

# BIOCHEMISTRY PART 2

DONE BY : SUHA AL SARHAN 

## Function :

- ❖ Creatine forms creatine phosphate ( phosphagen) which is the main storage form of energy in the cells .  
لہ منجہ ان ATP کن بتسعتی اسرع من ان ATP  
یعنی جراث انشاء ان muscular exercise ان یلون بستوللہا سرعتہ دیکول پی ADP
- ❖ During muscular exercise, ATP is consumed rapidly to ADP. ATP is formed quickly at the expense of creatine phosphate by reversal of the CPK reaction. This occurs before glycoysis starts to produce ATP. i.e. maintain ATP during 1<sup>st</sup> few minutes of muscle contraction.

Creatine kinase catalyzes



دائی بسعتی ہ۔ high energy phosphate  
گولہ ان ان ADP وگولہ ان ATP ہوا creatine phosphate  
لیتہ ما ان glycolysis تبتہ گولہ ان ATP لہہ خطواتہا کترہ ویدہا وقتہ ...

## FATE AND EXCRETION

- Creatine phosphate spontaneously and irreversibly loses Phosphate, forming creatinine. Creatine itself loses water to form the Same product but at a Slower rate.
- The two reactions result in the steady production of a Constant amount of creatinine that is proportional to the total amount of phosphocreatine + creatine in the body, which is in turn proportional to the muscle mass of the organism.
- The creatinine formed goes via the blood to the kidneys to be excreted in the urine.

- The plasma creatinine level varies between **0.6- 1.2 mg/dl.**, depending on muscle bulk (higher in males than in females).

- Higher levels are Observed in renal failure.

renal failure ← معناته في retention لا شيء كثير ومن فهموا ان creatinine

- Creatinine is excreted in the urine in an amount that is directly proportional to the muscle mass, averaging 1.5 g/day in males and 1.0 g/day in females.

creatinine → more accurate the urea

لان ال creatinine ما يتأثر باللال

لكن معن بعضكم يحكي

معن احنا ناكل كور وهاي الكور ال muscle fiber بتعوا فيها نسبة creatine وبالتالي انا دخلت على جسمي creatine وبع لاي ال creatinine ونزداد نسبة ال creatinine وبالتالي ال creatinine معن يتاخر في اللال

له صح الكور اللى بناكلها فيها نسبة creatine (لأنها مهمة ما روح تابع في نسبة ال creatinine في الجسم)

So for kidney function test → urea لأنه من ال creatinine أحسن من ال  
ها بتأثر في الأكل ...

لكن ال creatinine بحد ذاته من accurate أوي !!

لأنه كخيل مثلاً أنت بتبرعن بكليّة لحد ، أو لا قدر الله حد صار عنده مرض وطوره كليّة يا تامل  
نبة ال serum creatinine مع فصل normal

حتى لو عايش ينص كليّة

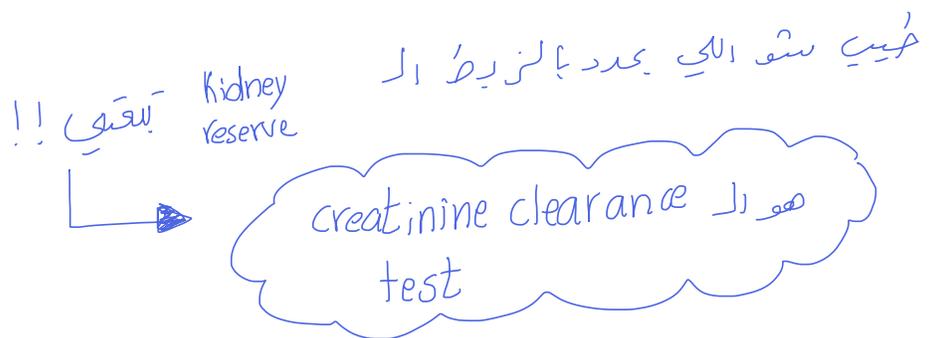
يرفع ال serum creatinine بعد ما يكونوا ال اربع أنصاهم تبعت اللية توقفت عن العمل

لو كان عندي normal urea and normal creatinine  
معناه عندي normal kidney function



مش معناها انه ال kidney reserve كاملة  
و مش معناها انه ال اربع أنصاهم متغالين بأفاد  
ليه !!

رنة ال serum creatinine مع فصل نورفال حتى لو أنت عايش بر نص كليّة



\* لو تخيرنا بين ال urea و ال creatinine كأدق test for kidney function

بنضار ال creatinine

\* لكن ال serum creatinine هو حد ذاته مش دقيق و ما بلمشني على ال kidney reserve

## II. Organic Acids

### A. Oxalic acid

- Urinary oxalic acid is **mostly exogenous**, being derived **from foods** containing oxalates (spinach, artichokes, tomatoes, strawberries, mangoes, apricots and peaches). A **small part** is **endogenous**, being derived from the **metabolism of glycine** or from the **metabolism of ascorbic acid**. → vit C
- Very small amounts of oxalates are normally excreted in the urine (10 - 30 mg/day), mostly in the form of calcium oxalate.
- Increased urinary oxalates (hyperoxaluria) may be dietary, due to the ingestion of foods rich in oxalates or the intake of large amounts of vitamin C. It also occurs in an **error in glycine metabolism** called "**primary hyperoxaluria**".
- Hyperoxaluria leads to the formation of calcium oxalate stones in the renal tract.

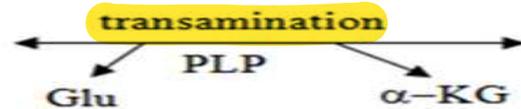
له هاي اكهوان لو تانب bilateral دايبة  
مع تدخل المريضة في renal failure

\* امشلة تكون في 1 metabolism of glyoxylic acid

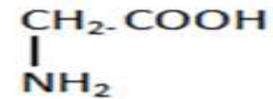
# Fate of glyoxylic acid

قابل لتفاعل reversible

glyoxylic acid

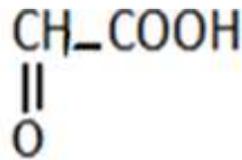


Glycine



[2] transamination to glycine

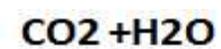
glyoxylic acid



Formic acid



O

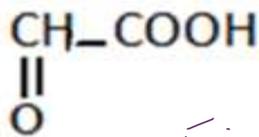


[1] oxidative decarboxylation

نزل  $\text{O}_2$  و خرج  $\text{CO}_2$

in primary hyperoxaluria  
 يكون عندهم امشلة في هاي الكبد  
 decreased metabolism of glyoxylic acid

glyoxylic acid



O



due to defect in

[1] oxidative decarb

urine

[2] او من عارفين زوجه  
 تاتي اي glycine

problem in the rate of transamination of glyoxylic acid

حتى احافنا  
 على نسبة تبقته  
 متوازنة في الجسم  
 لازم نصرفه  
 عن طريق

لما تكون كميتها كبيرة  
 يتحول الي oxidized oxalic acid

## Primary hyperoxaluria:

- Congenital disease caused by decreased metabolism of glyoxylic acid either by oxidative decarboxylation to formic acid or transamination to glycine .
- Accumulated glyoxylic acid is oxidized to oxalic acid. There is excretion of large amounts of oxalate in urine. [Oxalate reacts with calcium forming the insoluble Ca-Oxalate that leads to the formation of Ca-Oxalate stones in the urinary tract.

## B. Lactic acid

- Lactic acid is the end product of glycolysis in erythrocytes and in muscles during exercise. It mostly goes to the liver where it becomes converted to glucose. Little lactic acid is excreted in the urine (50-200 mg / day).

by gluconeogenesis

anaerobic

## C. Citric acid

- The citric acid in urine is mostly derived from [intermediary metabolism]. Some citric acid is excreted in the urine 200-1200 mg/day.

## D. Ketone bodies:

- The ketone bodies include acetone, acetoacetic acid, and  $\beta$ -hydroxybutyric acid. They are formed in the liver as intermediates in the metabolism of fatty acids. Small amounts of ketone bodies (less than 15 mg/day on an average diet, and up to 100 mg/day on a high fat diet), mostly  $\beta$  - hydroxybutyric acid, are excreted in the urine. Their excretion markedly increases in ketosis.

*in uncontrolled  
diabetes mellitus patient*

## E. Hippuric Acid

- [Hippuric acid] is the product of detoxication of benzoic acid, by conjugation with glycine. Benzoic acid is present in many fruits and vegetables, especially in plums and prunes. It is used as preservative in some food products, such as jams and ketchup. It also results from the action of intestinal bacteria on phenylalanine. The amount of hippuric acid excreted in the urine is related to the dietary intake of benzoic acid as well as to intestinal putrefaction. It normally ranges between 0.1 and 1.0 g/day.

### III. Sugars

tests قديمة ولا تستخدم حالياً ، وغير مهم حفظهم (أمرأؤهم وانسؤهم)

- Normally not more than 1 g of sugars is excreted in the urine per day. they cannot be detected by the ordinary tests of **Fehling** and **Benedict**. The chief sugar is **glucuronic acid** (about 0.5 g/day). which is present in urine conjugated with [xenobiotics]. In addition, smaller quantities of glucose , lactose, and L-arabinose may be present in urine.

- *Xenobiotics are foreign organic substances, which are substances not normally metabolized in the body. Xenobiotics of medical importance include drugs, toxins, food additives.*

L- arabinose → sugars exceptions من ال exceptions ال sugars

يعرف انه ال sugars في جسمنا الهم على شكل D-form  
عند ال L-arabinase يتون L-form

L- arabinose is an aldopentose presents in some  
fruits

وإذا أكلنا كميات كبيرة من هاي الفواكه ربح يكون ال L-arabinose  
عالي في ال urine وتسبب هاي الحالة

Alimentary pentosuria

# IV. Proteins

- Urine of normal subjects contains small amounts of **glycoproteins**, which are derived from the **mucous glands of the renal tract**. Tracts of albumin ( $< 30 \text{ mg /day}$ ) are excreted in urine. [They cannot be detected by the heat coagulation test.]

لـ لو حيت urine sample حطيتها في tube  
وسخنت ال tube من ناحية ال  
لوفيه بروئين رح تلاقى ال urine اللي قريب من الفتحة حصلوا  
و بين زي الكفتن ( يتجلط ) ...

\*) المفروض كمية البروتين النورمال قليلة فلما اسخن ال urine ما ح يحصل  
heat coagulation



# ABNORMAL CONSTITUENTS

## I. Proteinuria :

- This is the presence of detectable amounts of proteins in the urine. It may be:

### A Prerenal Proteinuria

...امشلة من في الكلية...

1. Albuminuria: This occurs in heart failure due to increased renal venous pressure.
2. Bence Jones Proteinuria: this is an abnormal globulin, composed of light chains only, formed by malignant plasma cells (multiple myeloma). It precipitates at 60°C, redissolves at 100 C, and reprecipitates on cooling.

the normal globulin →  
contain heavy and light chains

بينما هوون يكون abnormal وفيه فقط light chains.

3. Myoglobinuria: Myoglobinuria occurs in [crush syndrome] and in [myocardial infarction] due to release of myoglobin from crushed skeletal muscles and heart, respectively.
4. Hemoglobinuria: Hemoglobin appears in the blood plasma and in the urine if intravascular hemolysis occurs, e.g., in hemolytic anemia and in malaria.

albuminuria ← تسمى

## B-Renal Proteinuria

المسئلة في الكلية

- This is due to kidney affection. Albumin, having a higher plasma concentration and a lower molecular weight, appears in the urine in higher concentrations than globulins, and hence the name albuminuria.
1. False Albuminuria (Functional Albuminuria):
    - This is not pathological; no organic lesion is detectable in the kidneys. It is intermittent, occurring only when the renal venous pressure increases, e.g., during muscular exercise and on assumption of the erect posture (orthostatic), and disappears on lying down. Thus, it is absent in the morning sample, and only present in the day samples.

## 2. Microalbuminuria: [very important]

- Albumin is detected by ordinary tests only if urinary albumin exceeds 200 mg/d. Levels between 20 and 200 mg/L, called microalbuminuria, can only be detected by special tests. It is an early sign of glomerular affection in uncontrolled diabetes mellitus.

## 3. True Albuminuria :

- This is pathological. It is more commonly due to lesions of the renal glomeruli (glomerulonephritis and nephrosis) than lesions of the renal tubules (pyelonephritis).

## B-Postrenal Proteinuria

- This is caused by inflammation, tumors, or stones of the renal tract, leading to the secretion of mucus and the passage of blood (albumin, globulins, and hemoglobin) in the urine.

## II. Glycosuria:

- This term has long been used to indicate the presence of detectable amounts of [glucose] in the urine. More properly, it should be used to indicate the presence of [any sugar] in the urine, these include glucose, fructose, galactose, pentoses, or lactose.

### III. Chyluria

- Chyluria is the presence of absorbed fat (chylomicrons) in the urine. It rarely follows the ingestion of large amounts of fats, particularly in severe diabetic patients (decreased clearance of chylomicrons and VLDL due to decreased activity of lipoprotein lipase),
- it may also be caused by an abnormal connection between the intestinal lymphatics and the urinary tract. This may be congenital and may be caused by filariasis. The urine acquires a milky appearance that disappears upon shaking with ether.

## IV. Choluria

- Choluria is the appearance of bile in the urine. It includes:
  1. **Bilirubin and Bile Salts:** Bilirubin and bile salts appear in the urine in **obstructive Jaundice**, due to obstruction of the biliary passages and regurgitation of bile into the blood
  2. **Urobilinogen:** Urobilinogen is normally present in the urine in very small amounts (less than 4 mg/day). It markedly **increases hemolytic jaundice.**

## V. Ketonuria

- Ketonuria is the presence of detectable amounts of ketone bodies in the urine.