HEMOLYTIC ANEMIA 🩸

Definition

Hemolytic anemias are a heterogeneous group of disorders characterized by:

- Accelerated destruction of red blood cells (RBCs)
- Shortened RBC lifespan → Less than the normal 120 days (often markedly reduced)

📌 Key concept for exams:

The problem is increased destruction, not decreased production.

Pathophysiology of Hemolytic Anemia 🔄

- Increased RBC destruction → Reduced oxygen-carrying capacity → Tissue hypoxia → ↑

Erythropoietin (EPO) release from kidneys → ↑ Bone marrow erythropoiesis → ↑ Reticulocyte release into circulation

📌 Resulting hallmark findings:

- Marrow erythroid hyperplasia
- Peripheral blood reticulocytosis

✨ *Reticulocytosis is one of the strongest lab clues of hemolysis.*

Severe Hemolysis: Extramedullary Hematopoiesis 🧬

When erythropoietic drive becomes extreme:

- Bone marrow capacity is exceeded → Hematopoiesis occurs outside marrow

Sites involved:

- Liver
- Spleen

- Lymph nodes

📌 Seen in chronic or severe hemolytic anemias

Classification of Hemolytic Anemias 📊

Hemolytic anemias can be organized in two important ways:

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1. Based on Location of RBC Defect

Type	Defect Location	Examples (overview)
Intrinsic (Intracorpuscular)	Defect within RBC	Membrane, enzyme, hemoglobin defects
Extrinsic (Extracorpuscular)	External to RBC	Antibodies, mechanical trauma

📌 Intrinsic defects usually cause lifelong hemolysis

📌 Extrinsic defects are often acquired

2. Based on Site of Hemolysis (Clinically Most Important) ⭐

- Extravascular hemolysis
- Intravascular hemolysis

Extravascular Hemolysis 🩸

Definition

Hemolysis occurring outside blood vessels, mainly in:

- Spleen (most important)
- Liver
- Bone marrow

Mechanism 🔍

- RBC defect (↓ deformability or antibody coating) → RBC fails to pass through splenic sinusoids → RBC becomes trapped → Phagocytosis by splenic macrophages

📌 Why spleen is key:
RBCs must deform to pass through narrow splenic sinusoids.
Any rigidity = destruction.

Common Causes

- Reduced RBC deformability
- Antibody-coated RBCs
- Structural membrane abnormalities

Features of Extravascular Hemolysis 🧪

✔ Hyperbilirubinemia & Jaundice

- Due to macrophage degradation of hemoglobin

- ↑ Unconjugated bilirubin

✔ Splenomegaly

- Due to "work hyperplasia" of splenic macrophages

✔ Pigment Gallstones (Cholelithiasis)

- Seen in long-standing hemolysis
- Bilirubin-rich (black pigment stones)

📌 Iron status:

- Iron is efficiently recycled
- ❌ Iron deficiency NOT seen

Intravascular Hemolysis 💥

Definition

Hemolysis occurring within the circulation, where RBCs:

- Rupture directly in blood vessels

Mechanisms ⚙️

- Severe mechanical stress
  (e.g., defective prosthetic heart valves)
- Complement-mediated lysis
- Toxins (e.g., *Clostridium* toxins)
- Physical damage (e.g., heat)

Pathway of Hemoglobin in Intravascular Hemolysis 🔄

- RBC lysis in circulation → Free hemoglobin released into plasma → Hemoglobinemia → Hemoglobin filtered by kidneys → Partial tubular reabsorption → Conversion to hemosiderin → Tubular cell sloughing → Hemosiderinuria

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Features of Intravascular Hemolysis 🧪

✔ Hemoglobinemia

✔ Hemoglobinuria

✔ Hemosiderinuria

✔ Iron loss

- Chronic hemoglobinuria
  → Loss of iron in urine
  → May lead to iron deficiency anemia

📌 Key contrast:

- ❌ Iron deficiency = intravascular hemolysis
- ❌ NOT seen in extravascular hemolysis

Haptoglobin Levels in Hemolysis 📉

Haptoglobin

- Plasma protein that binds free hemoglobin
- Hb-haptoglobin complex is cleared by macrophages

In Hemolytic Anemias

- Serum haptoglobin levels ↓ ↓ ↓

📌 Important exam pearl:

Haptoglobin decreases in both intravascular AND extravascular hemolysis

✨ Explanation:

- Even in extravascular hemolysis, macrophages release enough hemoglobin into plasma to consume haptoglobin.

Quick Comparison Table: Extravascular vs Intravascular Hemolysis 📊

Feature	Extravascular	Intravascular
Site of destruction	Spleen (mainly)	Blood vessels
Mechanism	Phagocytosis	RBC rupture

Jaundice	✔ Common	✔ May occur
Splenomegaly	✔ Common	❌ Rare
Hemoglobinuria	❌ Absent	✔ Present
Hemosiderinuria	❌ Absent	✔ Present
Iron deficiency	❌ No	✔ Possible
Haptoglobin	↓	↓ ↓ ↓

Transition Point

We now proceed to specific types of hemolytic anemias, including:

- Hereditary
- Acquired
- Immune-mediated

- Membrane, enzyme, and hemoglobin disorders 📘

-> The End <-