THE EXCRETORY SYSTEM

EXCRETION

Excretion is the removal of harmful and unwanted substances, especially nitrogenous wastes from the body.

SUBSTANCES TO GET RID OFF

1. CO_2 and H_2O → CO_2 is eliminated through the lungs. H_2O becomes the part of the rest of the water in the body.
2. Nitrogenous metabolic wastes → Urea is excreted through the kidneys.
3. Excess salts → Salts are excreted through the kidneys.
4. Water → The excess quantity of water is removed through the kidneys.
5. Bile pigments → Some of the bile pigments are excreted in the urine.

THE EXCRETORY ORGANS

1. Kidneys → Primary excretory organs.
2. Sweat glands → Excrete sweat which contains nitrogenous waste.
3. Lungs → CO_2 is expelled by the lungs.

THE URINARY SYSTEM

The urinary system consists of :

1. 1 pair of kidneys
2. 1 pair of Ureters
3. Urinary bladder
4. Urethra

1 pair of kidneys	• Dark red, bean shaped, 10cm long 6cm wide • The right kidney is slightly lower than the left kidney • The renal artery supplies oxygenated blood to the kidneys. • The renal veins take away deoxygenated blood from the kidneys.
1 pair of ureters	• Ureters are tube-like structures which arise from notch i.e. hilum of each kidney. • The ureters connect behind the urinary bladder. • The ureters carry the urine produced to the urinary bladder.
Urinary bladder	• Muscular sac-like structure. • Stores urine temporarily.
Urethra	• Short muscular tube which expels urine out of the body. • It is long in males and very short in females. • The opening is guarded by sphincters which open at the time of urination.

- The longitudonal section of the kidneys shows two regions - an outer dark cortex and an inner light medulla.
- The medulla is composed of conical pyramids.
- The apex of each pyramid ie. papilla, projects into the pelvis.

URINIFEROUS TUBULE

The kidneys have an enormous number of uriniferous tubules. They are also known as nephrons, renal tubules or kidney tubules. Uriniferous tubules are the structural and functional units of the kidney.

BOWMAN'S CAPSULE :

- It is a thin walled, cup like depression.
- A knot-like mass of blood capillaries called glomerulus is located in the concave depression of the Bowman's capsule.
- The Bowman's capsule and the glomerulus together are called malpighian corpuscles or renal corpuscles.

PROXIMAL CONVOLUTED TUBULE (PCT) :

- It is also known as the first convuluted tubule.
- Nearly all the essential nutrients and 70-80% of electrolytes and water are reabsorbed by this segment.
- PCT lies in the cortex region of the kidney.

LOOP OF HENLE :

- It is the U-shaped middle part of the tubule.

DISTAL CONVOLUTED TUBULE :

- It is the end part of the kidney tubule.
- It opens into the collecting duct.
- Conditional reabsorption of Na^+ and water takes place in this segment.

BLOOD SUPPLY TO THE KIDNEY :

Dorsal Aorta

↓

Renal Artery

↓

Afferent arteride

↓

Glomerulus

↓

Efferent arteride

↓

Secondary capillary

↓

Vasa recta

↓

Renal Vein

↓

Posterior Vena cava

FORMATION OF URINE :

The process of urine formation occurs in three major steps :

(A) ULTRAFILTRATION :

- Due to the hydrostatic pressure built in the glomerulus, the liquid part of the blood filters out from the glomerulus and passes into the Bowman's capsule.
- This filtration under extraordinary force is called ultrafiltration.
- The filtrate is known as glomerular filtrate.

(B) REABSORPTION :

- The glomerular filtrate passes down the tubule; water and other substances required by the body are reabsorbed.
- This entire process is called selective reabsorption.
- K^+ ions and certain substances such as penicillin are passed into the urine through the DCT.

(c) TUBULAR SECRETION :

The cells of the walls of DCT are involved in bringing back into the renal tubule K^+ ions and other substances; hence, this process is known as tubular secretion.

PARTS OF THE RENAL TUBULE	ACTIVITY
1. Glomerulus	Ultrafiltration
2. Bowman's Capsule	Receives glomerular filtrate
3. Proximal Convoluted tubule	Reabsorbs water, glucose, Na^+ and Cl^- ions.
4. Loop of Henle	Absorption of H_2O & Na^+ ions
5. Distal Convoluted tubule	Reabsorption of Cl^- ions & H_2O

URINE EXCRETION :

- The filtrate left after reabsorption and tubular secretion is called urine.
- The urine passes from the collecting duct to the pelvis of the kidneys. From there, it is sent to the urinary bladder through the ureters.
- By relaxing the sphincters present at the opening of the urethra, the urine is expelled from the body. This process is known as micturition or urination.

PHYSICAL PROPERTIES OF URINE :

- **Colour :** Yellow, due to the pigment urochrome.
- **Volume :** 1-1.5 L (However, the volume can vary depending on the water intake of the person).
- **pH :** 5 to 8, Slightly acidic
- **Odour :** Faint smell ammonia like due to bacterial activity.
- **Specific gravity :** 3 to 1.035
- Urine is made of 95% water and 5% of solid wastes.

ABNORMAL CONSTITUENTS OF URINE :

1. **Haematuria :** Due to infection in the urinary tract, kidney stone or tumour, blood passes out with the urine.
2. **Glycosuria :** Excess glucose passes out with urine due to diabetes mellitus.
3. Due to anaemia, hepatitis or liver cirrhosis bile is passed out in the urine.

REGULATION OF URINE OUTPUT:

- The water in the urine is controlled by Antidiuretic hormone (ADH).
- Reduction in the secretion of ADH results in loss of water through the urine known as diuresis.
- Substances which increase the production of urine are called as diuretics.

OSMOREGULATION:

- While moving urea from the blood, the kidneys also regulates the composition of the blood i.e. the water and salt concentration in the blood. This is called as osmoregulation.
- Drinking enough water helps the kidneys to function properly.
- In summer, we lose a considerable amount of water through perspiration which makes the urine thicker and concentrated. Hence the kidneys have to reabsorb more water from the urine.

ARTIFICIAL KIDNEY:

- If one kidney is damaged or removed the other kidney is capable of fulfilling the excretory needs of the patient.
- However, the failure of both the kidneys would lead to death.
- Such a patient undergoes dialysis. The dialysis machine is an artificial kidney in which the patient's blood is led from the radial artery through the machine where excess salts and urea are removed.
- The purified blood returns to a vein in the same arm.