

امراض الدم الكورس الأول

Hemoglobin structure



Sawa University

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Department of Medical Laboratories

..... Third Stage

جامعة ساوة الاهلية

كلية التقنيات الصحية والطبية

قسم تقنيات المختبرات الطبية

....المرحلة الثالثة.....

محاضرة رقم 4

Lecture No.4..

الجانب النظري

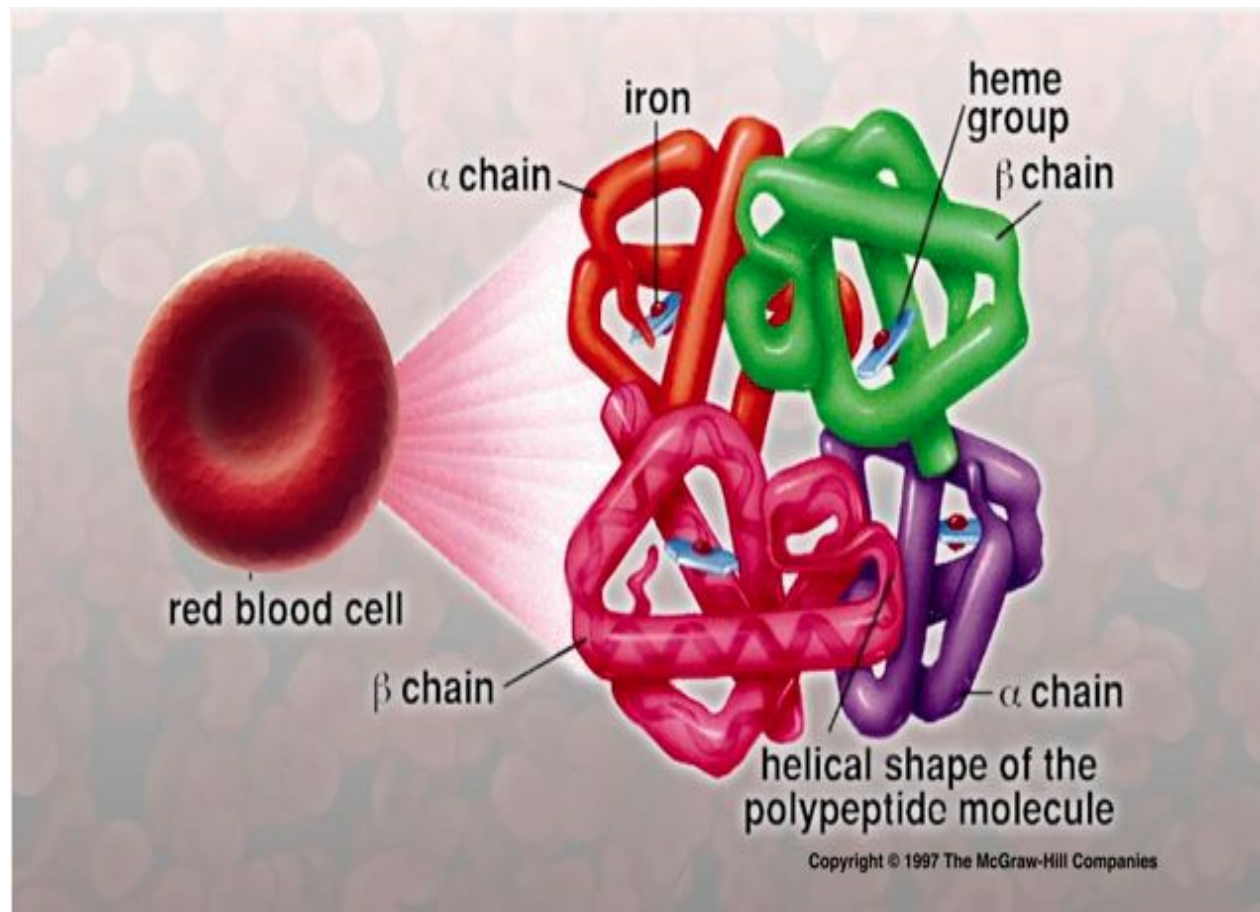
Theoretical

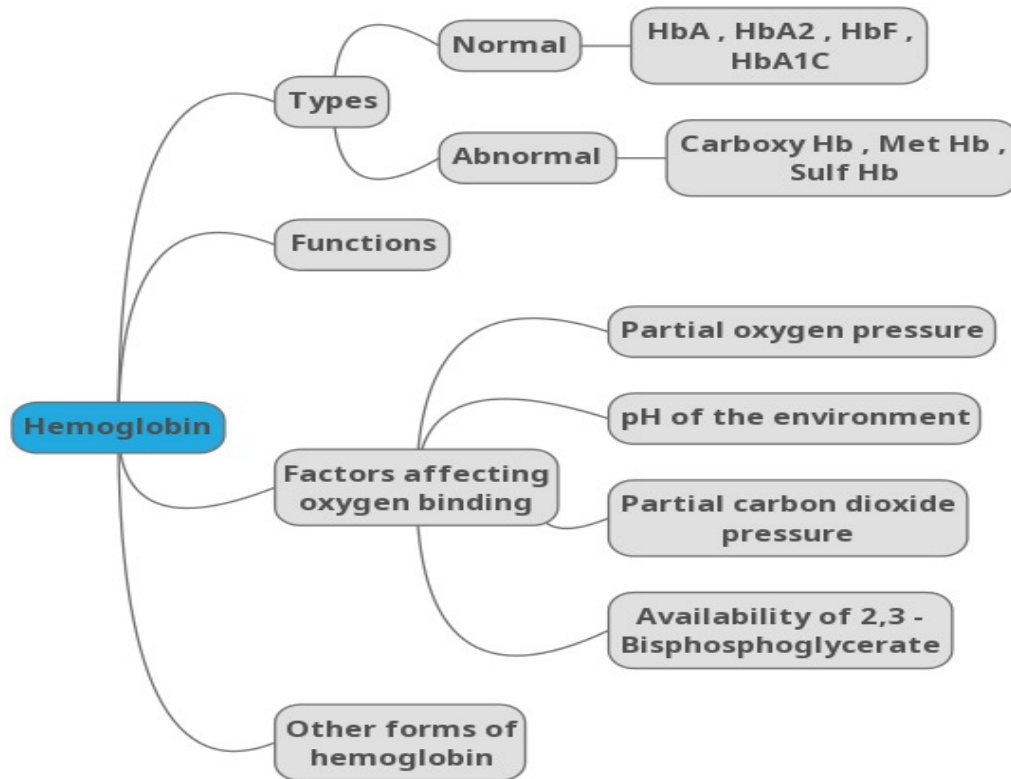
تدريسي المادة : د وضاح علي حسين

CONTENTS OF THIS TEMPLATE

- Hemoglobin structure
- Types of hemoglobin

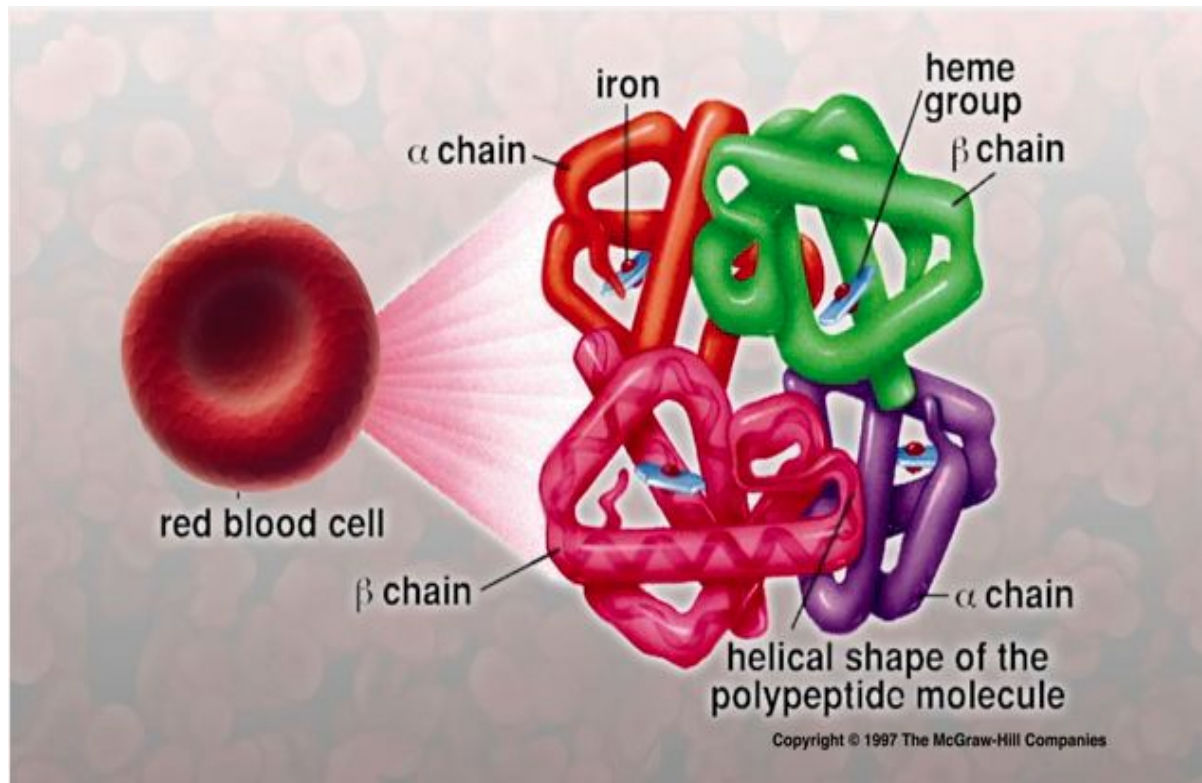
****** Hemoglobin is a protein in red blood cells that binds to oxygen in the lungs and carries the oxygen to the tissues.





- * Hemoglobin has 2 parts
- 1- protein part (globin)
- 2. Non protein part (heme)

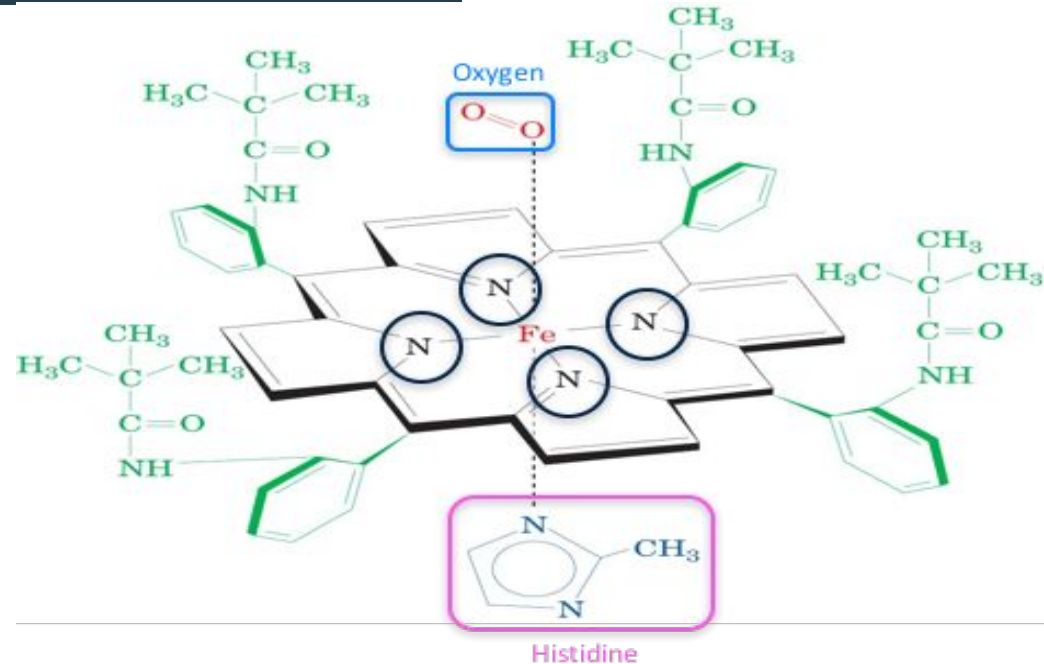
- ****Hemoglobin Hb A1** has a *tetrameric* structure; made up of four subunits (2 α chains 141 AA and 2 β chains 146 AA) bound together
- Each subunit contains a **iron containing pigment called heme** that can bind one molecule of oxygen (O_2).



** The heme group :

A complex of protoporphyrin and ferrous iron (Fe^{2+}).

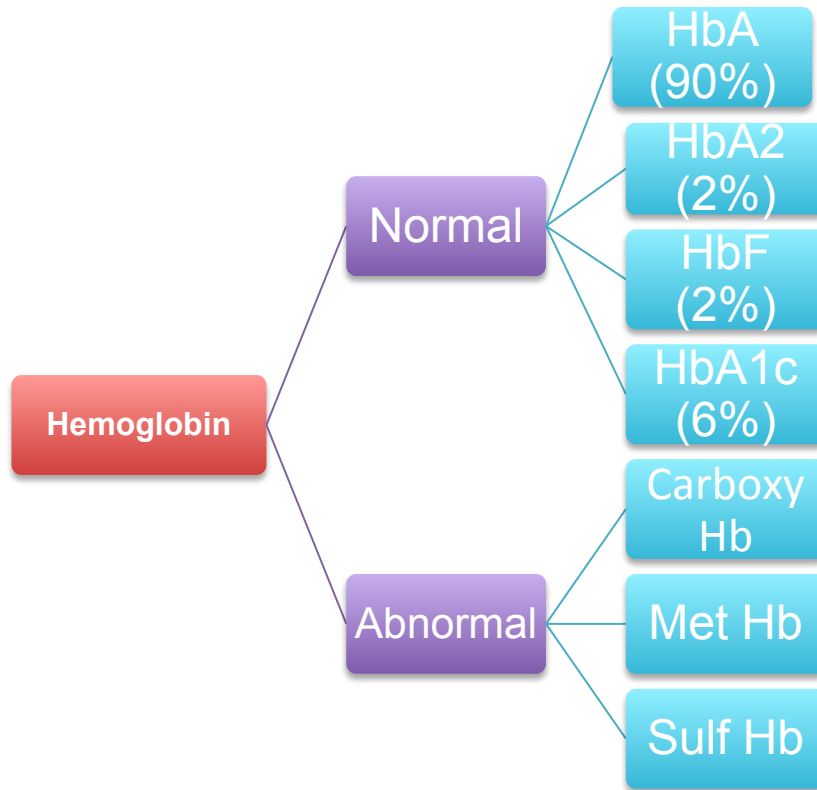
- Fe^{2+} is present in the center of the heme.
- Fe^{2+} binds to **four nitrogen atoms** of the porphyrin ring.
& two additional bonds with:
 1. Histidine residue of globin chain.
 2. Oxygen molecule.



*Heme group has iron in the center in **ferrous** state ,
if it is in **ferric** state it will not bind to **oxygen**
*in **ferrous** state it can have 6 bonds
4 with **nitrogen** we call it porphyrin ring
1 bond with molecular **O₂** (molecule(O_2))
1 attached to the **globin chain** (polypeptide)

The heme group:
 Fe^{2+} – porphyrin complex
with bound O_2

*** Types of hemoglobin in adults



****** Type of Hb according to the type of poly peptide chain

hemoglobin A1 the majority of the normal adult : 90%.

*chain composition of globin which are present

4 subunits : 2 alpha and 2 beta chain

*HbA1c is a modified form of HbA by adding glucose

HbF is a fetal hemoglobin it is present in the fetus
the levels of it goes down so in adult it is less than 2 %,
2 alpha and 2 gamma chains

* **HbA2** formed before birth and stay in a very small amount
2 % -- 5%
2 alfa chain and 2 delta chain

*Abnormal Hb = unable to carry oxygen

*Carboxy Hb = CO (carbon monoxide) is added NOT CO₂

*Met Hb = the iron in ferric state NOT ferrous so can not bind to oxygen
*

sulf Hb = amount of sulfa increased in blood because of sulfa containing
drugs

Form	Chain composition	Fraction of total hemoglobin
HbA	$\alpha_2\beta_2$	90%
HbF	$\alpha_2\gamma_2$	<2%
HbA ₂	$\alpha_2\delta_2$	2%–5%
HbA _{1c}	$\alpha_2\beta_2$ -glucose	3%–9%

** Hemoglobin A1 (HbA1)

– Major Hb in adults.

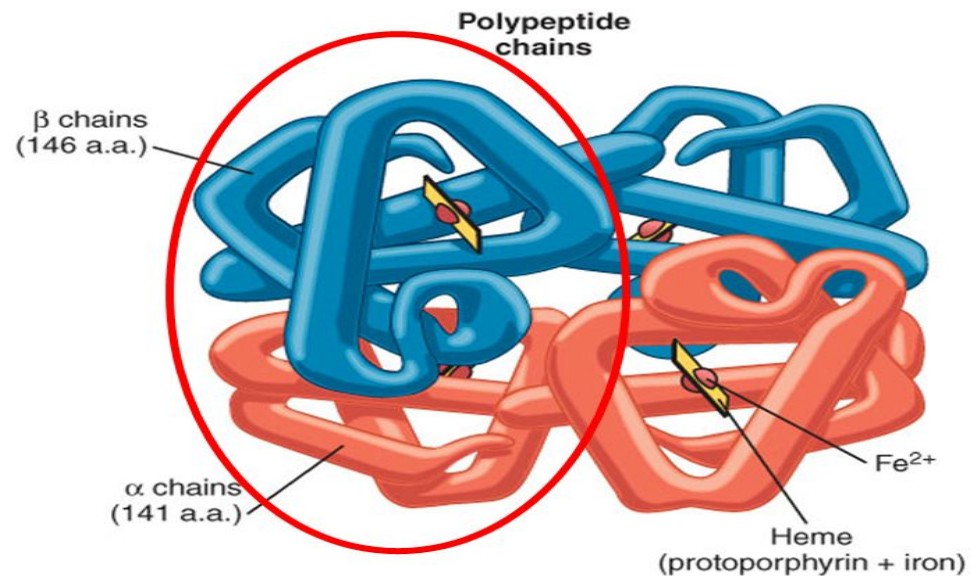
Composed of four polypeptide chains:

✓ Two α two β chains..

– Each chain is a subunit with a heme group in the center that carries oxygen.

– A Hb molecule contains 4 heme groups and carries 4 molecules of O_2

One dimer ($\alpha\beta$ subunit)



Other hemoglobin forms

Fetal Hemoglobin (HbF)	HbA ₂	HbA _{1c}
Tetramer with two α and two γ chains	Composed of two α and two δ globin chains	Two α and two β -Glucose
Major hemoglobin found in the fetus and newborn	Appears shortly before birth.	HbA1c levels are high in patients with diabetes mellitus
✓ Higher affinity for O₂ than HbA maternal O₂ which is mainly HbA has to be delivered to the fetal hemoglobin across the placenta which is HbF so it has to have higher affinity to O₂ ✓ Transfers O₂ from maternal to fetal circulation across placenta ✓	✓ Constitutes ~2% of total Hb	✓ HbA undergoes non-enzymatic glycosylation Glycosylation depends on plasma glucose levels Because they have higher amount of glucose bound to HbA1c level because it stays for 120 days so until the patient maintain his blood glucose level over a period of 3 months *

MCQ

Q1 regarding hemoglobin A1, globin chain composition which are present

- a. 2 alpha two beta chains
- b. 2 alpha and 2 gamma chains
- c. 2 alpha chain and 2 delta chain
- d. 2 beta chain and 2 gamma chain

Q2 normal hemoglobin A1 percentage

- a. 70 %
- b. 90 %
- c. 65%
- d. 45 %

Q3 Synthesis of erythropoietin mainly in the

- a. kidney
- b. lung
- c. bone marrow
- d. brain

T or F

Q1 regarding HbF

- a. fetal hemoglobin it is present in the fetus
- b. the levels in adult it is less than 2 %
- c. 2 alpha globin chain and 2 gamma globin chains
- d. 2 alpha globin chain and 2 beta globin chain

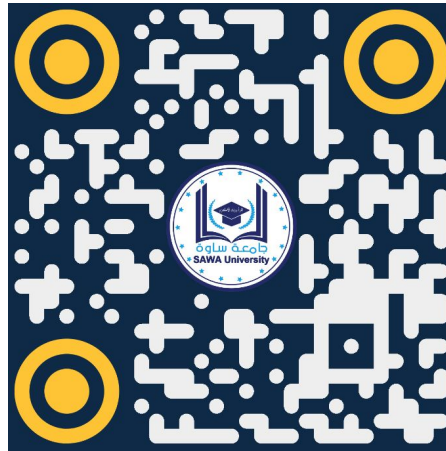
Q2 Regarding Hemoglobin structure

- a. protein part (albumen)
- b. Non protein part (heme)
- c. Iron in Heme part in ferrous state
- d. Ferric state have high affinity for oxygen
- e. protein part (globin)

Q3 regarding HbA2 structure

- a. Constitute 6 % -- 10 % of hemoglobin percentage
- b. 2 alpha globin chain and 2 delta globin chain
- c. 2 alpha globin and 2 gamma globin chain
- d. 2 alpha globin chain and 2 beta globin chain
- e. constitute 2 % of Hb percentage

Q4 describe the Type of Hb according to the type of poly peptide chain



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