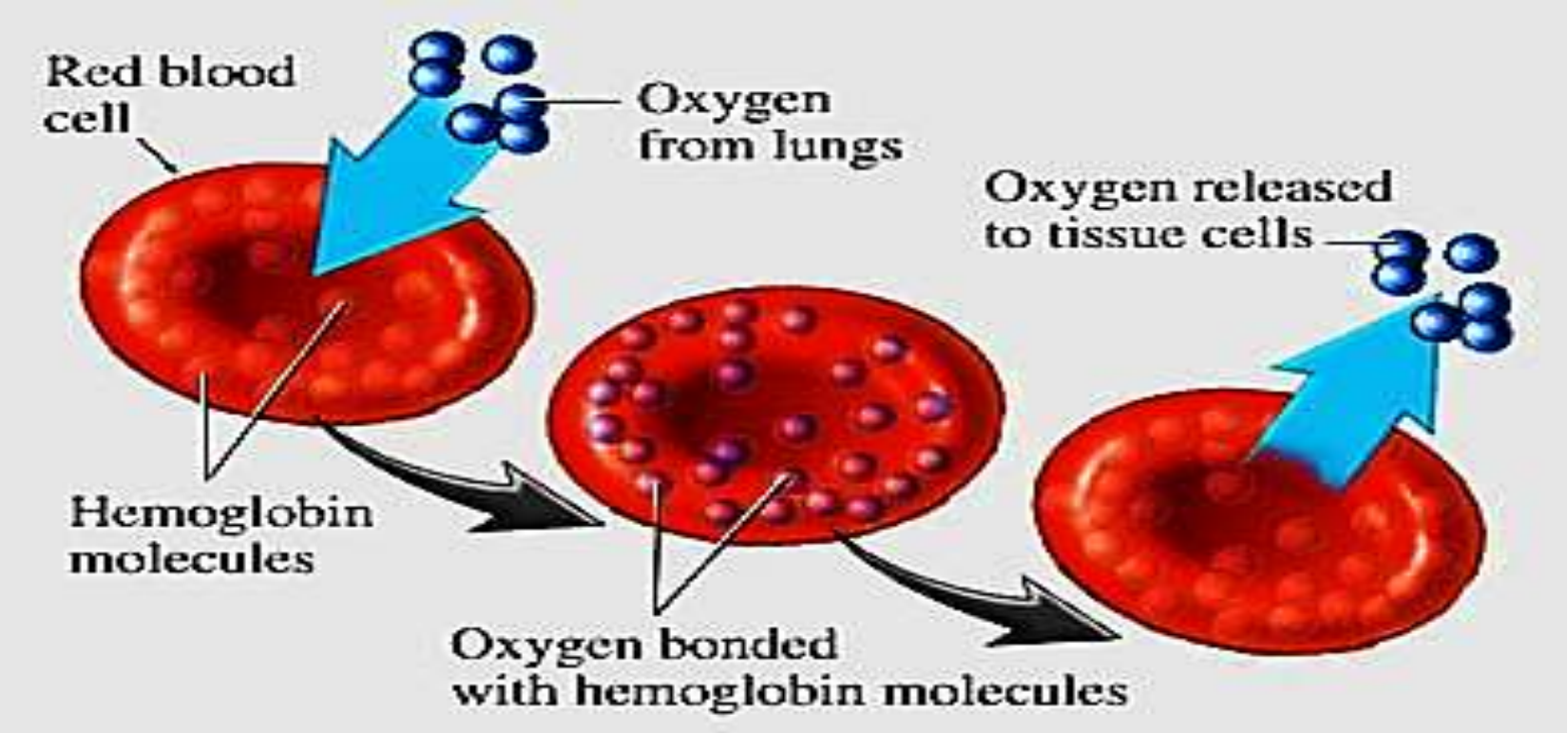
RBCs



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PROF. OF PHYSIOLOGY

STUDY OBJECTIVES

By the end of the lecture the student will able

- To understand hemoglobin, its formation, structure, and functions.
- To understand the fate of old red blood cells
- To describe the process of erythropoiesis and the factors that regulate it.
- To understand the role of erythropoietin in red blood cell formation
- To describe the definition, classification and manifestations of anemia .

Red Blood Cells
(Erythrocytes)

Normal value:

Average number = 5 million / mm^3.

In adult female = 4.5 - 5 million / mm^3

(due to menstruation & estrogen).

In adult male = 5 – 5.5 million /mm^3

(due to testosterone hormone).

In newborn = 7 million / mm^3

(due to intrauterine O_2 lack).

Shape: circular, biconcave, non nucleated discs.

Hemoglobin content

(normal value average =15 gm %).

♂ **14 – 18 gm/dl**

♀ **12 – 16 gm/dl**

may reach 19 gm/dl due to relative intrauterine hypoxia

Characters of RBCs

1- Flexible→ allows erythrocytes to be squeezed in small vessels without rupture. It is not elastic (ruptured when absorb more water).

2- Biconcave →↑ oxygen and Co_2 carriage due to:

A-↑ the surface area.

B- Hemoglobin remains distributed in the center of the RBC.

GIVE REASONS:

- RBCs in newborn are about 7 million / mm3?

Due to intra-uterine hypoxia that stimulate erythropoietin. It represents a store of iron because milk is poor in that mineral

-The biconcave shape of RBC is the optimal shape to its function?

Because the biconcave shape leads to A-↑ the surface area. B- Hemoglobin remains distributed in the center of the RBC.
C- To absorb water without rupture.

Hb

●**Hemoglobin:** 35% of RBC weight.

-Forms of Hemoglobin:

a. **Oxyhemoglobin:** When oxygen is bound to Hb. It gives blood its red color.

b. **Deoxyhemoglobin:** When no oxygen is bound to Hb.

c. **Carbaminohemoglobin:** When carbon dioxide is bound to Hb.

d. **Carboxyhemoglobin:** When carbon monoxide is bound to Hb.

Hb

1-Adult (HbA): contains 2 α chain and 2B chain (95-98% of adult Hb.)

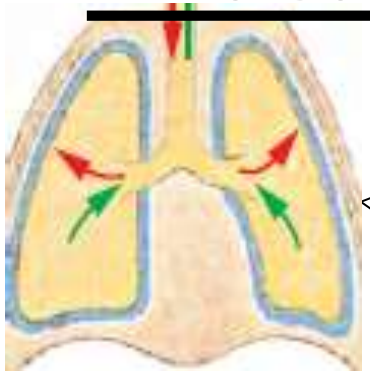
2-HbA2: contains 2α chains and 2 delta. (2-3% of adult Hb.)

3-Fetal Hb (HbF): contains 2α and 2 ɤ gamma (0.8-2% of adult)

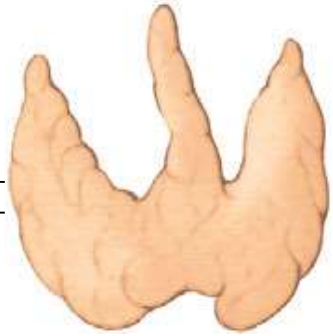
4-Glycosylated Hb: (Hb. A1C) glucose is attached to terminal valine amino acid in B-chain. It is indicator of control diabetes in last 3 months. It is increased in poorly controlled diabetes.

5-HbS : It is abnormal type of Hb due to congenital abnormality of B-globin → **hemoglobin-S** which causes sickle cell anaemia .

●Factors Affecting Erythropoiesis:



O_2 Lack



hormones

Diet

R.B.C's

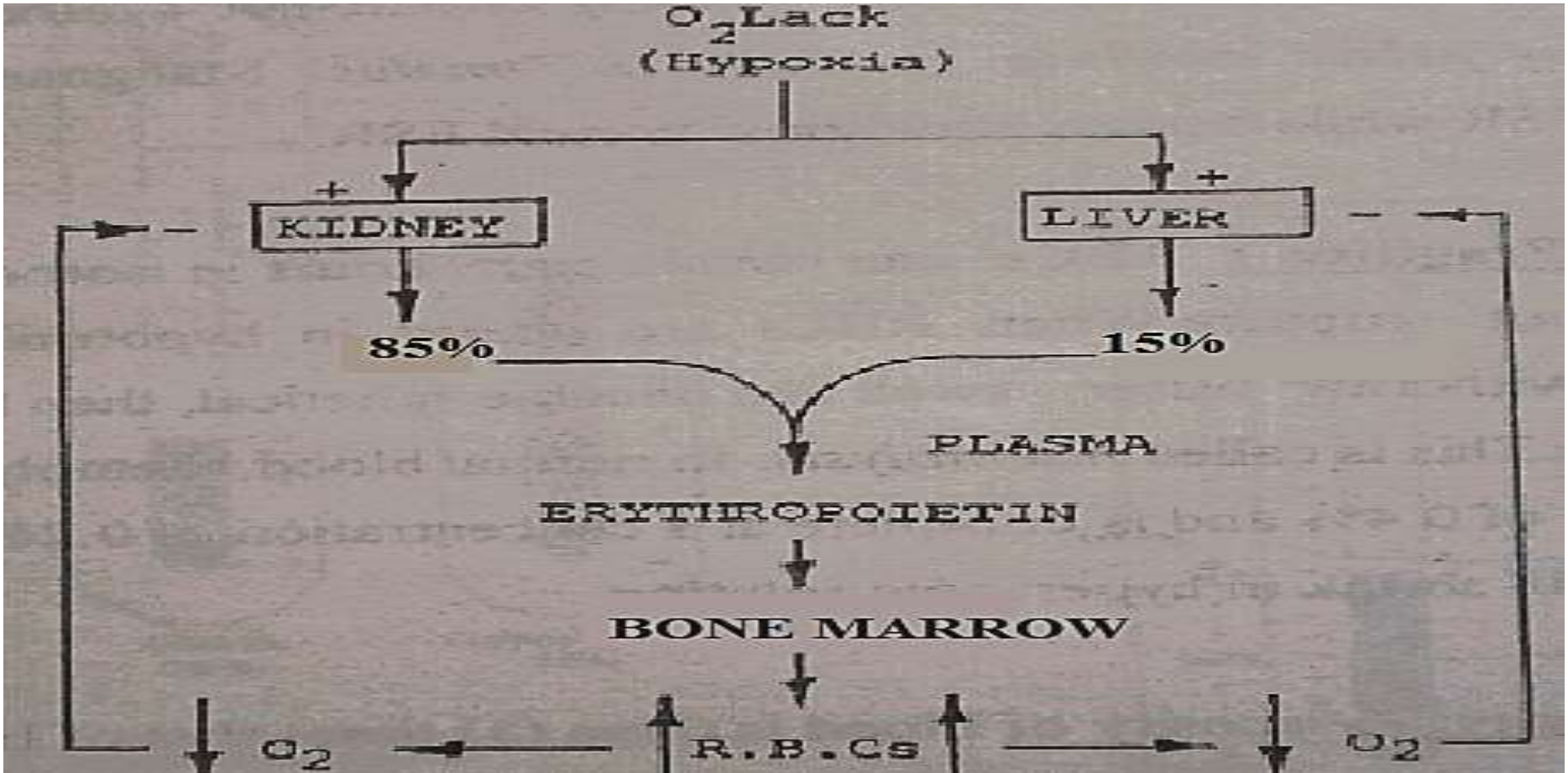
kidney

liver

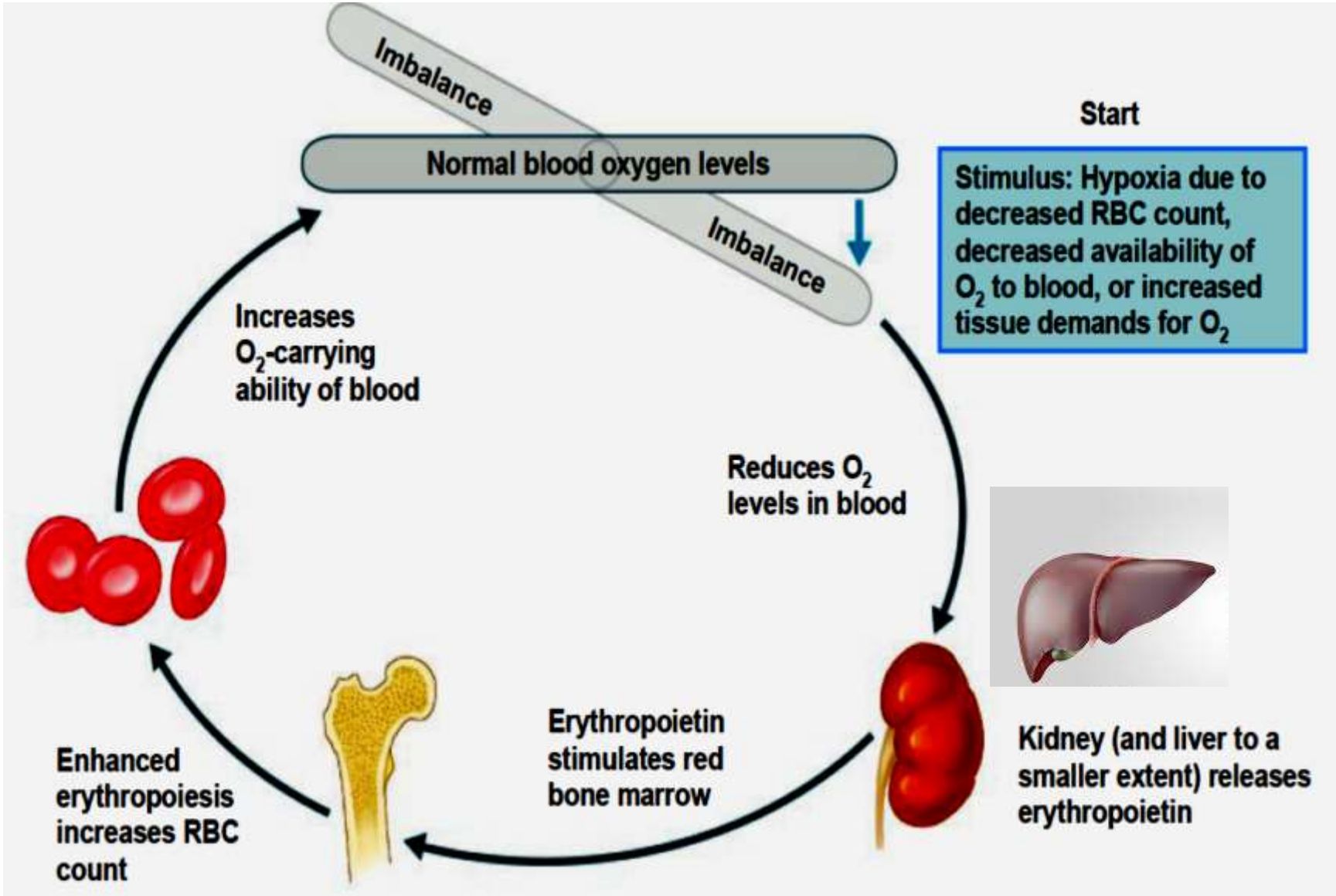
Bone marrow

●Factors Affecting Erythropoiesis:

1-Hypoxia (↓↓ O_2 Supply to Tissues) most important factor



●Factors Affecting Erythropoiesis:



2-Healthy Kidney:

secretes 85 % of erythropoietin hormone in response to hypoxia, anemia and androgen hormone

3-Healthy Liver:

1) Secretes 15 % of erythropoietin hormone.

2) Storage for globulin, iron, vitamin B_{12}, folic acid and copper.

4-Healthy Bone Marrow: It is the site of formation **in adult** .

5-Healthy Diet:

-Iron, **Proteins** and **vitamins:**

*Vitamin B_{12} & folic acid = RBCs maturation factors and Vitamin C (for synthesis of Hb).

↓Vitamin B_{12} & folic acid→ Megaloblastic Anemia

-Others: Copper & cobalt are cofactors in synthesis of Hb (needs small amount).

6-Hormones:

Androgen, thyroxin (general metabolic stimulant), adrenaline, noradrenaline, cortisol.

Anemia

Morphological Classification:

a-Microcytic hypochromic anemia e.g. iron deficiency anemia.

b-Normocytic normochromic anemia e.g. a plastic, hemorrhagic and hemolytic anemias.

c-Macrocytic anemia (megalablastic) e.g. vitamin B_{12} folic acid deficiency.

●Iron Deficiency Anemia:

- Def. : Microcytic hypochromic anemia.

-Causes: deficiency of iron.

1- ↓↓ Intake.

2- ↓↓ Absorption:

a- ↓↓ Hcl (gastritis or gastrictomy).

b- Intestinal diseases.

c-↑↑ Phosphate or ↓↓ Ca in diet.

3- ↑↑ Utilization: ↑↑ Of demand (in females and infants). ↑↑ of blood loss (hemorrage).

-Treatment: Oral ferrous iron.

Megaloblastic Anemia=Pernicious Anemia

-Causes: deficiency of *vitamin B_{12}*

-Manifestations: 1-Megaloblastic anemia. WBCs and platelets both decrease.

2-Degeneration of the peripheral and spinal nerves → peripheral neuritis and subacute degeneration of spinal cord.

3-Atrophy of the digestive mucosa and hepatosplenomegally.

Folic Acid Deficiency anemia

GIVE REASONS:

-Anemia due to deficiency of copper, cobalt & vitamin C is rare?

Because these substances requirements are so small.

-Renal failure patients are always anemic?

Due to absence of erythropoietin hormone which is secreted by kidney and it is necessary for erythropoiesis.

What is important of

-Vit. B12 and folic acid in erythropoesis?

They are essential for synthesis of DNA, which is essential for nuclear maturation of blood cells (RBCs, WBCs & platelets)and division.


Thank you