URINALYSIS

The GREATEST pleasure in life is doing what people say you cannot do!

URINE:

❖ **What is "urine"?**

Urine is a fluid excreted by most of mammals including humans.

❖ **It is formed in:**

the kidneys (renal glomeruli).

❖ **Urine Excretion:**

- The fluid undergoes chemical changes before it is excreted as urine.
- Normal urine excretion by a healthy person is about 1.5 L per day.

PHYSICAL PROPERTIES OF URINE (IMPORTANT):

PARAMETER	NORMAL	ABNORMAL	POSSIBLE CAUSES
Volume	0.4-2.0 L/day	Polyuria	Diabetes, chronic renal failure
		Oligouria	Dehydration, Acute renal failure
Appearance	Clear	Cloudy	Presence of pus cells, bacteria, salt or epithelial cells. في الحالة الطبيعية اليورين يكون صافي ، ولكن عند تواجد خلايا باليورين بيصير «مغبش» أو «مغيم».
Color غالبا تركيز اليورين يؤثر على لونه	Pale Yellow	Colorless	Excessive fluid intake, uncontrolled DM, DI, chronic renal failure
		Orange	Dehydration, carotenoid ingestion
		Yellow-Green	Jaundice
		Red	Blood, drugs etc
		Dark brown-black	Methemoglobin, alkaptonuria, melanoma, black water fever
		smoky	glomerulonephritis
Odor	Urineferous	Fruity	Diabetic ketoacidosis. التفاح الأخضر حامض ، وهنا عندنا اسيد «حمض».
		Ammoniacal	Contaminated and long standing exposed urine الامونيا غالبا تطلع بعد فترات زمنية طويلة ، فهنا اليورين قعد فترة فطلعت الامونيا وطلعت معاه ريحة الامونيا.
		Mousy	Phenylketonuria
		Burnt sugar	Maple syrup urine disease
Deposits	None	Crystals, salts or cells	Blood clots, necrotic tissues and urinary stones
Reaction (pH)	4.6 - 7.0	Acidic	ketosis (diabetes mellitus & starvation), severe diarrhea, metabolic and respiratory acidosis, excessive ingestion of meat and certain fruits
		Alkaline	Respiratory and metabolic alkalosis, Urinary tract infection, Vegetarians

CHEMICAL PROPERTIES OF URINE (IMPORTANT):

PARAMETER	NORMAL	ABNORMAL	POSSIBLE CAUSES
Protein	< 200mg/day	Proteinuria	Nephrotic syndrome, glomerulonephritis,, multiple myeloma, lower UTI, tumors or stones
Glucose	None	Glucosuria	Uncontrolled DM, gestational diabetes, Fanconi's syndrome
Ketones	None	Ketonuria	Diabetic ketoacidosis, Glycogen storage disease, starvation, Prolonged vomiting, Unbalanced diet: high fat & Low CHO diet
Nitrite	None	Detected	UTI
Bilirubin	None	Detected	Hepatic and post-hepatic jaundice
Urobilinogen	*Normal Trace (1mg/dl)*	> 2 mg/dl	Jaundice
Blood	None	Hematuria	Acute & chronic glomerulonephritis, *Trauma , cystitis , renal calculi and tumors,* Bleeding disorders *(Hemophilia).*
		Hemoglobinuria	Hemoglobinopathies, Malaria, Transfusion reaction *(Blood Incompatibility)*

* They can give us the physical and chemical characteristics and ask us to write the differential diagnosis, or vice versa.

PROTEIN:

- Normally **less than 200 mg protein** is excreted in the urine. daily
- more than this level leads to a condition called **"Proteinuria".**

	Glomerular proteinuria	Tubular proteinuria
Due to:	↑ glomerular permeability Which leads to filtration proteins	↓ tubular reabsorption with **normal** glomerular permeability Which leads to excretion of proteins.
	Filtration of high molecular weight proteins.	**Excretion of low molecular weight proteins.**
e.g.	glomerulonephritis	chronic nephritis

NEPHROTIC SYNDROME:

❖ **Clinical manifestations:**

Large amounts of protein are lost in the urine → hypoproteinaemia develops.

Increase protein excretion in urine can be one of the following two types:

High molecular weight protein excretion:

Glomerular proteinuria due to increase glomerular permeability leading to filtration of high molecular weight proteins.

low molecular weight protein excretion:

Tubular proteinuria due to decrease reabsorption with normal glomerular permeability.

URINALYSIS (USING DIPSTICK)

❖ Principle:

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

- **Function:** They provide quick determination of **pH**, **protein**, **glucose**, **ketones**, **urobilinogen**, **bilirubin**, **blood**, **hemoglobin**, **nitrite**, and **specific gravity**. The depth of color produced relates to the *concentration of the substance in urine*.

- Color controls are provided **against** which the actual color produced by the urine sample can be compared .The reaction times of the impregnated chemicals are **standardized**.

❖ Procedure:

Dip the strip in the urine sample provided then remove it immediately.

Remove the excess urine and keep the strip in a horizontal position.

Read the color produced within 30-60 seconds (Color changes after more than 2 minutes are of no significance).

Match the color changes to the color scale provided.

Give a full report about:

- Physical examination.
- Chemical examination.

CASE I

12-year-old girl, a known patient with T1DM, presented to Emergency drowsy with short history of vomiting and abdominal pain. On examination:

- Tachycardia
- Tachypnea with a fruity smell of breath.
- BP: 85/50 mmHg (Ref range: 100/66-135/85 mmHg)
- Blood sugar: 26.7 mmol/L (Ref range: 3.9-5.6 mmol/L)
- HbA1C: 9.9% (Ref range: 5.7-6.4%)
- Blood pH: 7.1 (Ref range: 7.35–7.45)
- Circulating Ketone bodies: positive

A mid stream Urine sample was collected for complete urinalysis.

Diabetic with ketonuria (diabetic ketoacidosis)

Important characteristics:

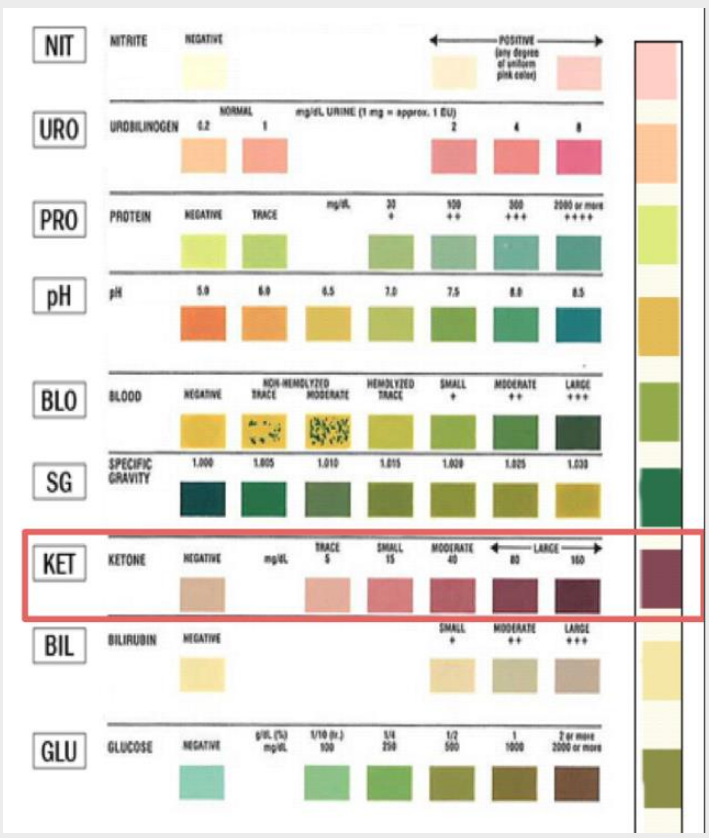
❖ **What are the Physical Properties of Urine.?**

Polyuria, Fruity Odor, Acidic PH, colorless
(usually the rest are normal)

❖ **What are the Chemical Properties of urine?**

Ketonuria, Glucosuria
elevated amount of keton and glucose in urine .
(usually the rest are normal)

Usually under 25 years patient
with type I diabetes When there
is no enough Insulin, the patient
can not use the glucose as a fuel
so the body breaks down fat
instead, lead to acid (ketones) build up.



CASE II

- **A 49-old woman came to hospital with fever, weakness and dysuria (pain during urination) for the last three days.**
- **The results of her laboratory tests were as the table below.**
- **A mid stream Urine sample was collected for complete urinalysis.**
- **Microscopic examination of urine showed:-**
  - **WBCs: over 100/HPF (Ref range: 2-3/HPF)**
  - **RBCs: 10 /HPF (Ref range: 0-2/HPF)**

Test	Result	Reference range
Fasting blood glucose	5.0	3.9-5.8 mmol/L
Creatinine	75	55-120 mmol/L
Urea	3.7	2.5-6.4 mmol/L
Sodium	140	135-145 mmol/L
Potassium	3.9	3.5-5.1 mmol/L

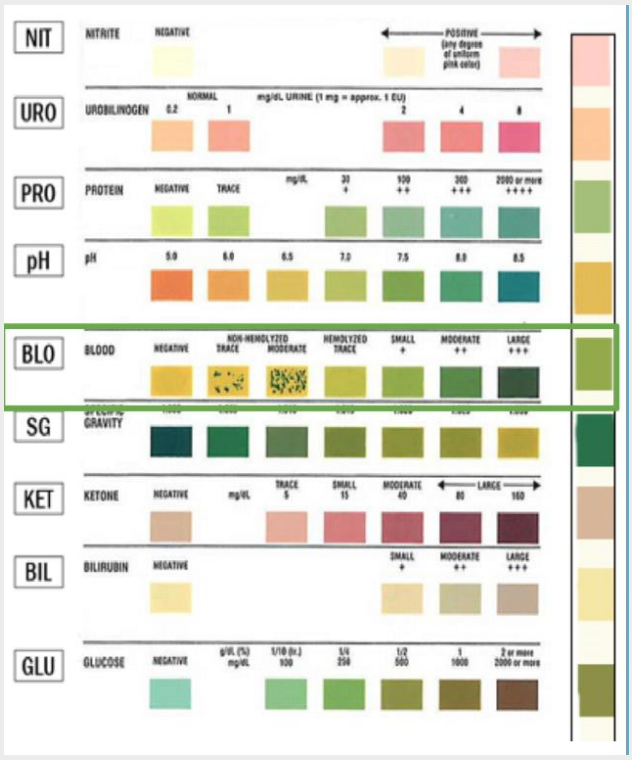
UTI

Important characteristics:

❖ **What are the Physical Properties of Urine?**
(Alklaine, cloudy) (usually the rest are normal)

❖ **What are the Chemical Properties of urine?**
(Proteinuria, Hematuria, Nitrate detected)
(usually the rest are normal)

UTI patients usually have:
1-Pain or a burning feeling during urination.
2 -a feeling of urgency.
3 -feeling the need to urinate frequently.
4-an altered appearance of the urine, either bloody (red) or cloudy.
5-pain or pressure in the rectum.



CASE III

❖ **A 6-year-old boy, developed marked edema over a period of few days. His mother had noted puffiness around the eyes, characteristically in the morning. She also noted that his urine had become frothy. His general practitioner ordered the following investigations (in the table below):**

A mid stream Urine sample was collected for complete urinalysis.

Test	Result	Reference range
creatinine	58	55-120 mmol/L
Urea	3.4	2.5-6.4 mmol/L
Sodium	136	135-145 mmol/L
Potassium	4.0	3.5-5.1 mmol/L
Total Protein	34	60-80 g/L
Albumin	14	35-50 gmL
Cholesterol	11	3.2-5.2 mmol/L
Triglycerides	1.5	0.5-2.27 mmol/L

Nephrotic Syndrome

Important characteristics:

What are the physical properties of urine?

Frothy urine.

(usually the rest are normal)

❖ **What are the Chemical Properties of urine?**

Heavy proteinuria.

(usually the rest are normal)

❖ **Nephrotic syndrome is a kidney disease with:**

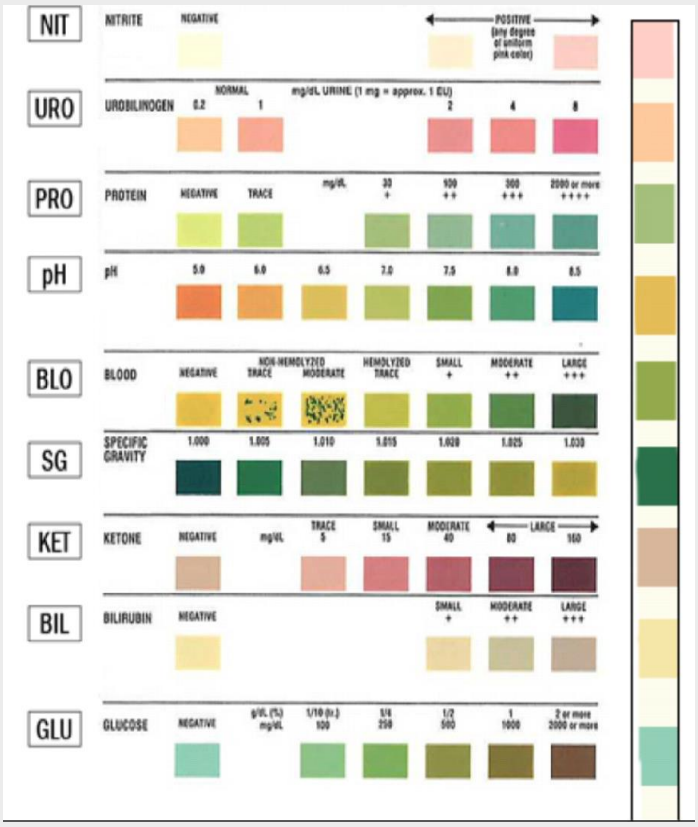
- Proteinuria
- Hypoalbuminemia
- Edema
- Hyperlipidemia
- Hypercholesterolemia

❖ **Symptoms:**

1-Frothy urine

2-Puffiness around the eye

3- Edema



Summary of SOME diseases:		
Disease:	**Physical appearance:**	**Chemical appearance:**
Diabetes insipidus:	1-polyuria. 2- Clear appearance. 3- colorless. 4-Hyposthenuria (low specific gravity).	
Diabetes mellitus:	1-Polyuria. 2- Clear appearance. 3- colorless. 4- increase specific gravity. 5-Fruity odor.	1- Glucosuria. 2- Ketonuria.
Dehydration:	1- Oliguria. 2-Orange color. 3- Hypersthenuria (High specific gravity).	
Urinary tract infection:	1-Cloudy appearance. 2- Alkaline.	1-Nitrate. 2- Hematuria (cystitis). 3-Proteinuria (Lower UTI).
Excessive fluid intake:	1-Polyuria. 2-colorless. 3-Low specific gravity.	
Tumor:	Red	1-Blood. 2-Protein.
Malaria:	Dark brown-black color.	Hemoglobinuria.
Glomerulonephritis:	Smoky color.	1-Proteinuria. 2- Hematuria.
Starvation:	Acidic urine.	Ketonuria.

CHECK YOUR UNDERSTANDING!

- **Describe the physical properties of a urine sample that has been taken from a diabetic insipidus patient:**
  - Low specific gravity.
  - Clear appearance.
  - Colorless.

- **Describe the chemical and physical properties of jaundice patients?**
  - Urobilinogen – yellow to green color of urine.

- **Describe the properties of urine sample of patient has renal failure?**
  - **Chronic renal failure:** 1-polyuria. 2-colorless.
  - **Acute renal failure:** oliguria.

- **24-old healthy male doesn't drink water for 24 h . what do expect of his urine sample?**
  - He's dehydrated → 1-oliguria. 2-orange color. 3-High specific gravity.

- **Abnormality of a urine sample of a patient with multiple myeloma:**
  - Proteinuria.

- **Describe the properties of urine sample has been taken from patient with UTI:**
  - **Physical properties:** 1-cloudy appearance. 2-Alkaline.
  - **Chemical properties:** 1-Nitrate. 2-Blood. (in case of cystitis).

- **"Dark to black urine" indicates which disease?**
  - Alkapturia.

- **The most likely diagnosis of a patient who has Mousy odor of his urine is:**

Phenylketonuria.

Best wishes in your exams!

Done by:

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