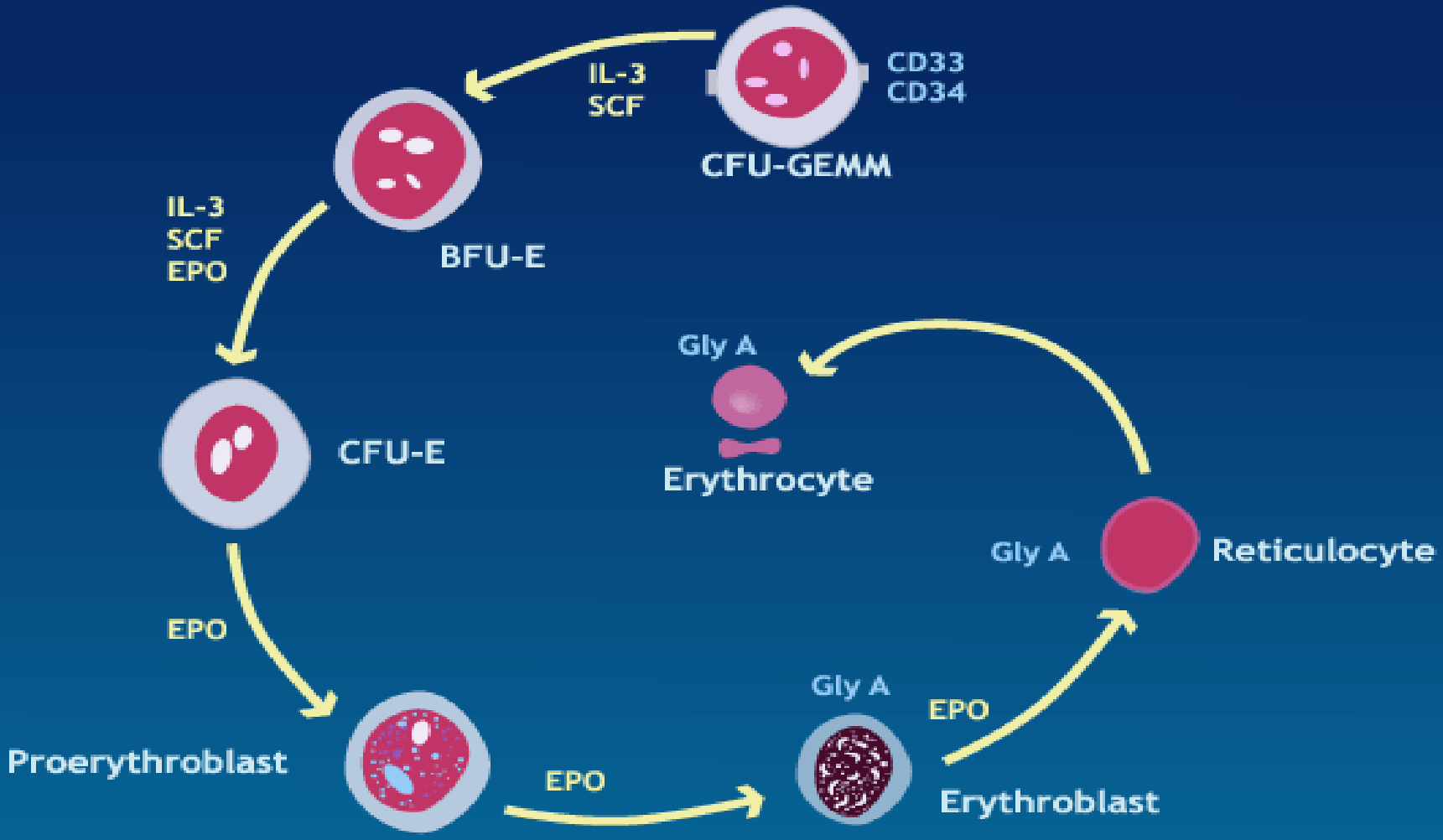
Anemia

Erythrocyte Development



Overview

- Definition of anemia
- Etiology of anemia
- Classifications of anemia
- Investigative tools
- Sign & simptoms of anaemia
- Physical Examination of anemia
- Blood smear components

Definition of Anemia

- Deficiency in the oxygen-carrying capacity of the blood due to a diminished erythrocyte mass.
- May be due to:
  - **Erythrocyte loss** (bleeding)
  - **Decreased Erythrocyte production**
    - low erythropoietin
    - Decreased marrow response to erythropoietin
  - **Increased Erythrocyte destruction** (hemolysis)

Measurements of Anemia

- **Hemoglobin** = grams of hemoglobin per 100 mL of whole blood (g/dL)
- **Hematocrit** = percent of a sample of whole blood occupied by intact red blood cells
- **RBC** = millions of red blood cells per microL of whole blood
- **MCV** = Mean corpuscular volume
  - **If > 100 → Macrocytic anemia**
  - **If 80 – 100 → Normocytic anemia**
  - **If < 80 → Microcytic anemia**
- **RDW** = Red blood cell distribution width
  - = (Standard deviation of red cell volume ÷ mean cell volume) × 100
  - Normal value is 11-15%
  - If elevated, suggests large variability in sizes of RBCs

Laboratory Definition of Anemia

- **Hgb:**
  - Women: <12.0
  - Men: < 13.5
- **Hct:**
  - Women: < 36
  - Men: <41

Criteria Anemia

WHO 1972 criteria include :

- **11 gr% infant age 6 month – 6 years**
- **12 gr% age 6 – 14 years**
- **13 gr% Adult male**
- **12 gr% Adult female non pregnance**
- **11 gr% Adult female pregnance**

Classification of Anemia

- Etiology
- Morphology
- Haemoglobin level

Causes of Anemia (kinetic approach)

Decreased erythrocyte production

- **Decreased erythropoietin production**
- **Inadequate marrow response to erythropoietin**
- **Bone marrow failure**

Erythrocyte loss

- **Hemorrhage (Blood loss)**
- **Hemolysis (Increased destruction)**

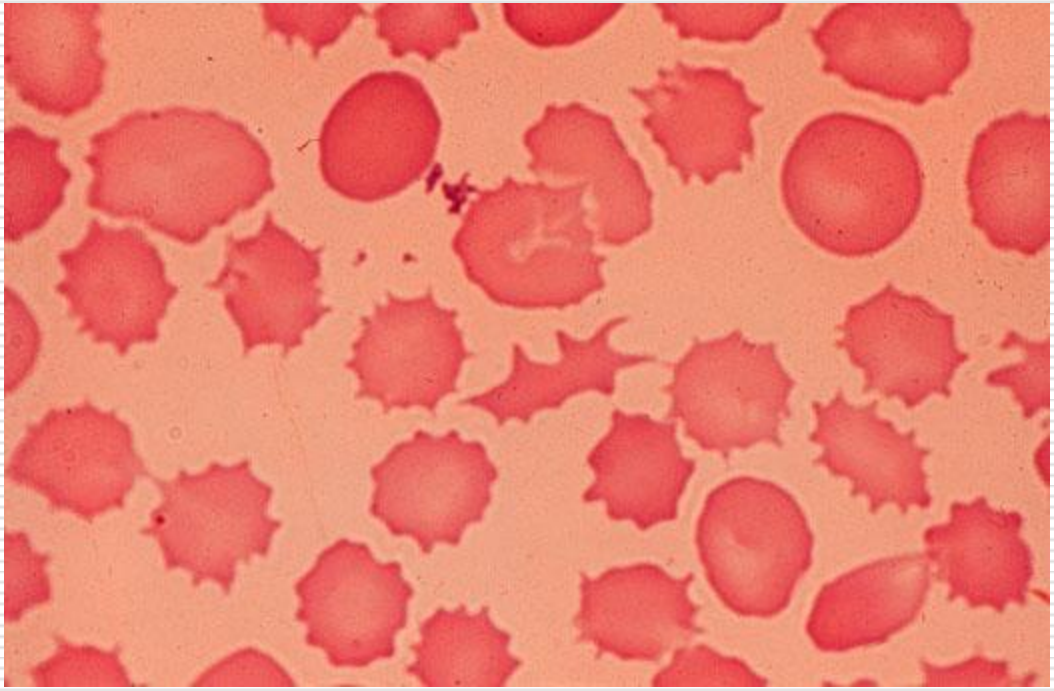
Causes of Anemia -- **Erythrocyte Loss**

- Bleeding
  - Chronic (Colonic polyp/carcinonma)
  - Acute/Hemodynamically significant:
    - Gastrointestinal (hematemesis melena)
    - Tractus urogenital (menometrorrhagi)
    - Traumatic

Anemia due to **Low Erythropoietin**

- Kidney Disease
  - Normochromic, normocytic
  - Low reticulocyte count
  - Frequently, peripheral smear in uremic patients show “burr cells” or echinocytes
  - Target hemoglobin for patients on dialysis is 11 to 12 g/dL
    - Administer erythropoietin or darbopoietin weekly
    - Good Iron stores must be maintained

Echinocytes (“burr cells”)



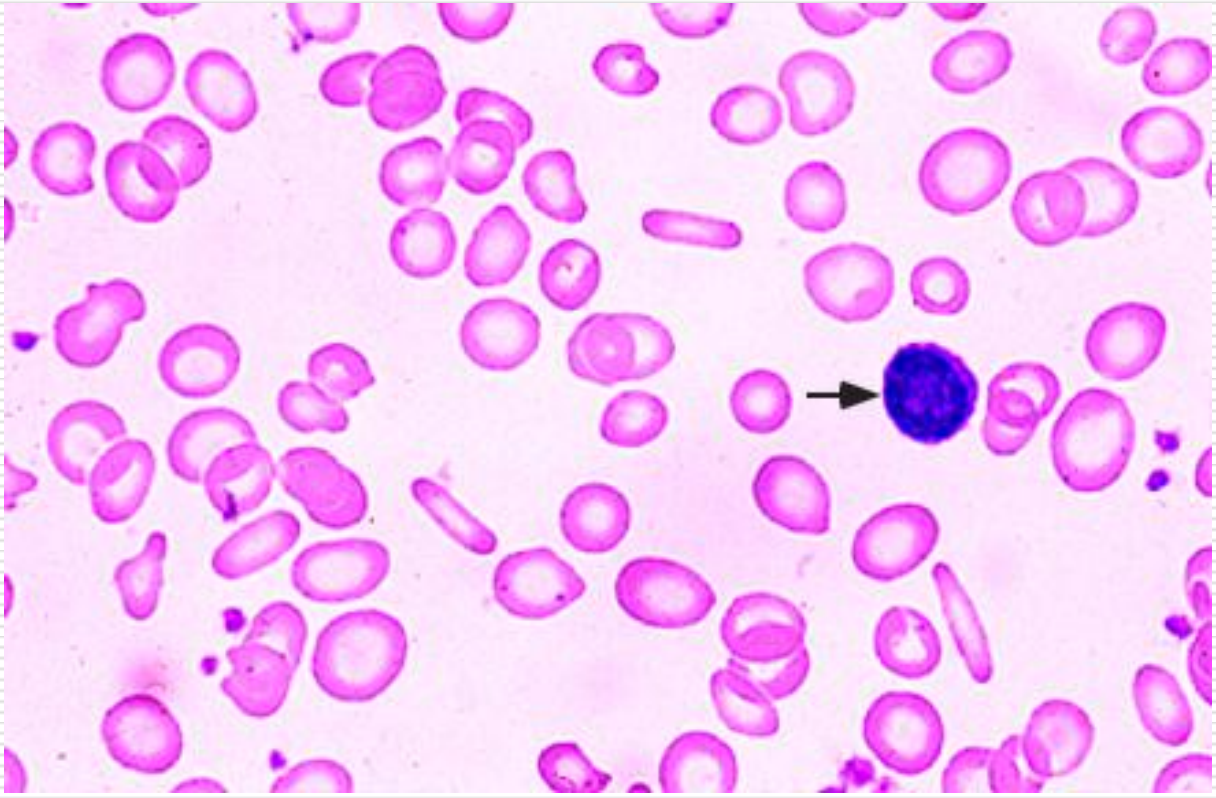
Anemia due to **Decreased Response to Erythropoietin**

- **Iron-Deficiency**
- **Vitamin B12 Deficiency**
- **Folate Deficiency**
- **Anemia of Chronic Disease**

Anemia due to **Decreased Response to Erythropoietin**

- **Iron Deficiency**
  - Can result from:
    - Pregnancy/lactation
    - Normal growth
    - Blood loss
    - Intravascular hemolysis
    - Gastric bypass
    - Malabsorption
      - Iron is absorbed in proximal small bowel; decreased abosrption in celiac disease, inflammatory bowel disease
  - May manifest as PICA
    - Tendency to eat ice, clay, starch, crunchy materials
  - May have pallor, koilonychia of the nails, beeturia
  - Peripheral smear shows **microcytic, hypochromic red cells with marked anisopoikilocytosis**.

Iron Deficiency Anemia



Iron Deficiency Anemia - koilonychia

Decreased Production

- Infectious
- Neoplastic
- Endocrine
- Nutritional Deficiency
- Anemia of Chronic Disease

Decreased Production INFECTIOUS

- Bacterial
  - Tuberculosis
- Viral
  - HIV
  - Parvovirus

Decreased Production NEOPLASTIC

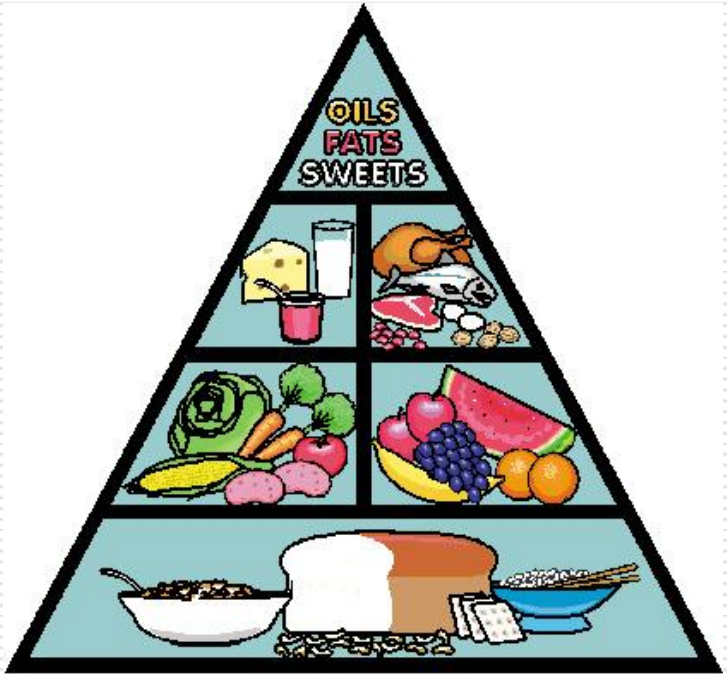
- Leukemia
- Lymphoma/Myeloma
- Myeloproliferative Syndromes
- Myelodysplasia

Decreased Production ENDOCRINE

- Thyroid Dysfunction
  - Hypothyroidism
- Erythropoietin Deficiency
  - Renal Failure

Decreased Production NUTRITIONAL DEFICIENCY

- Iron
- B12
- Folate



Anemia due to **Destruction of Red Blood Cells**

- Hemoglobinopathies
  - Sickle Cell Anemia
- Aplastic Anemia
  - Decrease in all lines of cells – hemoglobin, hematocrit, WBC, platelets
  - Parvovirus B19, EBV, CMV
  - Acquired aplastic anemia
- Hemolytic Anemia

Hemolytic Anemias

- **Hereditary spherocytosis**
- **Glucose-6-phosphate dehydrogenase (G6PD) Deficiency**
  - Most common enzyme defect in erythrocytes
  - X-linked
  - Brisk hemolysis when patients exposed to oxidative stress from drugs, infections or toxins.
- **Thrombotic Thrombocytopenic Purpura (TTP)**
  - Thrombocytopenia and microangiopathic hemolytic anemia, fever, renal insufficiency, **neurologic symptoms**
  - Schistocytes on smear
- **Hemolytic Uremic Syndrome**
  - Thrombocytopenia, Microangiopathic hemolytic anemia, renal insufficiency
- **Autoimmune Hemolytic Anemia**
  - **Warm-antibody mediated**
    - IgG antibody binds to erythrocyte surface
    - most common
    - Diagnosed by POSITIVE Coomb's Test (detectgs IgG or complement on the cell surgace)
    - Can be caused drugs
    - Treated with corticosteroids or splenectomy if refractory
  - **Cold agglutinin Disease**
    - IgM antibodies bind to erythrocyte surface
    - Does not respond to corticosteroids, but usually mild.
- **Infections**
  - **Malaria**
  - **Babesiosis**
  - **Sepsis**
- **Trauma**
  - Includes some snake, insect bites

Haemoglobin Level

- Mild : 8 – 10 gr%
- Moderate : 5 – 8 gr%
- Severe : < 5 gr%

- Gravis Anemia is names of severe anemia
- Refracter anemia is recurent anemia

Morphology Anemia

- Micrositic Hipochromic
- Normocitic Normochromic
- Macrocitic

Erithrosyte Indeks

- MCV= $\frac{Ht}{eri}$ x 10 (Normal 80-97 fl)
- MCH = $\frac{Hb}{eri}$ x 10 (Normal 27-31 pg)
- MCHC= $\frac{Hb}{Ht}$ x 100 (Normal 32-36 %)

MCV : Mikro/Makro

MCH , MCHC : Hipo / Hiper

Using MCV to Characterize Anemia

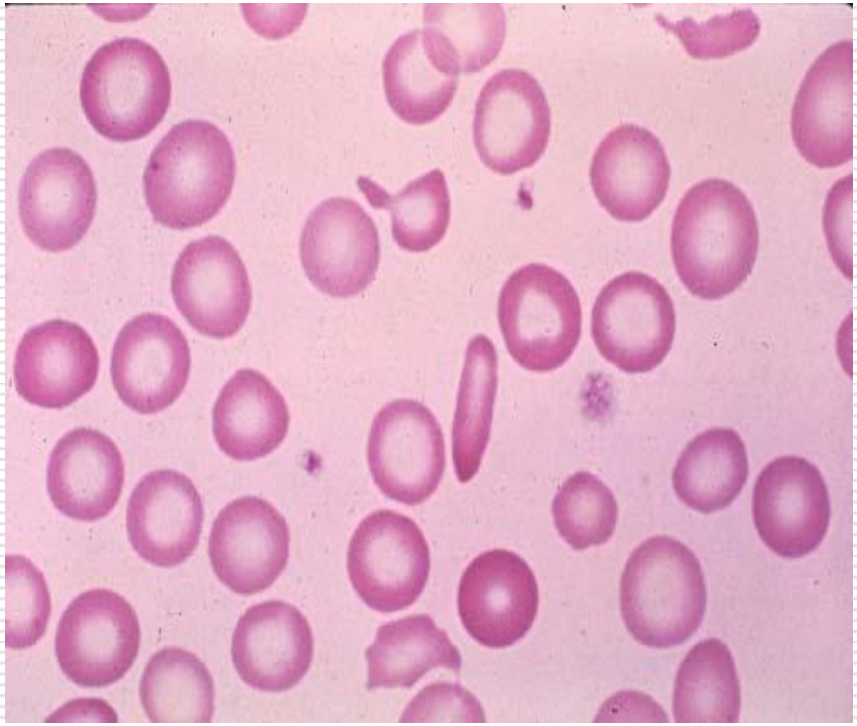
- Hypochromic Microcytic
  - Iron deficiency anemia
  - Thalassemia
  - Sideroblastic anemia
  - Chronic infection
  - Lead poisoning
  - Hemoglobin E trait
  - Inborn errors of iron metabolism
  - Copper deficiency
  - Severe Malnutrition

Macrocytic Anemia

- MCV > 100
- Megaloblastic:Abnormalities in nucleic acid metabolism
  - B12, Folate
- Non-megaloblastic:Abnormal RBC maturation
  - Myelodysplasia
- Liver dz, hypothryroidism, chemotherapy/drugs

Microcytic Anemia

- MCV <80
- Reduced iron availability
- Reduced heme synthesis
- Reduced globin production



Approach to Diagnosis of Anemia

- detailed history
- careful physical examination
- peripheral blood smear
  - red cell morphology
  - MCV
  - RDW
  - WBC and platelet morphology
- bone marrow evaluation
- additional testing

History

- diet
- family history
- environmental exposures
- symptoms (headache, exertion dyspnea, fatigue, dizziness, weakness, mood or sleep disturbances, tinnitis)

Evaluation of the Patient

- HISTORY
  - Is the patient bleeding?
    - Actively? In past?
  - Is there evidence for increased RBC destruction?
  - Is the bone marrow suppressed?
  - Is the patient nutritionally deficient? Pica?

Symptoms of Anemia

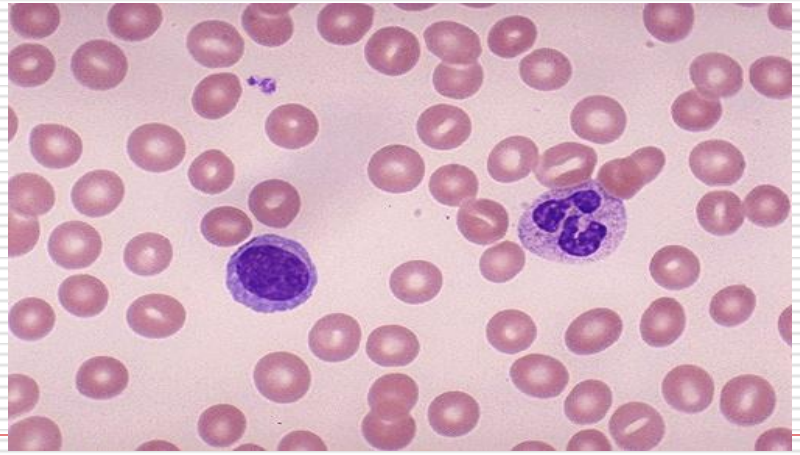
- Decreased oxygenation
  - Exertional dyspnea
  - Dyspnea at rest
  - Fatigue
  - Bounding pulses
  - Lethargy, confusion
- Decreased volume
  - Fatigue
  - Muscle cramps
  - Postural dizziness
  - syncope

Physical Examination

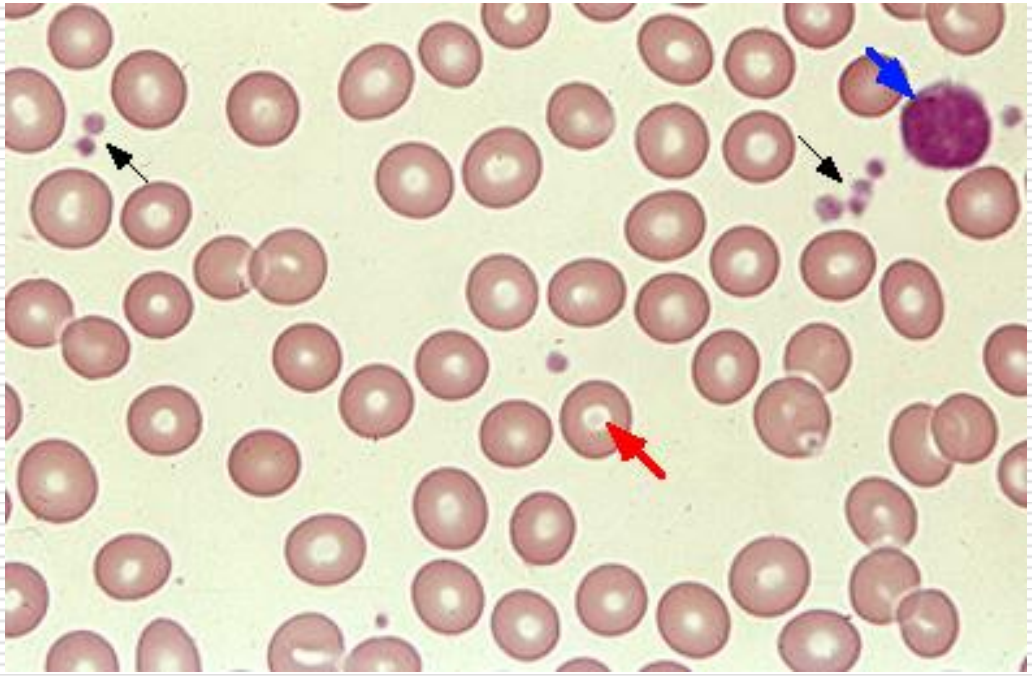
- pallor
- jaundice
- tachycardia
- tachypnea
- orthostatic hypotension
- venous hum
- systolic ejection murmur
- peripheral edema
- Hepatosplenomegaly
- glossitis
- gingival pigmentation
- Petechiae
- Bony pain

Laboratory Evaluation

- Initial Testing
  - CBC w/ differential (includes RBC indices)
  - Reticulocyte count
  - Peripheral blood smear



Normal Peripheral Smear



Peripheral Blood Components

- RBC
- Hgb
- HCT
- MCV - a calculated value
- MCH
- RDW
- Reticulocyte Count

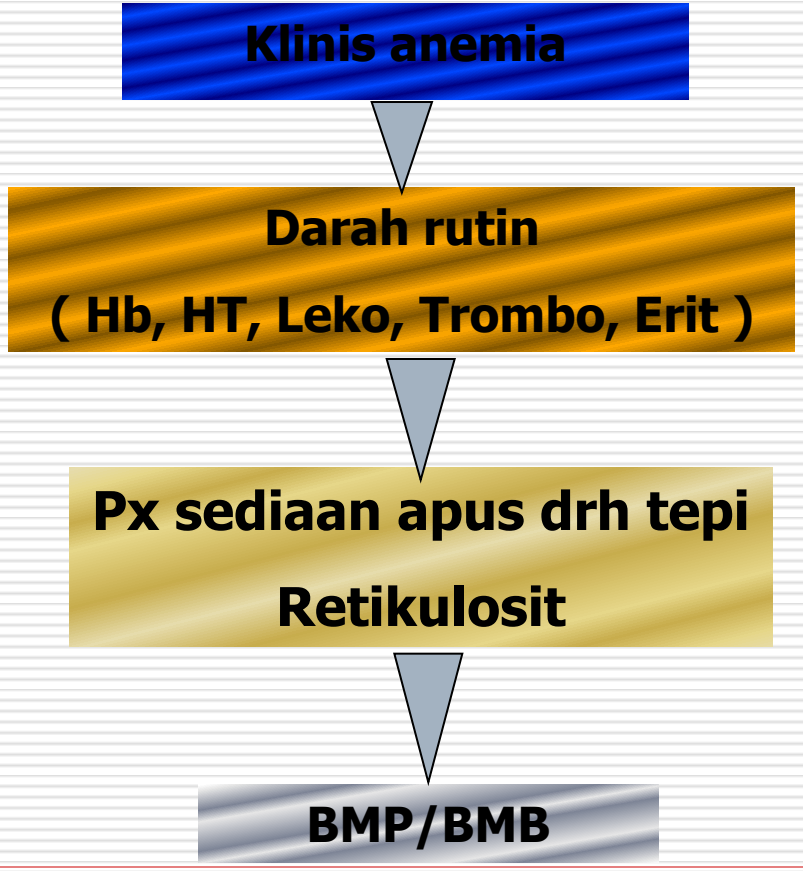
Laboratory Evaluation (2)

- Bleeding
  - Serial HCT or HGB
- Iron Deficiency
  - Iron Studies
- Hemolysis
  - Serum LDH, indirect bilirubin, haptoglobin, coombs, coagulation studies
- Bone Marrow Examination
- Others-directed by clinical indication
  - hemoglobin electrophoresis
  - B12/folate levels

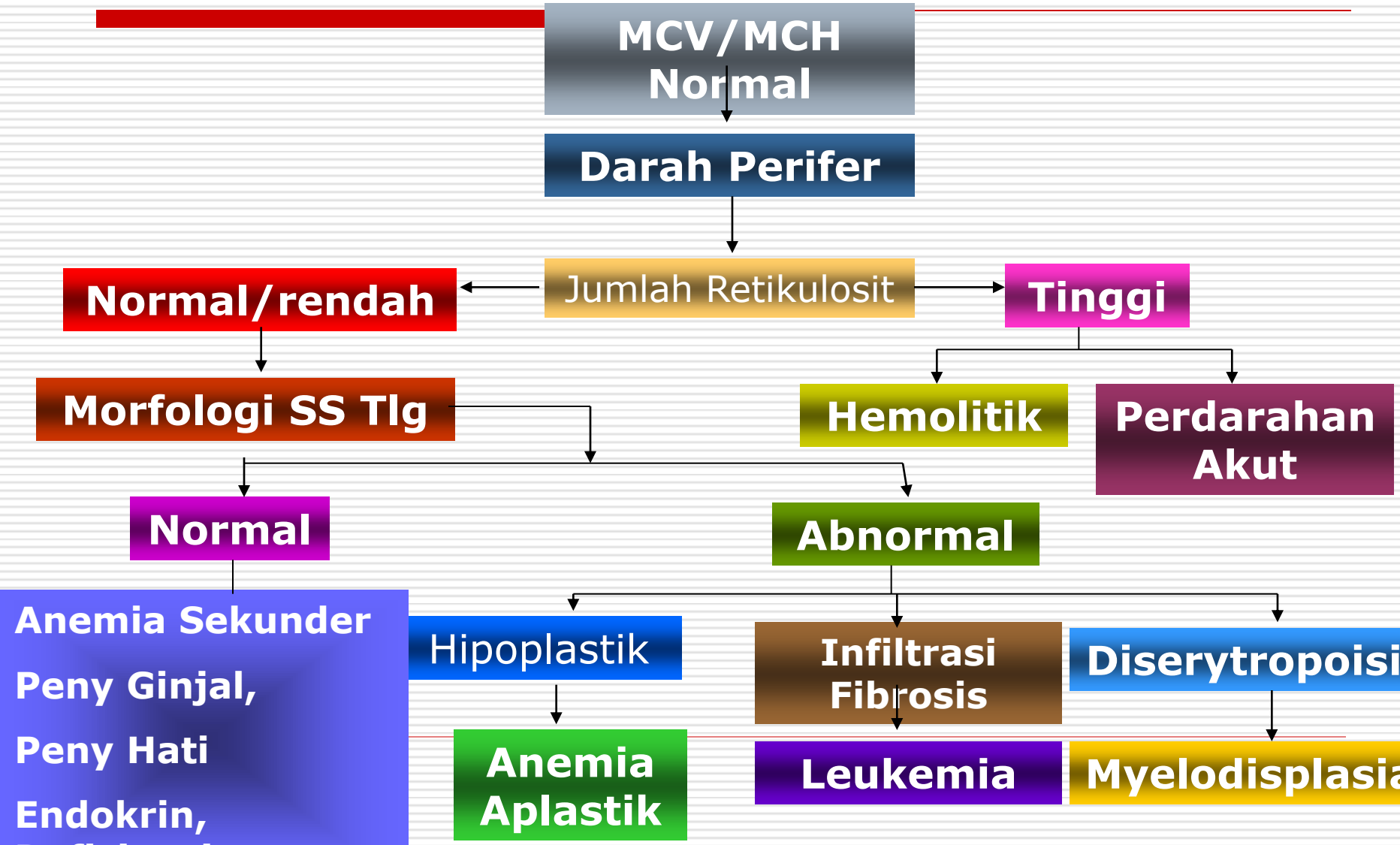
Red Cell Morphology

- anisocytosis
- poikilocytosis
- elliptocytes
- Howell-Jolly bodies
- Cabot's rings
- Heinz bodies
- Sickled cells
- Spiculated/Crenulated red cells
- Target cells
- Basophilic stippling

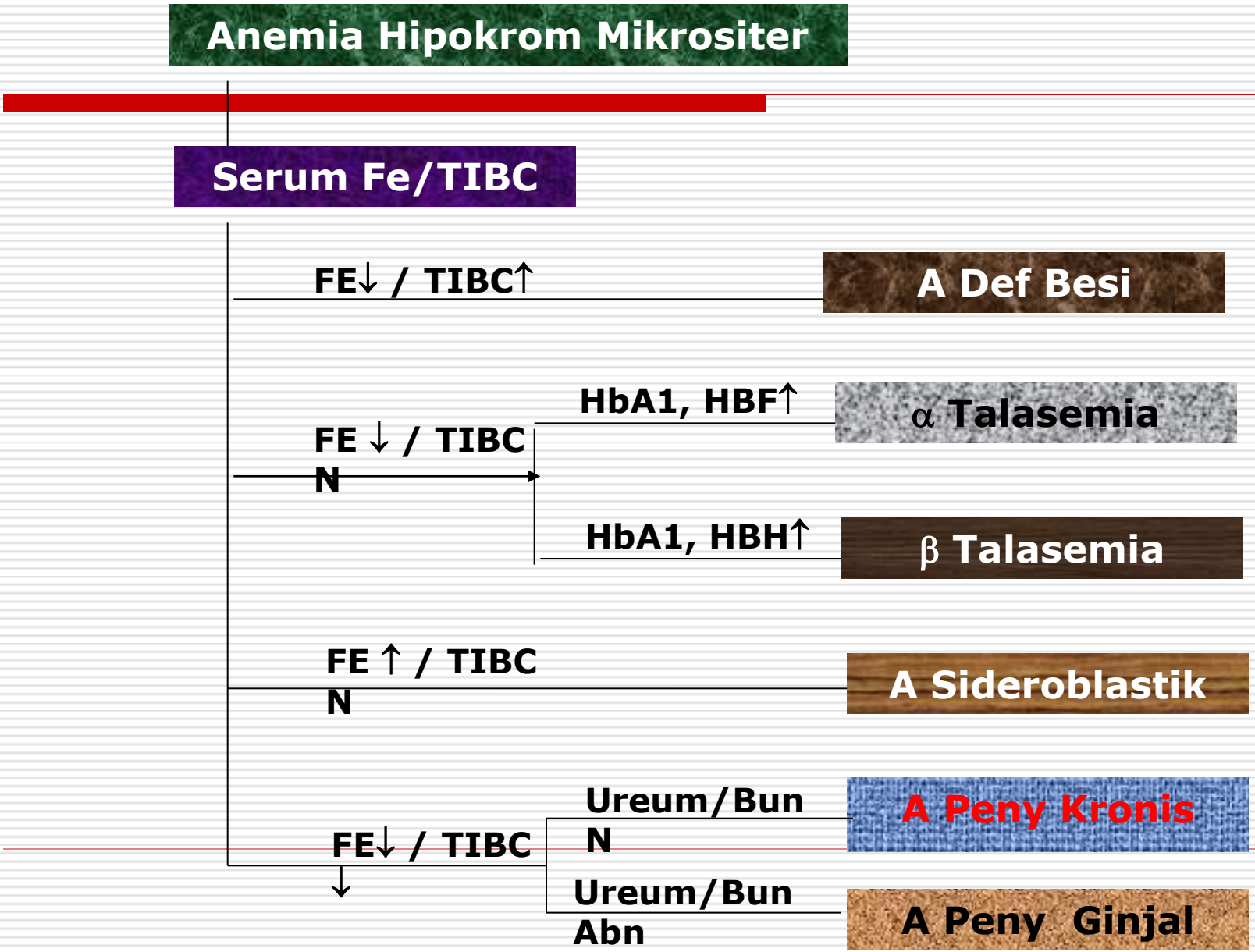
Diagnosis Anemia



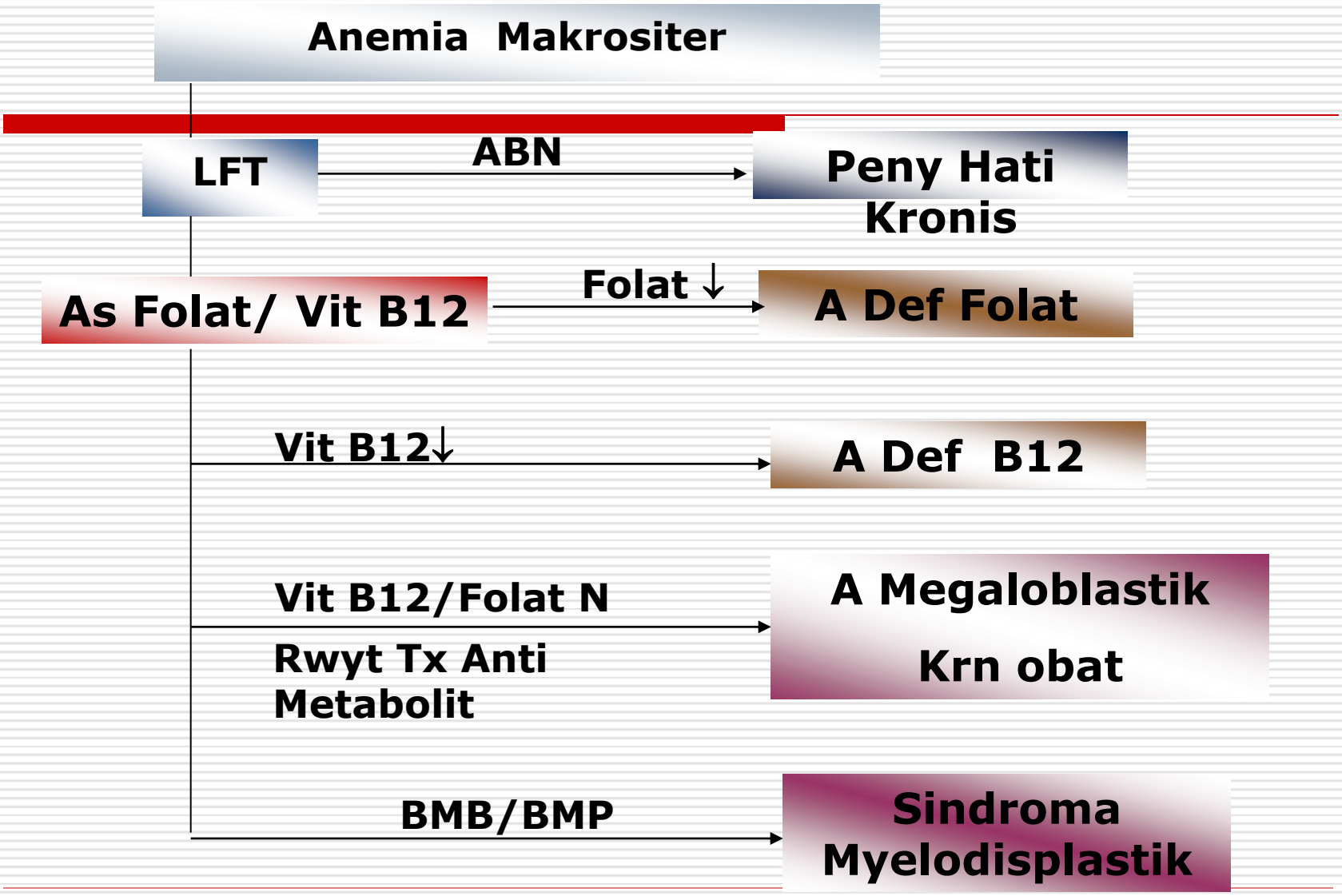
Algoritma Anemia Normokrom Normositer



Algoritme anemia Hipokrom Mikrositer



Algoritma Anemia Makrositer



Thank You for Your Attention