Haematological system

Anaemia

Introduction / Epidemiology

- Anaemia is defined as a decrease in the total amount of red blood cells (RBCs) or haemoglobin in the blood, leading to a reduced oxygen-carrying capacity. According to the World Health Organization (WHO), anaemia is defined as:
    - Haemoglobin <13 g/dL in men
    - Haemoglobin <12 g/dL in non-pregnant women
    - Haemoglobin <11 g/dL in pregnant women

Epidemiology:

- Anaemia affects about 25% of the global population.
- It is particularly prevalent in:
    - Women of reproductive age (due to menstruation and pregnancy)
    - Children under 5 years (due to nutritional deficiencies)
    - Elderly (due to chronic diseases or nutritional issues)
    - Low-income countries (due to malnutrition and infections)
- Iron deficiency anaemia (IDA) is the most common type, accounting for approximately 50% of all cases.

Etiopathogenesis (Causes and Pathophysiology)

Anaemia is broadly classified based on:

1. **Mechanism:**
    1. Decreased RBC production
    2. Increased RBC destruction (haemolysis)
    3. Blood loss
2. **Red cell indices (MCV):**
    - Microcytic (MCV <80 fL): Iron deficiency, thalassaemia
    - Normocytic (MCV 80–100 fL): Anaemia of chronic disease, acute blood loss
    - Macrocytic (MCV >100 fL): Vitamin B12 or folate deficiency

Common causes:

- **Iron deficiency anaemia**: Poor intake, blood loss (e.g., gastrointestinal bleeding, menstruation), malabsorption (e.g., celiac disease)

- **Megaloblastic anaemia**: Vitamin B12 or folate deficiency, due to poor intake or malabsorption (e.g., pernicious anaemia)
- **Anaemia of chronic disease**: Chronic infections (TB, HIV), autoimmune diseases (RA), CKD
- **Haemolytic anaemia**: Autoimmune haemolytic anaemia, hereditary spherocytosis, sickle cell anaemia
- **Aplastic anaemia**: Bone marrow failure due to toxins, radiation, drugs (e.g., chloramphenicol)

Pathophysiology:

- ↓ RBCs → ↓ oxygen delivery to tissues → compensatory mechanisms (e.g., ↑ cardiac output, ↑ 2,3-BPG, shunting of blood) → symptoms like fatigue and dyspnoea.

Clinical Features / Symptoms

General symptoms (due to hypoxia):

- Fatigue
- Weakness
- Dyspnoea on exertion
- Palpitations
- Dizziness or light-headedness
- Headache

Signs:

- Pallor (especially conjunctival, palmar)
- Tachycardia
- Systolic flow murmur
- Postural hypotension (if acute blood loss)

Specific features depending on type:

1. **Iron deficiency anaemia:**
   - Pica (craving for non-food items like clay)
   - Koilonychia (spoon-shaped nails)
   - Glossitis, angular stomatitis
2. **Vitamin B12 deficiency:**
   - Neurological signs: paresthesia, ataxia, memory impairment
3. **Haemolytic anaemia:**
   - Jaundice

- Dark urine
- Splenomegaly

Diagnosis & Investigations

1. Basic blood tests:

CBC (Complete Blood Count):

- Haemoglobin
- MCV (microcytic, normocytic, macrocytic)
- MCH, MCHC
- Reticulocyte count

2. Peripheral blood smear:

- Microcytic, hypochromic: Iron deficiency
- Macrocytic with hypersegmented neutrophils: B12/folate deficiency
- Spherocytes, schistocytes: Haemolysis

3. Iron studies:

- Serum iron: ↓ in IDA
- Ferritin: ↓ in IDA (acute phase reactant, can be ↑ in inflammation)
- TIBC (Total Iron Binding Capacity): ↑ in IDA
- Transferrin saturation: ↓

4. Vitamin B12 and folate levels:

- ↓ in respective deficiencies

5. Other tests:

- LDH, haptoglobin, bilirubin: For haemolysis
- Coombs test: Autoimmune haemolytic anaemia
- Bone marrow biopsy: For aplastic anaemia or unexplained cases
- Stool occult blood test, endoscopy: To detect chronic GI bleeding

Treatment Goals / Therapeutic Objectives

- Identify and treat the underlying cause of anaemia
- Correct haemoglobin levels and restore oxygen-carrying capacity
- Alleviate symptoms
- Prevent complications (cardiac failure, cognitive decline, etc.)
- Prevent recurrence

Non-Pharmacological Therapy

1. **Dietary changes:**
   - Iron-rich foods: red meat, spinach, legumes, fortified cereals
   - Vitamin C-rich foods: enhance iron absorption
   - B12: meat, dairy (for vegetarians, supplements may be necessary)
   - Folate: green leafy vegetables, beans
2. **Management of bleeding:**
   - Menorrhagia: consider hormonal therapy
   - GI bleeding: endoscopic management, surgery if needed

- **Avoidance of causative drugs**: if drug-induced anaemia is suspected

Pharmacological Therapy

Iron Deficiency Anaemia

First-line: Oral iron therapy

- **Drug**: Ferrous sulfate
- **Dose**: 100–200 mg elemental iron/day (usually 325 mg tablet TID)
- **Duration**: 3–6 months (until Hb normalizes + 3 months to replenish stores)
- **Mechanism**: Provides iron for haemoglobin synthesis
- **Rationale**: Oral route preferred due to efficacy, safety, and cost

Alternative: Intravenous iron

- Indications:
  - Intolerance to oral iron
  - Malabsorption (e.g., IBD, post-gastrectomy)
  - Need for rapid correction (e.g., pre-op, CKD)
- **Preparations**: Iron sucrose, ferric carboxymaltose
- **Monitoring**: Risk of hypersensitivity

Megaloblastic Anaemia

Vitamin B12 deficiency:

- **Cyanocobalamin IM**: 1000 mcg/day for 1 week → weekly for 1 month → monthly
- **Oral B12**: For non-neurological cases or maintenance
- Mechanism: Coenzyme for DNA synthesis

Folate deficiency:

- **Folic acid 1–5 mg/day PO** for 4 months or more
- Note: Always rule out B12 deficiency before giving folate (folate can worsen neuro symptoms in B12 deficiency)

Anaemia of Chronic Disease

- Treat underlying disease (e.g., infection, autoimmune)
- **Erythropoiesis-stimulating agents (ESAs)**: e.g., Epoetin alfa in CKD
- **Iron supplementation**: Often IV
- Monitor haemoglobin response and iron status

Haemolytic Anaemia

- **Autoimmune**: Steroids (prednisone), immunosuppressants, splenectomy
- **Inherited**: Supportive care, folic acid, transfusions, bone marrow transplant in some cases

Individualized Patient-Specific Therapeutic Plan

- **Age**: Elderly may have multiple causes, poor oral absorption
- **Comorbidities**:
  - CKD: Use ESAs + IV iron
  - Malignancy: Avoid ESAs unless symptomatic
- **Pregnancy**: Increased iron & folate requirements; avoid certain parenteral preparations
- **Renal/hepatic function**: Adjust iron dose; monitor for toxicity
- **Allergies**: Avoid specific iron salts; use alternatives
- **Dietary habits (e.g., vegetarian)**: May predispose to B12 deficiency

Controversies / Special Considerations

- **Oral vs IV iron**: Some argue IV is superior in certain chronic diseases (e.g., CKD), but cost and safety must be weighed
- **ESAs in cancer patients**: Risk of thrombosis vs benefit
- **Transfusions**: Thresholds debated; generally avoid unless Hb <7–8 g/dL or symptomatic
- **Latest Guidelines**:
  - WHO 2020 Anaemia recommendations
  - KDIGO 2021 (for CKD-related anaemia)
  - NICE, AABB guidelines on transfusion thresholds

Monitoring Therapy

1. Clinical:

- Resolution of symptoms (fatigue, dyspnoea)

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