Edexcel IAL Biology A-level

7.18-7.22 - The Kidneys, Osmoregulation and DNA Control

Flashcards

Describe the gross structure of a mammalian kidney

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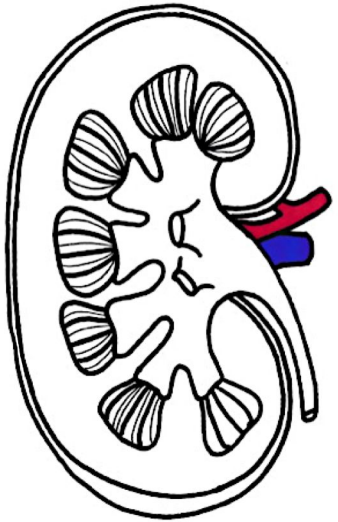
Fibrous capsule: protects kidney

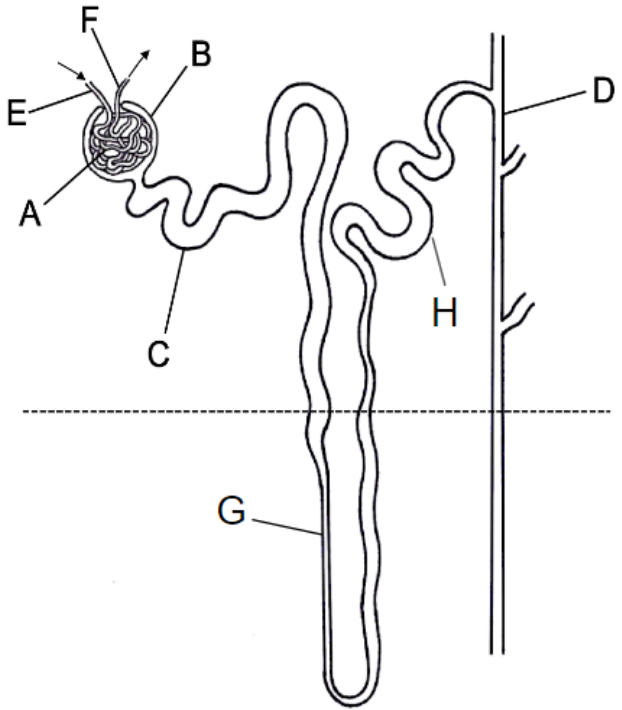
Cortex: outer region consists of Bowman's capsules, convoluted tubules, blood vessels

Medulla: inner region consists of collecting ducts, loops of Henle, blood vessels



Describe the structure of a nephron

A: Glomerulus
B: Bowman's capsule
C: Proximal convoluted tubule
D: Collecting duct
E: Afferent arteriole
F: Efferent arteriole
G: Loop of Henle
H: Distal convoluted tubule



Describe the blood vessels associated with a nephron

Describe the blood vessels associated with a nephron

Wide afferent arteriole from **renal artery** enters renal capsule & forms **glomerulus**: branched knot of capillaries which combine to form **narrow efferent arteriole**

Efferent arteriole branches to form **capillary network** that surrounds tubules

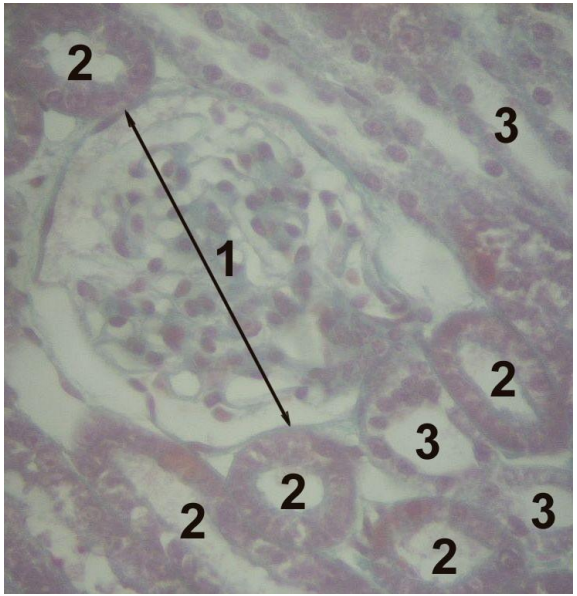
Describe the histology of the kidney

Describe the histology of the kidney

1: Glomerulum

2: Proximal tubule

3: Distal tubule



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Describe the sections of a nephron

Describe the sections of a nephron

Bowman's capsule at start of nephron: cup-shaped, surrounds glomerulus, inner layer of podocytes

Proximal convoluted tubule (PCT): series of loops surrounded by capillaries, walls made of epithelial cells with microvilli

Loop of Henle: hairpin loop that extends from cortex into medulla

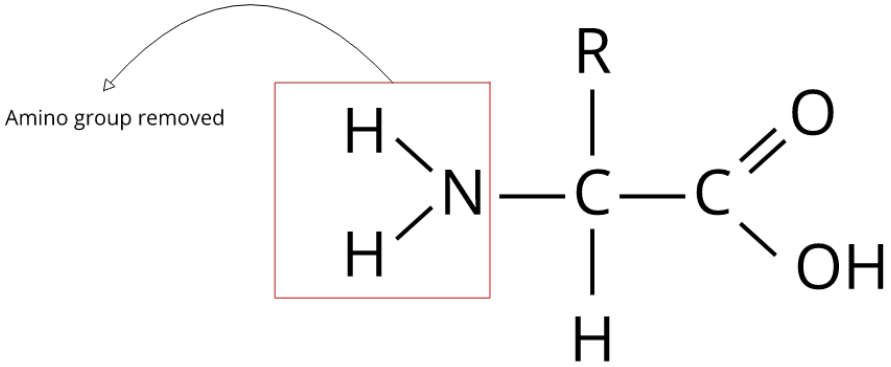
Distal convoluted tubule : similar to PCT but fewer capillaries

Collecting duct: DCT from several nephrons empty into collecting duct, which leads into pelvis of kidney

What is deamination?

What is deamination?

The removal of the amino group in an amino acid



What is urea?

What is urea?

A waste molecule produced in the liver as a product of amino acid breakdown which is excreted in urine

Describe the process of ultrafiltration

Describe the process of ultrafiltration

Occurs in **Bowman's capsule**

High **hydrostatic pressure in glomerulus** forces small molecules (urea, water, glucose, mineral ions) out of capillary fenestrations AGAINST osmotic gradient

Basement membrane acts as filter. Blood cells & large molecules e.g. proteins remain in capillary

How are cells of the Bowman's capsule adapted for ultrafiltration?

How are cells of the Bowman's capsule adapted for ultrafiltration?

- Fenestrations between epithelial cells of capillaries
- Fluid can pass between and under folded membrane of podocytes

State what happens during selective reabsorption and where it occurs

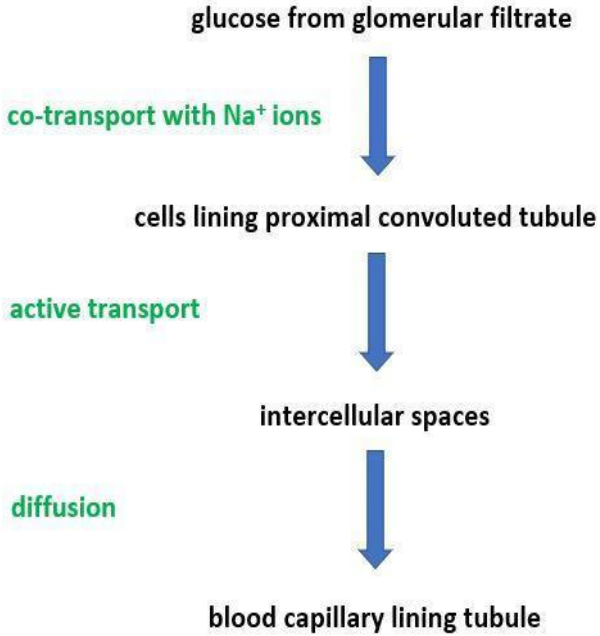
State what happens during selective reabsorption and where it occurs

Useful molecules from glomerular filtrate e.g. glucose are reabsorbed into the blood

Occurs in proximal convoluted tubule

Outline the transport processes involved in selective reabsorption

Outline the transport processes involved in selective reabsorption



How does the kidney produce urine?

How does the kidney produce urine?

After selective reabsorption, filtrate passes through Loop of Henle, which acts as countercurrent multiplier and then through distal convoluted tubule, where water and mineral ions are reabsorbed.

More water is reabsorbed in collecting duct. Remaining fluid (urine) contains only waste materials & water

What happens in the loop of Henle?

What happens in the loop of Henle?

1. Active transport of Na^+ & Cl^- out of **ascending limb**
2. Water potential of **interstitial fluid** decreases
3. Osmosis of water out of **descending limb** (ascending limb is impermeable to water)
4. Water potential of **filtrate** decreases going down descending limb: lowest in **medullary region**, highest at top of ascending limb

What is the pituitary gland?

What is the pituitary gland?

An endocrine gland found in the brain which secretes many regulatory hormones into the bloodstream. These hormones either have their own effects or stimulate other glands to secrete hormones. The pituitary gland is important in osmoregulation as it secretes antidiuretic hormone (ADH).

What is antidiuretic hormone (ADH)?

What is antidiuretic hormone (ADH)?

A hormone secreted by the **posterior pituitary gland** which **decreases water loss** in urine by increasing the water reuptake capacity of the collecting duct

What are aquaporins?

What are aquaporins?

A type of intrinsic membrane protein channel which allows water to pass across membranes

How does ADH increase water reuptake in the collecting duct?

How does ADH increase water reuptake in the collecting duct?

- ADH is secreted by the posterior pituitary gland and it binds to receptors cell membrane receptors on the collecting duct cells
- This triggers an intracellular signalling cascade which results in the exocytosis of vesicles which contain aquaporins embedded in their membranes
- These aquaporins then become part of the plasma membrane after exocytosis

Describe the process of ADH secretion by the pituitary gland

Describe the process of ADH secretion by the pituitary gland

- Osmoreceptors in the hypothalamus detect a **low** blood water content and generate an action potential
- This action potential travels down the pituitary stalk to the pituitary gland
- The pituitary gland then secretes ADH into the bloodstream

What are transcription factors?

What are transcription factors?

Proteins which bind to regulatory regions of DNA and control DNA transcription. They can turn genes on or off

How can peptide hormones affect DNA transcription?

How can peptide hormones affect DNA transcription?

By binding to **extracellular receptors** which produce changes within cells which are brought about by intracellular signalling cascades

Why must peptide hormones bind to extracellular receptors?

Why must peptide hormones bind to extracellular receptors?

Peptide hormones are hydrophilic and so cannot pass through the plasma membrane

How can steroid hormones affect DNA transcription?

How can steroid hormones affect DNA transcription?

They can diffuse into the nucleus and bind to **nuclear or cytoplasmic receptors** which can directly alter DNA transcription by binding to regulatory sections

Give one example of a peptide hormone

Give one example of a peptide hormone

Insulin is a peptide hormone which binds to membrane bound insulin receptors. It is secreted by the beta cells of the pancreas and it regulates blood glucose concentration

Give one example of a steroid hormone

Give one example of a steroid hormone

Testosterone is an example of a steroid hormone which binds to a nuclear receptor called the androgen receptor which acts as a transcription factor. It is secreted by the testes and it is the primary male sex hormone involved in the development of male sex organs

How do transcription factors work?

How do transcription factors work?

Transcription factors bind to DNA and either promote or inhibit transcription by either blocking or enhancing the activity RNA polymerase