

ENDOCRINE SYSTEM



Practical Biochemistry

Estimation of blood glucose in diabetes mellitus

Hormones regulating glucose levels

Increase blood glucose

Glucagon

Growth hormone

Cortisol

Epinephrine

Insulin

Decrease blood glucose

DIABETES MELLITUS: The most common disorder of carbohydrate metabolism

**Signs
and
symptoms**

- **Hyperglycemia**
- **Polyuria and glucosuria**
- **Polydipsia**
- **Polyphagia**

Comparison of type 1 and type 2 DM

	Type 1	Type 2
Age of onset	Childhood	Adult
Symptoms develop	Rapidly	Gradually
Defect & deficiency	Beta cells are destroyed	Insulin resistance + inability of beta cells to produce enough insulin
ketosis	common	Rare
Plasma insulin	low	A-high early in disease B-low in disease of long duration
Acute complication	Ketoacidosis	Hyperosmolar coma
Genetic predisposition	Moderate	Very strong
Use of oral hypoglycemic	Unresponsive	Responsive
Treatment	Insulin is always necessary	Diet, exercise, oral hypoglycemic, +/- insulin

Laboratory tests for glucose

Normal blood glucose range: 3.9-5.6 mmol/L (70-100 mg/dL)

Fasting plasma glucose (FPG) :

- Measurement of plasma glucose after 8 hours of fasting (no caloric intake)
- Normal level:
 - 3.9-5.6 mmol/l
 - i.e(70-100 mg/dL).

Oral Glucose tolerance Test (OGTT) and 2-hour post-prandial test :

- Serial measurement of plasma glucose before and after a specific amount of glucose given orally (75g glucose)

Normal level:
<140 mg/dl
< 7.8 mmol/L

HEMOGLOBIN A1C (HA1c)

- 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 DM**
- Normal level : 4 – 5.6 %

When does someone is said to have impaired glucose tolerance (Pre-diabetes state) ?

When **fasting plasma glucose** OR **2-hour postprandial glucose level** is above normal but below diabetic level .



Categories of increased risk & Diagnosis of DM

Test performed	Increased risk for DM	Diagnosed with DM
FPG	5.6 - 6.9 mmol/L 100 - 125 mg\dl	≥ 7 mmol/l ≥ 126 gm\dl
2 hours post glucose on the 75-g OGTT	7.8 - 11 mmol/L (140 – 199 mg\dl)	≥ 11.1 mmol/l ≥ 200 mg\dl
HA1C	5.7 - 6.4 %	$\geq 6.5\%$
Random plasma glucose	-	≥ 11.1 mmol/L ≥ 200 mg/dl

* We highly recommend memorizing the values

KETONE BODIES

Produced by the liver and utilized for energy production by peripheral tissues (characteristic of type I DM)

- Acetone (excreted by lungs, characteristic smell in DKA patients)
=> Acetone breath.
- Acetoacetate
- β -Hydroxybutyrate

URINE ANALYSIS USING DIPSTICK:

- ◆ **Dipsticks** are plastic strips with chemical reagents which react with many substances in the urine to produce color-coded visual results.
- ◆ They provide quick determination of pH, protein, glucose and ketones. The depth of color produced is proportional to the conc. of the substance in urine.
- ◆ Color controls “the references” are provided to be compared with the results produced by the urine sample.

Procedure:

1. Dip the dipstick in the urine sample.
2. Remove it immediately.
3. Wipe off the excess urine .
4. Compare color changes with the control charts “the references”.



Presence of nitrate in urine indicates infection

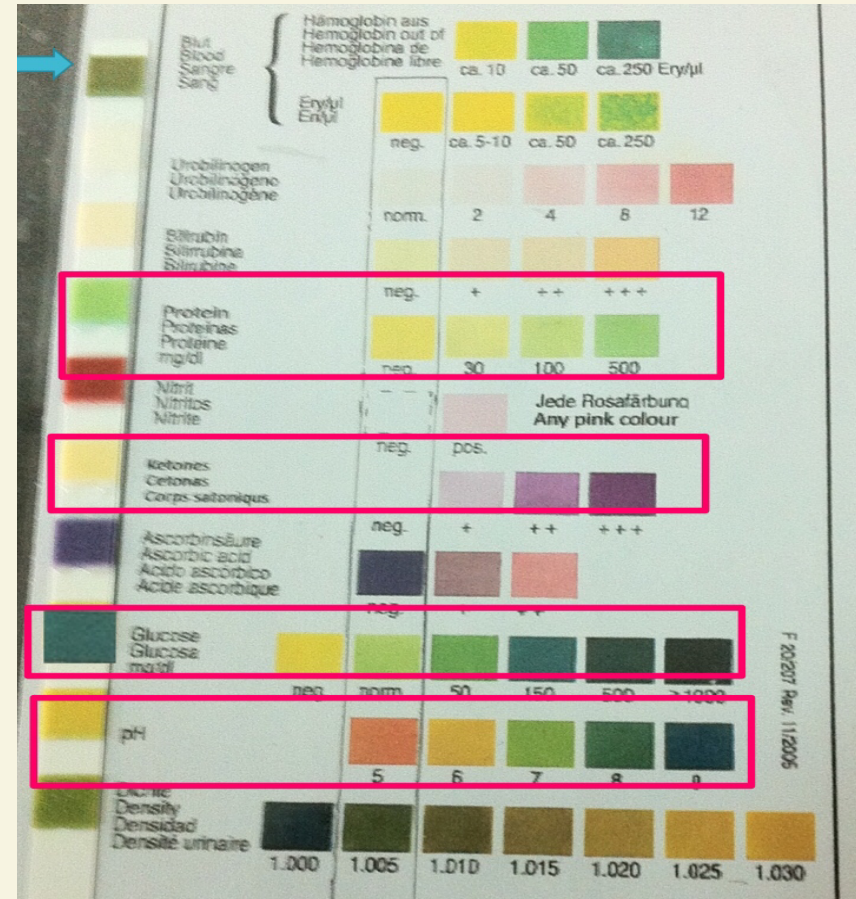
Changes in urine dipstick observed in diabetic patients and their interpretation

<u>Physical examination</u>		<u>Cause</u>
<u>Appearance</u>	Clear	
<u>Color</u>	Colorless	Polyuria
<u>Odor</u>	(Fruity in case of DKA)	↑ Ketogenesis
<u>Chemical parameters</u>		Cause
<u>Protein</u>	May be present (in case of nephropathy)	
<u>Glucose</u>	+	Hyperglycemia
<u>Ketones</u>	+ (In case of DKA)	↑ Ketogenesis
<u>PH</u>	Acidic (in DKA)	Ketone bodies

Case study 1

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:

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



* What is the most likely diagnosis?

- Diabetes mellitus.

What is the reason of presence of protein in the urine sample ?

- Nephropathy

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

Case study 2

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

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



* **What is your most likely diagnosis?**

- Diabetic ketoacidosis

* **Name the three molecules of ketone bodies?**

- Acetoacetate
- Acetone
- β -Hydroxybutyrate

Case study 3

A 32-year old moderately obese male has been feeling thirst most of the day so he drinks plenty of water which causes him to urinate during the day several times. He suspected himself of having diabetes mellitus and checked his blood sugar level using a glucometer at home and the result was 133 mg/dl . He wanted to do a check up at the hospital so he arranged and did not eat anything 8 hours prior to the test. Fasting plasma glucose measurement was performed and it was 6.3 mmol/l (113.4 mg/dl) .

*** What is your comment on the test results ?**

- Since his fasting plasma glucose is 6.3 mmol/l (113.4 mg/dl) so, he has increased risk of developing diabetes (He has impaired glucose tolerance)

What do you recommend for such a patient ?

- Healthy diet.
- Exercise and weight loss

If you want to check his glycemic control over the last 1-2 months, what is the proper test?

- Measurement of HA1C

Case study 4

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:

Test	Result	Normal range
OGTT	231 mg\dl (12.8 mmol\L)	<140 mg\dl < 7.8 mmol\L
HA1C	7.1 %	4 – 5.6 %

*** What is the most-likely diagnosis ?**

- Diabetes mellitus type 2

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

- Obesity.

- Sedentary life style.

- Aging

***Name two complications associated with her situation ?**

- Retinopathy.

- Neuropathy

***What is the main underlying cause of her disease ?**

- Insulin resistance

THANK YOU ...

We did our best to help and we hope we did 😊

DONE BY :
SARA ALDOKHYAYEL
MOHAMMED ALNAFISAH
ZIYAD ALAJLAN

