

# **Urinalysis (UA)**

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**Medical biochemistry 2022-2023**

# Intended learning outcomes



**Outline the importance of urine samples**

**Describe the collection of urine samples**

**Describe urine examinations**

# Urine samples

**Urine:** is a biological fluid responsible for removal of **waste products** of metabolism and other **toxic substances** from blood through urinary system.



# Urine samples

**Human urine** is mainly composed of **shed cells, debris,** and **secreted components** from the urinary tract as well as **blood components** that have passed through glomerular filtration and renal tubule reabsorption.

Therefore, urine contains useful information not only regarding the kidney and urinary tract, but also about more distant organs

# Urine samples

**Compared with plasma,** urine has unique advantages that make it a suitable source for both physiological research and disease biomarker discovery.



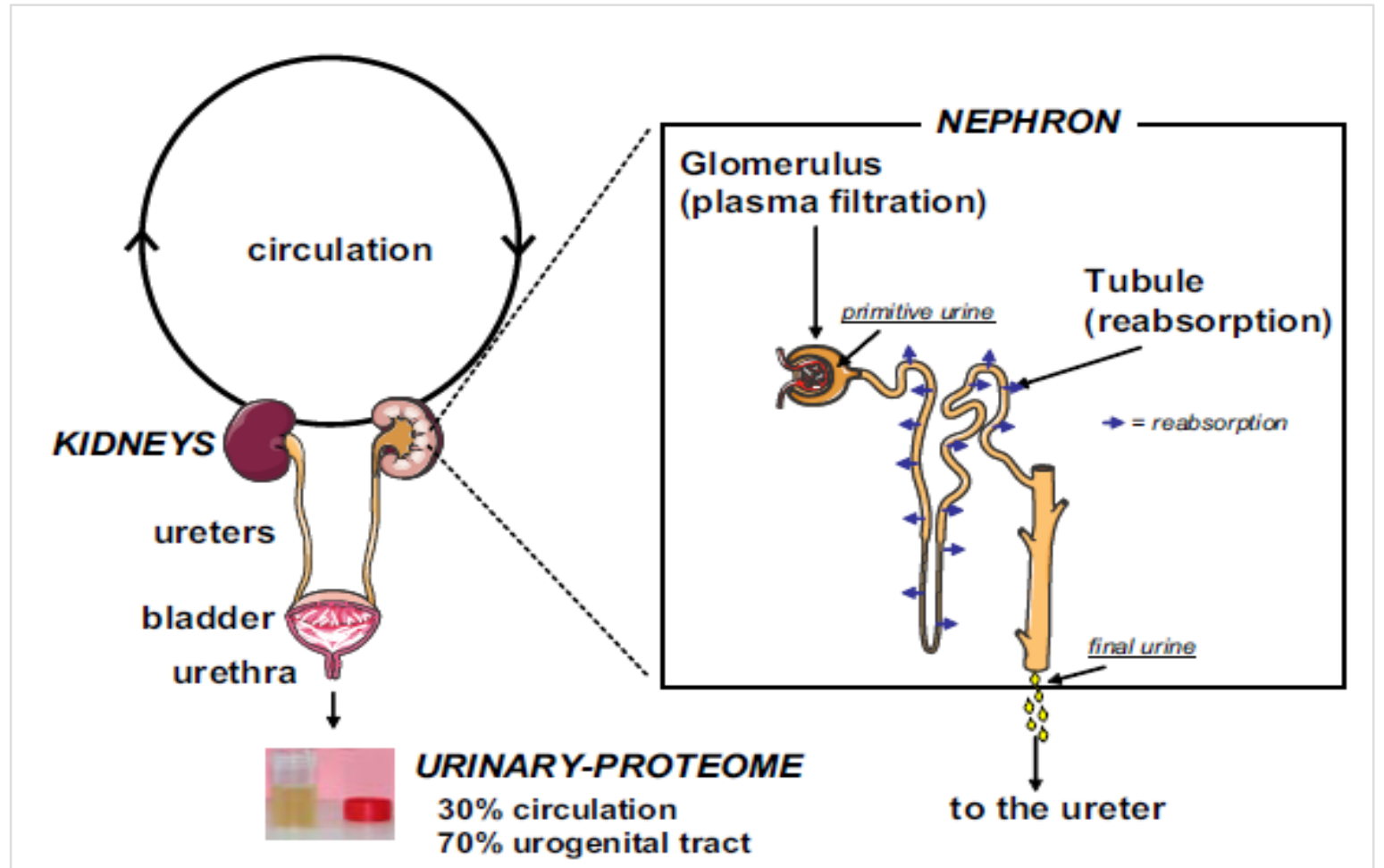
# Urine samples

**For example,**

- **Urine can be obtained non-invasively and in large quantities**
- **Changes in the urinary proteome directly reflect changes of the urinary system**
- **Because the urinary proteome contains a number of plasma proteins, some changes of plasma proteome can also be found in urine**

# Urine samples

## Urine Production



# Collection of urine sample

## ❖ **First morning voiding**

Used for:

- ✓ **Routine examination**
- ✓ **Fasting Glucose**
- ✓ **Protein**
- ✓ **Nitrite**
- ✓ **Pregnancy test**
- ✓ **Microscopic analysis of cellular elements**
- ✓ **Orthostatic proteinuria**
- ✓ **Bacteriological analysis**



# Collection of urine sample

## ❖ **The Random Specimen**

- **Can be collected at any point of time**
- **Routine examination**

## ❖ **Post-prandial specimen**

- **Collected two hours after a meal in the afternoon**
- **Insulin therapy monitoring in Diabetes Mellitus**
- **Urobilinogen**

# Collection of urine sample

## ❖ 24 –hour-specimen

used for quantitative estimation of:

Protein

Hormones

- Urine should be freshly collected into a clean, dry container
- It must be analysed within one hour to avoid bacterial contamination that can change the pH of urine and results in cast degeneration and cellular lysis

# Physical examination: Volume

**The 24 hrs average urine output 600 to 2000 ml (adult)**

## ➤ **Polyuria**

- More than 2000 ml per day
- Occurs in Diabetes Mellitus, Diabetes Insipidus , Chronic renal failure, diuretic therapy.

## ➤ **Oliguria**

- Less than 400 ml per day
- Febrile states, acute glomerulonephritis, congestive cardiac failure, dehydration

## ➤ **Anuria**

- Less than 100 ml per day
- Acute tubular necrosis, acute glomerulonephritis, complete urinary tract obstruction by stones

# Physical examination: Color and appearance

- Normal color in a fresh state is pale yellow or amber due to urochromes
- Depending on state of hydration, urine may be colorless (over hydration) or dark yellow (dehydration)
- Normal freshly voided urine is clear in appearance
- Foamy urine occurs in presence of excess proteins or bilirubin.

# Physical examination: Color

Different colours of urine	Found in
colorless	Dilute urine(diabetes mellitus, diabetes insipidus,
red	Haematuria , hemoglobinuria, porphyria, myoglobinuria
Dark brown to black	Alkaptonuria, melanoma
brown	hemoglobinuria
yellow	Concentrated urine
Yellow green or green	biliverdin
Deep yellow with yellow foam	bilirubin
Orange or orange brown	Urobilinogen, porphobilinogen
Milky white	chyluria
Red or orange fluorescence with UV light	porphyria

# Physical examination: Odor

- ❖ **Odor** is of a little diagnostic significance. The characteristic pungent odor of urine is due to presence of volatile aromatic acids
  - **Urinary tract infection (UTI) - a noxious, fecal smell**
  - **Diabetes mellitus - fruity odor due to ketones**

# Physical examination: pH

- ❖ **pH** this test must be performed on fresh samples.
- ❖ Normally it is **5-7**
- ❖ It might be change due to diet or drugs

Acidity of urine is caused by:

- **Phosphate salts with  $\text{Na}^+$  ,  $\text{K}^+$  ,  $\text{Ca}^{++}$  and  $\text{NH}_4^+$**
- **Nonvolatile metabolic acids (pyruvate, lactate and citrate)**

# Physical examination: pH

Renal tubules are responsible for acid base balance of the blood by  $\text{Na}^+/\text{H}^+$  exchange pump mechanism

- Acid urine  $< 5$  is seen in systemic acidosis
- Alkaline urine is seen in UTI



# Chemical examination:

- a. Point of care tests: Dipstick or reagent semi-quantitative strips
- b. Confirmatory test: specific quantitative tests

*In chemical urine analysis, we measure the following:*

1. **Glucose:** normally absent in urine, but increase in DM and some cases of pregnancy

# Chemical examination:

**2. Ketones:** they are the products of fatty tissue metabolism

(acetone, acetoacetate and  $\beta$ -hydroxy butyrate). They appear in urine in cases of diabetic ketoacidosis or starvation

**3. Protein:** normally the urine contains  $<30$  mg/ 24 hours. Its of two types, Tamm-Horsfall glycoprotein or albumin

# Chemical examination:

Proteinuria, is the presence of significant amount of protein

>300mg/ 24hours, mostly albumin. It can also occur when

macromolecules appear in urine due to increased glomerular

permeability

# Chemical examination:

**4. Nitrite** : it is a semi-quantitative test done by reduction of nitrate to nitrite by bacterial enzymes, **increase in bacterial infection**

**5. Leukocyte esterase** : it is an enzyme present in WBCs, **increase in pyuria** (pus cells in urine)

# Chemical examination:

**6. Bilirubin/urobilinogen:** normal urine contains no bilirubin and small amount of urobilinogen

A **fresh urine sample** is required because bilirubin is unstable when exposed to light and room temperature that may oxidized to biliveridin which gives a false negative result

**Bilirubinuria** (H<sub>2</sub>O soluble) occurs in hepatitis or biliary obstruction

**Increase in urobilinogen** in urine occurs in hepatitis or RBCs

haemolysis

# Chemical examination:

**7. Hb/ blood :** Haematuria is the presence of blood in urine whether intact or lysed RBCs. Its causes are:

- Renal stone
- UTI
- Renal tract injury
- Renal tract tumor

THANK YOU !

ANY QUESTIONS ??

PLEASE ASK