Biochemistry

ENDOCRINE Block Practical Sessions

King Saud University

MEDICINE
KING SAUD UNIVERSITY

BIOCHEMISTRY TEAM 436

Important Doctors slides

Extra Information Numbers **Doctors notes**

Editing file

A strong positive self-image is the best possible preparation for success.

\- Joyce brothers

Outline

❖ This file contains one lecture.

❖ This work is done by students, so if there are any mistakes please inform us .

❖ **Lecture title :**
 Blood glucose

Blood Glucose

❖**Diabetes Mellitus: Common signs, symptoms and Lab results:**

Hyperglycemia	Polyuria & Glycosuria
Polydipsia	Polyphagia

Comparison of Type 1 & Type 2 DM

	Type 1 Diabetes	Type 2 Diabetes
Age of onset	Usually during **childhood** or **puberty**.	Frequently after **age** 35
Prevalence %	10% of diagnosed diabetics.	90% of diagnosed diabetics.
Defect or Deficiency	β cells are destroyed, eliminating insulin production .	Insulin resistance combined with inability of β cells to produce appropriate quantities of insulin.
Ketoacidosis[1]	Common.	rare
Plasma Insulin	Low to absent .	High early in disease; low in disease of long duration.
Treatment	**Insulin** is always necessary.	1. Diet and exercise . 2. Oral hypoglycemic drugs. **3. +/- insulin,** required (not always depend on his/her condition)

1-Diabetic **ketoacidosis** is a serious complication of diabetes that occurs when your body produces high levels of blood acids called ketones. The condition develops when your body can't produce enough insulin.

Laboratory Tests For Glucose

Glucose laboratory tests	
1. Fasting plasma glucose :	Is a measurement of plasma glucose after 12 hours of fasting (no caloric intake). Normal blood glucose range: 3.9 – 5.6 mmol/L (70–100 mg/dL).
2. Oral Glucose tolerance Test (OGTT) & 2-hour post-prandial test	Serial measurement of plasma glucose before and after a specific amount of glucose given orally (75g glucose). Normal level: (< 7.8 mmol\L).
3. HEMOGLOBIN A1C measurement :	used to estimate glycemic control in the last 1-2 months & Recommended for the **detection of type 2 DM.** Normal level : 4 – 5.6 % .
4. Random Plasma Glucose Level :	_____
5. HEMOGLOBIN A1C :	• Hemoglobin A_{1C} (A_{1C}) is produced due to non-enzymatic glycosylation of hemoglobin. • It is used to estimate glycemic control in the last 1-2 months. • Recommended for the detection of **type 2 Diabetes Mellitus**. • HBA_{1C} and fasting plasma glucose are effective in diagnosing diabetes. • Cut-off point of ≥ 6.5 % is used to diagnose diabetes.
Q: When does someone is said to have an impaired glucose tolerance (Pre-diabetes state) ? When fasting plasma glucose OR 2-hour postprandial glucose level is above normal but below diabetic level.	

Criteria For Diagnosis of Diabetes Mellitus

Categories Of Increased Risk of DM & Diagnosis Of DM			
Test performed/ -	**Normal**	**Pre-diabetes**	**Diabetes**
Fasting Plasma Glucose (FPG)	Less than 100 mg/dl	FPG or IFG [1] : 100 - 125 mg\dl **5.6 - 6.9 mmol/L**	(fasting= No caloric intake for at least 8hs) 126 mg\dl and over 7 mmol/L and over
2 hours post glucose on the 75-g OGTT	Less than 140 mg/dl	OGGT or IGT[2] [2 : 140 – 199 mg\dl 7.8 – 11.0 mmol/L]	200 mg\dl and over 11.1 mmol/L and over
HA$_{1c}$	Less than 5.7%	5.7% - 6.4 %	6.5% and over
Random Plasma Glucose Level	———	———	200 mg/dl and over 11.1 mmol/L and over + signs and symptoms of hyperglycemia or hyperglycemic crisis

- **Ketone Bodies:**
- They produce by the liver and utilized for energy production by peripheral tissues . (common in type I DM)
  1. Acetone (exhaled by lungs, gives characteristic smell in diabetic ketoacidosis patients).
  2. Acetoacetate.
  3. β-Hydroxybutyrate.
  4. Produced by the liver and utilized for energy production by peripheral tissues.

1- IFG: impaired fasting glucose
2- IGT: impaired glucose tolerance

Urinalysis Using Dipstick

Principle:

- **<u>Dipsticks</u>** are plastic strips impregnated with chemical reagents which react with specific substances in the urine to produce color-coded visual results.

- They provide quick determination of <u>pH, protein, glucose and ketones</u>. <u>The depth </u>of color produced <u>is proportional</u> to the <u>conc</u>. of the <u>substance in urine.</u>

- Color controls are provided against which the actual color produced by the urine sample can be compared **"You must know how to compare color changes with the control charts."**
- The reaction times of the impregnated chemicals are standardized.

Procedure :

1. Dip the dipstick in the urine sample provided.

2. Remove it immediately.

3. Wipe off excess urine, Keep strip horizontally.

4. Read the color produced within 30- 60 seconds or immediately

   ⚠ Do not read it after 60 sec. Color changes after 60 sec . Are of no significance.

5. Compare color changes with the control charts provided.

Principle of urine strep

- **The urine strip** are impregnated with a variety of reagents that react with substances in the urine to produce color.

- **The intensity** of color is proportional to concentration of the substance being detected.

1- **Glucose** : glucose oxidase enzyme on the strip react with glucose in urine to produce gluconic acid and hydrogen peroxide that reacts with peroxidase to produce **bluish-green, greenish-brown, dark brown color.**

2-**Protein**: Tetrabromophenol reacts with proteins to produce **yellow-green, green, blue-green color**.

3-**Ketones**: sodium nitroprusside react with ketones to produce **pink , pink-purple color.**

4-**PH**: bromothymol and methyl red indicators change color due to acidity or alkalinity of urine.

	NEG	1.5	3	7.5	≥15
KETONES mmol/l					
	NEG	100	300	1000	3000
GLUCOSE mg/dl					
	NEG	0.3	1.0	3.0	≥10
PROTEIN g/l					
	5	6	7	8	9
pH					

Changes In Urine Dipstick Observed In Diabetic Patients And Their Interpretation

Physical examination *These results of diabetes patient*			
Parameter	**Results**	**Interpretation**	**reasons**
Appearance	Clear	Normal	----------
Color	Colorless	Polyuria	Diabetes
Odor	Fruity (in case of Dka[1])	↑ Ketogenesis	Diabetic ketoacidosis Starvation anxiety

Chemical parameters ”IMPORTANT”			
Test	**Results**	**Interpretation**	**reasons**
Urine Glucose	+	Glucosuria	diabetes mellitus Fanconi Syndrome
Urine Protein	May be present (in case of **nephropathy**)	Proteinuria	Chronic kidney disease Diabetes
Urine Ketones	+ (In case of DKA)	↑ Ketogenesis/ Ketonuria	Diabetic ketoacidosis Starvation
Urine PH	Acidic (in DKA) > 6	Aciduria	Uncontrolled diabetes dehydration

Extra :
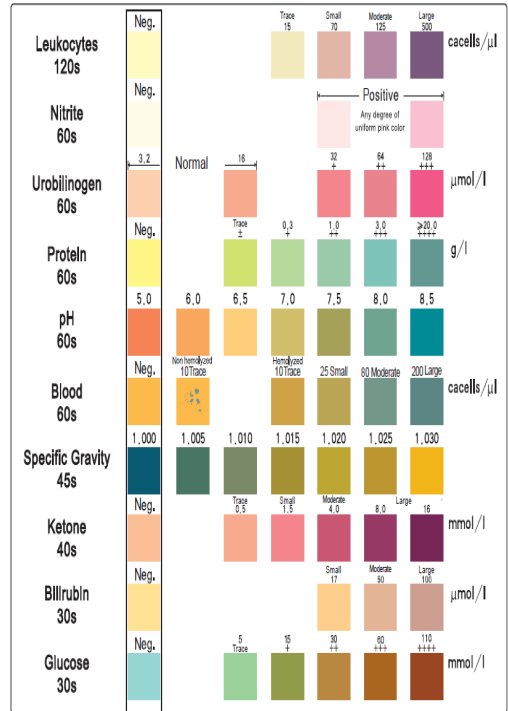
You might get a picture similar to this in the exam , and be asked to fill the schedule based on comparing the urine dipstick test of patient with color control.

1-Diabetic ketoacidosis

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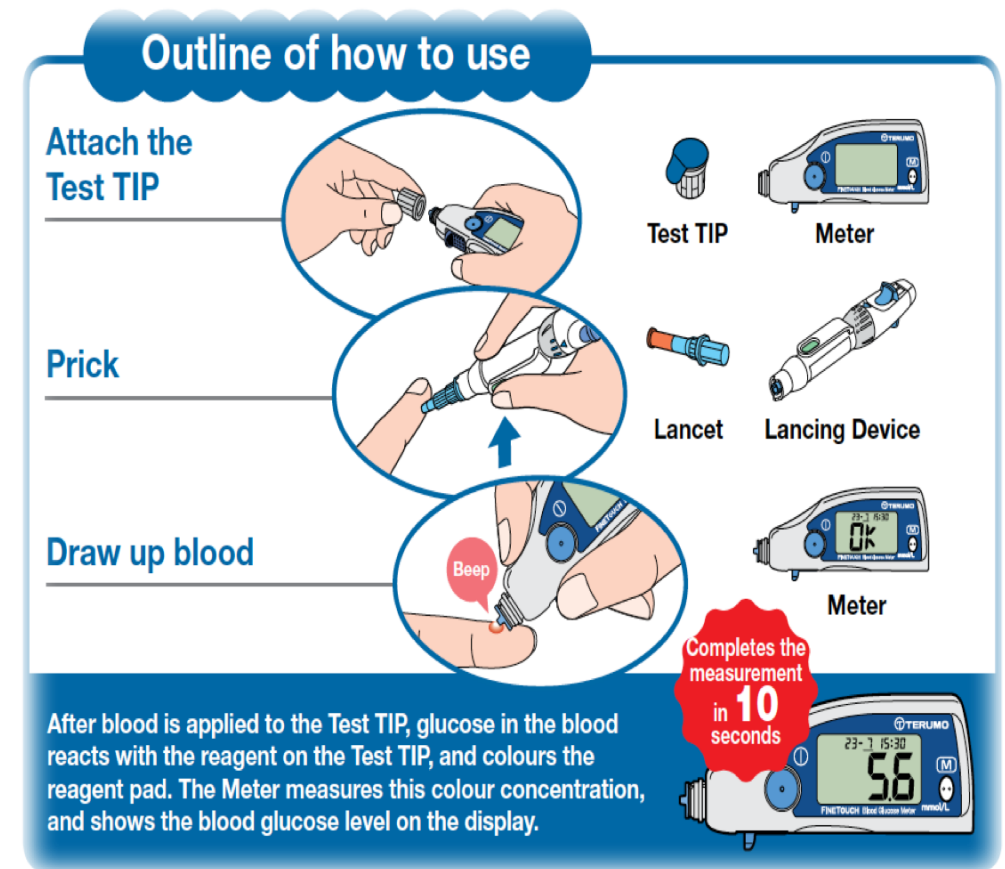# Measurement of Blood Glucose Level Using Glucometer

Instructions:

1. Attach the test tip to the glucometer as shown.

2. The meter will read "OK" indicating that it works properly.

3. Disinfect your fingertip using an alcohol swab.

4. Let it dry.

   ☣ **BIOHAZARD! The lancet in the lancing device is for single use only. Discard it after use .*** **don't reuse it again***

5. Prick the finger using the lancing device.

6. Draw up blood until the glucometer beeps.

7. Wait for 10 seconds until results are displayed.

8. Results can be read as mmol/L or mg/dL.

9. Interpret your results.

Outline of how to use

Attach the Test TIP — Test TIP — Meter

Prick — Lancet — Lancing Device

Draw up blood — Beep — Meter

Completes the measurement in 10 seconds

After blood is applied to the Test TIP, glucose in the blood reacts with the reagent on the Test TIP, and colours the reagent pad. The Meter measures this colour concentration, and shows the blood glucose level on the display.

Benefits of Self-monitoring of Blood Glucose Level

"IMPORTANT"

It allows patients to detect their blood glucose levels without visiting a clinic .

It helps patients to immediately confirm hypo or hyperglycemia to avoid complications.

It facilitates patient education about diabetes and its management by giving them more self-care responsibilities .

It helps to promote wellbeing of patients .

Q1) What is your Interpretation of the patient's results :

	Patient A	Patient B	Patient C
FPG	12 mmol/L	6.5 mmol/L 1	10.2 mmol/L
Hb A1C	10%	6%	9%
Serum ketones	50 mg/dl	Negative	Negative
Urine Ketones	+++	Negative	Negative
Urine Glucose	+++	Negative	++
Protein	+++	Negative	+++
pH	7.0	7.3	7.2

Test Your Self

The answer:

- Patient A :

1. Very High FPG "**Hyperglycemia**" and this indicates that the patient is diabetic
2. HbA1C is raised which shows his blood glucose level was uncontrolled for the last 2 months, this confirms diabetes.
3. "**Ketonemia**" and "**ketonuria**" indicate that the patient has DKA.
4. "**Glucosuria**" indicates the glucose filtration level is abnormally higher than the kidney threshold.
5. The presence of protein in urine "**proteinuria**" is caused by nephropathy (complication of uncontrolled DM). Low pH of urine "**Acidic urine**" indicates metabolic acidosis due to increase production of ketone bodies
- **The diagnosis is:** Diabetes ketoacidosis.

- Patient B :

1. FPG is higher than normal BUT not diabetic "**Pre-diabetic**" and shows Increase risk of diabetes.
2. HbA1C is raised and shows his blood glucose level was uncontrolled "**high**" for the last 2 months.

- **The diagnosis is**: Impaired Fasting Glucose "PreDiabetes"

- Patient C:

1. High FPG "**Hyperglycemia**" and this indicates that the patient is diabetic
2. HbA1C is raised and shows his blood glucose level was uncontrolled "**high**" for the last 2 months.
3. The presence of glucose in urine "**Glucosuria**" which this also indicates the patient has high blood glucose level.
4. And the glucose filtration level is abnormally higher than the kidney threshold.

- **The diagnosis is**: Diabetes Mellitus with nephropathy .

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Test Your Self

Q1) A 50 year male came to the clinic with symptoms of dehydration, polyuria and polydipsia. A urine sample was taken from him with the following results:

	Observation	Comment
Protein	+++	**Proteinuria**
Glucose	+++	**Glucosuria**
Ketone bodies	-	**Normal**
PH	6	**Acidic**

Q) What is the most likely diagnosis ?
Diabetes mellitus.

Q) What is the reason of presence of protein in the urine sample ?
Nephropathy.

N.B: You might be asked to fill the "comment" column.

Test Your Self

Q1) A known diabetic was presented to the emergency room with symptom of confusion, weakness, fruity breath, nausea and vomiting, the picture showes the results of his urine dipstick test:

	Observation	**Comment**
Color	Colorless	Polyuria
Odor	Fruity	Ketones
Protein	-	Normal
Glucose	+++	Glucosuria
Ketone bodies	+++	Ketonuria
PH	6	Acidic

Q) What is your most likely diagnosis ?
  Diabetic ketoacidosis.

Q) Name the three molecules of ketone bodies ?

1. Acetoacetate .

2. Acetone .

3. β-Hydroxybutyrate.

Test Your Self

Q) 60 year old female presented with polyphagia, fatigue and blurred vision. She is retired since 13 years staying at home most of the time. Despite losing weight, her BMI is 33. She mentioned that she had to wake up during the night to urinate in the pas 3 weeks. She has no family history of diabetes. The general practitioner ordered a blood glucose tests and the results were as the following:

	Result	Normal Range
OGTT	231 mg\dl (12.8 mmol\L)	< 140 mg\ dl < 7.8 mmol\L
HA1c	7.1 %	4 – 5.6 %

Q1) What is the most likely diagnosis ?

Diabetes mellitus type 2

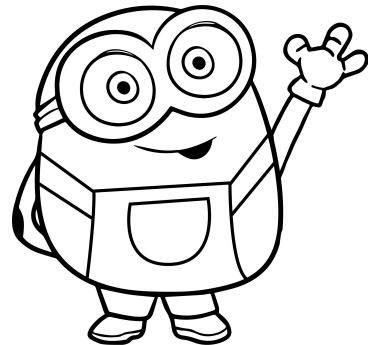**Q2) What are the factors which predisposed her to such a condition ?**

1-Obesity. 2- Sedentary life style. 3- Aging .

Q3) Name two complications associated with her situation ?

1.Retinopathy.

2.Neuropathy.

Q4) What is the main underlying cause of her disease ?

Insulin resistance.

THANK YOU

FOR CHECKING OUR WORK

PLEASE CONTACT US IF YOU HAVE ANY ISSUE

TEAM LEADERS

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