

[lecture 1]

Kidney Function Tests



Biochemistry
Team



Teams

The Objectives

Sorry, not given to us yet =(

Red =
Important

Blue =
explain

Green =
addition
notes

- nephron is the functional unit of the kidney, performs function by ultra filtration at glomerulus and secretion and reabsorption at renal tubules.

Kidney functions

- Excretion:** waste products & foreign chemicals.
- Hormonal:** secretion of erythropoietin & activation of **vitamin D** and activation of angiotensinogen by **renin**.
- Metabolic Function:** site for **gluconeogenesis**
- Homeostatic function:** - water and electrolyte balance, acid base balance , arterial blood pressure.

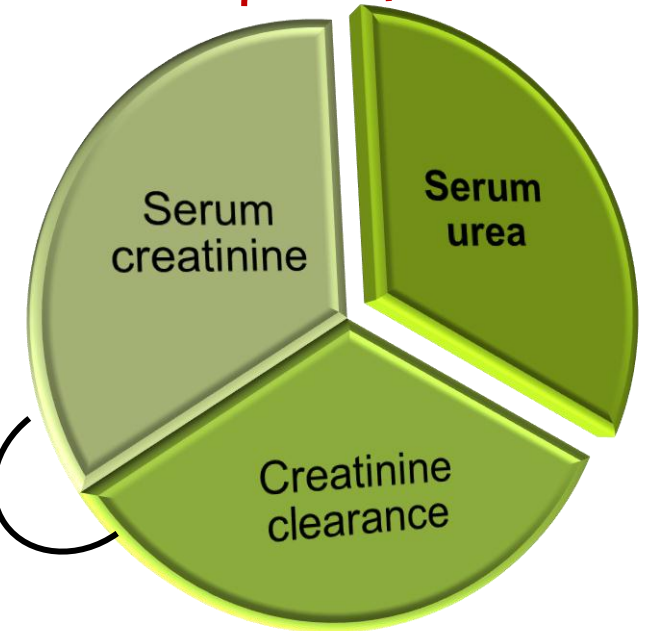
- Renal diseases might affect several functions, or there is selective impairment of glomerular function or one or more of tubular functions
- Most types of renal diseases cause destruction of complete nephron

Kidney Function Tests :

Creatinine dependent tests used to :

- Confirm the diagnosis of renal disease.
- Give an idea about the severity of the disease.
- Follow up the treatment.
(means : to check the patient repeatedly after using a high risk therapy)

Measured in the serum





Serum Creatinine

Definition	<ul style="list-style-type: none">- creatinine is the end product of creatine.- 98% of the body creatine is present in the muscles where it functions as store of high energy in the form of creatine phosphate.- 2% of creatine is converted into creatine phosphate into creatinine through the spontaneous (non enzymatic loss of water), (Normally because nothing is in a stable)
Characters	<ul style="list-style-type: none">-Filtered freely at the glomerulus (90%) and secreted by renal tubules (10 %) (considered as small amount, if more than 10% , creatinine wont be that great for testing)-not reabsorbed by the renal tubules.-Endogenous substance not affected by diet.-Remains fairly constant throughout adult life.
Normal level in blood	55 – 120 $\mu\text{mol/L}$
Normal level in Urine	0.5 – 2.0 g per 24 hours in a normal adult, varying according to muscular weight.
Indications when it is increased	<p>A good indicator of impaired renal function.</p> <p>But a normal serum creatinine does not necessarily indicate normal renal function as serum creatinine may not be elevated until GFR has been reduced be 50% of it's normal value.</p>



Serum Urea

Definition	Urea is formed in the liver from ammonia released from deamination of amino acids.
Characters	<ol style="list-style-type: none">1. 50 % or more of urea filtered at the glomerulus is passively reabsorbed by the renal tubules.2. Urea is not endogenous3. Amino Acid is converted to urea (Urea is affected by diet)4. Ammonia is toxic and can cross BBB and the person may enter a comma, so ammonia is converted to urea
Normal level in blood	2.5–6.6 mmol/L
Why it's helpless comparing to serum Creatinine ?!	<ol style="list-style-type: none">1. Increased in high protein diet. (as urea formed from amino acids)2. Any condition of ↑ proteins catabolism (Cushing syndrome, diabetes mellitus, starvation, thyrotoxicosis) → increase urea formation.3. Severe Vomitting and Diarrhea (Dehydration) leads to high Urea while <u>Serum Creatinine will be Normal</u>. Because of all these reasons; it's considered as an inferior test compared to serum creatinine.

Creatinine clearance (CC) : 1

3rd TEST :

Creatinine Clearance

Definition

Clearance : the volume of plasma cleared from the substance excreted in urine per minute

Creatinine clearance : volume of creatinine excreted from plasma in urine per minute.

The only difference between GFR and CC is the substance cleared and measured by in the test. (GFR: inuline, CC: Creatinine for sure =P)

Characters

- equals to GFR (glomerular filtration rate).
 - It detects the degree of renal impairment.
 - normal adult values : 90-140 (males) 80-125 (females)
 - usually about 110 ml/min in the 20-40 year old adults.
 - It falls slowly but progressively to about 70 ml/min in individuals over 80 years of age.
- to have an accurate measurement of clearance tests, we must choose a substance has the following characters :
- 1-Freely filtered at glomeruli.
 - 2-Neither reabsorbed nor secreted by tubules.
 - 3-Its concentration in plasma needs to remains constant throughout the period of urine collection.
 - 4-Better if the substance is present endogenously.
 - 5-Easily measured.

Creatinine has most of these criteria

Creatinine clearance (CC) : 2

How to be calculated

$$\text{Clearance (ml/min)} = \frac{U \times V}{P}$$

U = Concentration of creatinine in urine

V = Volume of urine per min

P = Concentration of creatinine in serum

measured by using a 24-hour urine collection, it's not accurate and might introduces errors. So we use another method :

Cockcroft-Gault Formula (uses constant parameters)

$$\text{GFR} = \frac{K \times (140 - \text{age}) \times \text{Body weight}}{\text{Serum creatinine } (\mu\text{mol/L})}$$

where K is a constant that varies with sex:
1.23 for male, 1.04 for females

Limitations: It should not be used if

- Serum creatinine is changing rapidly, e.g. exercises
- the diet is unusual, e.g., strict vegetarian
- Low muscle mass, e.g., muscle wasting
- Obesity

Creatinine clearance	Serum Creatinine
<ul style="list-style-type: none"> - Patients with early (minor) renal disease. - Assessment of possible kidney donors. - Detection of renal toxicity of some nephrotoxic drugs. (e.g. : chemotherapy) 	<ul style="list-style-type: none"> - creatinine is more accurate. - It's level is constant throughout adult life while creatinine clearance according to so many things (inc.

1. Which of the following tests gives a useful index of the number of functioning glomeruli?

- a) Serum creatinine
- b) Creatine clearance
- c) Serum urea

2. Which of the following is true about serum creatinine?

- a) It is more than serum urea
- b) It is affected by diet
- c) It is not reabsorbed by renal tubules

3. Which test is the most accurate?

- A) Serum creatinine
- b) Creatinine clearance
- c) Serum urea

4. patient with dehydration ,vomiting ,and diarrhea .. With normal serum Creatinine, but increased Serum Urea ... does it indicate renal impairment ?

- No . But because of loose of fluid "this question mentioned by DR. Amr"

5. Increased serum creatinine indicate which of the following ?

- a) indicate impaired renal function.
- b) normal renal function.

6. What does decreased creatinine clearance indicates ?

- a) indicate impaired renal function.
- b) normal renal function.





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If you find any mistake, please contact us:)

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