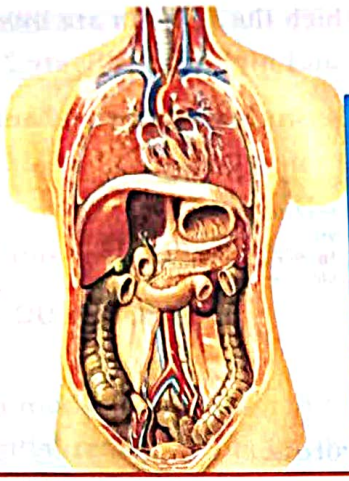
UNIT : 3
Human Body



most toxic substance in our body - ammonia

location of kidney:
Thoracic - 12
Lumbar - 3

Ureter - made up of transitional epithelium
↓
ability to stretch.

Another name of kidney - Renal

5 IN

SYLLABUS

Excretion : Definition

- Excretory organs and their excretory products (kidneys, sweat glands, lungs);
- Renal Excretory System — kidneys, ureter, urinary bladder, urethra (location and functions to be explained along with diagram);
- Role of kidneys in filtration of blood through millions of nephrons (details not required, structure of nephron not to be discussed); common disorders of the urinary system: Urinary Tract Infection, kidney stone.

WHAT IS EXCRETION ?

During different metabolic activities taking place in our body, the body produces many substances of which some are useful while the others are useless (not required by the body). If retained in the body, the useless unwanted substances may become poisonous and cause much harm and in severe cases, even death. The organs which remove these unwanted and toxic substances from the body are called **excretory organs**. The process of removal of unwanted and harmful metabolic waste substances is called **excretion**.

Substances to be Excreted

1. **Urea and uric acid** (nitrogenous wastes). These are produced as a result of the breakdown of excessive amino acids in the liver. If allowed to accumulate in the body, these are harmful.
2. **Bile pigments.** These are formed in the liver. They give a yellowish tinge to the urine. Excess of bile pigments become harmful, hence they are removed from the body.
3. **Water.** Water is taken in with food and beverages in large quantities. Plenty of

water in the body is essential for "washing out" of the nitrogenous wastes. The body retains some water required as a normal constituent while the excess water is removed from the body in different ways.

4. **Extra Salts.** Such as the common salt (NaCl). Sodium and chloride ions or any other ions are needed in the body only in certain proportions. Any extra quantity must be removed. Extra salts are expelled alongwith the urine.
5. **Extra Vitamins.** The vitamins absorbed from the food may be in excess. The fat-soluble ones are stored in the body to some extent, but the extra water-soluble ones such as vitamins B and C are passed out in urine. Similarly, certain medicines including antibiotics, if taken in extra quantity are passed out along with urine.

> Excretion is the removal of all toxic and unwanted metabolic waste products from the body.

THE EXCRETORY SYSTEM

The renal excretory system or simply excretory system in humans consists of a pair of kidneys, two ureters, a urinary bladder and a urethra.

1. **Kidneys.** The two reddish-brown bean-shaped **kidneys** are situated towards the back of the abdomen, one on either side of the backbone at the level of the last two ribs. The right kidney is located slightly lower than the left one (Fig. 5.1).

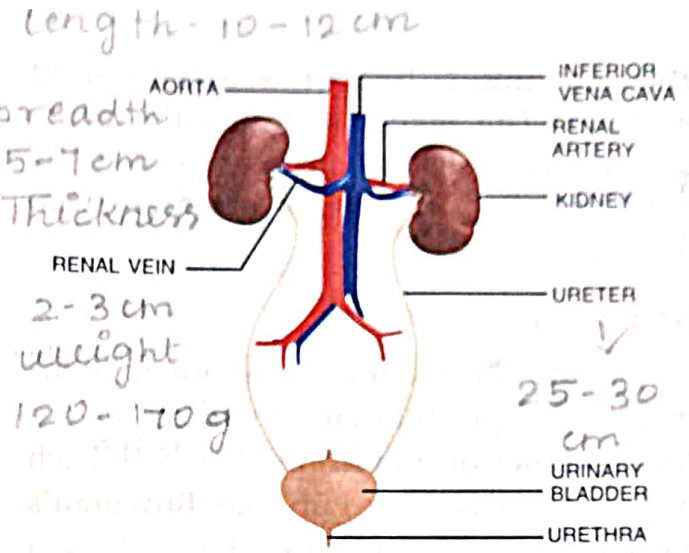


Fig. 5.1 The human excretory system (front view)

2. **Ureters.** A narrow tube called the **ureter** runs from the inner side of each kidney up to the **urinary bladder.**
3. **Urinary bladder.** It is a muscular bag situated in the lower abdomen.
4. **Urethra.** Leading from the urinary bladder is a single median tube called the **urethra** opening to the outside. It is longer in the males and shorter in the females.

Structure of the Kidney

Internally, each kidney is composed of an outer darker region called *cortex*

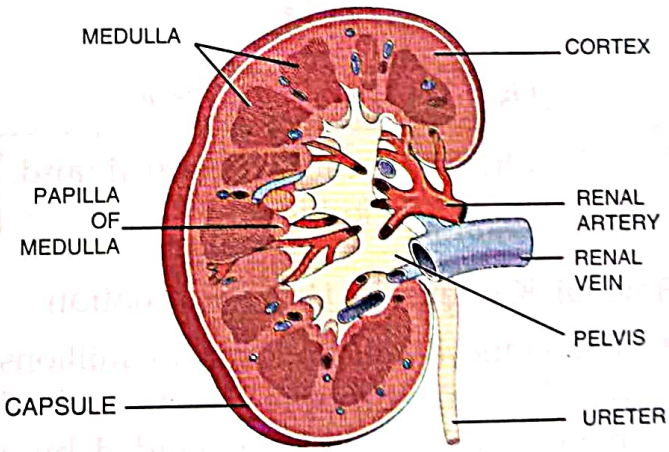


Fig. 5.2 Section through the kidney to show different regions

and an inner lighter region called ***medulla***. The medulla drains the urine into a funnel-shaped structure called the ***renal pelvis***. The ureters orginate from here (Fig. 5.2).

Nephrons

Inside the kidney, there are millions of microscopic tubular structures called ***renal tubules*** or **nephrons** (Fig. 5.3). Each nephron starts as a cup-like **Bowman's capsule** which continues behind as a narrow **tubule**. The tubule is convoluted (twisted) and opens into a collecting duct. All the collecting ducts then open into the renal pelvis which leads into the ureter.

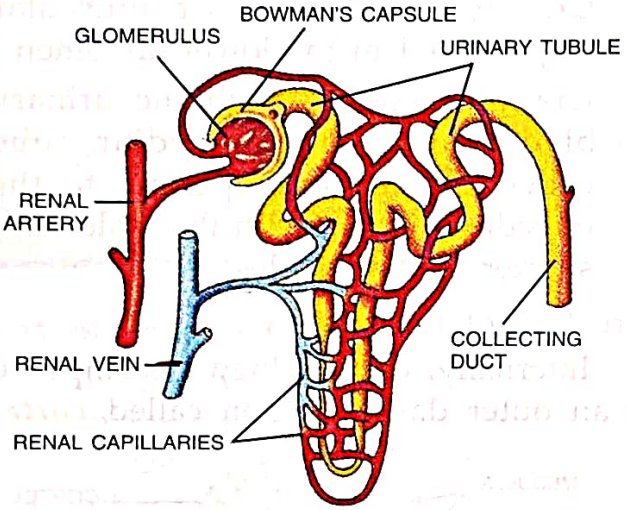


Fig. 5.3 Structure of a nephron

Nephron is the structural and functional unit of kidney.

Role of Kidneys in Urine Formation

- The kidneys are made up of millions of the microscopic units called **nephrons**. They are surrounded by a network of blood capillaries.
- The main function of the nephron to filter the blood, purify it and produce urine.
- Blood which enters the kidr through the renal artery conta unwanted waste substances as well some useful substances.
- The nephrons remove the was substances such as excess wat mineral salts and urea from the blo and convert it into urine.
- They also re-absorb certain usef substances like glucose, sodium ar potassium ions that are needed by t body and put it back into the blood
- The blood that finally leaves th kidney is pure, devoid of all waste and contains the right amount o water and other useful substance required by the body.
- The urine that is formed in the kidneys is sent to the ureters for its further temporary collection in the urinary bladder.
- When the bladder is full, the urine is expelled to the outside through the urethra.
- This process of expulsion of the urine to the outside is called **urination**.

The normal human urine mainly consists of **water, urea, uric acid** and some amount of **mineral salts**.

Accessory Excretory Organs (Skin, Lung, Liver, Salivary glands)

Besides kidneys, some other organs also help in the removal of waste products.

They are called **accessory excretory organs**. In human beings, the skin, lungs and liver are such organs.

Excretory role of skin : The major excretory function of the skin is production of sweat which on evaporation from the surface of the skin, cause cooling. Sweat is secreted by **sweat glands** which are located underneath the skin. These glands have ducts which open on the surface of the skin. Through these ducts, sweat comes out of the body. Sweat is composed of excess water, salts and traces of urea and uric acid.

Excretory role of lungs : You have learnt that the carbon dioxide is produced during breakdown of glucose during respiration. This passes from the blood into the lungs and exhaled through the nose.

Excretory role of liver : Breakdown of amino acids in liver produce urea. Urea is then carried to the kidneys from where it is excreted out in the urine.

Liver also helps in the elimination of bile pigments, extra vitamins and many drugs which get accumulated there.

OSMOREGULATION

Besides removing urea and uric acid from the blood, the kidneys also help in maintaining the water and salt concentration in it. This process is called **osmoregulation** (regulation of water and salt content).

During summer, we urinate fewer times than in winter and the urine passed is usually more concentrated. The reason being that in summers, we lose much water through sweat.

Common Disorders of the Urinary System

1. **Kidney stones :** They are formed when crystal forming substances such as calcium oxalate, calcium phosphate and uric acid are more than the fluid in the urine. When these chemicals start sticking together, they form crystals, commonly called **kidney stones**. They may be formed in any area of the excretory system and cause severe pain. They block the flow of urine if they are present in the ureters, urinary bladder or urethra. Very often they have to be removed surgically.

   It is very important to drink sufficient water each day, to prevent the formation of these crystals in one's body.

2. **Urinary tract infection :** It is an infection of any part of the urinary system — the kidneys, urethra, urinary bladder or ureters. It occurs when bacteria gain entry into the urinary tract and overcomes the body's defence present there.

   Common symptoms include a strong and frequent urge to urinate and a painful and burning sensation while urinating. It is treated with antibiotics and can be cured within 2-3 days of treatment in case of mild infections.

3. **Diabetes :** Presence of glucose in the urine, indicates that the person is suffering from diabetes mellitus. This is a disease in which the sugar level in the blood is much higher than the normal level. The excess sugar is excreted out through the urine.

4. Presence of blood cells in the urine may indicate an infection, tumor, internal bleeding or damage to the kidneys.

WHAT HAPPENS IF KIDNEYS FAIL ?

Sometimes, one or both the kidneys may stop working properly. This may happen if they become infected, seriously injured, or damaged due to some reason.

A person can well manage with just one kidney, but if both fail, the blood soon becomes loaded with urea and other waste substances. If nothing is done in such situations, the person may die.

One of the treatments for such a person is to use a machine which filters and cleans the blood. The process is known as dialysis (Fig. 5.4).

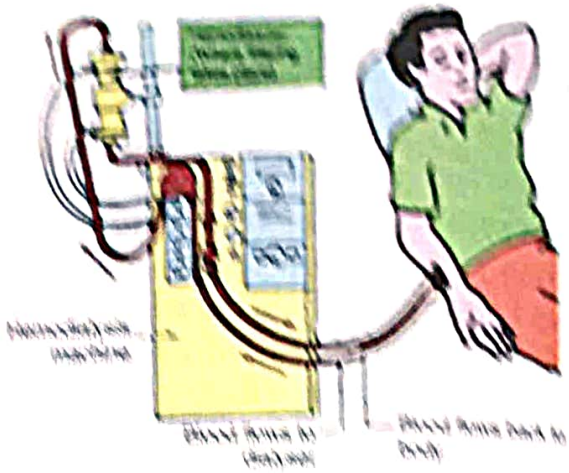


Fig. 5.4 Dialysis

A person with complete kidney failure needs regular dialysis done in a hospital to lead a normal life. As an alternative, a patient with both kidneys damaged can undergo kidney transplant from a suitable donor. The donor can live normally with one single kidney and the recipient gets a lease of life.

RENAL TUBULES

Tiny, so many and for so much!

- Total number in both kidneys : approximately 2 million.
- Each single tubule : 4-5 cm long.
- Total length of all tubules together : more than 16 kilometres.
- Blood flowing through kidneys per minute : 1 litre.
- Primary urine produced in 24 hours : 180 litres, but 179 litres is reabsorbed back into the system.
- Final urine produced from the primary urine after reabsorption per day : 1·2 litre.

Blood vessels in kidney

A preparation of the kidney. All tissues except the main blood vessels have been dissolved away. The two kidneys contain about 16 km of tubules and 160 km of blood vessels.

REVIEW QUESTIONS

OBJECTIVE TYPE QUESTIONS :

1. Put a tick (√) against the most appropriate alternative in the following statements.

(i) The kidneys are made up of tiny tubular units called :

(a) glomerulus ☐ (b) nephrons ☐

(c) capillaries ☐ (d) neurons ☐

(ii) In human beings, urea is produced in :

(a) liver ☐ (b) kidney ☐

(c) spleen ☐ (d) urinary bladder ☐

(iii) Besides water, the urine mainly contains :

(a) urea ☐ (b) nitric acid ☐

(c) glucose ☐ (d) bile pigments ☐

(iv) Filtration of excretory wastes from the blood occurs in :

(a) collecting tubule ☐ (b) ureter ☐

(c) urinary bladder ☐ (d) nephrons ☐

(v) The process of the breakdown of excessive amino acids occurs in :

(a) Kidney ☐ (b) Liver ☐

(c) Small intestine ☐ (d) Lung ☐

(vi) The process of removal of nitrogenous waste products from the body of a living organism is called as :

(a) Transpiration ☐ (b) Excretion ☐

(c) Exudation ☐ (d) Evaporation ☐

(vii) In human beings, urea is filtered out from :

(a) Liver ☐ (b) Skin ☐

(c) Kidney ☐ (d) Lungs ☐

(viii) The outermost protective covering of the kidneys is termed as :

(a) Epithelium ☐ (b) Pleura ☐

(c) Capsule ☐ (d) Pericardium ☐

(ix) The process of regulation of water and salt content in the body is called as :

(a) Filtration ☐ (b) Osmoregulation ☐

(c) Ultrafiltration ☐ (d) Osmosis ☐

(x) The process of expulsion of urine from the body is termed as :

(a) Excretion ☐ (b) Secretion ☐

(c) Urination ☐ (d) None of the above ☐

2. **Match** the terms given in column A with those of column B :

Column A	Column B
(i) Beverages	(a) Fat-soluble
(ii) Vitamins B and C	(b) Ammonia, Uric acid
(iii) Vitamins A and D	(c) Urea, Mineral salts
(iv) Nitrogenous wastes	(d) Tea, Coffee
(v) Constituents of urine	(e) Water-soluble

3. **Name** the following :
   (i) The basic structural and functional unit of kidney.
   (ii) The cup-shaped structure of nephron.
   (iii) The part of nephron which collects urine from the convoluted tubule.
   (iv) The process of filtration of blood through a machine, outside the human body.
   (v) The disease which can be identified by the presence of glucose in the urine.
   (vi) The blood vessel that brings blood to the kidneys.
4. Write ***True*** **(T)** or ***False*** **(F)** for the following statements in the spaces provided. Rewrite the false statements in correct form .
   (i) Removal of solid undigested food is excretion.
   (ii) Medulla of kidney passes urine into urinary bladder.
   (iii) Excess sugar in blood is a symptom of diabetes.
   (iv) Urine is devoid of blood cells.
5. Where in the urinary system do the following processes take place ?
   (i) Urine formation *(ii)* Transport of urine away from kidney *(iii)* Temporary storage of urine

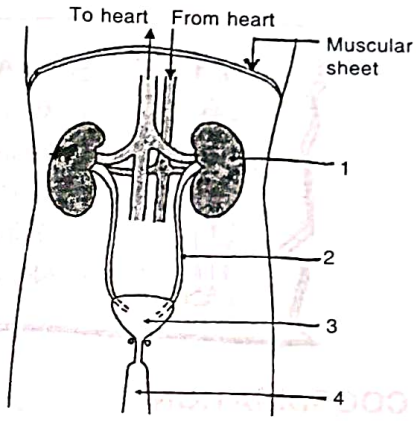
SHORT ANSWER QUESTIONS:

1. **Name** :
   (i) *Three* nitrogenous wastes of the body.
   (ii) *Four* main organs of the human urinary system.
   (iii) *Three* accessory excretory organs in humans.
   (iv) *Three* crystalline substances which can cause kidney stones.
   (v) *Two* water soluble vitamins.
2. Define the following :
   (i) Excretion *(ii)* Excretory organs *(iii)* Dialysis *(iv)* Nephron *(v)* Osmoregulation
3. **Write** the exact location of each of the following :
   (i) Kidney *(ii)* Urinary bladder *(iii)* Renal cortex
   (iv) Renal medulla *(v)* Pelvis
4. **Write** one important excretory function / role of each of the following :
   (i) Kidney *(ii)* Ureter *(iii)* Urinary bladder
   (iv) Urethra *(v)* Skin
5. Why is excretion necessary in living beings ?
6. What are the two ways by which a person can get relief in case of kidney failure ?

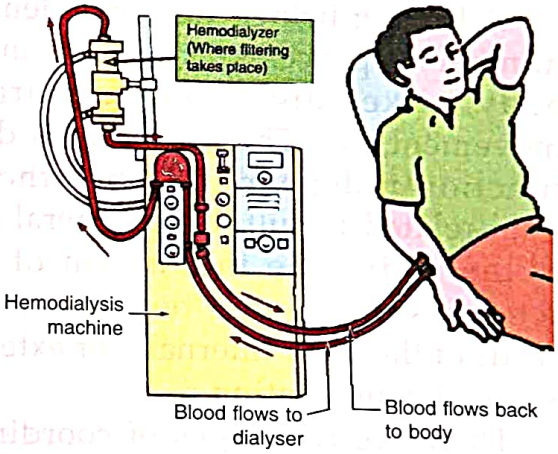
7. How are kidney stones formed ?
8. What are the symptoms of a urinary tract infection ?

LONG ANSWER QUESTIONS (Write the answers in your notebook) :

1. **Distinguish** between the following pairs on the basis of the words indicated in the brackets [ ] :
   (i) Ureter and Uterus [Organ system]
   (ii) Nephron and Neuron [Location in body/organ]
   (iii) Lungs and Liver [Excretory products]
   (iv) Blood of renal artery and renal vein [Nitrogenous wastes]
   (v) Urinary bladder and urethra [Function]
2. **Draw** a neat diagram of the vertical section of a human kidney and **label** its five important parts : Capsule, Renal cortex, Renal medulla, Papilla of medulla and Renal pelvis.
3. Given alongside is the diagram of an organ system of humans. Study the same and **answer** the following questions :
   (i) **Name** the organ systems shown completely and partially respectively.
   (ii) **Label** the guidelines 1 to 4.
   (iii) **Name** the muscular sheet which divides the thorax and abdomen.
   (iv) **Mention** the blood vessel which supplies blood from the heart to the kidney.
   (v) **Name** the blood vessel which carries deoxygenated blood that is devoid of nitrogenous wastes.



4. The figure shown alongside represents a process for the treatment of a person. Study the same and **answer** the following questions.
   (i) **Name** the process.
   (ii) In **what** condition of the patient, is this treatment suggested by the doctors ?
   (iii) **What** other kind of treatment is suggested by the doctors, if both kidneys fail to work ?
   (iv) **Can** a person survive normally with one kidney ?
   (v) **Write** one important function of the Hemodialysis machine.



PROJECT

Research and find out at least three factors which affect the nature of urine excreted from the pair of kidneys.