

امراض الدم الكورس الأول

Anemia definition



Sawa University

College of health and medical techniques

Department of Medical Laboratories

..... Third Stage

جامعة ساوة الاهلية

كلية التقنيات الصحية والطبية

قسم تقنيات المختبرات الطبية

....المرحلةالثالثة

محاضرة رقم 5

Lecture No. 5

الجانب النظري

Theoretical

تدريسي المادة : د وضاح علي حسين

Anemia

Definition , Causes and Classification

Definition :

Anemia Reduction of one or more of the major RBC measurements: hemoglobin concentration , hematocrit (PCV) , or RBC count below the normal range for the age and gender . *

****According to World Health Organization criteria (WHO)**

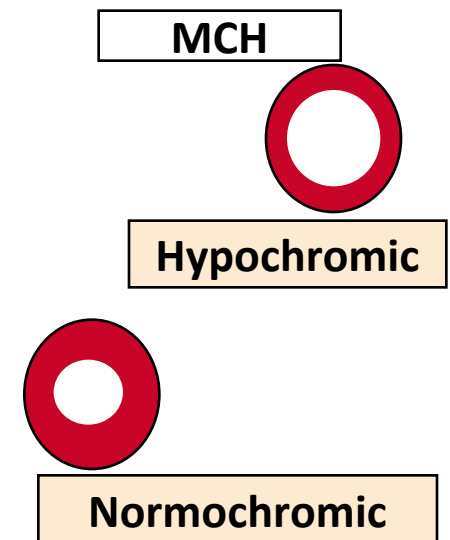
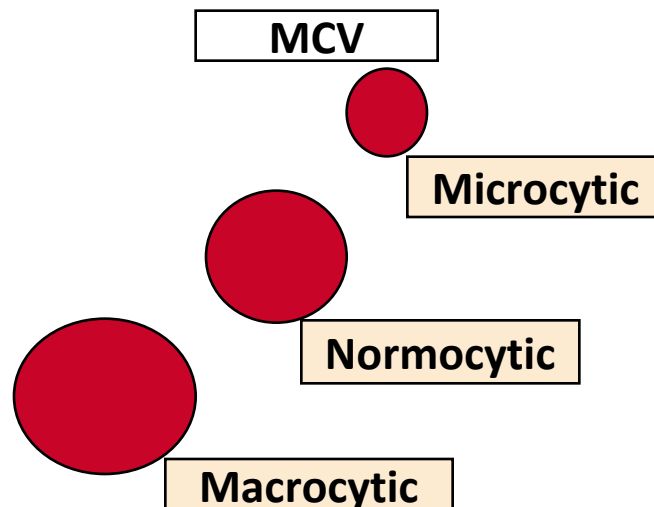
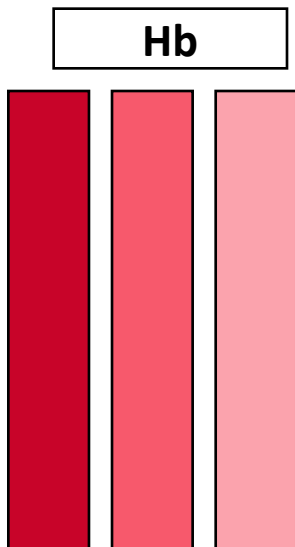
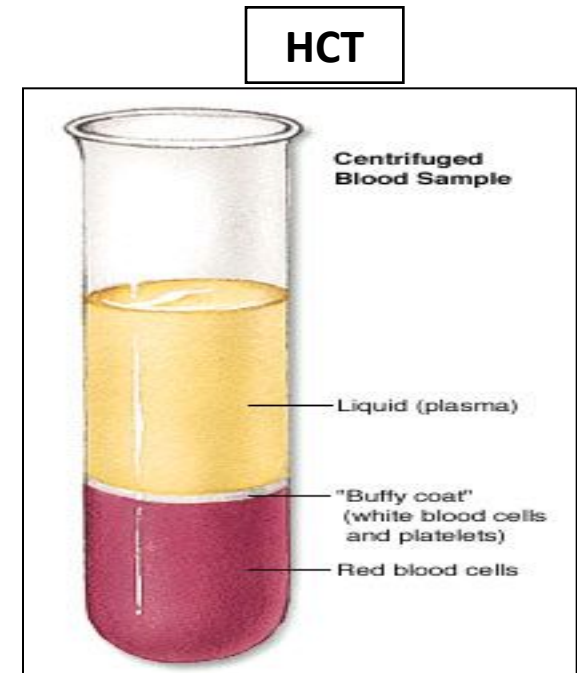
Anemia is defined as :

**Blood hemoglobin (Hb) concentration (<13 g/dL)
or Hematocrit (Hct) $<39\%$ in adult males .**

Hb concentration (<12 g/dL) or Hct $<37\%$ in adult females.

**Normal Ranges

Indices	Male	Female
Hemoglobin(g/dL)	13.5-17.5	11.5-15.5
Hematocrit (PCV) (%)	40-52	36-48
Red Cell Count ($\times 10^{12}$)	4.5-6.5	3.9-5.6
Mean Cell Volume (MCV) (fL)	80-99	
Mean Cell Hemoglobin (MCH) (pg)	30-35	

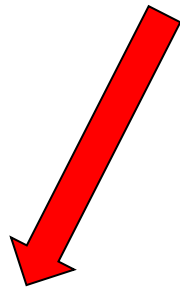


- . The function of the RBC is to deliver oxygen from the lungs to the tissues and carbon dioxide from the tissues to the lungs .
- . This is accomplished by using hemoglobin (Hb), a tetramer protein composed of heme and globin.

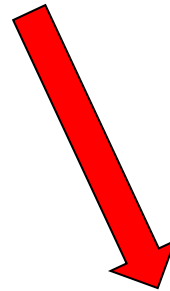
Consequence of anemia , a decrease in the number of RBCs transporting oxygen and carbon dioxide impairs the body's ability for gas exchange. leading to decreased O₂ carrying capacity of blood and thus availability to tissues hypoxia

The symptoms and findings of anemia concern due to the widespread nature of hypoxia

Anemia ?



Production ?



Blood loss /Destruction?

Functional Classification of Anemia

- Marrow production defects (Hypoproliferative)
- Red cell maturation defects (Ineffective erythropoiesis)
- Decreased red cell survival (Blood loss/ Hemolysis)

Harrison's Principles of Internal Medicine 19 th Edition

****Anemia's may also be classified according to**

1 . The morphology of the RBC.

The normocytic, normochromic anemia.

The macrocytic, normochromic anemia.

The microcytic, hypochromic anemia.

2. The etiology (pathophysiology)

. Increased RBC loss.

Decreased or defective cell production in the bone marrow

Physiological classification of Anemia

Hypoproliferative

Marrow damage-

- Malignant Infiltration , fibrosis , aplastic anemia , acute leukemia

Chronic disease include ;

Kidney disease

Liver disease

Chronic infections

Collagen vascular diseases

Maturation disorder

Cytoplasmic defects –

- Iron deficiency
- Thalassemia
- Sideroblastic anemia

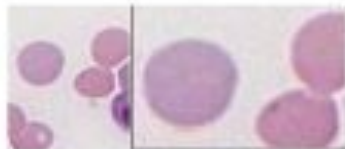
Nuclear defects

- Folate/ vit B 12 deficiency
- drug toxicity
- Refractory anemia MDS

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Erythropoiesis

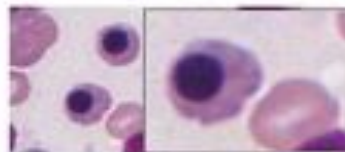


Erythrocytes

No nucleus and red cytoplasm

Reticulocytes

No nucleus and blue - grey cytoplasm



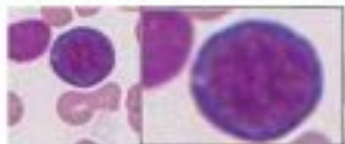
Orthochromatophilic
erythroblasts

Dark, small, spherical nucleus
blue – grey cytoplasm



Polychromatophilic
erythroblasts

Darkening, fractured ,spherical
nucleus and mixed pools of grey and
blue cytoplasm



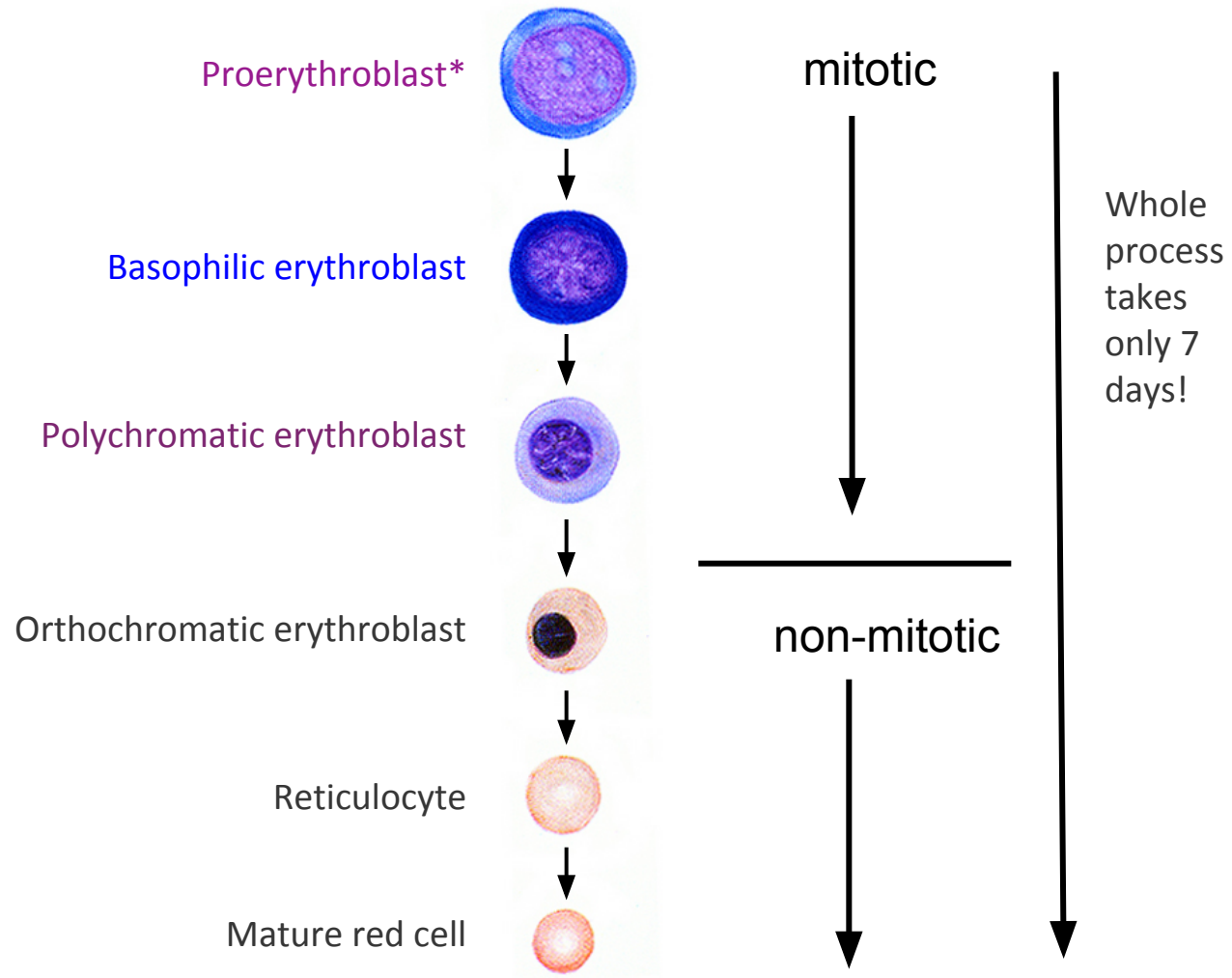
Basophilic erythroblasts

Fractured, spherical nucleus and
thin rim of dark blue cytoplasm



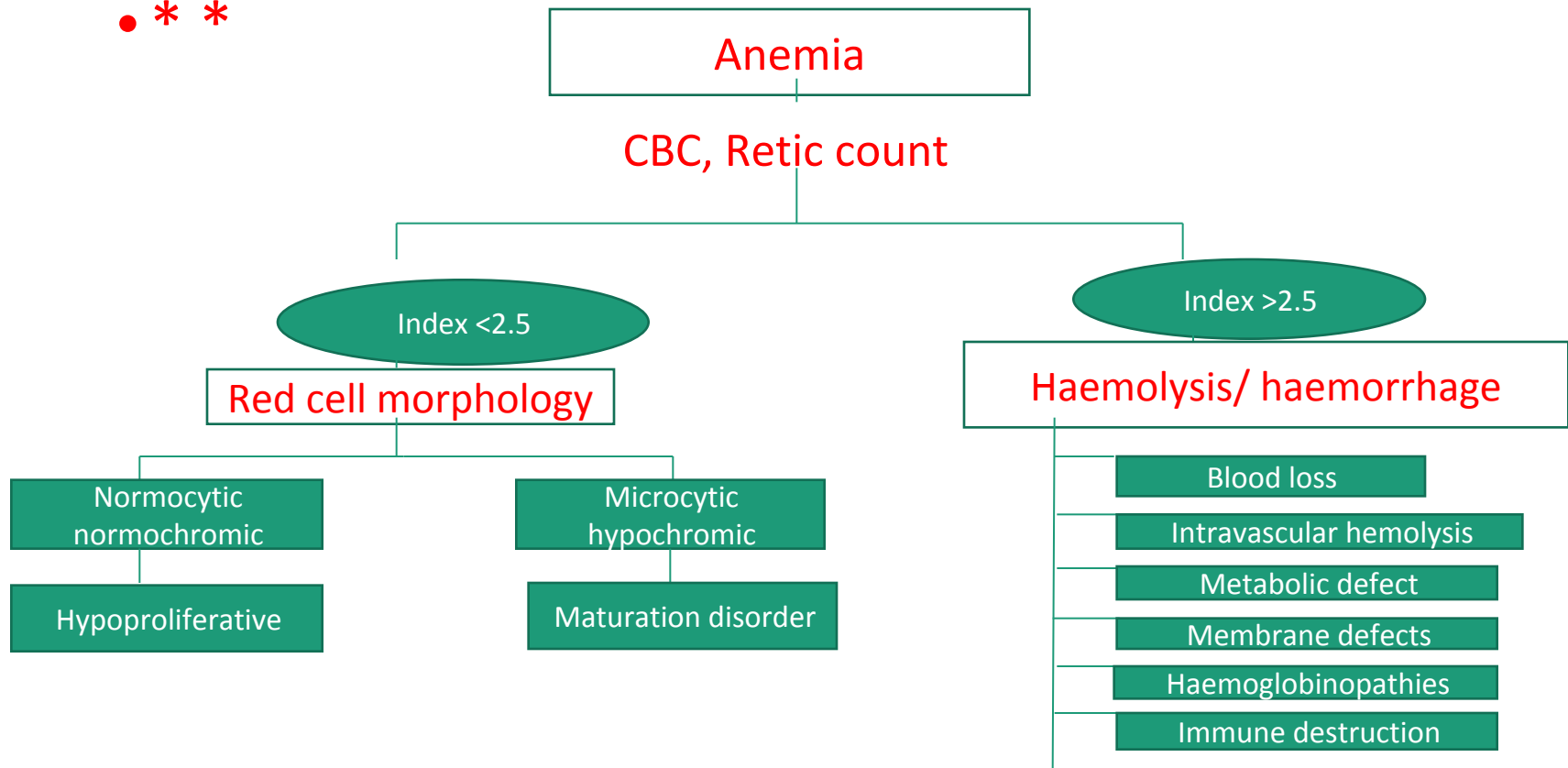
Proerythroblasts

Uniformly light, spherical
nucleus with thin rim of medium
to dark blue cytoplasm

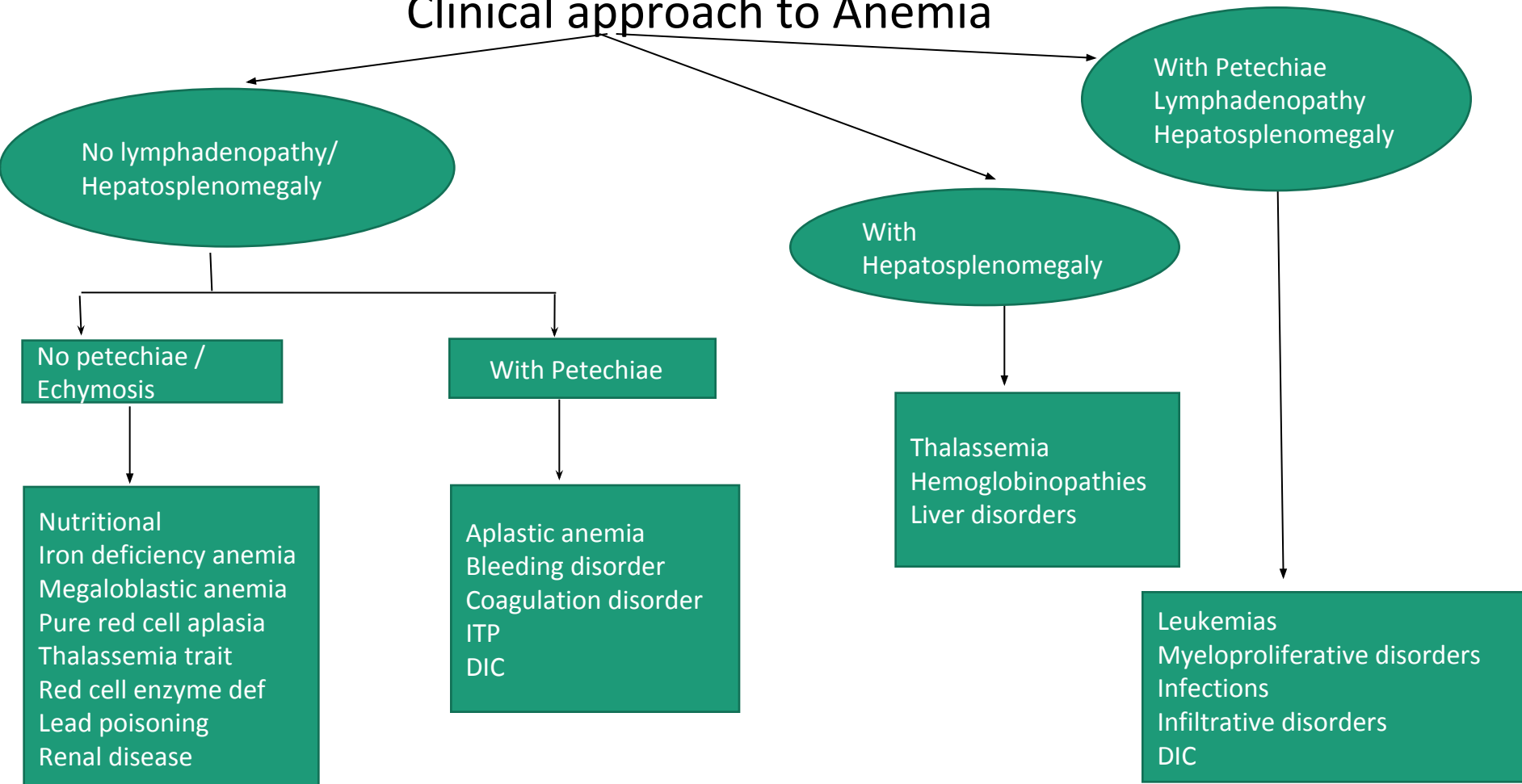


Physiological classification of Anemia

● * *



Clinical approach to Anemia



****Clinical Features**

1-General features of anemia

- Weakness
- Headache
- Pallor
- Lethargy
- Dizziness
- Palpitation (tachycardia)
- Angina
- Cardiac failure

Related to anemia

Related to compensatory
mechanism

2-Specific features

Specific signs are associated with particular types of anemia :

- ❖ Spoon nail with iron deficiency,
- ❖ Leg ulcers with sickle cell anemia
- ❖ Jaundice with hemolytic anemia
- ❖ bone deformities in thalassemia major

Clinical signs in Anemia

Pallor



Blue sclera



Clinical signs in Anemia

Koilonychia



Angular cheilitis



Clinical signs of Anemia

Alopecia



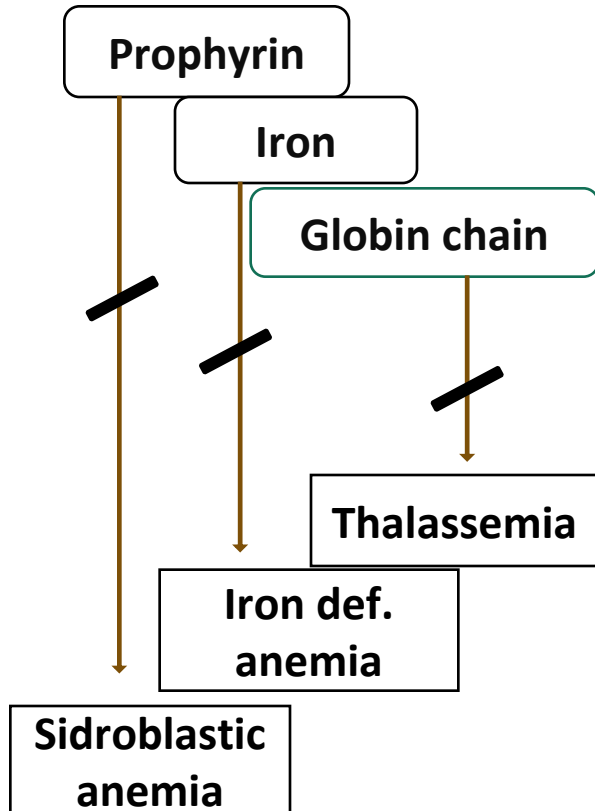
****A rational approach to determining etiology**

If the anemia is microcytic (mean corpuscular volume [MCV] < 84 fL)

or macrocytic (MCV > 96 fL) or if certain abnormal RBCs or white blood cells (WBCs) are observed in the blood smear, the investigative approach can be limited.

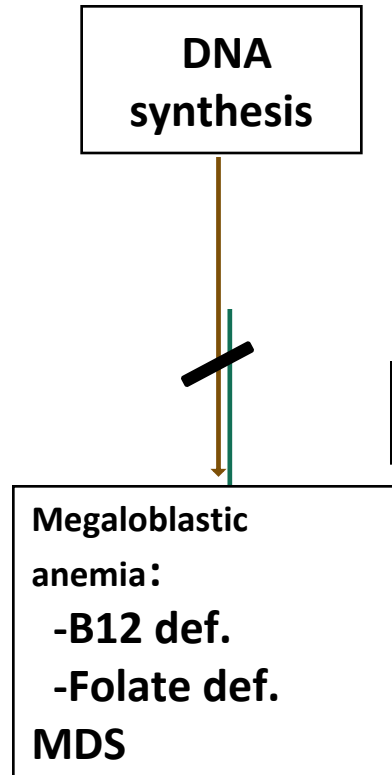
Presently, RBC cellular indices are computer calculated and automatically placed on laboratory reports. :

Hemoglobin



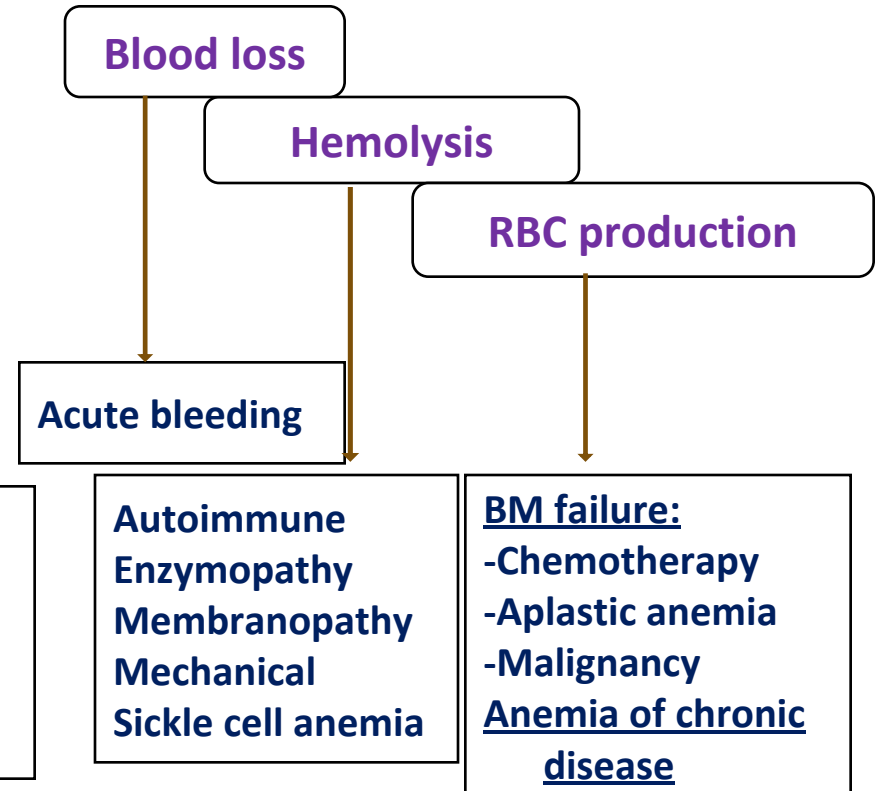
Hypochromic
****microcytic**
anemia

DNA



Macrocytic
anemia

RBC count



**** Normocytic**
normochromic
anemia

**** Conditions associated with microcytic hypochromic anemia,, are .**

Microcytic Hypochromic Anemia ($MCV < 83$; $MCHC < 31$)

Iron deficiency anemia

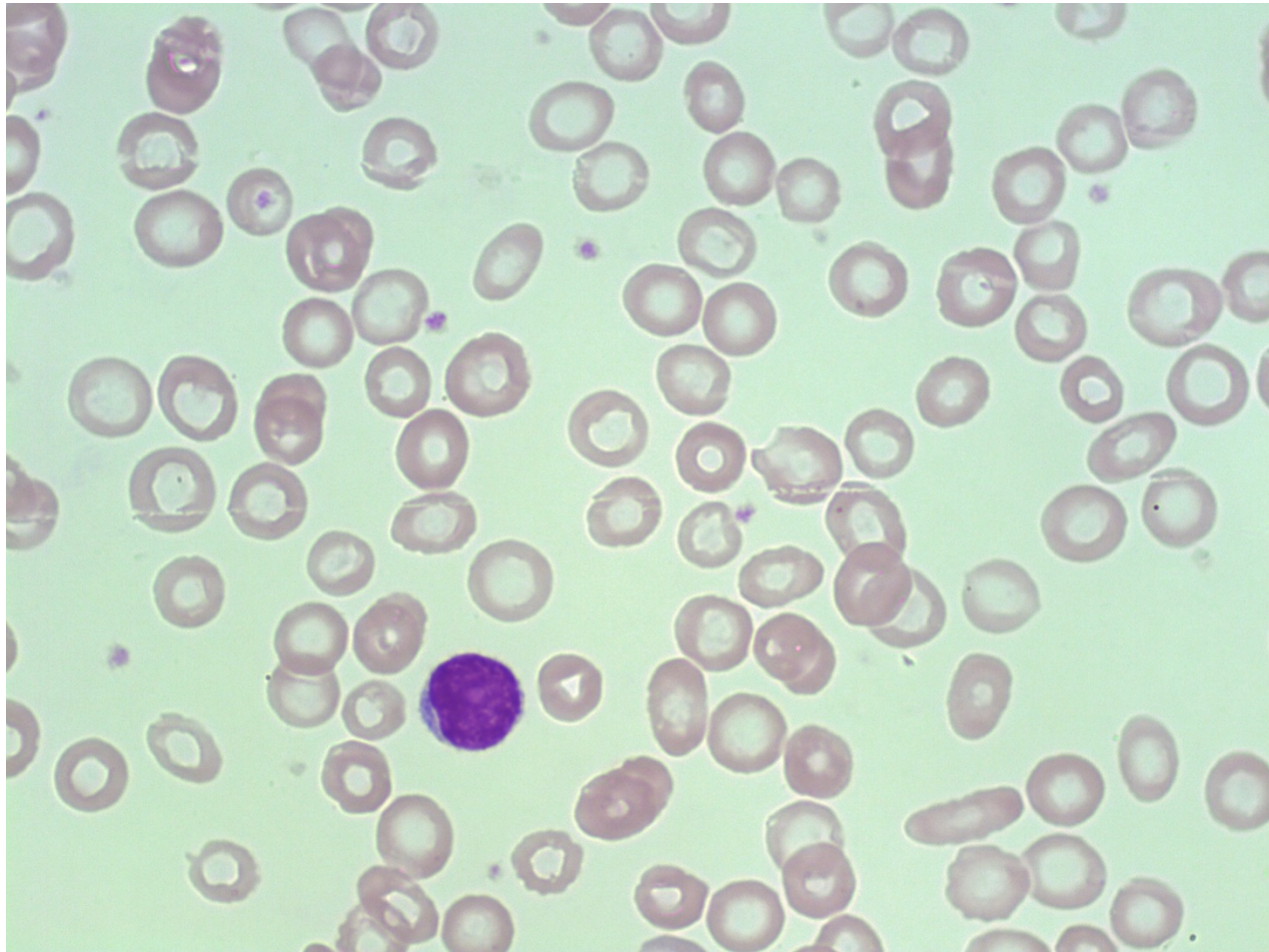
thalassemia major

Thalassemia minor lead poisoning

Anemia of chronic disease

Lead poisoning

Sidroblastic anemia



In microcytic hypochromic anemia,

The appropriate laboratory tests are serum iron level and TIBC and either serum ferritin level or stain of bone marrow specimen for iron.

If the serum iron level is decreased and the TIBC is increased, a diagnosis of iron deficiency can be made, therapy can be initiated, and a search for the cause of the iron deficiency can be started.

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Blood loss

Gastrointestinal disorders (esophageal varices, hemorrhoids and

*GIT cancer * colon , gastric , rectal cancer ***)

Extensive and prolonged menstruation

Pulmonary (hemoptysis,), urologic, or nasal disorders

Chronic blood donations

Dialysis

Hookworm infestation

Inadequate iron supply

- Poor nutritional intake in children (not a common independent mechanism in adults but often a contributing factor)
- Gastric bypass surgery for ulcers or obesity
- Achlorhydria from gastritis or drug therapy
- ***Severe malabsorption (for example, celiac disease)***
- Abnormal transferrin function
- Congenital atransferrinemia
- Autoantibodies to transferrin receptors

Iron Deficiency Anemia vs. Inflammatory Block

- Smear:
 - hypochromic and microcytic (low MCV) RBCs, usually not seen unless Hct < 30%
 - platelet count is often elevated
- ↓ Ferritin: a measure of total body iron stores, but also an acute phase reactant
 - **<15µg/l = Fe deficiency,**
 - **>150 µg/l = Not Fe deficiency**

Iron Deficiency Anemia vs. Inflammatory Block

- Low Iron Saturation (Fe/TIBC ratio)
 - ↓ Fe (not reliable)
 - ↑ **TIBC**
 - Fe/TIBC (% saturation) <15%
- BM bx: absent Fe stores
 - Gold standard
- Therapeutic Trial of Oral Iron

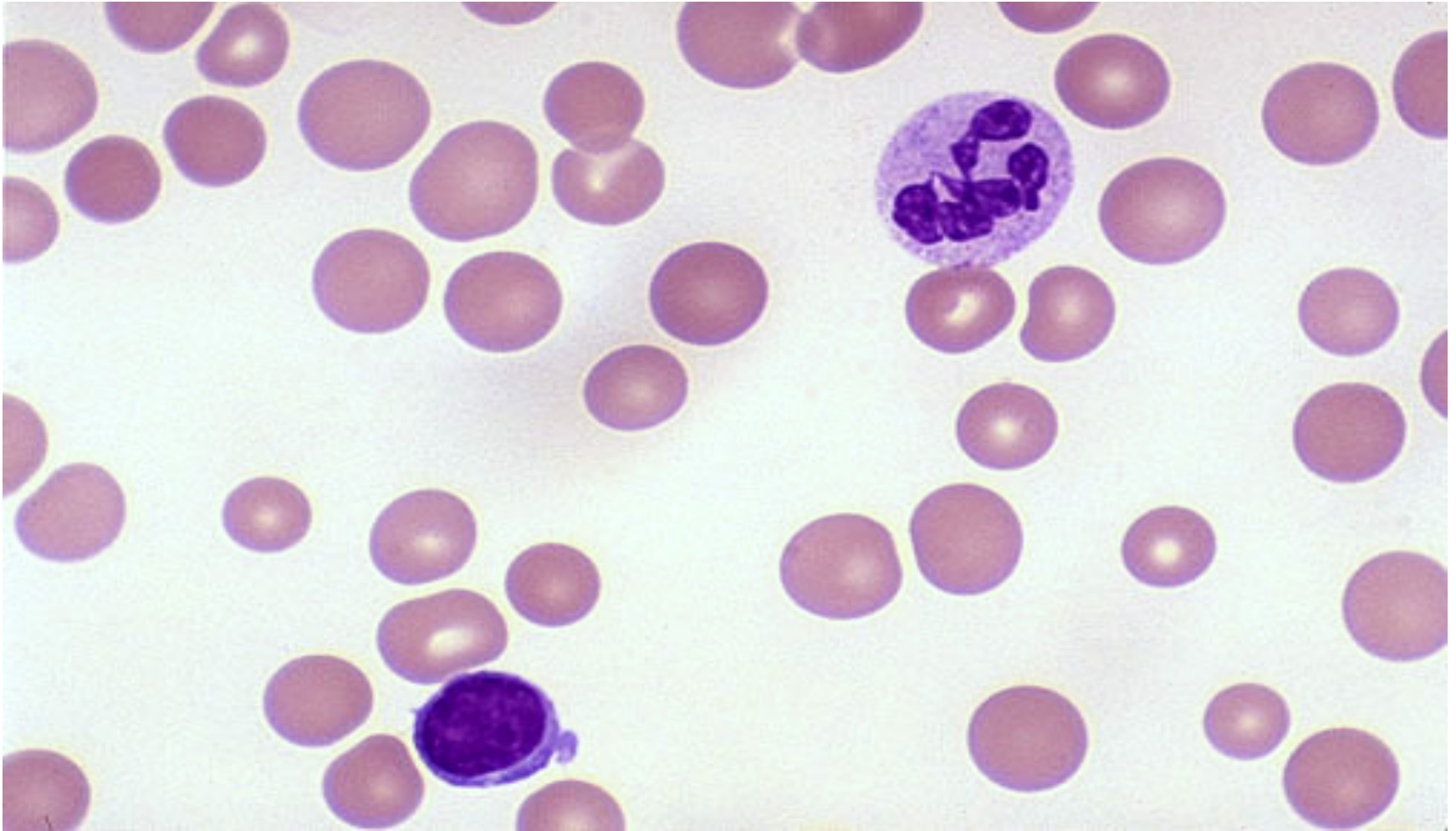
(** macrocytic anemia)

MCV 100 – 115 fl

- **B12, Folate**
- **Drugs that impair DNA synthesis**
chemotherapy
- **MDS**
- **Hypothyroidism**

* Macrocytosis

refers to the finding of enlarged red blood cells (RBCs)



B12/Folate Deficiency

- Etiology:
 - Anemia-- Vitamin B12 and folate are needed for DNA synthesis deoxyuridate to thymidylate , including RBC precursors
 - Deficiency
 - B12 - Dietary intake, acid-pepsin in the stomach, pancreatic proteases, gastric secretion of intrinsic factor, an ileum with Cbl-IF receptors (fish tapeworm)
 - Folate-- Poor dietary intake $\pm$ EtOH, malabsorption, increased demand (pregnancy, hemolytic anemias), inhibitors of DHFR

B12/Folate Deficiency (2)

- Dx:

- Smear: Macrocytic (High MCV) RBCs, +/- hypersegmented neutrophils, +/- modest neutropenia, but...
- the diagnosis of B12 def. was made in patients in whom only 29 percent had anemia, and only 36 percent had a MCV greater than 100 fL (Pruthi RK, Tefferi A, Mayo Clin Proc 1994 Feb;69(2):144-50)

- B12

- Low serum B12, elevated serum methylmalonic acid levels
- Anti-IF Abs, Schilling test (?), PA accounts for 75%

- Folate

- Serum folate level-- can normalize with a single good meal

B12/Folate Deficiency (3)

- Tx:
 - B12 deficiency: B12 1 mg/month IM, or 1-2 mg/day po
 - Folate deficiency: Improved diet, folate 1 mg/day
- Monitor for a response to therapy.
- Pernicious Anemia – monitor for gi cancers.

** Hemolytic Anemias

Hemolytic anemias are either acquired or congenital. The laboratory signs of hemolytic anemias include:

1. Increased LDH (LDH1) - sensitive but not specific.
2. Increased indirect bilirubin - sensitive but not specific*.
3. Increased reticulocyte count - specific but not sensitive
4. Decreased haptoglobin - specific but not sensitive.
5. Urine hemosiderin - specific but not sensitive.

*The indirect bilirubin is proportional to the hematocrit, so with a hematocrit of 45% the upper limit of normal is 1.00 mg/dl and with a hematocrit of 22.5% the upper limit of normal for the indirect bilirubin is 0.5mg/dl. Since tests for hemolysis suffer from a lack of sensitivity and specificity, one needs a high index of suspicion for this type of anemia.

**General Principles

- Anemia is a sign, not a disease.
- Anemias are a dynamic process.
- Its never normal to be anemic.
- The diagnosis of iron deficiency anemia mandates further work-up.

***AABB guidelines for blood Transfusion in Anemia 2023

- For hemodynamically stable patients without active bleeding
 - Hb <6 g/dL – Transfusion recommended
 - Hb - 6 to 7 g/dL – Transfusion generally likely to be indicated.
 - Hb - 7 to 8 g/dL – Transfusion is appropriate in patients undergoing orthopedic surgery or cardiac surgery, and in those with stable cardiovascular disease, after evaluating the patient's clinical status.
 - Hb - 8 to 10 g/dL – Transfusion generally not indicated, but should be considered for some populations (eg, those with symptomatic anemia, ongoing bleeding, acute coronary syndrome with ischemia, and hematology/oncology patients with severe thrombocytopenia who are at risk of bleeding)
 - Hb >10 g/dL – Transfusion generally not indicated

- Q1 The laboratory signs of hemolytic anemias
- Q2 Conditions associated with microcytic hypochromic anemia
- Q3 definition of anemia According to World Health Organization criteria (WHO)
- Q4 guidelines for blood Transfusion in Anemia