Iron Deficiency Anemia: Causes, Pathophysiology and clinical features

Anemia may result from the decreased production of erythrocytes by the bone marrow. Iron deficiency anemia is a common type of anemia that develops when body stores of iron drop very low to support normal red blood cell production.

A deficiency of nutrients for hemoglobin synthesis (iron) or DNA synthesis (cobalamin or folic acid) may reduce red cell production by the bone marrow. A deficiency of red cells also results when the marrow itself fails or is replaced by nonfunctional tissue.

The normal hemoglobin levels in men is 13.5 to 17.5g/dl and in female its 12.0 to 16.0 g/dl.

Iron deficiency anemia is a type of anemia that results from insufficient iron intake or excessive blood loss.

Iron deficiency is a common worldwide cause of anemia affecting persons of all ages.

Risk factors of iron deficiency anemia

1. Alcohol abuse
2. Gastrectomy
3. Acute/chronic gastrointestinal bleeding
4. Poor nutrition
5. Excessive menstruation
6. Pregnancy
7. Vitamin B6 deficiency
8. Worm infestation

Causes of iron deficiency anemia

The causes of iron deficiency anemia include;

Dietary deficiency,

Excessive blood loses as a result of excessive menstruation, upper or lower gastrointestinal bleeding.

Mal-absorption such as in coeliac disease may cause refractory iron deficiency anemia

Poor diet in babies and pregnant mothers

Increased body demands such as in puberty and pregnancy.

Infestation by heminthics most commonly hookworms and schistomiasis

Iron is a component of heme, having that in mind, a deficiency of iron leads to reduced hemoglobin synthesis and consequent impairment of oxygen delivery.

Body iron is used repeatedly. When red cells become old after approximately 120 days and are broken down, their iron in them is released and reused in the process of erythropoiesis (production of new red cells).

Despite this efficiency, small amounts of iron are lost in the feces and need to be replaced by dietary uptake.

The body iron balance is maintained by the absorption of about 0.5 to 1.5 mg of iron daily to replace the 1 mg lost in the feces.

The average balanced diet supplies about 20 mg. Therefore, the absorbed iron is more than enough to supply the needs of most individuals, but may be barely adequate in toddlers, adolescents, and women of child-bearing age.

The usual reason for iron deficiency in adults is chronic blood loss because iron cannot be recycled to the pool.

In men and postmenopausal women, blood loss may occur from gastrointestinal bleeding because of peptic ulcer, intestinal polyps, hemorrhoids, or cancer.

Excessive aspirin intake may cause undetected gastrointestinal bleeding.

In women, menstruation may account for an average of 1.5 mg of iron lost per day, causing a deficiency. Although cessation of menstruation removes a major source of iron loss in the pregnant woman, iron requirements increase at this time, and deficiency is common.

The expansion of the mother's blood volume requires approximately 500 mg of additional iron, and the growing fetus requires approximately 360 mg during pregnancy. In the postnatal period, lactation requires approximately 1 mg of iron daily. A child's growth places extra demands on the body.

Blood volume increases, with a greater need for iron.

Iron requirements are proportionally higher in infancy (3 to 24 months) than at any other age, although they are also increased in childhood and adolescence.

In infancy, the two main causes of iron deficiency anemia are low iron levels at birth because of maternal deficiency and a diet consisting mainly of cow's milk, which is low in absorbable iron.

Adolescents are also susceptible to iron deficiency because of high requirements due to growth spurts, dietary deficiencies, and menstrual loss.

Iron-deficiency anemia is characterized by:

- Low hemoglobin levels and
- Low hematocrit,
- Decreased iron stores, and

· Low serum iron and ferritin.

The red cells are decreased in number and are microcytic and hypochromic.

Poikilocytosis (irregular shape) and anisocytosis (irregular size) are also present.

Laboratory values in patients with iron deficiency anemia indicate a reduced mean corpuscular hemoglobin concentration (MCHC) and Mean corpuscular volume (MCV).

Membrane changes may predispose to hemolysis, causing further loss of red cells.

Clinical features

Individuals with iron deficiency anemia present with:

Koilonychia (Spoon-shaped nails)

Atrophic glossitis

Angular cheilosis

Post cricoid webs (Plummer-Vinson syndrome)

Other features of anemia are related to impaired oxygen transport and lack of hemoglobin. Depending on the severity of the anemia and may include Fatigability,

1. Easy fatigability
2. Palpitations,
3. Pallor
4. Dyspnea,
5. Cold extremities
6. Pica
7. Angina, and
8. Tachycardia may be present.

Epithelial atrophy is common and results in waxy pallor, brittle hair and nails, sometimes a spoon-shaped deformity of the fingernails, smooth tongue, sores in the corners of the mouth, and sometimes dysphagia and decreased acid secretion.

Pica may also be present

Iron deficiency in infants may also result in long-term manifestations such as poor cognitive, motor, and emotional function that may be related to effects on brain development or neurotransmitter function.

Avoidance of cow's milk, iron supplementation at 4 to 6 months of age in breast-fed infants, and use of iron-fortified formulas and cereals are recommended for infants younger than 1 year of age.

In the second year, a diet rich in iron-containing foods and use of iron-fortified vitamins will help

prevent iron deficiency.

Diagnosis and Investigations

Patients presenting with features suggestive of iron deficiency anemia need to be examined adequately with a thorough history taking and physical examination to confirm the diagnosis and rule out other differentials.

A good history taking is essential. It should cover dietary history and any history of menstrual disorders,

Laboratory investigations

Full hemogram (Complete blood count)

Thin blood film to assess cell morphology and parasites.

Stool for ova and cyst and also occult blood

Hb electrophoresis

Bone marrow examination

Serum ferritin levels are confirmatory. These patients will have a reduced serum ferritin levels and also total iron is reduced but they demonstrate an increased total iron binding capacity (TIBC).

Red blood cells protopophyrin levels are also elevated.

*Remember ferritin is an acute phase protein and therefore its levels may sometimes be elevated in patients with active inflammation.

An investigation to find out the causative factor are also required. For example, in patients who are suspected to have developed anemia as a result of gastrointestinal bleeding may need to have a gastroscopy or sigmoidoscopy done to find out the cause. In patients suspected to have hookworms, then a stool microscopy for ova and cysts can be ordered.

Laboratory findings

A full hemogram indicates:

Microcytic hypochromic anemia with anisocytosis and poikilocytosis

Reduced MCV

Reduced MCH

Reduced MCHC

Treatment

As it is in the general management of anemia, treatment should aim at finding and treating the cause.

The treatment of iron-deficiency anemia in children and adults is directed toward

- controlling chronic blood loss,
- increasing dietary intake of iron, and
- administering supplemental iron.

Oral iron in the form of Ferrous sulfate, which is the usual oral replacement therapy, that replenishes replenish iron stores. A usual adult dose of 200mg/8 hourly is given.

The use of ferrous sulfate may be associated with side effects such as nausea, abdominal discomfort or dark stool.

With its use, hemoglobin level is expected to rise by 10g/L per week. This regimen is the continued for atleast three months to replenish the depleted iron stores.

Parenteral iron (iron dextran, iron sucrose or sodium