

Functional Anatomy of the kidney

Urinary System Organs: Kidneys

- Filter 200 liters of blood daily, allowing toxins, metabolic wastes, and excess ions to leave the body in urine
- Regulate volume and chemical makeup of the blood
- Maintain the proper balance between water and salts, and acids and bases
- Produce renin to help regulate blood pressure and erythropoietin to stimulate red blood cell production
- Activate vitamin D and produce glucose during prolonged fasting

Other Urinary System Organs

- Urinary bladder – provides a temporary storage reservoir for urine
- Paired ureters – transports urine from the kidneys to the bladder
- Urethra – transports urine from the bladder out of the body

Other Urinary System Organs

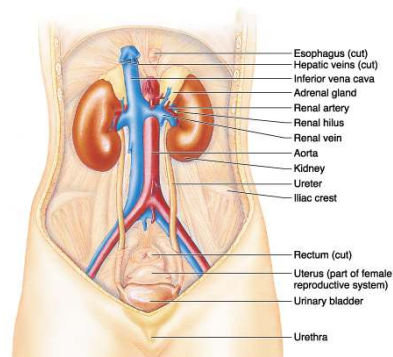


Figure 24.1a

Location and External Anatomy of the Kidneys

- The bean-shaped kidneys lie in a retroperitoneal position in the superior lumbar region and extend from the twelfth thoracic to the third lumbar vertebrae
- The right kidney is lower than the left because it is crowded by the liver
- The lateral surface is convex and the medial surface is concave, with a vertical cleft called the renal hilus leading to the renal sinus
- Ureters, renal blood vessels, lymphatics, and nerves enter and exit at the hilus

Location and External Anatomy of the Kidneys

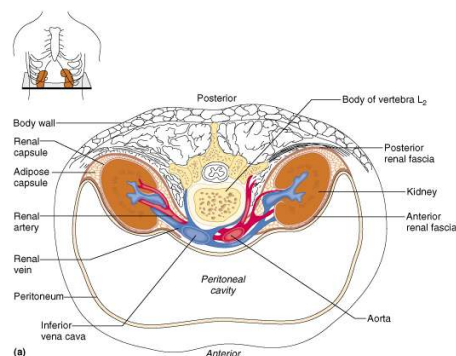


Figure 24.2a

Kidney: Associated Structures

- A functionally unrelated adrenal gland sits atop each kidney
- Three supportive tissues surround the kidney
 - Renal capsule – adheres to the kidney surface and prevents infections in surrounding regions from spreading to the kidneys
 - Adipose capsule – cushions the kidney and helps attach it to the body wall
 - Renal fascia – dense fibrous connective tissue that anchors the kidney

Internal Anatomy of the Kidneys

- A frontal section shows three distinct regions
 - Cortex – the light colored, granular superficial region
 - Medulla – exhibits cone-shaped medullary (renal) pyramids
 - Pyramids are made up of parallel bundles of urine-collecting tubules
 - Renal columns are inward extensions of cortical tissue that separate the pyramids
 - The medullary pyramid and its surrounding capsule constitutes a lobe
 - Renal pelvis – flat, funnel-shaped tube lateral to the hilus within the renal sinus

Internal Anatomy of the Kidneys

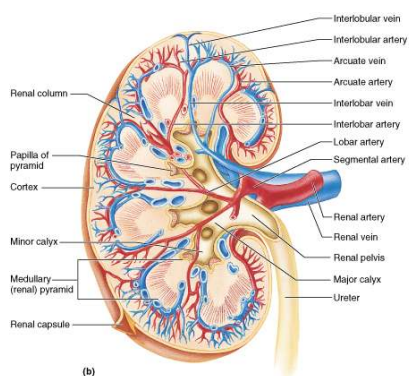


Figure 24.3b

Internal Anatomy of the Kidneys

- Major calyces – large branches of the renal pelvis
 - Collect urine draining from papillae
 - Empty urine into the pelvis
- Urine flows through the pelvis and ureters to the bladder

Blood and Nerve Supply

- Approximately one-fourth (1200 ml) of systemic cardiac output flows through the kidneys each minute
- Arterial flow into and venous flow out of the kidneys follow similar paths
- The nerve supply is via the renal plexus

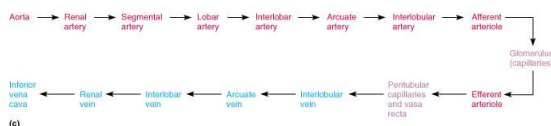
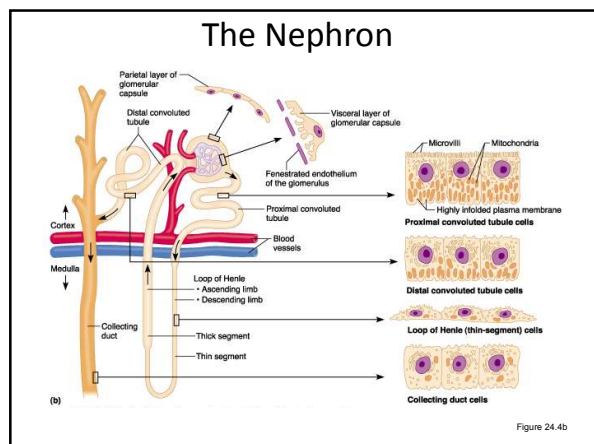


Figure 24.3c

The Nephron

- Nephrons are the blood-processing units that form urine, consisting of:
 - Glomerulus – a tuft of capillaries associated with a renal tubule
 - Glomerular (Bowman's) capsule – blind, cup-shaped end of a renal tubule that completely surrounds the glomerulus
 - Renal corpuscle – the glomerulus and its Bowman's capsule
 - Glomerular endothelium – fenestrated epithelium that allows solute-rich, virtually protein-free filtrate to pass from the blood into the glomerular capsule



Anatomy of the Glomerular Capsule

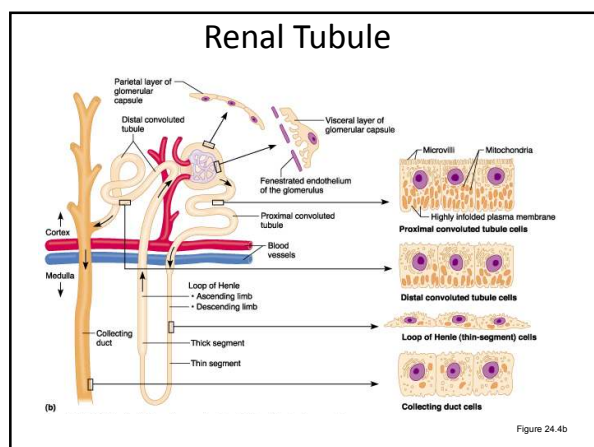
- The external parietal layer is a structural layer
- The visceral layer consists of modified, branching, epithelial podocytes
- Extensions of the octopus-like podocytes terminate in foot processes
- Filtration slits – openings between the foot processes that allow filtrate to pass into the capsular space

Renal Tubule

- Proximal convoluted tubule (PCT) – composed of cuboidal cells with numerous microvilli and mitochondria
 - Reabsorbs water and solutes from filtrate and secretes substances into it

Renal Tubule

- Loop of Henle – a hairpin-shaped loop of the renal tubule
 - Proximal part is similar to the proximal convoluted tubule
 - Proximal part is followed by the thin segment (simple squamous cells) and the thick segment (cuboidal to columnar cells)
- Distal convoluted tubule (DCT) – cuboidal cells without microvilli that function more in secretion than reabsorption



Connecting Tubules

- The distal portion of the distal convoluted tubule nearer to the collecting ducts
- Two important cell types are found here
 - Intercalated cells
 - Cuboidal cells with microvilli
 - Function in maintaining the acid-base balance of the body
 - Principal cells
 - Cuboidal cells without microvilli
 - Help maintain the body's water and salt balance

Nephrons

- Cortical nephrons – 85% of nephrons; located in the cortex
- Juxtamedullary nephrons:
 - Are located at the cortex-medulla junction
 - Have loops of Henle that deeply invade the medulla
 - Have extensive thin segments
 - Are involved in the production of concentrated urine

