UNIT 4: EXCRETORY SYSTEM

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4.1 LEARNING OBJECTIVES

After going through this unit, you will be able to:

- learn the structure and functions of excretory organs
- understand the structure and functions of nephron
- explain the effect of yogic practices on excretory system

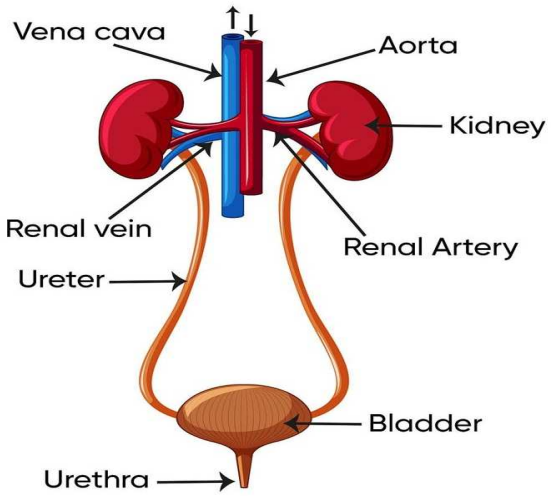
4.2 INTRODUCTION

This is the fourth unit of the Human Anatomy and Physiology course. We will discuss about the basics knowledge of excretory system with their structure and function in this unit. At the beginning of the unit we will discuss about anatomy and physiology of excretory system. There after we will discuss about the structure and functions of the nephron. At the end we will know the effect of yogic practices on excretory system.

4.3 STRUCTURE AND FUNCTIONS OF EXCRETORY SYSTEM

The process by which our body eliminates the metabolic waste products is called excretion. The system which works to remove excretory substances present in the body is called the excretory system and the organs which take part in this process are called excretory organs. Solid waste products are eliminated from our bodies through the large intestine as feces, liquid waste products are eliminated through the kidney and skin as perspiration and urine, and gaseous waste products are released through the lungs as breath.

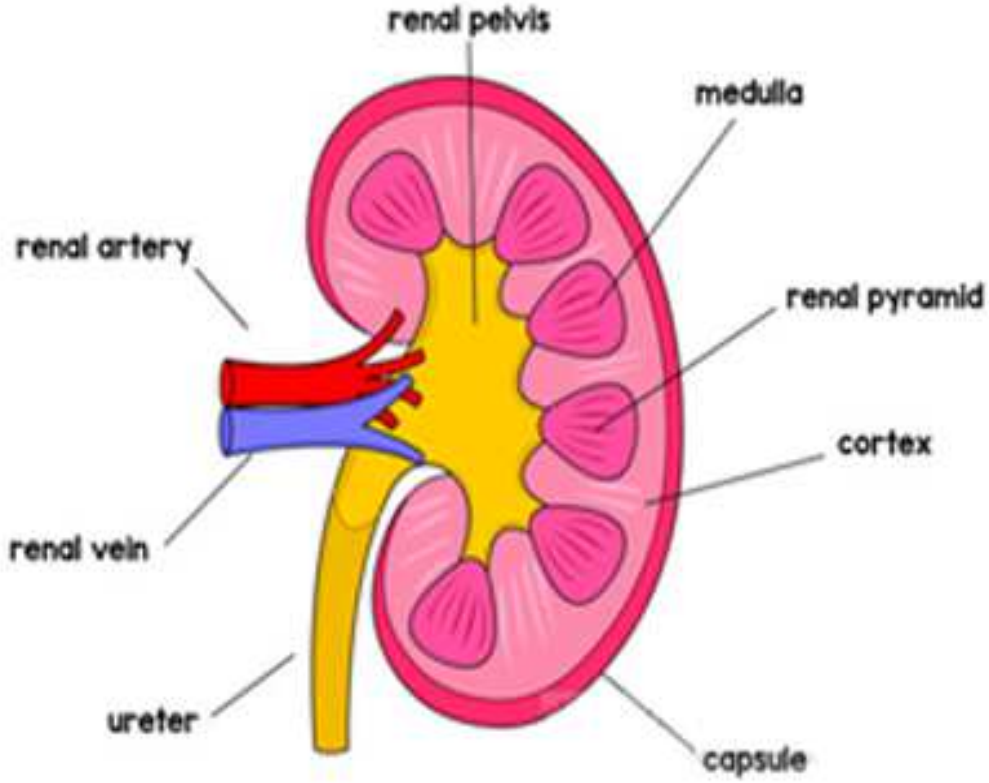
This system carries out the vital task of cleansing the body. When it functions correctly, the skin, blood, and other organs stay healthy and clean. The excretory system is also known as renal or urinary system. It regulates electrolyte balance; maintain the acid base balance and RBC production. The excretory system consists of – two kidneys, two Ureter, the bladder and the urethra.



4.3.1 Structure of the kidneys

In the human body, a pair of kidneys is situated near posterior wall of abdomen and protected by 11^{th} and 12^{th} ribs cage, it is look like a reddish bean shaped organ. The right kidney is presented slightly lower than the left kidney. Normally, the size of each kidney is 12cm long, 6 cm wide and 3 cm thickness. It is an average weight 120-170 gm. The kidneys' upper and lower poles are referred to as the upper and lower poles, respectively. On each kidney's top pole is an adrenal gland. Kidneys are connected with two large blood vessels which supply them with the blood.

The outer part of the kidney is called as cortex and inner part is called as medulla. And it presents many pyramids. Internally, each pyramid contains million of small filters called as nephron. It is also said to be functional unit of the kidney. Each nephron contains two parts, first part is renal corpuscle in which main function filtration and second part is called as renal tubule in which the filtered part moves and some of that is reabsorbed. Renal pelvis is the upper expanded pat of ureter and it consists of major calyx, minor calyx enclosing the papillae.



Urine is the result of the kidneys filtering waste, poisons, and excess chemicals out of the circulation. It also regulates the amount of water expelled in urine, which helps to keep the body's fluid balance. To guarantee appropriate cellular and organ function, the kidneys control the levels of vital electrolytes including calcium, sodium, and others. By reabsorbing bicarbonate when necessary and excreting hydrogen ions, the kidneys regulate the pH of the blood. The kidneys regulate fluid levels and release the rennin enzyme, which influences sodium

retention and blood vessel constriction, to control blood pressure. Erythropoietin is a hormone that the kidneys manufacture and that encourages the bone marrow to create red blood cells.

4.3.2 Ureter

It is about 25 to 30 cm long with narrow diameters. The ureter wall is composed of three layers, with smooth muscles making up the middle layer. It begins at the renal pelvis and terminates at the bladder. The ureter carries urine from the kidneys to the bladder. Salts and solid urea particles can be found in urine. So, it is needed the proper amount of water in urine otherwise the sold material may block the ureter which obstructs the flow towards bladder. Thus the urine is congested in kidney too much by reverse pressure.

4.3.3 Urinary bladder

It is hallowed; distensible muscular organ situated in pelvic cavity when it is empty it is in collapsed state. When it is filled with urine it becomes pear shaped and rises into abdominal cavity. Bladder can store urine up to 700-800ml urine which is called as capacity of bladder. Usually when the 200ml of urine is stored, the natural urge of urination is stimulated. The stimulation is generated by spinal cord segment at sacral region. It works autonomously. But the act of urination is under voluntary control also. So even if the urge is created one can refuse the urge up to some extent.

4.3.4 Urethra

It extends from lower end of bladder and throws urine outs Urethral tube is near about 20 cm long in male and 6cm long female. The tube contains smooth muscle which helps to throw the urine outside by creating contractions. Due to long urethra male can control the urine up to some hours. It is very difficult to control it female as their urethra is very small. Even sometimes dung laughing or coughing, it is leaked. At the junction of urethra and bladder the special tissue called sphincter is situated. Because sphincter the junction is closed for some time to collect the urine and then during urination it is relaxed. Sometimes due to stress the sphincters fail to hold the urine and thus urination happens automatically. Especially, in stressed children this phenomenonis common. More acidic urine irritates the inner wall of urethra while passing out. This is

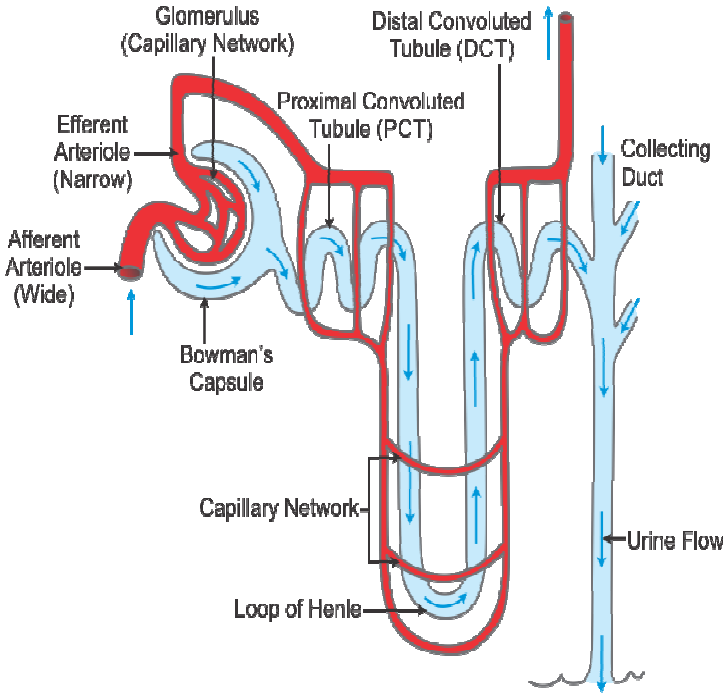
called as burning micturition. Even if the amount of water in urine is less then acidic property is increased.

4.4 ANATOMY AND PHYSIOLOGY OF NEPHRON

The nephron is the functional unit of the kidney, responsible for filtering blood and producing urine. Each kidney contains about 1 - 1.5 million nephrons. . It consists of Bowman's capsule, Glomerulus, and Proximal Convoluted Tubule. The Bowman's capsule collects blood filtrate, the Glomerulus filters blood plasma, and the Proximal Convoluted (PCT) absorbs water, glucose, amino acids, and ions.

Structure of the Nephron

Bowman's capsule (Glomerular Capsule) a cup-shaped structure surrounding the glomerulus. Together, they form the renal corpuscle, where start the blood filtration. It's the main function received filtrate blood from the glomerulus. Glomerulus a network of capillaries inside the Bowman's capsule. Where blood is filtered under pressure. It is filters water, ions, glucose, urea and other small molecules from the blood. Proximal Convoluted Tubule (PCT) a coiled tube close to the Bowman's capsule. Reabsorbs water, glucose, amino acids, and ions from the filtrate into the blood; it also secretes wastage materials into the tubule. Loop of Henle a U-shaped structure with descending and ascending limbs. It is divided into two parts descending limb it permeable to water, allows water reabsorption and ascending limb it impermeable to water, reabsorbs sodium, potassium, and chloride ions.Establishes a concentration gradient in the kidney medulla, aiding water reabsorption.Distal Convoluted Tubule (DCT) located further from the Bowman's capsule.Reabsorbs sodium and calcium while secreting potassium and hydrogen ions. Regulated by hormones like aldosterone and parathyroid hormone. Collecting Ductreceives urine from multiple nephrons.Further concentrates urine by reabsorbing water under the influence of antidiuretic hormone (ADH).Transports urine to the renal pelvis.



There are several functions of nephrons are -

- Filtration: Occurs in the glomerulus.Blood pressure forces water, ions, glucose, and waste products into the Bowman's capsule.
- Reabsorption: Essential substances (water, glucose, ions) are reabsorbed into the blood, primarily in the PCT, Loop of Henle, and DCT.
- Secretion: Unwanted substances like hydrogen ions, potassium, and toxins are secreted into the filtrate.
- Excretion: The final urine, containing waste products and excess substances, is excreted through the ureters, bladder, and urethra.

This specific balance of filtration, reabsorption, and secretion allows the nephron to maintain fluid and electrolyte balance, regulate blood pressure, and remove waste products from the body.

4.5 EFFECT OF YOGIC PRACTICES ON EXCRETORY SYSTEM

Yogic practices can positively impact the excretory system by improving its efficiency and promoting overall detoxification. Here are some effects:

- Improved Detoxification: Yoga enhances blood circulation and stimulates the organs involved in the excretory system, such as the kidneys, liver, and intestines, aiding in the elimination of toxins. Yoga improves peristalsis (the wave-like movement of the intestines), which aids in smooth bowel movements and prevents constipation. Different yogic practices asana, pranayama, shatkarma, meditation etc improved the excretory system. Some yogasanatwisting category postures like Vakrasana, Ardha Matsyendrasana (Half Spinal Twist) massage the abdominal organs, improving their function. Forward bending category practices like Paschimottanasana, padahastasana etc and backward bending category like dandyamanardhachakarasana, Bhujangasana (Cobra Pose) stimulate kidney function, promoting the filtration and removal of waste products from the blood. And other postures such as pavanamuktasana, dhanurasana, naukasana etc help release trapped gas and ease digestive discomfort.
- Pranayama also very important role play to improvement the excretory system. Different breathing exercises and pranayama like Nadi suddhi, anulomvilom, bhastrika etc enhance the metabolic activities; it can help control sweat and urination.
- Stress can negatively affect the excretory system by improper digestion and increasing toxins in the body. In chronic stress, kidney also fatigue. Yoga, particularly relaxation practices like Shavasana and Meditation, helps reduce stress and maintain a healthy excretory system.
- Different mudra and bandhas also very good major impact on the excretory system. Different practice of mulabandha, ashwini, uddiyana bandha, vajroli etc helps to improve the tone of pelvic muscles and also improvement the tone of smooth muscles of urethra. These can be practiced to control the incontinence.
- Shatkarma practice shankhaprakshalana also good beneficial for the excretory system. When drinks water orally, that time some of the water is absorbed and filtered by kidney. After filtered indirectly it is the cleaning of urinary tract.

The excretory system is the most important role play to balance the internal body and removes the toxins from our body. The system coordinated functioning of organs such as the Kidneys, liver, lungs and skin it regulates essential process like water balance, blood pressure etc. Regular practice can prevent issues like urinary tract infections (UTIs), constipation, and other excretory-related disorders by maintaining the health of the organs. Incorporating yoga into your daily routine can enhance the functioning of the excretory system, leading to better health and well-being.

Your Check Progress

Q1) What is the main function of excretory system?

Q2) Name the primary organs involved in the human excretory system?

Q3) What is the structural and functional unit of the kidney?

Q4) What is the name of the tube that carries urine from the kidneys to the bladder?

Q5) Fill in the blanks:

i. The Kidney filter blood and produce_____ .

ii. The _____ stores urine temporarily before it is excreted.

iii. The process of removing waste products from the blood in the kidneys is called _____.

iv. The main nitrogenous waste excreted by human is_____

v. The blood vessels that brings oxygenated blood to the kidney is the ----------

4.6 LET US SUM UP

- The process by which our body eliminates the metabolic waste products is called excretion.
- The excretory system also known as renal or urinary system. It regulates electrolyte balance; maintain the acid base balance and RBC production.
- The excretory system consists of – two kidneys, two ureters, the bladder and the urethra.
- Urine is the result of the kidneys filtering waste, poisons, and excess chemicals out of the circulation.

- Urinary bladder is hallowed; distensible muscular organ situated in pelvic cavity when it is empty it is in collapsed state.
- Urethra extends from lower end of bladder and throws urine outs Urethral tube is near about 20 cm long in male and 6cm long female. The tube contains smooth muscle which helps to throw the urine outside by creating contractions.
- The nephron is the functional unit of the kidney, responsible for filtering blood and producing urine.
- **Bowman's Capsule (Glomerular Capsule):** A cup-shaped structure surrounding the glomerulus. Together, they form the renal corpuscle, where start the blood filtration. It's the main function received filtrate blood from the glomerulus.
- **Glomerulus:** A network of capillaries inside the Bowman's capsule. Where blood is filtered under pressure. It is filters water, ions, glucose, urea and other small molecules from the blood.
- **Proximal Convoluted Tubule (PCT):** A coiled tube close to the Bowman's capsule. Reabsorbs water, glucose, amino acids, and ions from the filtrate into the blood; it also secretes wastage materials into the tubule.
- **Loop of Henle:**A U-shaped structure with descending and ascending limbs. It is divided into two parts descending limb it permeable to water, allows water reabsorption and ascending limb it impermeable to water, reabsorbs sodium, potassium, and chloride ions.Establishes a concentration gradient in the kidney medulla, aiding water reabsorption.
- **Distal Convoluted Tubule (DCT):**Located further from the Bowman's capsule.Reabsorbs sodium and calcium while secreting potassium and hydrogen ions.Regulated by hormones like aldosterone and parathyroid hormone.
- **Collecting Duct:**Receives urine from multiple nephrons.Further concentrates urine by reabsorbing water under the influence of ant diuretic hormone (ADH).Transports urine to the renal pelvis.
- Yogic practices can positively impact the excretory system by improving its efficiency and promoting overall detoxification.

- Regular practice can prevent issues like urinary tract infections (UTIs), constipation, and other excretory-related disorders by maintaining the health of the organs.
- Integrating yoga into your daily routine can enhance the functioning of the excretory system, leading to better health and well-being.

✓ ANSWERS TO CHECK YOUR PROGRESS

Answer to Q1- The main function of the excretory system is to remove waste products and toxins from the body to maintain internal balance.

Answer to Q2- kidneys, Ureter, Urinary bladder and Urethra.

Answer to Q3- Nephron.

Answer to Q4 – Uretor.

Answer to Q5 - i) Urine ii) Urinary bladder iii) Filtration iv) Urea v) Renal Artery

4.7 FURTHER READING

Bhalekar.S (2018). ANATOMY & PHYSIOLOGY: YOGIC CONTEXT. Kaivalyadham, Lonavala

1) Bhalekar. S (2018). ANATOMY & PHYSIOLOGY: YOGIC CONTEXT, Kaivalyadham, Lonavala.
2) Waugh, A. & Grant, A. (2014). Ross & Wilson Anatomy and physiology in health and illness, Elsevier Health Sciences
3) Gray, H. Anatomy of the Human Body, Lea & Febiger, Philadelphia

4.8 MODEL QUESTIONS

Q1. What is excretory system?

Q2. What is the function of the kidney?

Q3. What is the role of the skin in excretion?

Q4. What is urea?

Q5. Describe the composition of urine.

Q6. Write a short note on the nephron.

Q7. Write short note on the kidney.

Q8. What are the functions of the ureters, bladder and urethra?

Q9. Describe the structure and functioning of the human kidney?

Q10. Describe the effect of yogic practices on excretory system?

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