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Chapter 10

URINARY SYSTEM

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OUTLINE

- Introduction to the urinary system
- Kidneys
- Ureters
- Urinary bladder
- Urethra
- Histology of the urinary organs
- Case study
- SAQ
- MCQ
- Answers
- References

INTRODUCTION TO THE URINARY SYSTEM

- Urinary system produces, stores and eliminates urine.
- It consists of paired kidneys and ureters and unpaired urinary bladder and urethra.

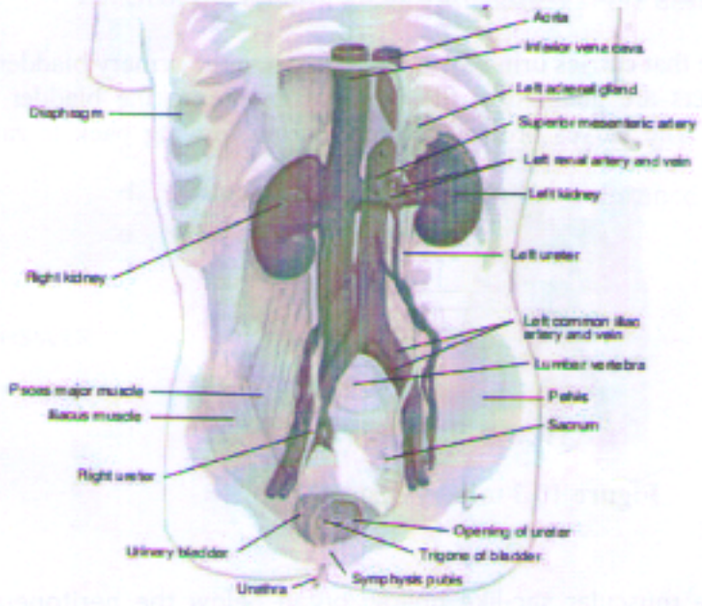


Figure 10.1 Posterior abdominal wall and some organs of the urinary system.

Functions of urinary system

- Removal of waste products from the body (mainly urea and uric acid)
- Regulation of electrolyte balance (e.g. sodium, potassium and calcium)
- Regulation of acid-base homeostasis
- Control of blood volume and maintenance of blood pressure

THE KIDNEY

- The kidneys are a pair of bean-shaped organs,
- Each kidney is a retroperitoneal organ found along the posterior wall of the abdominal cavity, one on each side of the vertebral column at the level of T12 and L3 vertebrae.
- The rib cage encloses and shields the upper parts of the kidneys, which lie on the lower side of the diaphragm.
- A condensed, membrane layer of renal fascia surrounds the kidneys, suprarenal glands, and surrounding fat, but not covers the inferior aspect
- Each is also surrounded by a layer of adipose tissue (perirenal fat) and renal fascia that hold it in place.
- The medial side of each kidney contains **hilus from which the** the renal artery enters the kidney, and the renal vein and ureter leave.

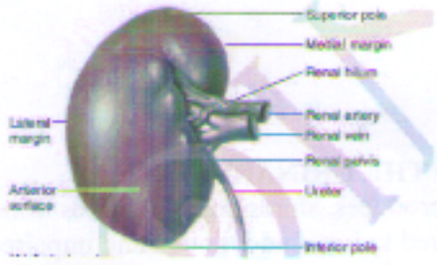


Figure 10.2 Anterior view of the Kidney

URETERS

- It is a tubular structure that carries urine from the kidneys to the urinary bladder,
- The ends of the ureters are guarded at the point of entry into the bladder by the ureterovesical valves. The valves prevent the urine from flowing back towards the kidneys.

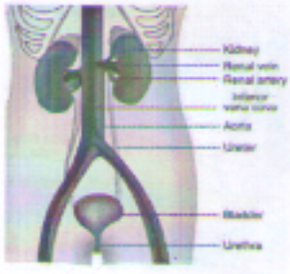


Figure 10.3 urinary system

6. URINARY BLADDER

- The **urinary bladder** is a muscular sac-like hollow organ below the peritoneum and behind the pubic bones

- the bladder is located superior to the prostate gland In men while its inferior to the uterus women,
- The urinary bladder stores urine temporarily,
- Its location varies depending on the its contents, it is located within the lesser pelvis (when empty), just behind the pubic bones; however, the urinary bladder could rise to the abdominal cavity if full.
- When empty, the bladder mucosa appears wrinkles with folds called rugae.
- The floor of the bladder contains a triangular area called **trigone which receives the ureters**
- The wall of the bladder has layer of smooth muscle called detrusor muscle which forms **internal urethral sphincter around the urethra**
- Its elastic walls allows it to stretch to hold up to 600-800 ml urine.

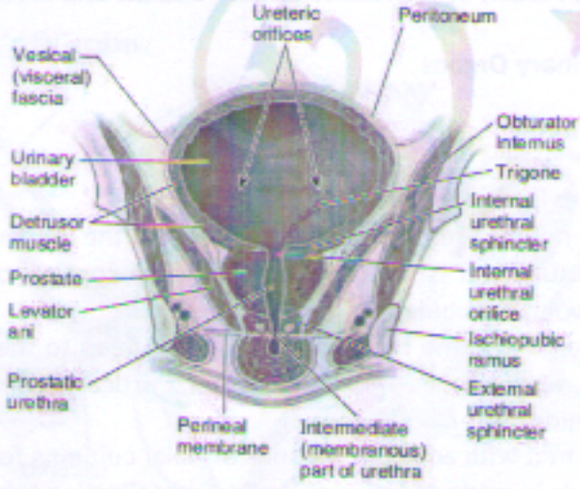


Figure 10.4 Structure of urinary bladder

URETHRA

- The urethra is the channel through which urine passes from the urinary bladder to the exterior of the body,
- The female urethra is around 2 inches long and ends anterior to the vaginal opening.
- In males, it is around 8-10 inches long and ends at the tip of the glans penis; the urethra is also an organ of male reproductive system as it also conveys semen,
- The flow of urine through the urethra is controlled by the internal external urethral sphincter muscles,
- The internal urethral sphincter is made of smooth muscle cells, while the external urethral sphincter is made up of skeletal muscles and is subject to volitional control.

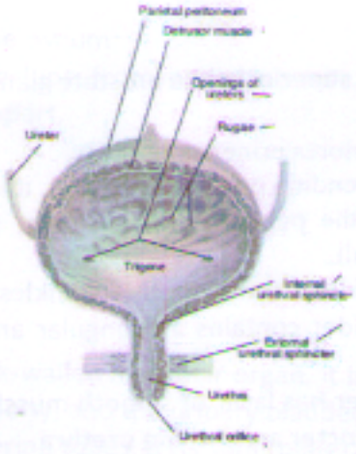


Figure 10.5 Frontal section of the female urinary bladder and urethra

Histology of the Urinary Organs

Structure of the Kidney

- Internal structure the kidney is organized such that;
- The lateral and middle areas form layers tissue and the medial area is a cavity.
- The external tissue layer is the **renal cortex which** consists of renal corpuscles and the associated convoluted tubules
- The inner tissue layer is the **renal medulla. It** lies deep to the cortex; it contains several renal pyramids, whose bases adjoin the cortex. Cortical tissues extend inwards, between the renal pyramids, as renal columns
- Each renal pyramid with adjacent portions of renal columns form a lobe of the kidney
- The renal medula is made of loops of Henle and collecting tubules

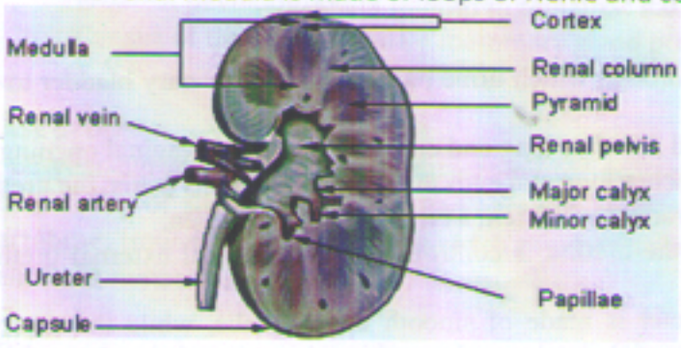


Figure 10.6 Interior of the kidney.

In the kidney,

- **Uriniferous tubules** extend throughout the substance of this organ They consist of nephrons and collecting tubules
- The nephrons filtrate and modify the plasma. Each consists of a renal corpuscle and renal tubules,

- Each renal corpuscle consists of a tuft of blood vessels called glomerulus The glomerulus is surrounded by the glomerular (Bowman's) capsule
- The renal tubule lies partly in the cortex and partly in the medulla; it consists of the convoluted and straight parts.
- Connective tissue occupies the interstices between the uriniferous tubules, thus binding them together.

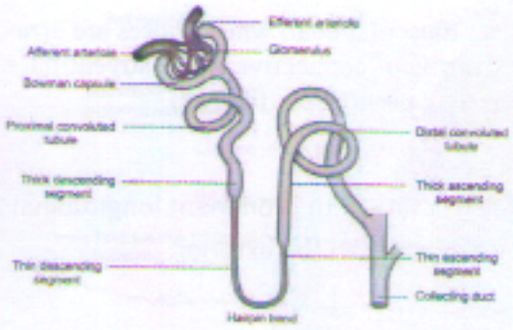


Figure 10.7 Structure of the Nephron

Juxtaglomerular apparatus

Juxtaglomerular apparatus is a specialized structure located beside the glomerulus of each nephron.

Juxtaglomerular apparatus is formed (i) Macula densa (ii) Extraglomerular mesangial cells and (iii) Juxtaglomerular cells.

juxtaglomerular apparatus secretes hormones and It also regulates the glomerular blood flow and glomerular filtration rate.

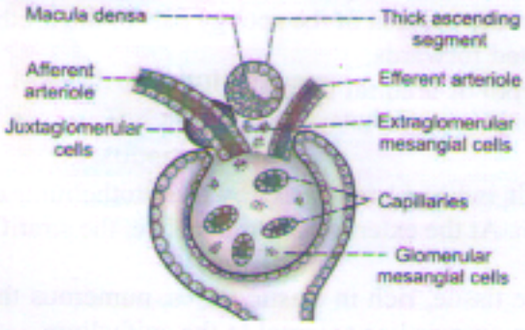


Figure 10.8 juxtaglomerular apparatus.

Structure of the Ureter

From internal externally, the ureter consist of:

- **Mucosa:** This is lined by the urothelium (or transitional epithelium;
- **Muscular coat:** This is usually not distinctly laminated; and abundant connective tissue

mingles with the muscle fibres of this coat

- **Fibrous adventitia:** This is rich in collagen and elastin fibres, and fibroblasts.

Structure of the Urinary Bladder

The urinary bladder

- Has a mucosa lined by the urothelium. It possesses no distinct submucosa (as in the ureter and calyces).
- Has an intermediate muscular coat, whose fibres are arranged into 3 layers
- Has an external covering of connective tissue adventitia, except on its superior surface. The latter is covered by peritoneum (serosa)

Urethra

The urethra is a tube-like structure with prominent longitudinal folds in the mucosa. It which conveys the urine from the bladder to the exterior.

Mucosa of Male Urethra

Note the following:

In men, in addition to urine transportation, spermatic duct which transport sperm during ejaculation join the urethra at the prostate gland.

- The prostatic urethra is lined by a transitional epithelium (urothelium); while the membranous and spongy parts of the urethra are lined by stratified columnar epithelium. Mucous cells are common among the columnar epithelial cells
- Patches of stratified squamous epithelium also occur in the spongy urethra
- The navicular fossa and the external urethral orifice are lined by keratinized stratified squamous epithelium.
- The lamina propria of urethral mucosa consists of loose connective tissue, with abundant elastic fibres. This layer lies external to the epithelium
- Several recesses, termed lacunae, occur in the mucosa of the spongy part of the urethra. The open ends of these lacunae are directed forwards
- Branched tubular glands open into the depth of urethral lacunae

The mucosa of the female urethra

- Possesses numerous longitudinal folds. It is lined proximally by the urothelium, and distally by stratified squamous epithelium. At the external urethral orifice, the stratified squamous epithelium is keratinized.
- Has a lamina propria of loose connective tissue, rich in elastic fibres, numerous thin-walled veins and nerve fibres. The lamina propria lies external to the epithelium
- Possesses numerous outpocketings of its wall. These outpocketings are lined by mucous-secreting cells.

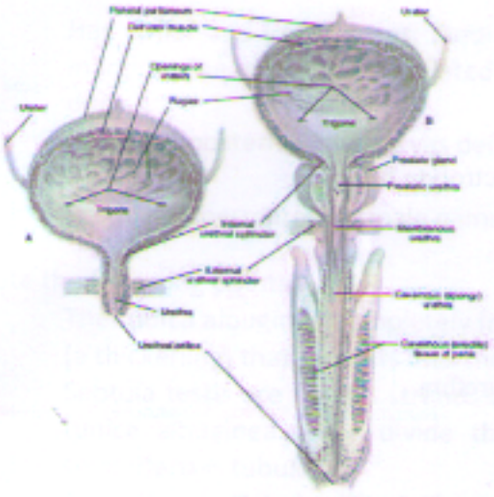


Figure 10.9 Frontal section of (A) female and (B) male urinary bladder and urethra

CASE STUDY

A 70-year-old man with prostatic hypertrophy complained of inability to urinate for several hours and was having extreme pain. His urologist had to pass a suprapubic tube into his urinary bladder to empty it. Why did urine build up within the man's urinary bladder; through what structures would the suprapubic tube traverse to reach the urinary bladder?

SAQ

- Using a table, compare and contrast the gross anatomy of the male and female urethrae. Add a note on their applied anatomy.
- Highlight differences between ureter and urethra
- Describe the internal structure of the kidney
- Describe juxtaglomerular apparatus. Add note on its functions
- Name the major parts of a nephron. State the general function of nephrons.

1 in 5 MCQ questions

▪ Which of the following promote detrusor contraction
(a) Parasympathetic fibres
(b) Ansa pelvicalis
(c) Sympathetic fibres
(d) Hypogatric nerve
(e) Lumbar splanchnic nerve fibres
▪ External urethral sphincter receives somatic fibres from
f. Pelvic splanchnic nerves
g. Iliohypogastric nerve
h. Obturator nerve
i. Pudendal nerve
(e) Inferior rectal nerve
3. Which of the following filters wastes and excess fluids from the blood
(a) Proximal convoluted tubule

(b) Loop of Henle
(c) Glomerulus
(d) Medulla apparatus
(e) Distal convoluted tubule

4. Which part of the kidney regulates electrolyte balance
3. Juxtaglomerular apparatus
4. Bowman capsule
5. Renal cortex
6. Loop of Henle
7. None of the above

5. Which of these muscles surround the urethra
VII. Detrusor
VIII. Urethral muscle
IX. Sphincter muscle
X. Obturator internus
XI. pudenda

ANSWERS
MCQ (1 in 5)

- A
- D
- C
- A
- C

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