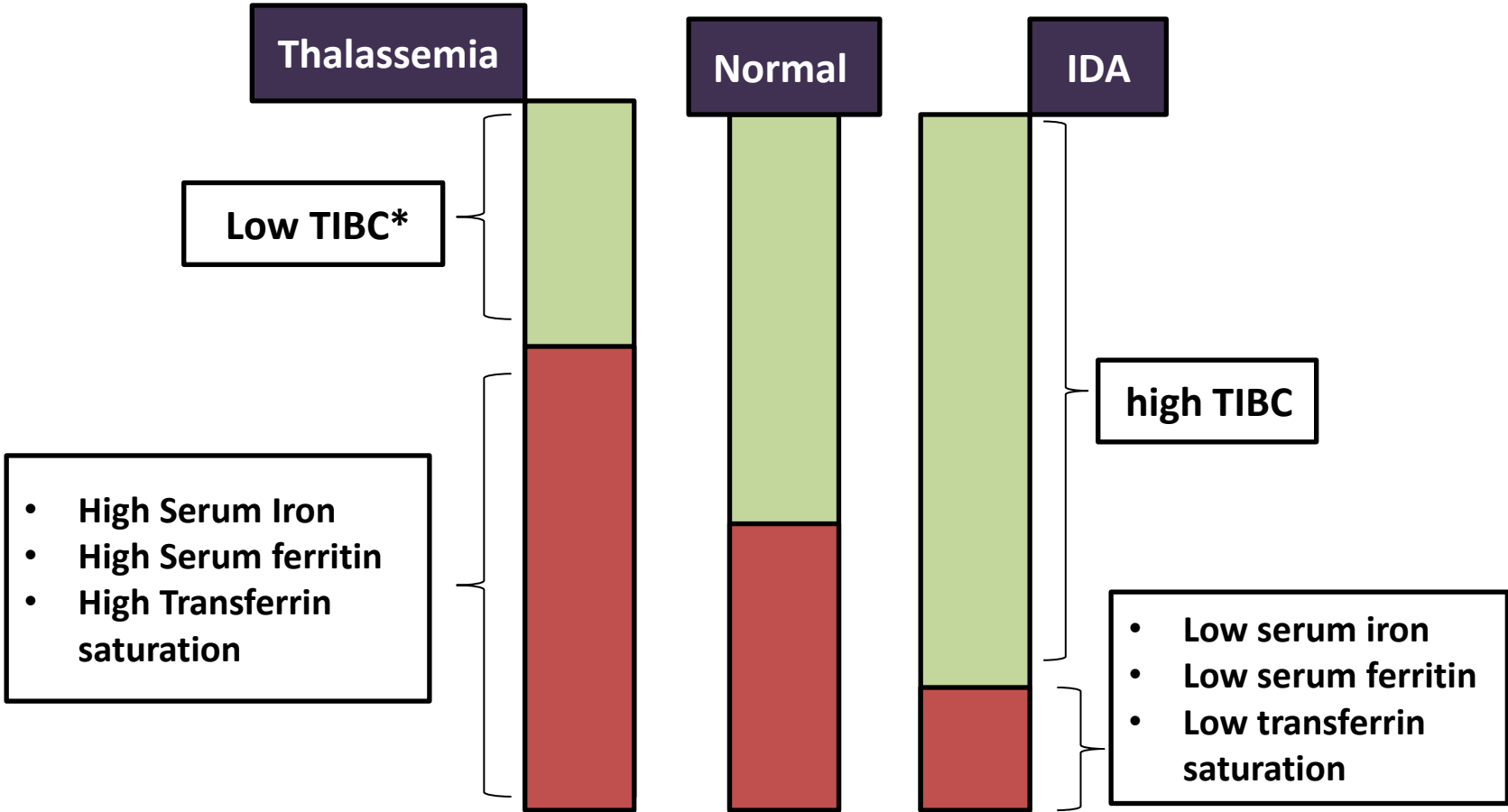
- Serum Iron
- Serum ferritin
- Transferrin saturation

- Low serum iron
- Low serum ferritin
- Low transferrin saturation

TIBC : total iron binding capacity of transferrin

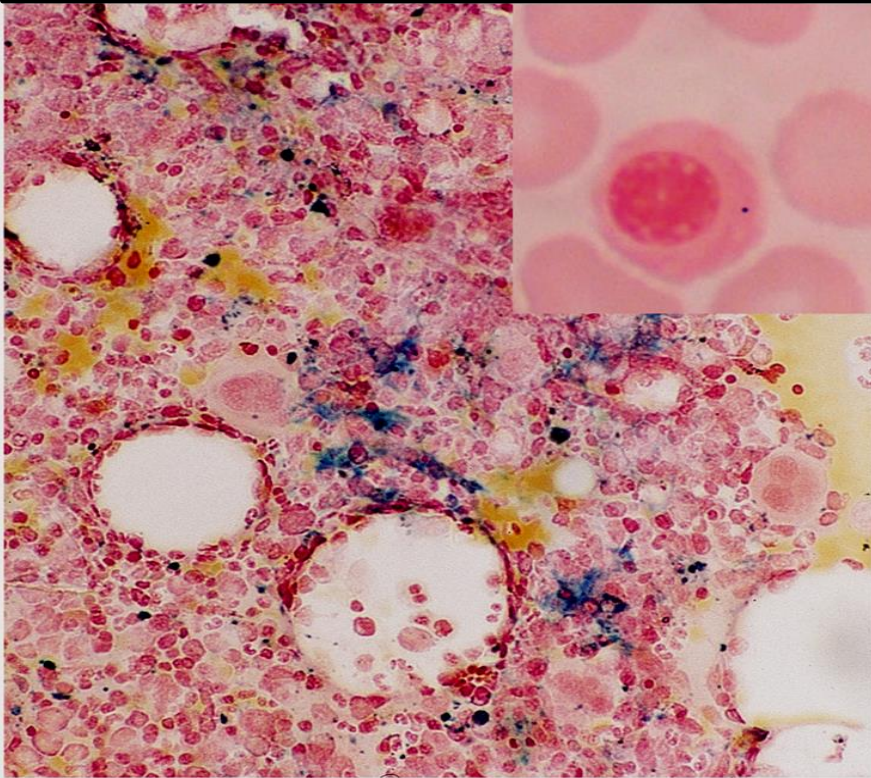


Iron Studies



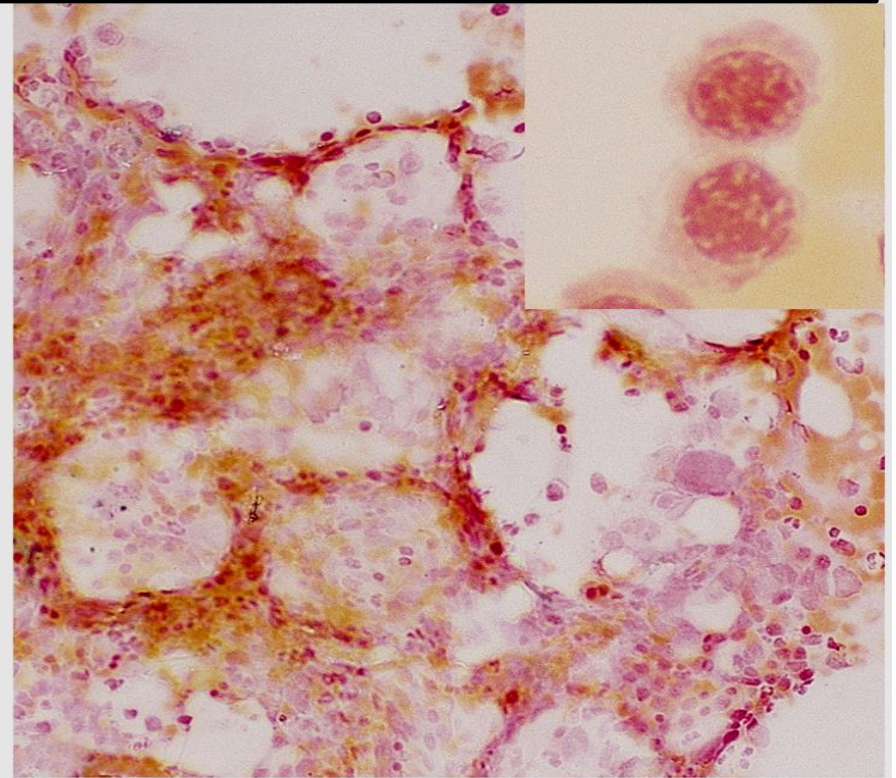
Investigation

BM Iron stain (Perl's stain): The gold standard but invasive procedure



(a)

Normal



(b)

**IDA: reduced or absent iron stores
(hemosiderin)**

Treatment of IDA

- **Treat the underlying cause**
- **Iron replacement therapy:**

Oral :(Ferrous Sulphate OD for 6 months)

Intravenous:(Ferric sucrose OD for 6 months)

Hb should rise 2g/dL every 3 weeks

PREVENTION OF IDA

- **Dietary modification**
Meat is better source than vegetables.
- **Food fortification (with ferrous sulphate)**
- GIT disturbances ,staining of teeth & metallic taste.
- **Iron supplementation:**
For high risk groups.

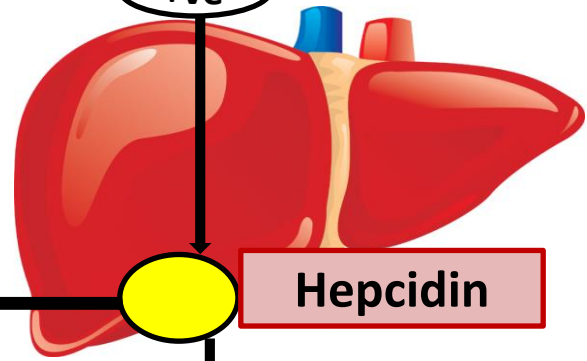
Anemia of chronic disease

- **Normochromic normocytic (usually) anemia caused by decreased release of iron from iron stores and reduction of iron absorption due to raised serum Hepcidin .**
- **Associated with**
 - **Chronic infection including HIV, malaria**
 - **Chronic inflammations**
 - **Tissue necrosis**
 - **Malignancy**

Tuberculosis
SLE
Carcinoma
Lymphoma

IL-6
IL-1
TNF

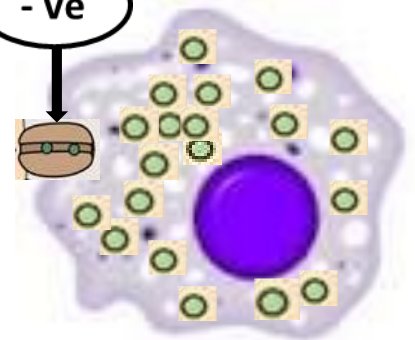
+ve



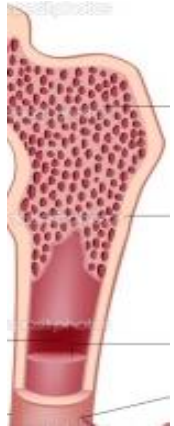
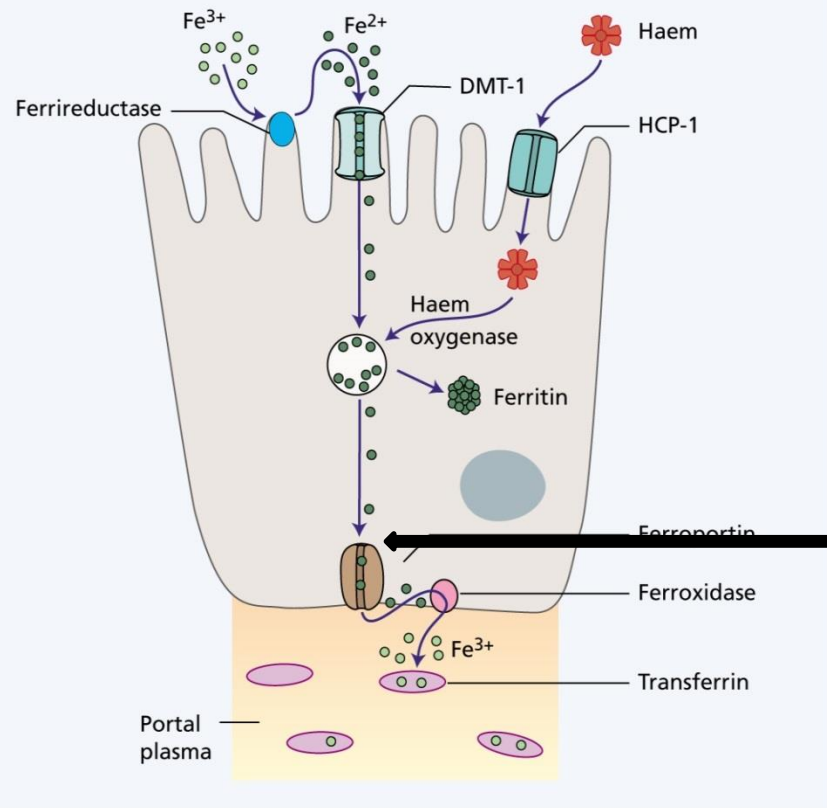
Hepcidin

- ve

- ve



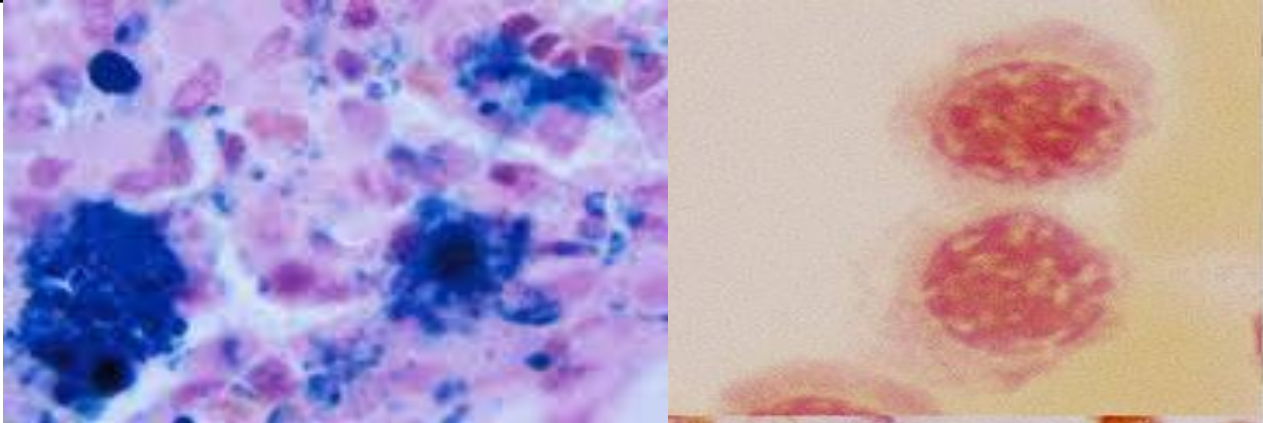
BM macrophage



no Iron for erythropoiesis

Work-up and treatment

- Normocytic normochromic or mildly microcytic anaemia
- Low serum iron and TIBC
- Normal or high serum ferritin (acute phase reactant)
- High haemosiderin in macrophages but low in normoblasts



Management:

Treat the underlying cause
Iron replacement +/- EPO

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