



treatment of iron deficiency anemia



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Red blood corpuscles (RBC) laboratory data

- Haemoglobin (Hb) concentration: (13-18gm/dl)
- RBCs count: (4,5-5,5 millions/cm)

Absolute values of RBC

- Packed cell volume (PVC): (40-50%)
- Mean corpuscular volume (MCV): (85-95 fl)
- Mean corpuscular haemoglobin concentration (MCHC): (30-35%)

g

* **Reticulocyte count: (0,2-2,0% of RBC count)**



RBC absolute values in various types of anaemia

- Hypochromic RBC: MCH $<28\text{pg}$
- Normochromic: MCH $28-32\text{pg}$
- Microcytic RBCs: MCV $<85\text{fl}$
- Macrocytic RBCs: MCV $>95\text{fl}$
- Normocytic RBCs: MCV $85-95\text{fl}$
- Reticulocytosis: Reticulocytes $>2\%$



الرقم مطلق
من خلايا الدم الحمراء
معتاد
ما حفر الحاضرة

Types of anaemias



- o **Deficiency anaemias:** (Fe, vit B12, folic acid)

- ✓ → ● Iron deficiency anaemia

- ✓ ● Megaloblastic (pernicious) anaemia (B12 Deficiency)

- ✓ ● Megaloblastic anaemia of folate deficiency

- o **Aplastic anaemia:** (depression of bone marrow)

- o **Haemolytic anaemia:** (++_(more) destruction of RBCs)

- o Anaemias due to haematological diseases

↳ like leukemia, cancer

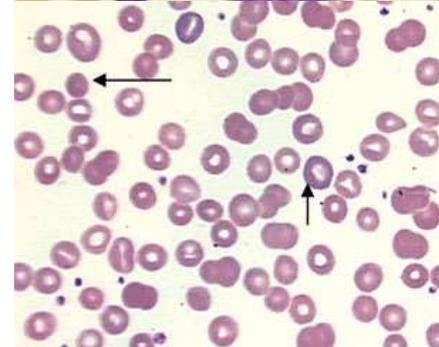
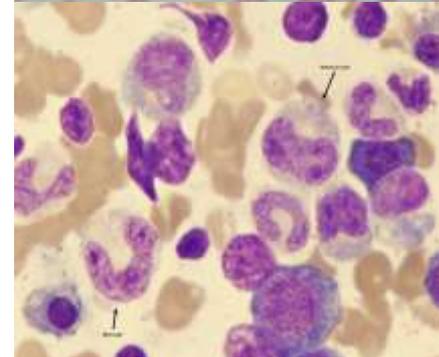
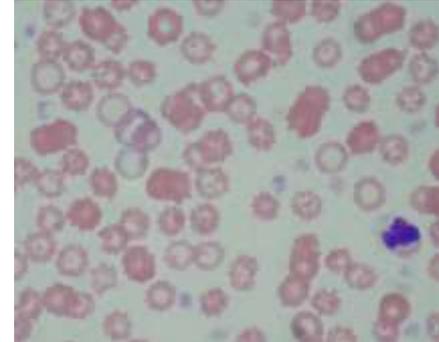
Microscopic diagnosis of deficiency anaemias

o Iron deficiency anemia:

- Is diagnosed by presence of : microcytic hypochromic RBC

o Pernicious (megaloblastic anemia):

- Is diagnosed by presence of : macrocytic megaloblastic RBC



Iron (Fe)

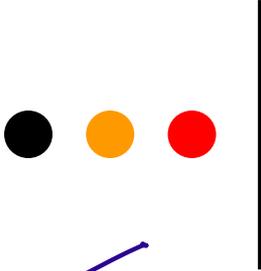


ترتيزه قليله ، لكنهم باذنهم يدخل في تصحيح Hb

- ✓ Total male body (70kg) content: 4 gm
- Body **distribution** of Fe:
 - Circulating blood haemoglobin (within red cells): 70%
 - ● Tissues stores for Hb synthesis (liver, spleen, bone marrow): 20%
(ferritin and haemosiderin)
تخزنه بصوره
 - Tissues stores **not** for Hb synthesis (myoglobin, cytochromes): 10%
- **Daily requirements** for adult men = 1.0-1.5 mg/day
 - * Increased daily doses is required for:
 - ✓ Pregnant and menstruating women (1,0-3,0 mg/day)
 - ✓ During rapid growth periods

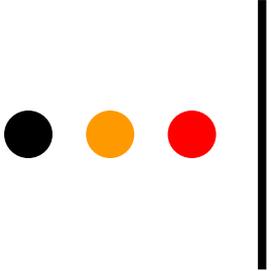
في نحتاجه
من 1.0
يومياً
تزداد
الحاجة
في حالات

كمية قليلة



Iron (Fe)

- 
- Average healthy diet contains (10-20 mg Fe/day) *كمية اليه بتصلها*
 - Normal adults absorb 5-10% of the dietary Fe, while in pregnancy or Fe deficiency absorption rises up to 30%

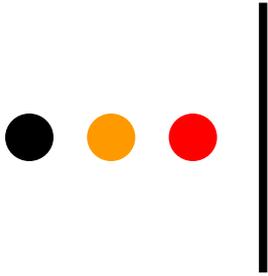


Iron (Fe)

Food iron is found in 2 forms:

● Haem Fe

● Non-haem Fe

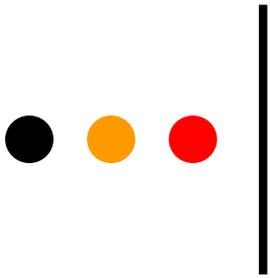


اللحم الحمراء

o Haem Fe:

- Is derived from the Hb & myoglobin found in meat and accounts for 10-25% of ingested Fe in well economic communities (up to 20% is absorbed)
- Prior to absorption the Haem Fe is cleaved from the globin.
- Absorption is influenced by body Fe stores.
 - The more deficiency, the greater the absorption
- Iron is relatively well absorbed

بـ يـ حـ تـ (absorption) فقط في حالة الحاجة | Balance



o **Non-haem Fe:**

- Is supplied by plant and dairy products.
- ✓ ● It is **not well absorbed** (ہی نہیں ہے علیہ اد (Absorbability))
- Non-haem Fe consists mainly of **Fe salts** which are bound to foods and therefore must be hydrolyzed or solubilised prior to absorption. (کے تھمن قبل علیہ الامتصاص)
- ● Consumption of non-haem Fe with haem Fe increases non-haem Fe absorption

Fe absorption

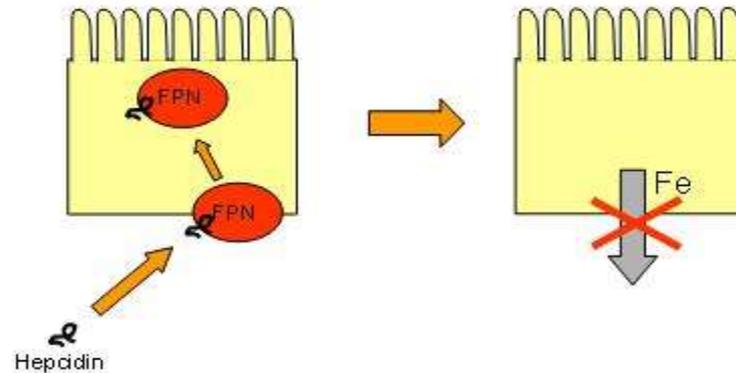
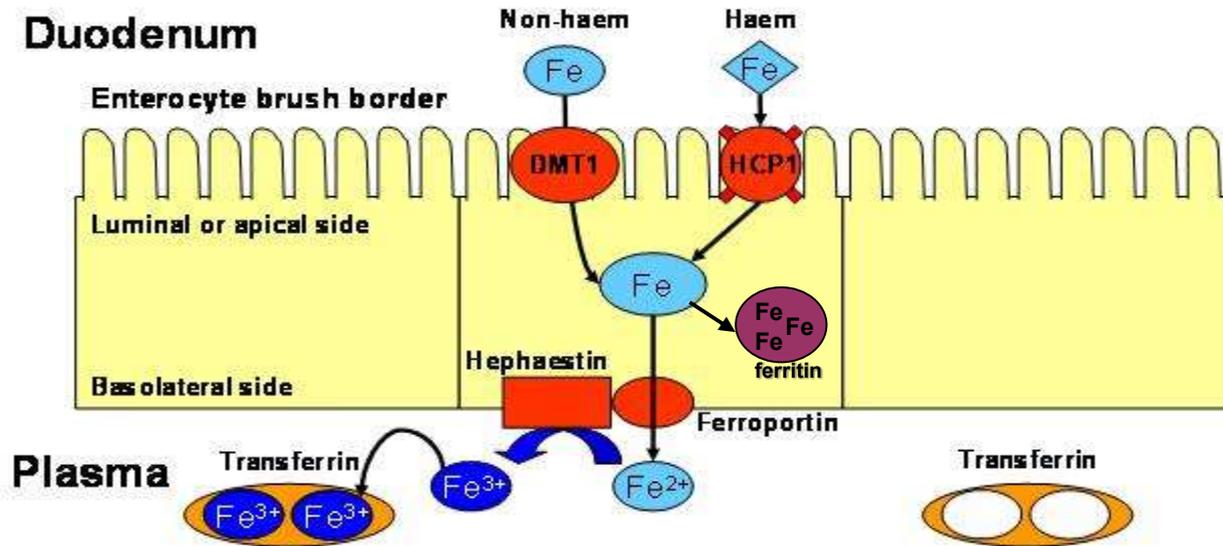
* يتحول من Fe^{+3} إلى Fe^{+2}
حتى يصل عملية الامتصاص



- Fe is present in 2 states: ferric (Fe^{3+}) and ferrous (Fe^{2+}).
- At neutral pH most iron is in the Fe^{3+} state, which is insoluble & not absorbed.
- Gastric acidity is essential for converting Fe^{3+} to Fe^{2+} .
- Fe^{2+} form is best absorbed compared with Fe^{3+} form
- Ascorbic acid (vit. C) promotes conversion of Fe^{+3} to Fe^{2+} form
- Absorption is primarily influenced by the amount of Fe stores.

α

Intestinal Fe absorption

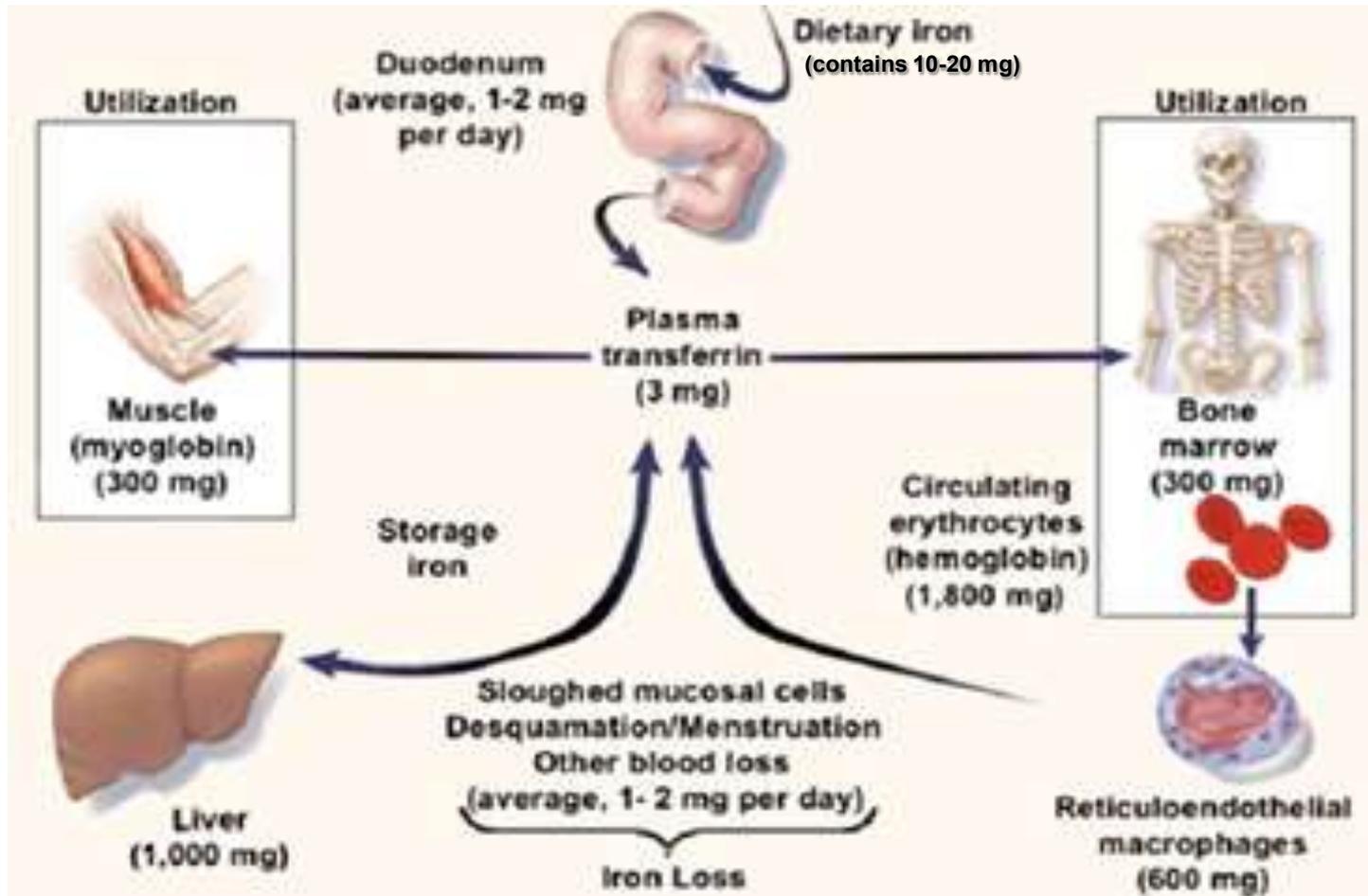


(hormone) is produced by hepatocytes when iron stores are full. Inflammation can also stimulate hepcidin production

DMT1 (divalent metal transporter-1), **HCP1** (haem carrier protein-1), **FPN** (ferroprotein) basolateral transporter

α

Normal iron store and distribution



Iron is bound and transported in the body via transferrin and stored in ferritin molecules. 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.

Factors affecting Fe absorption



o Increased absorption:



- Increased demands (Pregnancy, growth, ...)
- Reducing agents that increase ferrous forms e.g. HCl, Vit.C, SH groups of amino acids

o Decreased absorption:



- ✓ ● Gastric resection ^{فقدان جزئية المعدة}
- ✓ ● Mal-absorption syndrome (small intestine abnormalities; e.g. autoimmune diseases, tumors)
- ✓ ● Others
↳ like drugs

ما هي اذنين الاله

Indications of Fe therapy



لا لازم قبل ما تعطى (if a) تعرف السبب

Fe deficiency anaemia:

- **Chronic blood loss** (excessive menstruation, haemorrhoids)
- **Occult GIT bleeding** (with peptic ulcer or NSAID)
- **Treatment of the cause is mandatory**

بسبي
demand
o **Prophylaxis in pregnancy** (start from 4th month)

o **Mal-absorption syndrome** (Parenteral Fe indicated)
* → not oral due to malabsorption

o **Premature babies** (human and cow milk are deficient in Fe)

o **During treatment of pernicious anemia with vit. B12 or folic acid** (due to depletion of Fe stores by rapid RBC formation)

بسبب بل متحانه
only

Treatment of Iron deficiency Anaemia



- 1 Find cause & treat if possible
- 2 Diet with increased iron content e.g. red meat
- 3 Iron supplements:
 - These include:
 - Oral iron
 - Parenteral iron

Iron therapy:

Oral Fe preparations

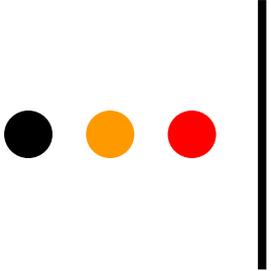


○ Ferrous sulphate

- Is most commonly used and is cheap
- In iron 200 mg tab, it contains about 65 mg of elementary Fe
- Given with or after meal, to reduce GIT disturbances ✓
- Treatment should be given until Hb becomes normal, then a lower dose of Fe is continued for 2 month to replenish Fe stores

(Non heme)
يعني مواد آوية
تساهم على امتصاص
الحديد

(at least)



Iron therapy: Oral Fe preparations

o Side effects of oral Fe therapy include:

● GIT disturbances:

- heart burn, diarrhoea or sometimes constipation, nausea

● Allergic reactions

- Black stool (Fe doesn't interfere with test for occult blood)

لذلك خذوا 24 ساعة
لازم - راجع الطبيب
في حال حدوث نقص



● ● ● |

○ Organic ferrous salts :

- These cause **less gastric irritation & produce better compliance**
- Ferrous gluconate
- Ferrous fumarate
- Others : For children or elderly, **solution or syrup preparations** are available such as **Ferrous glycine sulphate, Iron edetate**

Iron therapy: Oral Fe preparations

- **Slow release preparations** (e.g. spansules) would slowly release iron in intestine for absorption
- ○ This causes **less gastro-intestinal side effects** and **improves patient compliance** esp. in elderly

! **Note**: Oral iron corrects the anemia as quick as parenteral iron!

(Parenteral) * بزوع ال
في حالة سوء
Complications

Iron therapy:

Parenteral Fe preparations



o Indications of parenteral therapy:

- ➔ ● If oral therapy causes or aggravates GIT disturbances
- In mal-absorption syndrome (where Fe is not absorbed)
Celiac disease *جے مثل فری*
- Non-compliance to oral therapy

Iron therapy: Parenteral Fe preparations

○ Iron sorbitol citric acid complex:

- Given by deep **IM** injection daily or on alternate days 100 mg/d .
- ● Rapidly absorbed into blood, bound to transferrin, and is stored in liver and bone marrow.
- ✓ ● Excess unbound iron (about 30%) is excreted in urine which may thus becomes dark transiently.
- ✓ ● It can irritate kidney



Iron dextran (ferric hydroxide with dextran):

- Given by IM, slow IV infusion حتى عمق اصبغ وانه من فاي
الظرفه والنت ٥١٧ ...
- ➔ ● In blood, it is not bound to transferrin
- Most adult patients with anemia need about 1 - 2 g (or 20 – 40 ml) of parenteral iron
- ➔ ● A small test dose (0.25 - 0.5 ml) is used first to exclude any allergy
- **Total dose infusion (TDI):**
 - The calculated total dose of Fe required to be administered parenterally to correct anaemia and replenish Fe stores:

$$\text{mg of Fe} = \text{Hb deficit (in gm \%)} \times \text{body weight (Kg)} \times 3$$

total dose ↗



at least ↴

Note: Oral Fe must be stopped 24 h before parenteral iron, and not resumed for at least 5 days after last injection (توقف ل (oral)

o Side effects of parenteral iron :

↴ ● Local side effects

- Parenteral iron include pain and black-brown staining at site of injection; IM iron, this can be decreased by the Z-technique of injection

لے تحظ الابرة مباشرة في العضلة

↴ ● Systemic side effects :

- Dizziness, disorientation, arthralgia, and metallic taste
- ↴ • Allergy : esp. occur with IV iron in TDI; they include urticaria , hypotension, anaphylactic shock.

pid sidi
nie ngi
Antidote

آلة سويف في السوائل - سويف و صفة فية

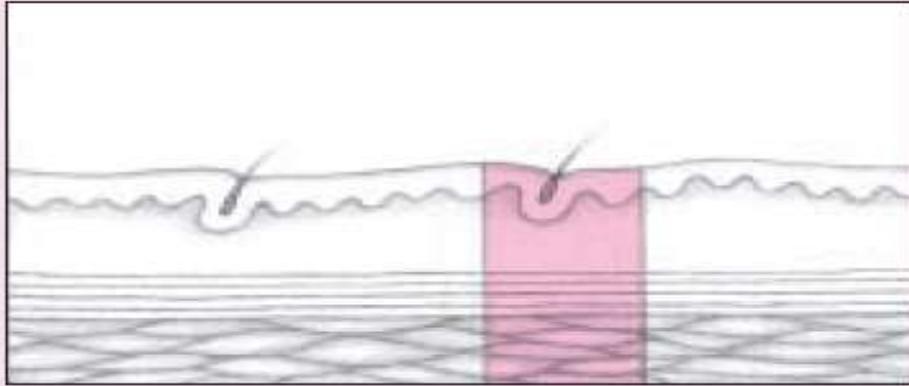


→ Adrenaline, cortisol, H1-anti-histamines,
and facilities for CPR (cardiopulmonary
resuscitation) must be available so that
they can be used quickly in anaphylaxis

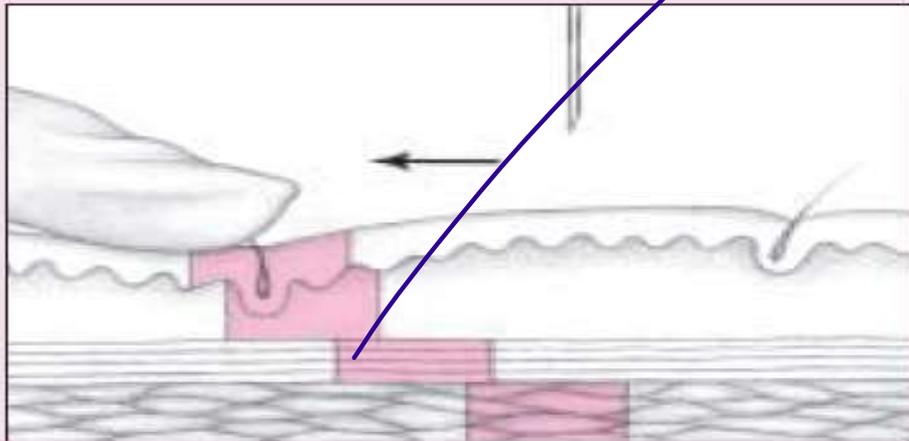
Displacing the skin for Z-track injection

By blocking the needle pathway after an injection, the Z-track technique allows I.M. injection while minimizing the risk of subcutaneous irritation and staining from such drugs as iron dextran. The illustrations below show how to perform a Z-track injection.

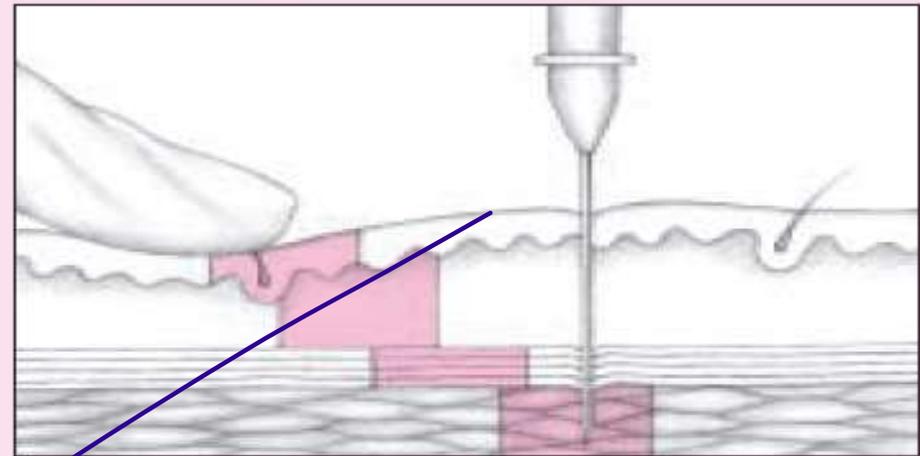
Before the procedure begins, the skin, subcutaneous fat, and muscle lie in their normal positions.



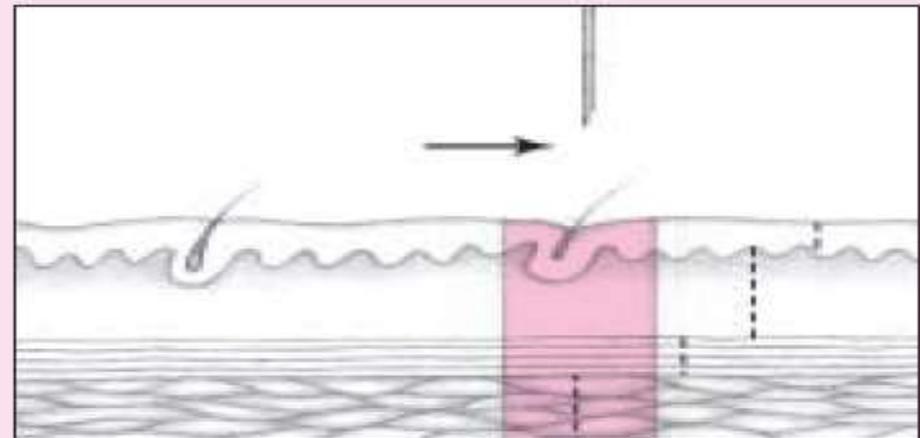
To begin, place your finger on the skin surface, and pull the skin and subcutaneous layers out of alignment with the underlying muscle. You should move the skin about 1/2" (1 cm).



Insert the needle at a 90-degree angle at the site where you initially placed your finger. Inject the drug and withdraw the needle.



Finally, remove your finger from the skin surface, allowing the layers to return to their normal positions. The needle track (shown by the dotted line) is now broken at the junction of each tissue layer, trapping the drug in the muscle.

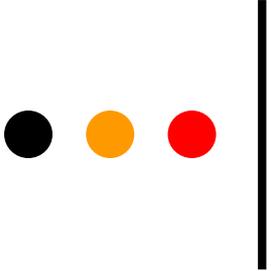


Iron toxicity:

Acute Iron toxicity



- May occur in children (accidental ingestion) يستخدم في عمليات الانتحار ↗
- ○ Iron is a corrosive metal; as little as 10 tablets can cause serious toxicity or death in children
- Its incidence has decreased by use of child-proof drug containers.
- **Clinical manifestations** include:
 - ● Acutely, toxic amounts of iron impairs oxidative phosphorylation and mitochondrial function leading to cell death.
 - ● GIT manifestations (necrotizing gastro-enteritis with abdominal pain, vomiting , bloody diarrhea, hepatic injury)
 - ● CNS and metabolic manifestations (Metabolic acidosis, hypoglycaemia, encephalopathy, convulsions, coma and death)



o Treatment of acute Fe toxicity:

● **Gastric lavage**. Sodium bicarbonate (which by making pH alkaline would decrease iron absorption) or with **Desferrioxamine** (that binds iron and prevent its absorption in intestine; desferrioxamine itself is not absorbed by intestine)

● **Raw egg or milk** to bind and precipitate Fe

● **Haemofiltration** or exchange transfusion in serious anuric cases

● Supportive treatment for shock, metabolic acidosis, liver damage, and encephalopathy

في السقري

في عدم القدرة على التبول

Iron toxicity:

● ● ● Chronic iron toxicity or haemochromatosis



- ✓ ○ It is a genetic disorder where individuals adsorb more Fe than normal
- The increased Fe in the body is deposited in the major organs (liver, heart, pancreas)
- Treatment:
 - ➔ ● **Phlebotomy** (blood withdrawal): a single venesection of 500ml of blood remove ~200-250mg of Fe. It can be repeated weekly
 - ➔ ● **Desferrioxamine** by intermittent IM injection