University Of Fallujah
College Of Medicine
Medical Biochemistry

Lecture 3: Estimation of HbA1c

Stage: 2nd Year

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Department: Medical Biochemistry

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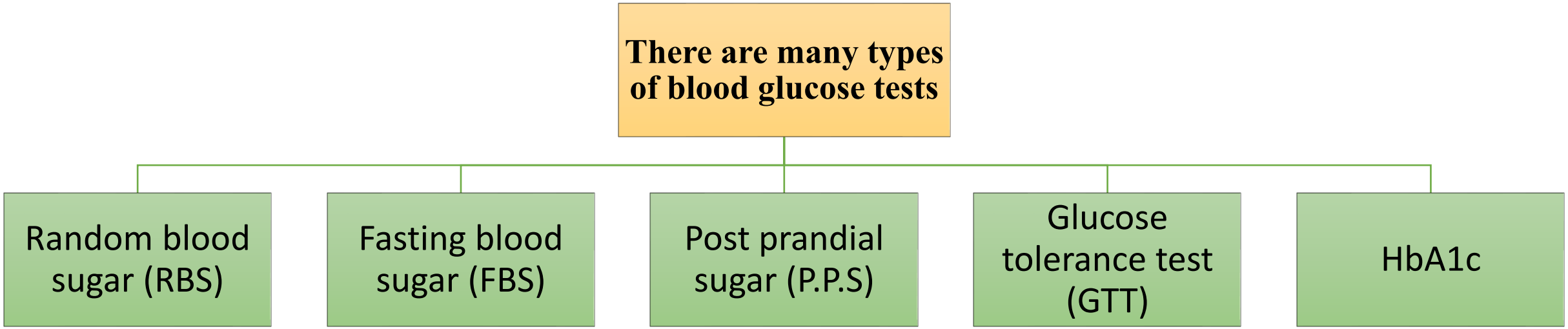
Learning Objectives

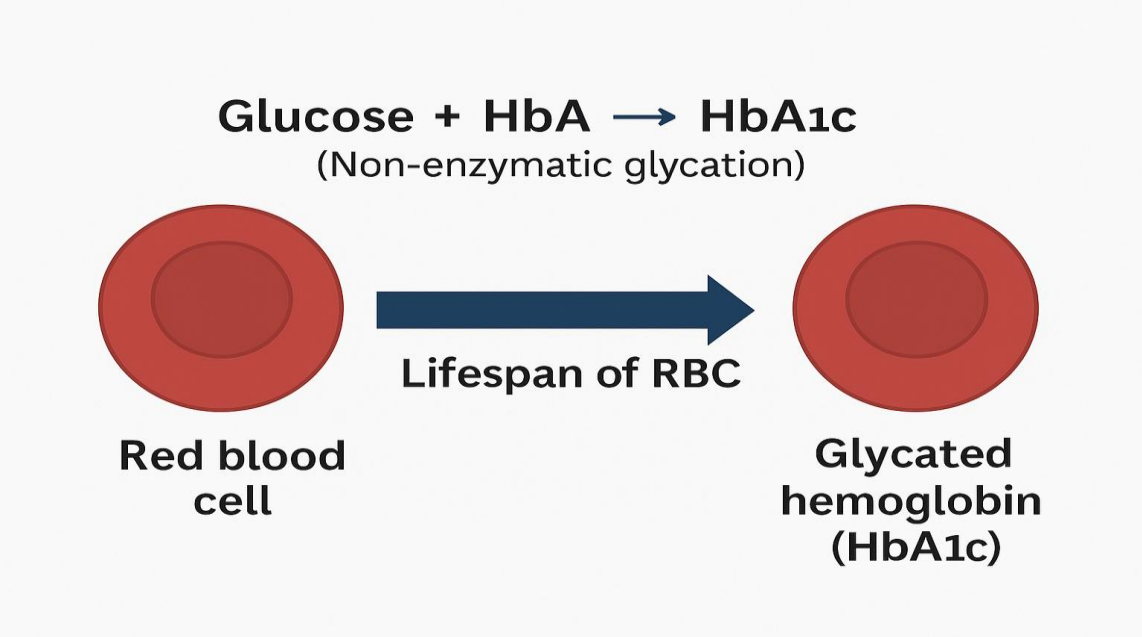
- Define glycated hemoglobin (HbA1c) and explain how it is formed.
- Describe the biochemical principle underlying the HbA1c test and its relation to the lifespan of red blood cells .
- Explain the clinical significance of HbA1c measurement in the diagnosis and monitoring of diabetes mellitus.
- Identify the normal reference ranges of HbA1c and interpret results for normal, prediabetic, and diabetic individuals.
- Recognize the factors that can interfere with HbA1c
- Differentiate between HbA1c testing and other blood glucose estimation methods (FBS, RBS, PPS, GTT).
- Apply knowledge through interpretation of clinical case scenarios involving HbA1c results.

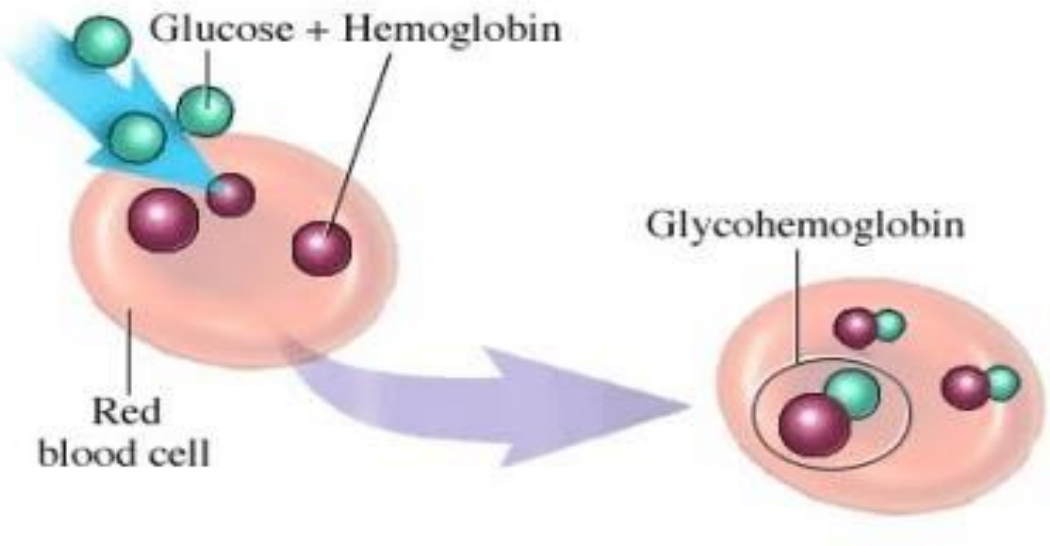
Diabetes mellitus (DM)	It is a group of metabolic disorders characterized by high blood sugar (Hyperglycemia) resulting from defects in insulin secretion, insulin action, or both.
Symptoms of hyperglycemia	Polyuria, Glycosuria, Polydipsia, and Polyphagia.
Types of DM:	**Diabetes mellitus type I** **Diabetes Mellitus Type II (Adult onset)** **Gestational diabetes**

Estimation of blood glucose



Glycated Hemoglobin (HbA1c) test

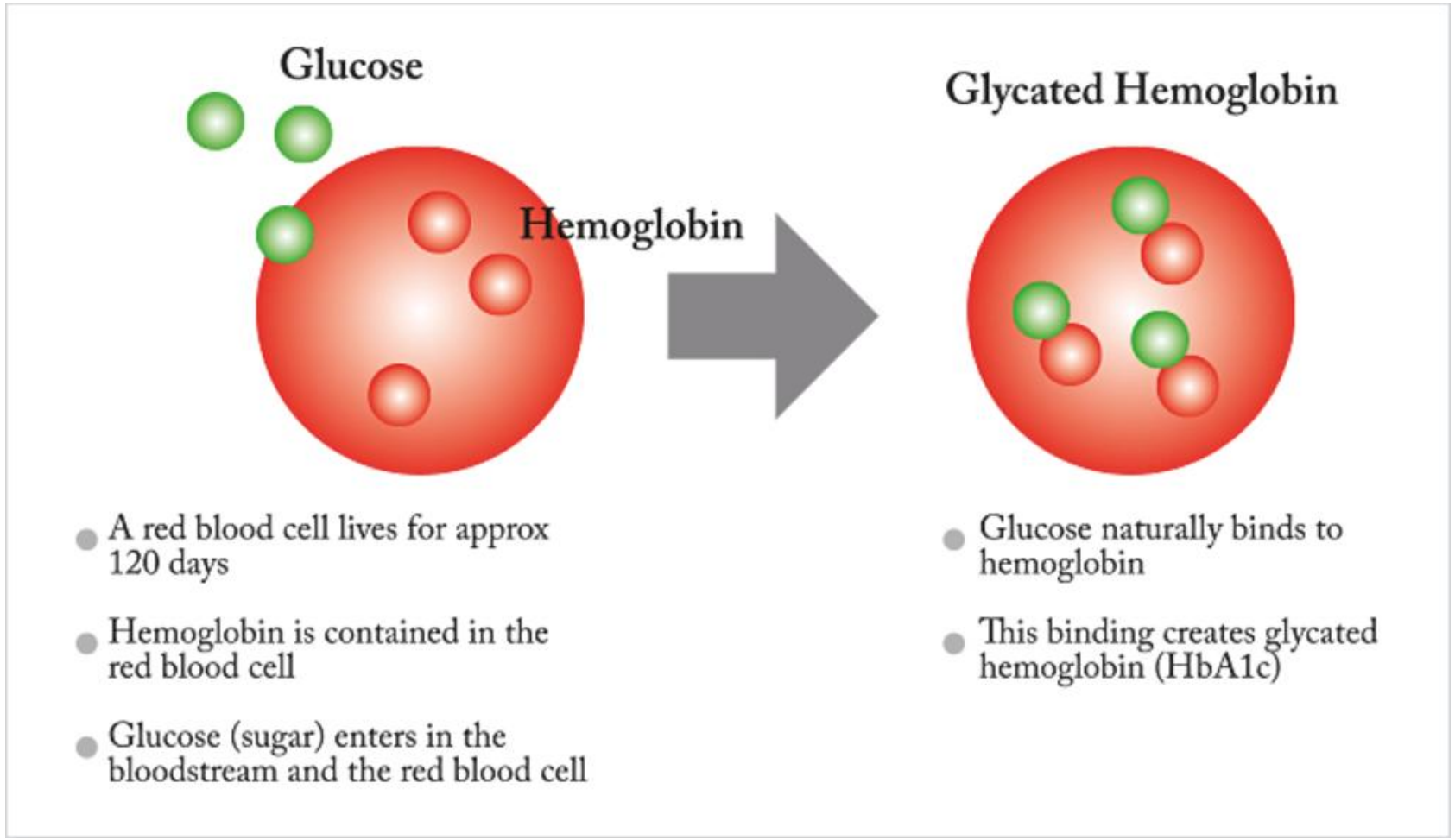




Estimation of glycated hemoglobin (HbA1c)

- The HbA1c test, also known as the hemoglobin A1c or glycated hemoglobin test.
- It is an Important blood test that gives a good indication of how well your diabetes is being controlled.
- **HbA1c is now part of the WHO diagnostic criteria** and **not affected by short-term fluctuations**
- Most of the hemoglobin is of a type called HbA.
- A small fraction of HbA becomes modified during its lifetime (HbA1).
- In the late 1950s, it was found that HbA1 could be separated further into HbA1a, HbA1b, and HbA1c.
- A decade later, the clinical significance of HbA1c became apparent when it was revealed that many people with diabetes had high levels of this hemoglobin variant.

- HbA1c is formed when glucose molecules attach to HbA molecules in a process known as glycosylation.



- Red blood cells have ‘insulin-independent’ glucose transporters on their surface.
- So, if glucose levels in the plasma are high, then glucose levels inside the red blood cells will also be high; therefore, more glycosylation of hemoglobin will occur.
- Together with the fasting plasma glucose test, the HbA1c test is one of the main ways in which type 2 diabetes is diagnosed.
- The A1c test measures how much glucose is bound to the hemoglobin in your red blood cells.
- Red blood cells live for about 3 months (120 days), so the test shows the average level of glucose in your blood for the past 3 months.

Factors that affect the test

- Anemia may get misleading results with this test
- High cholesterol and TG levels.
- Kidney disease (erythropoietin)
- Liver disease may also affect the test.
- Being pregnant (GDM) can also result in an inaccurate HbA1c.
- Genetic variants (e.g., HbS trait, HbC trait) (sickle cell anemia, beta-thalassemia)
- Iron, vitamin B12 deficiency, decreased erythropoiesis.
- Newborn (Child less than 6 months old).
- hemolysis, recent blood transfusion

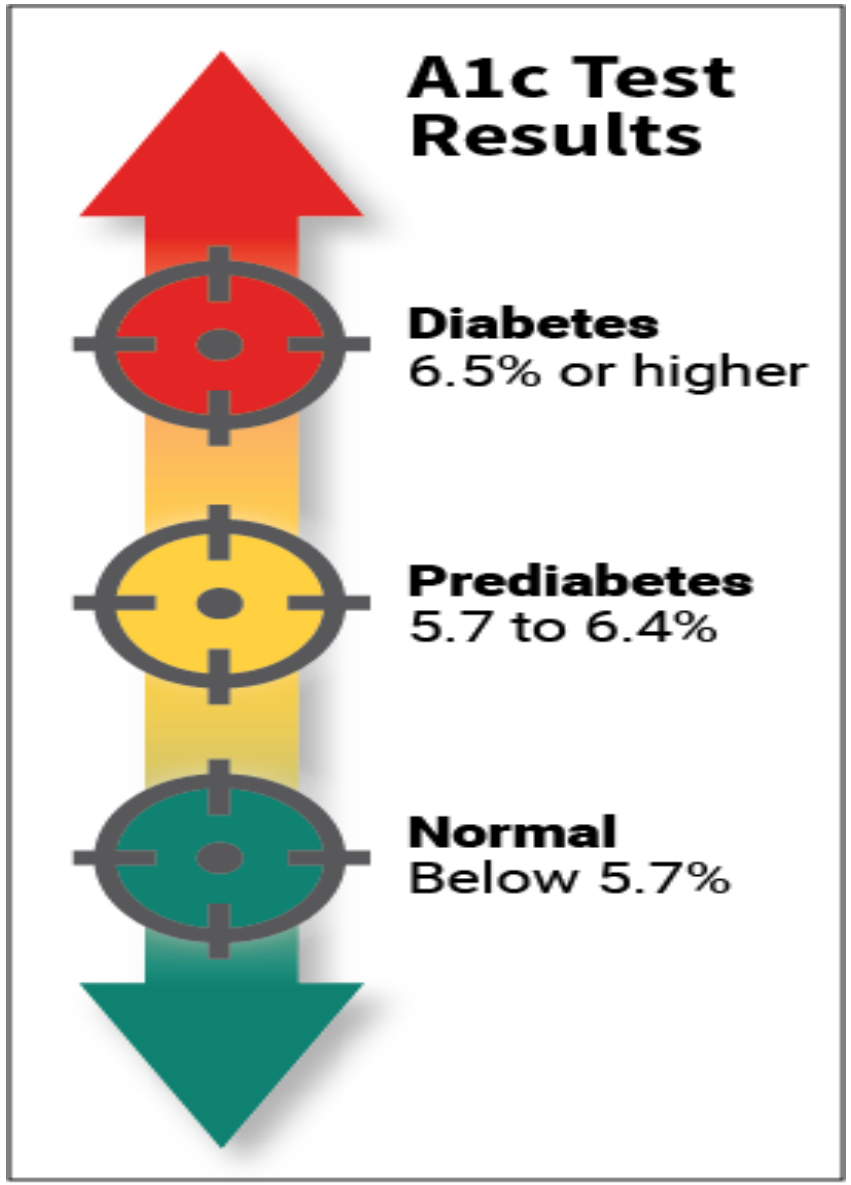
Normal levels

- **Normal:** A1C below 5.7%.
- **Prediabetes:** A1C between 5.7% and 6.4%

(means you have a higher chance of getting diabetes)

- **Diabetes:** A1C of 6.5% or higher

(Poor Glycemic Control)



A1c and Blood Sugar

A1c (%)	Average Blood Sugar (mg/dL)
4	68
5	97
6	126
7	152
8	183
9	212
10	240
11	269
12	298
13	326
14	355

Sample Collection

- Whole blood in EDTA tube.

Thank you