ANEMIA

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Objectives

- What is pallor
- Etiology
- Assessing seriousness
- Managements

- **Paleness (*pallor* in Latin) is abnormal loss of color from normal skin or mucous membranes due to reduced amount of the blood in the skin arteries.**

Paleness should be distinguished from **other causes of prominent white skin**:

- **Fair skin** is genetically determined **skin hue** with low concentration of skin pigment (melanin) in the skin.
- **Myxedema** (in hypothyroidism) –
- **Albinism** is a rare genetic disorder with partial or complete lack of melanin in the skin, hair and iris of the eye.
- **Vitiligo** is a patchy loss of skin color due to destruction of pigment cells (melanocytes) from an unknown cause.

Paleness does not always mean you are ill.

- When exposed to **low environmental temperature**, your face, palms or other body parts may become pale because of narrowing (constriction) of the small skin arteries as part of a body's heat-saving process.
- **Skipped meal** and resulting drop of glucose blood level, or **dehydration,** may trigger adrenalin release and constriction of your skin arteries.
- **In exertion or fear, blood is redirected from the skin to muscle arteries. Your skin may remain pale for several minutes after exertion**

Sudden pallness caused by many medical conditions

- **Orthostatic hypotension – temporary fall of blood pressure after standing up after prolonged sitting or lying.**
- **Stomach upset from heavy food combination, alcohol or food poisoning**
- **Dehydration from insufficient drinking, excessive sweating, vomiting, diarrhea**
- **Acute infection (usually with fever)**
- **Fainting (vasovagal syncope) due to strong pain, emotions, heat or unpleasant sensations**
- **Motion sickness**

Skin with decreased turgor remains elevated after being pulled up and released

A.D.A.M.

- Allergy to drugs

  Rapid stomach emptying (dumping syndrome)
- Migraine
- Heat stroke
- Hypothermia
- Heart failure due to heart attack, arrhythmia, infective endocarditis or other heart disorder, when the heart can not efficiently pump the blood into the circulation
- Low blood sugar (hypoglycemia), common in insulin-dependent diabetics after an exercise, skipped meal or insulin overdose
- Blood loss due to external or internal bleeding (in car accidents, shooting or stitch injuries), heavy menstrual bleeding, surgery

- Hypothermia
- Shock – a sudden, deep fall of blood pressure – due to poisoning, severe infection, burns, severe blood loss
- Side effect of medications:
  - warfarin, corticosteroids, aspirin and other anti-rheumatic drugs may cause intestinal bleeding
  - iron poisoning
- Drug overdose: amphetamine (speed), cocaine
- Chemical poisoning (pesticides), plant poisoning (Atropa belladonna)
- Death


Q
&
A

anemia

Ahmed elmeshhedany

OBJECTIVES

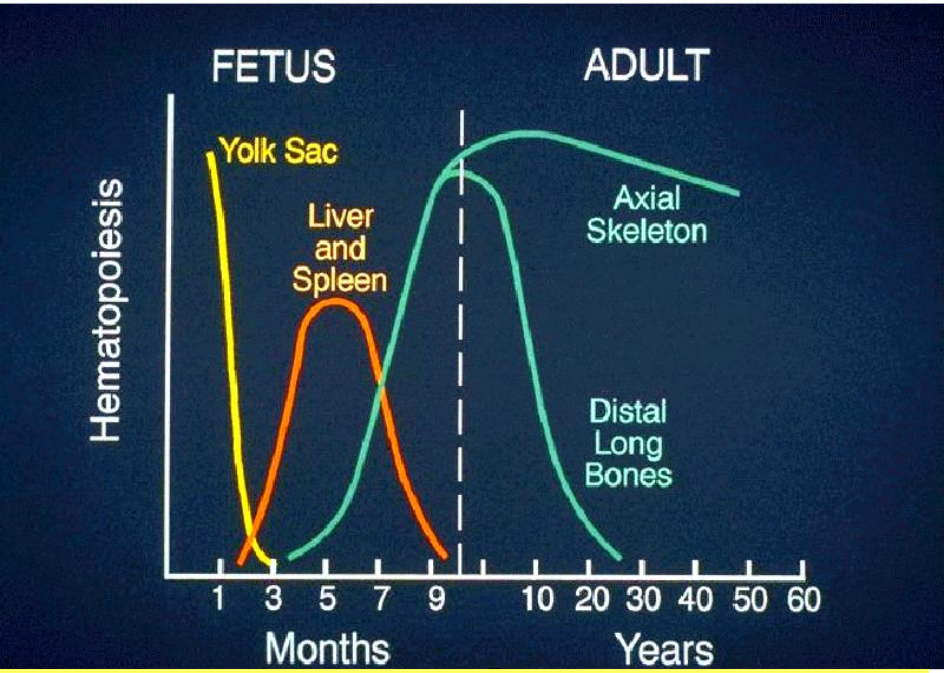
- What is hemopoiesis
- WHAT IS ANEMIA
- Whats the effect of anemia on body functions
- Types
- Symptoms
- Management

Haematology: is the study of the blood and its diseases

- **Blood :** is a suspension of non-dividing end-stage cells of three types namely, red cells (erythrocytes), White cells (leucocytes) and platelets (thrombocytes). The suspending fluid is the Plasma.

- **Haemopoesis :** is the process of blood formation.

Sites of hemopoiesis



- The first site of blood formation in fetus is in the yolk sac, which is replaced by liver & spleen, and finally shifts to the bone marrow of all skeleton at about 7 months fetal life, and at Birth, the BM becomes the main Hematopoietic organ.
- As the child gets older hemopoiesis becomes restricted to central skeleton (pelvis, vertebral column, cranium, ribs and sternum, and epiphysis of long proximal bones).

Life span of blood cells in peripheral circulation

- - Red cells : 120 days.
  - Granulocytes : ~ 1day.
  - Platelets : 7-10 days.
- **About 2.5 million red cells are removed from the circulation per second.**
- **Around 200 billion red cells, 200 billion platelets and 80 billion granulocytes produced by Bone marrow per day.**
- **It is estimated that a normal individual produces a numbers of end-stage blood cells, equivalent to his body weight per year.**

Control of Erythropoiesis

- Functional Feedback
- End Product Feedback
- Hormonal factors.
- Nutritional factors.

Control of erythropoiesis

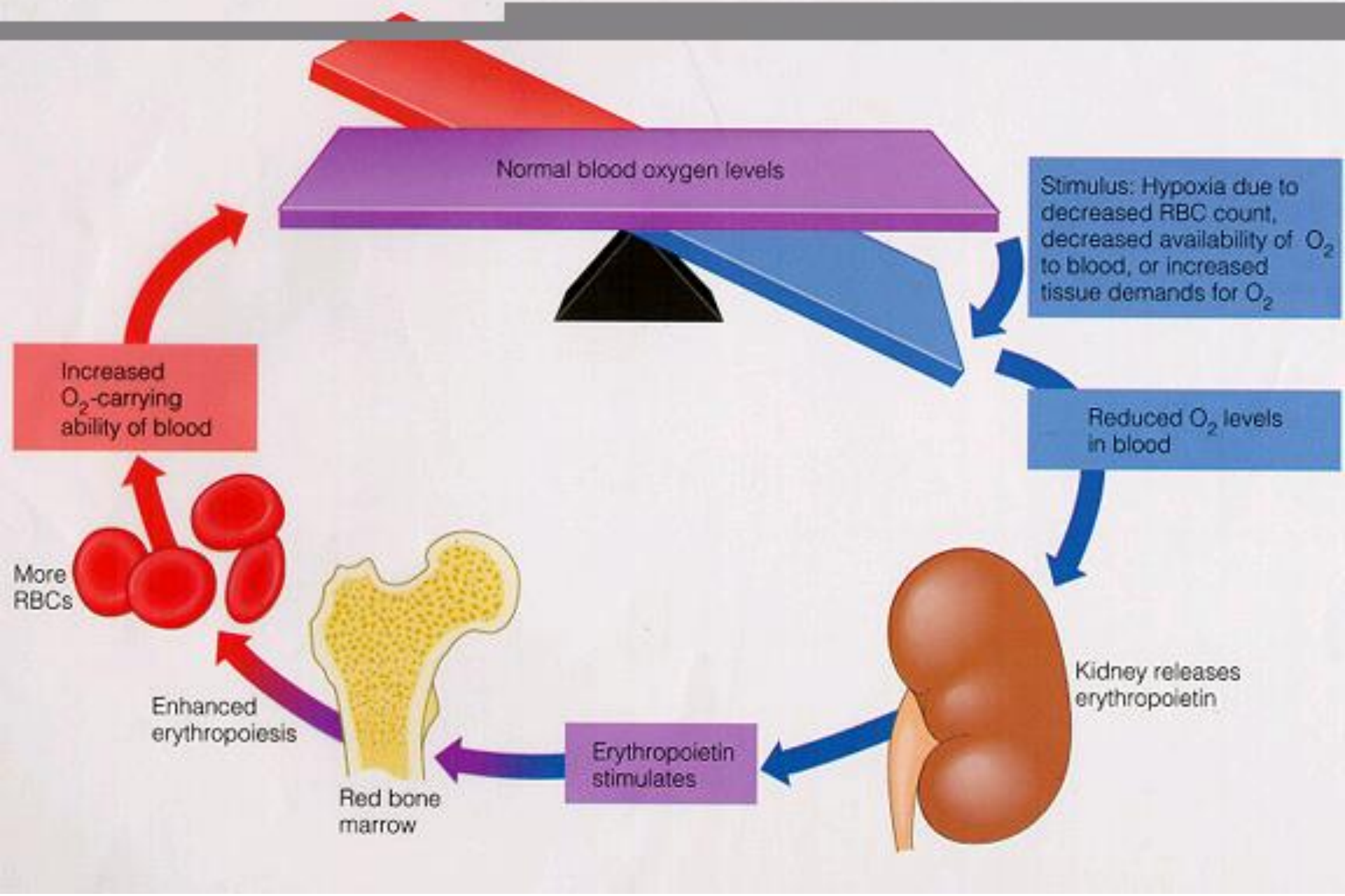
- **Functional feedback :** achieved by ***Erythropoietin (Ep)*** which is a glycoprotein produced mainly by the kidney, and it :
- **1.stimulates red cell stem cell proliferation**
- **2. influences the rate of maturation**
- **3.Hb synthesis**
- **4. Release of red cells from the marrow.**

➢Secretion of Ep is triggered by reduced Oxygen carriage of blood (reduced Hb or hypoxia).

Control of erythropoiesis

- **End-product feedback** : end products of red cell destruction will stimulate erythropoiesis.
- **Certain hormones**, growth hormone, steroids, Androgen enhance erythropoesis, while estrogen suppress.
- **Nutritional factors** like folate , iron, B12 etc are important in control of erythropoiesis.

Erythropoietin mechanism for regulating the rate of erythropoiesis



Definition of Terms

- In a hematological evaluation of a patient we usually do What is called a ***full blood count***. This usually includes basically the estimation of Hemoglobin concentration, leucocyte count, Platelets count, in addition to red cell indices and leucocyte differential. Also a blood film stained with Leishman or MGG stain is examined for morphology of red cells, differential and morphology of leucocytes and for platelets assessment.

Red cell Indices : Normal values (Adults)

- **Hb :**

  Males : 13.0– 17.0 g/dl

  Females : 12.0- 15.0 g/dl

- **PCV :**

  Males :40-50 *l/l*

  Females *:* 36-46 *l/l*

- **Red cell count :**

  Males : 5.0 ± 0.5 x 10^{12}/L

  Females : 4.3 ± 0.5 x 10^{12}/L

Red cell indices : Normal values (Adults)

- **MCV : 83-100 *fl.***
- ***MCH :* 27-32 *pg.***
- ***MCHC :* 32-36 g/dl.**
- **Reticulocyte count : is the percentage of immature circulating RBC as detected by a special stain for them (New Methyelene blue stain) : 0.2-2.2%**

Bone marrow examination

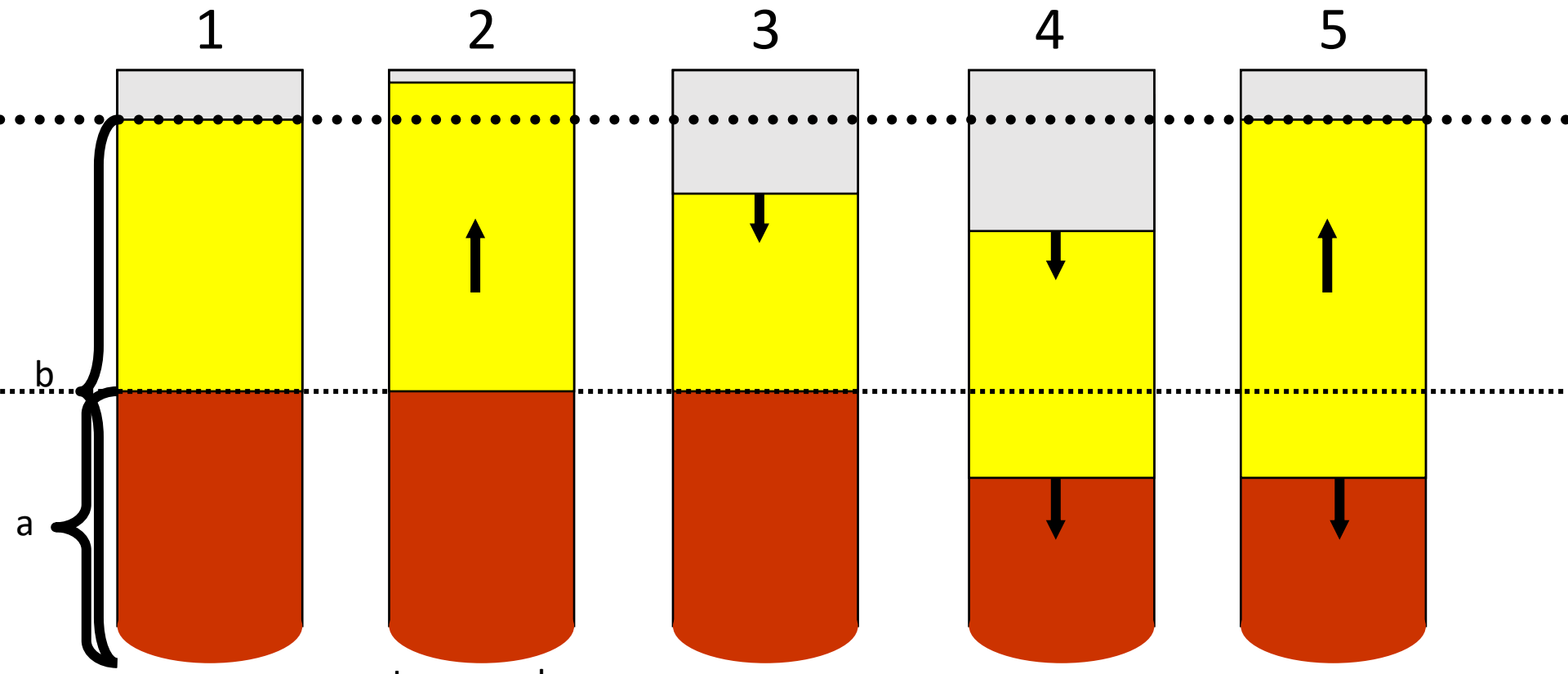
1. **Bone marrow aspirate :** done from iliac crest or sternum, in which a specimen is aspirated using a wide bore needle from the active marrow, smeared, stained and then examined for any abnormalities.

2. **Bone marrow biopsy :** here a core of bone marrow tissue is taken, and processed and stained as in histopathological specimens (H&E stain)

anemia

- **This is defined as a reduction in the haemoglobin concentration of the blood below normal for age and sex resulting in a lower ability for the blood to carry oxygen to body tissues .**
- **RBC count and plasma volume: Reduction in plasma volume (as in dehydration) may mask anaemia or even cause (apparent, pseudo) polycythaemia conversely, an increase in plasma volume (as with splenomegaly or pregnancy) may cause anaemia even with a normal total circulating red cell and haemoglobin mass.**

Volume changes/acute bleeding and anemia



normal

Hct (a/b%):Normal

Increased plasma volume
Hct: Low

Dehydration
Hct:Increased

Acute blood loss(early)
Hct:unchanged

Chronic anemia
Hct: Low

Clinical features of anaemia

- The major adaptations to anaemia are in the cardiovascular system (with increased stroke volume and tachycardia) and in the haemoglobin O2 dissociation curve.

1. **Speed of onset**
2. **Severity**
3. **Age**
4. **Haemoglobin O2 dissociation curve**

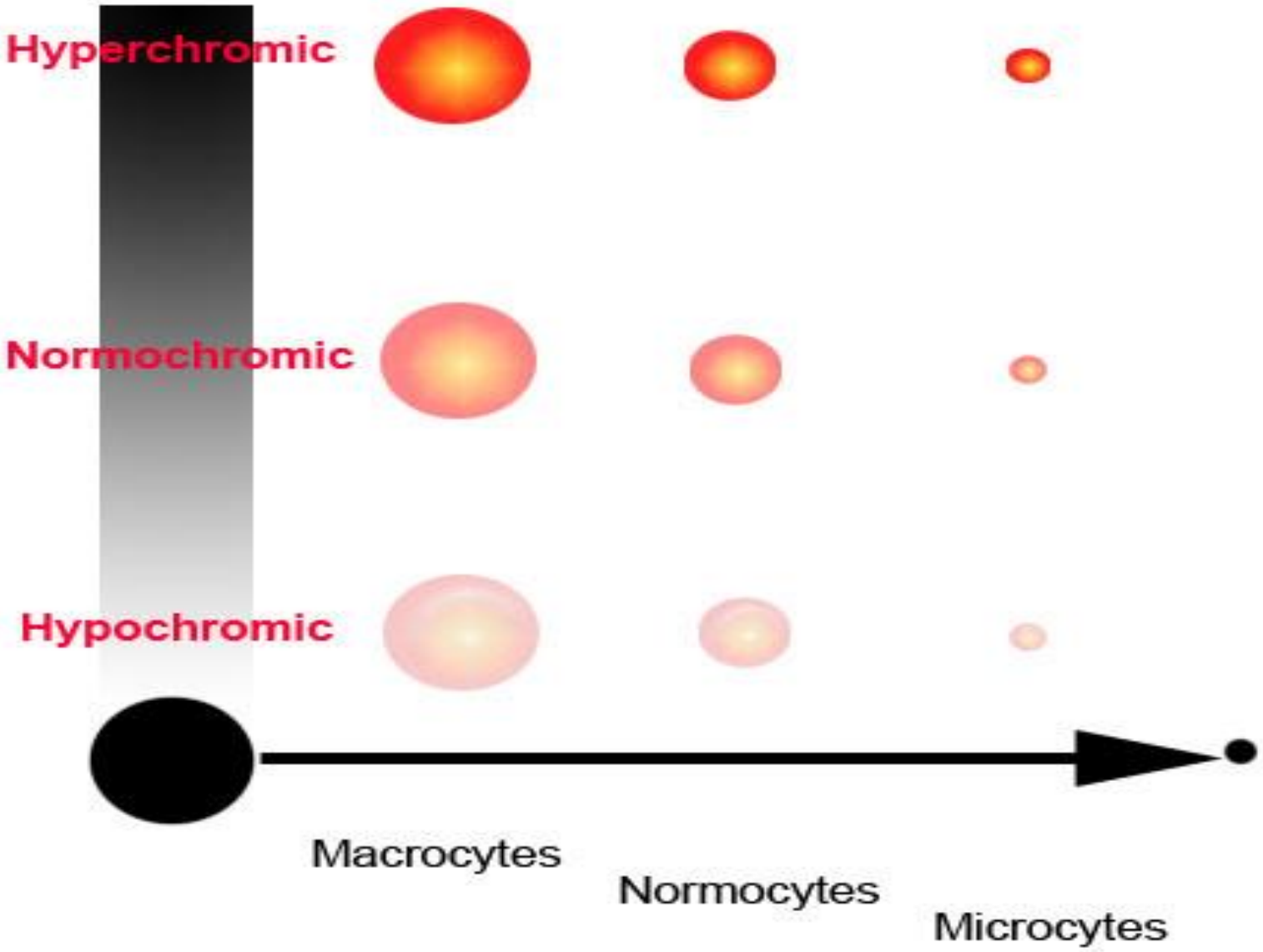
Classification of anemia

- Morphologic
  - Normocytic: MCV= 80-100fL
  - Macrocytic: MCV > 100 fL
  - Microcytic : MCV < 80 fL
- Pathogenic (underlying mechanism)
  - Blood loss (bleeding)
  - Decreased RBC production
  - Increased RBC destruction/pooling

TYPES OF ANEMIA

- **Normochromic, normocytic anemia (normal MCHC, normal MCV).**These include:
  - anemias of chronic disease
  - anemia of acute blood loss
- **Hypochromic, microcytic anemia (low MCHC, low MCV).**These include:
  - iron deficiency anemia
  - thalassemias
  - anemia of chronic diseases
  - Sideroblastic anemia
- **Normochromic, macrocytic anemia (normal MCHC, high MCV)**.These include:
  - vitamin B_{12} deficiency
  - folate deficiency
  - aplastic anemias (those characterized by disappearance of rbc precursors from the marrow)
  - hemolytic anemias (those characterized by accelerated destruction of rbc's)

TYPES OF ANEMIA



Impaired RBC Production

1. Abnormal bone marrow
   - 1.1 Aplastic anemia
   - 1.2 Myelophthisis : Myelofibrosis, Leukemia, Cancer metastasis
2. Essential factors deficiency
   - 2.1 Deficiency anemia : Fe, Vit. B12, Folic acid, etc
   - 2.2 Anemia in renal disease : Erythropoietin
3. Stimulation factor deficiency
   - 3.1 Anemia in chronic disease
   - 3.2 Anemia in hypopituitarism
   - 3.3 Anemia in hypothyroidism

Excessive Destruction of RBC(cont.)

Hemolytic anemia

1. **Intracorpuscular defect**

   1.1 Membrane : Hereditary spherocytosis

   Hereditary ovalocytosis, etc.

   1.2 Enzyme : G-6PD deficiency, PK def., etc.

   1.3 Hemoglobin : Thalassemia, Hemoglobino-pathies

Excessive Destruction of RBC

2. Extracorpuscular defect

2.1 Mechanical : March hemolytic anemia

MAHA (Microangiopathic HA)

2.2 Chemical/Physical

2.3 Infection : *Clostridium tetani*

2.4 Antibodies : HTR, SLE

2.5 Hypersplenism

Blood Loss

1. Acute blood loss ： Accident, GI bleeding
2. Chronic blood loss : Hypermenorrhea
   Parasitic infestation

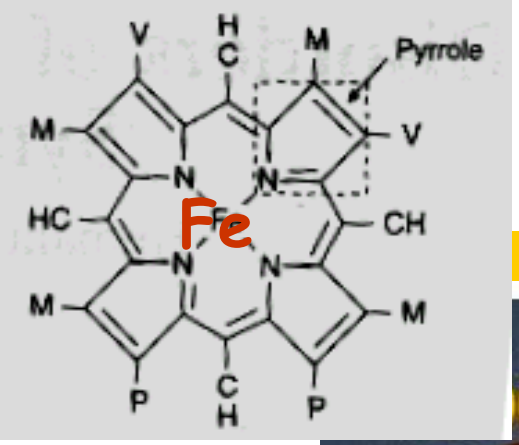
Q&A

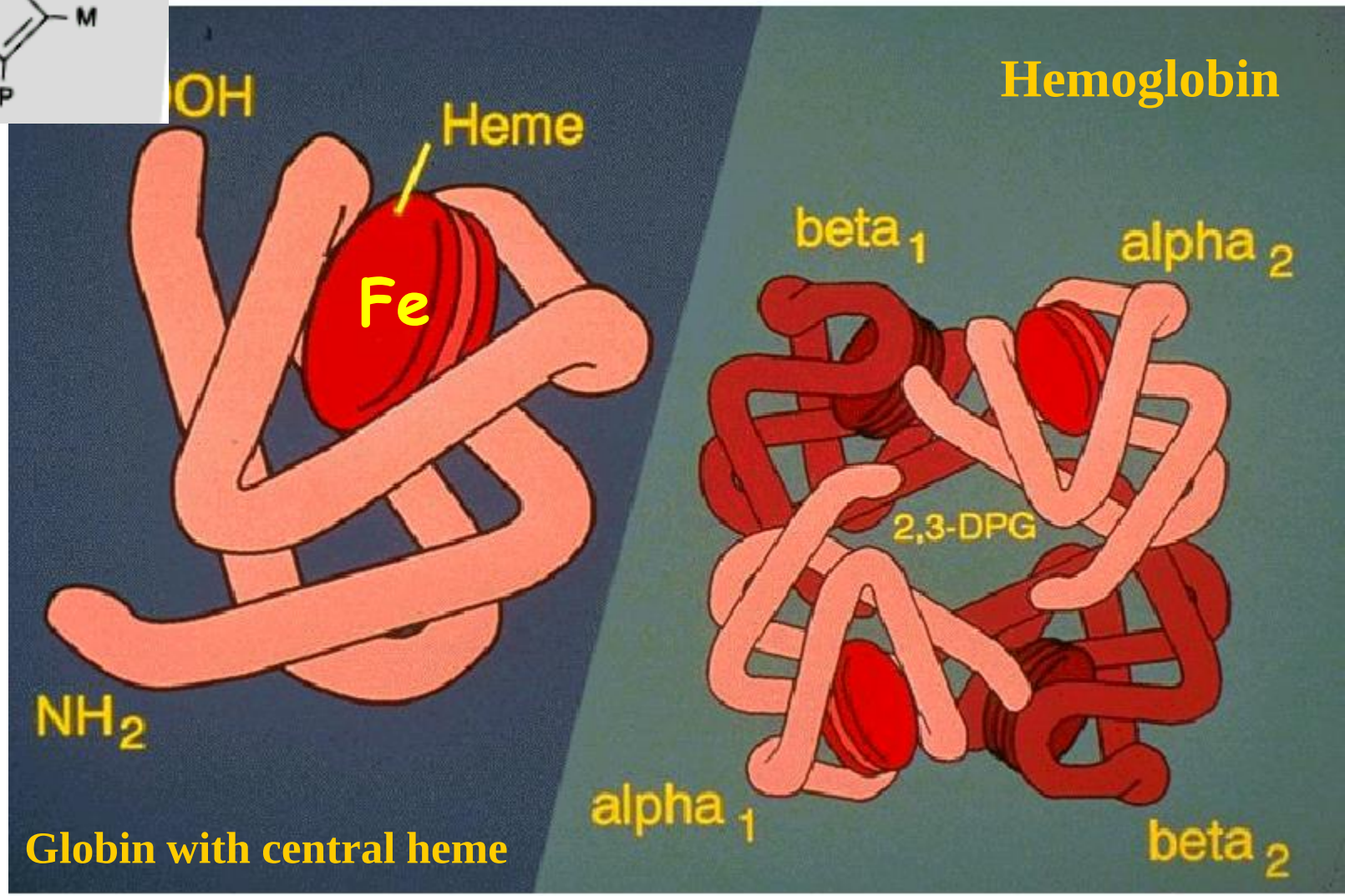
Iron deficiency anemia

Prevalence of IDA:

- Iron Deficiency Anaemia is the most common form of anaemia, with an estimated **> 500 million** people affected worldwide.
- It is more common in developing countries like ours.
- It is frequently encountered in erbil area.

Heme

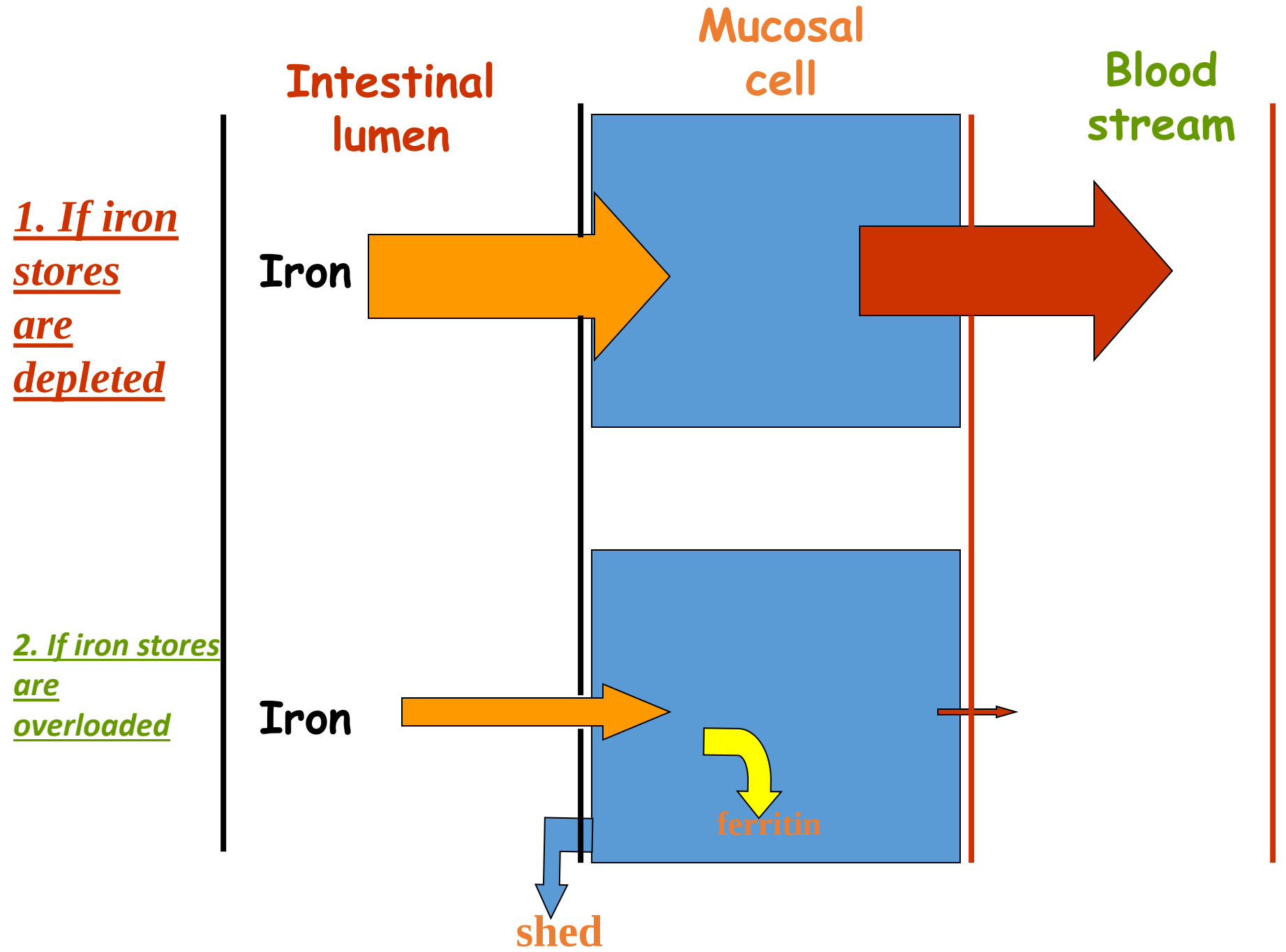

V
HC
M
Pyrrole
M
V
N
N
HC
Fe
CH
N
N
M
M
P
C
H
P


OH
Heme
Fe
NH2
Globin with central heme
Hemoglobin
beta 1
alpha 2
2,3-DPG
alpha 1
beta 2

Iron absorption :

- Normal mixed diet contains about 10-20 mg of iron /day. This present in inorganic or organic forms.
- Dietary sources include : meats especially liver and kidney, egg yolk, some green vegetables like Peas, lentil and beans. Milk has low iron content generally.
- Usually only 5-10% of ingested iron is absorbed.

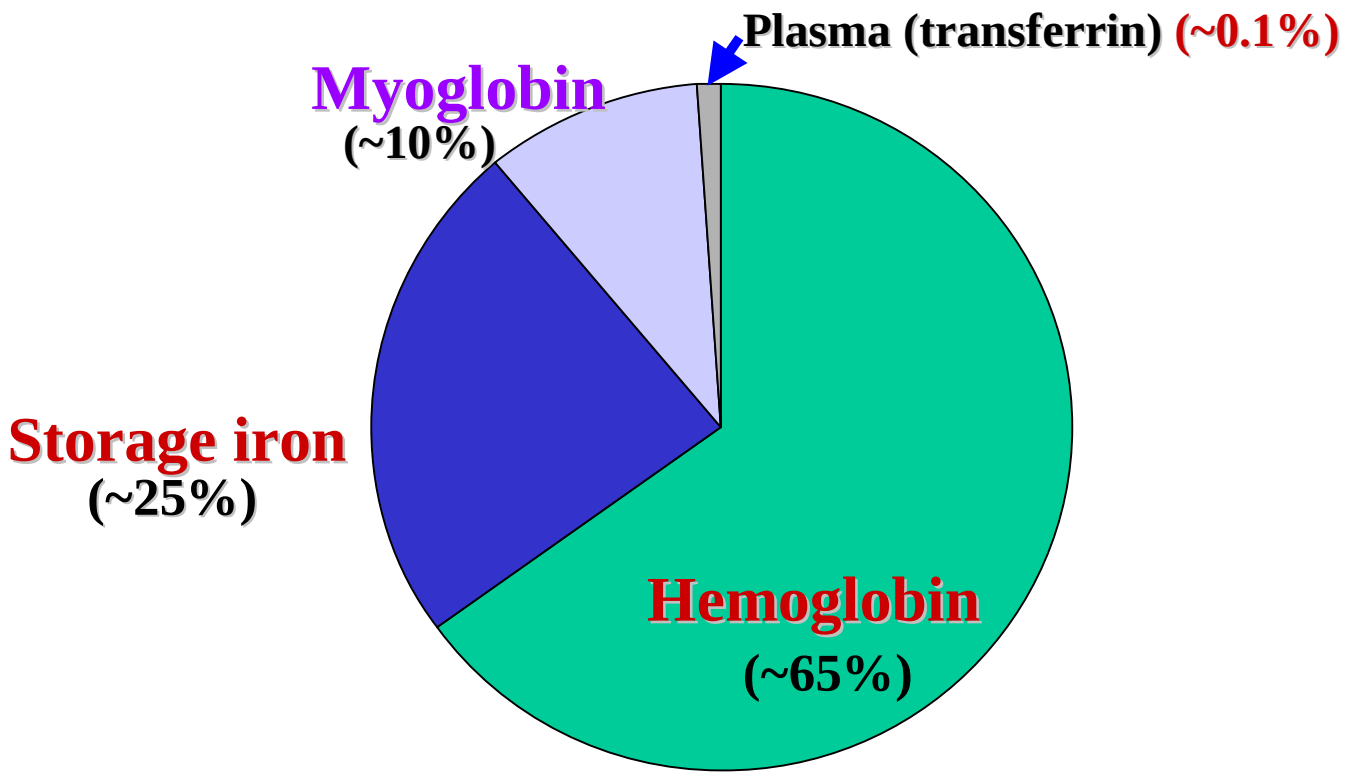
- After ingestion of iron containing foods, Iron is released from protein complexes by acid and proteolytic enzymes in stomach and SI, and then is maximally absorbed in duodenum and less so Jejunum.


Intestinal lumen
Mucosal cell
Blood stream
1. If iron stores are depleted
Iron
2. If iron stores are overloaded
Iron
ferritin
shed

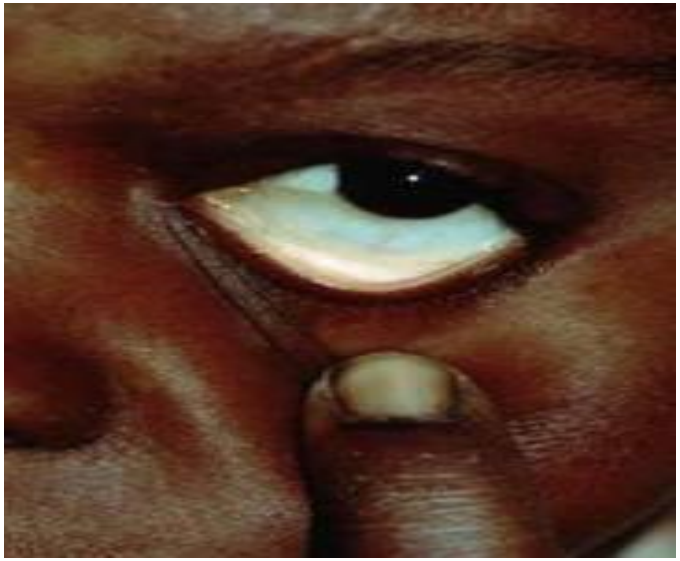
Excretion of Iron :

- There is no physiological mechanism for excretion of Iron, and losses of iron occur through:
- 1. Shedding of intestinal cells and macrophages in stool.
- 2. Urine.
- 3. Nails, hair and desquamated skin cells.
- 4. Menstruation in females.
- Total losses of Iron/day ~ 1 mg is counterbalanced by a daily absorption of ~ 1 mg from diet.

Distribution of Body Iron



Symptoms&Signs



Causes of Iron Deficiency:

1. Blood Loss : Most common cause in developed countries; Most likely from the gastrointestinal tract (hookworm infestation, Duodenal ulcer, Ca stomach or colon, crohn's , ulcerative colitis, hemorrhoids, salicylates).

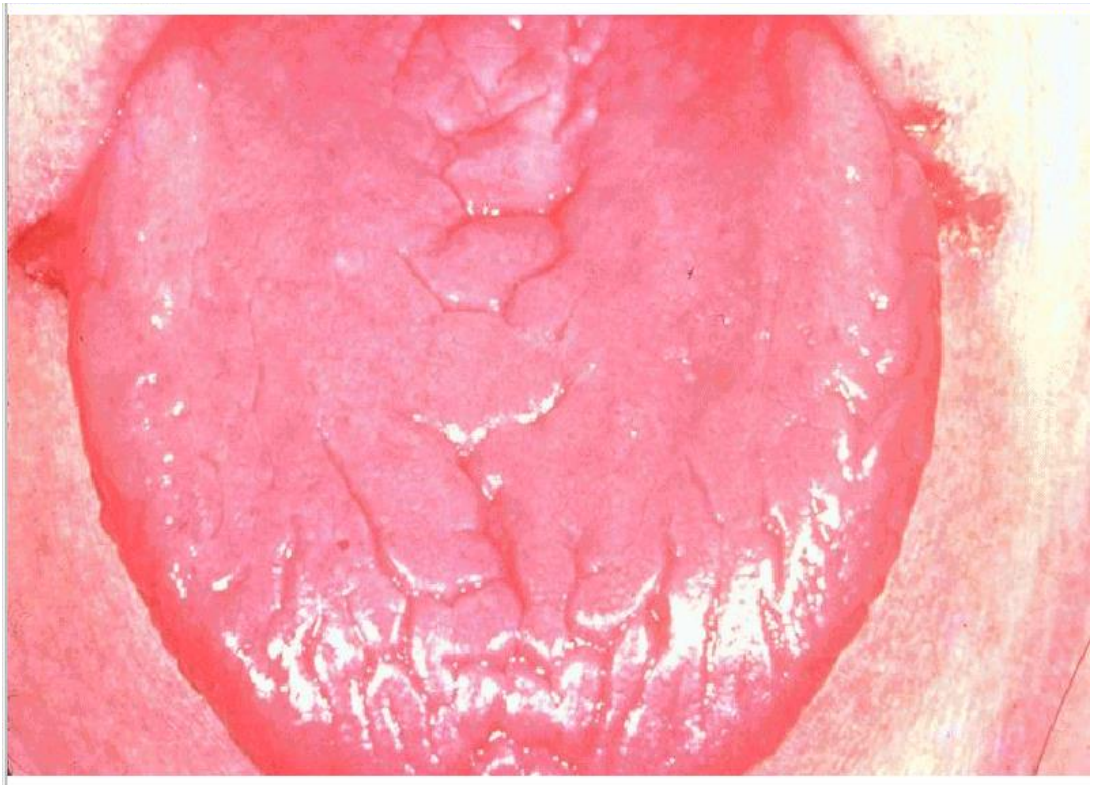
   In females bleeding from genital tract is also quite common.

2. Nutritional : Quite common cause of Iron deficiency in developing and underdeveloped countries, especially if inadequate intake is coupled with increased demand (e.g infancy and pregnancy and adolescence).

3. Inadequate absorption : Malabsorption syndromes e.g. Celiac disease.

Pallor

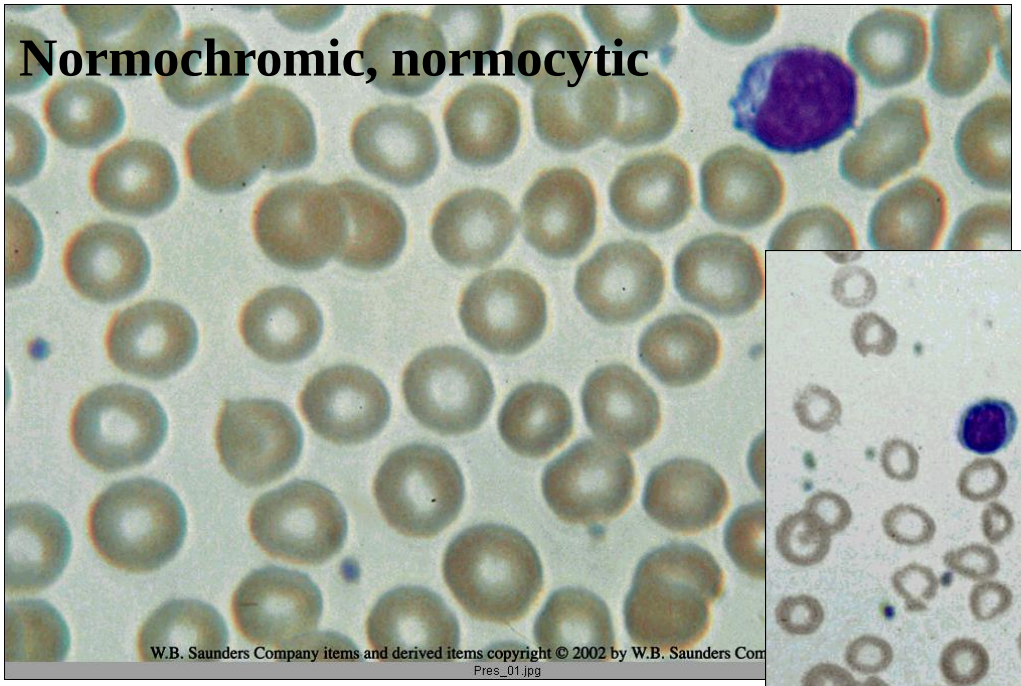
Glossitis



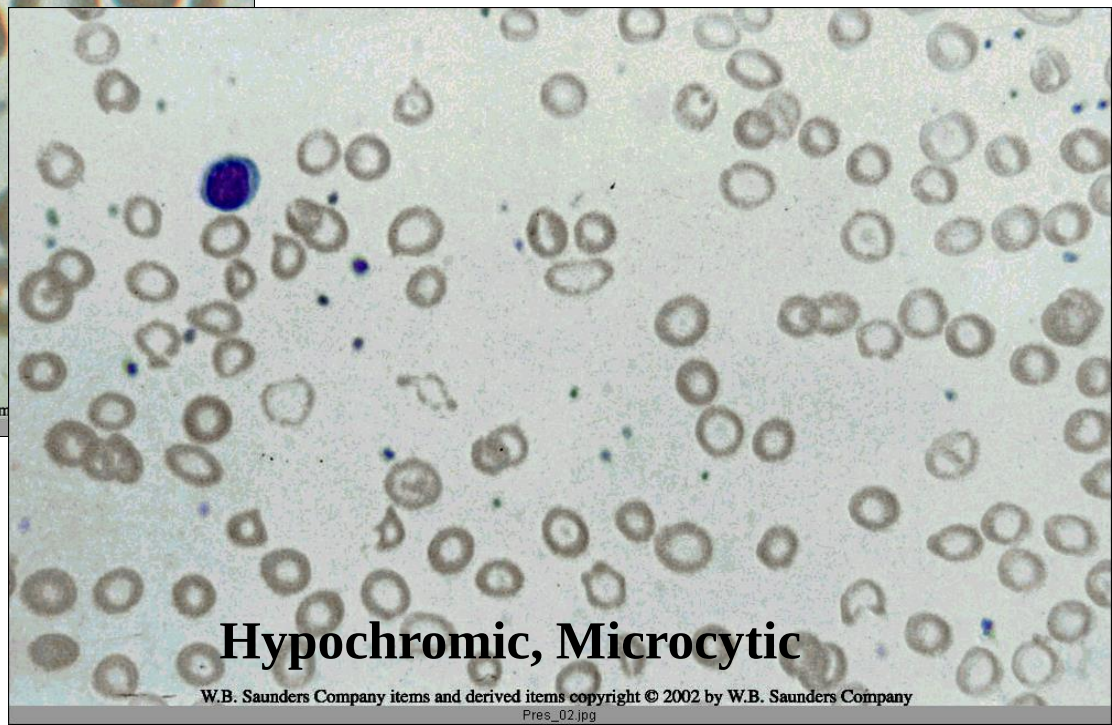
Koilonychia (Spooning of the nails)

Blood Film findings in IDA:

NORMAL



IDA



Diagnosis of IDA :

- 1. **Hematological findings** .
- 2. **Serum Iron and TIBC** :
- Serum Iron reduced.
- Total Iron binding capacity increased
- S. Iron/TIBC : Transferrin saturation reduced

(< 15%).

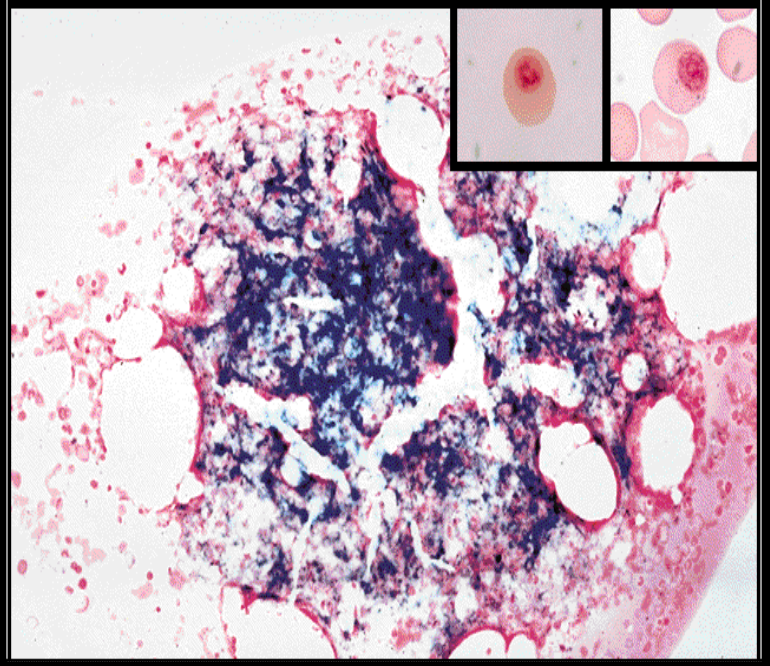
- 3. **S. Ferritin** : **(< 15ug/L).**
- 4. **Bone marrow Iron** : as determined by Prussian blue stain for marrow Iron is depleted. (**Diagnostic).**

Iron stain on marrow

Iron is represented by blue granules

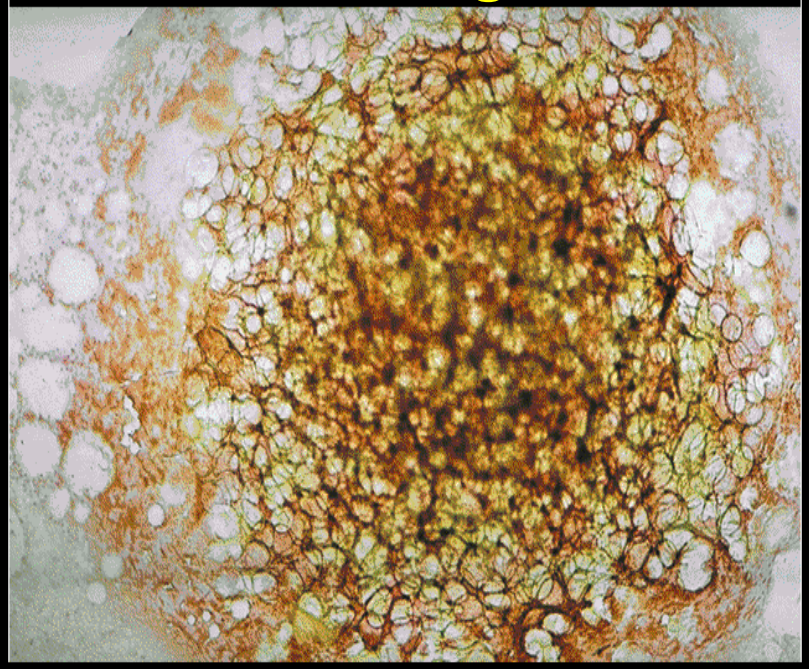
Normal Marrow

Normal storage Iron



Iron deficient marrow

Absent storage iron



Management of IDA:

1. Check and exclude causes of Iron deficiency especially pathological blood loss.
2. in adults , iron deficiency equal blood loss unless proved otherwise
3. Oral Iron therapy: treatment of choice.
4. Paraenteral Iron : is only indicated if there is malabsorption or intolerence to oral iron

Differential diagnosis of IDA (from other causes of hypochromic Anaemia:

1. Thalassaemia :

   Clinical features, Iron studies and Hb electrophoresis.

2. Sideroblastic Anaemia.

   Clinical features, Iron studies, bone marrow iron stain.

3. Lead poisoning:

   History, blood film, Iron steady, urine lead.

4. Anaemia of Chronic disorders:

   History, Iron studies.

CONCLUSION

- IRON DEFICIENCY IS COMMONEST TYPE OF ANEMIA
- BLOOD LOSS MUST BE EXCLUDED
- ORAL IRON IS BEST therapy.