# Physiology (code)-year 2

# Renal physiology

## Lecture 3 (Functional unit of the kidney)

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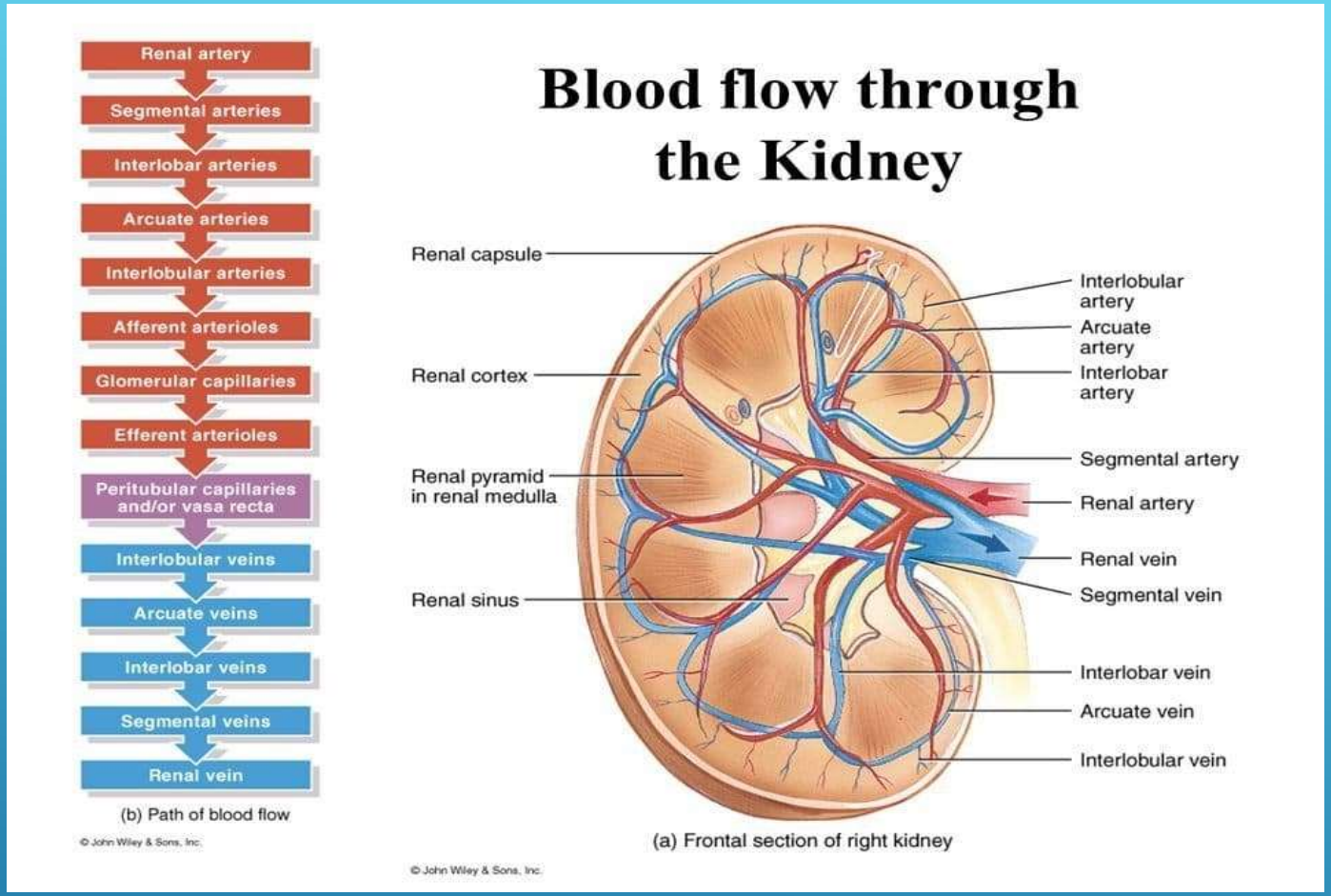


# RENAL CIRCULATION

# Functions of the kidney

- The mnemonic A WET BED aids in memory of kidneys functions.
- A – maintaining ACID-base balance
- W – maintaining WATER balance
- E – ELECTROLYTE balance
- T – TOXIN removal
- B – BLOOD Pressure control
- E – making ERYTHROPOIETIN
- D – Vitamin D metabolism

- Non excretory function
- Secretion of hormones
- Secretion of erythropoietin, which regulates red blood cell production in the bone marrow.
- Secretion of renin, which is a key part of the renin–angiotensin–aldosterone system.
- Secretion of the active form of vitamin D (calcitriol) and prostaglandins.

# Gluconeogenesis

- The kidney in humans is capable of producing glucose from lactate, glycerol and glutamine.
- The kidney is responsible for about half of the total gluconeogenesis in fasting humans. The regulation of glucose production in the kidney is achieved by action of insulin, catecholamines and other hormones.
- Renal gluconeogenesis takes place in the renal cortex.
- The renal medulla is incapable of producing glucose due to absence of necessary enzymes

- Homeostasis
- The major homeostatic control point for maintaining this stable balance is renal excretion.
- Action of aldosterone, antidiuretic hormone (ADH, or vasopressin), atrial natriuretic peptide (ANP), and other hormones.
- Abnormal ranges of the fractional excretion of sodium can imply acute tubular necrosis or glomerular dysfunction.

- The kidney's ability to perform many of its functions depends on the three fundamental functions of filtration, reabsorption, and secretion, whose sum is renal excretion. That is:
- Urinary excretion rate = Filtration rate – Reabsorption rate + Secretion rate

- Urin formation
- Filtration
  - The blood is filtered by nephrons,
  - of ultrafiltration, leaving an ultrafiltrate that resembles plasma (except that the ultrafiltrate has negligible plasma proteins) to enter Bowman's space. Filtration is driven by Starling forces.
  - The ultrafiltrate is passed through, in turn, the proximal convoluted tubule, the loop of Henle, the distal convoluted tubule, and a series of collecting ducts to form urine.

# Reabsorption

- Tubular reabsorption is the process by which solutes and water are removed from the tubular fluid and transported into the blood. It is called reabsorption (and not absorption) because these substances have already been absorbed once (particularly in the intestines).
- Reabsorption is a two-step process beginning with the active or passive extraction of substances from the tubule fluid into the renal interstitium (the connective tissue that surrounds the nephrons), and then the transport of these substances from the interstitium into the bloodstream. These transport processes are driven by Starling forces, diffusion, and active transport.

# Indirect reabsorption

- bicarbonate ($HCO_3^-$) does not have a transporter,
- begins with the active secretion of a hydrogen ion ($H^+$) into the tubule fluid via a Na/H exchanger:
- In the lumen
- The $H^+$ combines with $HCO_3^-$ to form carbonic acid ($H_2CO_3$)
- Luminal carbonic anhydrase enzymatically converts $H_2CO_3$ into $H_2O$ and $CO_2$
- $CO_2$ freely diffuses into the cell
- In the epithelial cell
- Cytoplasmic carbonic anhydrase converts the $CO_2$ and $H_2O$ (which is abundant in the cell) into $H_2CO_3$
- $H_2CO_3$ readily dissociates into $H^+$ and $HCO_3^-$

- Hormones
- Some key regulatory hormones for reabsorption include:
- aldosterone, which stimulates active sodium reabsorption (and water as a result)
- antidiuretic hormone, which stimulates passive water reabsorption
- Both hormones exert their effects principally on the collecting ducts

- Secretion
- Tubular secretion is the transfer of materials from peritubular capillaries to renal tubular lumen. Tubular secretion is caused mainly by active transport.
- Usually only a few substances are secreted. These substances are present in great excess, or are natural poisons.
- Many drugs are eliminated by tubular


Thank
you