IRON DEFICIENCY ANE

Haematopoietic system

- Erythrocytes
- Leukocytes
- Thrombocytes

Types of anaemia

- Microcytic hypochromic anaemia
- Megaloblastic anaemia
- Pernicious anaemia
- Haemolytic anaemia
- Aplastic anaemia
- Sickle cell anaemia
- Sideroblastic anaemia

Iron deficiency anaemia

- Pallor
- Fatigue
- Dizziness
- Exertional dyspnoea
- **Iron deficiency**
- *Dietary deficiency*
  - Faulty absorption, transport and storage
  - Excessive blood loss
  - Worm infestation

- Max iron absorption: duodenum & jejunum
- Haem iron & non haem iron (Fe^{+++})
- Ascorbic acid,, Succinic acid facilitate conversion of Fe^{+++} to Fe^{++} form

ANEMIA?

Anemia can be defined as a reduction in the hemoglobin, hematocrit or red cell number.

In physiologic terms an anemia is any disorder in which the patient suffers from tissue hypoxia due to decreased oxygen carrying capacity of the blood

HEMATINICS

These are drugs used to treat anemia

- ✓ Iron
- ✓ Vitamin B12, Cyanocobalamin
- ✓ Folic acid
- ✓ Erythropoietin

IRON FACTS

- All body cells need iron. It is crucial for oxygen transport, energy production, and cellular growth and proliferation.
- The human body contains an average of 3.5 g of iron (males 4 g, females 3 g).
- The typical daily normal diet contains 10–20 mg of iron.
- Only about 10% of dietary iron is absorbed (1–2 mg/day).

IMPORTANCE OF IRON

Iron forms the nucleus of the iron-porphyrin heme ring, This with globin chains forms hemoglobin.

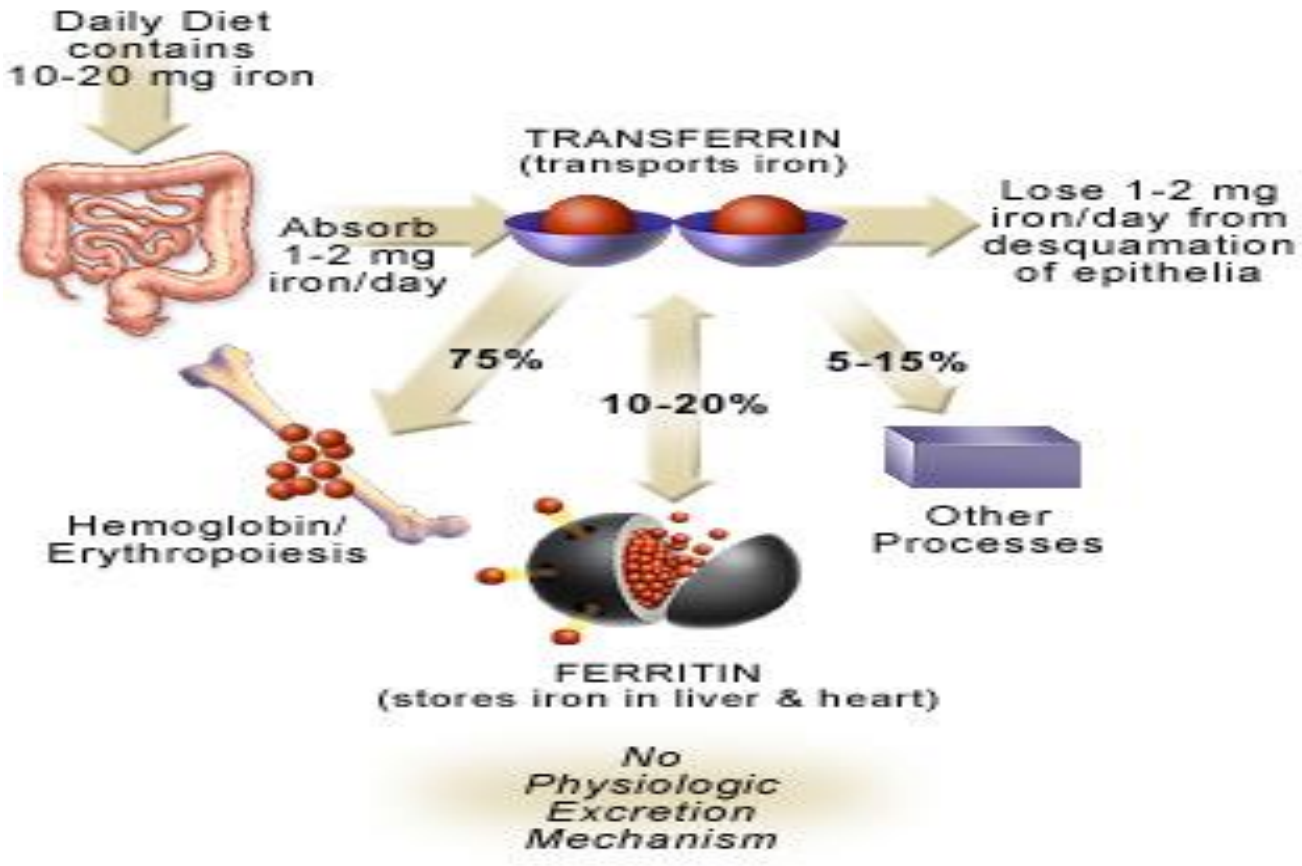
Function of Haemoglobin:

Reversibly binds oxygen and provides the critical Mechanism for oxygen delivery from the lungs to other tissues.

In the absence of adequate iron, small erythrocytes With Insufficient hemoglobin are formed, giving rise to ***Microcytic hypochromic anemia***

IRON ABSORPTION

- Iron is mainly absorbed in the duodenum and upper jejunum.
- A protein called divalent metal transporter 1 (DMT1) facilitates iron transfer across intestinal epithelial cells.
- Normally, individuals absorb less than 10% of dietary iron, or 1–2 mg per day balancing the daily loss from desquamation of epithelia.
- Most absorbed iron is used in bone marrow for erythropoiesis.
- Iron homeostasis is closely regulated via intestinal absorption.
- Once iron is absorbed, there is no physiologic mechanism for excretion of excess iron from the body other than blood loss (i.e., pregnancy, menstruation or other bleeding.)


Daily Diet contains 10-20 mg iron
TRANSFERRIN (transports iron)
Absorb 1-2 mg iron/day
Lose 1-2 mg iron/day from desquamation of epithelia
75%
10-20%
5-15%
Hemoglobin/ Erythropoiesis
Other Processes
FERRITIN (stores iron in liver & heart)
No Physiologic Excretion Mechanism

IRON TRANSPORT

- Most absorbed iron is transported in the bloodstream bound to the glycoprotein transferrin.
- Transferrin is a carrier protein that plays a role in regulating the transport of iron from the site of absorption to virtually all tissues.
- Transferrin binds only two iron atoms.
- Normally, 20–45% of transferrin binding sites are filled (measured as percent transferrin saturation [TS]).

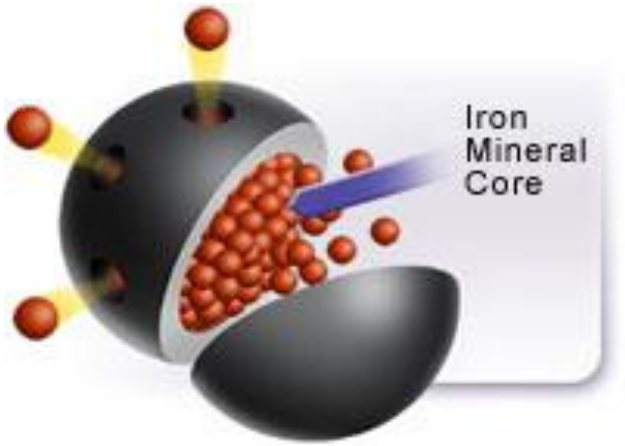
IRON USE IN THE BODY

- 75% of absorbed iron is bound to proteins such as hemoglobin that are involved in oxygen transport.

- About 10% to 20% of absorbed iron goes into a storage pool that is also recycled in erythropoiesis, so storage and use are balanced.

IRON STORAGE

- Iron is initially stored in ferritin molecules.
- A single ferritin molecule can store up to 4,000 iron atoms.
- When excess dietary iron is absorbed, the body responds by producing more ferritin to facilitate iron storage.



FERRITIN MOLECULES STORE THOUSANDS OF IRON ATOMS WITHIN THEIR MINERAL CORE. WHEN EXCESS DIETARY IRON IS ABSORBED, THE BODY RESPONDS BY PRODUCING MORE FERRITIN TO FACILITATE IRON STORAGE.

IRON FORMULATIONS

ORAL:

Ferrous sulfate
Ferrous gluconate
Ferrous fumarate

PARENTERAL:

Iron Dextran
Iron-sucrose complex
Iron sodium gluconate complex

ORAL IRON THERAPY

Treatment with oral iron should be continued for 3–4 months after correction of the cause of the iron loss. This corrects the anemia and replenishes iron stores.

Common adverse effects of oral iron therapy include:

- Nausea
- epigastric discomfort
- abdominal cramps
- Constipation
- diarrhea.

These effects are usually dose-related and can often be overcome by lowering the daily dose of iron or by taking the tablets immediately after or with meals

PARENTERAL IRON THERAPY

Reserved for patients with documented iron deficiency who are unable to tolerate or absorb oral iron.

For patients with extensive chronic blood loss who cannot be maintained with oral iron alone

- Postgastrectomy conditions
- Previous small bowel resection
- Inflammatory bowel disease
- Malabsorption syndrome

- Iron-dextran: iv or im (50mg/ml)
- Iron sucrose complex: iv or im
- Iron-sodium gluconate: iv or im
- Iron-sorbitol-citrate: only im

Iron dextran:

- A stable complex of ferric hydroxide and low-molecular-weight Dextran.
- Can be given by deep intramuscular injection or by intravenous Infusion
- Intravenous administration eliminates the local pain and tissue staining
- Adverse effects of intravenous iron dextran therapy include:

Side effects

- Headache, light-headedness, fever, arthralgias, nausea and vomiting, back pain, flushing, urticaria, bronchospasm, and, rarely, anaphylaxis and death.
- Hypersensitivity reactions may be delayed for 48–72 hours after administration.
- Owing to the risk of a hypersensitivity reaction, a small test dose of iron dextran should always be given before full intramuscular or intravenous doses.

- **Iron-sucrose complex** and **iron sodium gluconate complex** are alternative preparations.
- These agents can be given only by the intravenous route.
- These preparations appear to be much less likely than iron dextran to cause hypersensitivity reactions

- Body requirement of iron
- Hb has 33% of iron (50 mg in 100 ml of blood)
- Daily requirement

Male: 0.5-1 mg

Female: 1-2 mg

Children: 25 mg

Pharmacokinetics of iron

- Iron absorbs by active transport across intestinal mucosa.
- Converted Fe^{2+} to Fe^{3+}
- Apoprotein-iron complex (ferritin)
- Release on demand
- Absorption depends on apoprotein to ferritin ratio.
- Transferrin binds with free Fe^{2+} or Fe^{3+} from ferritin and carries to bone marrow

- Haemosiderin granules seen with iron overload & gives rise to haemosiderosis or bronze diabetes.

Treatment of iron deficiency anaemia

- Oral iron therapy: ferrous salts of sulfate, fumerate, gluconate, lactate, succinate and glycine sulfate etc.
- Ferric salts: ferric ammonium citrate, iron polysaccharide and ferric hydroxide polymaltose complex.
- Ferrous salts better absorbed than ferric salts.

- Ferrous salts: 100mg provides 20% of elemental iron
- Ferrous fumerate: 33%
- Ferrous sulfate:19%
- Ferrous succinate: 12%
- Adult: 200mg of elemental iron administered in 2-3 divided doses after meal
- Children:3-5mg/kg in 3 divided doses
- 325mg tablets of ferrous sulfate, thrice a day

- Ferrous sulfate: FERSOLATE 200mg tab
- Ferrous fumerate: NORI-A 200mg tab
- Ferrous gluconate:FERRONICUM 300mg tab
- Collodial ferric hydroxide: NEOFERRUM 200 mg tab. 400mg/5ml syrup

- Antioxidants

Erythropoietin

- Cytokine produced in juxtatubular cells in the kidney and also in macrophages.
- Produced by recombinant technology.
- Available as epoeitin α and β.
- 25-100 IU/kg, s.c. or i.v. 3 times a week.

Uses of Erythropoietin

Anaemia due to:

- Chronic renal failure.
- Cancer chemotherapy.
- AIDS.
- Premature infants.
- Blood transfusion
- Adverse effects: flu-like symptoms, mild hypertension, encephalopathy, occasionally convulsions, risk of thrombosis due to hematocrit rises.

Erythropoietin preparations available

- Erythropoietin, EPOX, ZYROL, EPREX 2000 IU, 4000 IU/ml inj.