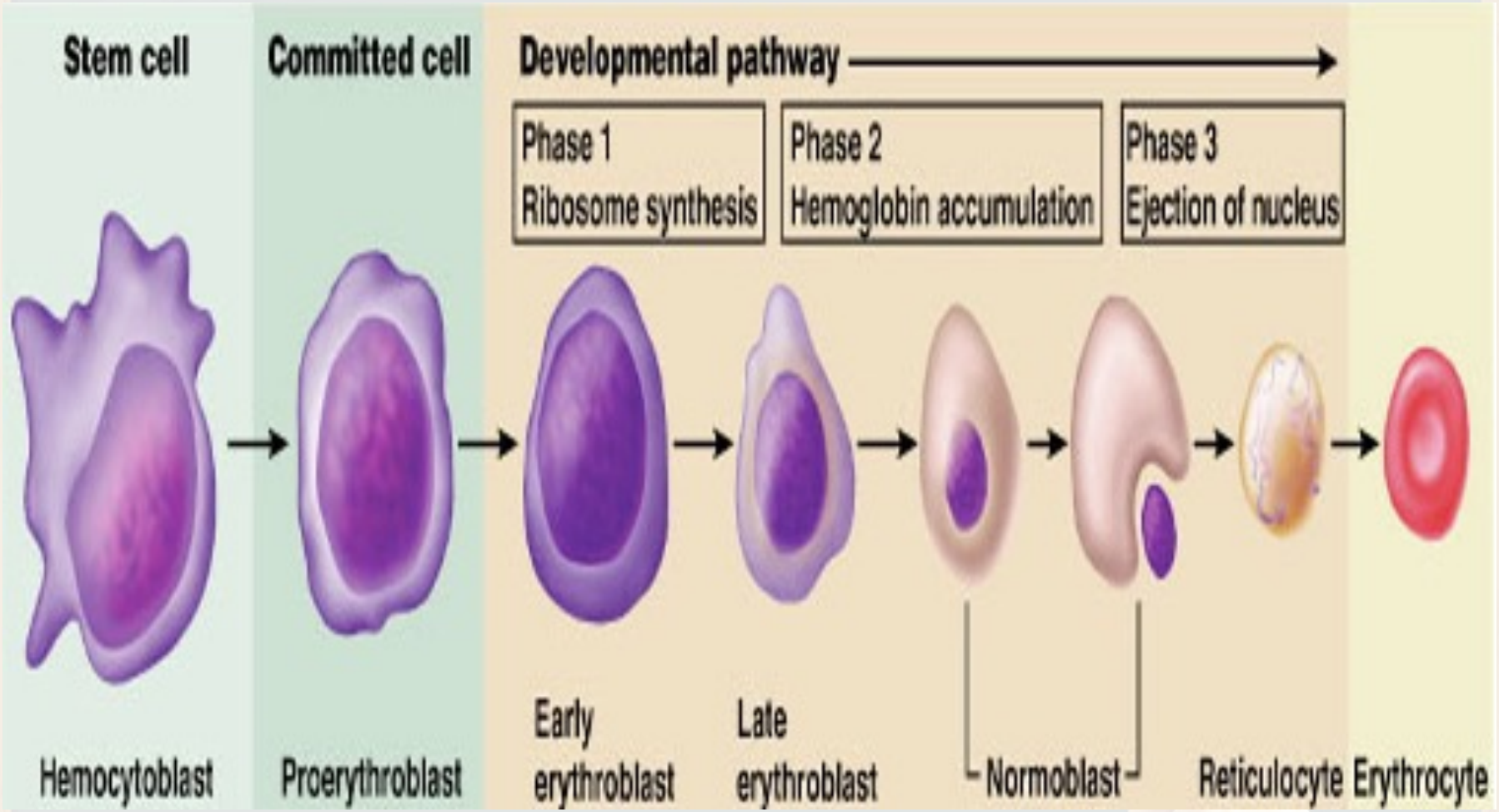
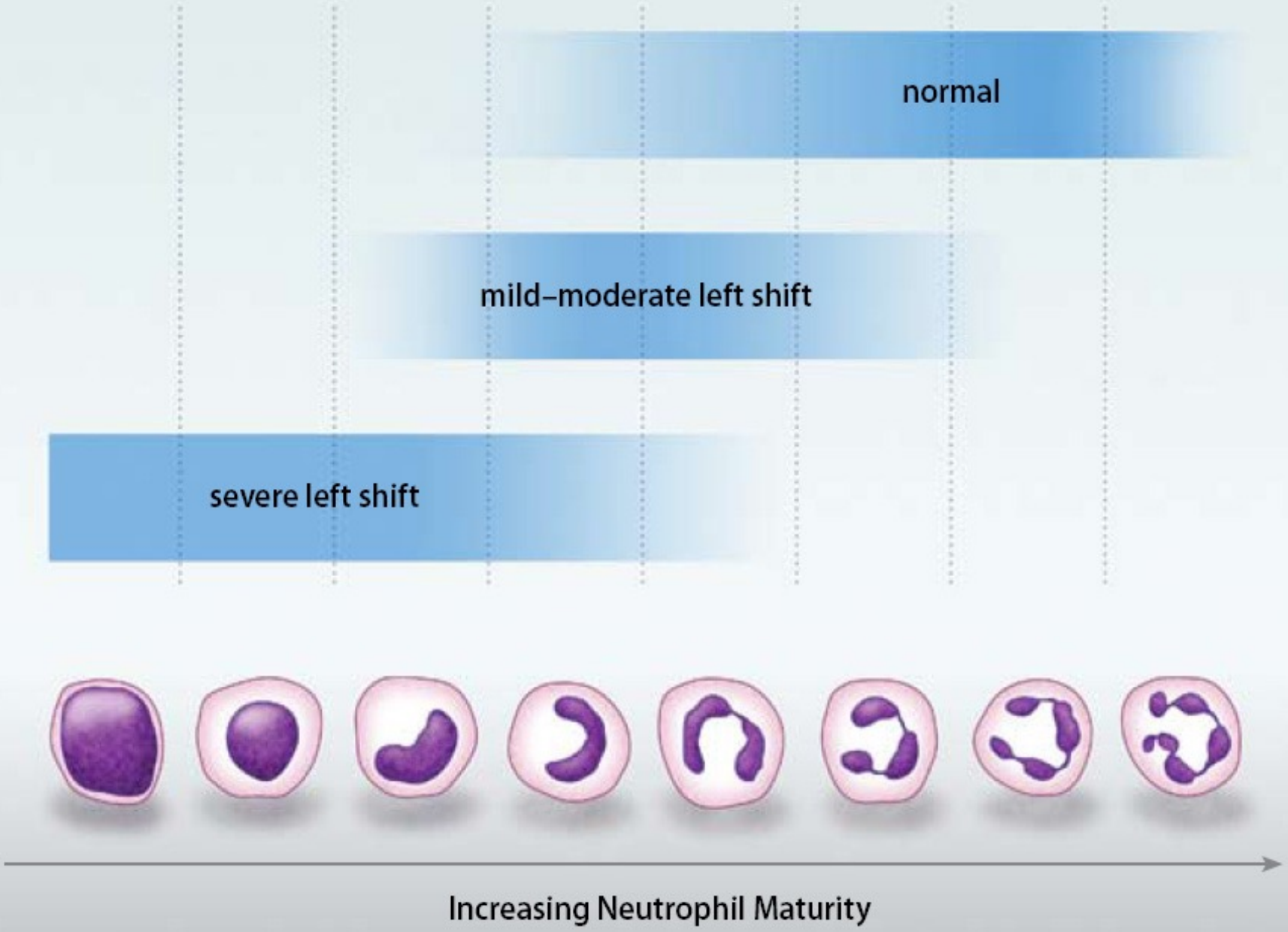
Blood Disorders

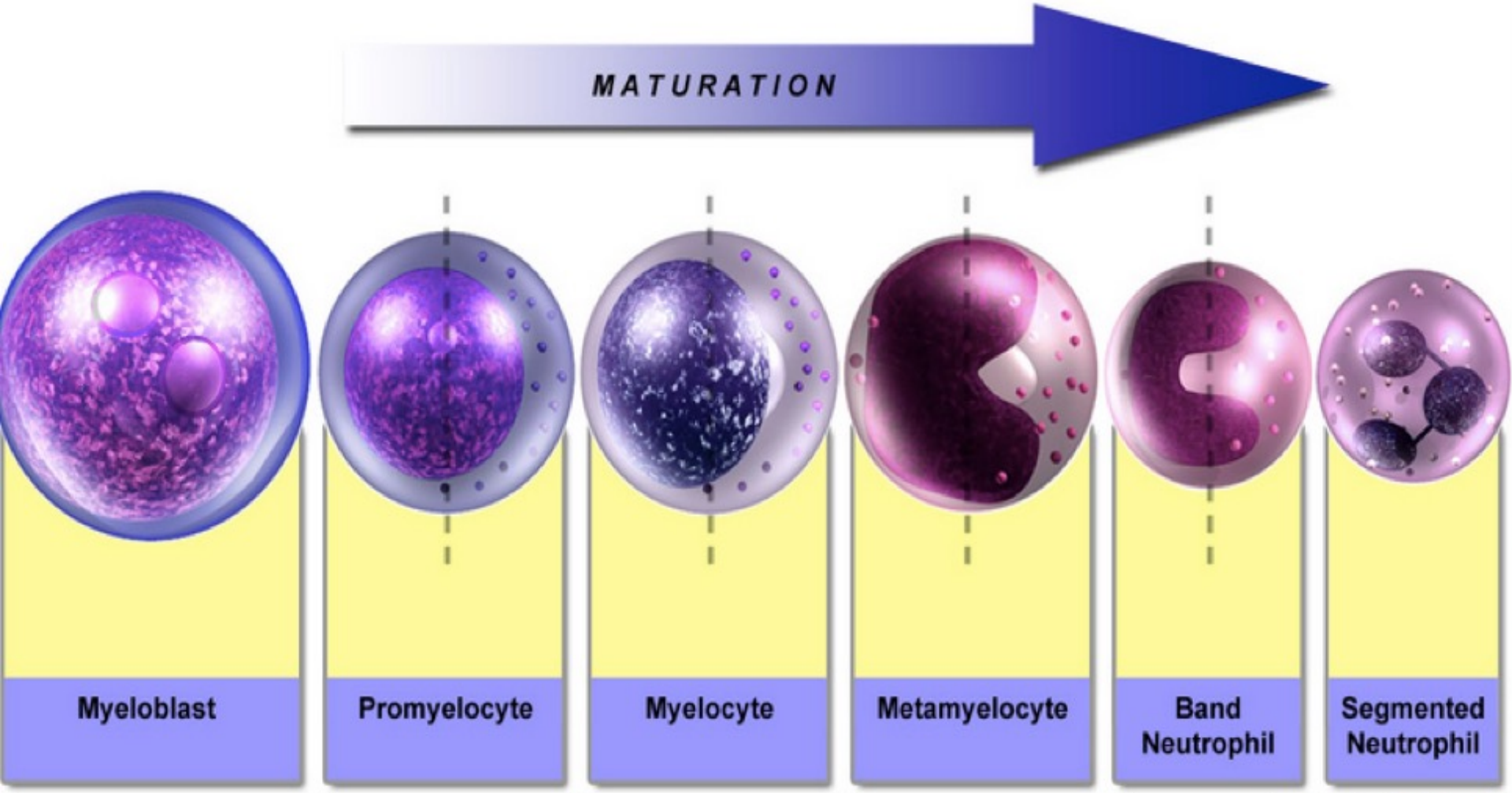
Dr. Gary Mumaugh - Campbellsville University

RBC Shift to the Left




normal
mild–moderate left shift
severe left shift
Increasing Neutrophil Maturity

WBC Shift to the Left

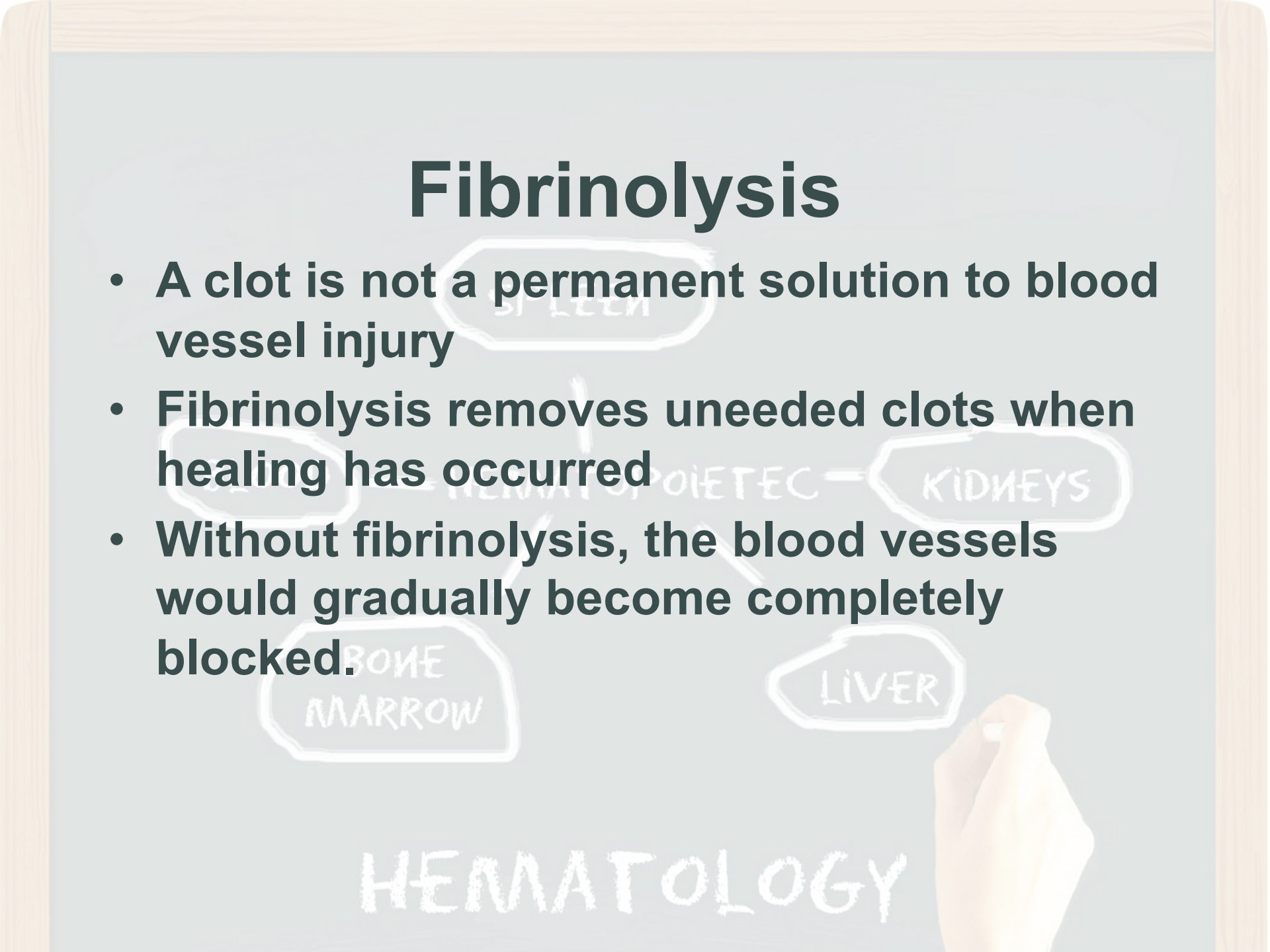


What are the risks of a left shift?

HEMATOLOGY

Fibrinolysis

- A clot is not a permanent solution to blood vessel injury
- Fibrinolysis removes uneeded clots when healing has occurred
- Without fibrinolysis, the blood vessels would gradually become completely blocked.



Alterations of Coagulation

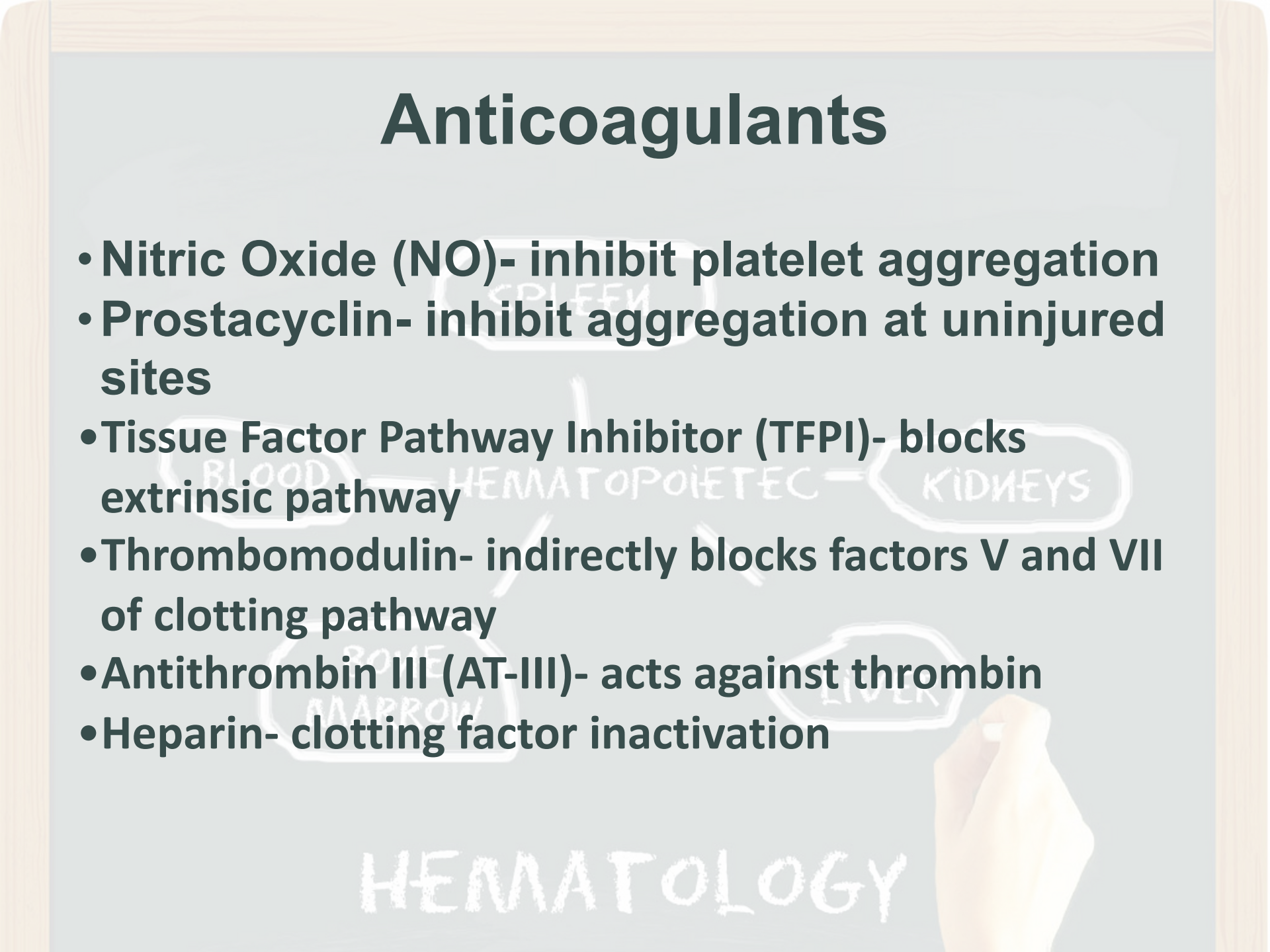
- **Vitamin K deficiency**
  - Vitamin K is necessary for synthesis and regulation of prothrombin, the prothrombin factors
- **Liver disease**
  - Liver disease causes a broad range of hemostasis disorders:
    - Defects in coagulation
    - Fibrinolysis
    - Platelet number and function

Anticoagulation

- **Hemodynamics- movement of blood limits coagulation**
- **VISCOSITY MATTERS - remember HCT**
- **Endothelial Mediation- secrete agents that oppose platelet aggregation**

Anticoagulants

- Nitric Oxide (NO)- inhibit platelet aggregation
- Prostacyclin- inhibit aggregation at uninjured sites
- Tissue Factor Pathway Inhibitor (TFPI)- blocks extrinsic pathway
- Thrombomodulin- indirectly blocks factors V and VII of clotting pathway
- Antithrombin III (AT-III)- acts against thrombin
- Heparin- clotting factor inactivation



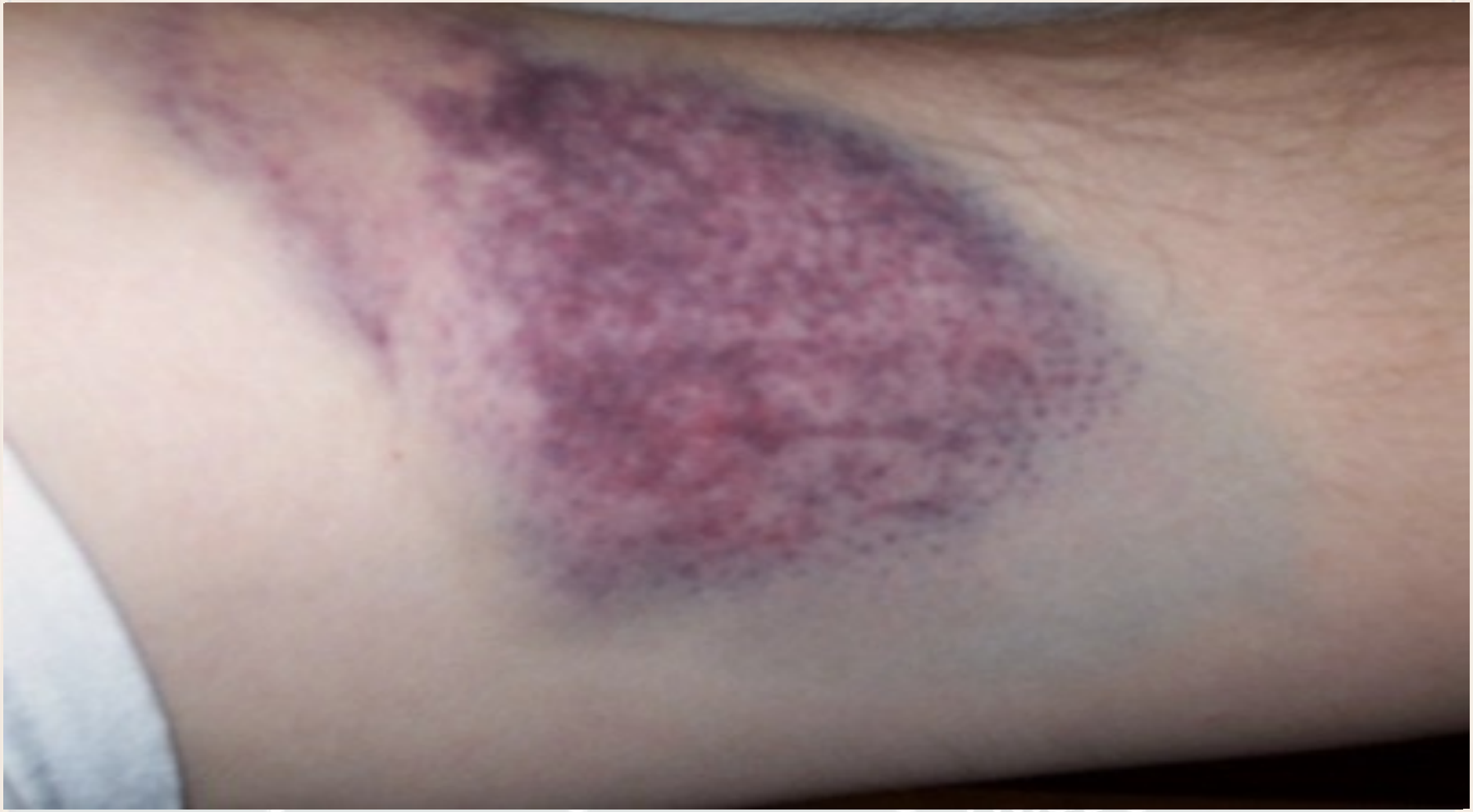
The Fibrinolytic System

- **Must eventually break down clots to repair vessels**
- **Plasmin- an enzyme that breaks down fibrin and several clotting factors**
- **Plasminogen- Inactive plasmin precursor**

Bleeding Disorders

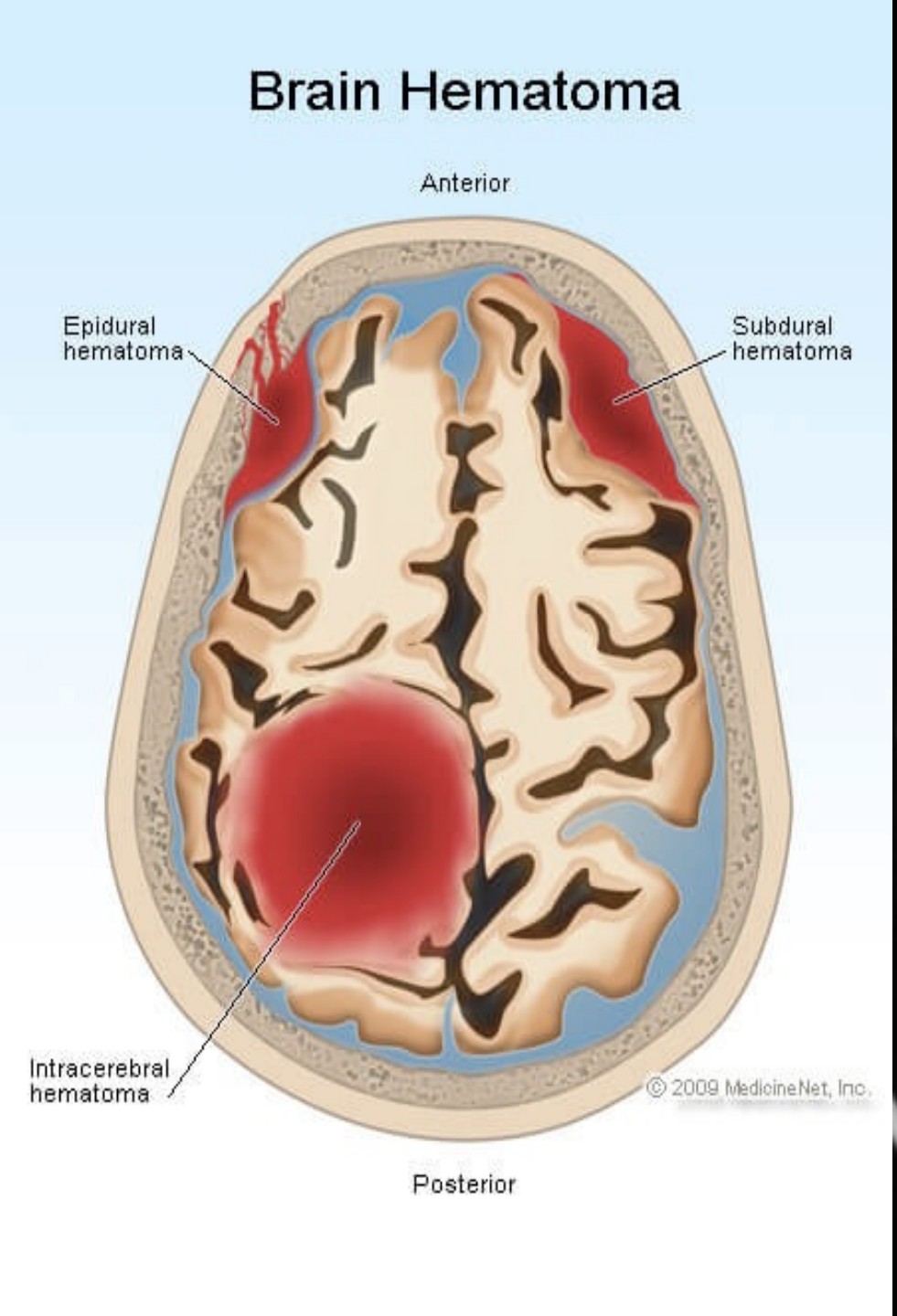
Hemorrhage

- Blood flow in an inappropriate place, RBCs are trapped in surrounding tissues
- Color characteristics of hemorrhage - purple, through blue/black, to green, and finally yellow



Hematoma - A large amount of blood trapped in a tissue/organ which can compress adjacent organs or ducts

What is the main thing to consider with a hematoma ??


Brain Hematoma
Anterior
Epidural hematoma
Subdural hematoma
Intracerebral hematoma
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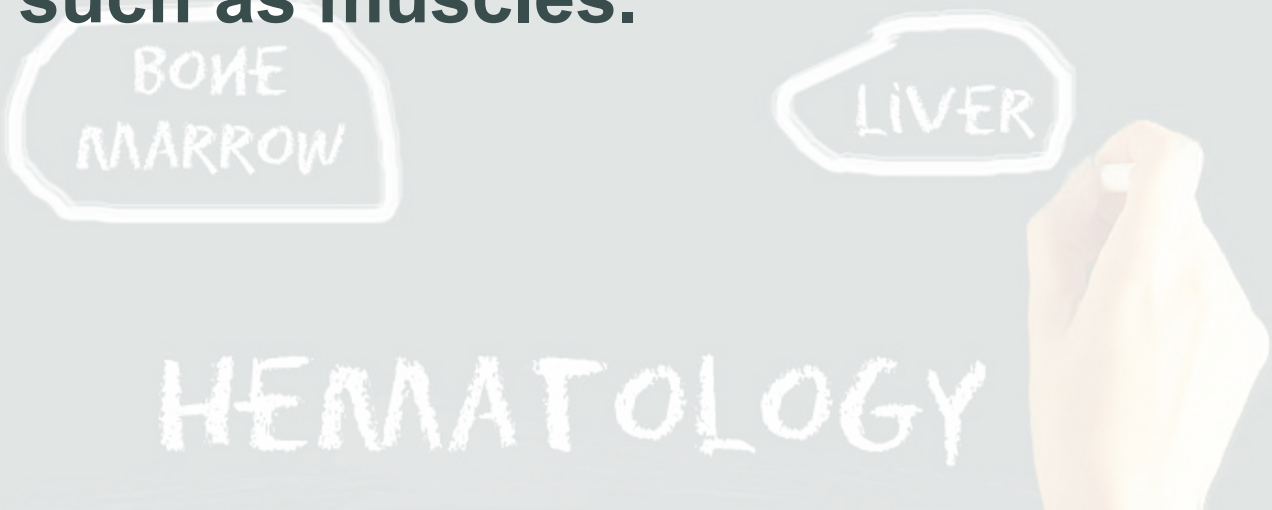
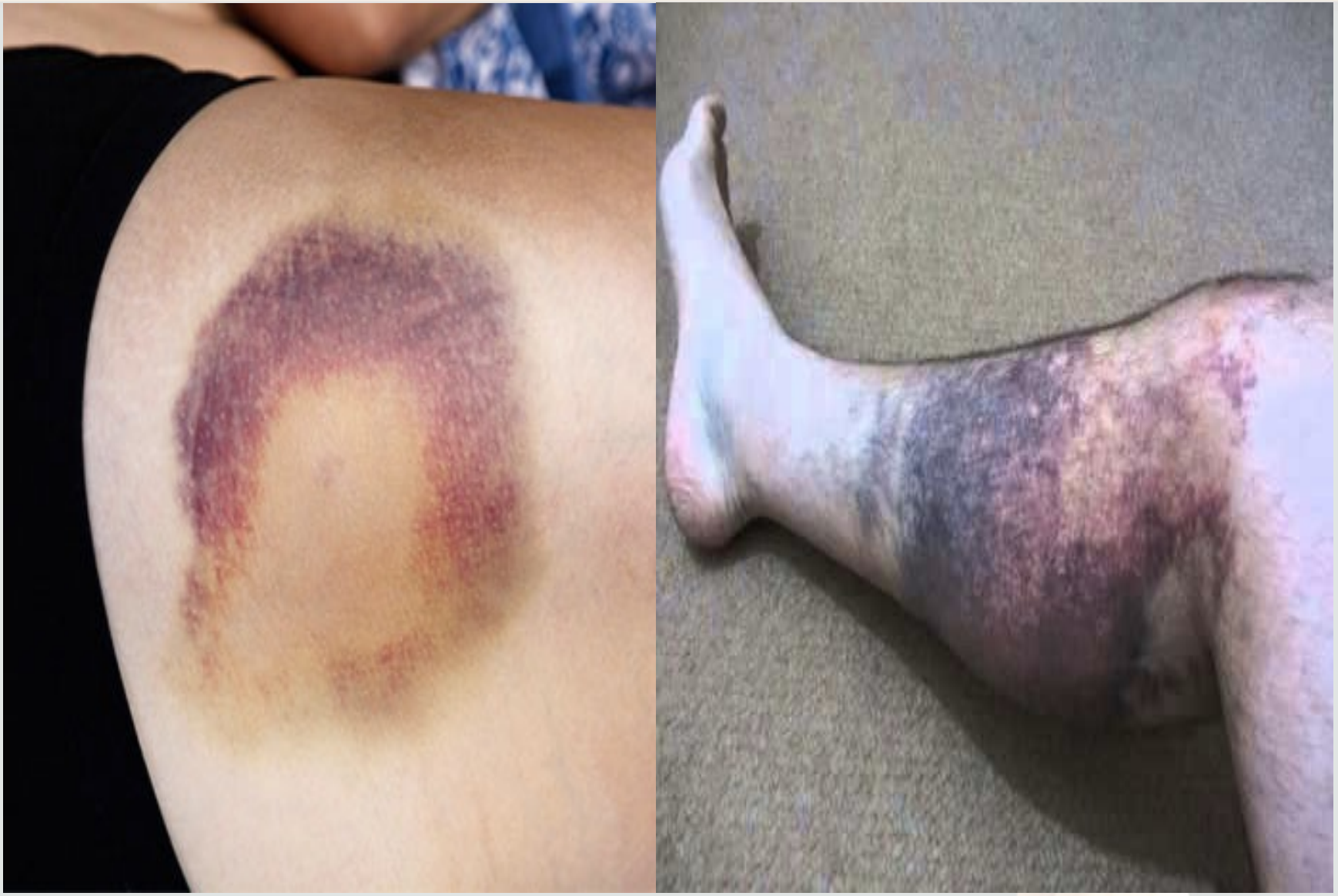
Posterior

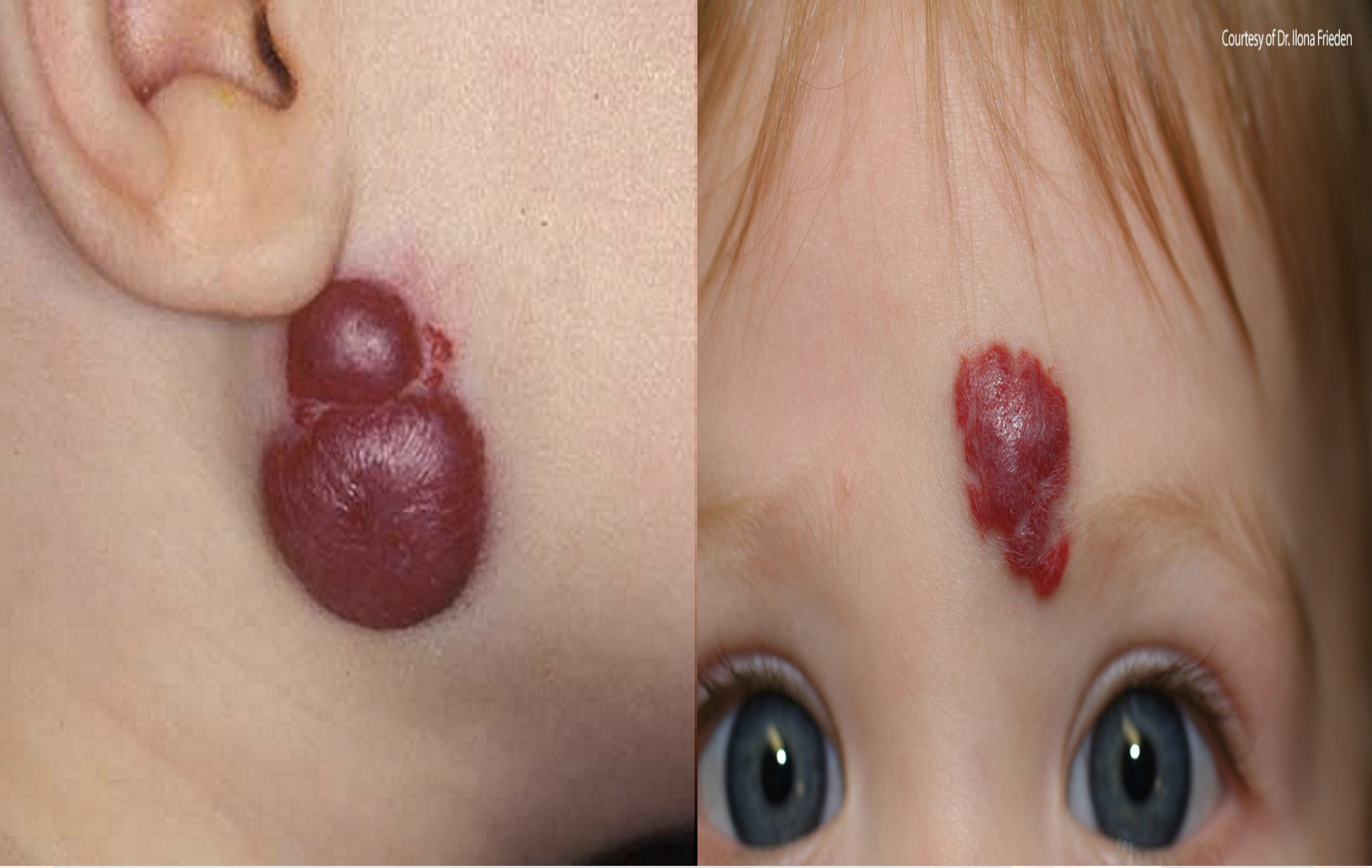
Different Terms

- **Ecchymosis** - a bruise that is a hematoma larger than 10 cm.
- **Hemangioma** - blood vessel birth mark
- Internal bleeding - is generally referred to as bleeding in the abdomen or thoracic cavities or in the skull. This term is not used for other areas such as muscles.

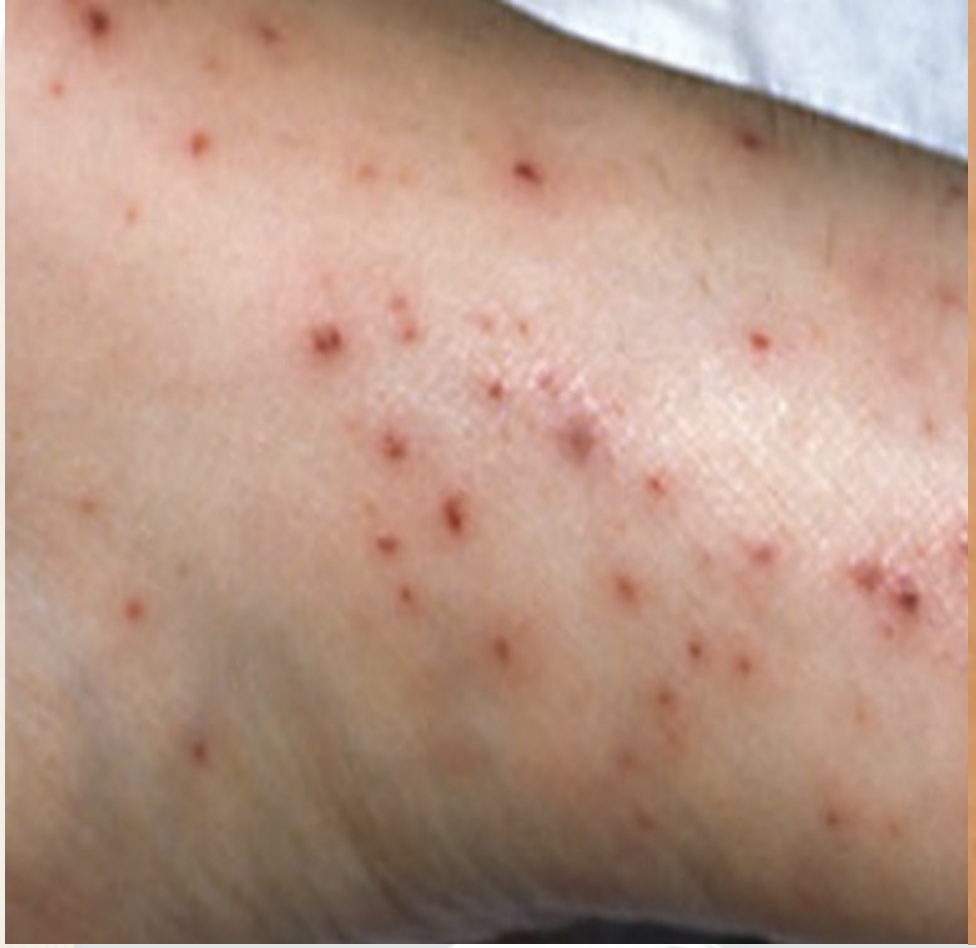


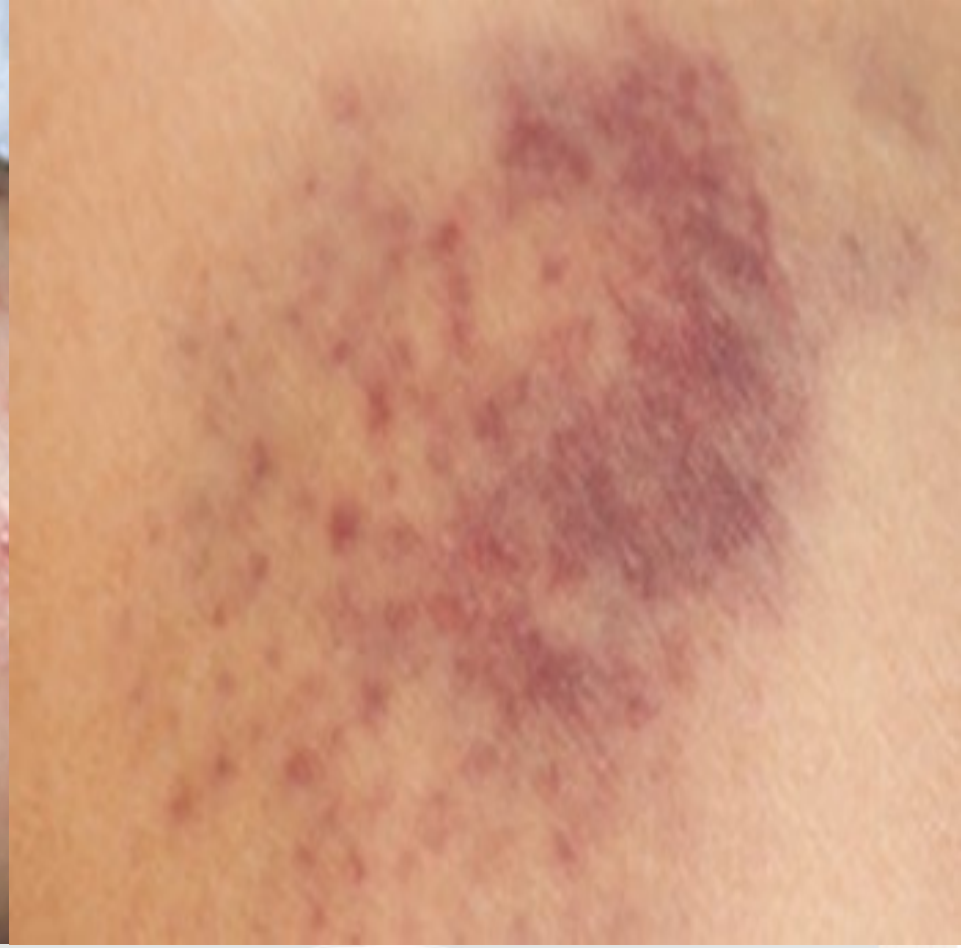


Ecchymosis - a bruise that is a hematoma larger than 10 cm.

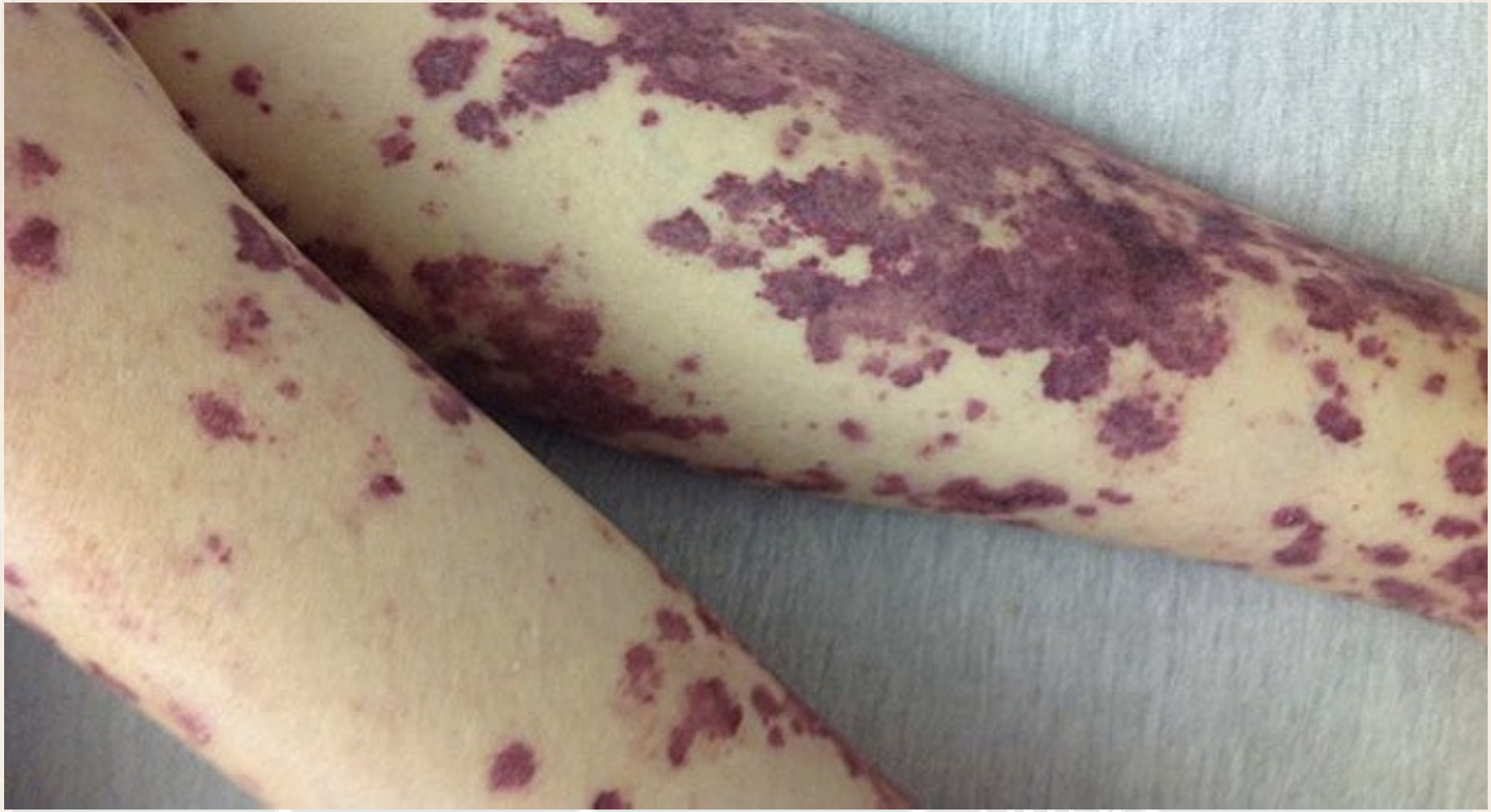


Infantile hemangioma occurs in 5-10% of infants

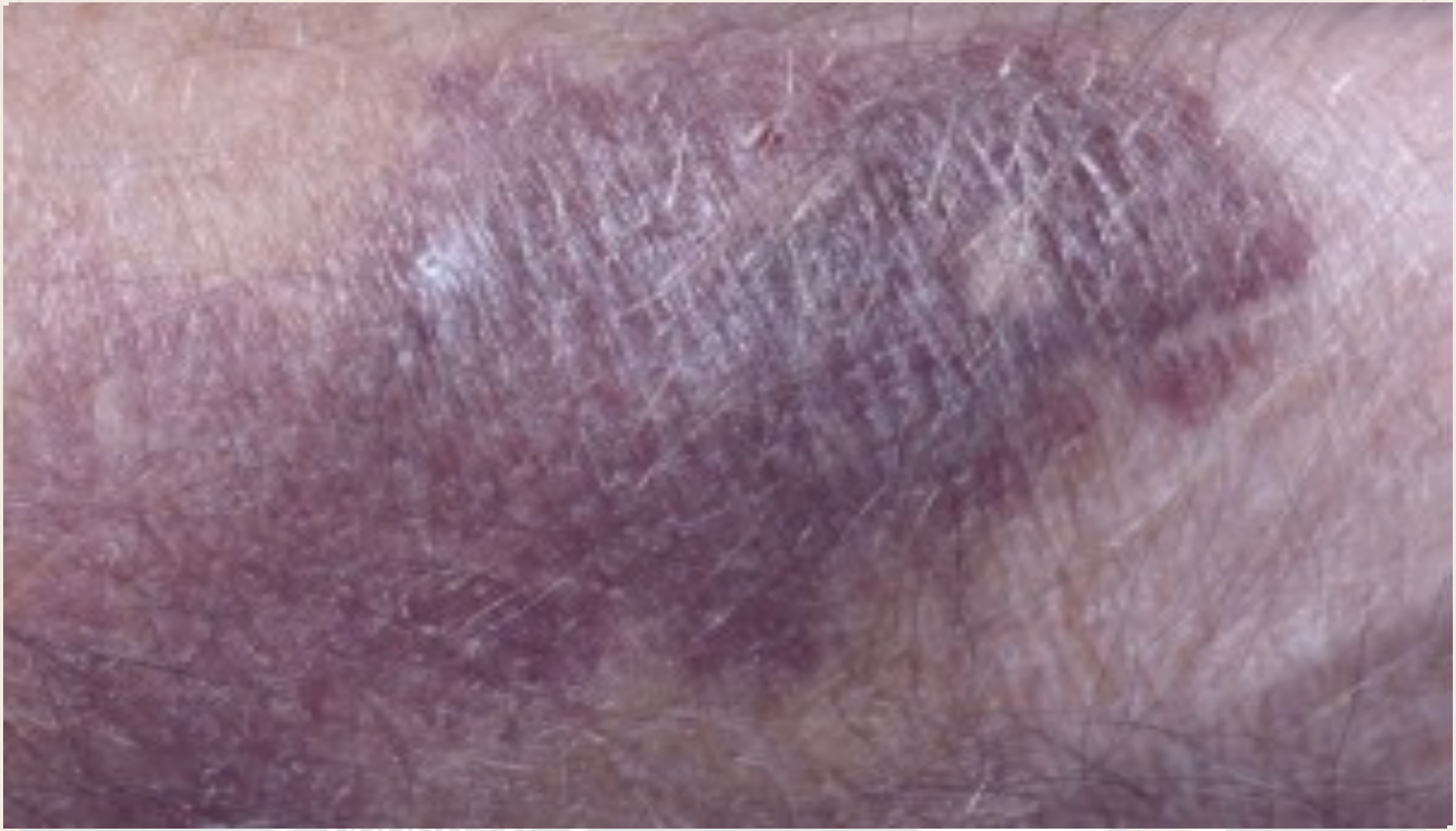




Petechiae- Small, well-defined areas of hemorrhage in tissue and/or organs



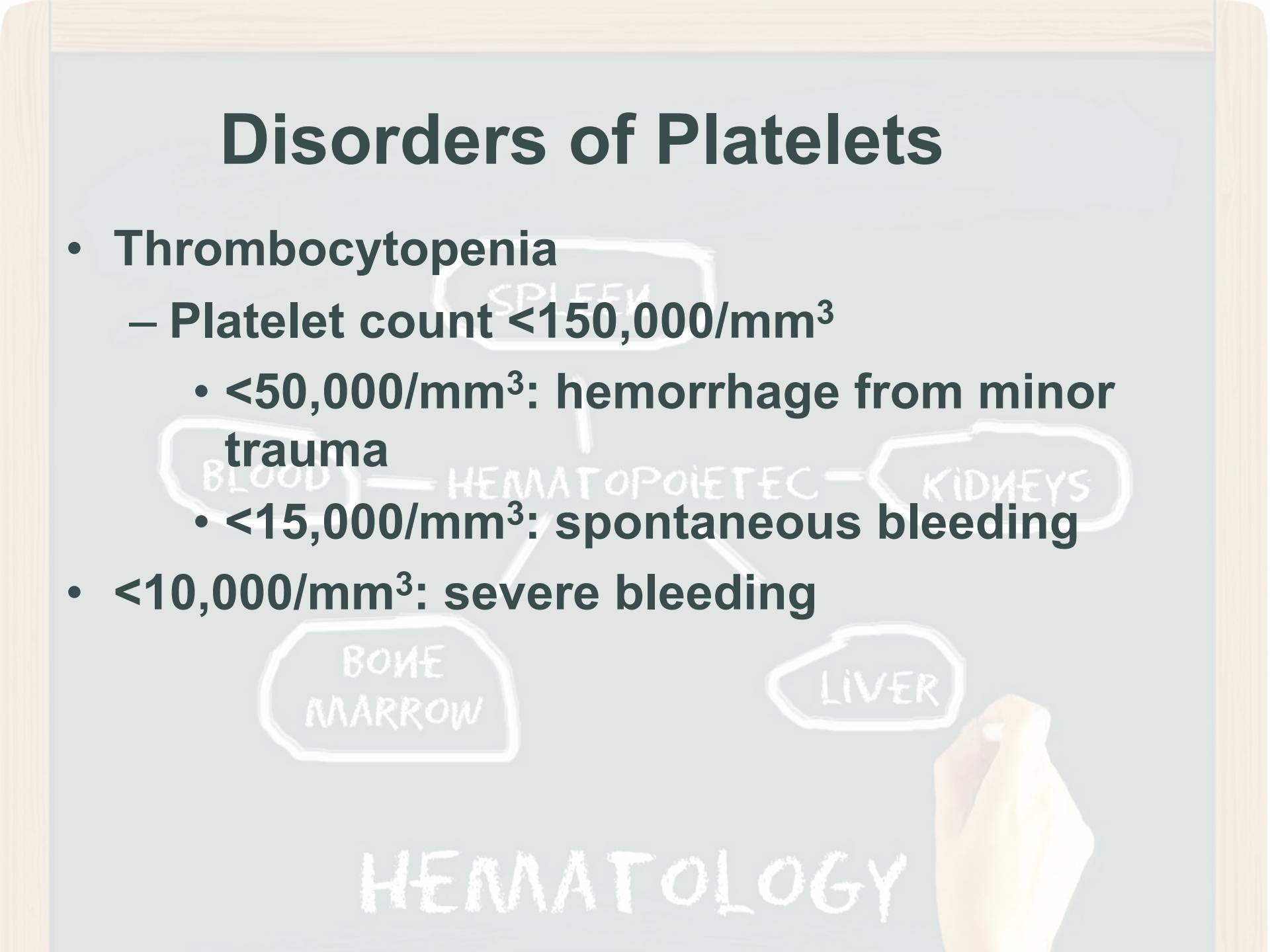
Purpura- Areas of larger, more diffuse hemorrhaging

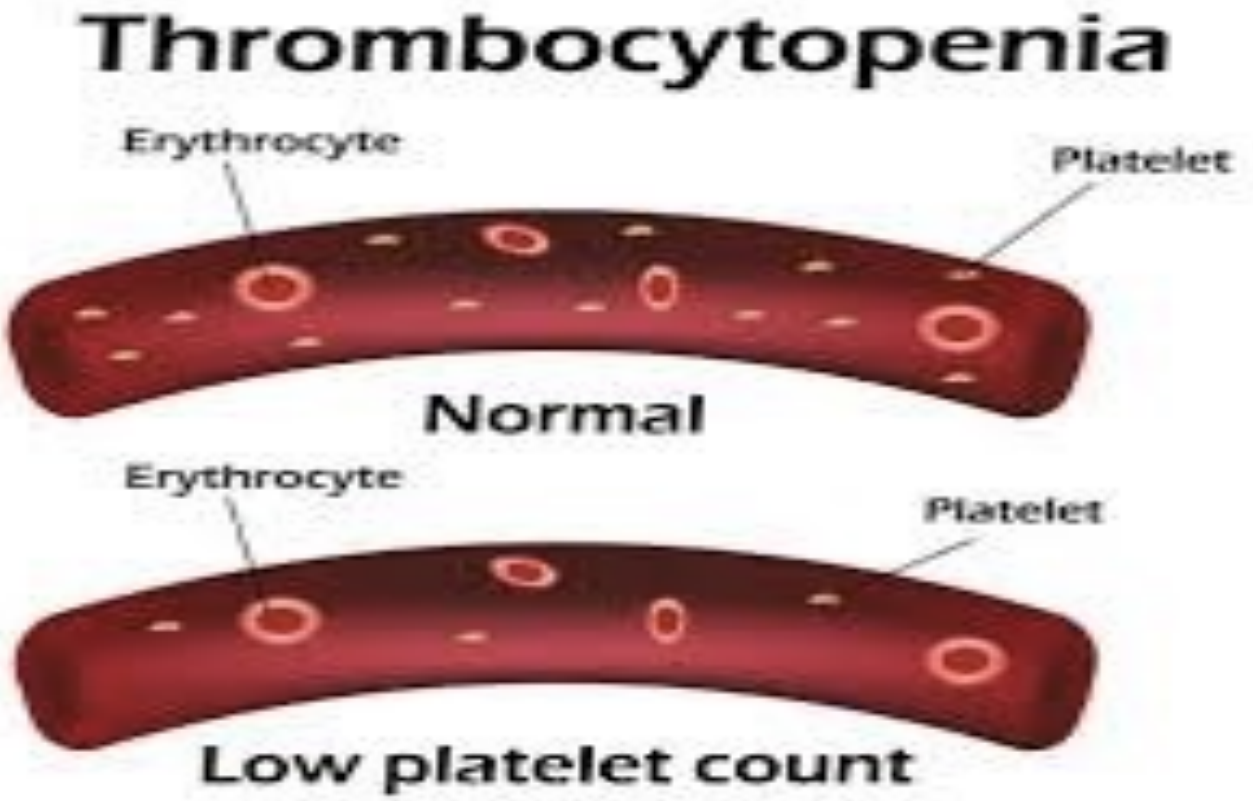


Senile purpura

Disorders of Platelets

- Thrombocytopenia
  - Platelet count <150,000/mm^3
    - <50,000/mm^3: hemorrhage from minor trauma
    - <15,000/mm^3: spontaneous bleeding
- <10,000/mm^3: severe bleeding





- Many diseases involved impaired platelet function as well (ex. Uremia)
- Aspirin reduces platelet aggregation at sites of injury

Disorders of Platelets

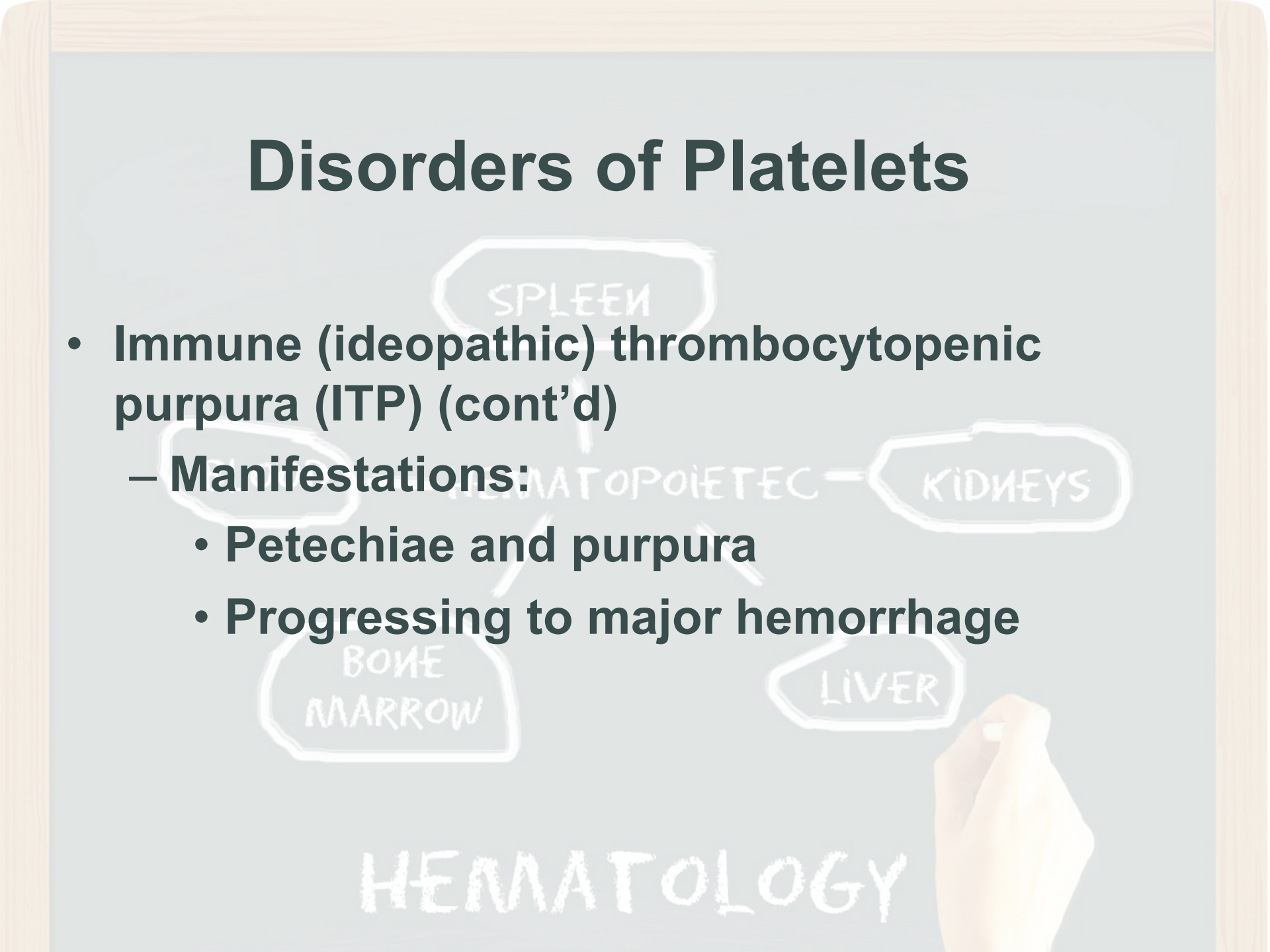
- **Thrombocytopenia**
  - Causes:
    - Hypersplenism
    - Autoimmune disease
    - Hypothermia
    - Viral or bacterial infections that cause disseminated intravascular coagulation (DIC)

Disorders of Platelets

- Immune (ideopathic) thrombocytopenic purpura (ITP)
  - IgG antibody that targets platelet glycoproteins
  - Antibody-coated platelets are sequestered and removed from the circulation
  - The acute form of ITP that often develops after a viral infection is one of the most common childhood bleeding disorders

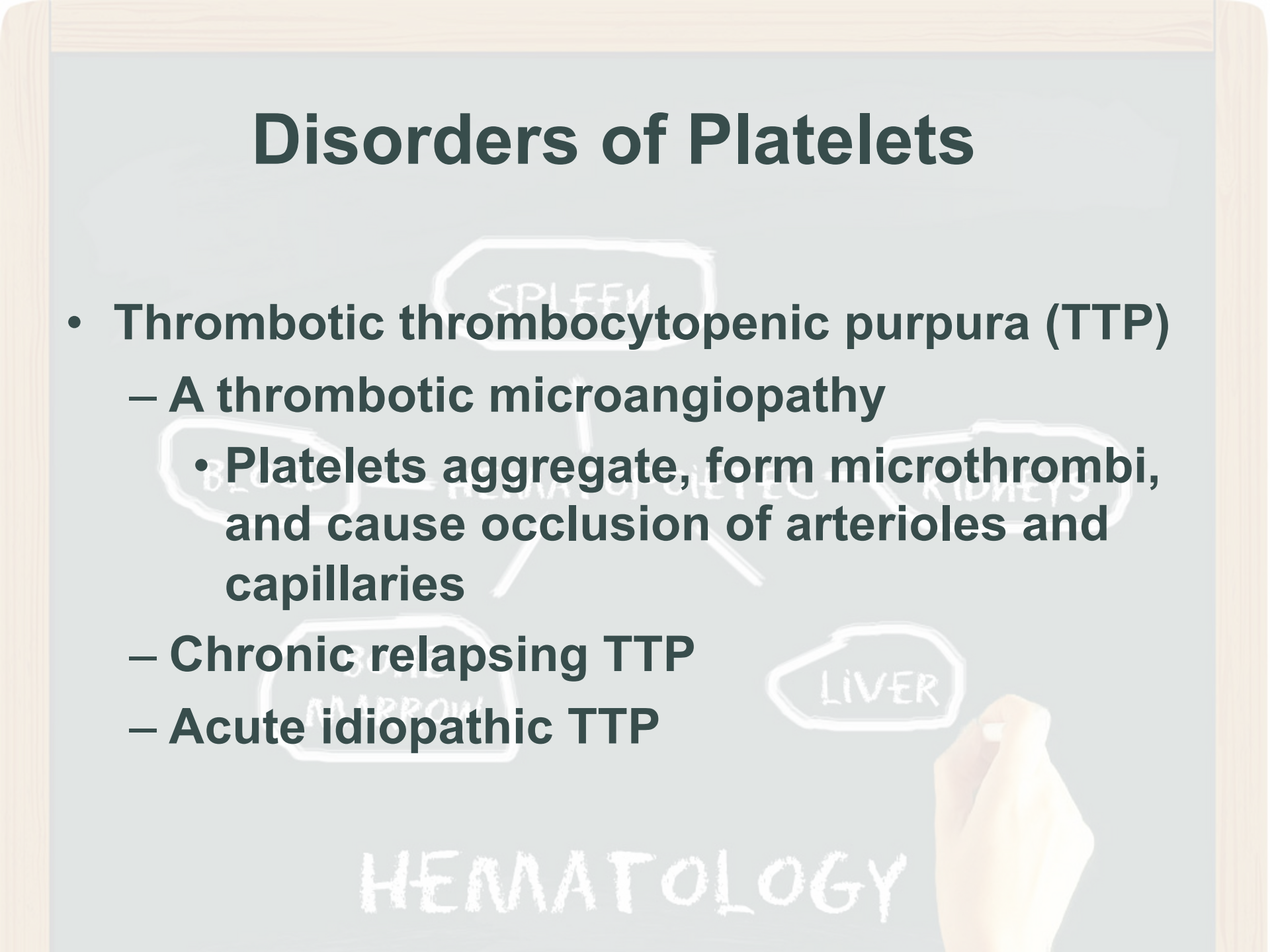
Disorders of Platelets

- Immune (ideopathic) thrombocytopenic purpura (ITP) (cont'd)
  - Manifestations:
    - Petechiae and purpura
    - Progressing to major hemorrhage



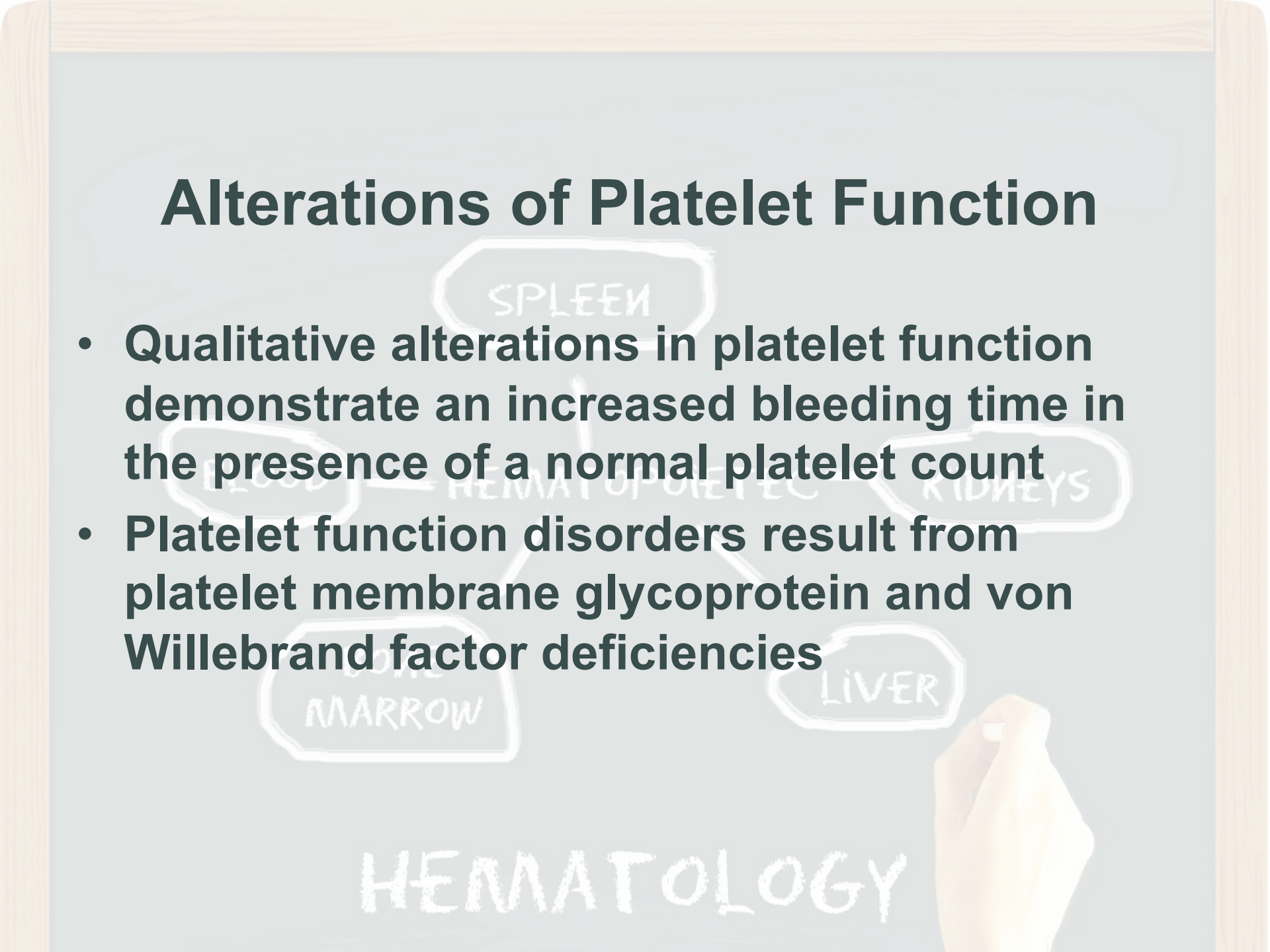
Disorders of Platelets

- Thrombotic thrombocytopenic purpura (TTP)
  - A thrombotic microangiopathy
    - Platelets aggregate, form microthrombi, and cause occlusion of arterioles and capillaries
  - Chronic relapsing TTP
  - Acute idiopathic TTP



Alterations of Platelet Function

- Qualitative alterations in platelet function demonstrate an increased bleeding time in the presence of a normal platelet count
- Platelet function disorders result from platelet membrane glycoprotein and von Willebrand factor deficiencies



Alterations of Platelet Function

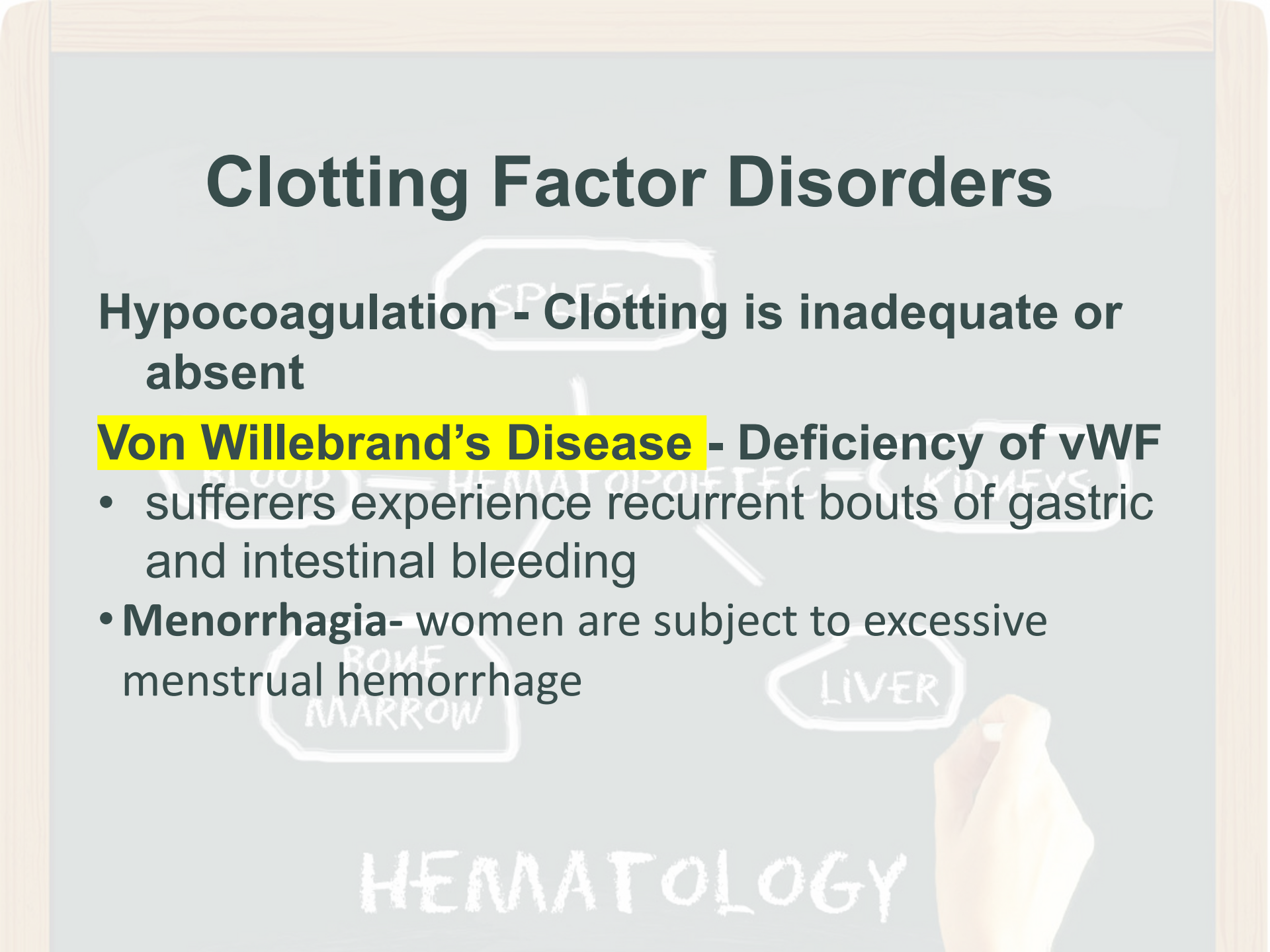
- Manifestations:
  - Petechiae
  - Purpura
  - Mucosal bleeding
  - Gingival bleeding
  - Spontaneous bruising
- Disorders can be congenital or acquired

Clotting Factor Disorders

Hypocoagulation - Clotting is inadequate or absent

Von Willebrand's Disease - Deficiency of vWF

- sufferers experience recurrent bouts of gastric and intestinal bleeding
- **Menorrhagia-** women are subject to excessive menstrual hemorrhage



Hemophilia

- Any disease in which blood will not clot properly (usually genetic in origin)
- Many clotting disorders may be acquired due to:
  - Liver damage (many clotting factors are produced there)
  - Vitamin K deficiency (required for synthesis of many clotting factors)
  - Use of drugs with anticoagulating side effects

Erythrocyte Disorders

- **Hypoxia- tissues deprived of oxygen**
- **Possible Clinical Manifestations:**
  - **Pallor (paleness)**
  - **Weakness**
  - **Exercise Intolerance**
  - **Irregular Heartbeat**
  - **Liver Damage (necrosis and/or fatty changes)**

Erythrocyte Disorders

Hematocrit

- Measure of RBC volume of blood
- RBCs should be ~45% of normal blood

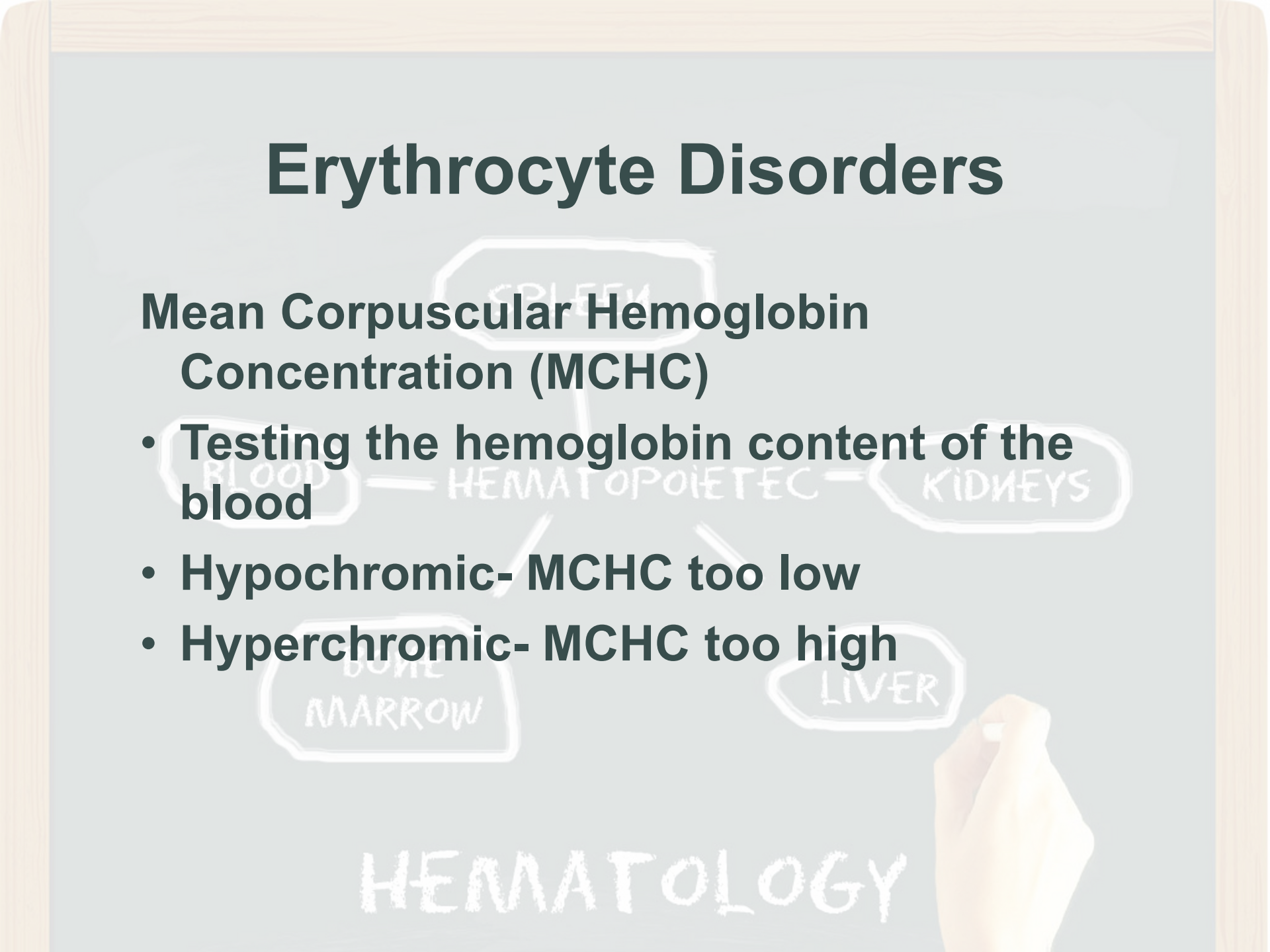
Mean Corpuscular Volume (MCV)

- Testing the size of RBCs
- Macrocytic- MCV too high
- Microcytic- MCV too low

Erythrocyte Disorders

Mean Corpuscular Hemoglobin Concentration (MCHC)

- **Testing the hemoglobin content of the blood**
- **Hypochromic- MCHC too low**
- **Hyperchromic- MCHC too high**



Erythrocyte Disorders - Anemia

Anemia

hemoglobin or erythrocyte numbers low; oxygen transport compromised

- **May be caused by many factors**
  - **Deficiency in progenitors of RBCs- (Pure Red Cell Aplasia (PRCA), Aplastic anemia)**
  - **Iron Deficiency**
  - **Vitamin B_{12} Deficiency**
  - **Folic Acid Deficiency**

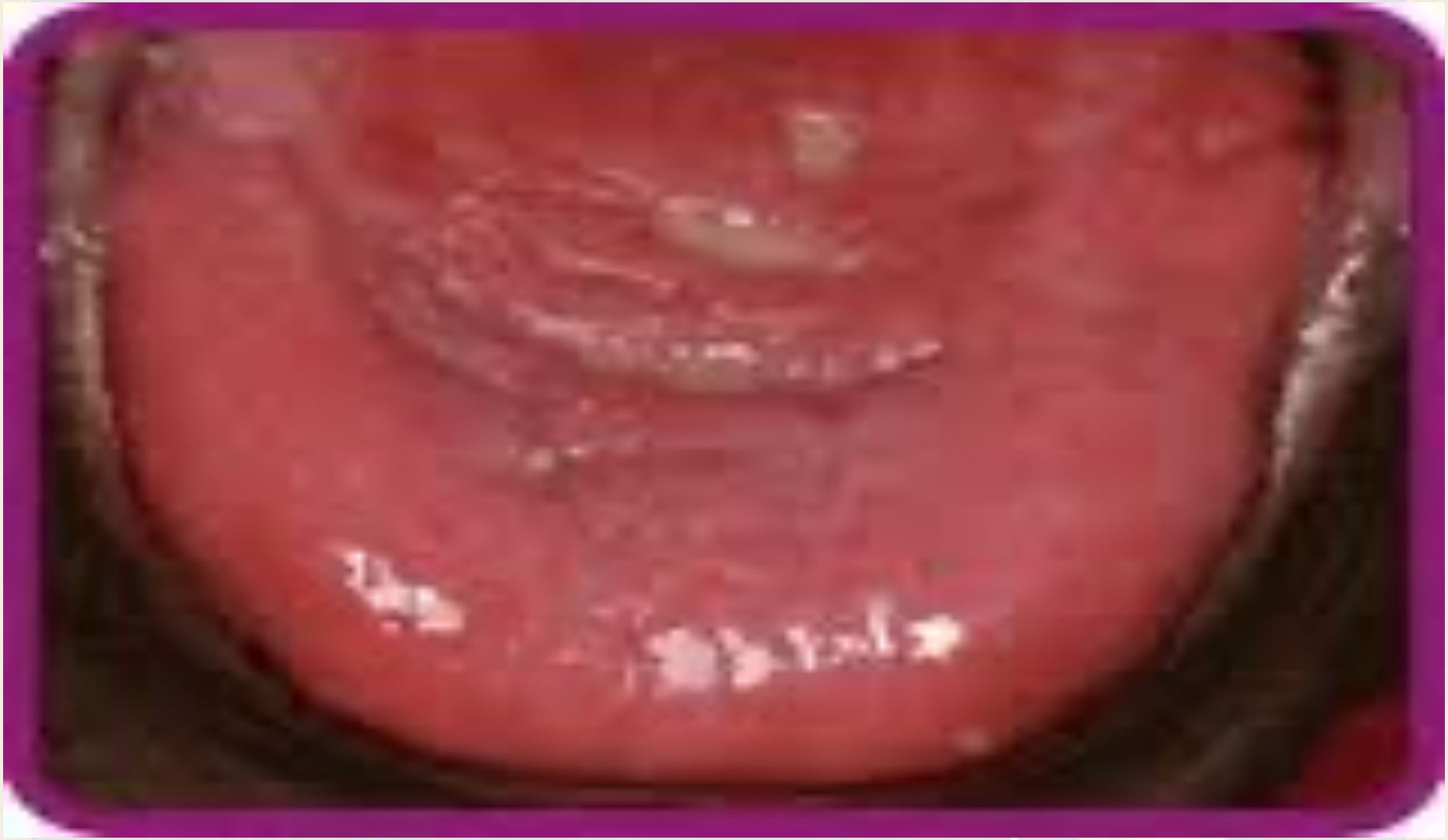
Pernicious Anemia

- Macrocytic (large cells) Normochromic (WINL HgB)
- Caused by a lack of intrinsic factor from the gastric parietal cells
- Required for vitamin B_{12} absorption
- Results in vitamin B_{12} deficiency
- Typical anemia symptoms
- Neurologic manifestations:
  - Nerve demyelination
  - Absence of intrinsic factor

Pernicious Anemia

- Pernicious anemia
  - Other Symptoms:
    - Loss of appetite, Abdominal pain
    - Beefy red tongue (atrophic glossitis), Icterus
    - Splenic enlargement
  - Treatment
    - Parenteral or high oral doses of vitamin B_{12}

Pernicious Anemia



Folate Deficiency Anemia

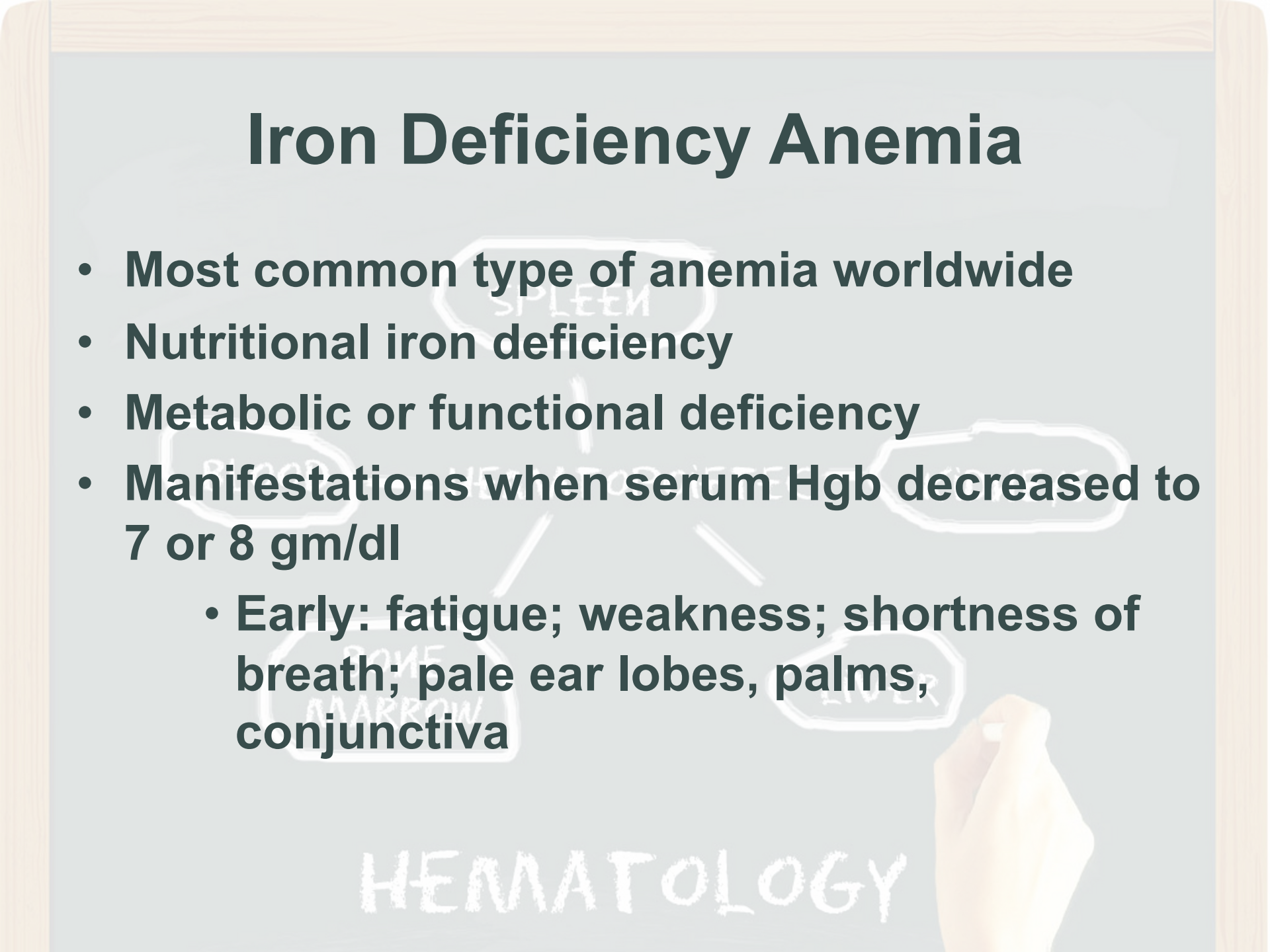
- Macrocytic (large cells) Normochromic(WINL HgB)
- Absorption of folate occurs in the upper small intestine
- Similar symptoms to pernicious anemia except neurologic manifestations generally not seen
- Treatment requires daily oral administration of folate

Microcytic-Hypochromic Anemias

- Microcytic (small cells) Hypochromic (low HgB)
- Characterized by red cells that are abnormally small and contain reduced amounts of hemoglobin
- Related to:
  - Disorders of iron metabolism
  - Disorders of porphyrin and heme synthesis
  - Disorders of globin synthesis

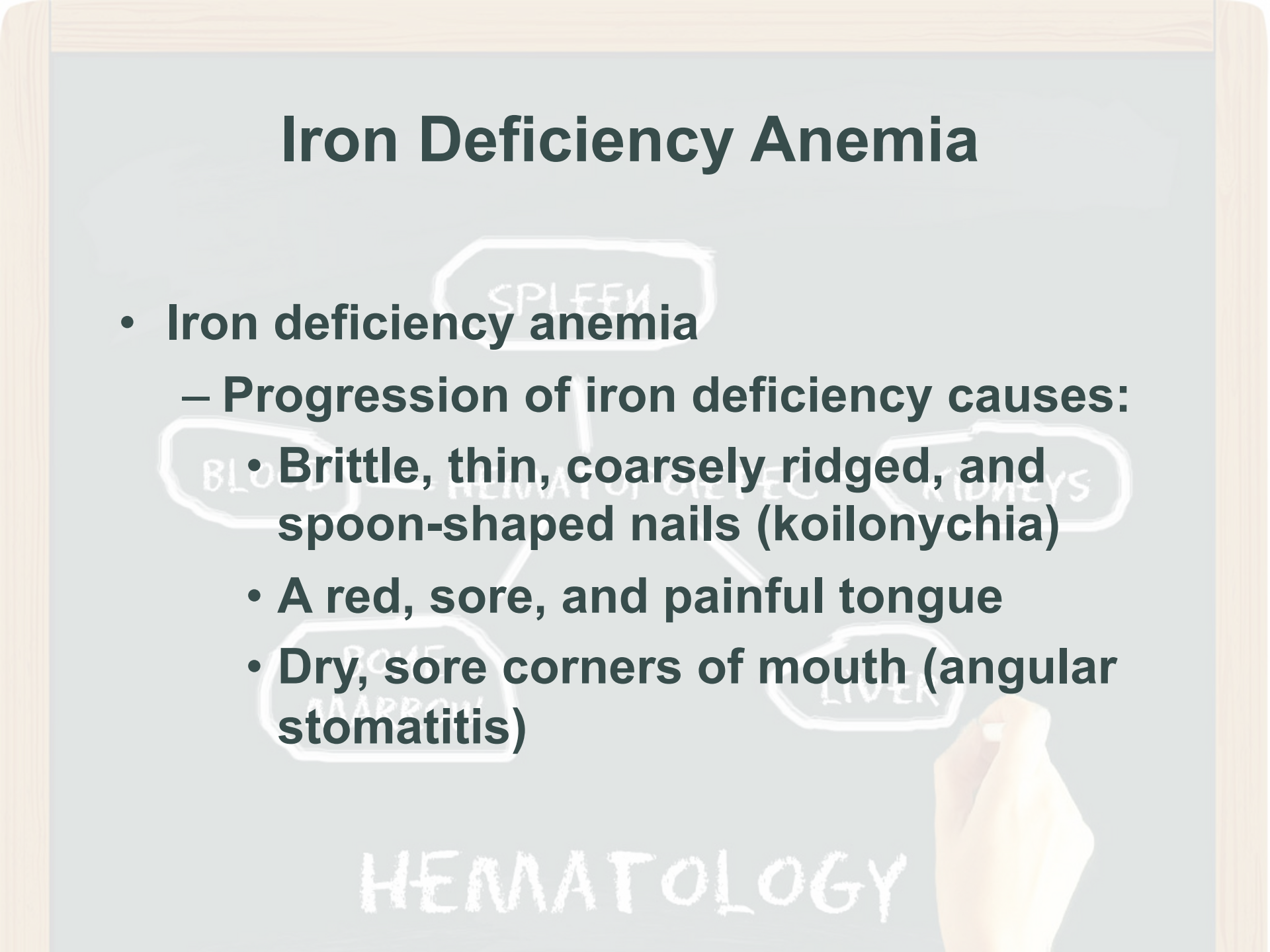
Iron Deficiency Anemia

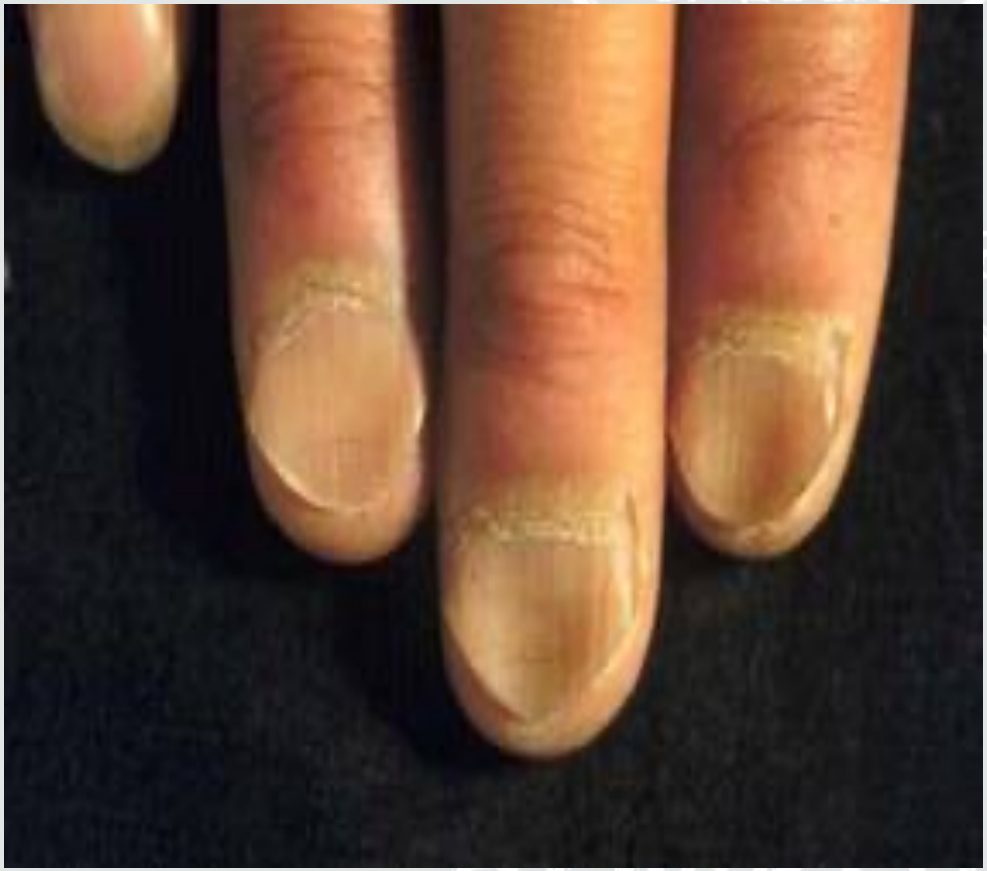
- Most common type of anemia worldwide
- Nutritional iron deficiency
- Metabolic or functional deficiency
- Manifestations when serum Hgb decreased to 7 or 8 gm/dl
    - Early: fatigue; weakness; shortness of breath; pale ear lobes, palms, conjunctiva

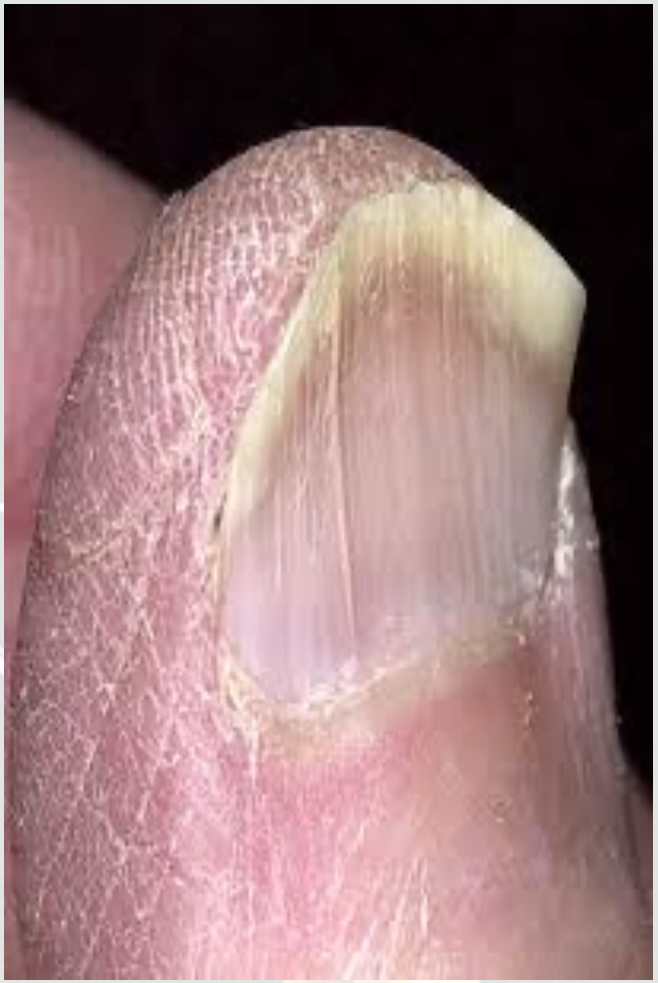


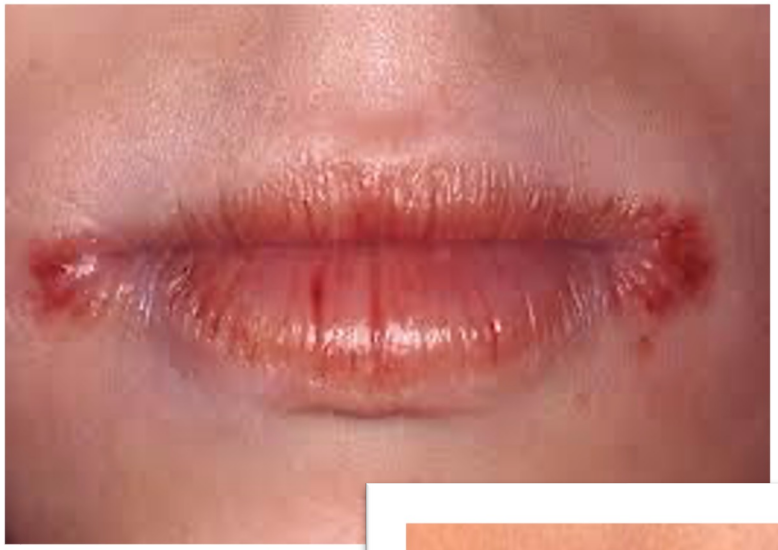
Iron Deficiency Anemia

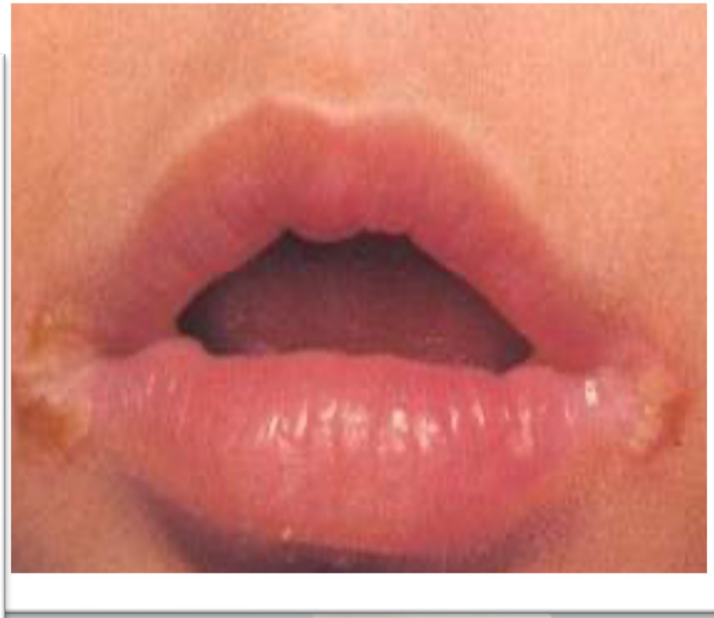
- Iron deficiency anemia
  - Progression of iron deficiency causes:
    - Brittle, thin, coarsely ridged, and spoon-shaped nails (koilonychia)
    - A red, sore, and painful tongue
    - Dry, sore corners of mouth (angular stomatitis)











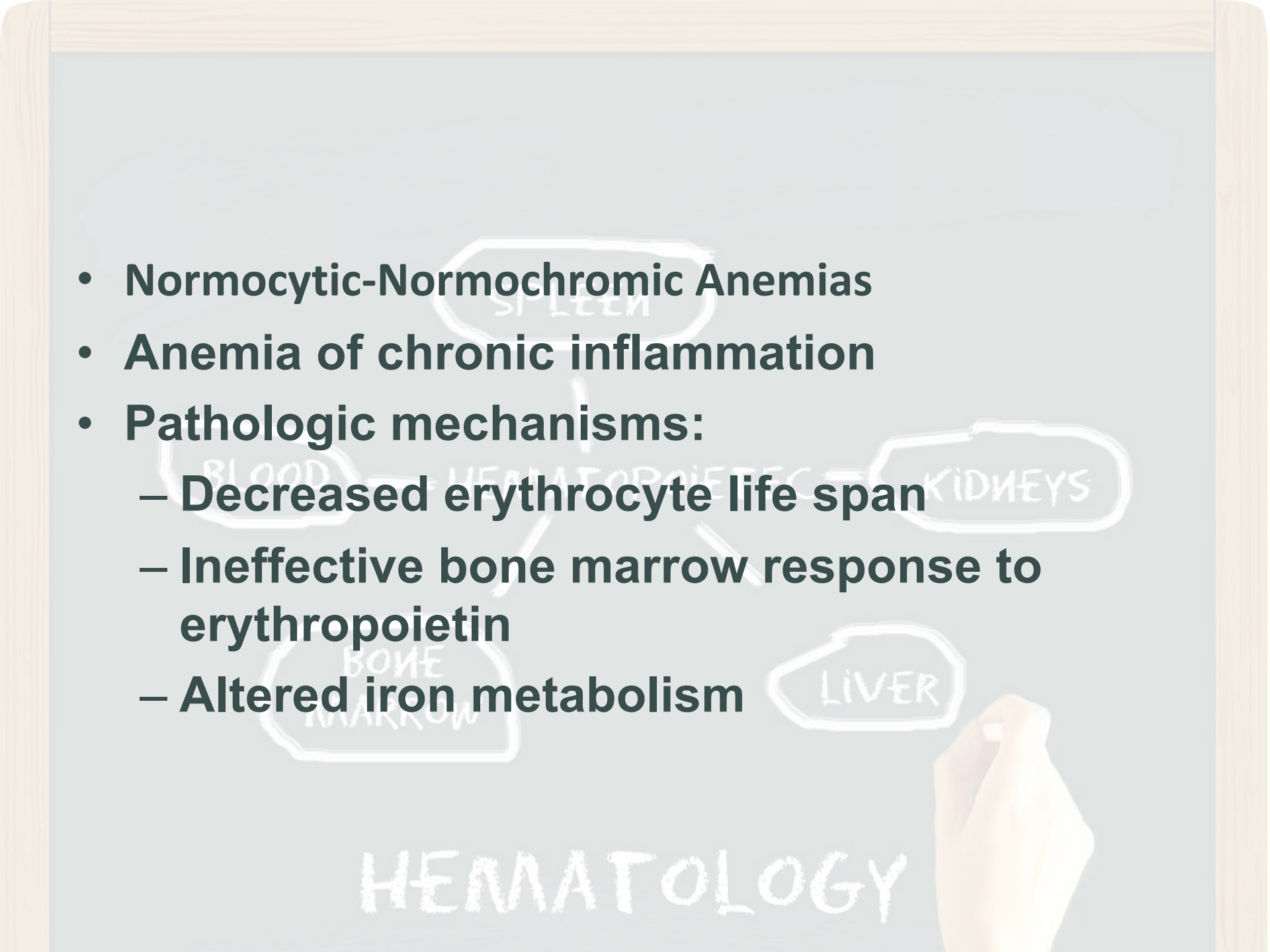
Hemolytic Anemia

- Normocytic-Normochromic Anemia
  - Normal cell size and normal hemoglobin
- Accelerated destruction of red blood cells
- Autoimmune hemolytic anemias
- Immunohemolytic anemia
- Warm antibody immunohemolytic anemia
- Drug-induced hemolytic anemia
- Cold agglutinin immunohemolytic anemia
- Cold hemolysin hemolytic anemia

Sickle Cell Anemia

- Normocytic-Normochromic Anemia
  - Normal cell size and normal hemoglobin
- Anemia of chronic inflammation
- Mild to moderate anemia seen in:
  - AIDS
  - Rheumatoid arthritis
  - Lupus erythematosus
  - Hepatitis
  - Renal failure
  - Malignancies

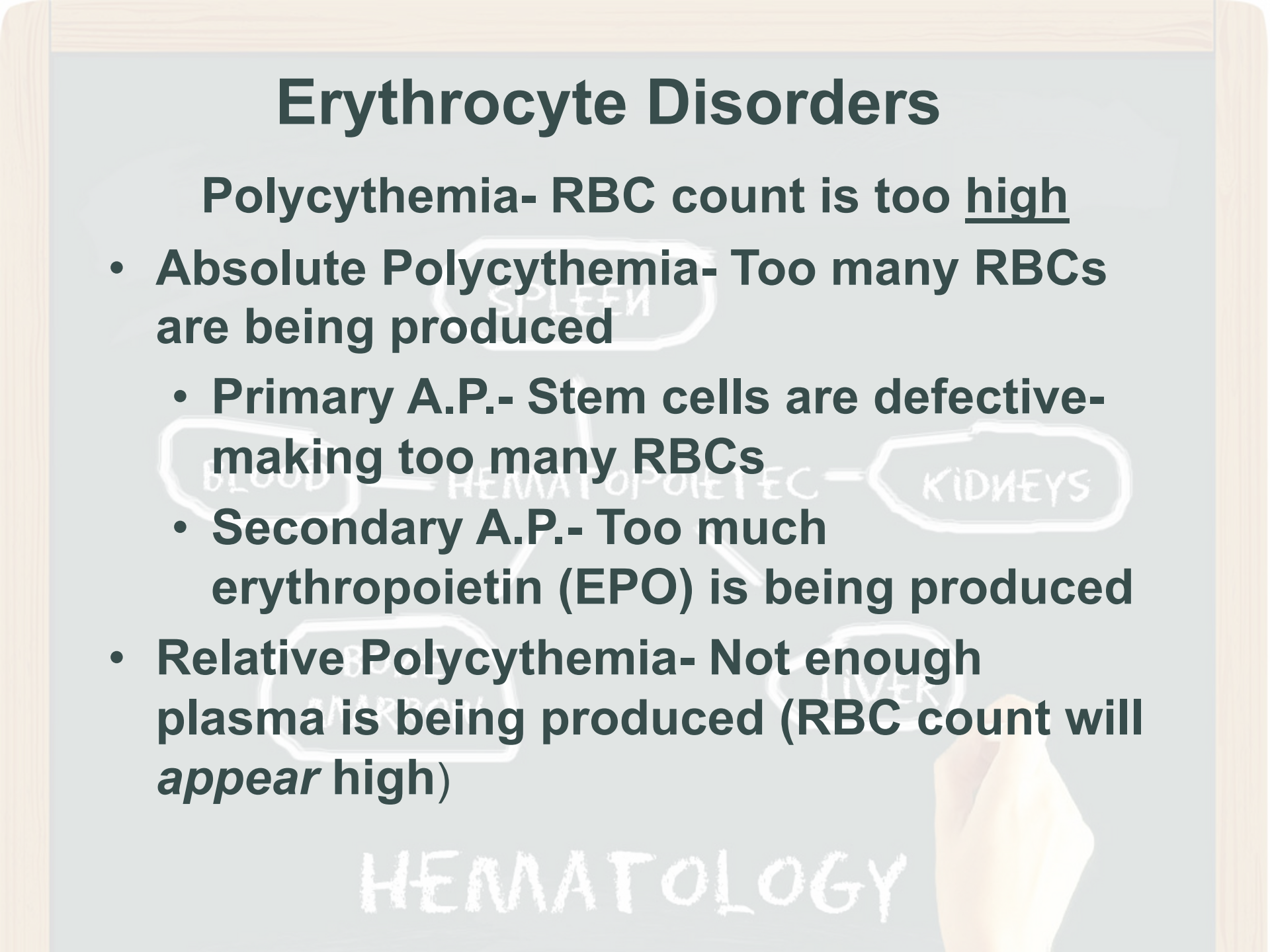
- Normocytic-Normochromic Anemias
- Anemia of chronic inflammation
- Pathologic mechanisms:
  - Decreased erythrocyte life span
  - Ineffective bone marrow response to erythropoietin
  - Altered iron metabolism



Erythrocyte Disorders

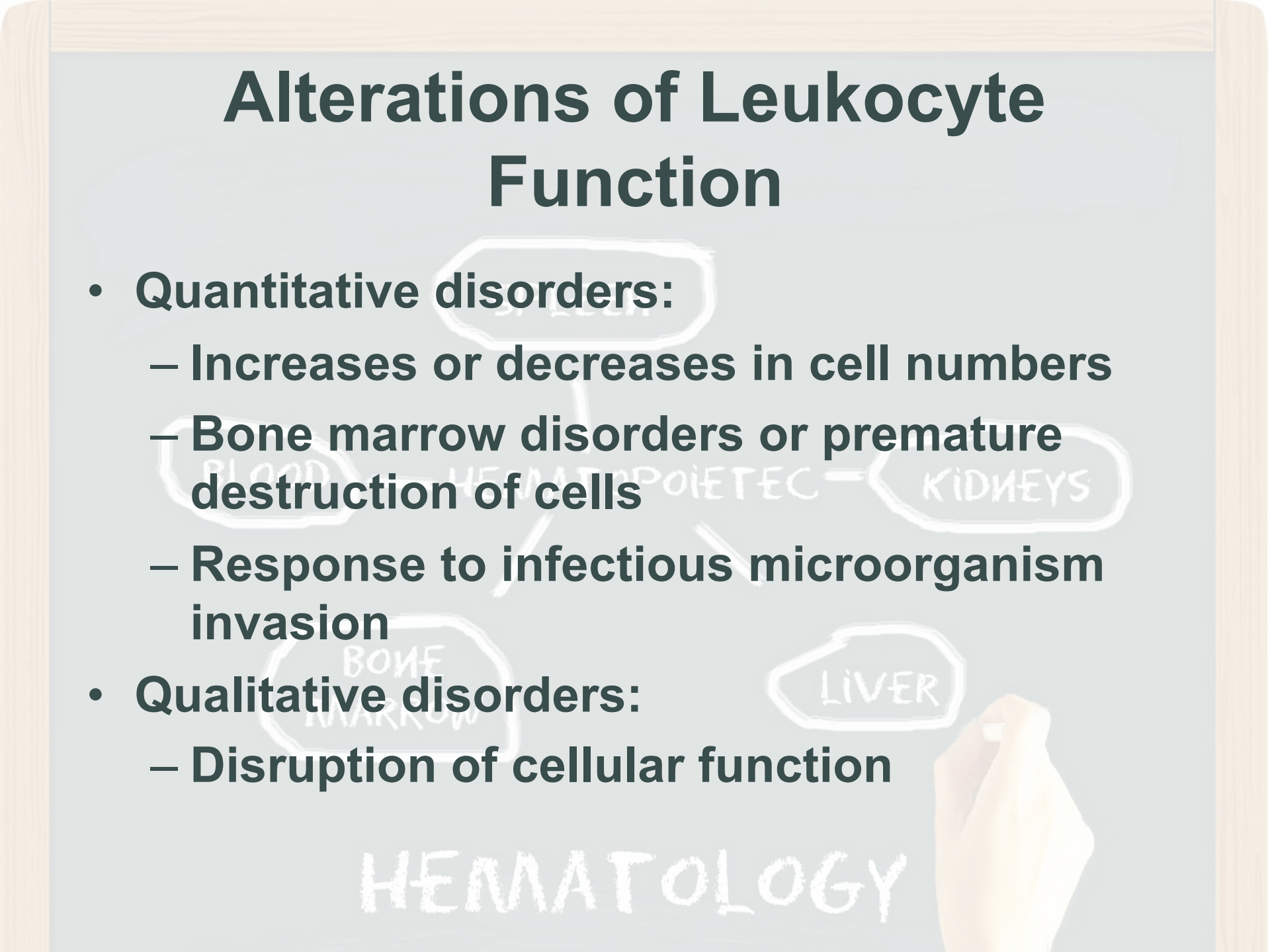
Polycythemia- RBC count is too <u>high</u>

- **Absolute Polycythemia- Too many RBCs are being produced**
  - **Primary A.P.- Stem cells are defective- making too many RBCs**
  - **Secondary A.P.- Too much erythropoietin (EPO) is being produced**
- **Relative Polycythemia- Not enough plasma is being produced (RBC count will *appear* high)**



Alterations of Leukocyte Function

- Quantitative disorders:
  - Increases or decreases in cell numbers
  - Bone marrow disorders or premature destruction of cells
  - Response to infectious microorganism invasion
- Qualitative disorders:
  - Disruption of cellular function



Quantitative Alterations of Leukocytes

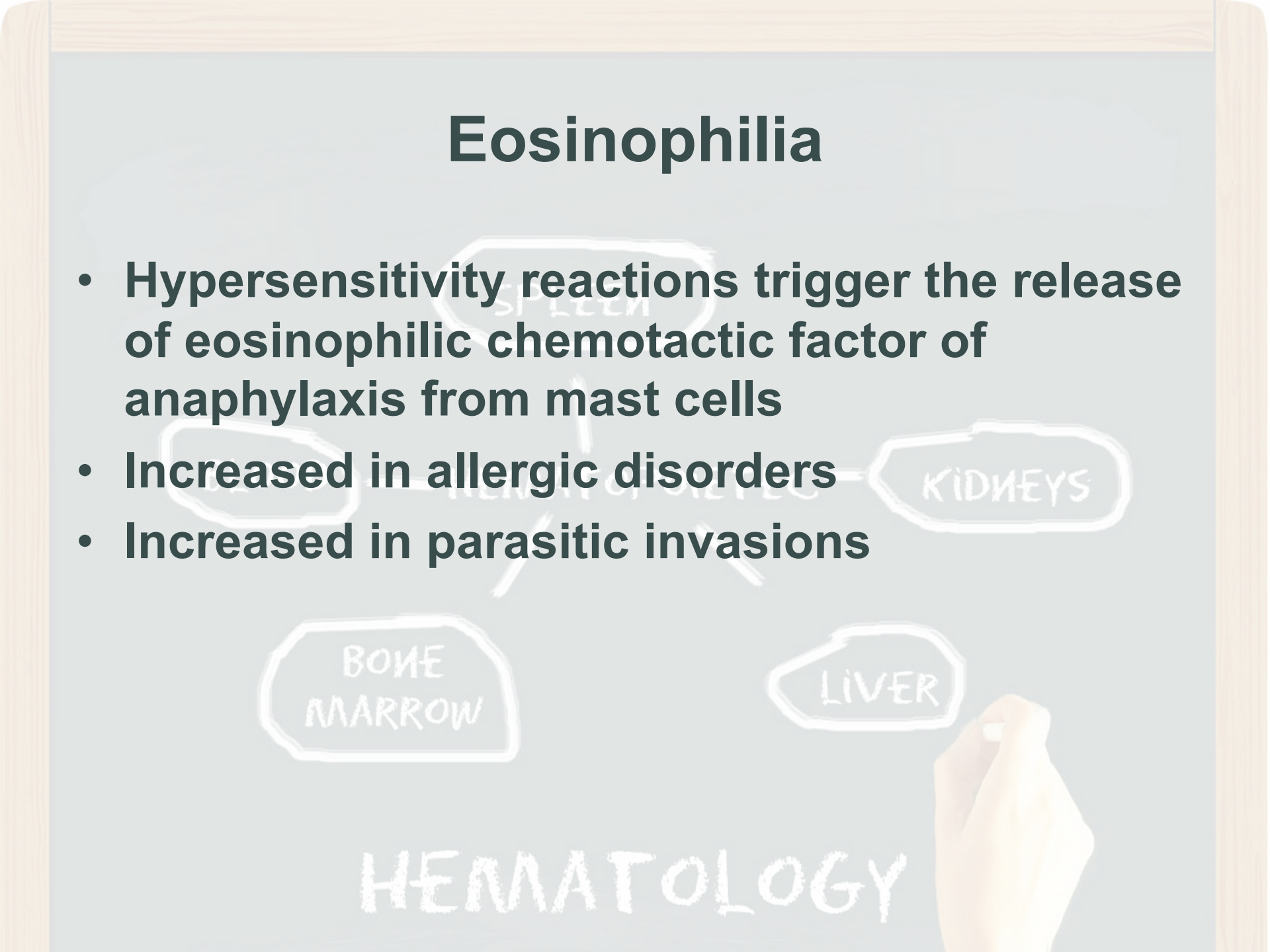
- Leukocytosis
  - Leukocytosis is a normal protective physiologic response to physiologic stressors
- Leukopenia
  - Leukopenia is not normal and not beneficial
  - A low white count predisposes a patient to infections

Neutropenia

- Reduction in circulating neutrophils
- Causes:
  - Prolonged severe infection
  - Decreased production
  - Reduced survival
  - Abnormal neutrophil distribution and sequestration

Eosinophilia

- Hypersensitivity reactions trigger the release of eosinophilic chemotactic factor of anaphylaxis from mast cells
- Increased in allergic disorders
- Increased in parasitic invasions

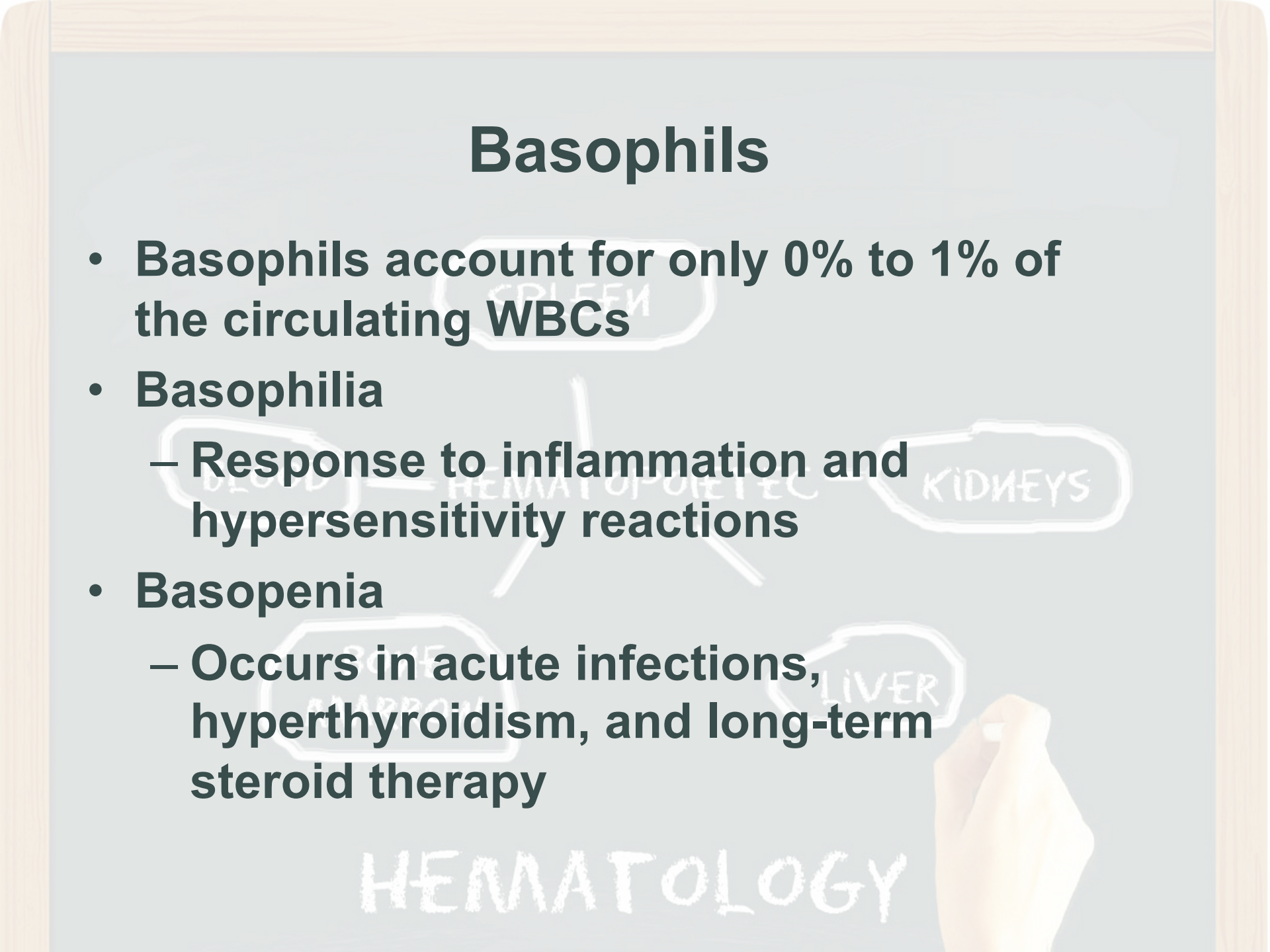


Eosinopenia

- Decrease in circulation numbers of eosinophils
- Usually caused by migration of cells to inflammatory sites
- Other causes:
  - Surgery
  - Shock
  - Trauma
  - Burns
  - Mental distress

Basophils

- Basophils account for only 0% to 1% of the circulating WBCs
- Basophilia
  - Response to inflammation and hypersensitivity reactions
- Basopenia
  - Occurs in acute infections, hyperthyroidism, and long-term steroid therapy

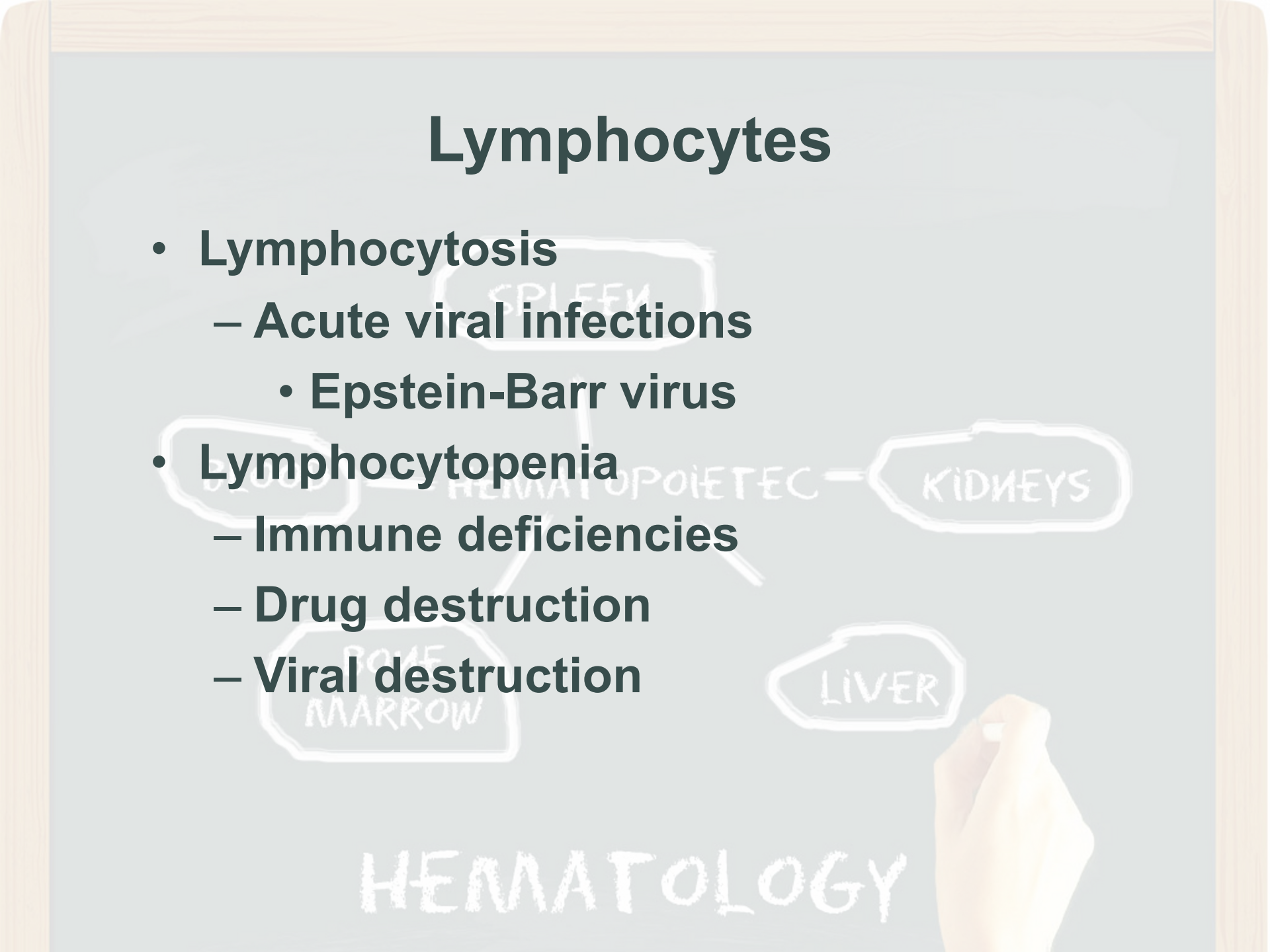


Monocytes

- Monocytosis
  - Poor correlation with disease
  - Usually occurs with neutropenia in later stages of infections
  - Monocytes are needed to phagocytize organisms and debris

Lymphocytes

- Lymphocytosis
  - Acute viral infections
    - Epstein-Barr virus
- Lymphocytopenia
  - Immune deficiencies
  - Drug destruction
  - Viral destruction



Infectious Mononucleosis

- Acute, self-limiting infection of B lymphocytes transmitted by saliva through personal contact
- Commonly caused by the Epstein-Barr virus (EBV)—85%
  - B cells have an EBV receptor site
  - Others viral agents resembling IM:
    - Cytomegalovirus (CMV)
    - Hepatitis
    - Influenza
    - HIV

Infectious Mononucleosis

- Symptoms:
  - Fever
  - Sore throat
  - Swollen cervical lymph nodes
  - Increased lymphocyte count
  - Atypical (activated) lymphocytes
- Serious complications are infrequent (<5%)
  - Splenic rupture is the most common cause of death

Infectious Mononucleosis

- >50% lymphocytes and at least 10% atypical lymphocytes
- Diagnostic test
  - Monospot qualitative test for heterophilic antibodies
- Treatment: symptomatic

Leukemia

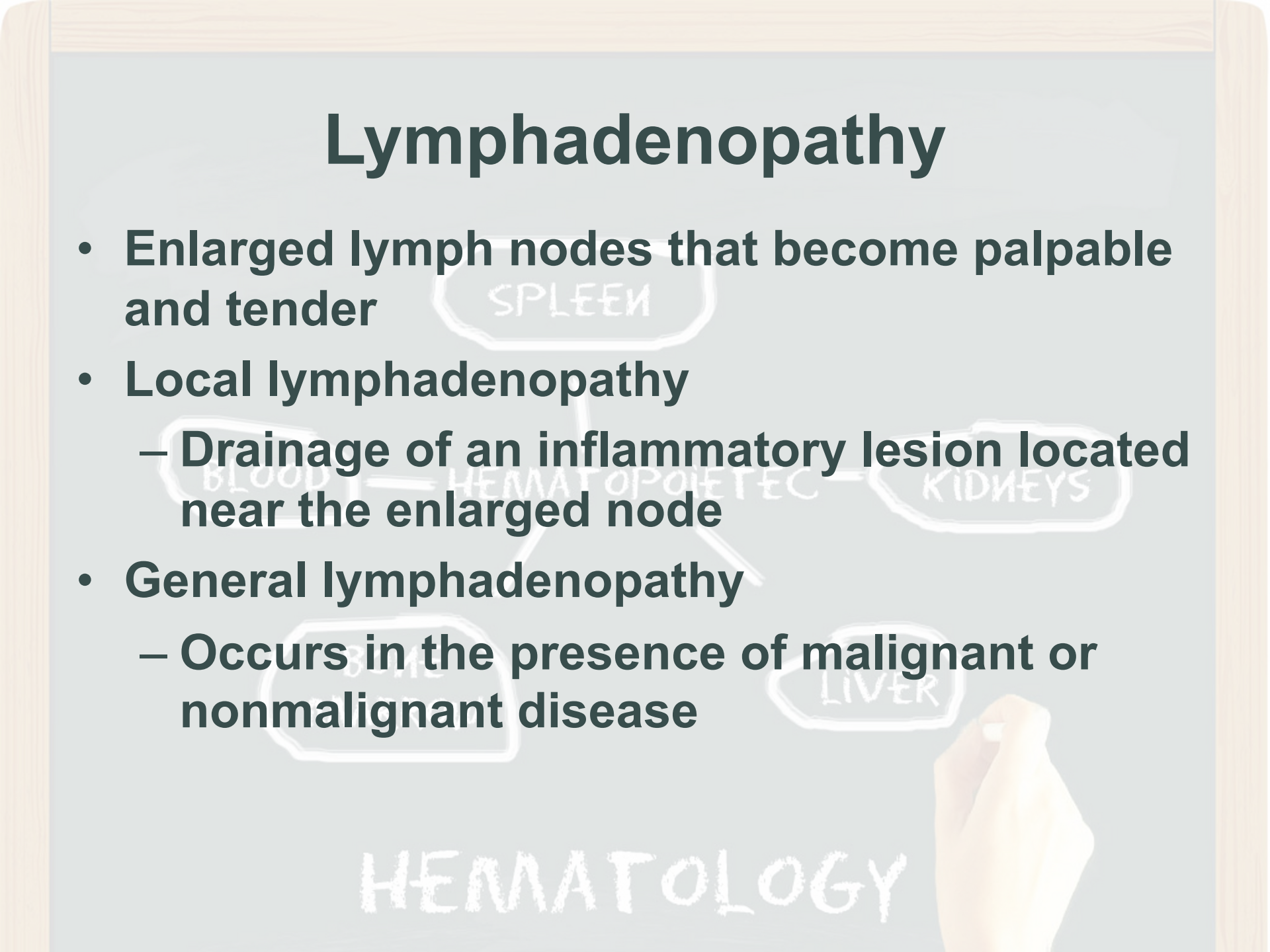
- Malignant disorder of the blood and blood-forming organs
- Excessive accumulation of leukemic cells
- Pancytopenia if cells crowd bone marrow
- Acute leukemia
  - Presence of undifferentiated or immature cells, usually blast cells
- Chronic leukemia
  - Predominant cell is mature but does not function normally

Leukemias

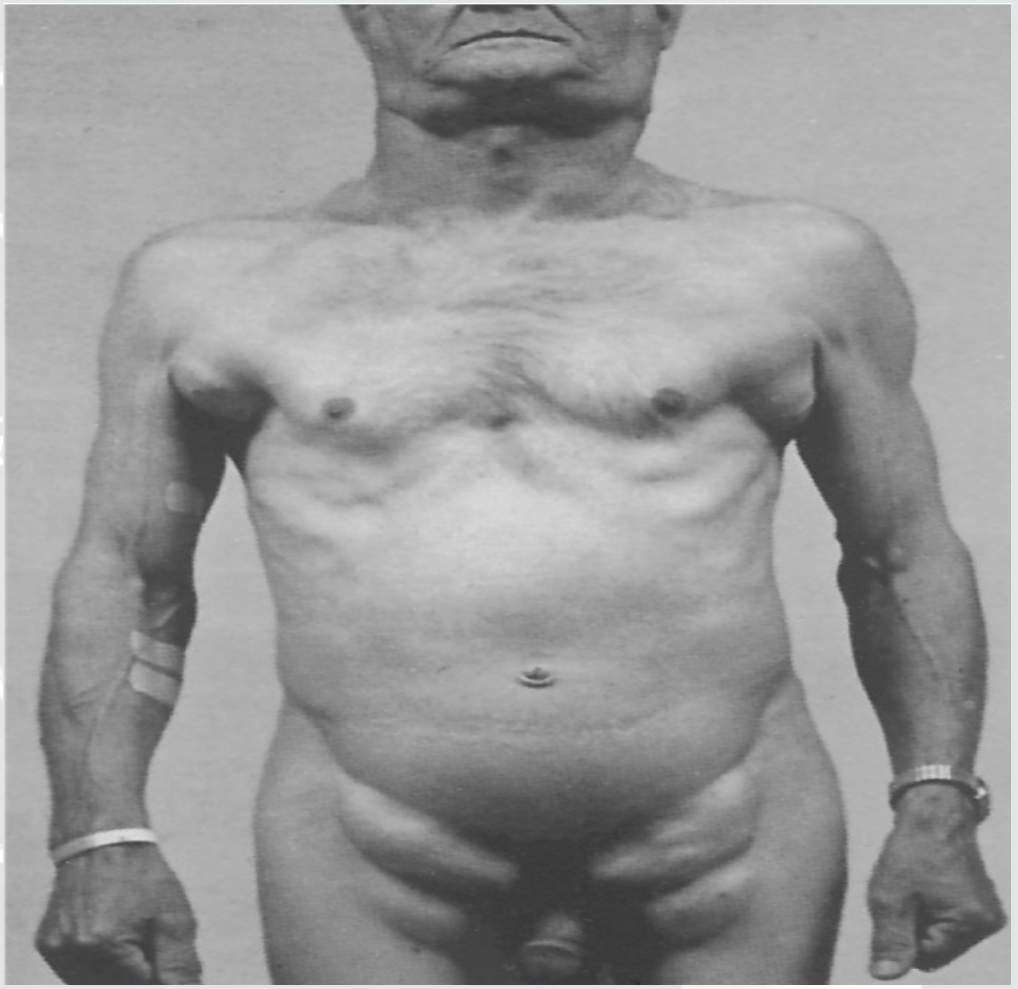
- **Signs and symptoms of leukemia**
  - Anemia
  - Bleeding purpura B-lymphocytes
  - Petechiae
  - Ecchymosis
  - Thrombosis
  - Hemorrhage
  - DIC
  - Infection
  - Weight loss
  - Bone pain
  - Elevated uric acid
  - Liver, spleen, and lymph node enlargement

Lymphadenopathy

- Enlarged lymph nodes that become palpable and tender
- Local lymphadenopathy
  - Drainage of an inflammatory lesion located near the enlarged node
- General lymphadenopathy
  - Occurs in the presence of malignant or nonmalignant disease



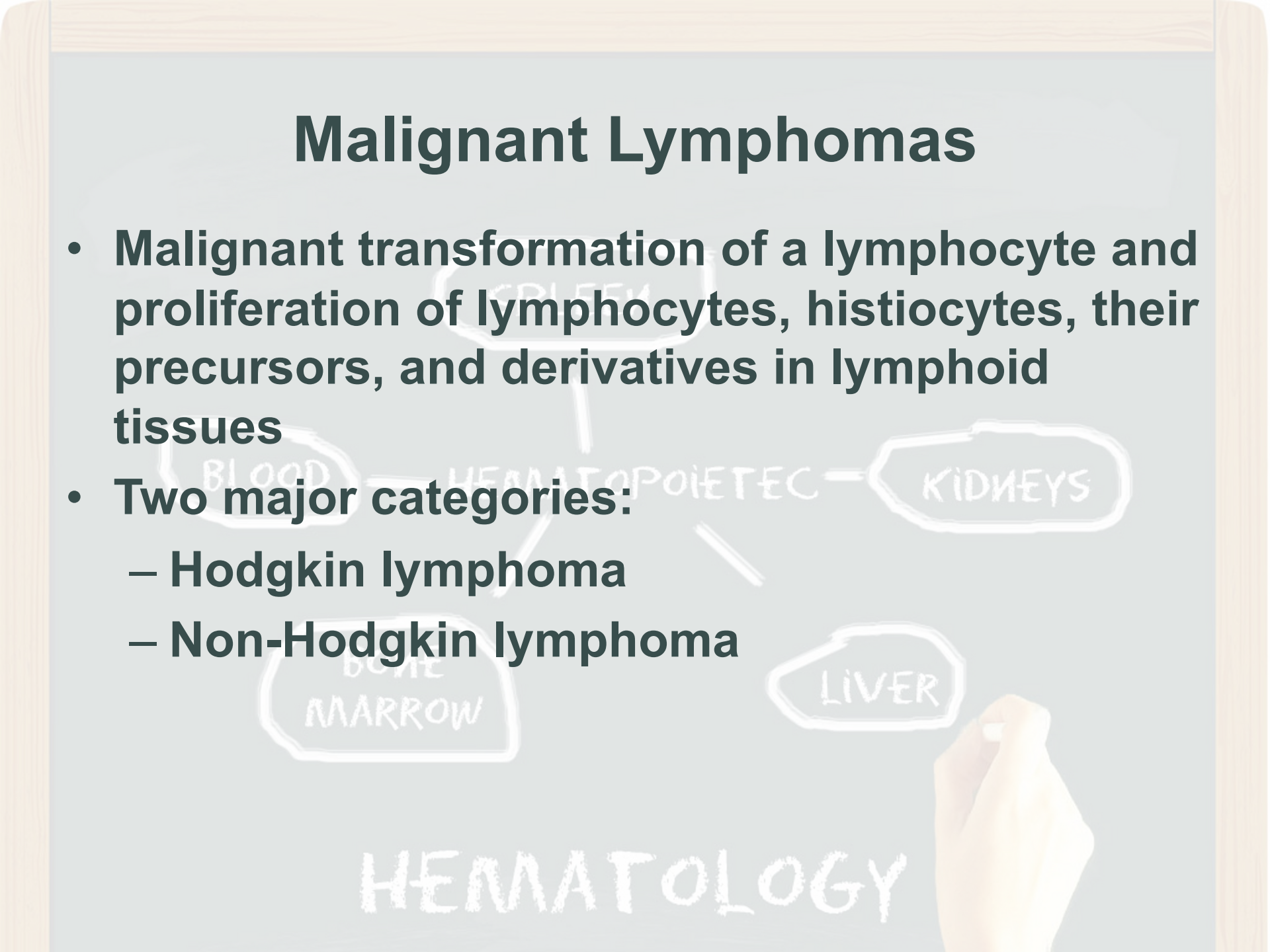
Lymphadenopathy



HEMATOLOGY

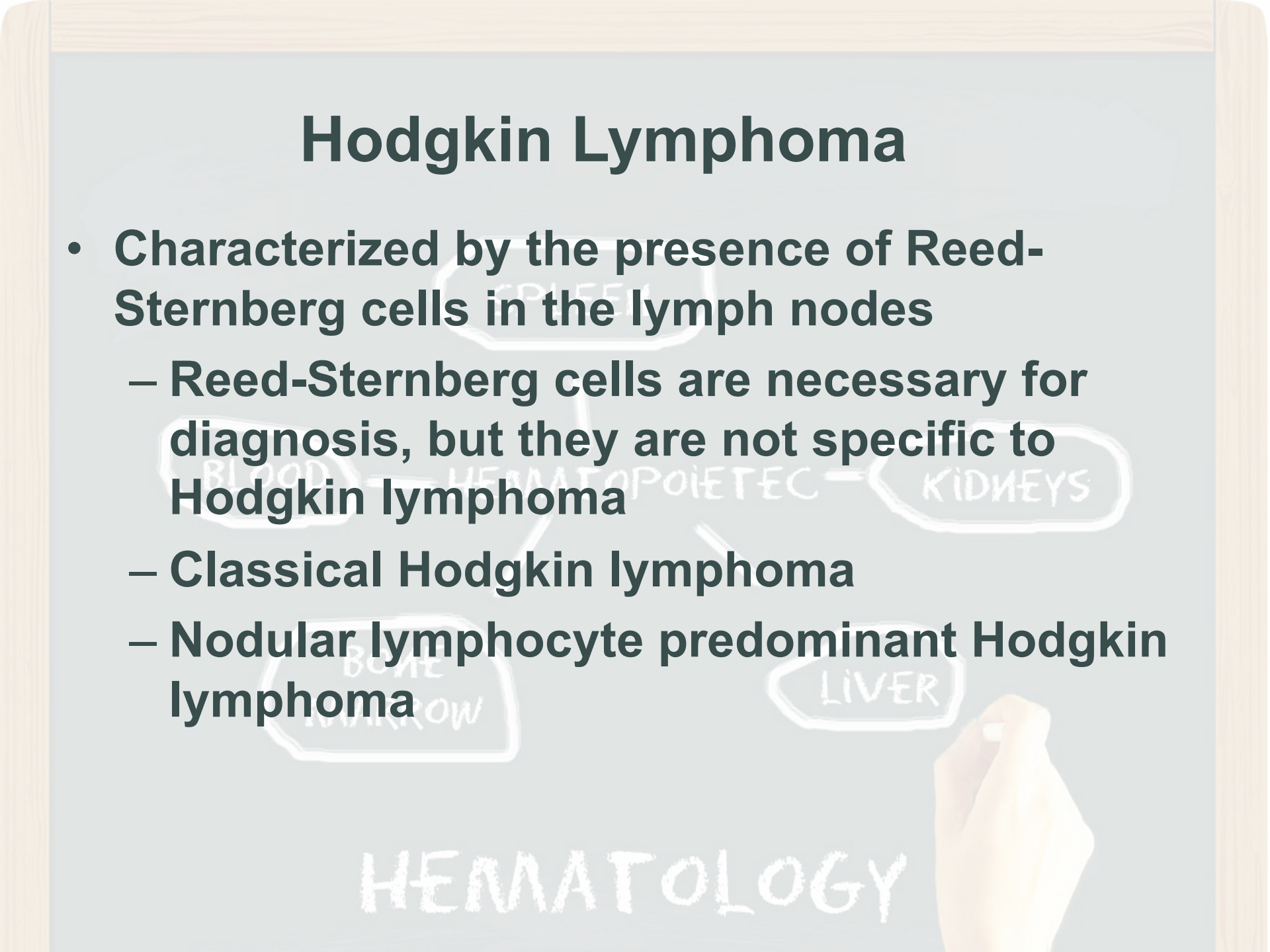
Malignant Lymphomas

- Malignant transformation of a lymphocyte and proliferation of lymphocytes, histiocytes, their precursors, and derivatives in lymphoid tissues
- Two major categories:
  - Hodgkin lymphoma
  - Non-Hodgkin lymphoma



Hodgkin Lymphoma

- Characterized by the presence of Reed-Sternberg cells in the lymph nodes
  - Reed-Sternberg cells are necessary for diagnosis, but they are not specific to Hodgkin lymphoma
  - Classical Hodgkin lymphoma
  - Nodular lymphocyte predominant Hodgkin lymphoma

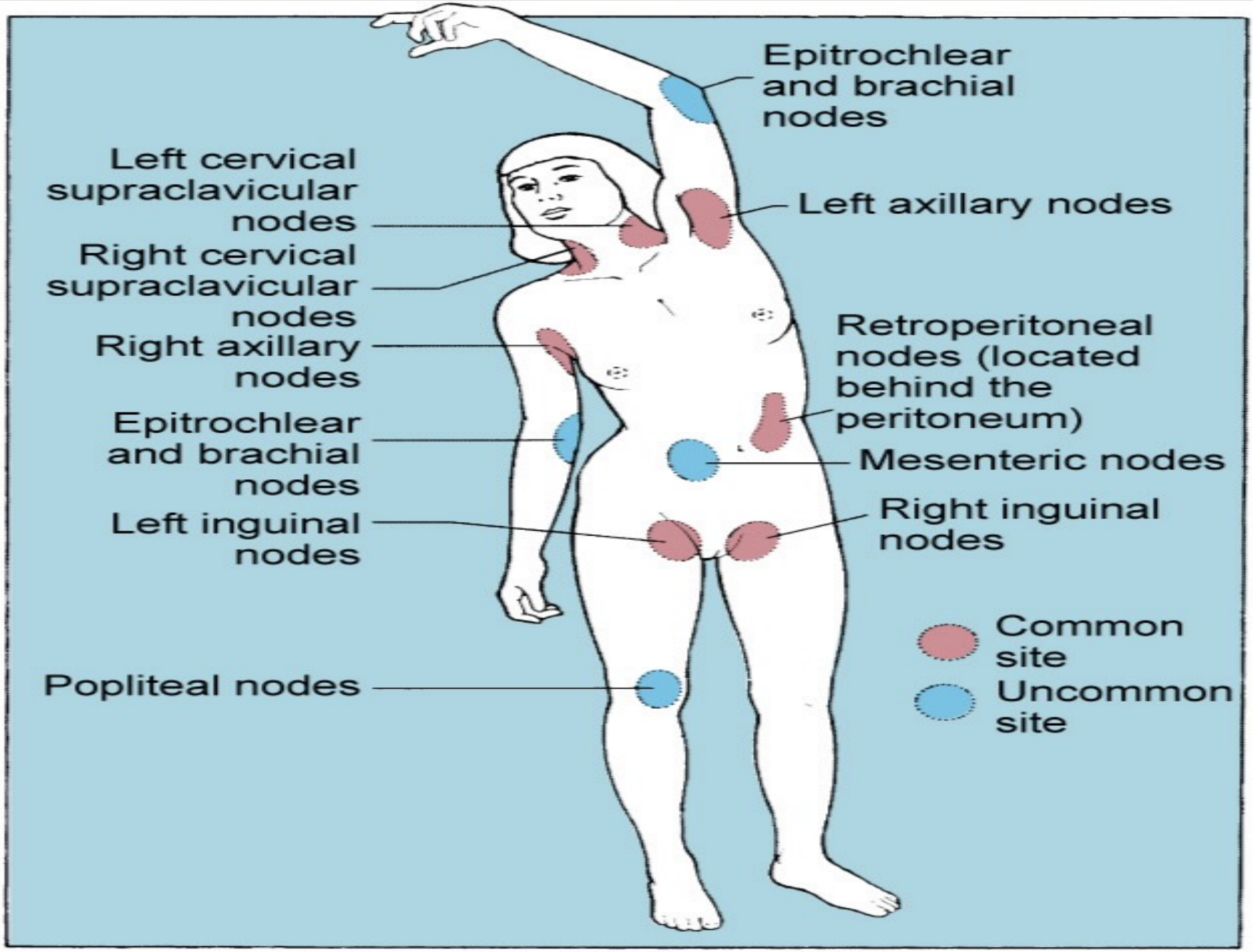


Hodgkin Lymphoma

- Physical findings
  - Adenopathy, mediastinal mass, splenomegaly, and abdominal mass
- Symptoms
  - Fever, weight loss, night sweats, pruritus
- Laboratory findings
  - Thrombocytosis, leukocytosis, eosinophilia, elevated ESR, and elevated alkaline phosphatase

Hodgkin Lymphoma

(From del Regato JA, Spjut HJ, Cox JD: *Cancer: diagnosis, treatment, and prognosis,* ed 6, St Louis, 1985, Mosby.)

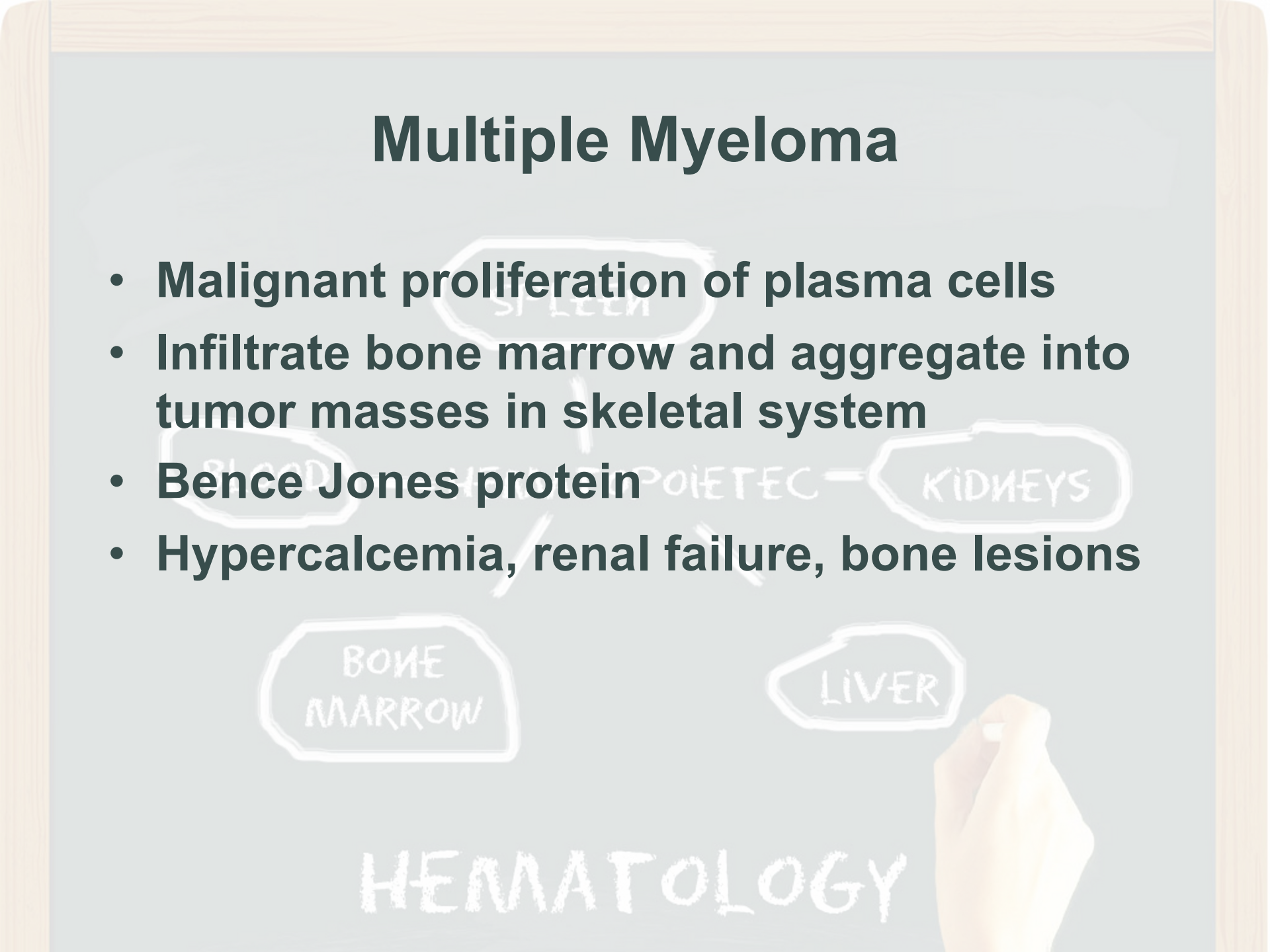


Non-Hodgkin Lymphoma

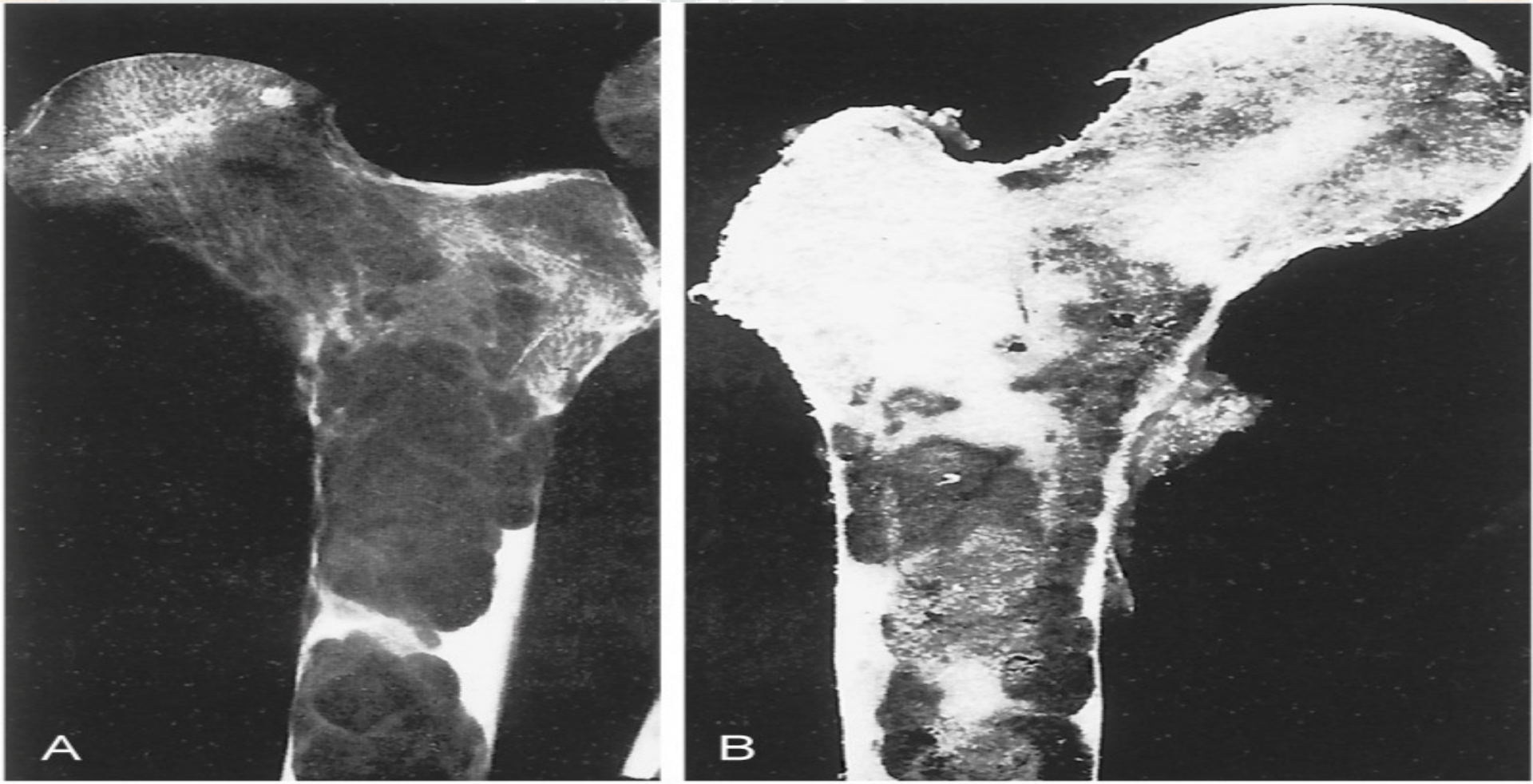
- Generic term for a diverse group of lymphomas
- Differentiated based on etiology, unique features, and response to therapies
- Non-Hodgkin lymphomas are linked to chromosome translocations, viral and bacterial infections, environmental agents, immunodeficiencies, and autoimmune disorders

Multiple Myeloma

- Malignant proliferation of plasma cells
- Infiltrate bone marrow and aggregate into tumor masses in skeletal system
- Bence Jones protein
- Hypercalcemia, renal failure, bone lesions



Multiple Myeloma



(From Kissane JM, editor: *Anderson's pathology*, ed 9, St Louis, 1990, Mosby.)