

(a) Anterior view of dissection of right kidney





\* Damage to the kidneys is irreversible; as nephrons don't undergo repair. So, after the age of 40, the number of nephrons decreases by 10% every 10 years.

But other parts of the kidney compensate for such loss.

\* After nephrectomy, a person can live just fine with one normal kidney.



\* 1/4 of cardiac output goes to renal artery. Which divides into: segemental, interlobar, then arcuate arteries.
\* Arcuate arteries bring blood to nephrons through afferent arterioles, which then bring blood to a capillary bed called glomerulus, then it coalesces into efferent arterioles, then another capillary bed called peritubular capillaries.

(Notice the presence of 2 capillary beds)

- **1 Filtration**: Blood enters the glomerulus through afferent arteriole
- **2 Reabsorption**: Blood moves from tubular part back to vascular part (peritubular capillaries)
- **3 Secretion**: Movement of some substances from peritubular capillaries to tubular part; to be eliminated.
- 4 Excretion: What's left in the tubule will be excreted through urine
- & important table

Filtration	No energy required (passive)	- Somewhat variable, but not selective. - Filtered fluid is identical in composition to plasma, except for proteins, as they can't pass, in normal conditions.	Composes 20% of renal plasma flow	2
Reabsorption	Highly variable and <b>selective (due to the</b> <b>presence of special transporters)</b> towards most electrolytes (Na <sup>+</sup> , K <sup>+</sup> , Cl-) and nutritional substances (glucose); as they're almost completely reabsorped.	While toxic substances like urea are poorly reab	3	
Secretion	Active process	Highly selective	Facilitates rapid excretion of waste products like H+ or of drugs and toxins	$\checkmark$
				Urinary excretion



Blood supply of nephron

Afferent

arteriole

Glomerular

capillaries

Bowman's

capsule

Efferent

arteriole

1. Filtration

3. Secretion

4. Excretion

Peritubular capillaries

Renal vein

2. Reabsorption



\* There a are 3 main barriers between the blood in glomerulus and the lumen of bowman's capsule :

**1. Fenestrated endothelial cells:** negatively charged and the fenestrations are limited in size.

**2. Basal lamina**: composed of negatively charged proteoglycans.

**3. Podocytes and their pedicels**: negatively charged and the pedicels make small slits that are only selective for small molecules.

All these 3 layers prevent the filtration of plasma proteins because proteins are usually large and negatively charged.





- From the kidneys urine flows down the ureters to the bladder propelled by peristaltic contraction of smooth muscle. The bladder is a balloon-like bag of smooth muscle = detrussor muscle, contraction of it empties bladder during micturition.
- Voluntary and involuntary muscle contractions.
- <u>Bladder can hold 700-800 ml</u> ( differes between males and females)
- <u>Volumes exceeding (200-400)stretch bladder walls and initiate</u> micturation reflex:
- Spinal reflex (micturition center in the spinal cord)
  Parasympathetic impulses from the spinal cord causes <u>bladder to</u> contract and the Internal urethral sphincter to relax. (In normal conditions, there is a tonic contraction).
  - Internal sphincter (smooth muscle) opens.
  - <u>Simultaneously mict. Cinhibits the external sphincter (skeletal muscle)</u> and then it relaxes. (This part can be controlled voluntary)

## Micturition



		• In all nephrons	• In all nephrons	• In all nephrons
		Filtration	reabsorption	excretion
	<u>L/day Water</u>	<u>180</u>	<u>179</u>	1
	<u>Na+</u> mmol/day	<u>25,560</u>	<u>25,410</u>	<u>150</u>
normally, there's no glucose in urine, unless pt. is diabetic ←	<u>Glucose</u> gm/day	<u>180</u>	<u>180</u>	<u>0</u>
- a byproduct of muscle excersize - no absorption - execretion might be > 1.8 due	<u>Creatinine</u> gm/day	<u>1.8</u>	<u>0</u>	<u>1.8</u>

to further secretion.



## \* <u>Na+</u> is important for maintaining homeostasis of fluids; as any increase indicates:

- increase of osmolarity in ECF

\* Factors that affect filterability:

filterability

comparison to water's.

- Size

filterability

- increase in blood volume

\* When Na+ intake increases 10 times, the kidney will inhibit its reabsorption process (which in turn, enhances secretion) by hormonal regulation. But this process is relatively slow, lags behind → retention happens.
\* When we get back to normal Na+ diet, the reabsorption levels will start to increase gradually (slowly) → loss of excess Na+.

-Charge

lower (due to repulsion)

Dextrans are polysaccharides of which charge and size

can be easily manipulated; hence we used them in this

experiment where we measure their filterability in





## ပြီ Clinical Application

- What Would happen if Filtration went wrong?
- <u>Edema</u>
- Some kidney diseases result in a damage of the glomerular Capillaries leading to an increase in their permeability to large proteins .
- Hence, Bowman's capsule colloid pressure will increase significantly leading to drawing more water from plasma to the capsule (i.e more filtered fluid).
- <u>Proteins will be lost in the urine causing</u> <u>deficiency in the blood colloid pressure which</u> <u>worsens the situation, blood volume decreases</u> <u>and interstitial fluids increases causing edema</u>.



يحمد الله تعالى

Done by: hrea Haddad تذکروني بدعوة طيّبة :