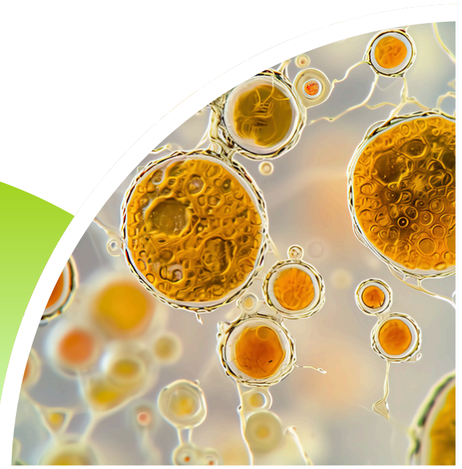
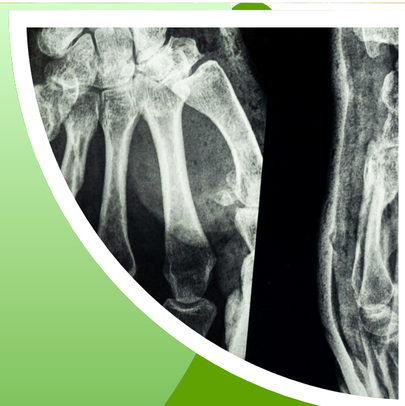
มหาวิทยาลัยราชภัฏนครปฐม





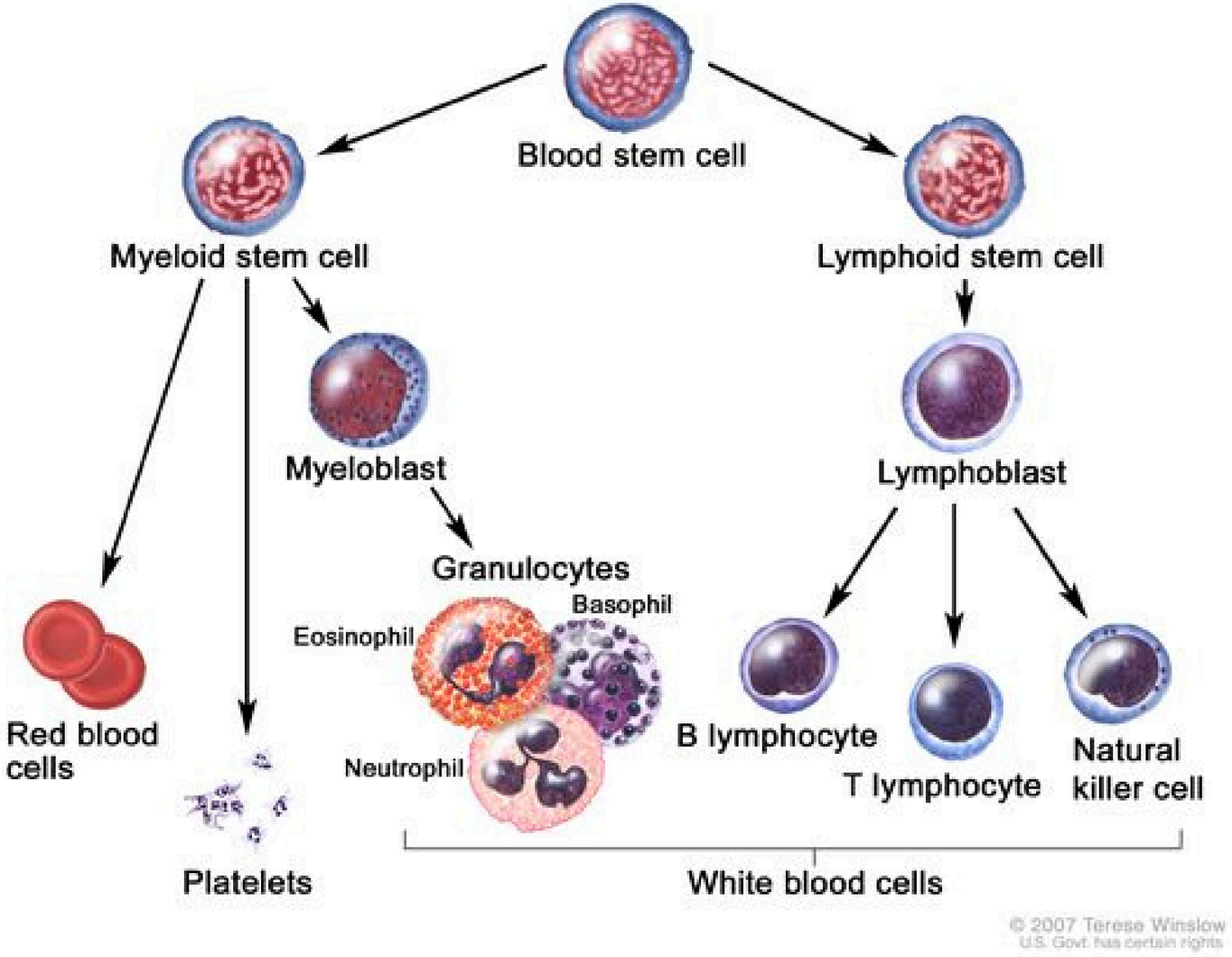

Mechanism and Illness of Human Body 2

Lecturer Unchisa Rattanakunuprakarn
Asst.Prof. Jutatip Tepsuwan
Lecturer Napat Rattanahongsa

5

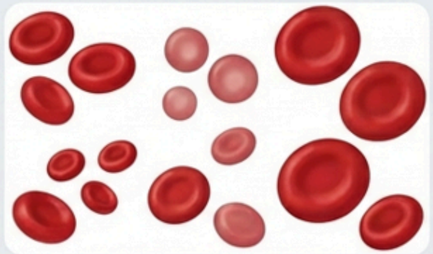
Disorders of the Hematologic System

Overview


Blood stem cell
Myeloid stem cell
Lymphoid stem cell
Myeloblast
Lymphoblast
Granulocytes
Basophil
Eosinophil
Neutrophil
Red blood cells
Platelets
B lymphocyte
T lymphocyte
Natural killer cell
White blood cells
© 2007 Terese Winslow
U.S. Govt. has certain rights

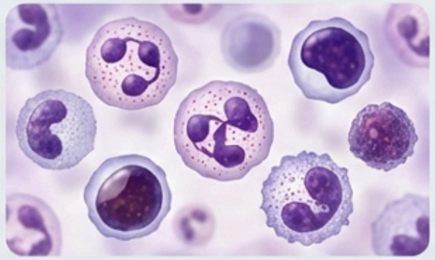
Overview of Blood Disorders

RBCs



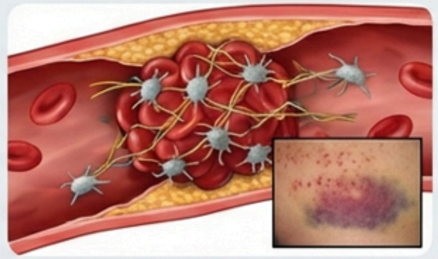
- **Anemia** = Oxygen Deficit
- **IDA** = Microcytic cells + Spoon Nails
- **B12 Deficiency** = Macrocytic cells + Neuro signs

WBCs

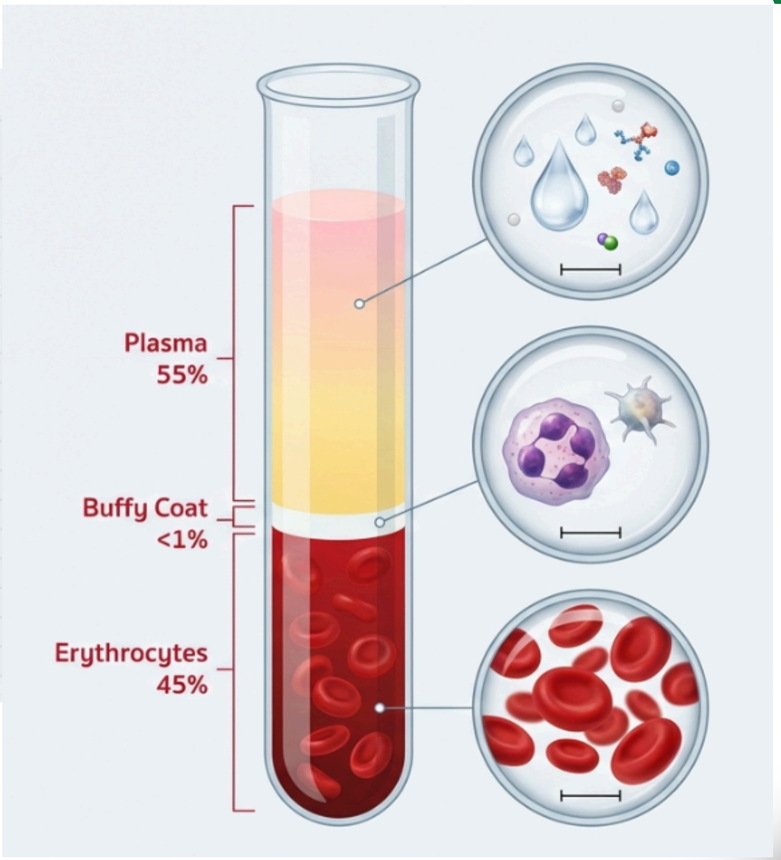


- **Neutropenia** (<1500) = Infection Risk
- **Agranulocytosis** (<500) = Medical Emergency

Hemostasis

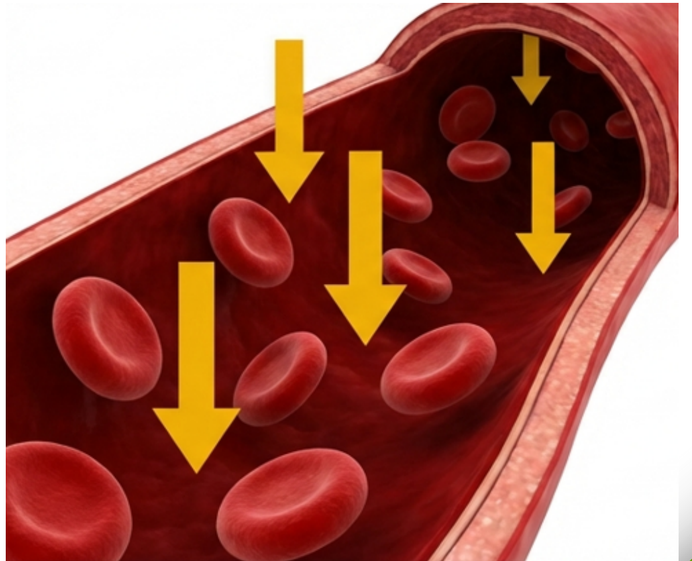


- **Petechiae** = Platelet problem
- **Ecchymosis/Hemarthrosis** = Coagulation Factor problem (Hemophilia)



Disorders of Red Blood Cells - Anemia

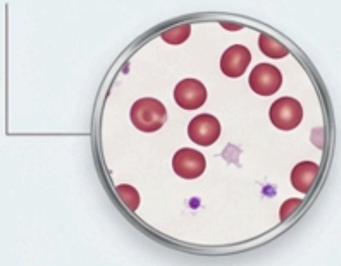
- **Definition:** A condition where the number of RBCs or hemoglobin (Hb) level is lower than normal.
- **Clinical Signs:** Fatigue, exhaustion, and increased cardiac workload due to tissue hypoxia.
- **Markers:** Low Hemoglobin and Hematocrit.



Classification of Anemia by Pathogenesis

1. Blood Loss

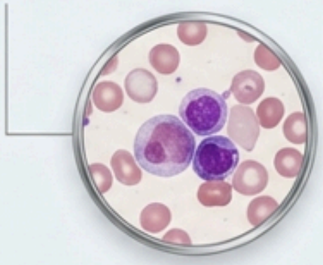
Acute: Trauma / Hemorrhage



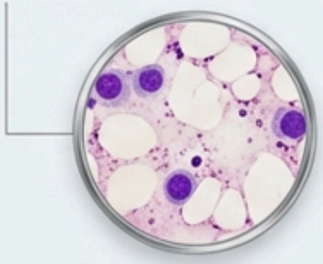
Chronic: Parasites (Hookworms), GI Ulcers, Menstruation

2. Impaired Production

Nutritional Deficiency: Iron, Vitamin B12, Folate

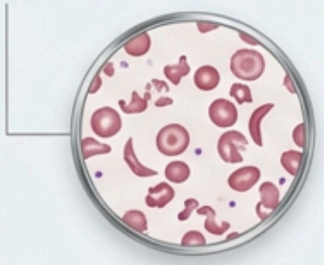


Bone Marrow Disturbance: Stem cell failure

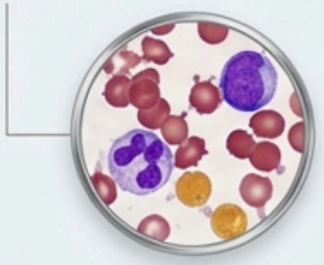


3. Increased Destruction (Hemolysis)

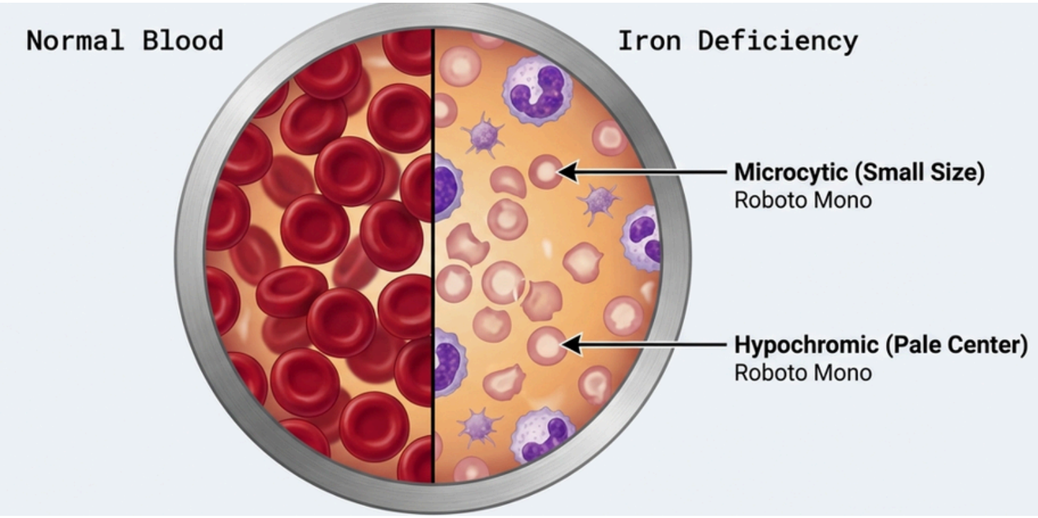
Intrinsic: Genetic defects (e.g., Thalassemia, Sickle Cell)



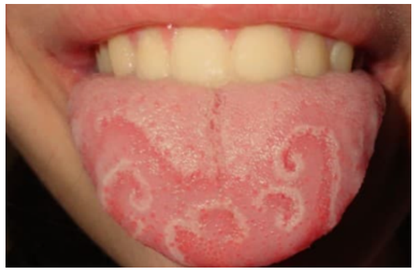
Extrinsic: Autoimmune disorders, Infection



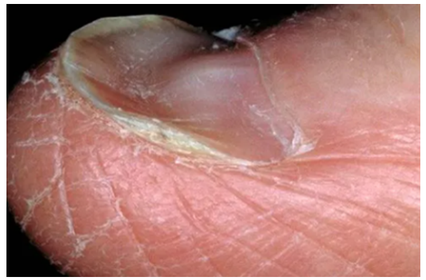
Iron Deficiency Anemia (IDA)



glossitis



koilonychia / spoon nail

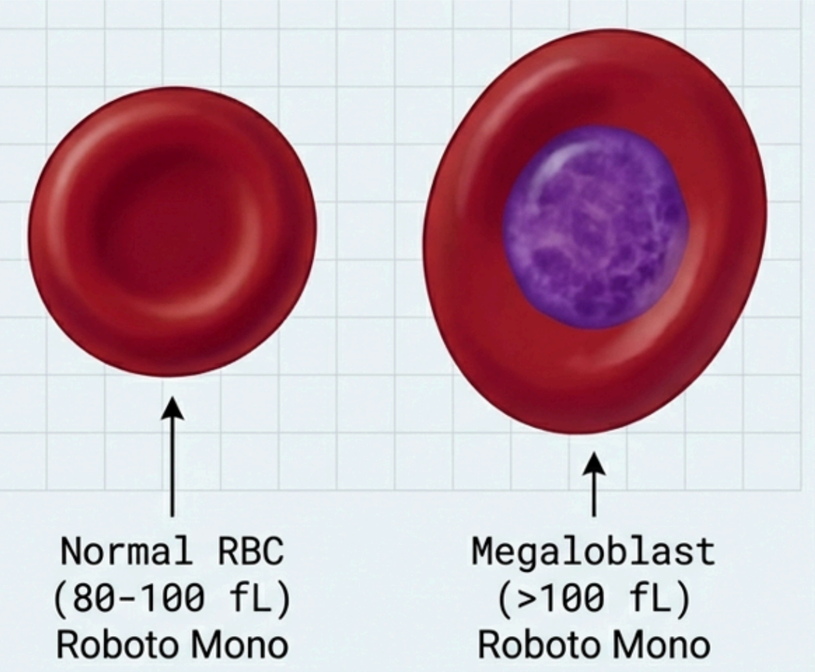


Most Common Cause: Poor nutrition, malabsorption, or chronic blood loss (e.g., hookworms, menstruation).

Pathophysiology: Lack of Iron → decreased Heme synthesis → low Hemoglobin.

CBC Findings: Microcytic (small cells) and low reticulocyte count

Megaloblastic Anemia



Cause: Deficiency of Vitamin B12 or Folate.

Pathophysiology: Impaired DNA synthesis leading to abnormal cell maturation.

CBC Findings: Megaloblast (large RBCs)

Extra Note: B12 deficiency can cause neurological symptoms

Aplastic Anemia (Bone Marrow Failure)

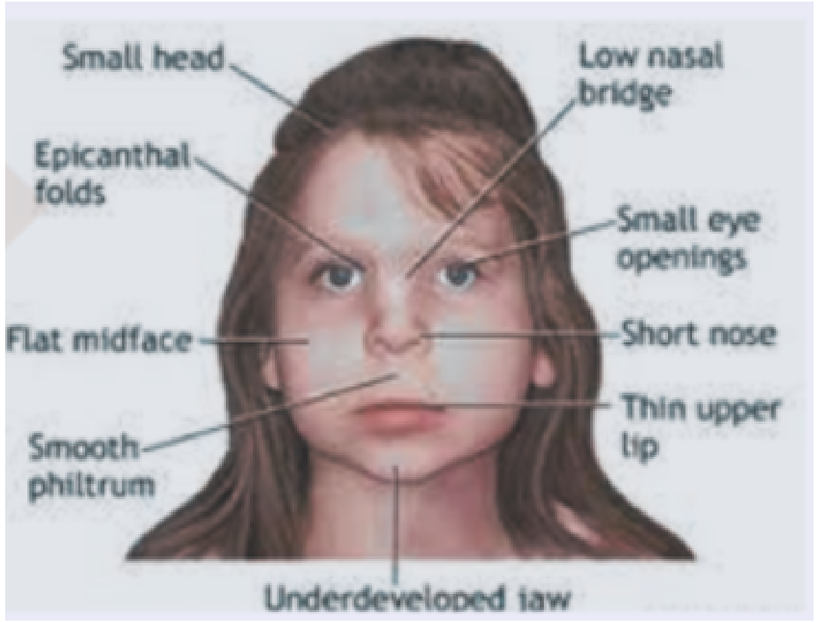
Definition: Failure of the bone marrow to produce all types of blood cells (Pancytopenia).

Pathogenesis: Stem cells are often suppressed by T-cells.

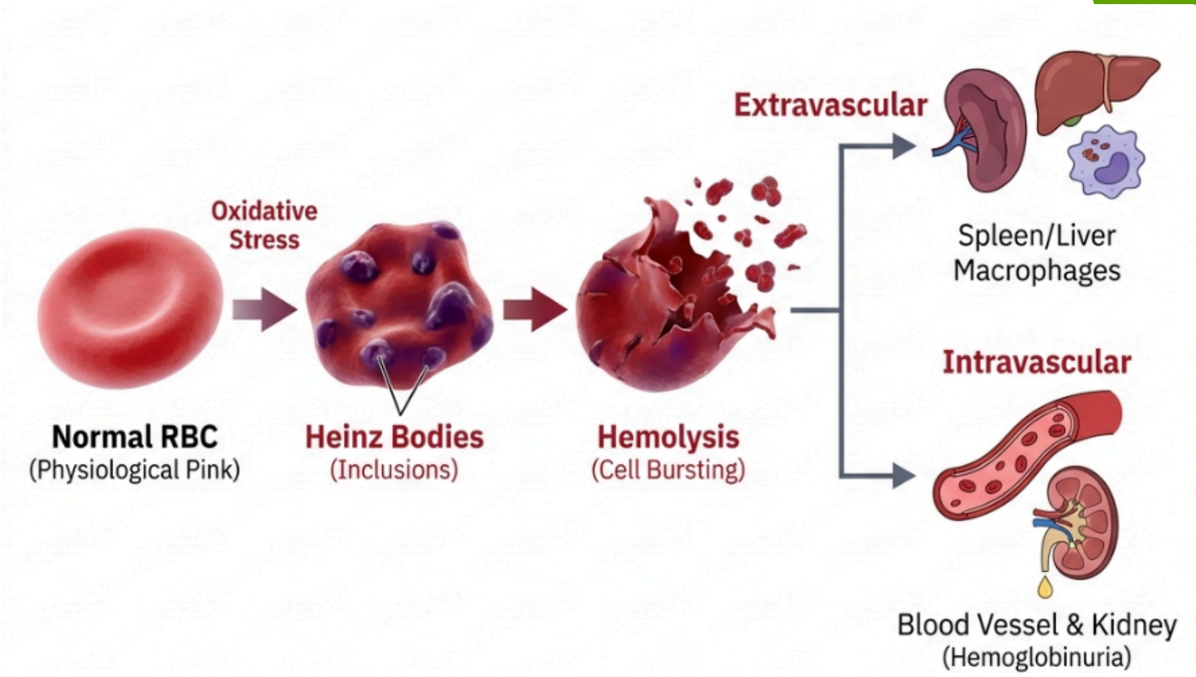
Causes: Drugs, chemicals (benzene), viruses, or idiopathic.

Treatment: Immunosuppressants or Marrow Transplantation

Thalassemia (Genetic Anemia)

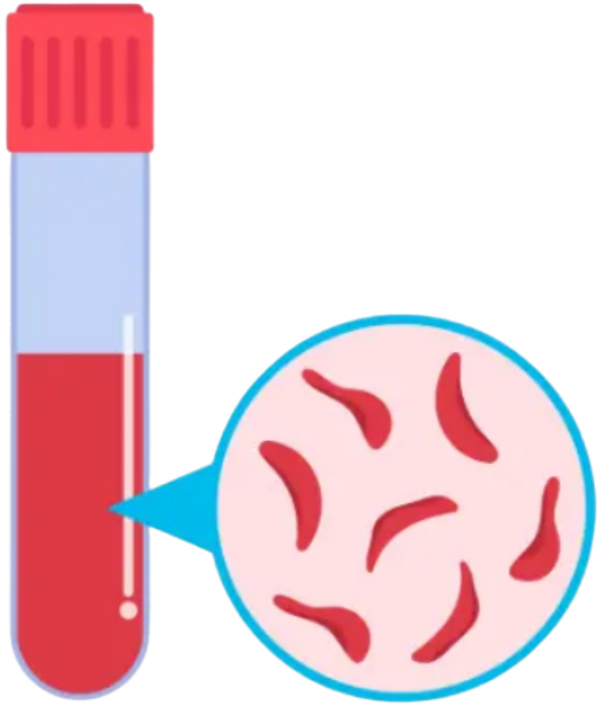


(Novum, 2019)

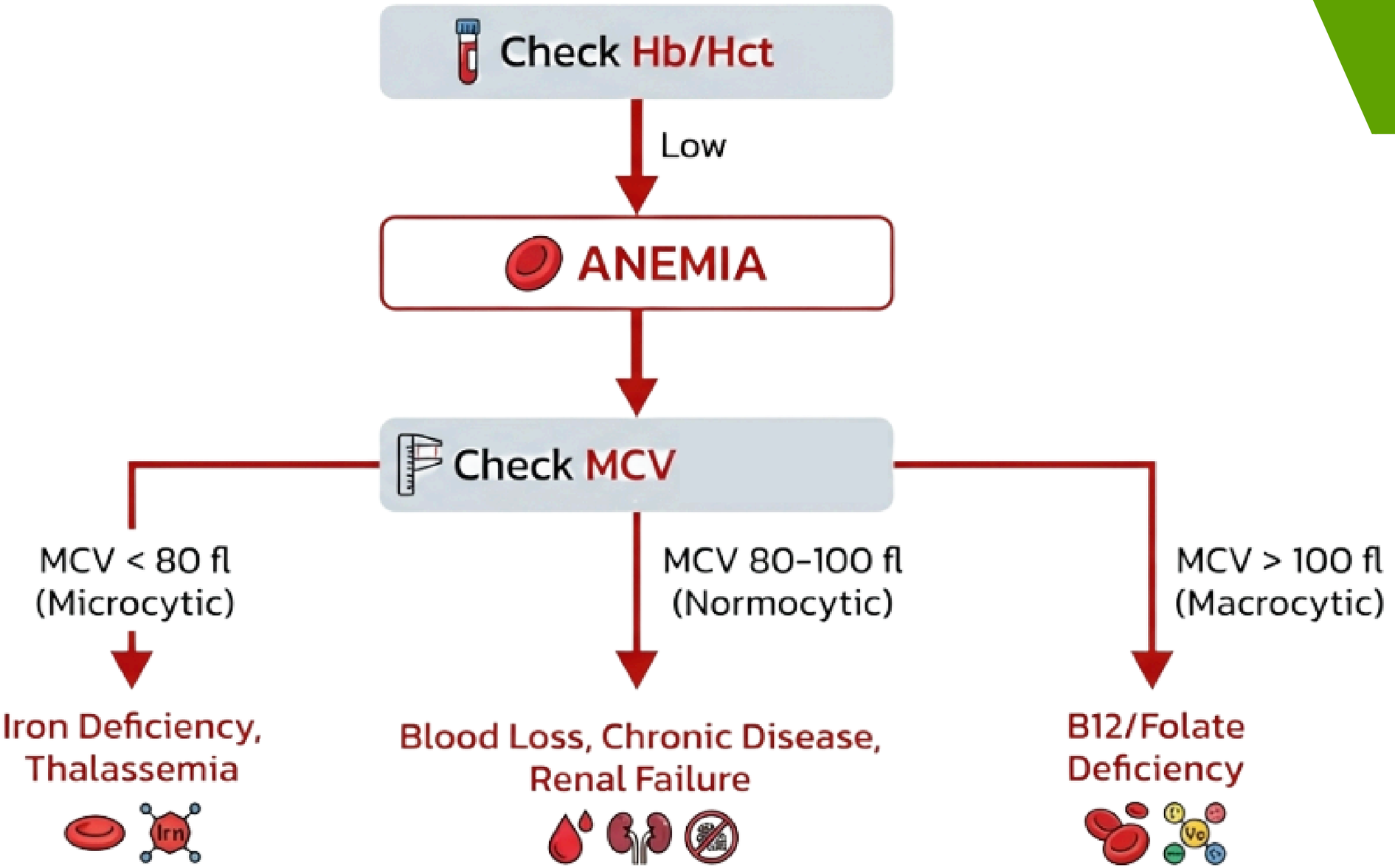


Pathophysiology: Genetic defect in Globin chain synthesis (Alpha or Beta chain)
Hemolysis: Abnormal hemoglobin precipitates, causing RBC destruction in spleen
Complications: Iron overload (Hemosiderosis), splenomegaly, and skeletal changes due to marrow expansion

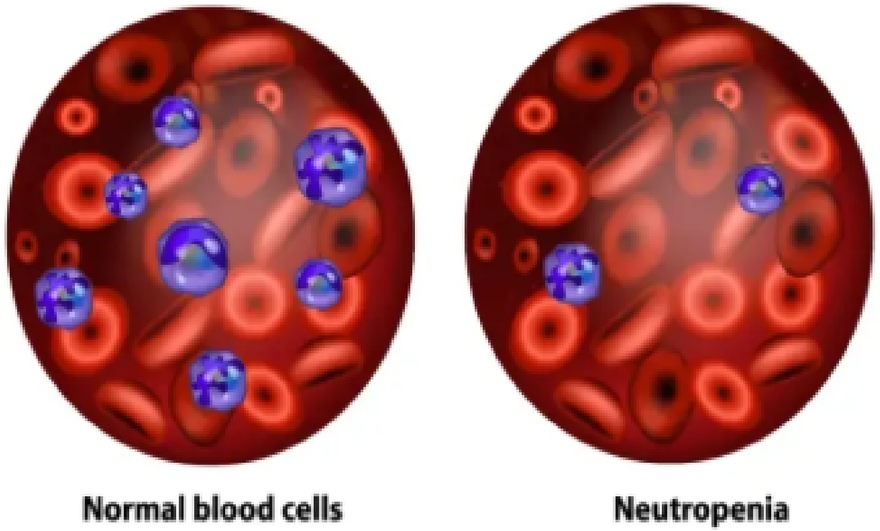
G6PD Deficiency



Type: X-linked recessive metabolic disorder.
Pathophysiology: Deficiency of G6PD enzyme makes RBCs vulnerable to oxidative stress.
Triggers: Infections, certain drugs (Sulfa), or Fava beans.
Result: Intravascular hemolysis leading to dark urine (hemoglobinuria)


Check Hb/Hct
Low
ANEMIA
Check MCV
MCV < 80 fl
(Microcytic)
MCV 80-100 fl
(Normocytic)
MCV > 100 fl
(Macrocytic)
Iron Deficiency,
Thalassemia
Blood Loss, Chronic Disease,
Renal Failure
B12/Folate
Deficiency
Iron
Vc

WBC Disorders - Leukopenia and Neutropenia



Neutropenia: Neutrophil count **< 1,500 cells/µL**

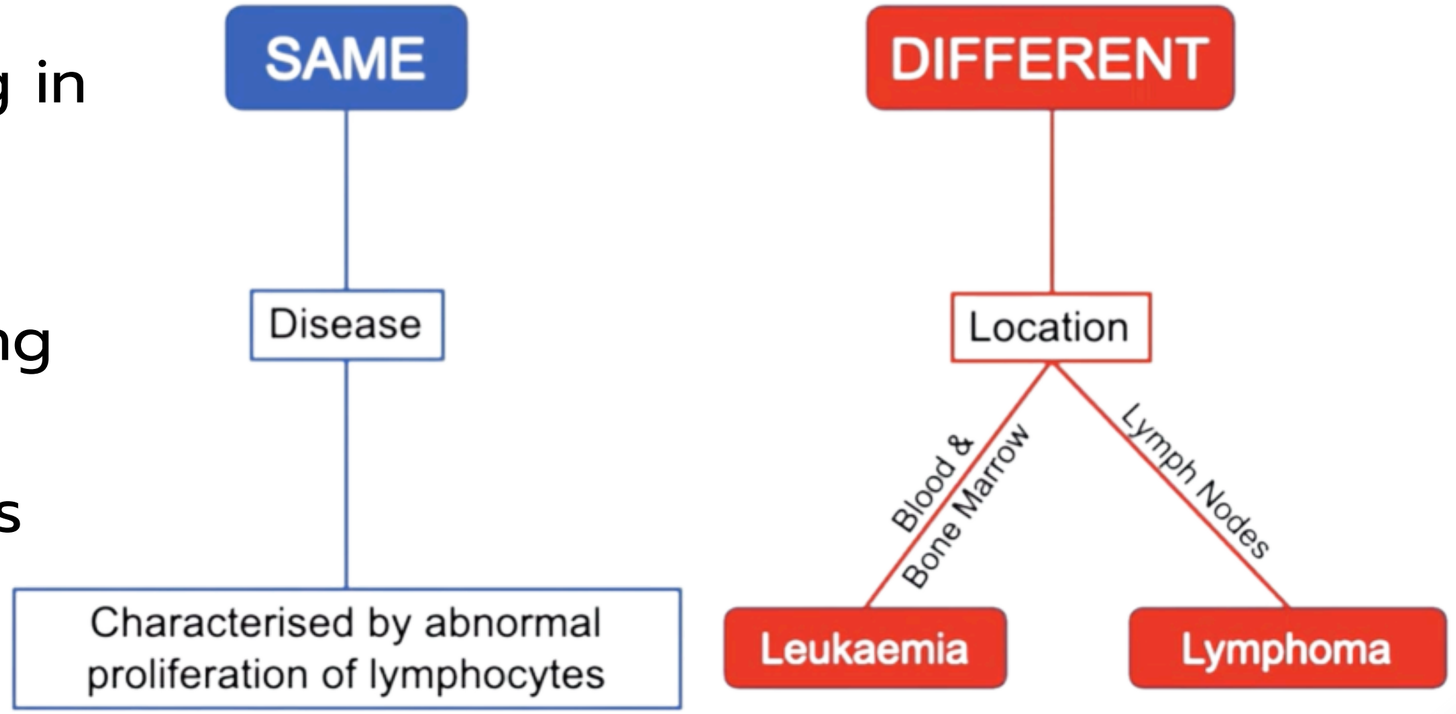
Agranulocytosis: Severe neutropenia (< 500 cells/µL), high risk of life-threatening infection

Causes: Chemotherapy, drug reactions (Sulfa), or marrow suppression

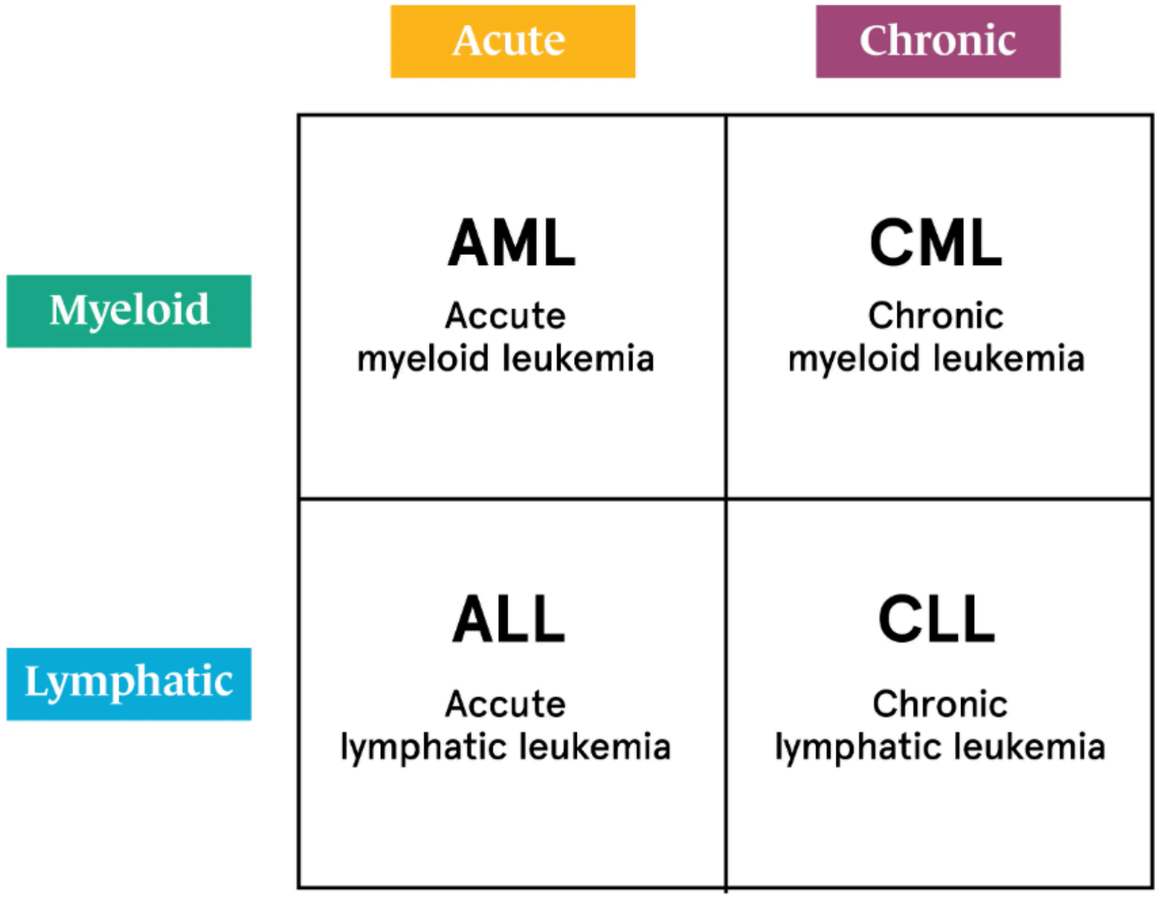
Hematologic Malignancies: Leukemia vs. Lymphoma

Leukemia: Cancer originating in the bone marrow; malignant cells are found in the blood

Lymphoma: Cancer originating in the lymphoid tissue (nodes/organs); usually forms solid masses



Leukemias

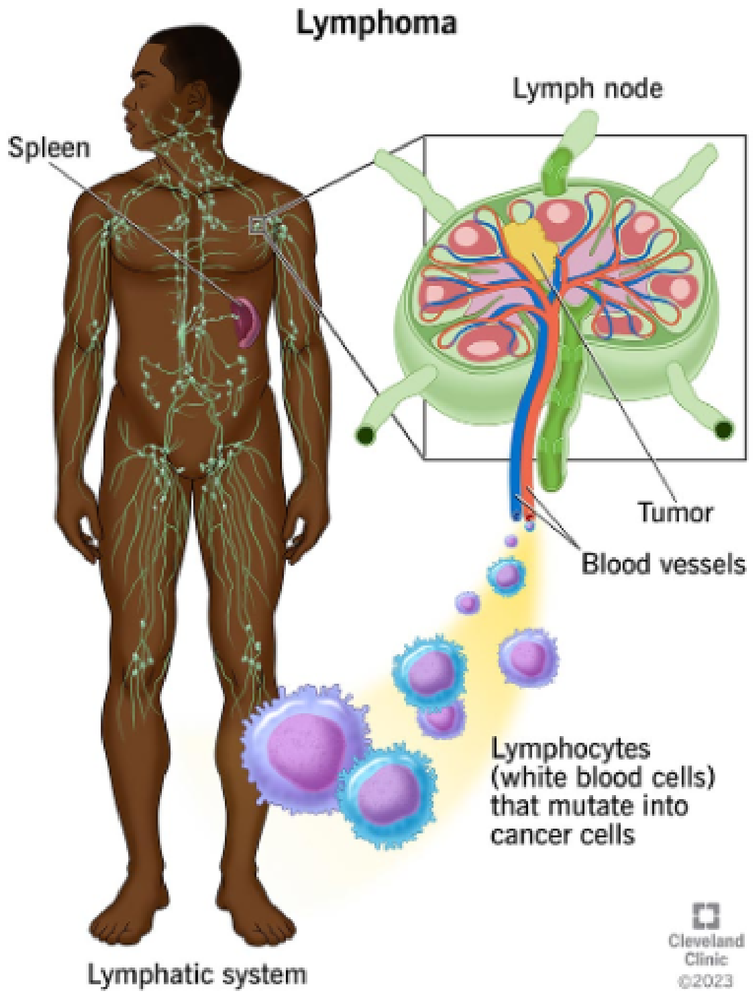


(Rocky Mountain Cancer Centers, 2026)

Acute: Rapid onset, involves immature "Blast" cells (≥ 20-25% in marrow)

Chronic: Slow progression, involves mature-looking cells

Lymphoma



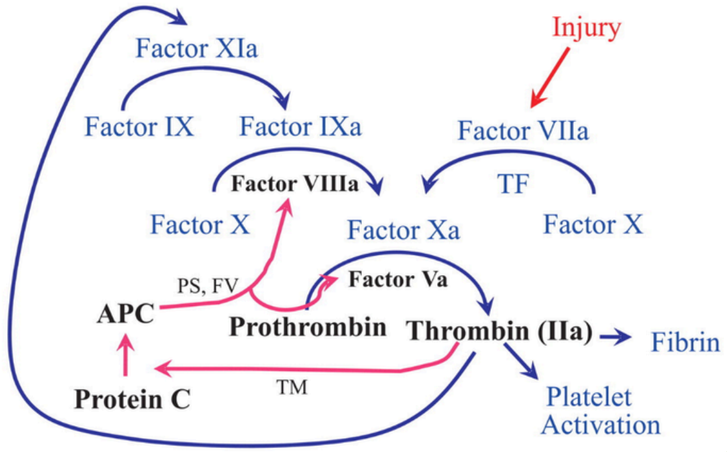
1. **Hodgkin Lymphoma (HL):** Characterized by Reed-Sternberg cells ("Owl's eye" appearance).
2. **Non-Hodgkin Lymphoma (NHL):** Includes B-cell and T/NK-cell types; more common than HL.

Clinical Presentation: Painless swollen lymph nodes (mostly in the neck) and night sweats

Hemostatic Mechanism: Bleeding

Primary Hemostasis

1. Vascular Response: Vasoconstriction to reduce blood flow.
2. Platelet Response: Platelet adhesion (via Von Willebrand factor), activation, and aggregation to form a Platelet Plug



Secondary Hemostasis (Gale, A.J., 2012)

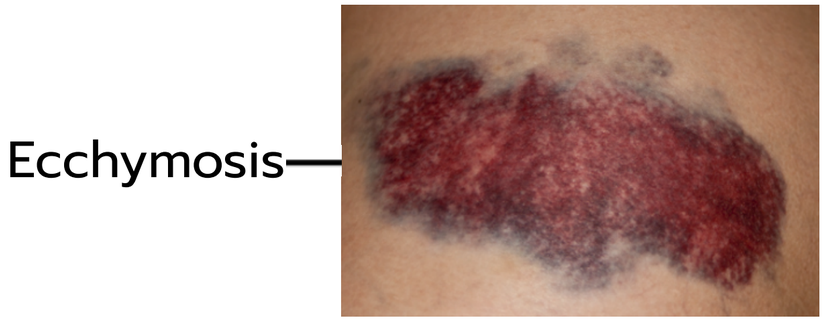
Secondary Hemostasis

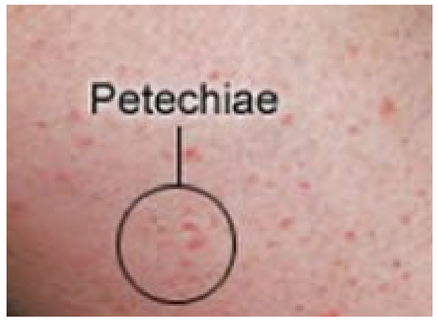
Extrinsic Pathway: Triggered by Tissue Factor (Factor III).

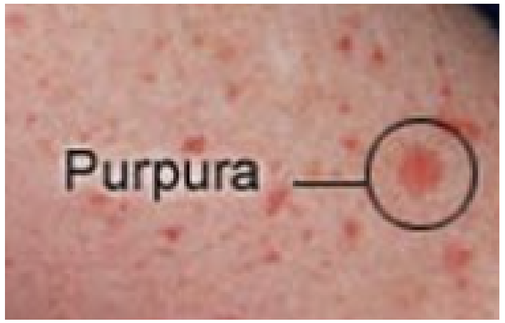
- Intrinsic Pathway: Triggered by contact with collagen (Factor XII).
- Common Pathway: Activation of Factor X → Prothrombin to Thrombin → Fibrinogen to Fibrin

Bleeding Disorders

Petechiae: Small red dots (1-5 mm), typical of low platelets.
Ecchymosis: Bruises/purplish patches.
Hemarthrosis: Bleeding into joints (typical of Hemophilia).
Hematoma: Deep collection of blood in muscles

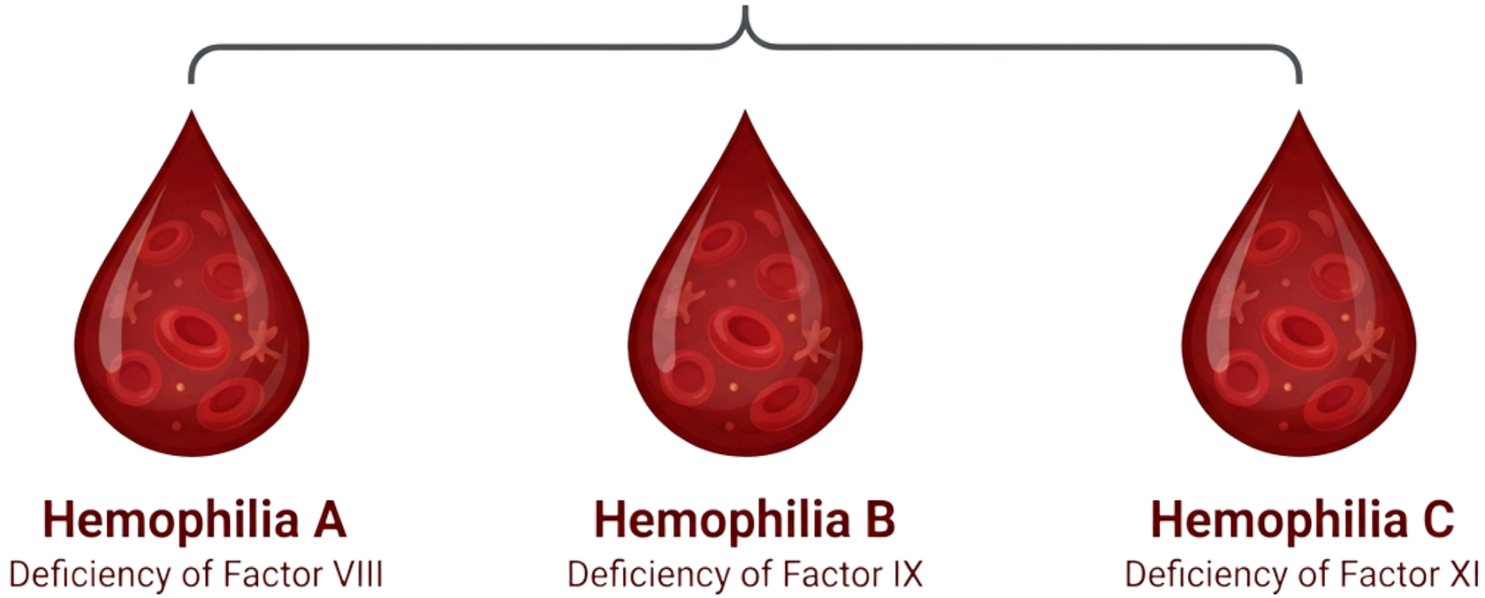






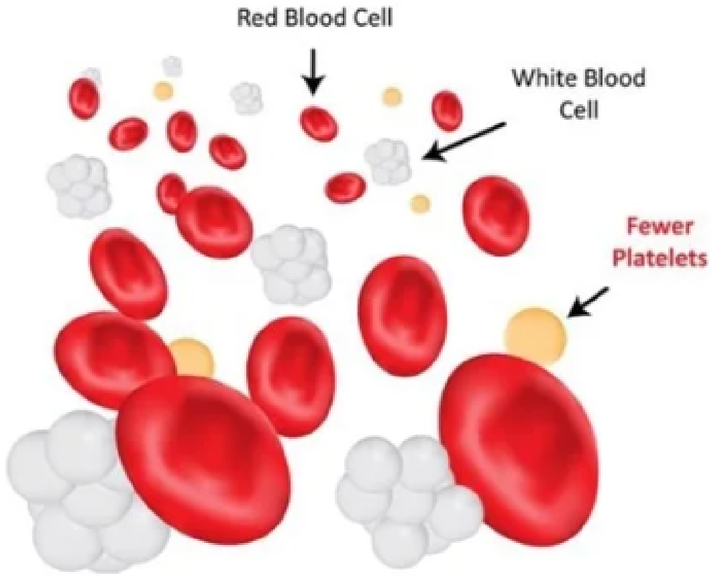
Hemophilia (Factor Deficiencies)

Hemophilia A: Deficiency of Factor VIII (85% of cases)
Hemophilia B: Deficiency of Factor IX
Hemophilia C: Deficiency of Factor XI



(Seema, et al., 2024)

Platelet Disorders

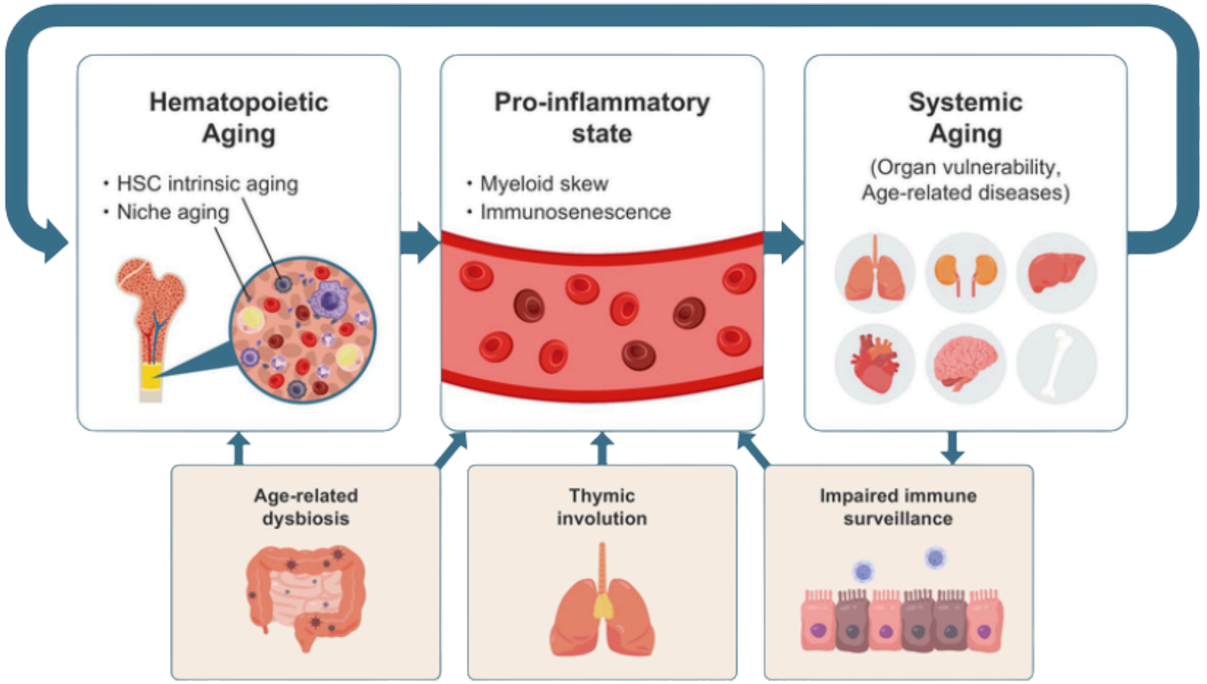


Thrombocytopenia: Low platelet count due to infections (Dengue), drugs, or ITP (autoimmune)

ITP (Idiopathic Thrombocytopenic Purpura): Antibodies destroy platelets

Abnormal Function: Platelets are normal in count but fail to work (e.g., Aspirin use, Uremia)

Hematologic Changes in Aging



(Miyawaki, et al., 2026)

Anemia of Renal Failure: Common in the elderly due to chronic kidney disease (CKD), leading to decreased Erythropoietin (EPO) production.

Anemia of Chronic Disease: Often seen in elderly patients with long-term infections, inflammation, or malignancies.

Case study

Mr. A, a 72-year-old male.

Chief Complaint: Increasing fatigue, pale skin, and shortness of breath on exertion for 3 months.

Past Medical History: Chronic Kidney Disease (CKD) Stage 4 and Hypertension.

Physical Examination:

Pale conjunctiva and pale palms,.

Laboratory Results:

Hemoglobin (Hb): 9.2 g/dL

Hematocrit (Hct): 28%.

Question

1. Based on the patient's age and gender, how do you interpret his Hemoglobin (Hb) level of 9.2 g/dL?
2. What is the most likely pathophysiological mechanism causing anemia in this patient?

Answer

1

Significant anemia, as the threshold for elderly men is 13.0 g/dL. According to the sources, the normal Hemoglobin threshold for elderly men (and postmenopausal women) is 13.0 g/dL,. A level of 9.2 g/dL indicates a clear state of Anemia, which explains his fatigue and tachycardia as the heart works harder to supply oxygen to tissues

Answer

2

Decreased Erythropoietin (EPO) production due to Chronic Kidney Disease.

The patient has Stage 4 CKD. The sources state that Anemia of Renal Failure occurs because the failing kidneys produce less Erythropoietin (EPO),. EPO is the essential hormone that stimulates the bone marrow to produce Red Blood Cells. The low reticulocyte count in this patient confirms that the bone marrow is not producing enough new cells

มหาวิทยาลัยราชภัฏนครปฐม