



Renal Block

Physiology Team

## 4th Lecture

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# Tubular reabsorption

**This Lecture is Done By :**

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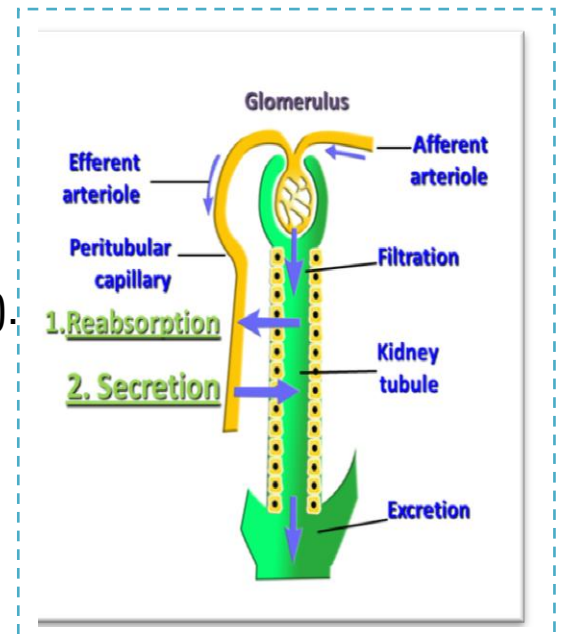
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## ❖ The Nephron :

### Parts of Nephron

- Glomerulus.
- Proximal Convoluted Tubule (in cortex).
- Loop of Henle ( in medulla ).
- Distal Convoluted Tubule ( in cortex ).
- Collecting Duct (in medulla).



## ❖ Calculations :

### a. Tubular reabsorption or secretion from renal clearances

Quantity Filtrated = **P<sub>x</sub> x GFR**

Quantity Excreted = **U<sub>x</sub> x V**

**P<sub>x</sub>**: Substance in plasma

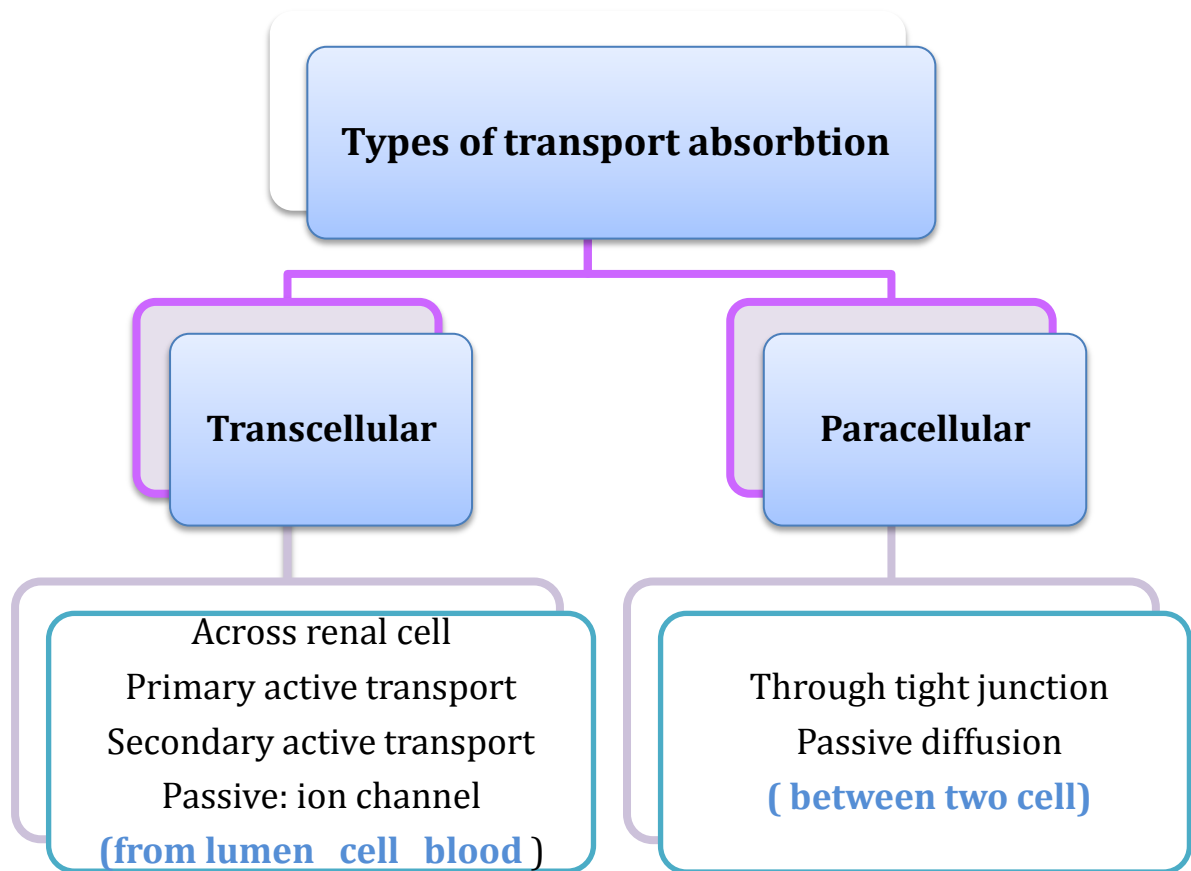
**U<sub>x</sub>**: Concentration of Substance in urine

Reabsorption or secretion = **Quantity Filtrated - Quantity excreted**

(Renal transport) **T<sub>x</sub> = GFR x P<sub>x</sub> - U<sub>x</sub>V ( filtered - Excreted )**

<b><u>T<sub>x</sub> = 0</u></b>	<b><u>T<sub>x</sub> = positive</u></b>	<b><u>T<sub>x</sub> = negative</u></b>
GFR x P <sub>x</sub> = U <sub>x</sub> V <b>Filtered not reabsorbed Or secreted</b>	GFR x P <sub>x</sub> > U <sub>x</sub> V <b>Filtered and absorbed</b>	GFR x P <sub>x</sub> < U <sub>x</sub> V <b>Filtered and secreted</b>
e.g. Inulin	e.g. glucose	e.g. PAH - creatinine

## ❖ Types of transport absorption :



## ❖ Proximal Convoluted Tubule (PCT) :

High capacity for reabsorption :

- Special tubular epithelial cell
- Metabolically active (lot of mitochondria)
- Brush border (↑surface area)
- Tight junction is not so tight ( to Allow passive diffusion )
- Contain a lot of protein carrier (for transportation)

## The cells

- Simple cuboidal cells with brush border Highly permeable to water and many solutes.

## Substances absorbed in PCT :

Tubular re-absorption	Secretion
☆Sodium (most important cation )	☆ <b>PAH</b>
☆Chloride (most important soluble )	☆ <b>H<sup>+</sup></b>
☆Urea	☆ <b>K</b>
☆Glucose ☆Water ☆Amino acid	
Bicarbonate ☆Phosphate	

## ❖ Sodium Reabsorption

- 65-70% of filtered sodium is reabsorbed in PCT.
- Followed by water & chloride .
- **Iso-osmotic** absorption (equal quantity of solute & water).
- Na absorption is Important for ?  
**the absorption of (Glucose - Amino acids – phosphates)**

## Mechanism of sodium reabsorption:

### 1. Basolateral membrane (apical membrane) :

a)  $\text{Na}^+/\text{K}^+$  ATPase ( Active transport ) :

- 3 Na / 2 K  
( pump out renal cell/ in peritubular)
- K leak out of the cell

b) Results in :

- Low intracellular Na Concentration
- high peritubular osmolality

### 2. Na enter the cell passively following :

- a. Electrical difference (inside the cell -70mv, lumen -4mv)
- b. Na concentration differences (140 mEq/L to 12mEq/L)

12mEq/L: NA in THE CELL  
140 mEq/L : NA in PLASMA  
(LUMEN)

### 3. Na enter the cell across the luminal membrane: (2ndry active)

- a. Cotransport with glucose, amino acids
- b. Na in exchange H (counter transport)
- c. Na channel

## ❖ Chloride Reabsorption:

Cl reabsorbed down concentration gradient following the positively charge Na (passive).

## ❖ Water Reabsorption:

- 60-70% of filtered water is reabsorped in PCT → Active pump of Na from renal cell to peritubular space results in increases the osmolality of peritubular space → Drag water by osmosis → Filterate remain iso-osmotic (~equal quantity of water & solute are absorbed) .

## ❖ Glomerulo – tubular balance:

- **Feed back mechanism** to keep a fixed percentage of reabsorbed glomerular filtrate normal (60%)
- The higher the filtration in the glomerulus → the higher oncotic (osmotic ) pressure in efferent & peritubular capillaries → ↑ reabsorption in PCT.

## ❖ Glucose Reabsorption :

- In healthy adult all filtered glucose is reabsorbed and no glucose will appear in urine
- If plasma glucose (PG) level reach 200 mg/dl, glucose appear in the urine – this level is the “**Renal threshold**” :
  - ( 200mg/dl in arterial - 180 mg/dl in venous)

- The amount of reabsorbed glucose at very high filtered glucose, **remains constant**, this is called **tubular transport maximum for glucose (TmG)= 375 mg/min** (female 300mg/min)
- At this maximum transport, all the glucose carriers are saturated and no more glucose can be transported

### Mechanism of Glucose reabsorption :

- Secondary active transport ( depend on Na , K)
- Luminal membrane : Cotransport with Na
- Basolateral membrane : GLUT 1 & 2 (GLUT = glucose transport )

### ❖ Amino acid reabsorption :

- All filtered AAs are reabsorbed in PCT
- Luminal membrane : Cotransport with Na
- Basolateral membrane : diffusion

## QUIZ

- ♠ Plasma Na concentration = 140 mEq/L
- ♠ GFR (inulin clearance) = 125 ml/min
- ♠ Urine flow rate = 1 ml/min
- ♠ Urine concentration of Na= 70 mEq/L

**Calculate the amount of Na transported ??**