

Urinary System

The urinary system, also known as the renal system or urinary tract, consists of

- The kidneys (two)
- Ureters (two)
- Bladder (one)
- The urethra(one)

The purpose of the urinary system is to eliminate waste from the body, regulate blood volume and blood pressure, control levels of electrolytes and metabolites, and regulate blood pH.

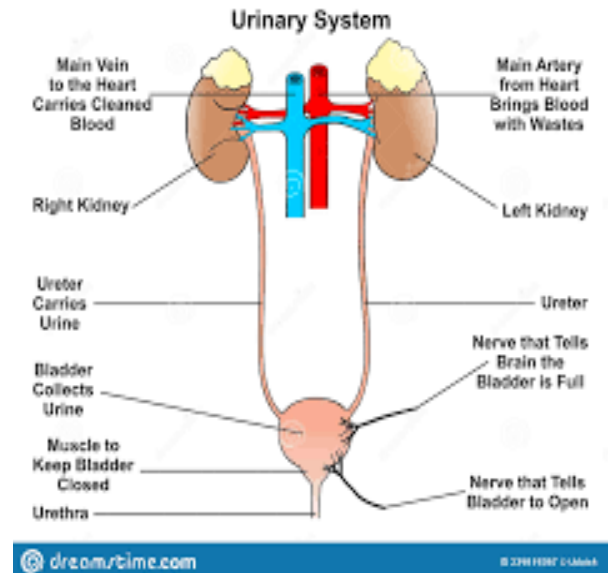
The urinary tract is the body's drainage system for the eventual removal of urine.

There are several functions of the Urinary System:

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

The kidneys:

- Reddish-brown, bean shaped 12cm long, 6cm wide, 3cm thick
- High on posterior abdominal wall at the level of T₁₂ to L₃- superior lumbar region
- Retroperitoneal & against the dorsal body wall
- The right kidney is slightly lower than the left, convex laterally attached to ureters, renal blood vessels, and nerves at renal hilus (medial indentation)
- Atop each kidney is an adrenal gland



Coverings of the Kidneys:

Adipose capsule

- Surrounds the kidney
- Provides protection to the kidney
- Helps keep the kidney in its correct location against muscles of posterior trunk wall
- Ptosis-kidneys drop to a lower position due to rapid fat loss, creating problems with the ureters.
- Ptosis can lead to hydronephrosis, a condition where urine backs up the ureters and exerts pressure on the kidney tissue.

Renal capsule

- Surrounds each kidney

Regions of the Kidney:

Three regions of kidneys

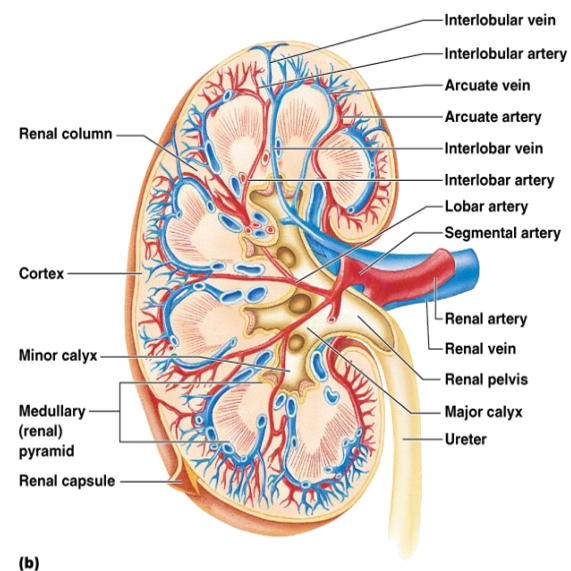
- Renal cortex
- Renal medulla
- Renal pelvis

Renal cortex

- outer region, forms an outer shell
- Renal columns- Extensions of cortex- material inward

Renal medulla

- Inside the cortex, contains medullary (renal) pyramids
- Medullary pyramids – triangular regions of tissue in the medulla, appear striated



Renal pelvis

- Inner collecting tube, divides into major and minor calyces
- Calyces – cup-shaped structures enclosing the tips of the pyramids that collect and funnel urine towards the renal pelvis

Nephrons:

The microscopic functional unit constituting the parenchyma (functional portion) of kidneys is known as Nephron.

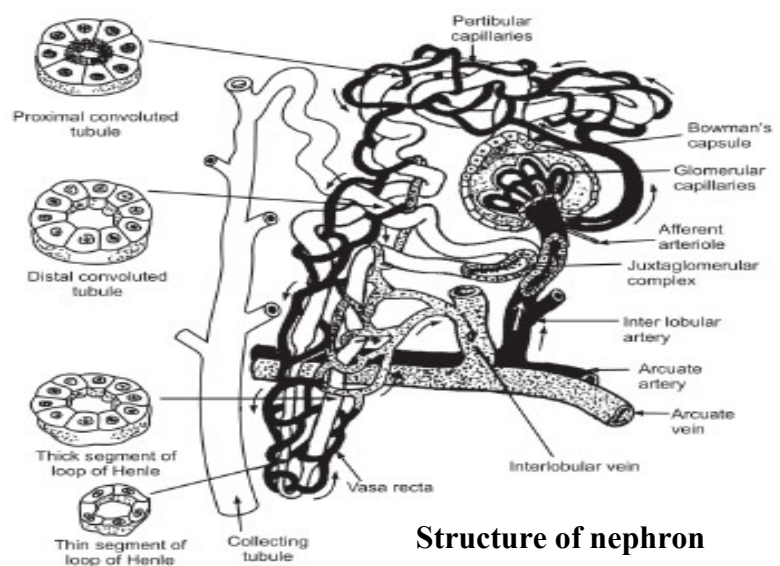
In each kidney there are about one million nephrons.

Each nephron consists of two parts, i.e. a renal corpuscle and a tubule.

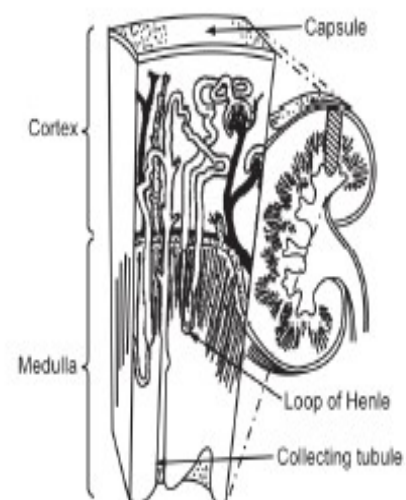
The proximal end of the closed tubule is indented to form a double walled cup shaped structure known as glomerular capsule (Bowman's capsule).

There is a fine network of blood capillaries in close contact within the cup shaped glomerular capsule, called as glomerular capillaries. **The glomerular capsule with glomerular capillaries is known as the renal corpuscle (Malpighian body).**

Beyond glomerular capsule, the nephron forms a long tube, with convolutions and a loop, this part of nephron is known as tubule



Structure of nephron



Location of a nephron in kidney

Renal Corpuscles:

These are located in the cortical region of the kidney known as cortical nephrons.

Some of the renal corpuscles located deep in the cortex, near the medulla of the kidney are termed as juxtamedullary (besides the medulla) and with their tubules in medullary region are known as Juxtamedullary nephrons.

Glomerulus:

Glomerulus is a tuft of capillaries formed by

- The afferent arteriole – a fine branch of renal artery.
- Blood from the glomerulus is carried away by an efferent arteriole.

Large afferent arteriole-arises from interlobular artery (feeder vessel); large in diameter, high resistance vessels that force fluid & solutes (filtrate) out of the blood into the glomerular capsule.

Narrow efferent arteriole-merges to become the interlobular vein; draining vessel.

99% of the filtrate will be reclaimed by the renal tubule cells and returned to the blood in the peritubular capillary beds (blood vessels surrounding renal tubule).

Renal Tubule:

It has three main parts: proximal convoluted tubule, loop of Henle, and distal convoluted tubule.

The renal tubule begins with a double walled cup-like structure called Bowman's capsule, which encloses the glomerulus.

The continuation of glomerular capsule in the form of tube which is coiled is referred as proximal (close to capsule) convoluted tubule.

The proximal convoluted tubule continues further to form a 'U' shaped loop, called as loop of Henle and is situated in the pyramid of the medulla of kidney.

The descending limb of this loop is formed of a thin squamous epithelium and is referred as thin segment of the loop. The ascending limb of the loop passes back into the cortex of the kidney.

The ascending limb of the loop on entering into cortex region comes into contact with the blood vessel called afferent arteriole.

The cells of both tubule and blood vessel get modified and form a specialized structure called as Juxtaglomerular apparatus. Beyond the Juxtaglomerular apparatus the tubule further becomes coiled and is referred as distal convoluted tubule.

The distal convoluted tubules of different nephrons join to form a common collecting tubule.

The Ureters:

The ureters are a pair of narrow, thick walled muscular tubes which convey urine from kidneys to urinary bladder.

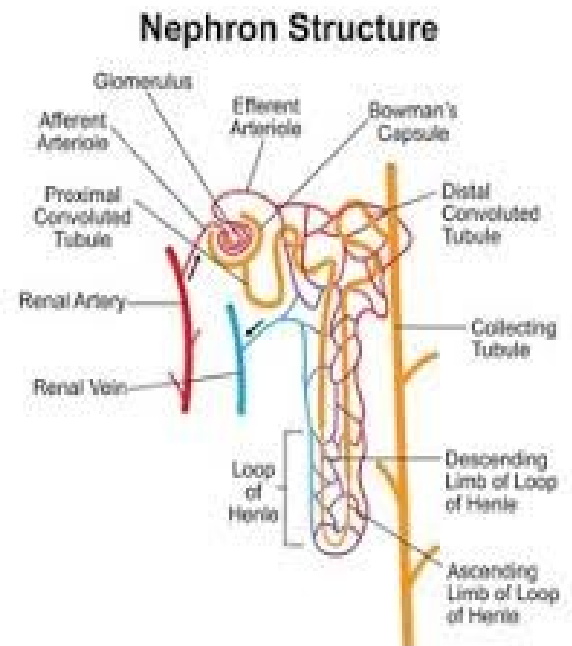
Dimensions:

Each ureter is about 25cm (10 inch) long.

The upper half lies in the abdomen and the lower half in the pelvis.

It measures 3mm diameter, but it slightly constricted at three places.

- At the pelviureteric junction



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- At the brim of lesser pelvis
- At its passage through the bladder wall

Ureter is divided into 2 parts:

- From the site of origin to pelvic brim- abdominal part
- From pelvic brim to entry into urinary bladder- pelvic part

Function: transports urine from kidney to urinary bladder

Urinary Bladder:

The urinary bladder is a hollow, muscular organ, which functions as the reservoir for the urine received from the kidneys and to discharge it out periodically.

Position:

- Empty bladder, in the adult situated within the pelvis. When distended, it rises upto the abdominal cavity and becomes an abdominal pelvic organ.
- The mean capacity of the bladder is 220ml, filling beyond 220ml causes a desire to micturate. Filling upto 500ml may be tolerated, but it becomes painful.

Shape:

An empty bladder is 4-sided pyramid in shape and has:

- 4 angles- an apex, neck & 2 lateral angles.
- 4 surfaces- base (posterior surface), 2 inferiolateral surfaces, superior surfaces.

Function: Urinary bladder stores urine and expels through urethra

Urethra:

The urethra is a canal extending from the neck of the bladder to the exterior, at the external urethral orifice.

- Male urethra: about 20cm (8'') long
- Female urethra: 3-4 cm (1.5'') long

Function: discharge urine from the body.