Physiology

RBC Formation, Anemia, and Jaundice

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RBCs are essential for oxygen transport, carbon dioxide removal, and pH balance. Their formation (erythropoiesis) is tightly regulated, and disruptions can lead to anemia or jaundice.

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RBC Formation (Erythropoiesis)

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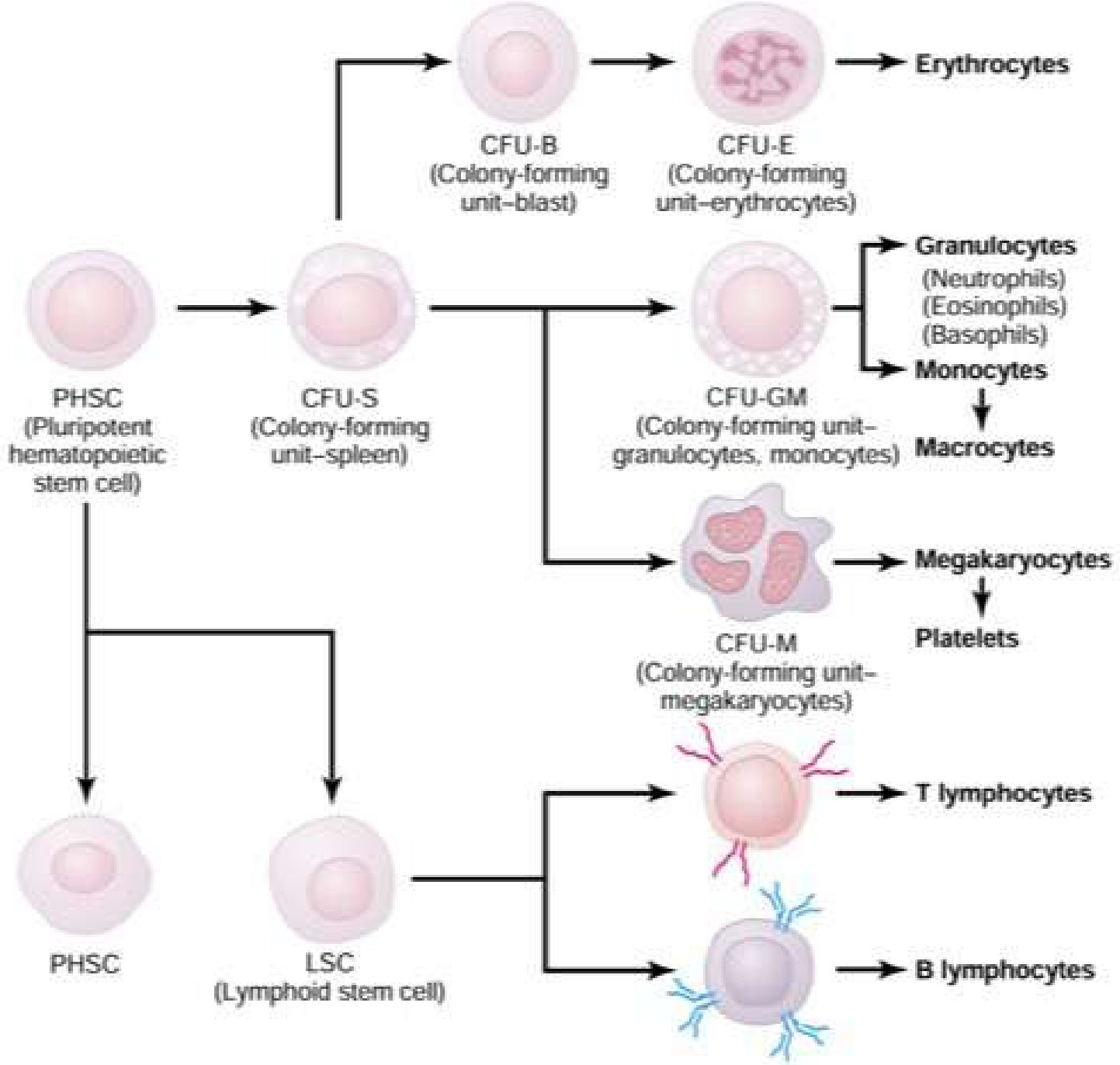

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Sites of Erythropoiesis

- **Fetal**: Yolk sac → Liver/spleen → Bone marrow
- **Adults**: Bone marrow (vertebrae, sternum, ribs, pelvis, proximal long bones)

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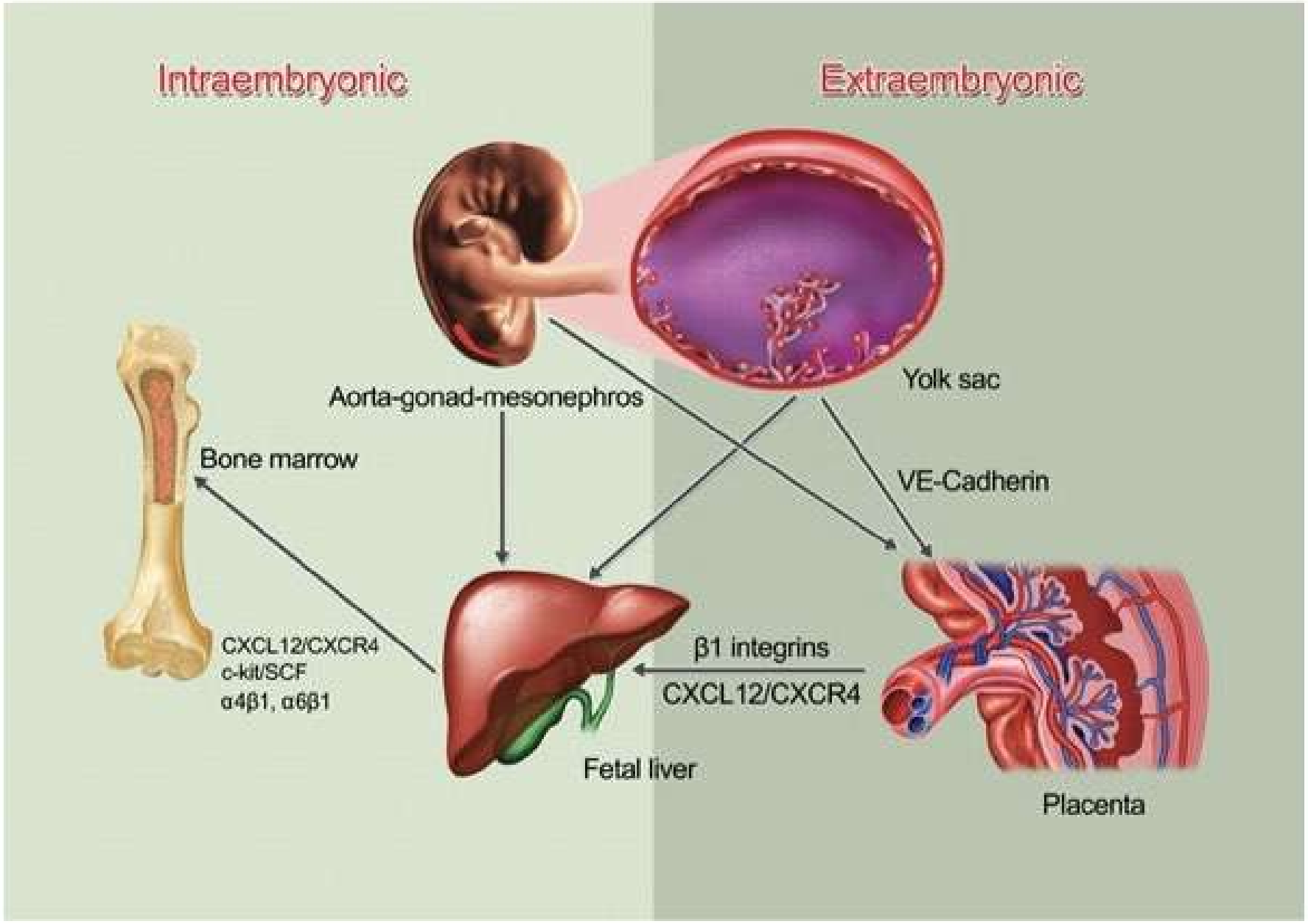

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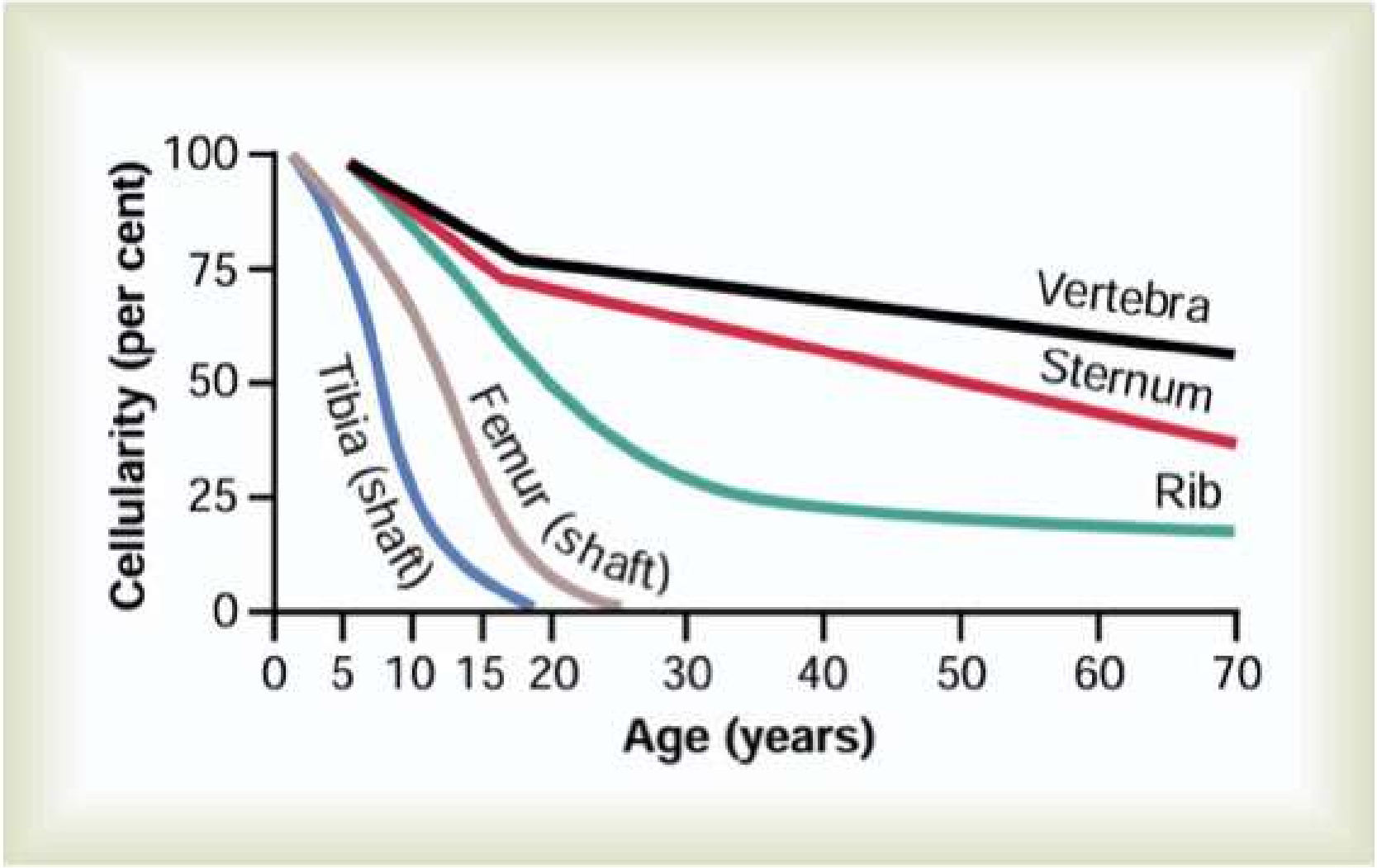

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Stages of RBC Development

1. Proerythroblast → 2. Basophilic erythroblast → 3. Polychromatophilic erythroblast → 4. Normoblast → 5. Reticulocyte → 6. Mature RBC

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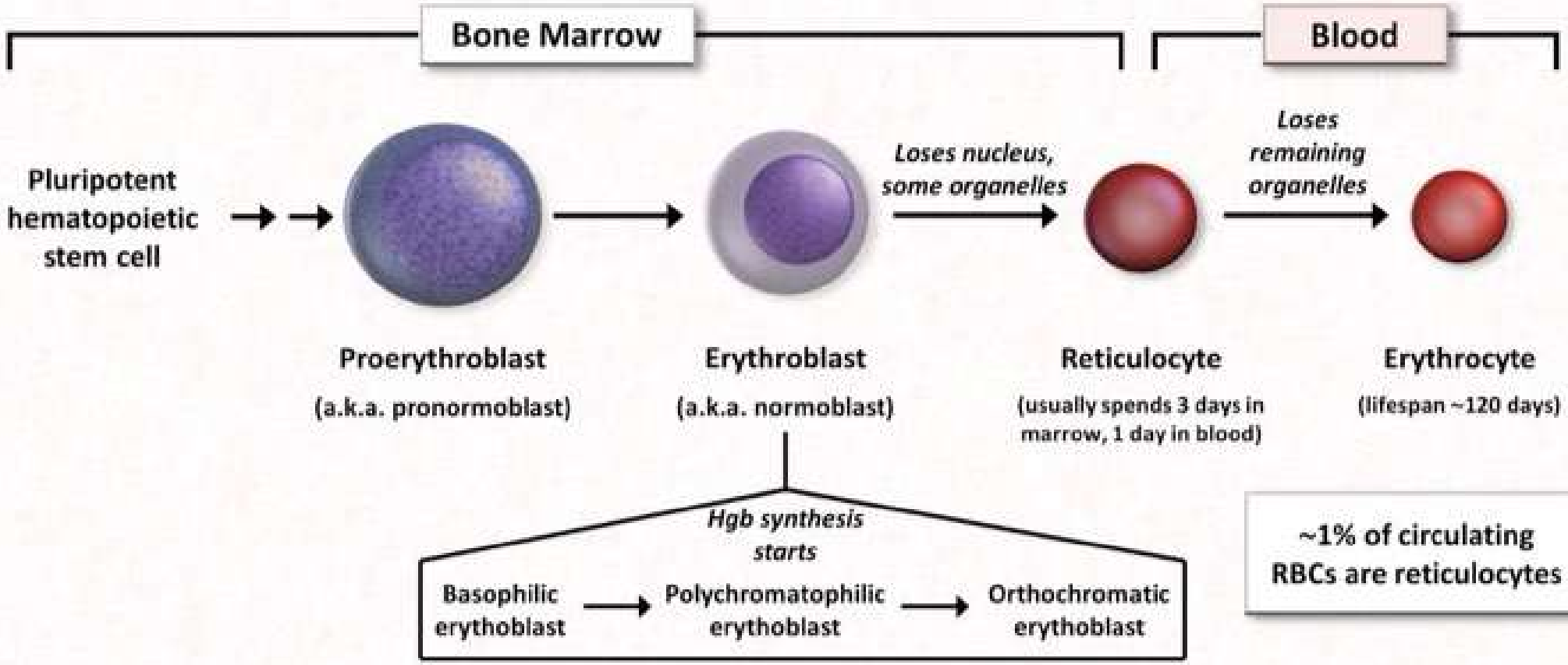
Erythropoiesis

(RBC Production and Maturation)



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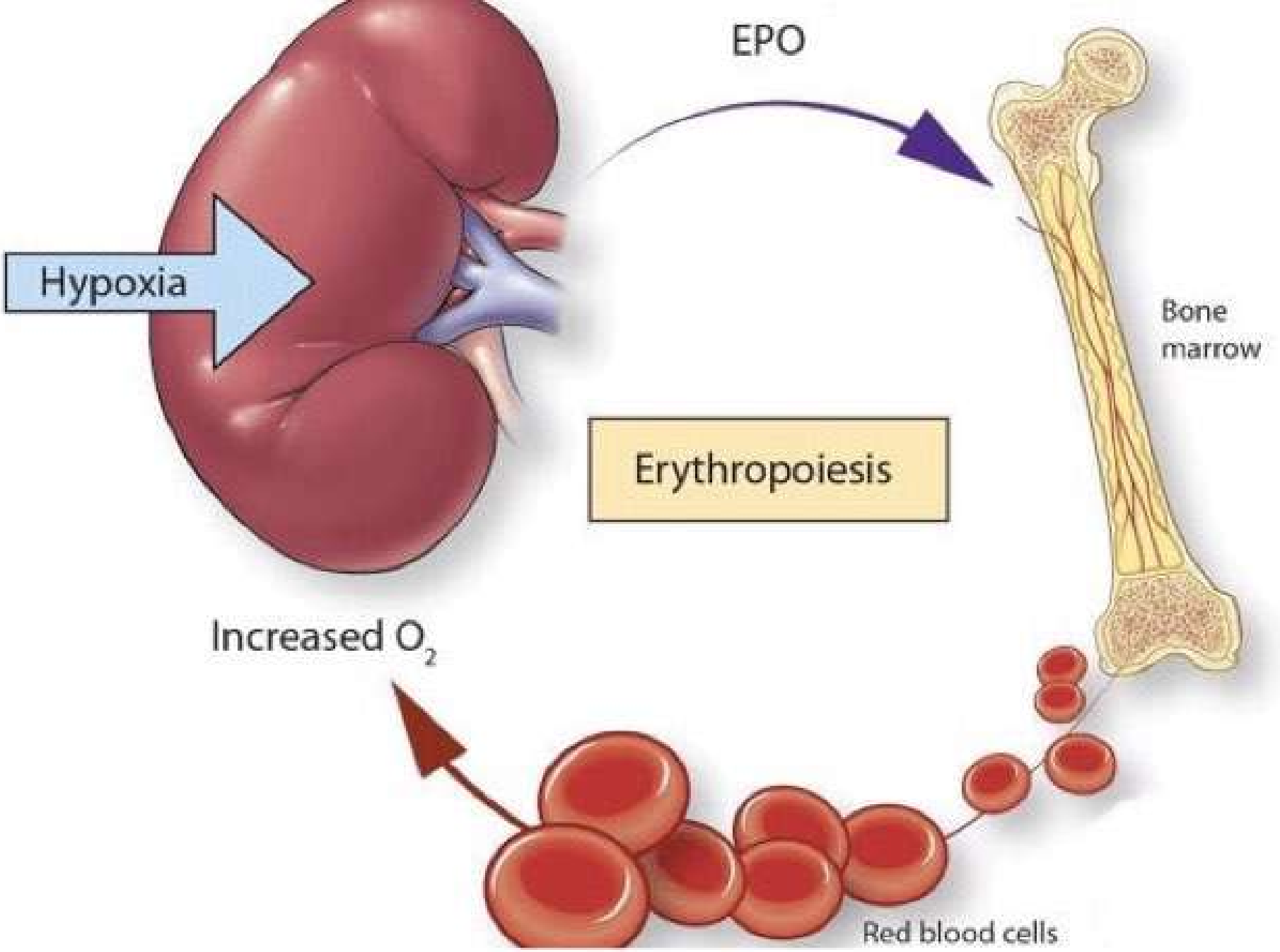

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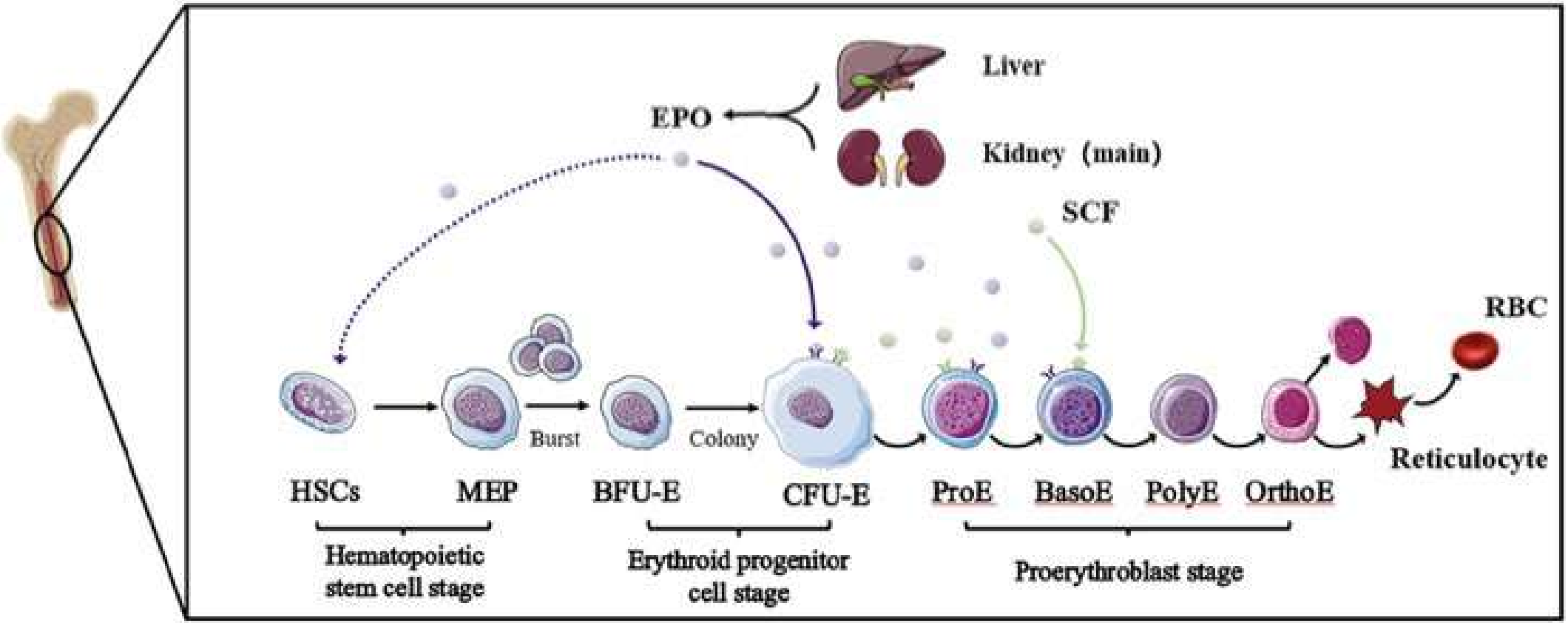

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Regulation of Erythropoiesis

- **Erythropoietin** (EPO) (from kidneys) stimulates RBC production in response to hypoxia.
- **Nutrients** Required: Iron, vitamin B12, folate, proteins.

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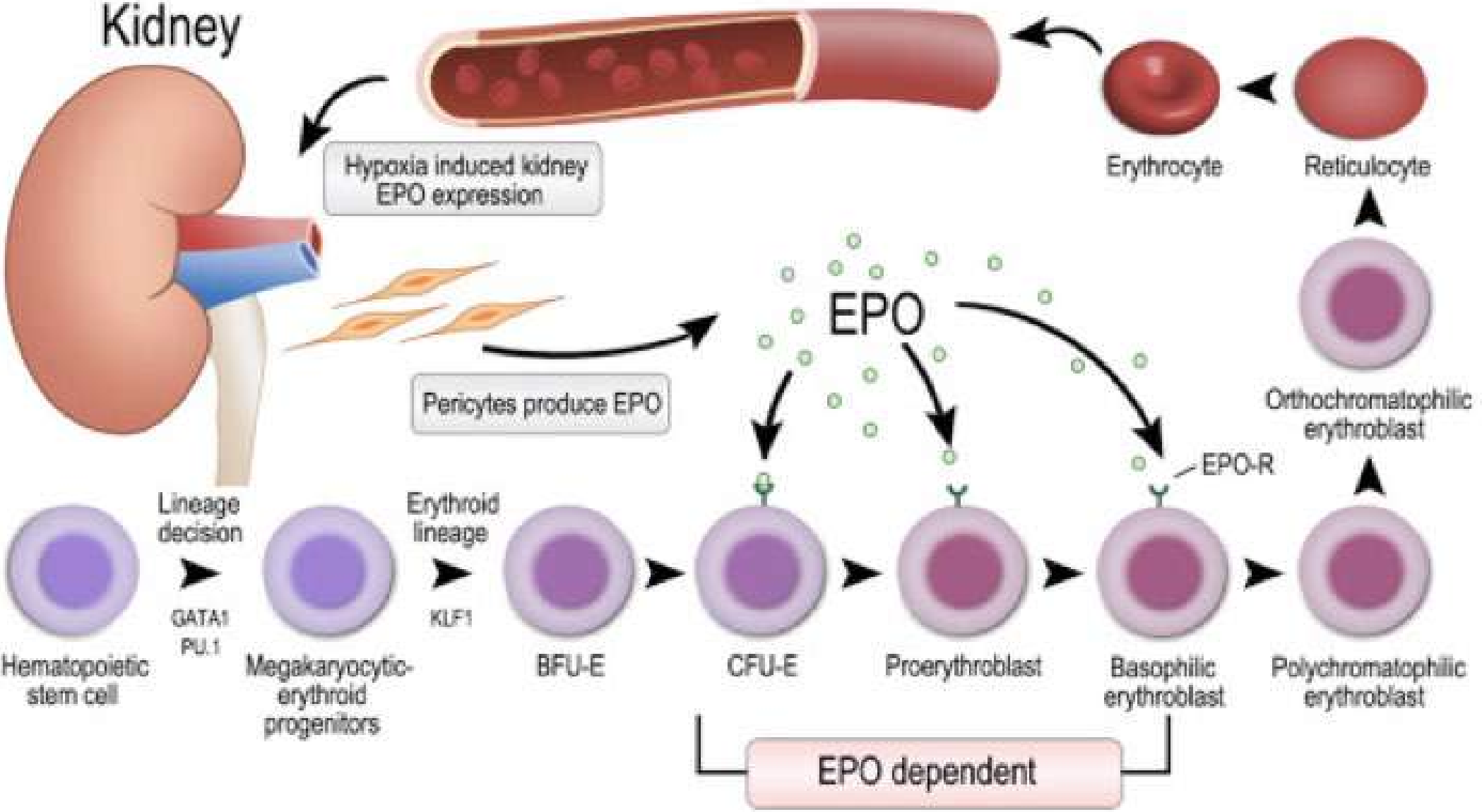

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Anemia

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Definition: **Low** RBCs, hemoglobin, or hematocrit → Reduced oxygen delivery.

- Reduction in Hb, Hct, or RBC count below normal
- WHO criteria:
- - Men: Hb < 13 g/dL
- - Women: Hb < 12 g/dL
- - Pregnant women: Hb < 11 g/dL

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Classification of anemia (types of anemia):

By MCV (mean corpuscular volume):

- **Microcytic** (<80 fL): Iron deficiency, thalassemia
- **Normocytic** (80-100 fL): Acute blood loss, chronic disease
- **Macrocytic** (>100 fL): B12/Folate deficiency

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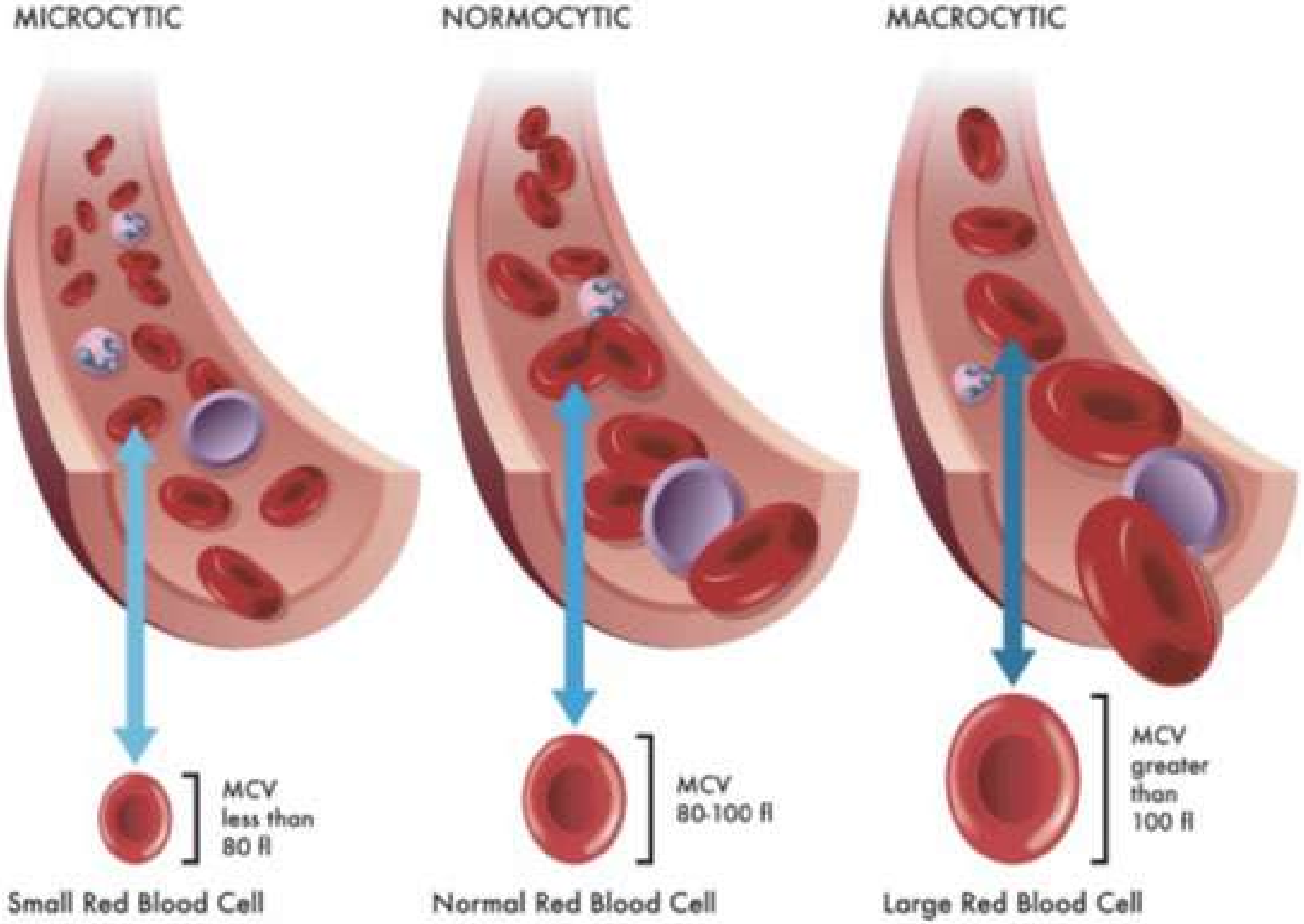

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Classification of anemia (types of anemia):

By Cause:

- **Reduced Production**: Iron deficiency, bone marrow failure (aplastic anemia)
- **Blood Loss**: Acute (trauma), chronic (GI bleeding)
- **Increased Destruction**: Hemolysis (sickle cell, G6PD deficiency)

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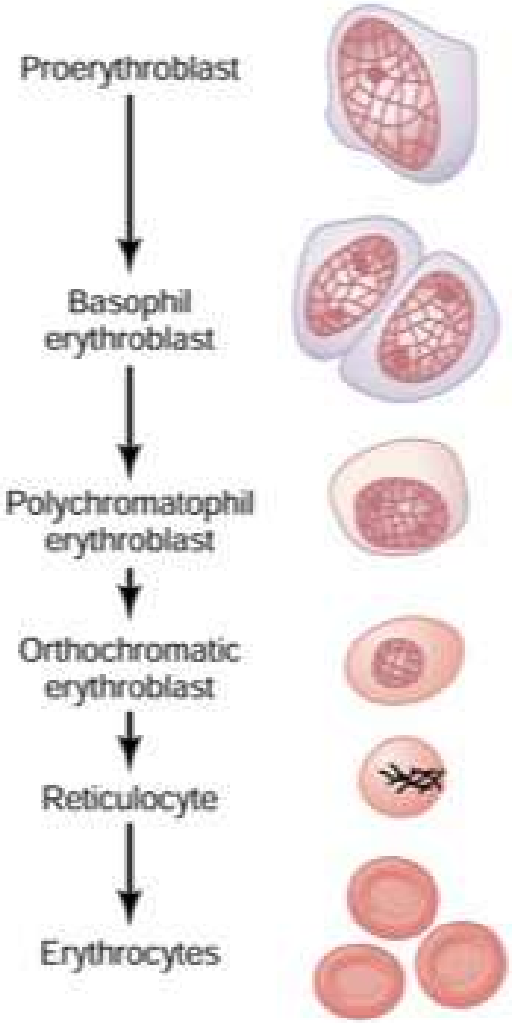
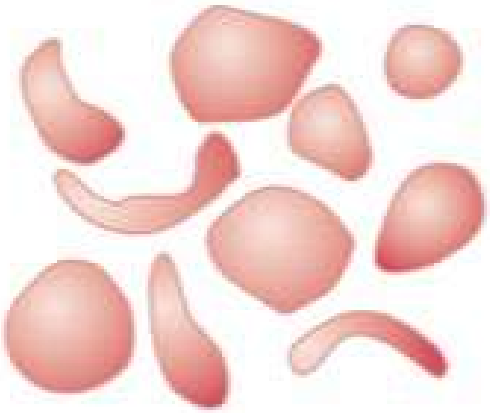
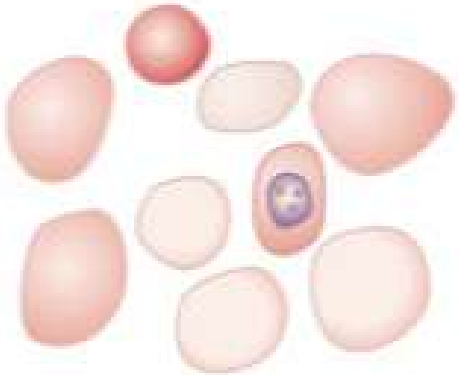


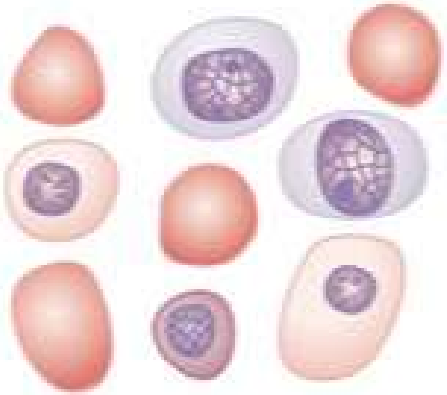
Microcytic, hypochromic anemia



Sickle cell anemia



Megaloblastic anemia



Erythroblastosis fetalis

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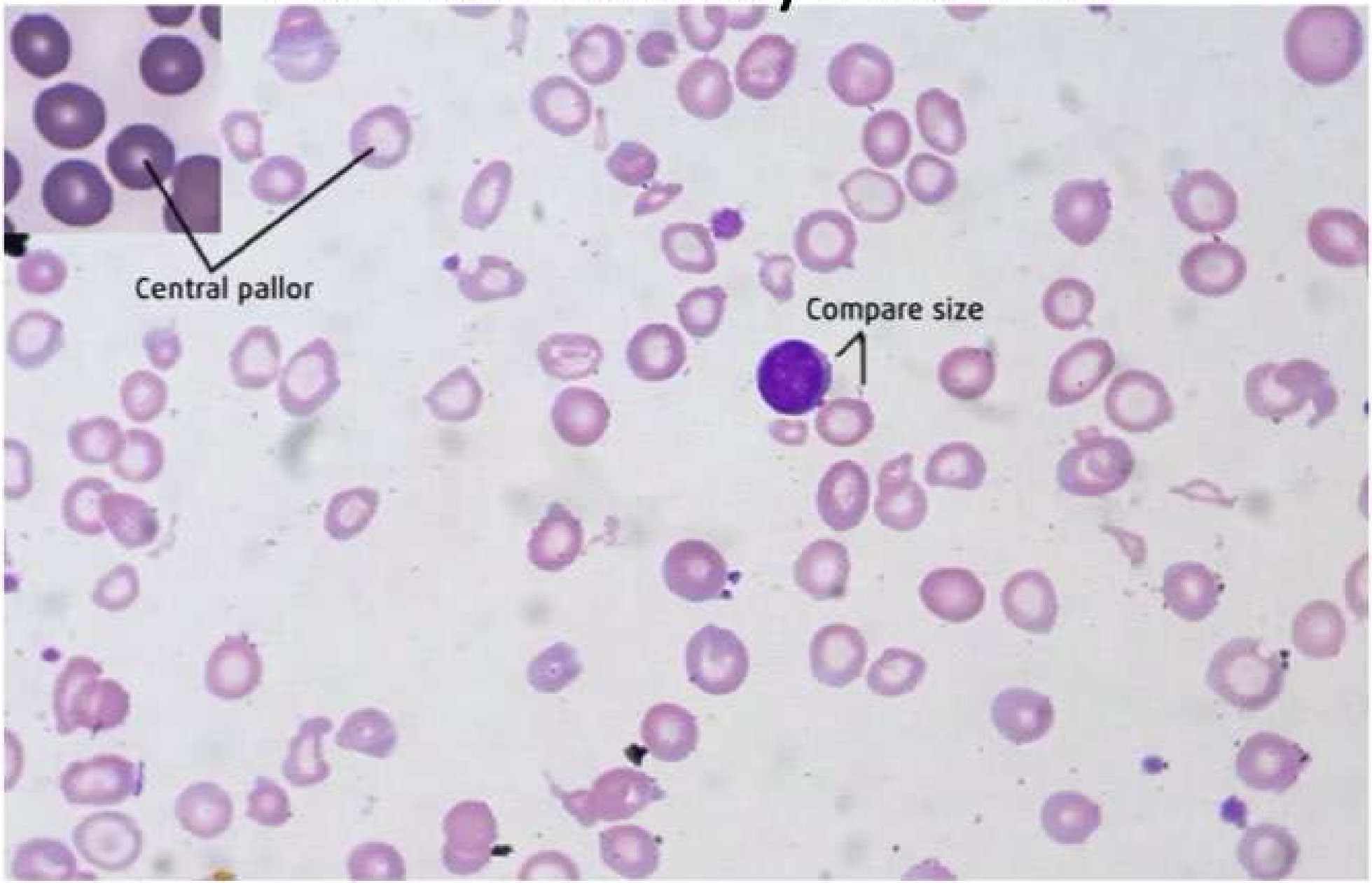
Iron Deficiency Anemia



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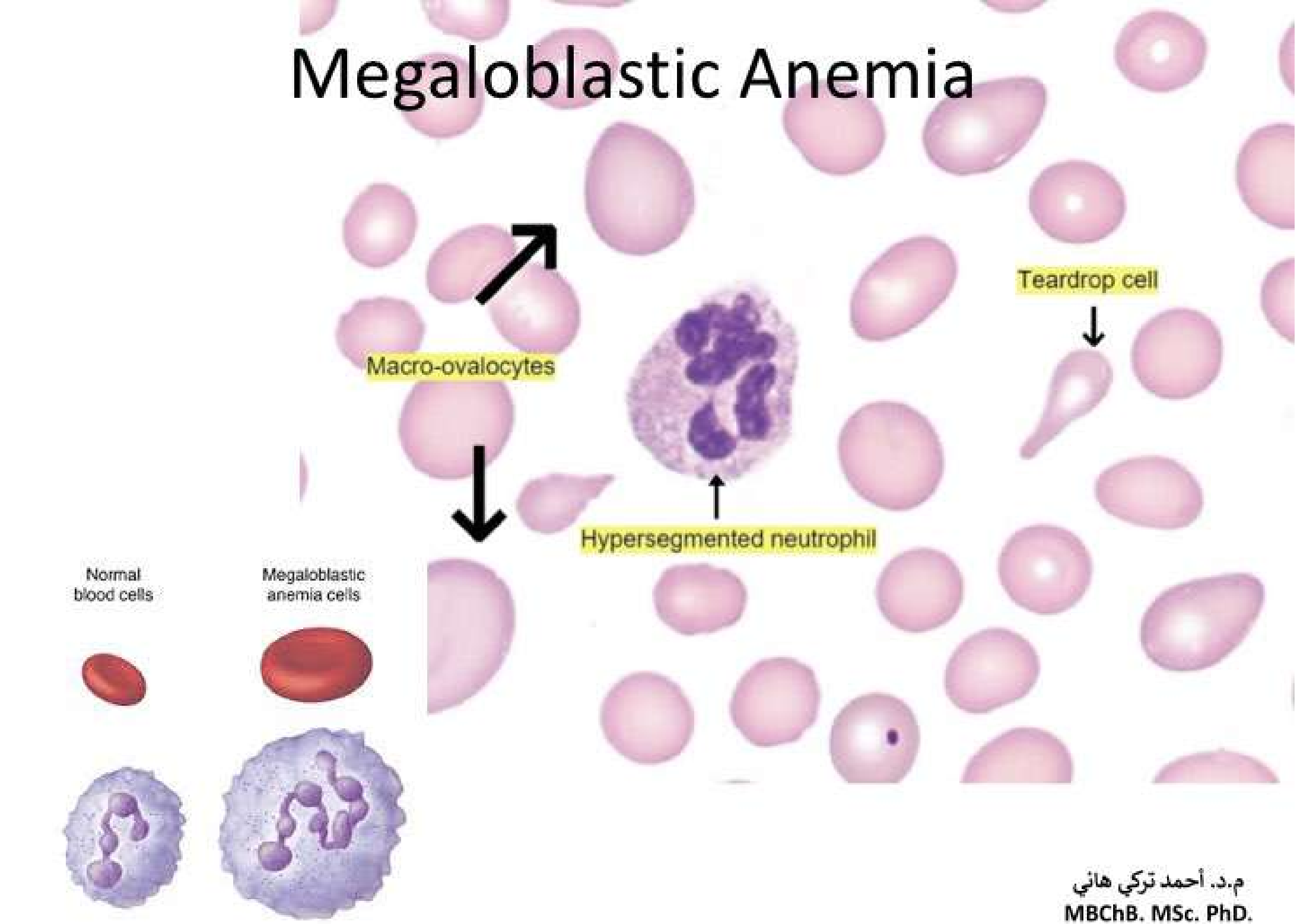
Megaloblastic Anemia



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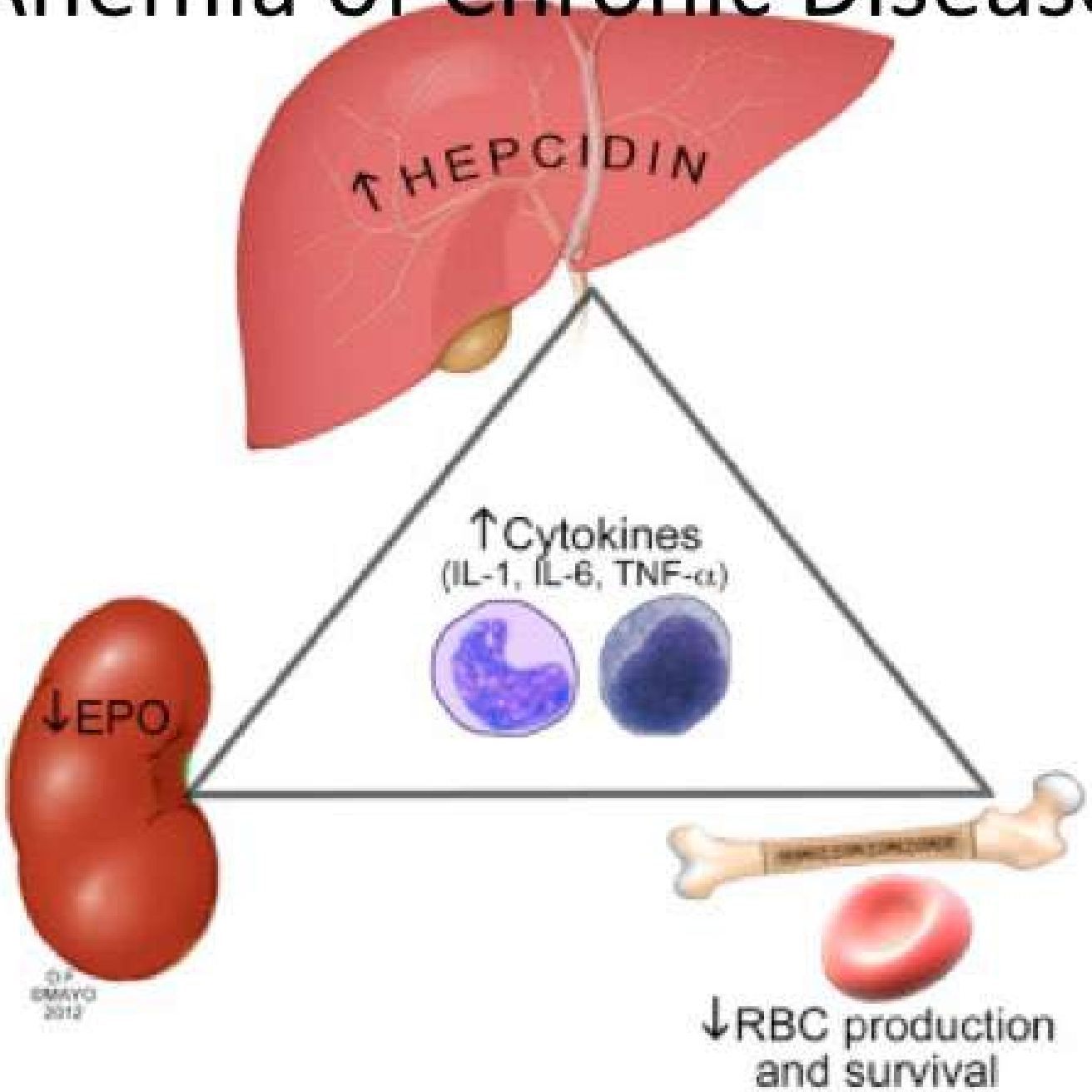
Anemia of Chronic Disease



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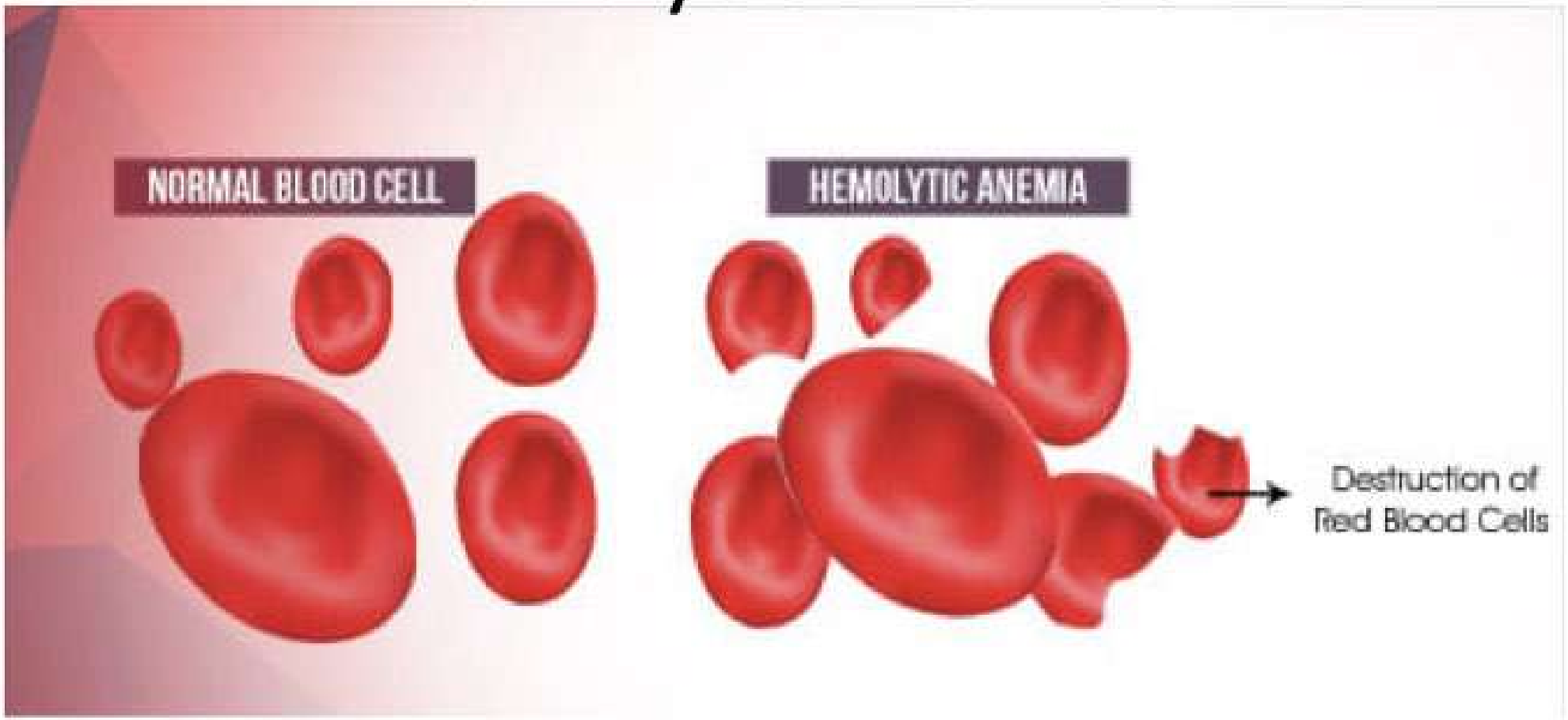
Hemolytic Anemias



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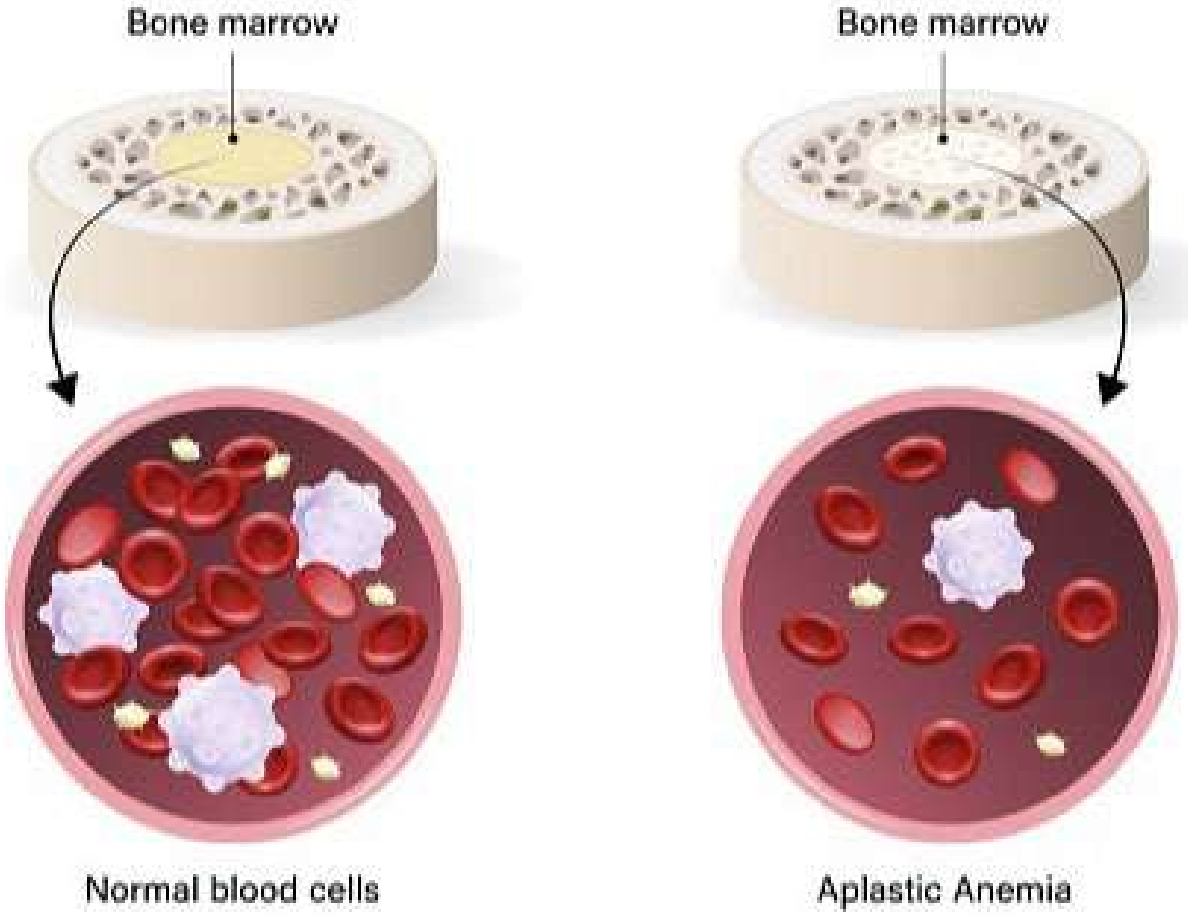
Aplastic Anemia



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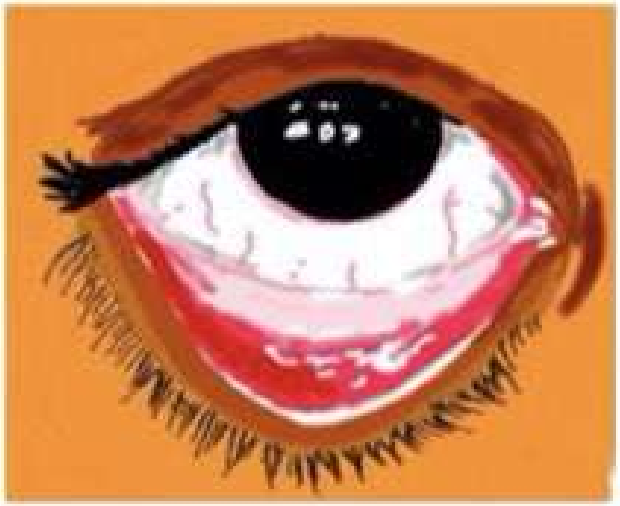
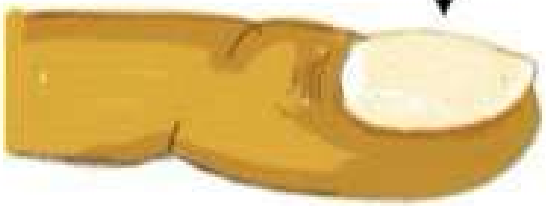
Diagnostic Approach

- History and physical
- CBC with indices, peripheral smear
- Reticulocyte count
- Iron studies, B12/folate levels
- Bone marrow biopsy if needed

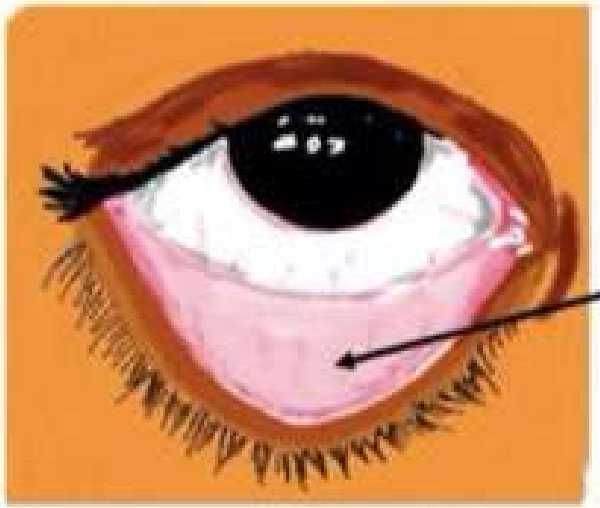
NORMAL



Nail with convex surface



CLINICAL FEATURES
IRON DEFICIENCY ANEMIA



Pale conjunctiva

Nail losing convexity.
It is concave in the illustration (**Spoon** shaped)

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Summary

- Classify anemia using MCV and etiology
- Identify key features and labs for major types
- Tailor treatment to underlying cause

Jaundice

Definition: Yellow discoloration due to excess bilirubin (>2.5 mg/dL).

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Bilirubin Metabolism

- **RBC breakdown** → Heme → Unconjugated bilirubin → Liver conjugation → Excretion in bile → Stercobilin (feces) & Urobilinogen (urine).

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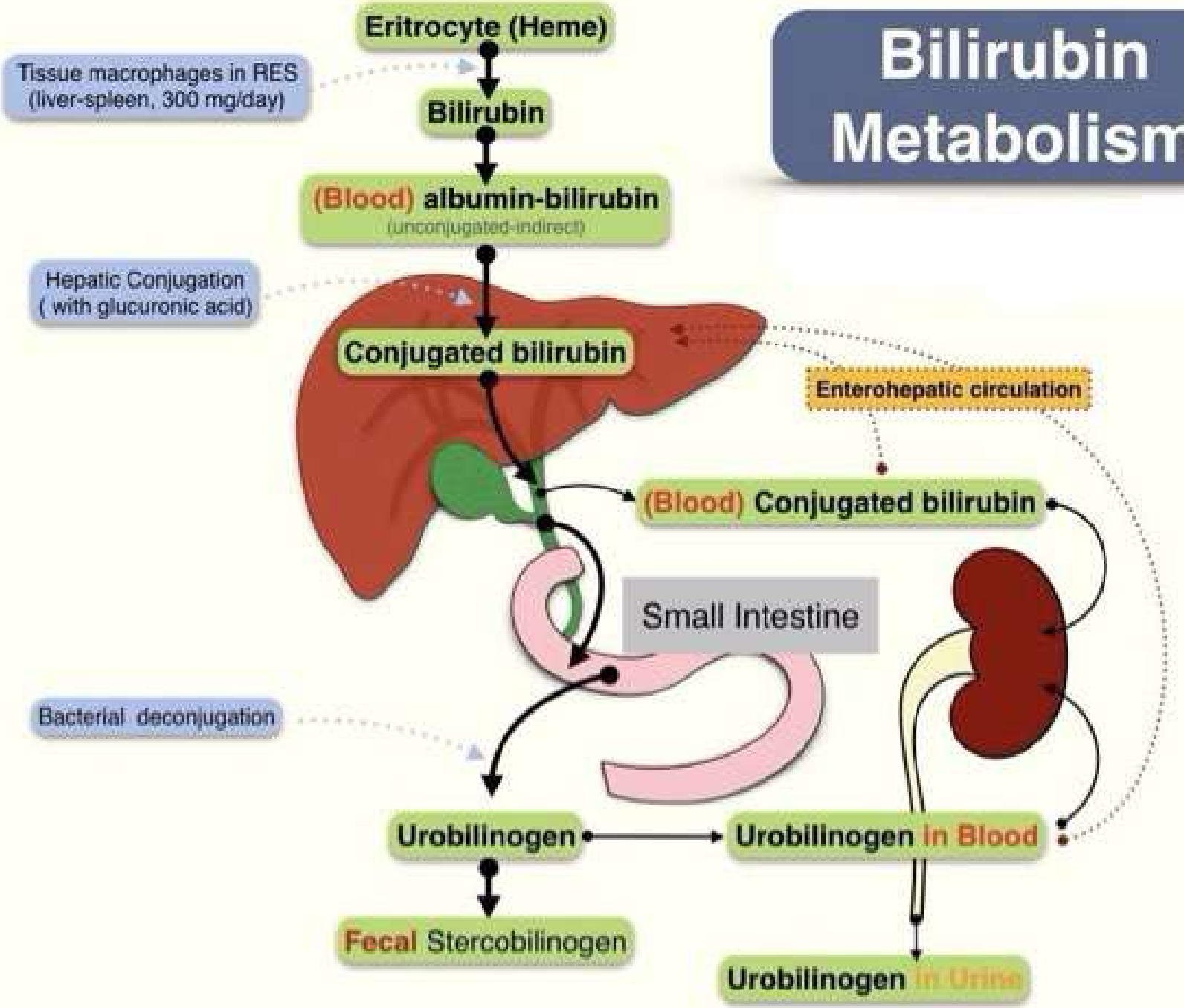
Bilirubin Metabolism



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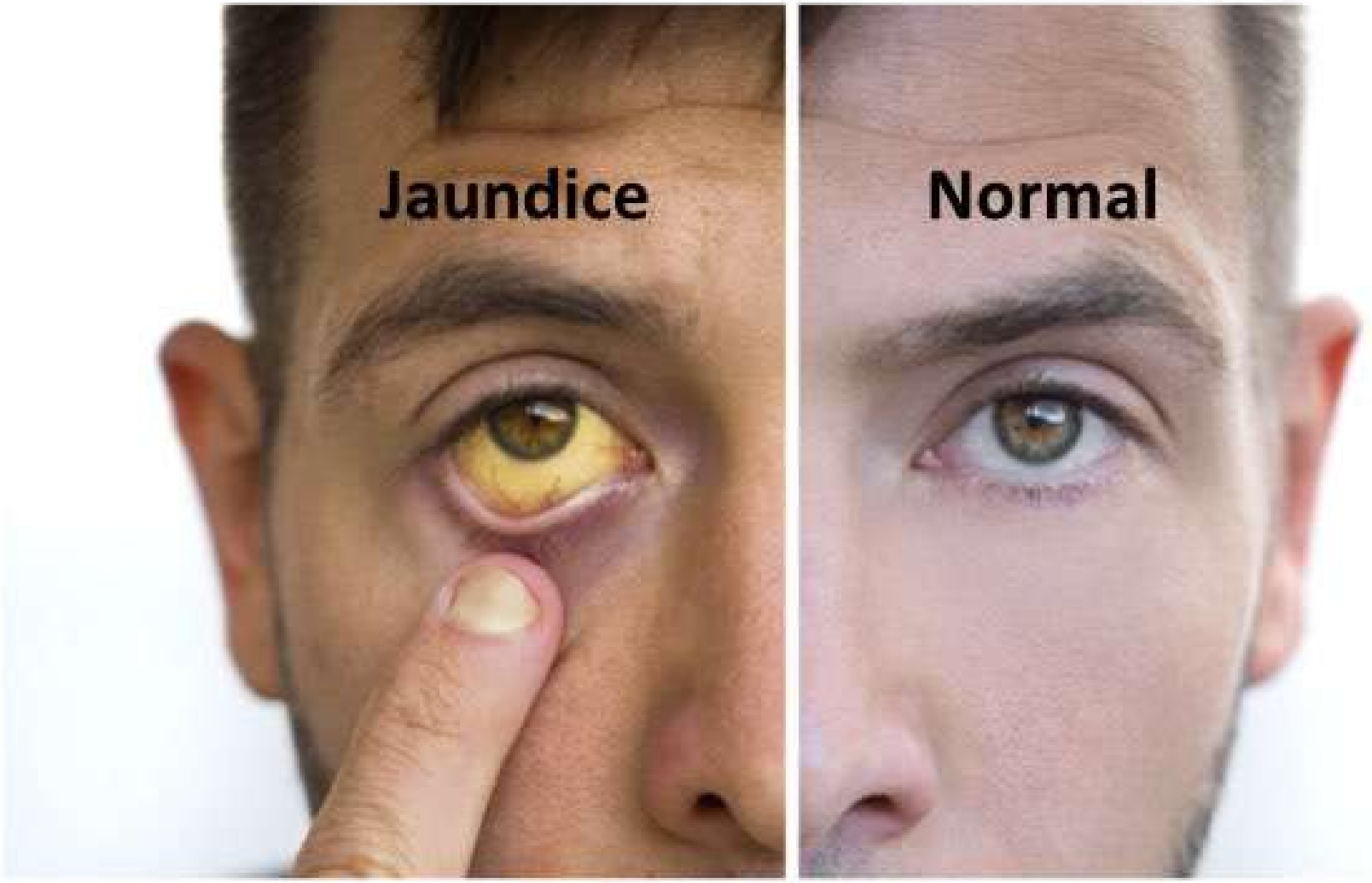

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Types

1. **Prehepatic** (Hemolytic): increased ↑ Unconjugated bilirubin, normal liver function.
2. **Hepatic**: Liver disease (hepatitis, cirrhosis) → Mixed bilirubin increase.
3. **Posthepatic** (Obstructive): Biliary obstruction → increased ↑ Conjugated bilirubin, dark urine, pale stools.

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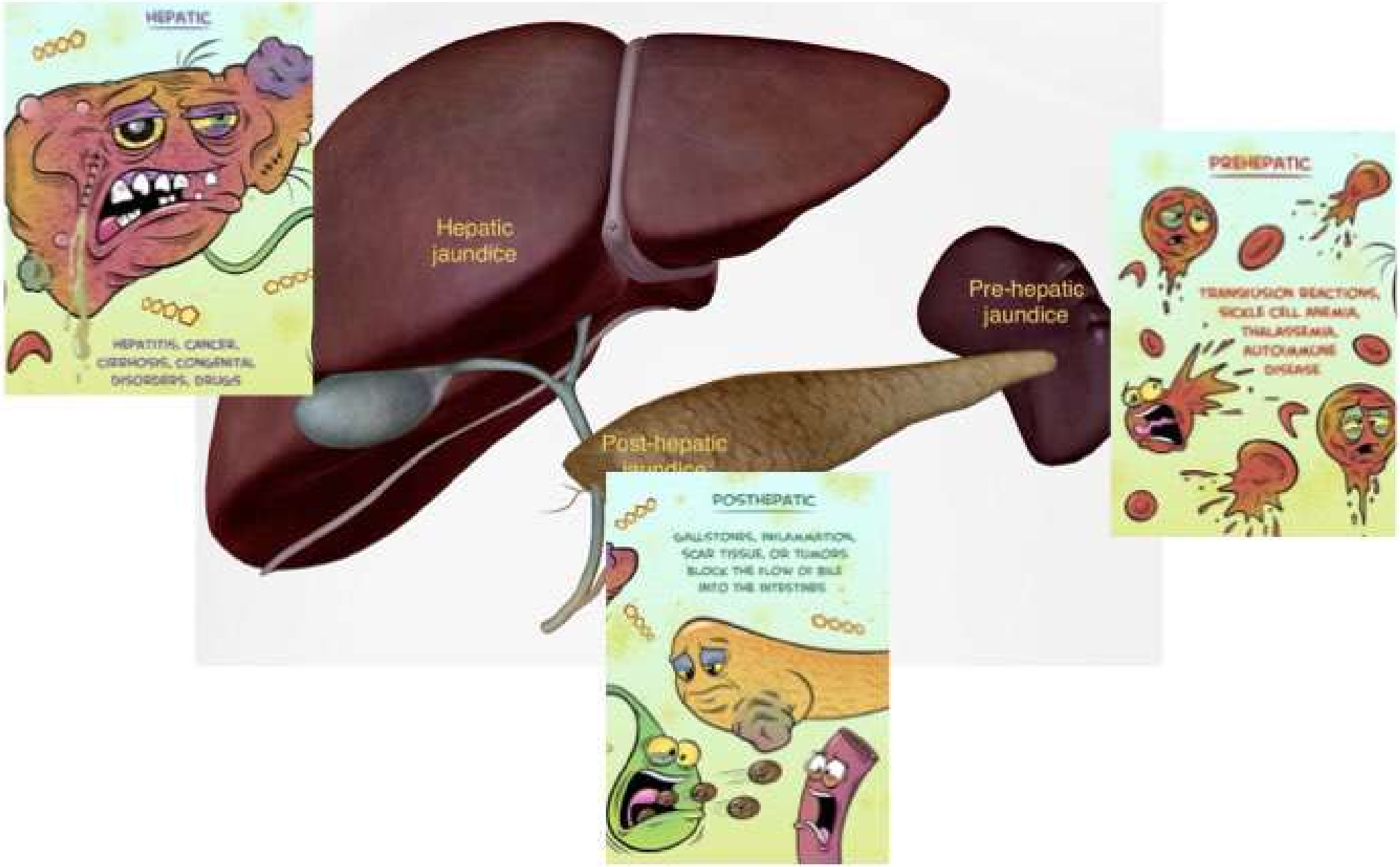

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Summary

- Erythropoiesis is regulated by EPO and nutrients.
- Anemia is classified by RBC size and cause.
- Jaundice results from bilirubin metabolism disorders (prehepatic, hepatic, posthepatic).

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