[lecture 2]

Chemical Examination of Urine

Biochemistry Team

Teams

The Objectives

- Introduction
- Normal composition of urine
- Abnormal composition of urine
- Proteinuria:
  - Pre-renal (multiple myeloma)
  - Renal
  - Post-renal
- Glycosuria: fructosuria, galactosuria
- Ketonuria
- Hematuria: hemoglobinuria

Red = Import-ant

Blue = explain

Green = addition notes

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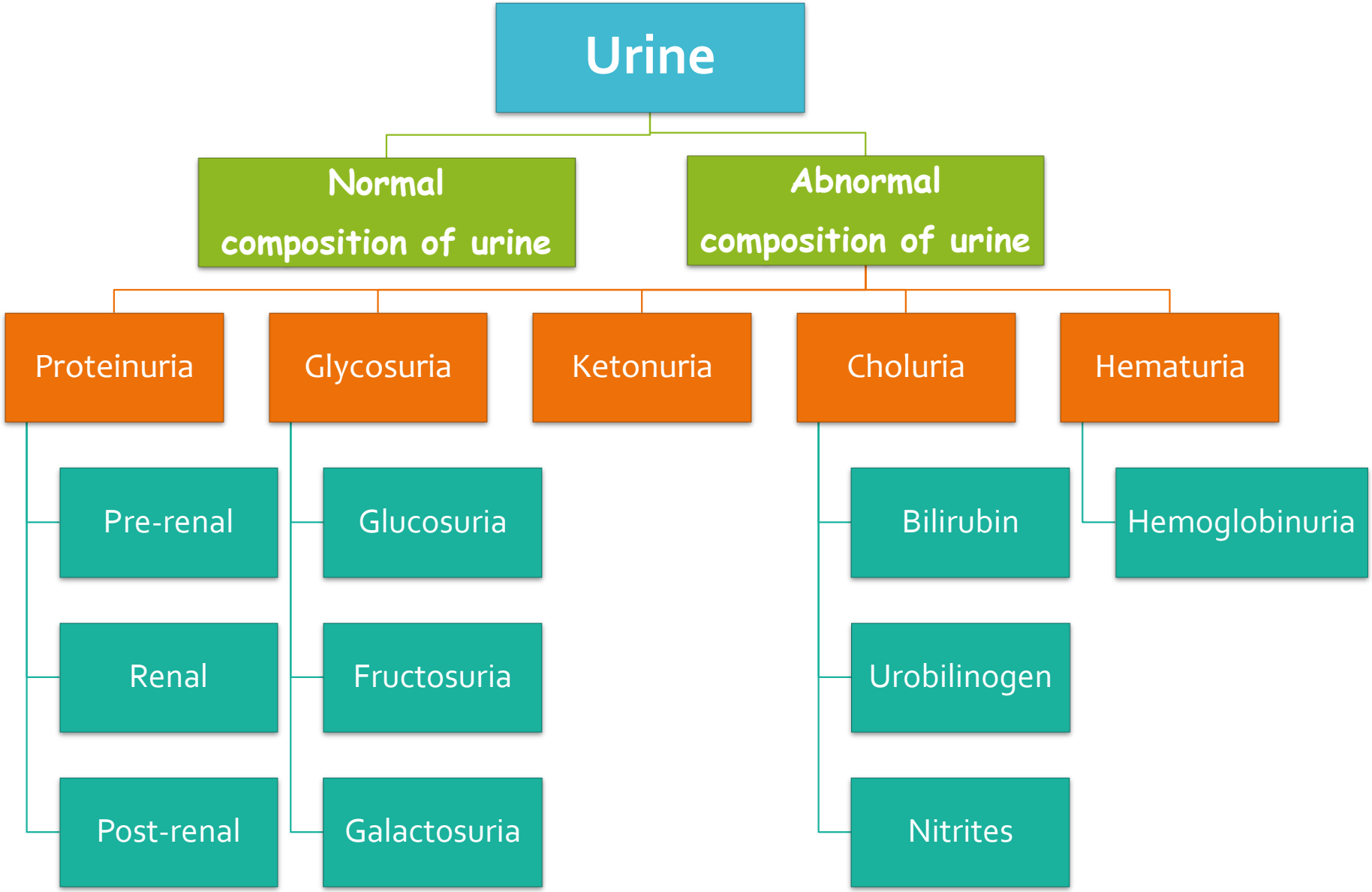
.. Mind Map ..


Urine
Normal composition of urine
Abnormal composition of urine
Proteinuria
Glycosuria
Ketonuria
Choluria
Hematuria
Pre-renal
Renal
Post-renal
Glucosuria
Fructosuria
Galactosuria
Bilirubin
Urobilinogen
Nitrites
Hemoglobinuria

Urine..

- **Urine is a fluid excreted by most animals including humans**
- **It is formed in the kidneys (renal glomeruli)**
- **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**

Normal composition of urine..

Urine contains organic and inorganic constituents:

- Major inorganic constituents:
  - Sodium.
  - Potassium.
  - Chloride.
  - Small amounts of Ca, Mg, sulfur and phosphates.
  - Traces of Fe, Cu, Zn, I.
- Major organic constituents:
  - Non-protein nitrogen (NPN) compounds.
  - Organic acids.
  - Sugars (normal amount).
  - Traces of proteins, vitamins, hormones, pigments.

Abnormal composition of urine..

Proteins:

- Normal urine contains small amount of protein:
  - < 200 mg/day
- Excretion of more than this level causes proteinuria

Proteinuria:

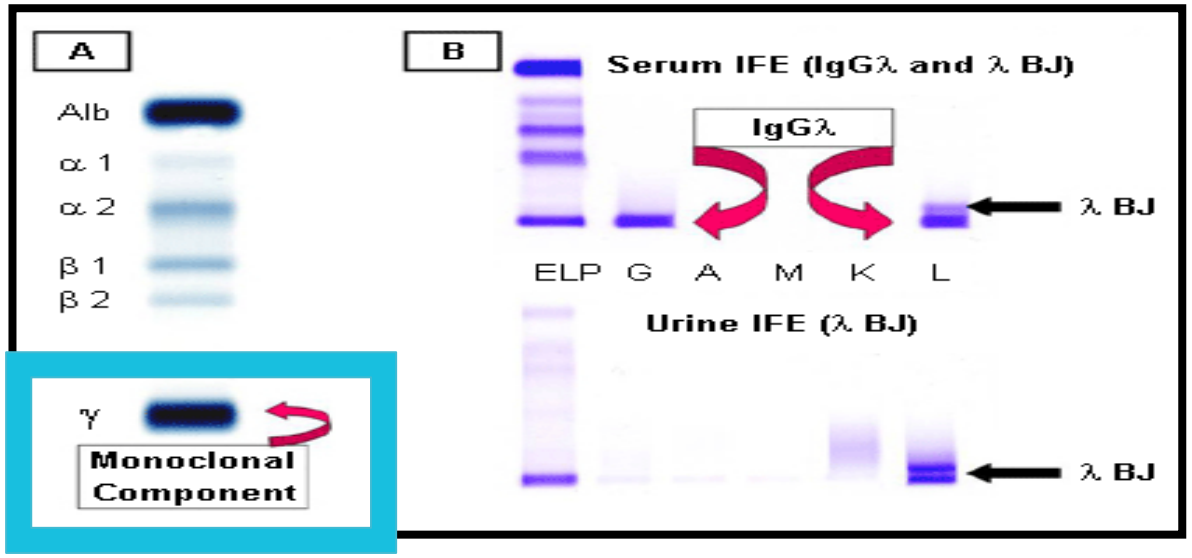
- Excretion of abnormal amounts of protein in urine
- Proteinuria has three types:
  - Pre-renal
  - Renal
  - Post-renal

	Pre-renal proteinuria..	Renal proteinuria..	Post-renal proteinuria..
Location of the disease	**Some diseases or conditions increase plasma protein levels not involving the kidneys.**	***Associated with renal disease "kidneys"***	**Proteins are added to the urine after kidney filtration.**
Properties	• **Causes increased filtration of these proteins in the kidneys → exceeds the normal reabsorptive capacity of renal tubules → overflow of proteins in the urine.**	**FOUR TYPES:** **1- Glomerular proteinuria:** • **High glomerular permeability → filtration of high molecular weight proteins** **2- Tubular proteinuria:** • **Low tubular reabsorption with normal glomerular permeability → excretion of low mol. wt. proteins** **3- Orthostatic (postural) proteinuria: (ortho:stright) , (static: position)** • **A form of benign or physiological proteinuria** • **Occurs frequently in young adults due to periods spent in a vertical posture (body position) or during muscular exercise** • **Disappears in horizontal posture** **4-Microalbuminuria:** • **Presence of small amounts of albumin in the urine** ○ 20–200 mg/L • **Cannot be detected by ordinary urine testing, needs special tests for detection.**	**Proteins are added to the urine while passing through the lower urinary tract (ureters, bladder, urethra, prostate, vagina).**
Due to	**1- Multiple myeloma (a disease):** ➢**Cancer of the antibody-producing plasma cells.** "The serum contains elevated levels of light-chain monoclonal antibodies called **Bence-Jones protein** → filtered in the kidneys in high amounts → Exceeding the tubular reabsorption capacity → Hence excreted in the urine" ➢ **Bence-Jones protein coagulates at 40–60 °C and dissolves at 100 °C (old way for diagnosis).**	**1- Glomerular proteinuria due to:** Glomerulonephritis **2- Tubular proteinuria due to:** Chronic nephritis **3- Orthostatic (postural) proteinuria due to:** Increased pressure on the renal vein in the vertical position causes orthostatic proteinuria. **4-Microalbuminuria :** Early indicator of glomerular dysfunction due to: ○ Uncontrolled diabetes mellitus ○ Hypertension	**1- Lower urinary tract infection (because the infection leads to tissue damage)** **2- Trauma** **3- Tumors** **4- Stones**

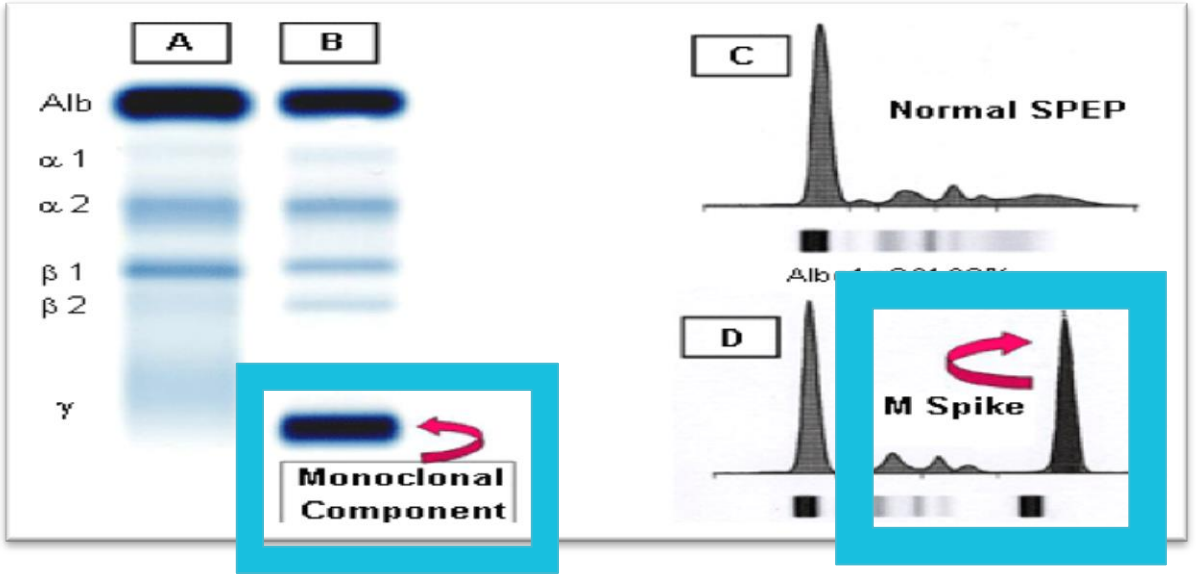
electrophoresis : migration of a mixture of substances in electrical felid and depends on (charge-shape-size) of the molecule.

.. Multiple myeloma ..

- ***Multiple myeloma cases are diagnosed by:***
  - Serum electrophoresis.
  - Immunoelectrophoresis.



A: Serum protein electrophoresis showing the M component.
B: Serum and urine immunofixation electrophoresis.



A: Normal serum.
B: Multiple myeloma (M component in g region).
C: Densitometry of "A". – NORMAL -
D: Densitometry of "B" (M component is called M Spike).

Glycosuria..

Presence of sugar in urine.

Glucosuria:

Presence of detectable amount of glucose in urine.

- **Due to diabetes mellitus: = Hyperglycemia**
  - Plasma glucose level exceeds the renal threshold.
- **Due to renal disease (renal glucosuria): = NON-Hyperglycemia**
  - Normal plasma glucose level with proximal tubular malfunction.

  (Glucose here is ok but the renal tubules have a problem so, they don't reabsorbed the glucose then, it is execrated in the urine.)
  - Decreased renal threshold as observed in gestational(=pregnancy) diabetes and Fanconi's syndrome.(=abnormal in renal tubules reabsorption).

Fructosuria:

Presence of fructose in urine.

- **Nutritional cause:**
  - High fructose intake.
- **Metabolic cause:**
  - Low fructokinase or aldolase B in the liver.

Galactosuria:

Presence of galactose in urine.

- **Nutritional cause:**
  - high galactose intake.
- **Metabolic cause:**
  - Low galactokinase or galactose -1-PO_4 uridyl transferase in the liver.

Ketonuria..

Presence of ketones, acetone, acetoacetic acid and β-hydroxybutyric acid in urine. = (أنواع الكيتون)

- **Due to:**
  - Diabetic ketoacidosis.(DKA)
  - Starvation. في حالة الجوع والجسم لايوجد به جلوكوز ولا دهون يلجأالجسم لتكسير الكيتون في الدم حتى يوفر طاقة
  - Dietary imbalance: high fat and low CHO diet.

    عند نقصان تناول الكربوهيدرات يلجأ الجسم ايضا لتكسير الكيتون في الدم لكي يوفر طاقة
  - Phenylketonuria (PKU).

Choluria..

Presence of bile, bilirubin and bile salts in urine.

Bilirubin:

normally no billirubin is detected in urine.

- **It is detected in:**
  - Hepatocellular (liver) damage.
  - Obstruction of bile duct due to stones (extrahepatic) and hepatic tumors (intrahepatic).

Urobilinogen:

normally present in trace amounts.

- **High urobilinogen is found in:**
  - Hemolytic anemia.
  - Hepatocellular damage.

Nitrites:

Positive nitrite test indicates bacteria in urine

يصنع Bilirubin في الكبد لهذا السبب أي شي يضر أو يأثر على الكبد يسبب لنا Choluria سواء كان

Intra or Extra - hepatic

Hematuria..

Presence of detectable amount of blood in urine.

- **Due to:**
  - Acute / chronic glomerulonephritis.
  - Local disorders of kidney and genito-urinary tract.
    - Trauma, cystitis, renal calculi, tumors
  - Bleeding disorders.
    - Hemophilia.

Hemoglobinuria:

Presence of hemolysed blood in urine .

- **Due to:**
  - Hemoglobinopathies.
    - Sickle cell anemia.
    - Thalassemia.
  - Malaria.
  - Transfusion reaction.
    - Blood group incompatibility.

Questions

Q1: one of the following is an Abnormal composition of urine ?

A. Sodium.
B. Potassium.
C. Chloride.
D. Proteinuria.

Q2: if the serum contains elevated levels of light-chain monoclonal antibodies called Bence-Jones protein This indicated for ?

A. Multiple myeloma.
B. Glomerulonephritis.
C. chronic nephritis.
D. Fanconi's syndrome.

Q3: Positive nitrite test indicated for ?

A. Bacteria in urine.
B. Viral in urine.
C. Fungal in urine.
D. Non of them.

*Answers (D,A,A)

Biochemistry
Team

If you find any mistake, please contact us:)

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