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THE ISSUE OF IRON DEFICIENCY

Iron deficiency anemia, by far the most common cause of anemia in general and of microcytic anemia in particular, is a result of insufficient iron available for the normal production of hemoglobin, anemia results. The cells which are produced are small and pale, and indices from such specimens show low values for MCHC and MCV. Therefore, the classic anemia that occurs in iron deficiency is hypochromic, microcytic. Since this is a hyporegenerative anemia, the retic count would be expected to be low; however, because so many cases of IDA are due to chronic bleeding, it is not uncommon to see patients with episodes of hemorrhage that have produced an elevated RPI on clinical presentation. Another finding commonly seen on clinical presentation is thrombocytosis, again probably reflecting marrow response to bleeding. In summary, the laboratory features of IDA are:

Hypochromic, microcytic anemia	Variable retic count
Increased erythrocyte zinc protoporphyrin	Increased free erythrocyte protoporphyrin
Decreased serum iron	Increased TIBC
Decreased serum ferritin	Absent marrow storage iron
Variable platelet count	

It is important economically because it diminishes the capability of individuals who are affected to perform physical labor, and it diminishes both growth and learning in children. Iron-deficiency affects more than 1/4 of world's population.

Iron metabolism

- Daily diet contain 15-20 mg of iron
- Only 10 % of this is absorbed
- Absorption increases (20-30 %) in iron-deficiency and pregnancy
- Haem iron (in meat) is better absorbed than non-haem iron (in cereals, milk)
- Absorption takes place in duodenum and jejunum
- Absorption is favored by acidity of stomach keeping iron in ferrous rather than ferric form.

Iron stores

- 2/3 of total body iron is in circulation as Hb (2500-3000 mg)

- Iron is stored in reticuloendothelial cells, hepatocytes, and skeletal muscles (500-1500 mg)
- 2/3 of stored iron is in form of ferritin and 1/3 in form of hemosiderin
- About 4 mg is found in plasma bound to transferrin
- Each day 0,5-1,0 mg of iron is lost in feces, urine, and sweat
- Menstruating women lose 40 ml of blood per month (0,7 mg of iron/day)
- Blood loss in excess of 100 ml through menstruation will result in iron-deficiency anemia
 - Causes of iron deficiency anemia
- Most common is blood loss usually from uterus or GIT (menorrhagia, peptic ulcer, stomach cancer, ulcerative colitis, intestinal cancer, hemorrhoids)
- Increased demands (growth and pregnancy, lactation)
- Decreased absorption (e.g., postgastrectomy)
- Poor intake
 - Gastrointestinal (GI) diseases presenting with iron deficiency

Occult GI blood loss
Common
NSAID use
Colonic cancer/polyp
Gastric cancer
Angiodysplasia
Crohn's disease
Ulcerative colitis
Uncommon
Oesophagitis
Peptic ulcer
Oesophageal cancer
Watermelon stomach
Intestinal telangiectasia
Lymphoma, leiomyoma and other small bowel tumours
Duodenal polyp (Brunner's gland adenoma)
Carcinoma of the ampulla of Vater
Meckel's diverticulum
Hookworm
Malabsorption
Coeliac disease
Gastrectomy (partial and total) and gastric atrophy
Gut resection or bypass
Bacterial overgrowth
Whipple's disease
Lymphangiectasia

- Clinical features. Symptoms (non-specific): see above. Specific signs:
 - Sideropenic syndrome:
 - Pica (consumption of largely non-nutritive substances such as metal, clay, coal, sand, dirt, soil, feces, chalk, pens and pencils, paper, batteries, spoons, toothbrushes, soap, etc.)
 - Perversion of taste and smell
 - Poor attention span
 - Poor memory
 - Lack interest in surroundings
 - Poor work performance
 - Defective structure and function of epithelial tissue: especially affected are the hair (brittle hair, hair loss), the skin (dry, pale skin), the nails (brittle nails, koilonychia (spoon shaped nail), the tongue (atrophy of papillae of tongue glossitis), the mouth (angular stomatitis), the hypopharynx and the stomach (dysphagia (Plummer-Vinson or Paterson-Kelly syndrome), atrophic gastritis
 - Muscle weakness, in severe cases enuresis and urinary incontinence may occur
- Abnormalities in physical examination
 - Pale and dry skin, pallor of lips, nail beds and conjunctival mucosa
 - Nails – flattened, fragile, brittle, koilonychia, spoon-shaped
 - Tongue and mouth glossitis, angular cheilosis, stomatitis dysphagia (Peterson-Kelly or Plummer-Vinson syndrome
 - Stomach atrophic gastritis, (reduction in gastric secretion, malabsorption)
 - The cause of these changes in iron deficiency is uncertain, but may be related to the iron requirement of many enzymes present in epithelial and other cells
- Investigations. Blood count and film:
 - RBCs are microcytic (MCV <80 fl) and hypochromic (MCH<27 pg)
 - There is poikilocytosis (variation in shape) and anisocytosis (variation in size)
 - Target cells are seen
 - leukocytes – normal
 - platelets – usually thrombocytosis
 - Low serum ferritin (N: male: 23-336 ng/mL, female: 11-306 ng/mL)
 - Low serum iron (N: 13-30 pmol/L for males, 11-15 pmol/L for females) and high total iron binding capacity (TIBC) (N: 30-85 pmol/L). To obtain a better result, it is advisable not to take any iron containing drugs 5 days before investigation.
 - Transferrin saturation (serum iron divided by TIBC) is <19 %
 - BM: high cellularity, erythroid hyperplasia (25-35 %; N 16-18 %) with ragged normoblasts, bone marrow showing absence of stainable iron, but BM examination is not essential for diagnosis.
- Iron deficiency – stages
 - Prelatent
 - reduction in iron stores without reduced serum iron levels

• Hb (N), MCV (N), iron absorption (↑), transferrin saturation (N), serum ferritin (↓), marrow iron (↓)

• Latent

• iron stores are exhausted, but the blood hemoglobin level remains normal

• Hb (N), MCV (N), TIBC (↑), serum ferritin (↓), transferrin saturation (↓), marrow iron (absent)

• Iron deficiency anemia

• blood hemoglobin concentration falls below the lower limit of normal

• Hb (↓), MCV (↓), TIBC (↑), serum ferritin (↓), transferrin saturation (↓), marrow iron (absent)

Differential diagnosis of microcytic and hypochromic anemia.

• Thalassemia (α or β): serum Fe is normal, and TIBC normal, also ferritin is normal

• Sideroblastic anemia: serum Fe is raised, TIBC is normal, serum ferritin raised

• Anemia of chronic disease: serum Fe is reduced, TIBC is reduced, and serum ferritin normal or raised

Treatment. It is necessary to find and treat the underlying cause of anemia (Benzidine test, Gastroscopy, Colonoscopy, Gynaecological examination). In some cases (such as pregnancy, lactation, polymenorrhœa (syn: polymenia), hereditary hemorrhagic diathesis, Goodpasture's syndrome, endometriosis and others), in which elimination of cause is not possible, ferrotherapy will be the only solution. There are five principles of management:

1. Do not rely on a diet only (it is because daily dietary intake of iron is not sufficient to compensate blood loss and iron absorption from food is restricted). Despite consumption of food rich in iron, iron deficiency anemia will not be treated without ferrotherapy.

2. Do not administer RBC mass transfusion. Transfusion can only be monitored when Hb level is lower than 50 g/L or before any urgent operations.

3. Do not begin with parenteral therapy. Parenteral iron is required by occasional patients having severe intolerance to all oral iron preparations or significant dyspepsia after drug intake. Parenteral iron may also be given to those with severe malabsorption and chronic gastrointestinal diseases such as ulcerative colitis or Crohn's disease. Intravenous infusions usually cause severe allergic reactions. Some studies show that sarcoma, phlebitis, and abscess in the place of injection may take place after intramuscular injections of iron preparations.

4. Daily dose of bivalent iron is 100-300 mg. Iron preparations should meet the following criteria (by WHO):

• They should contain optimum amount of bivalent iron;

• They should be well-tolerated by patients. The side-effects should be as minimal as possible;

• They should be comfortable for intake;

• They should contain additional compounds, which can improve their absorption.

• Drug components affecting their absorption should be removed.

5. The basic course of iron therapy is usually 1,5-2 months. The effectiveness of this therapy depends on raised Hb on the 21st day of treatment. After normalizing Hb level; daily dose of the preparation should be reduced to two times and a supportive therapy is subsequently commenced for 3-6 months. Do not take drugs or food, which can impair the iron absorption, such as coffee, tea, milk products, phosphoric acid, tetracycline, almagel, calcium salts, magnesium, aluminum etc.

- Correction of the iron deficiency (orally, intramuscularly, intravenously)
- Finally give iron to replace iron stores
- Iron is best given orally as ferrous sulphate on empty stomach, if side effects develop such as nausea, diarrhea or constipation, tablets given with food or reducing dose with another preparation as ferrous gluconate.

Oral iron therapy. The optimal daily dose – 200 mg of elemental iron:

- Ferrous (Gluconate 5 tablets/day, Fumarate 3 tablets/day, sulphate 3 tablets/day)
- iron is absorbed more completely when the stomach is empty
- it is necessary to continue treatment for 3-6 months after the anemia is relieved.

Iron absorption:

- is enhanced: vit C, meat, orange juice, fish
- is inhibited: cereals, tea, milk

Side effects: heartburn, nausea, abdominal cramps, diarrhea.

Oral 200 mg of iron daily 1 hour before meal (e.g. 100 mg twice daily) 14 days + (Hb required level – Hb current level)x4.

Parenteral iron substitution.

- Bad oral iron tolerance (nausea, diarrhoea)
- Necessity of quick management (CHD, CHF)
- 50-100 mg daily
- IV only in hospital (risk of anaphylactic shock)
- IM in outpatient department
- Total dose by IV infusion: Iron to be injected (mg) = (15-Hb g) x body weight (kg)x3.

Failure of response to oral iron:

- Lack of compliance
- Continuing hemorrhage
- Severe malabsorption
- Another cause for the anemia
- These possibilities should be considered before using parenteral iron.

Parenteral iron therapy is indicated when the patient:

- demonstrated intolerance to oral iron
- loses iron (blood) at a rate to rapid for the oral intake
- has a disorder of gastrointestinal tract
- is unable to absorb iron from gastrointestinal tract

Preparations and administration:

- iron-dextran complex (50 mg iron /ml)
 - intramuscularly or intravenously
 - necessary is the test for hypersensitivity
 - the maximal recommended daily dose – 100 mg (2ml)
- total dose is calculated from the amount of iron needed to restore the haemoglobin deficit and to replenish stores.
Parenteral iron therapy. Side effects:
- local: pain at the injection site, discoloration of the skin, lymph nodes become tender for several weeks, pain in the vein injected, flushing, metallic taste
- systemic:
 - immediate: hypotension, headache, malaise, urticaria, nausea, anaphylactoid reactions
 - delayed: lymphadenopathy, myalgia, arthralgia, fever.

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