The topic of the lecture :

1) To talk about urine concentration and the affect of **ADH**

2) urea water cycle

*** Formation of urine**

***** filtration → re - absorption → secretion

*****The key for **re - absorption** is **sodium handling**

Note when the **sodium** enter the **capillary** it carry with it **electrolytes** .

* **Afferent** arteriole takes the blood to → glomerular capillary → "**filtration** " by the **4** net filtration forces → the filtrate fluid continue in the proximal convoluted tubule in the proximal convoluted tubules in the first half of the **P.C.T** it absorbs :

1. (Na+ , glucose , Co – transport) .

2. (Na + , amino acid Co- transport) .

3. (Na-H counter transport) .

((100% of the filtrated **glucose** is re - absorbed))

((100% of he filtrated **amino acid** is re - absorbed))

→in the second half → **Na*** and **Cl** re - absorption → the filtrate will continue to the loop of the **Henle**

#**NOTE** : As long as the filtrate is in the PCT it absorbs Na and other solutes but only if water is reabsorbed with it "absorbing solutes is related to absorbing H2O".....the resulting filtrate that moves to loop of henle is so osmotic.

The difference between osmolarity and tonicity :-

osmolarity : the concentration of **salts** in the solution (تركيز الأملاح في المحلول)

and when solution is the **blood plasma** we called it "**tonicity**"

 # osmolarity and tonicity: both indicate to the amount of the salt in a solution , but When this solution is the blood plasma it's **tonicity**

tonicity : the **osmolarity** of the plasma when **RBCs** floating in the plasma.

** IF the **osmolarity** of the any solution :

1. equal the **osmolarity** of the plasma (tonicity) we call it (isotonic) .

2. more than the plasma we call it hypertonic .

3. less than the plasma we call it hypotonic .

Continues to formation of urine :

*the **filtrate** will reach the **descending limp** of loop of **HENLE.**

Note :

the **descending** loop of **HENLE** is composed of **epithelium** cells and it's highly permeable to water , because it contain aquaporins **1** , and impermeable to solutes (أملاح)

→ so the osmolarity is increasing gradually → then it reaches the point between

the **last** part of the **descending** and the **first** part of the **ascending limp and starts to gradually get lower** → in the thin part of the ascending limb of loop **HENLE** we have chloride **re - absorption** followed by passive sodium **re – absorption** → this **ascending** limp is impermeable for water but permeable to solutes so the osmolarity is **decreasing** by the activity of sodium **potasium** , 2 **chloride** pump , and this is followed by :

1) bicarbonate **re – absorption**

2) calcium **re – absorption**

3) magnesium **re – absorption**

All of these are **electrolytes** which are absorbed , so the osmolarity is **decreasing** gradually .

Then ,the **DCT** is separated functionally to two halfs :

1) the proximal one which has same structure but with more **sodium** and **chloride** **re – absorption**

2) the other late one , it contain two types of the cell :

A) A)principle cells , they secret potassium-hydrogen ... potassium is secreted to blood and hydrogen is secreted to lumen

B) intercalated cell (**IC**) : function : it contains **H-pump**

* it pumps the **H*** from the blood to the lumen

Those cell are needed in **acid – base balance** :-

1) If I want to get rid of the extra hydrogen → in the proximal conveluted tubule +**sodium** – **hydrogen** counter transport → in the principle cell → **potassium – hydrogen** counter → **potassium** secretion and hydrogen absorption → in the interrelated cell Hydrogen pump which is primary active transport working against electrochemical gradient and using energy to secrete hydrogen

after the **DST** → the urine enter the collecting duct .

Note : "THE one collecting duct maybe linked with more than one nephron → by the **DCT**

revision to understanding :

There are two type of nephron
1) cortical nephron
2) juxtamedullary nephron

SO
the collecting duct has **two** part :
1) cortical collecting duct
2) medullary collecting duct

***** In the collecting duct there a site inside it "**receptors**" for antidiuretic hormone → this
hormone is secreted from the **posterior** loop of **pituitary** gland
*****This hormone helps in the formation of concentrated **URINE** .
Then this hormone bind with the receptor in the collecting duct and stimulate the collecting duct secrete **aquaporins 2** which increase the expressure → increase the formation of **aquaporins** in the cell of **DCT** → water re – absorption occur

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OBLIGATORY WATER RE – ABSORPTION

NOTE :
In the proximal convoluted tubule **65**% of the water **re – absorbed** there , this amount of the water called obligatory , then according to the **hydration** , the human condition ' thiroty or not thirsty → ' the water will be **re -absorbed** this amount of water called facultative water **re – absorption** , depending of the level of the ADH hormone , or in another word , depending on the **hydration** of the person .
 # The urine is formed #
1) If the person is well **hydrated** , your body will not make concentrated urine (diluted urine) → especially in winter

2) If the fasting " **not well hydrated** " your body will excrete poisons and waste product with less concentration of water it called "hyperosmolar urine " → this case especially in summer.

HOW THE KIDNEY CONCENTRATE THE URINE ??

the peritubular capillary branch in the medulla to **vasa recta** and supply **juxtamedullary** nephron with blood that circulate in slow motion and low pressure.

* The stimulus for making concentrated urine is " **blood volume decreasing** " antidiuretic hormone is secreted → go to the DCT → then to the collecting duct and open the channels of aquaporins to increase water **re - absorption .**

NOTE :

The water will not **re -absorbed** just for opening the aquaporins channel , it want osmotic pressure in the medullary interstitial " **hyperosmotic** " , and what the **osmolarity** is **ascending** limb of the loop of the **HENLE** .

So , for concentrated urine we needed few factors :-

1) counter current mutiblier → caused by long loop of **HENLE** of the juxtamedullary nephron (it is **U** shaped and the fluid inside it move in two different ways ⇅ and both are parallel to each other and close ….)

So , after making the medullary interstitial hyperosmotic → the fluid move from the **collecting duct** → medullary interstitial → re-absorbed

*** vasa recta** is not responsible for the hyper osmolarity of the medullary interstitial. It just keep it by saving (keeping) **HENLE** loop .

NOTE :

Vasa recta capillaries work in a way similar to loop of **HENLE** ,in the **descending** part it makes **Na - wate**r counter transport , in the **ascending** part it throws the solutes into the **medullary ISF** and reabsorb water secreted by the collecting duct

2) The interstitial , it called "**counter current exchange** "

هاي النقطة مهمة بvasa recta

3) UREA CYCLE

الاشي المهم المتعلق فيها هو solvent drag

* the urea is a free substance in the blood → it is filtrated in the glomerular capillary it has a small coefficient but high osmotic activity

* as a result → proximal convoluted tubule → descending limb of loop of henle ascending limp of loop of the **HENLE** → **DCT** → medullary and collecting duct water **re - absorption** by the aquaporins and **hyperosmolarity** taking with it the urea

بهاي المرحلة urea تتسكع ما بتدخل على الدم .

* the urea hanging in the medullary interstitial → it will make **hyperosmolarity** → it go to the ascending limb of loop of the **HENLE** → active secretion for it anther time (ffrom medullary interstitial to the filtrate again)

* **ascending limb** of loop of the **HENLE** → to **DCT** → collecting duct → **re – absorbed** → hanging in the medullary interstitial → active secretion …..and so on .

حيث انها تقابل الـ urea اللي بالدورة الثانيه
" يعاد امتصاص urea مع الماء في collecting duct "
هي free filtrated ما حدا بعمل إلها re -absorption
ما في free بكمل لـ segments ما عدا الـcollecting duct
هناك بصير اشي اسمه solvent drag

solvent drag : water combined by urea (**Water and urea re – absorption**)

بعدين الـ urea بتضل تتسكع بالـmedullary interstitial
عشان تساهم بـ hyperosmolarity of medullary interstitial
بعدين بزيد اعادة امتصاص الماء وبعديها بصير لهاي urea
ب الجزء النحيف من انبوب الصاعد active secretion ويتقابل الـ urea اللي ترشح عشان تدخل بالدورة إللي بعديها ....وهكذا ....

#ملاحظة مهمة : مش كل **urea** بصيير الها **re- absorption**

* when they sympathetic stimulation is worked → and in mild sympathetic stimulation the efferent arteriole will be vaso constriction → big filtration → increase glomerular capillary hydrostatic pressure → increase GFR → big filtration but less activity so
→ concentrated urine mechanism well start :-
* in the efferent arterioles → small amount of the blood → slow blood slow speed to vasa recta keep the hyperosmolarity of medullary interstitial

دور الـ anti diuretics hormone
* أقل كميه urine يخرجها الجسم 0.5 L بالحالة الطبيعية ....أقل كمية H2O ممكن يذوب فيها WASTE

* less amount of urine in the normal person 0.5 L
* there is a limit for the osmolarity tell it reach 1200

نسأل الله العظيم أن نكون أوفيناكم حقكم من العلم .كان معكم زملائكم :
التبيض :تسنيم الرواشدة , لينا محمود.
الحوسبة: أحمد معايطة
التدقيق: يوسف حاتم الطراونة ,سُلاف المعايطة
التنسيق : فراس أحمد .
#لجنة تبييض 2018
#لجنة_الطب_والجراحة