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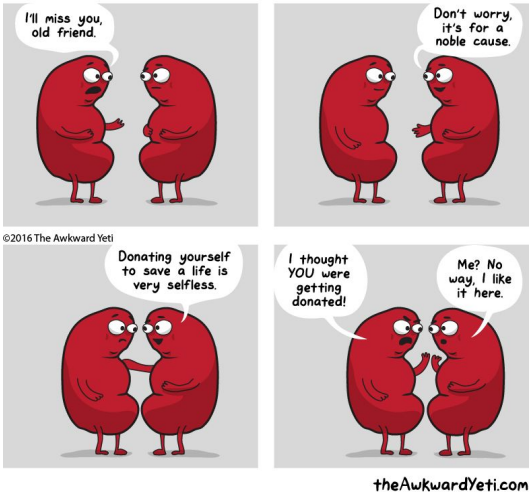
The Renal System



Dental Relevance

One of the main reasons that we learn about the renal system is because of the RAAS. It is a long-term compensatory mechanism response to haemorrhage. As dental professionals, we often make our patients bleed and unfortunately, haemorrhage can be a consequence of that, so we should learn about how the body restores homeostasis. Patients also often take medication that may interfere with the RAAS or their blood pressure. By learning about RAAS and the renal system, we can understand the health effects and impacts it may have on our patients.

Contents:

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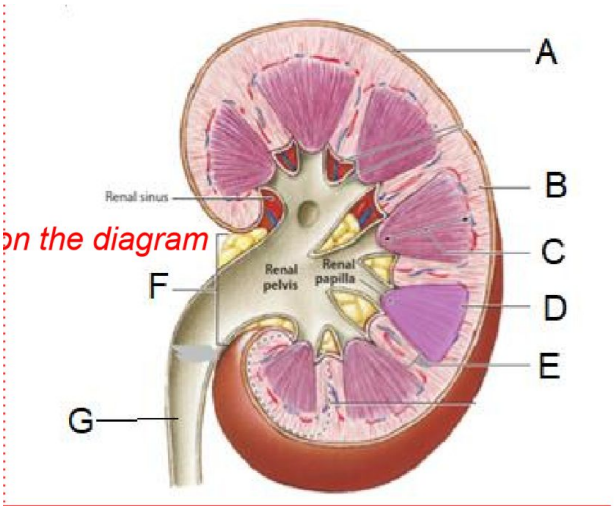
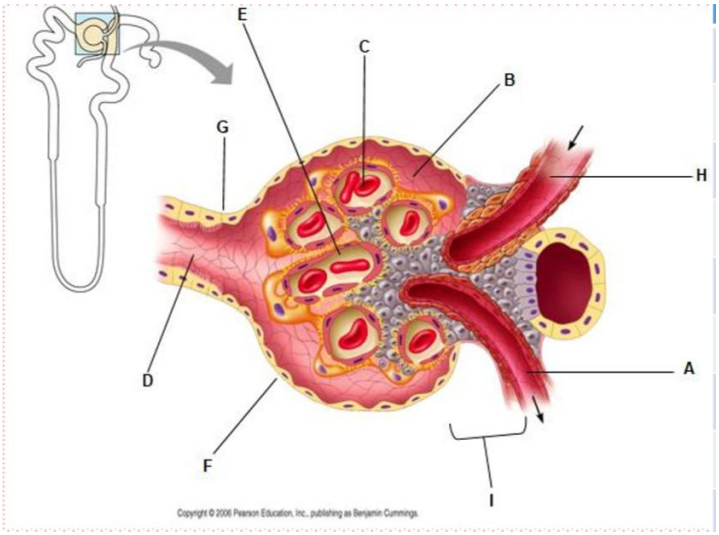
1. *Kidney components:*



A: Fibrous capsule or CT capsule
B: cortex
C: medulla
D: renal pyramid
E: renal column
F: hilum
G: ureter

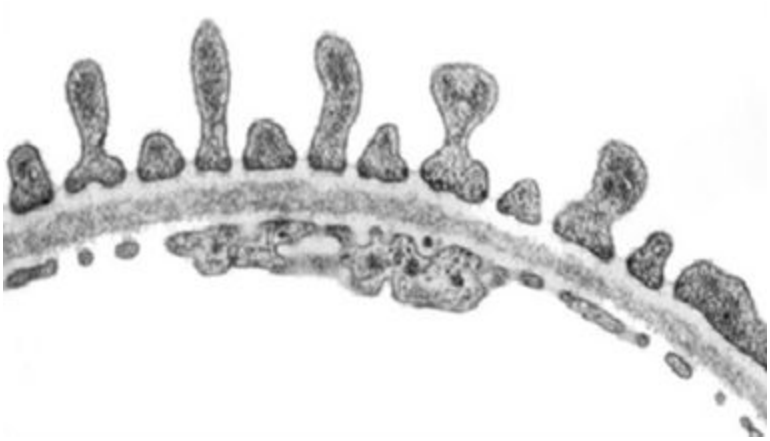
2. *Juxtaglomerular apparatus components*
   The juxtaglomerular apparatus filters the blood that passes through it. On top of the endothelial cells, there are 2 other barriers that allows liquid, waste products, ions, glucose, amino acids to pass from blood to renal corpuscle and form the filtrate. The 3 layers (including the endothelial layer) blocks out larger molecules like blood cells and proteins, which remain in the blood.



A: efferent arteriole
B: bowman's capsule or capsular space
C: erythrocyte
D: proximal convoluted tubule
E: glomerular capillary

F: parietal layer of bowman's capsule
G: simple cuboidal epithelium
H: afferent arteriole
I: mesangial cells

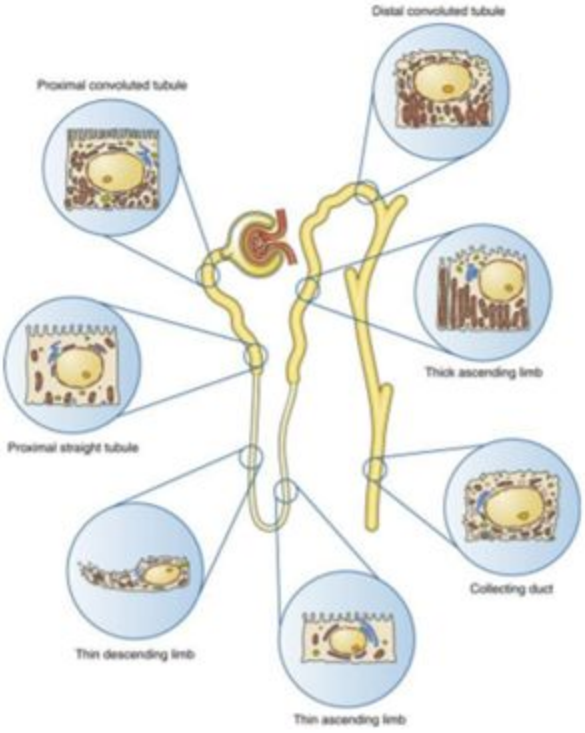
3. *Layers and function of the glomerular filtration membrane:*



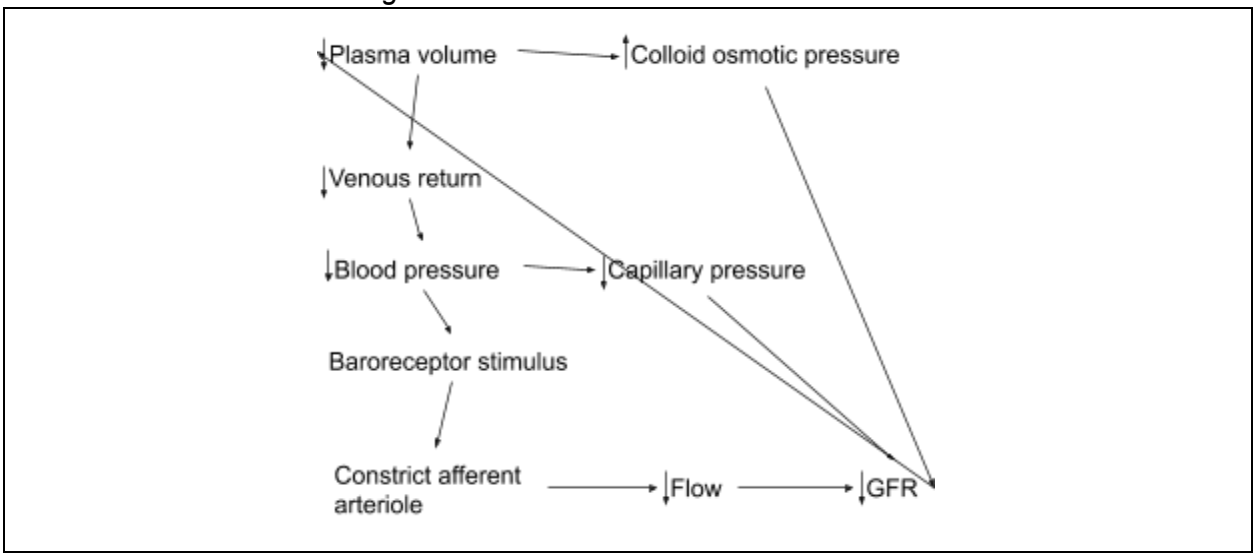
a.

Peripheral/columnar layer: podocytes
Function: forms filtration slits
Middle layer: Basement membrane:
Function: repel albumin and other plasma proteins which are also negatively charged (the reason proteins can't cross capillary walls is because of their large size)
Inner layer: Endothelial cells
Function: have traditional pores, perforated by large holes or fenestrations

4. *Tubular reabsorption and secretion*



a. *Where does most sodium reabsorption occur?* Proximal tubule (note PCT epithelium: cuboidal, microvilli, lots of mitochondria to make ATP→ power pumps that pull Na+ and water from filtrate using active transport)
b. *What substance does not require energy for transport?* Water (reabsorption) (travels via osmosis, TIP: water follows salt!)
c. *What increases glomerular capillary hydrostatic pressure?*
Afferent arteriolar diameter (increase) → glomerular capillary hydrostatic pressure (increase)
Efferent arteriolar diameter (increase) → glomerular capillary hydrostatic pressure (decrease)
d. *What controls glomerular filtration rate?*

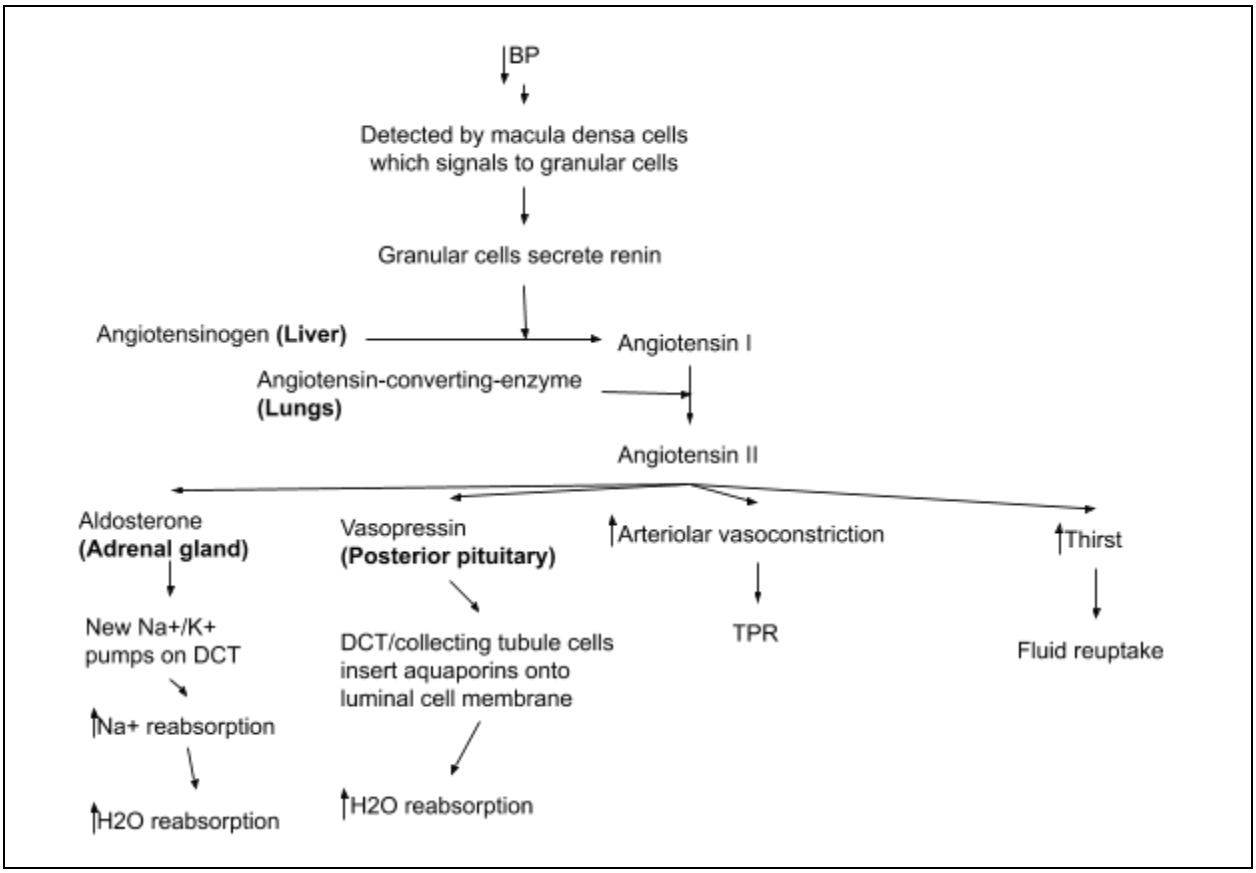


What can reduce glomerular filtration pressure?

- Permeability of membrane
- Glomerular capillary blood pressure
- Bowman's capsule hydrostatic pressure
- Plasma colloid osmotic pressure
- ANP (increases GFR)

e. *Why is creatinine used as filtration marker?*
GFC can be calculated using any substance that is freely filtered, not absorbed, not secreted and has a steady state plasma concentration. Creatinine is a bi-product of muscle metabolism and meets the criteria above.
f. Why is there high glucose level the urine of those with diabetes?
    i. Inability to regulate blood glucose level→ glucose remains in filtrate→ influences osmotic potential within nephron→ prevents Loop of Henle reabsorb water→ too much urine produced
    ii. High glucose in proximal convoluted tubule surpasses maximum reabsorption for glucose
    iii. Increased urine volume and glucosuria
    iv. Thirst due to loss of water

5. *RAAS*



a. How does ADH/Vasopressin increase water reabsorption?
    i. ADH travels from the posterior pituitary to the peritubular capillaries and binds to its receptor sites on basolateral membrane of DCT or collecting tubule cell
    ii. DCT or collecting tubule cell inserts aquaporins onto luminal cell membrane
    iii. Permeability of cell to H2O increases
    iv. H2O reabsorbed because of osmotic potential gradient established through the Loop of Henle