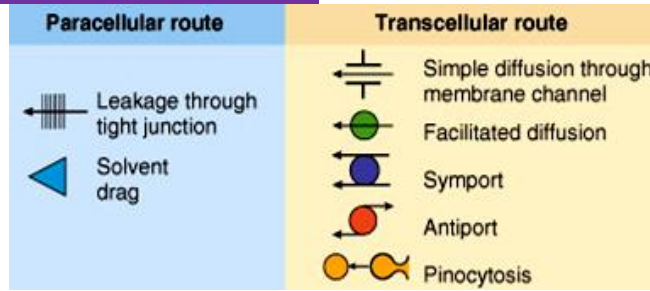


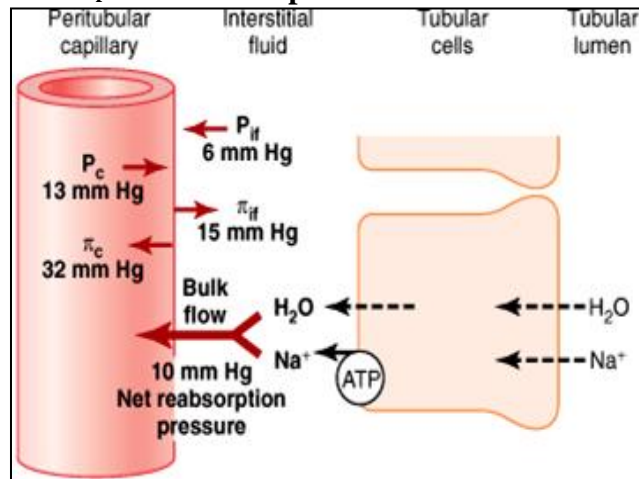


Mechanisms of tubular reabsorption:

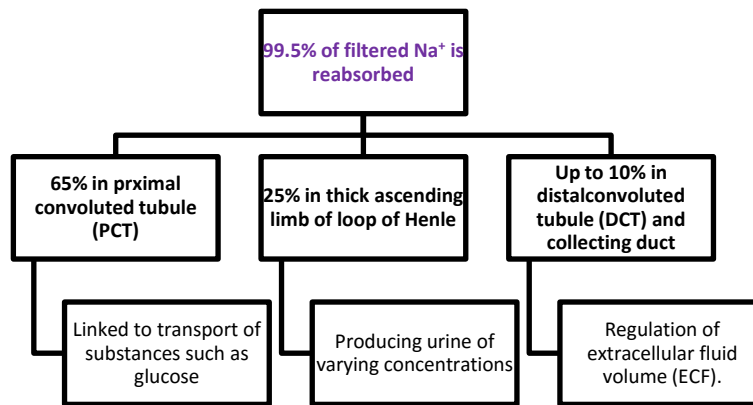


Dynamics of reabsorption by peritubular capillaries:

- $\text{Reabsorption} = K_f \cdot \text{Net reabsorptive force}$



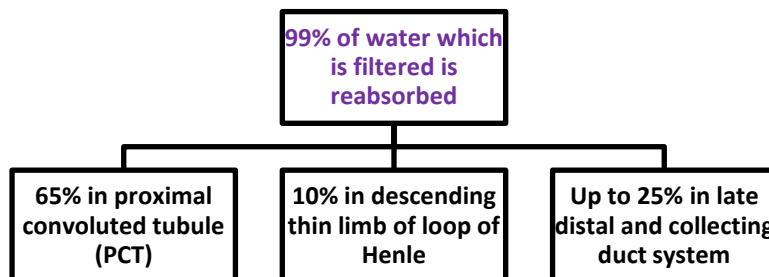
Sodium reabsorption along the tubule:



Driving forces for Na⁺ reabsorption:

- ✓ Na⁺ diffuse across basolateral membrane by Na⁺-K⁺ pump.
- ✓ Na⁺ diffuses across luminal membrane into the cell according to electrochemical gradient established by Na⁺-K⁺ pump.

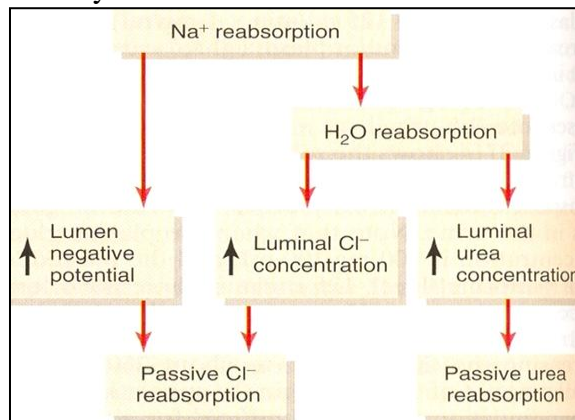
Water reabsorption along the tubule:





- Proximal Convolved Tubule (PCT):

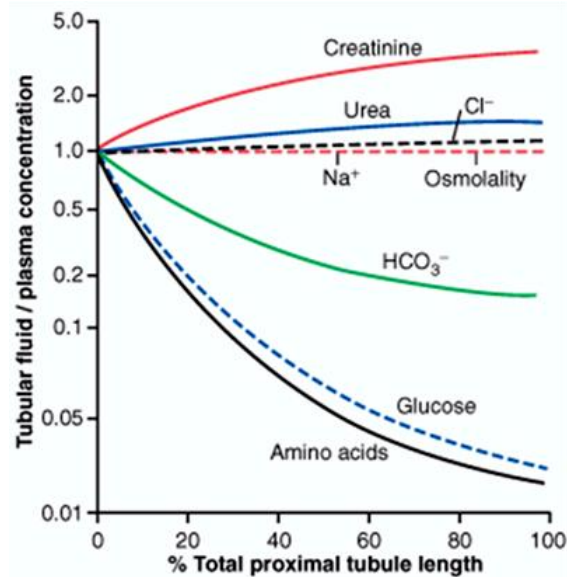
- **Na⁺ reabsorption:**
 - ✓ Early proximal tubule: co-transport with nutrients at luminal membrane.
 - ✓ Late proximal tubule: mainly reabsorbed with Cl⁻
- **Water reabsorption:**
 - ✓ Proximal convoluted tubule is highly permeable to water.
 - ✓ Water reabsorption is driven by osmotic gradient (sodium reabsorption is followed by water) through:
 - ❖ Water channels (aquaporin-1).
 - ❖ Tight junctions.
 - ❖ Simple diffusion.
- **Urea reabsorption:**
 - ✓ At the beginning of proximal tubule filtered urea is the same as in the plasma.
 - ✓ Notice that proximal tubule is moderately permeable to urea. Therefore, some of it will be reabsorbed.
 - ✓ In impaired kidney function: less than half of urea concentration is excreted.



- **K⁺ reabsorption:**
 - ✓ 65% of K⁺ is reabsorbed from proximal convoluted tubule.
 - ✓ Paracellular reabsorption of K⁺ is represented by:
 - ❖ Solvent drag (with water).
 - ❖ Electro-diffusion.
- **Glucose and amino acid reabsorption:**
 - ✓ This is done by secondary active transport:
 - ❖ At luminal membrane, through sodium-glucose co-transport (SGLT).
 - ❖ Crossing basolateral membrane through glucose transporters (GLUTs).
 - ✓ Tubular maximum-glucose reabsorption:
 - ❖ Glucose at a normal plasma level is completely reabsorbed in proximal tubule by Na⁺-glucose co-transport.
 - ❖ At plasma glucose of nearly 200 mg/dL → glucosuria begins (threshold). Glucosuria is an important clinical clue to diabetes mellitus.
 - ❖ At nearly 375 mg/dL → all transporters are fully saturated (T_m).
 - ❖ In normal pregnancy there is decreased reabsorption of glucose and amino acids in the proximal tubule leading to glucosuria and aminoaciduria.
- **Phosphate reabsorption:**
 - ✓ Mainly in the early segment of proximal tubule.
 - ✓ There are two distinct families of sodium-dependent phosphate transporters:
 - ❖ NaPi-II.
 - ❖ PiT-II.
 - ✓ Notice that parathyroid hormone decreases phosphate reabsorption in early segment of proximal convoluted tubule.

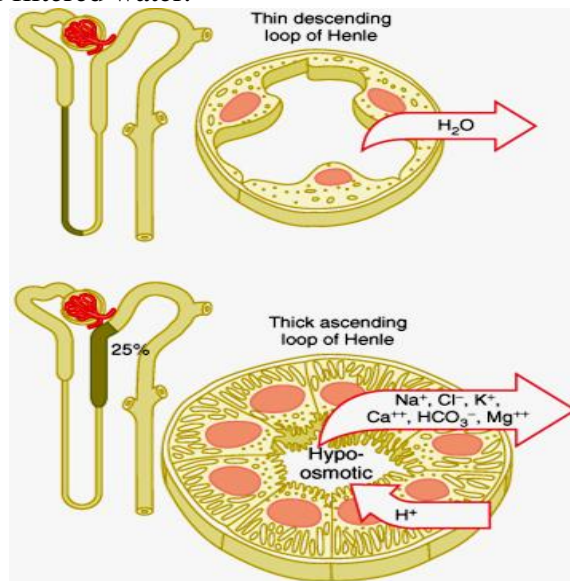


- **Concentrations in proximal tubule fluid:**



- **Loop of Henle:**

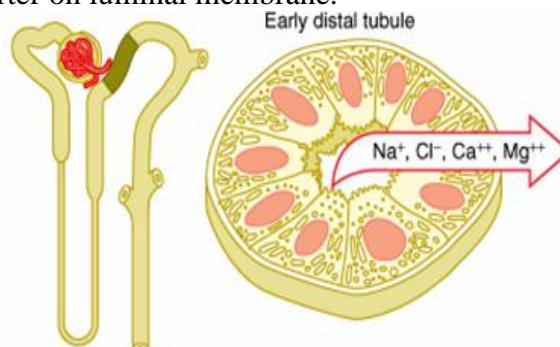
- 25% reabsorption of filtered Na⁺ in thick ascending limb
- There is secretion of H⁺ in exchange with Na⁺
- Characterized by the presence of Na⁺-2Cl⁻-K⁺ symporter.
- 50% paracellular reabsorption of Na⁺ and other cations.
- 10% reabsorption of filtered water.



- **Distal Convoluted Tubule (DCT):**

- **Early distal tubule reabsorption:**

- ✓ It is impermeable to water.
- ✓ Reabsorption of 5% of filtered NaCl.
- ✓ Na⁺-Cl⁻ symporter on luminal membrane.





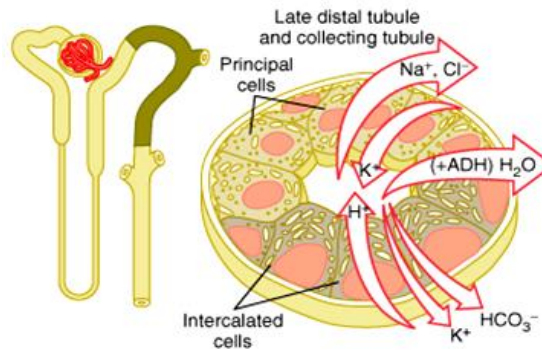
- **Late distal tubule and cortical collecting duct – hydrogen secretion**

- ✓ Intercalated cells:

- ❖ Bicarbonate reabsorption is indirect and dependent on H^+ secretion.
 - ❖ Primary active secretion of H^+ by H^+-K^+ ATPase at luminal membrane.
 - ❖ These cells have the key role in maintaining acid-base balance.

- ✓ Principle cells:

- ❖ Reabsorbing 5% of Na^+ and water and secreting K^+
 - ❖ Water reabsorption in response to antidiuretic hormone secretion (vasopressin) through insertion of aquaporin-II



- Regulation of tubular reabsorption:

- Peritubular capillary and renal ISF physical forces.
 - Changes in GFR (glomerulotubular balance).
 - Changes in tubular reabsorption rate of Na^+ in the tubules which is affected by:
 - ✓ Levels of circulating hormones.
 - ✓ Pressure-Natriuresis and Pressure-Diuresis.

- Hormonal control of tubular processing:

Hormone	Site of Action	Effects
Aldosterone	Collecting tubule and duct	↑ $NaCl$, H_2O reabsorption, ↑ K^+ secretion
Angiotensin II	Proximal tubule, thick ascending loop of Henle/distal tubule, collecting tubule	↑ $NaCl$, H_2O reabsorption, ↑ H^+ secretion
Antidiuretic hormone	Distal tubule/collecting tubule and duct	↑ H_2O reabsorption
Atrial natriuretic peptide	Distal tubule/collecting tubule and duct	↓ $NaCl$ reabsorption
Parathyroid hormone	Proximal tubule, thick ascending loop of Henle/distal tubule	↓ PO_4^{3-} reabsorption, ↑ Ca^{++} reabsorption