

Chapter: 4

Urinary System of Man

Excretion:

"Removal of chemical wastes from body produced by metabolic processes within cell"

	Ammonia	Urea	Uric acid
Description	→ Highly Toxic → Raises pH of blood → Interferes with membrane transport system → Highly Soluble in water and diffuses rapidly in the cells.	→ Less water is required to remove urea. → Some energy invested to convert ammonia into urea. → 100,000 less toxic than ammonia.	→ Less toxic than urea. → Formed by the breakdown of purine. → Allows 4 nitrogen atoms excretion per uric acid molecule.
Amount of Water Required	→ Amount of water required to remove 1g of ammonia is 500ml.	→ Amount of water required to remove 1g of urea is 50 ml.	→ Amount of water required to remove 1g of uric acid is 1ml.
Animals Called	→ Ammonotelic	→ Ureotelic	→ Uricotelic
Example	→ Most fishes, protozoans, sponges, cnidarians, echinoderms and crustaceans	→ Man, many amphibians and some marine animals	→ Terrestrial insects, reptiles and most birds.

Excretory System of Man:

→ Kidneys:

The kidneys lie on either side of the vertebral column between the twelfth thoracic and third lumbar vertebrae.

→ Ureter:

Each ureter is a tubular organ about 25 cm long, which begins as the funnel-shaped renal pelvis.

→ Urinary Bladder:

The urinary bladder is a hollow, distensible, muscular organ, located within the pelvic cavity.

→ Urethra:

The urethra is a tube that carries urine from urinary bladder to the outside of the body.

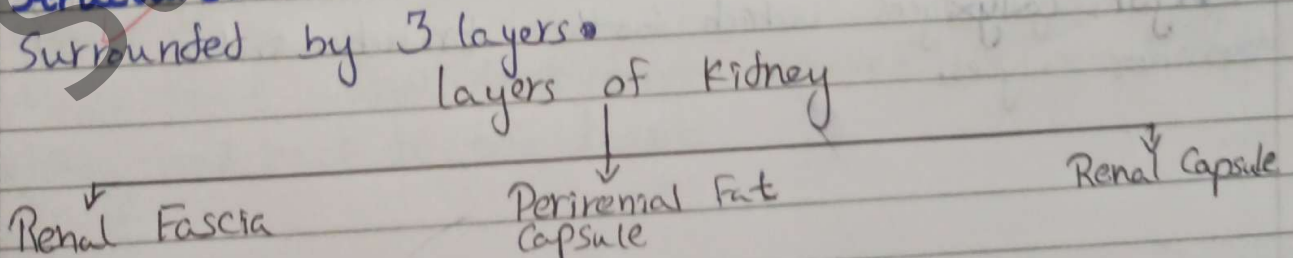
Kidney

Location:

- Pair of bean shaped structures located just below the liver (posterior side).
- Adrenal glands are on the top of kidney.
- Right kidney is slightly lower than the left due to right lobe of the liver that occupied considerable space.

Structure:

→ Surrounded by 3 layers:



Three regions of kidney

Renal Cortex

Renal Medulla

Renal Pelvis

Renal Cortex:

Outer granular part due to presence of nephrons.

Renal Medulla:

Consists of many renal pyramids.

Renal columns: Space b/w the pyramids, contains blood vessels.

Renal Papillae: The tips of the pyramids pointed towards renal pelvis.

Average number of Renal Pyramids are eight in a kidney.

Lobes of the kidney:

Renal pyramids along with the adjoining cortical region (eight)

Renal Pelvis:

It is in a region called hilum (concave side), where blood vessels, nerves and ureter enter and exit the kidney.

It branches into two or three extensions called major calyx/calices which further branches into minor calices.

Relationship b/w structure & Functions of Kidneys:

Kidney Capsule:

- Has three layers of connective tissue to protect the kidney from injury, increases their stability and connects the kidney to surrounding tissue.

Renal Artery:

- large blood vessels that control blood flow to the kidneys.
- At rest most people pump 1.2 litre (5 cups) of the blood in a minute.

Renal Capsule:

- Outer layer where blood filtering units i.e. nephron located.
- Also creates a hormone erythropoietin (EPO), which helps to make RBCs in the bone marrow.

Renal Medulla:

- Inner part of the kidney which contains glomerulus and renal tubules of the nephron.

Renal Papillae:

- Pyramid shape structure, transfers urine to the ureter.

Renal Pelvis:

- Funnel shape structure, that collects the urine and passes by the ureters into the bladder.

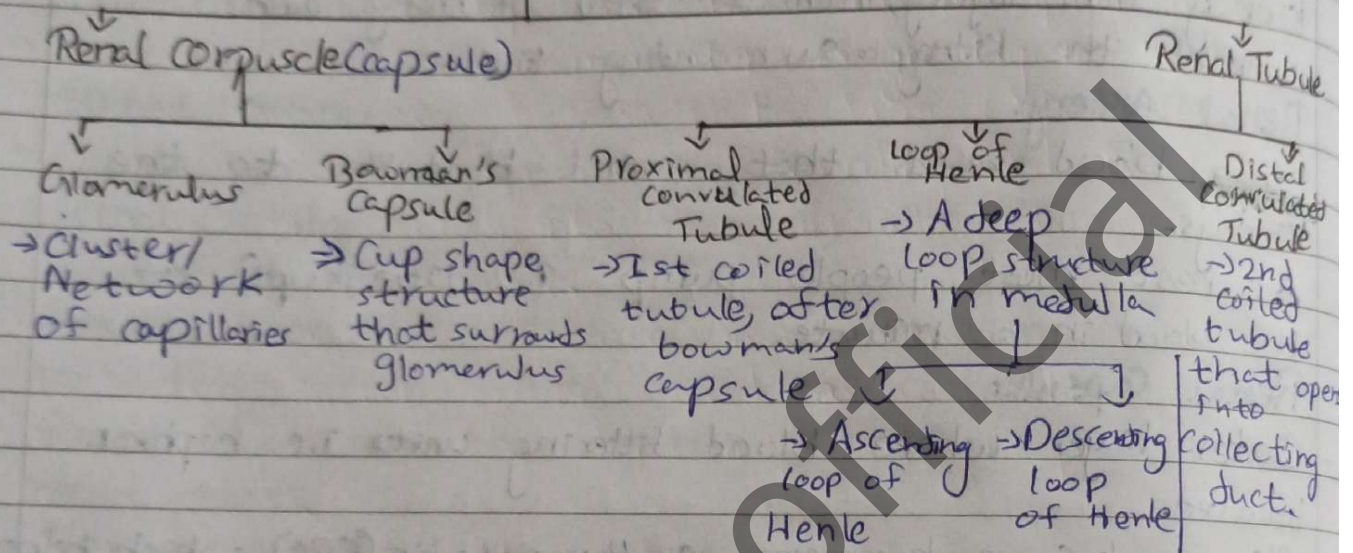
Renal Vein:

- Main blood vessel that carries filtered blood out of the kidney and back to the heart.

Structure of Nephron:

Structural and Functional unit of kidney:

Parts



Blood Circulation to Nephron:

- Renal Artery within the kidney give rise to the branches and form Afferent Arteriole.
- Afferent arteriole supply the blood to the Glomerulus
- Glomerulus forms the Efferent Arteriole
- Efferent Arteriole give rise to Peritubular Capillaries (that surrounds proximal and distal convoluted tubule)
- Vasa recta: Specialized part of peritubular capillaries that surrounds the Loop of Henle.
- Peritubular capillaries drains into the

Urine Formation: (Function of Nephron)

Formation of urine takes place in 3 steps:

1) Glomerular Filtration:-

- It takes place in the renal capsule/corpuscle under the hydrostatic pressure.
- Glomerulus have high blood pressure because diameter of efferent arteriole is half as compared to afferent arteriole.
- Due to high pressure water and small molecules (ions, glucose, amino acids) are filtered out from glomerulus to the Bowman's Capsule.
- Large molecules (RBCs, proteins and platelets) are left behind in the blood.
- The filtered fluid is called Glomerular filtrate, which has similar composition to the blood plasma.

Selective Reabsorption:

- Certain substances that have been filtered out are selectively reabsorbed back into the blood.
- Example: Glucose, amino acids, vitamins, ^{inorganic salts} and some water.

Tubular Secretion:

- Certain substances ^{e.g.:} ammonium and hydrogen ions are secreted by the epithelial cells of loop of Henle and convoluted tubule.
- The main purpose of this secretion is to maintain the pH of the urine, that is 4.8 to 7.5 pH.

Mechanism of Urine Concentration:

Formation of hypertonic urine is dependent on the re-absorption of water from loop of Henle and collecting duct by counter-current multiplier mechanism.

- Due to this mechanism, water is greatly re-absorbed in the capillaries of vasa recta from loop of Henle.
- As fluids travel up in the ascending limb, NaCl is actively transported into the surrounding area under the action of Aldosterone.
- This causes the decrease in concentration of water in kidney interstitium and as a result water passes out of the descending limb loop of Henle by osmosis.
- This movement of water is also promoted by anti-diuretic hormone (ADH).

Disorders of Kidney

(From Book)