BLOOD DISORDERS

1st Course

Lecture : 9

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Introduction

Blood diseases affect one or more components of blood — red cells, white cells, platelets, or plasma.

Understanding their mechanisms is essential in anesthesia and surgery to maintain oxygen delivery and hemostasis.

Learning Objectives

- At the end of this lecture, students should be able to:

1. Describe the major types of blood disorders.
2. Understand their pathophysiology and clinical features.
3. Recognize implications for anesthesia and critical care.

Composition of Blood

1. Plasma (~55%) – water, proteins, electrolytes, hormones.
2. Formed elements (~45%): RBCs, WBCs, platelets.
3. Hematocrit, Hemoglobin concentration, and RBC indices are key diagnostic values.

Normal Hematologic Parameters

Parameter	Normal Value
Hb (M)	13–17 g/dL
Hb (F)	12–15 g/dL
Hct	36–50%
WBC count	4,000–11,000 /µL
Platelets	150,000–400,000 /µL

Classification of Blood Disorders

1. **Red cell disorders** – anemias, polycythemia
2. **White cell disorders** – leukemias, leukopenia
3. **Platelet & coagulation disorders** – thrombocytopenia, hemophilia, DIC

Anemia: Definition & Types

- Anemia = ↓ RBC mass or Hb concentration → ↓ oxygen-carrying capacity.

Major types:

1. Iron deficiency anemia
2. Megaloblastic anemia
3. Hemolytic anemia
4. Aplastic anemia

Iron Deficiency Anemia

- **Causes:** chronic blood loss, poor diet, malabsorption, menstruation.

- **Features:** fatigue, pallor, spoon nails, pica.

- **Labs:** microcytic hypochromic RBCs, low ferritin.

Treatment: iron supplementation and treat the cause.

Megaloblastic Anemia

- Due to deficiency of vitamin B12 or folate.

- **Mechanism:** impaired DNA synthesis → large immature RBCs.

- **Features:** glossitis, paresthesia, weakness.

- **Labs:** macrocytosis, hypersegmented neutrophils.

Hemolytic Anemia

- Premature destruction of RBCs (intravascular or extravascular).

- **Causes:** autoimmune, hereditary spherocytosis, G6PD deficiency.

- **Signs:** jaundice, splenomegaly, reticulocytosis, ↑ bilirubin.

Aplastic Anemia

- Bone marrow failure → pancytopenia.

- **Causes:** radiation, drugs (chloramphenicol), viral infections.

- **Management:** stop offending agent, bone marrow transplant.

Polycythemia

- ↑ RBC mass → ↑ blood viscosity → risk of thrombosis.

Types:

- *Primary (Polycythemia vera)* – myeloproliferative disorder.
- *Secondary* – due to chronic hypoxia (COPD, high altitude).

White Blood Cell Disorders

1. **Leukocytosis:** ↑ WBC due to infection or stress.
2. **Leukopenia:** ↓ WBC (e.g., chemotherapy, viral infections).
3. **Leukemia:** malignant proliferation of WBC precursors.

Acute vs. Chronic Leukemia

Type	Example	Features
Acute	AML, ALL	Rapid onset, anemia, bleeding, infections
Chronic	CML, CLL	Slow progression, splenomegaly, fatigue

Platelet Disorders

- **Thrombocytopenia:** platelet count <150,000 /μL.

- **Causes:** drugs, infections, bone marrow failure, immune causes.

- **Symptoms:** petechiae, bleeding gums, easy bruising.

Coagulation Disorders

1. **Hemophilia A (factor VIII deficiency)**
2. **Hemophilia B (factor IX deficiency)**
3. **Von Willebrand disease (platelet adhesion defect)**
4. **Disseminated Intravascular Coagulation (DIC)** – widespread activation of coagulation and bleeding.

Disseminated Intravascular Coagulation (DIC)

- **Triggers:** sepsis, trauma, obstetric complications.

- **Features:** bleeding, oozing from IV sites, low platelets, prolonged PT/aPTT.

- **Treatment:** treat cause, transfuse platelets and plasma.

Blood Transfusion Principles

- Indicated when Hb <8 g/dL or significant blood loss.
- Cross-matching and blood typing are essential.
- Watch for transfusion reactions and volume overload.

Transfusion Reactions

- **Types:**

1. Acute hemolytic (ABO incompatibility)
2. Febrile non-hemolytic
3. Allergic (urticaria, anaphylaxis)
4. Delayed hemolytic

   Management: stop transfusion, supportive therapy.

Hemostasis & Clotting

- **Steps:**

1. Vascular spasm
2. Platelet plug formation
3. Coagulation cascade (intrinsic & extrinsic)

Key factors: fibrinogen, prothrombin, calcium, vitamin K.

Anticoagulant Therapy

- Used to prevent or treat thrombosis.

Examples:

1. Heparin (IV, rapid action)
2. Warfarin (oral, delayed action)
3. New oral agents (apixaban, rivaroxaban).

- **Monitoring:** PT, INR, aPTT.

Blood Disorders & Anesthesia

- Anemia → low O_2 delivery.
- Leukemia → infection risk.
- Thrombocytopenia → bleeding tendency.

Always correct abnormalities before surgery.

Critical Care Relevance

- Massive transfusion protocols in trauma or obstetrics.
- Monitoring coagulation in ICU.
- Managing DIC, sepsis-related coagulopathy.

Summary

- Blood diseases involve abnormalities in cells or clotting components.

Understanding pathophysiology is vital for safe anesthesia, transfusion management, and perioperative care.