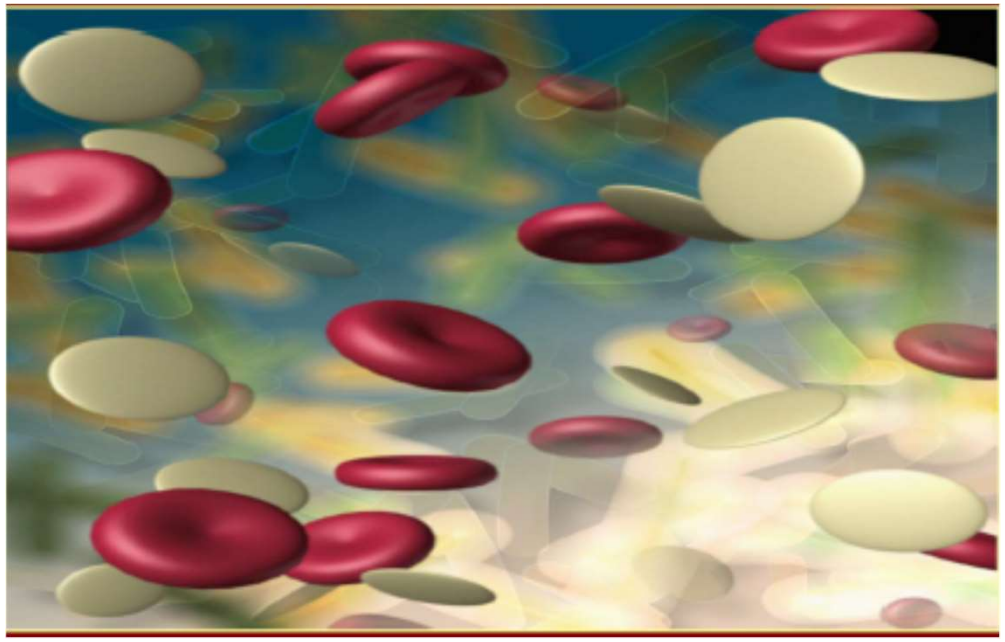

بسم الله الرحمن الرحيم

Complete Blood Count



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CBC COMPONENTS

- Red Blood Cells (RBCs)
- Hematocrit (Hct)
- Hemoglobin (Hgb)
- Mean Corpuscular Volume (MCV)
- Mean Corpuscular Hemoglobin(MCH)
- Mean Corpuscular Hemoglobin
- Concentration (MCHC)
- Red cell distribution width (RDW)
- White Blood Cells (WBCs)
- Platelets
- Mean Platelet Volume (MPV)

RBC

- Transport hemoglobin which carries oxygen from the lung to tissues throughout your body

- Produced in the bone marrow and stimulated by erythropoietin which is made in the kidneys

  M: ۴٫۲۰ to ۵٫۸۰ m/uL
  F: ۳٫۸۰ to ۵٫۲۰ m/uL

HEMOGLOBIN AND HEMATOCRIT

Hemoglobin :
M: ١٤/٠ to ١٨ gm/dL
F: ١٢ to ١٦ gm/dL
Hematocrit : Percentage of the volume of whole blood that is made up of red blood cells. (Hint: Hb x ٣)
M: ٤٢to ٥٤ %
F: ٣٦ to ٤٨ %

MCV and MCH

- MCV = mean corpuscular volume

  HCT/RBC count= ٨٠-١٠٠ fL

  - small = microcytic
  - normal = normocytic
  - large = macrocytic

- MCH= mean corpuscular hemoglobin

  Hb/RBC count= ٢٧-٣٤ pg

  - decreased = hypochromic
  - normal = normochromic
  - Increased = hyperchromic

MCHC and RDW

- MCHC = mean corpuscular hemoglobin concentration
  Hb/HCT = ٣٢- ٣٦ gm/dl

- RDW = red cell distribution width It is correlates with the degree of anisocytosis or variation in red blood cell width.
  Normal range from ١٠-١٥%

Hemoglobin

Elevated

- Primary erythrocytosis

-Polycythemia Vera

- Secondary erythrocytosis

-Chronic hypoxia(COPD,
heart disease, highaltitude)

-Elevated erythropoietin
due to malignancy

Low

- Anemia

DEFINED:

Anemia can be defined as:

١. *reduction in hemoglobin concentration*
٢. *hematocrit, or*
٣. *number of red blood cells*

Birth	16.5	13.5
2 weeks	16.5	12.5
2week_3months	11.5_16.5	9(Term) 7(Preterm)
3–6 months	11.5	9.5
6month_6years	12	10.5
6–12 years	13.5	11.5
12–18 years Female	14	12
12_18years Male	14.5	13

How to Approach Anemia

- Decreased production of RBC's

- ex. bone marrow failure, nutritional deficiencies

- Increased destruction of RBC's

- ex. hemolysis

- Loss of RBC's

- ex. bleeding

MICROCYTIC ANEMIA

The 3 major diagnostic possibilities for microcytic amaenia are :

- Iron deficiency anemia (IDA),
- Thalassemia,
- Anemia of chronic disease (ACD)

IDA

- RBC: normal or low
- Hb: low
- MCV: low
- RDW: high

Thalassemia

- RBC: normal or high
- Hb: low
- MCV: low
- RDW: normal

Disproportionate !!!

An extremely low MCV may suggest Alpha – thalassemia !!!

Mentzer index

- Is used to differentiate IDA from B-thalassemia.
- MCV / RBC : is < 13, thalassemia is more likely.
- If the result > 14, then iron-deficiency anemia is more likely.

ACD

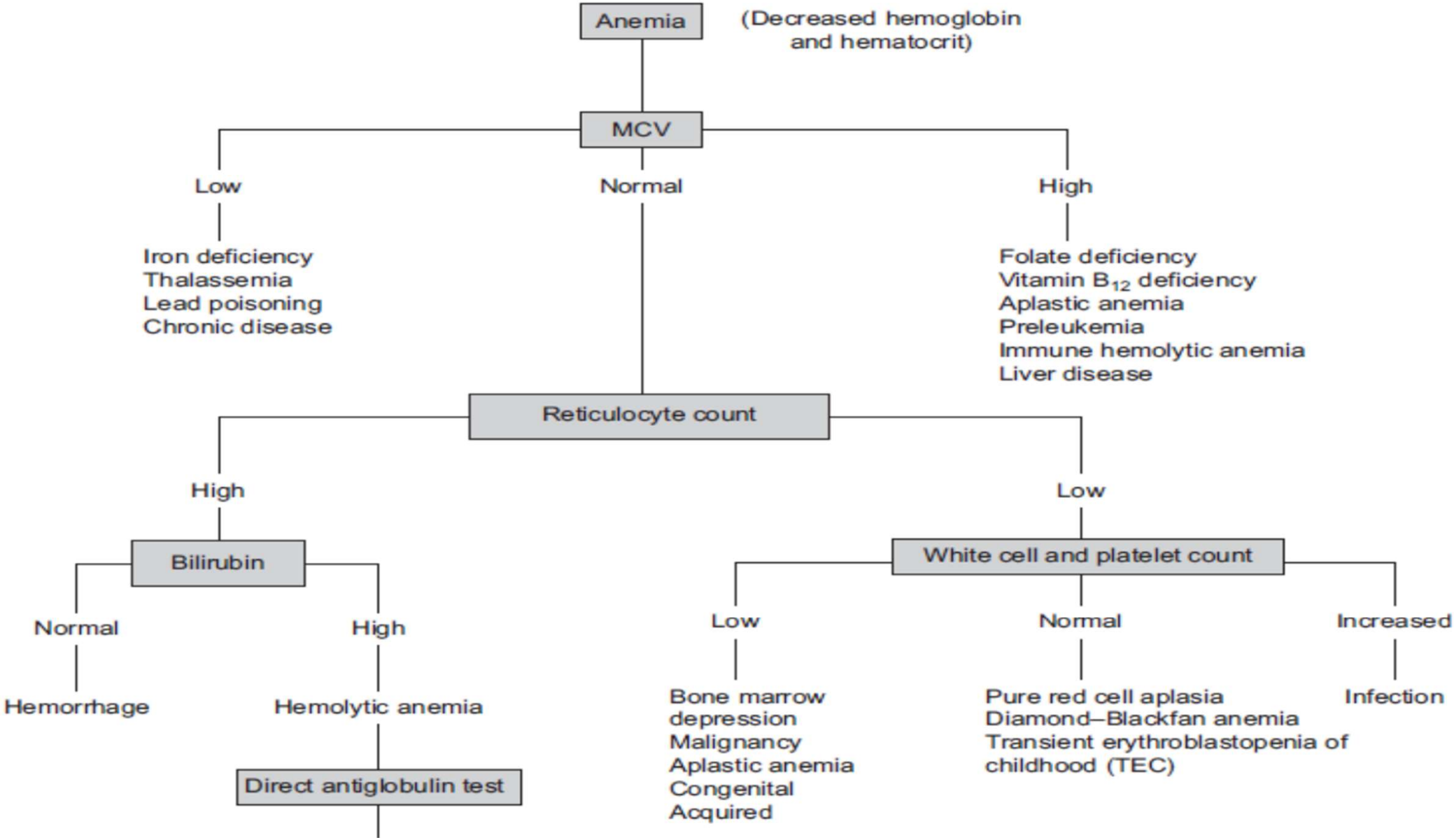
- RBC: normal or low ?
- Hb: low
- MCV: normal
- RDW: normal

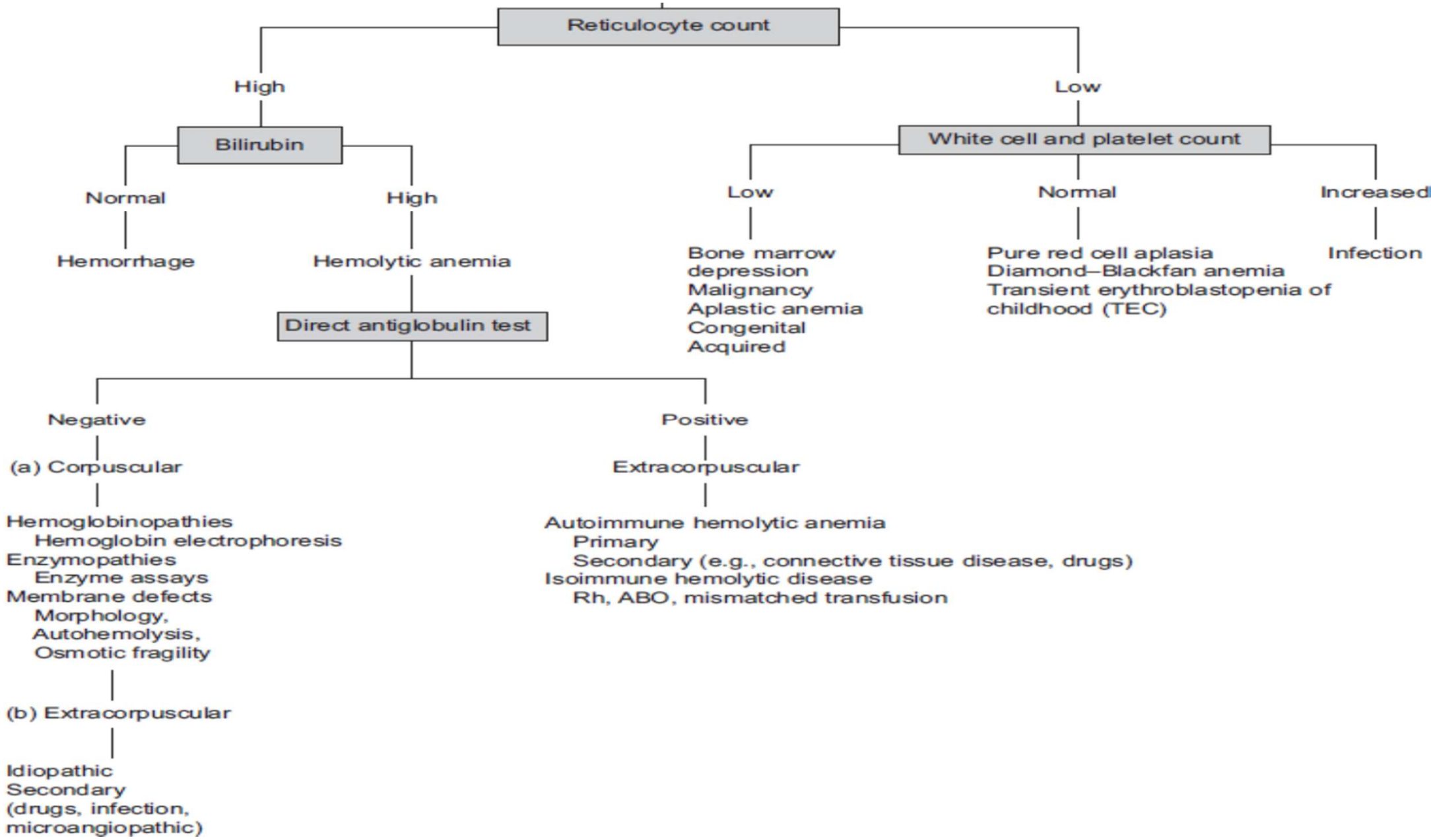
Anemia of Chronic Disease(AOCD)

- Thyroid diseases
- Malignancy
- Collagen Vascular Disease
-Rheumatoid Arthritis
-SLE
-Polymyositis
-Polyarteritis Nodosa

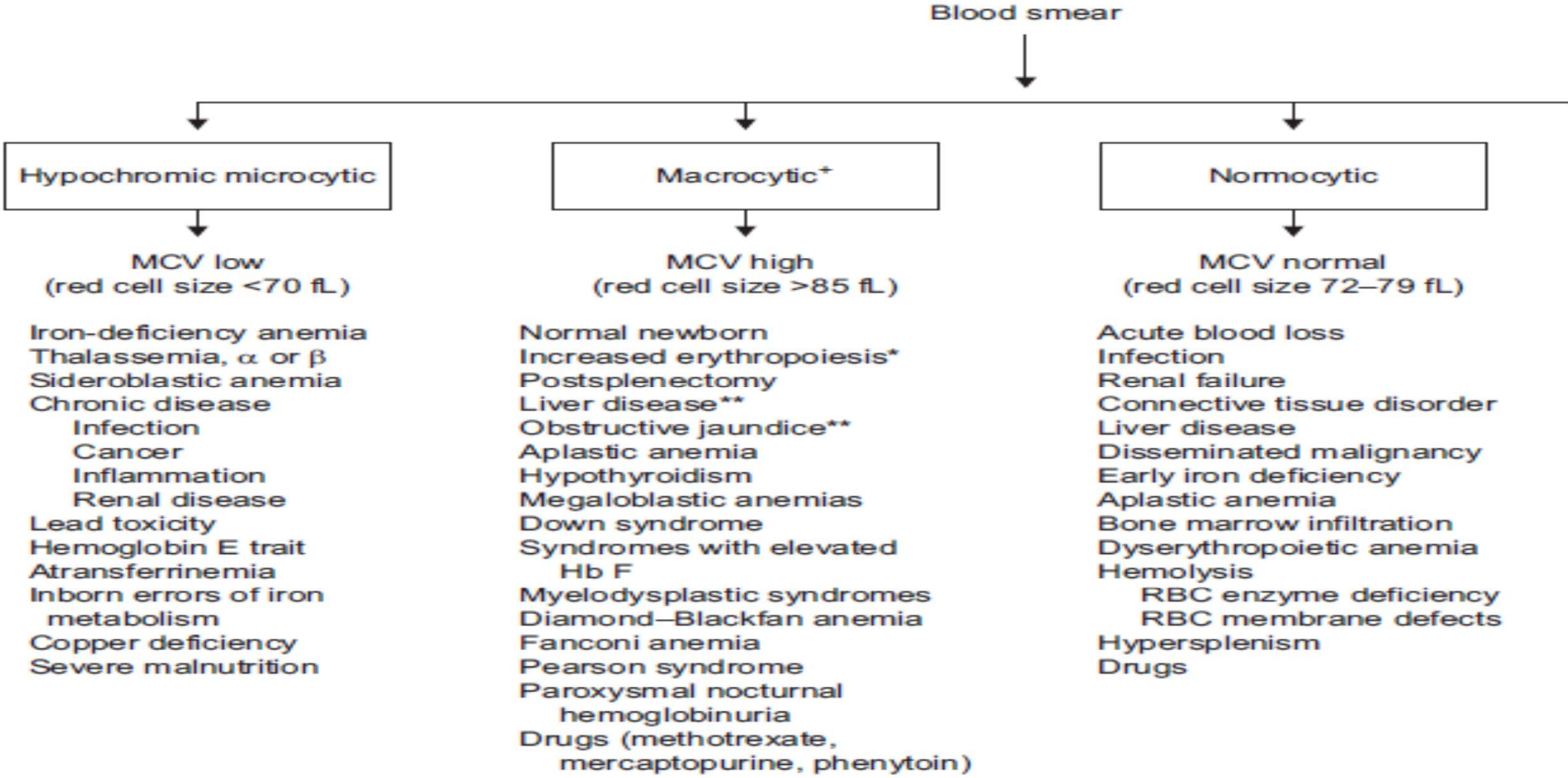
- IBD
– Ulcerative Colitis
– Crohn's Disease
- Chronic Infections
– HIV, Osteomyelitis
– Tuberculosis
- Renal Failure

3. Classification and diagnosis of anemia in children and neonates




Reticulocyte count
High
Low
Bilirubin
White cell and platelet count
Normal
High
Low
Normal
Increased
Hemorrhage
Hemolytic anemia
Bone marrow depression
Malignancy
Aplastic anemia
Congenital
Acquired
Pure red cell aplasia
Diamond–Blackfan anemia
Transient erythroblastopenia of childhood (TEC)
Infection
Direct antiglobulin test
Negative
Positive
(a) Corpuscular
Extracorpuscular
Hemoglobinopathies
Hemoglobin electrophoresis
Enzymopathies
Enzyme assays
Membrane defects
Morphology,
Autohemolysis,
Osmotic fragility
Autoimmune hemolytic anemia
Primary
Secondary (e.g., connective tissue disease, drugs)
Isoimmune hemolytic disease
Rh, ABO, mismatched transfusion
(b) Extracorpuscular
Idiopathic
Secondary
(drugs, infection,
microangiopathic)

Classification of Anemia



White Blood Cells (WBC)

- WBCs are involved in the immune response
- The normal range: ٣٫٥ – ١٠٫٥x١٠^٩ K/L
- Two types of WBC:

١) Granulocytes consist of:

– Neutrophils: ٥٠ - ٧٠%

– Eosinophils: ١ - ٥%

– Basophils: up to ١%

٢) Agranulocytes consist of:

_ Lymphocytes: ٢٠ - ٤٠%

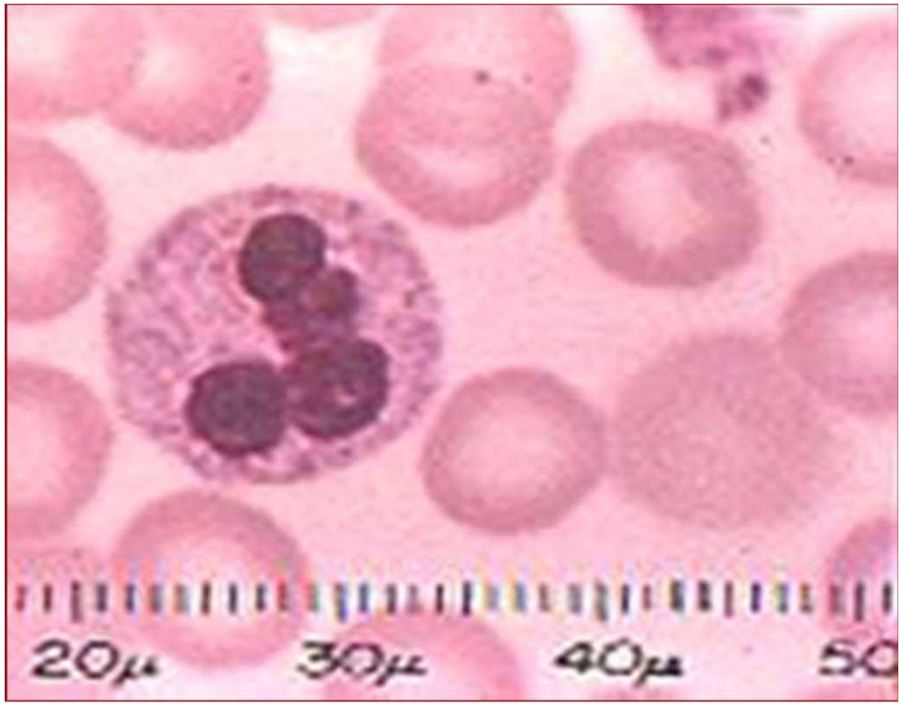
– Monocytes: ١ - ٦%

Age	TotalWBC (Range)	Neutrophils%	Lymphocyte%
Birth	9-30,000	60%	40%
24h-6Mo	5,000 -17,000	30-45%	40-60%
6Mo-6Year	5,000-14,000	30-50%	40-60%
6-16Year	4500-11,000	50-60%	30_40%

Neutrophil

Neutrophilia – an increase in neutrophils

- Bacterial infections
- Tissue destruction (burns)
- Inflammation (SLE, RA, UC)
- Thyrotoxicosis
- Cigarette smoking
- Corticosteroids
- Leukemia



Neutropenia

Mild neutropenia:ANC ١’٠٠٠ - ١٥٠٠

Moderate neutropenia:ANC ٥٠٠ - ١٠٠٠

Severe neutropenia:ANC less than ٥٠٠

Agranocytosis:ANC Less than ٢٠٠

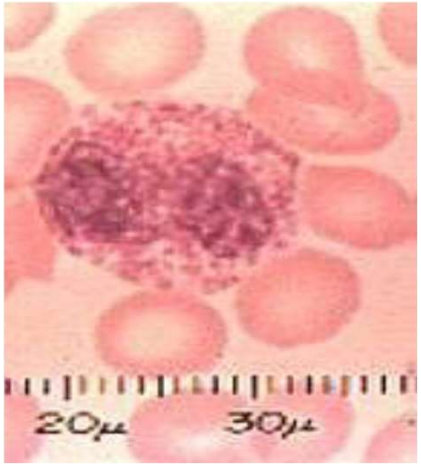
Neutrophil

Neutropenia – a decrease in neutrophils

- Decreased bone marrow production
- Medications (ex. dapsone, cephalosporins)
- Immune related (ex. SLE, RA)
- Post acute infection (HSV, CMV, HIV, EBV)

Eosinophil

- *Eosinophilia*: increased eosinophil count
  - Parasitic infections
  - Allergic conditions and hypersensitivity reaction
  - Aspergillosis
  - Vasculitis
- *Eosinopenia :* decreased *eosinophil* count
  - Sepsis



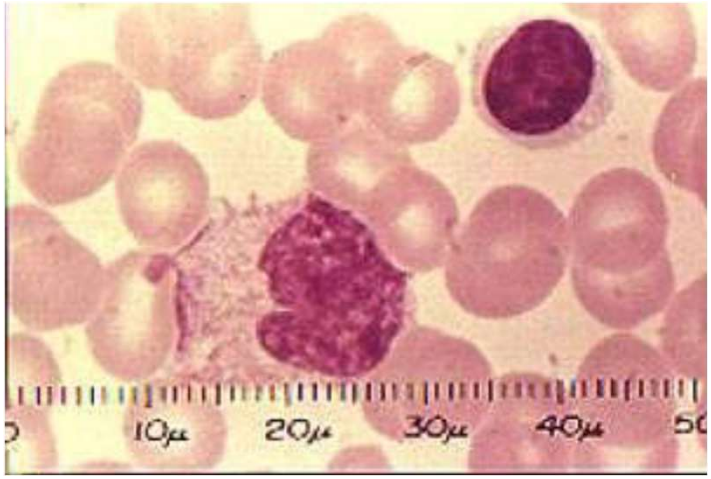
Lymphocyte

- Lymphocytosis – increased lymphocyte count

  -Viral infection(EBV, CMV, HIV, Infectious)mononucleosis
  -Leukemia/Lymphoma (CLL)

- Lymphopenia – decreased lymphocyte count

  -Viral infections
  -Medication induced
  -Autoimmune disorder



Monocytes

- Monocytosis

-Pregnancy

-TB

-Syphilis

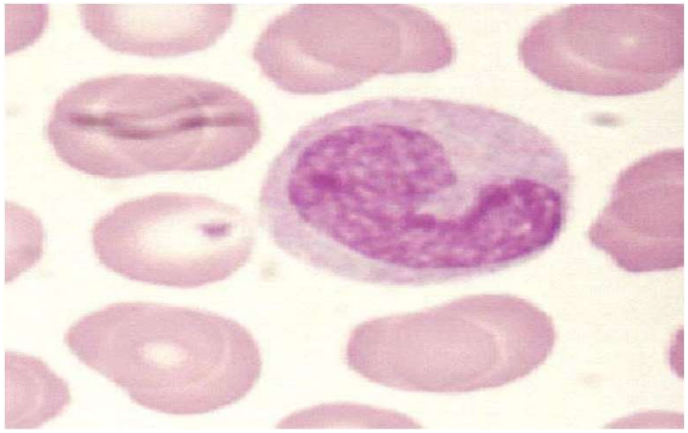
-Sarcoid

- Monocytopenia

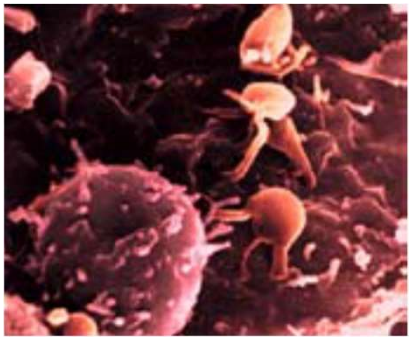
- Acute infection

- Steroids

-Leukemia



Platelets



- Platelets/thrombocytes principal function is to prevent bleeding
- The normal range is ١٥٠-٤٠٠ K/UL

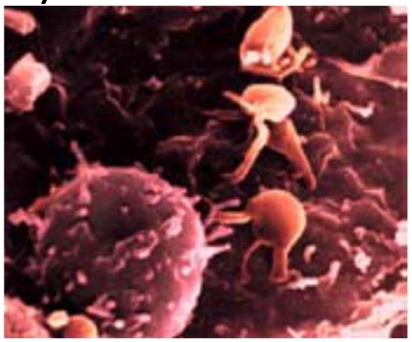
Platelets

Increased (Thrombocytosis)

- Splenectomy
- Inflammation(Reactive)
- Myeloproliferative disease (ET)
- Iron deficiency anemia

Decreased (Thrombocytopenia)

- TTP, DIC, ITP, HIT
- Blood loss
- Splenomegaly
- Medications (antibiotics)
- Viral Infections
- ETOH abuse
- Bone marrow disorder (leukemia)




Thank You For Your Attention