

Anemia - defined as a condition in which the Hb concentration of blood (or RBC count) is below the normal range for the age & sex of subject.

- male  $< 13 \text{ g/dL}$
- female  $< 12 \text{ g/dL}$
- Newborn  $< 15 \text{ g/dL}$

Depending on level of Hb level, grades of Anemia.

- mild -  $9 - 11 \text{ g/dL}$
- moderate -  $7 - 9 \text{ g/dL}$
- severe :  $< 7 \text{ g/dL}$

Clinical features:

- pallor of skin & mucous membrane: palpebral conjunctiva.
- Tissue hypoxia: tiredness, easy fatigue, muscle weakness.

CVS : palpitation, tachycardia, cardiac murmurs.

Resp : breathlessness, tachypnoea

CNS : lethargy, headache, confusion drowsiness

ocular : visual disturbance, cotton wool spots

GI : anorexia, constipation.

rep. system : amenorrhoea.

## Classification

- Etiological (Whitby's)
- Morphological (Wintrobe's)

## Etiological.

Increase RBC destruction - Hemolytic anemia

defective formation of RBC.

Blood loss - Hemorrhagic anemia

## 1. Hemolytic anemia:

### Intracorpuscular defects:

1. RBC membrane defects - spherocytosis.
2. Disorders of glycolysis - G6PD deficiency.
3. Globin chain defects - sickle cell anemia.

### Extra corpuscular defect:

Incompatible transfusion, malaria, snake venom, drugs, Autoimmune hemolytic anemia.

## 2. Defective formation of RBC:

deficiency anemia: Iron, folic acid, B12, B6  
Cu, Co

defective absorption: Intrinsic factor, vit C deficiency.

Aplastic anemia: bone marrow atrophy -  
drugs, cancers, radiation.

Anemia due to chronic disorders: Chronic renal disease.

## 3. Hemorrhagic anemia.

- acute : RTA , childbirth.
- chronic : hookworm infestation, bleeding ulcer etc

## Morphological Classification.

Mean Corpuscular Volume (MCV)

• average volume of single RBC.

$$\text{MCV} = \frac{\text{PCV in 100 ml blood} \times 10}{\text{RBC count in million/mm}^3}$$

$$= \frac{45 \times 10}{5} = 90 \text{ fL}$$

Normal value = 78-96 fL Normocyte.

< 80 : microcyte.

> 100 : macrocyte.

## Mean Corpuscular Hemoglobin (MCH)

- average weight of Hb in each RBC.

$$\text{MCH} = \frac{\text{Hb (g/dL)} \times 10}{\text{RBC count}}$$

$$= \frac{15 \times 10}{5} = 30 \text{ pg.}$$

Normal = 27-33 pg.

< 25 : Hypochromic - iron deficiency anemia.

Increased in megaloblastic anemia, spherocytosis.

## Mean Corpuscular Hemoglobin Concentration in

### MCHC

- amount of RBC Hb expressed as a percentage volume of RBC.
- % con of Hb in a single cell.

$$\text{mCHC} = \frac{\text{Hb g/l} \times 100}{\text{PCV in 100 mL}} = \frac{13 \times 100}{45} = 33\%$$

• Normal range = 33-37%

• decrease mCHC - hypochromia

### Morphological classification.

#### Normocytic normochromic.

• acute hemorrhage, aplastic anemia.

#### Microcytic hypochromic:

• Iron deficiency an., thalassemia, Chronic

hemorrhagic an.

#### Macrocytic normochromic

• megaloblastic anemia

(B<sub>12</sub>, folate deficiency)

## Iron deficiency anemia.

- most common nutritional def. disorder.
- common in women of rep. age group & infancy & childhood.
- daily iron req. = 5-10 mg/day (males)  
20 mg/day (females)

Source: meat, liver, egg, leafy vegetables, jaggery, whole wheat

### Cause.

- dietary def.
- defective absorption (vit C def)
- increased iron loss - injury, menorrhagia, bleeding, haemorrhoids etc.
- increased demand - pregnancy, lactation, childhood.

## • Clinical features

• all general features

• Koilonychia - nail dry, spoon-shaped

• Atrophic glossitis - angry red tongue.

• Angular stomatitis - mouth.

## DIAGNOSIS

### Blood Examination.

Low RBC count.

• microcytic hypochromic

• Anisocytosis, poikilocytosis.

• low Hb content.

• Red cell indices - MCH, MCV, MCHC low.

### Bone marrow findings.

Erythroid hyperplasia.

Marrow iron deficient

## Biochemical findings.

- Serum iron low.
- Ferritin low.
- TIBC high (Total Iron Binding Capacity)

## Treatment.

Oral Iron salts.

Intramuscular injections.

Correct underlying cause.

## Megaloblastic Anemia.

megaloblast cells - abnormally large cells of RBC.

Cause: def. DNA sy. B12 or folate def.

B12: cause:

1. Dietary deficiency (veg - breast fed infants?)

more common.

2. malabsorption - deficiency of intrinsic factor  
(pernicious anemia) gastrectomy,  
tropical sprue, Crohn's disease.

Folate deficiency causes.

1. dietary def. (less veg, alcoholics)
2. malabsorption: coeliac
3. Increased demand: pregnancy, lactation.
4. Drugs - methotrexate, oral contraceptive etc

Clinical features

1. General feature of anemia.
2. Characteristic features in blood,  
bone marrow & biochemical findings.

## Blood pictures & Blood Indices.

1. Hb - low.
  2. MCV Increased.
  3. MCH Increased.
  4. MCHC - usually normal.
- peripheral smears RBC - larger in size (macrocytes) with normal Hb (normochromic).
  - large Immature nucleated RBCs - megaloblasts.
  - Reticulocyte count Increased.
  - WBC, platelets decreased.
- 
- Bone marrow: megaloblastic hyperplasia.

## Biochemical findings:

Serum B<sub>12</sub> / folate levels low.

## Treatment

- B12 administration - intramuscularly (IM)
- Oral folate replacement

## Sickle cell anemia

- Hemoglobinopathy
- caused by the mutation of  $\beta$  globin gene.
- Glutamic acid residue at 6th position  
→ valine :- Haemoglobin S (HbS)
- when reduced (low  $O_2$  tension) - HbS polymerises reversibly & precipitates within the cell.
- These precipitates - characteristic sickle shaped cell. {sickling}.

- Cells with HbS → less flexible → block in microcirculation.
- Increase in viscosity - decrease blood flow to organs.
- More fragile - Break easily - causes sickle cell anemia (hemolytic) normochromic normocytic.
- Autosomal recessive disease.
- If heterozygous → sickle cell → resistant to malaria.

### Clinical features:

- General features of anemia.
- Pain - due to block in tiny vessels of hands & feet by sickled RBCs.
- Visual defects, infections.

## Treatment

• Medications: Hydroxyurea.

• Blood transfusion

• Bone marrow transplantation.

## Reticulocyte response.

• B12 injection in pernicious anemia.

• Increase in reticulocyte count in blood, peaks by 10 days.

• Earliest sign of clinical improvement.