Lec 6

- tubular reabsorption goes through tubular lumen → tubular cells → interstitium → peritubular capillaries
- nutritional passage into peritubular capillaries is called Bulk flow & is Regulated by 6 mechanisms:
  - Glomerulotubular balance
  - Peritubular physical factors
  - Hormones
  - Sympathetic NS
  - Arterial pressure
  - osmotic factors

load = GFR × Plasma substance conc.

- tubular load is the amount of filtered Renal plasma fluid, & when load ↑ then tubular reabsorption ↑, but to a limit, then Reabsorption plateaus

* reabsorption reffers to peritubular capillaries while filtration refers to glomerular capillaries

Glomerulotubular Balance

- minimizes the changes in urine volume due to changes in GFR
- lets say GFR ↑ from 125 ml/min → 150, & there is no glomerulotubular balance ... what happens ?
  - → reabsorption stays the same (124) & urine volume ↑ from 1 to 26 ml/min
  - → b/c reabsorption didnt ↑, the % reabsorbed will ↓

* urine volume = GFR - Reabsorption

* % Reabsorbed = Reabsorption / GFR × 100

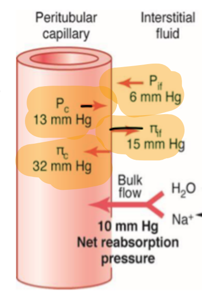
- So % reabsorbed in this case is 82.7% instead of the normal 99.2 %

- lets say GFR ↑ from 125 - 150 & we have perfect glomerulotubular balance....

↳ Reabsorption will ↑ from 124 - 148.8 & urine volume will be 1.2 ml & % Reabsorbed is 99.2 %

Peritubular Physical forces

- forces that govern peritubular reabsorption :



Capillary hydrostatic Pressure

- 13mmhg w/ direction going outside the capillary (negative pressure)

Interstitial fluid oncotic pressure

- 15 mmhg w/ direction outside the capillary (negative pressure)

Interstitial hydrostatic pressure

- 6mmhg w/ direction into the capillary (positive pressure)

Capillary oncotic pressure

- 32 mmhg w/ direction into the capillary (positive pressure)

So...

- Net Reabsorption pressure = 10 mmhg

* direction of forces are the same as bowmans capsule, but have different values

Calculating tubular Reabsorption Rate

When Excretion is less than filtration

- meaning the substance is being reabsorbed
- in order to find how much of the substance was reabsorbed, we need to find the filtration rate & excretion Rate
- Filtration Rate = GFR x Plasma conc. of substance (P_s)
  - Filtration Rate → mg/min
  - GFR → ml/min
  - Plasma conc. of substance → mg/ml
- Excretion Rate = Urine conc. of s (U_s) x Urine flow rate (V)
  - Excretion Rate → mg/min
  - U_s → mg/ml
  - V → ml/min
- then we can find Reabsorption = filtration - excretion

When Excretion is more than filtration

- meaning the substance had undergone net secretion, so we measure tubular secretion Rate

* Same equations as above then

> **Remember:**
> Filt s = GFR x Ps
> Excret s = Us x V

Secretion = Excretion - Filtration

Transport Maximum

- Some substances have a maximum transport rate due to Saturation of carriers or limited ATP
- once all nephrons reach transport maximum, an ↑ in tubular load will not be reabsorbed, & they will be excreted
- Some nephrons have a lower max than others, so the tubular load at which some nephrons exceeded their max is called

the Threshold

- at threshold, there is an ↑ in excretion of certain substance, but other nephrons can still Reabsorb this substance

✱ Threshold & transport max are related but not the same

- examples of substances w/ threshold & max: glucose, amino acids, phosphate, sulphate
- ex. if transport max is 150, but tubular load is 180, then 30mg/ml of the remaining substance will be excreted b/c all nephrons are saturated

Determinants of Peritubular Capillary Reabsorption

- to measure peritubular capillary reabsorption = net reabsorption pressure (NRP) x filtration coefficient (K_f)

$$10 \text{ mmhg} \times 12.4 \text{ ml/min/mmhg} = 124 \text{ ml/min}$$

- ↑ K_f = ↑ peritubular reabsorption
- ↑ peritubular oncotic pressure = ↑ reabsorption
- ↑ peritubular capillary hydrostatic pressure = ↓ reabsorption
- if arterial pressure ↑ → ↑ in glomerular & peritubular hydrostatic pressure → ↓ reabsorption
- ↑ resistance of afferent arteriole → ↓ renal glomerular blood flow → ↓ glomerular hydrostatic pressure → ↓ blood in peritubular capillary → ↓ peritubular hydrostatic pressure → ↑ reabsorption rate

- ↑ resistance in efferent arteriole → peritubular blood flow ↓ → peritubular hydrostatic pressure ↓ → ↑ reabsorption

Determinants of Peritubular Capillary Colloid Osmotic Pressure

- ↑ oncotic pressure → ↑ reabsorption
- oncotic pressure of peritubular capillary ↑ due to ↑ in plasma proteins or an ↑ in filtration fraction

Filtration Fraction = GFR / RPF

RPF → renal plasma flow

- Filtration fraction ↑ due to ↓ renal plasma flow or ↑ GFR