The Urinary System

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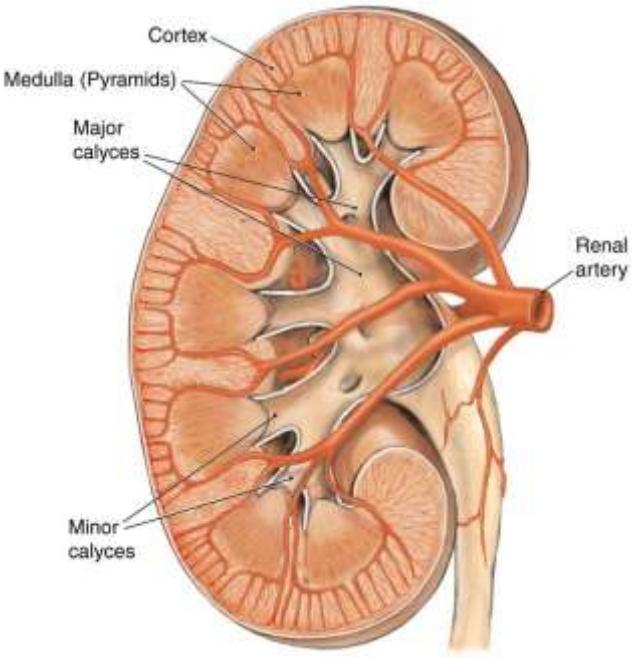
(2021)



Overview

The urinary system is formed of several organs with different functions:

Organ	Functions
Kidneys (2)	1. Regulate blood volume and contents, pH, and blood pressure. 2. Produce hormones. 3. Excrete waste products in urine.
Ureters (2)	Transport urine from kidneys to urinary bladder.
Bladder (1)	Stores urine and expels it into the urethra when necessary.
Urethra (1)	Excretes urine to the outside of the body.

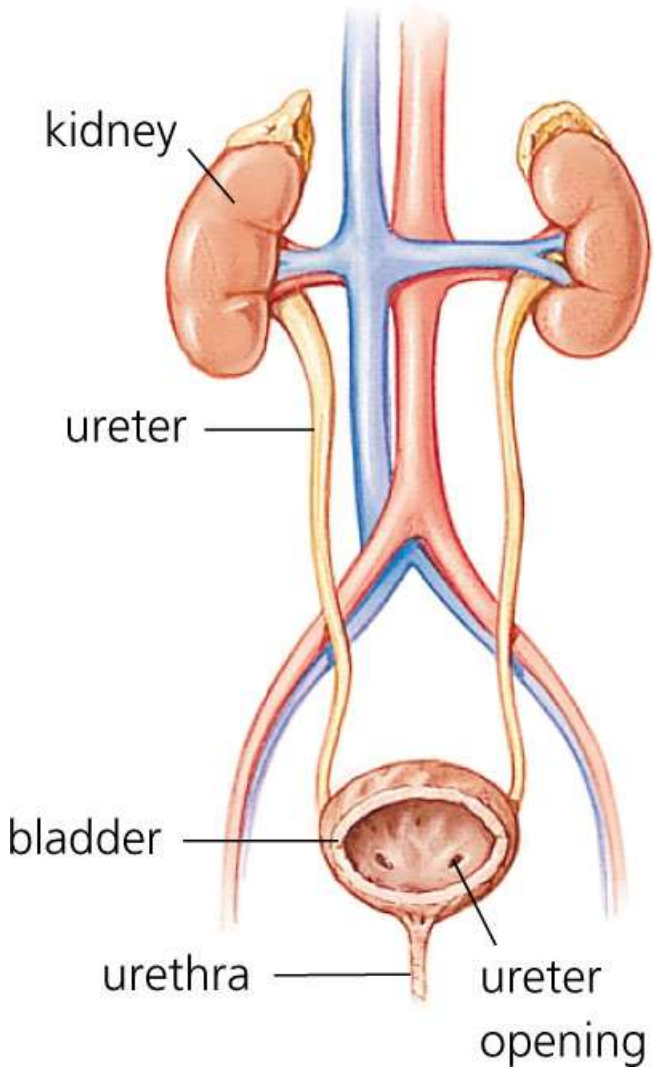


Fig.1: Organs of the urinary system.

The Kidneys

- Bean-shaped organs.
- Located on the posterior abdominal wall on each side of the vertebral column.
- Right kidney is lower (pushed down by the liver).
- Each kidney has upper and lower poles, anterior and posterior surfaces, and medial and lateral borders.
- The concave medial border is the hilum. Through it pass: the ureter, renal artery and vein, lymphatics, and nerves.

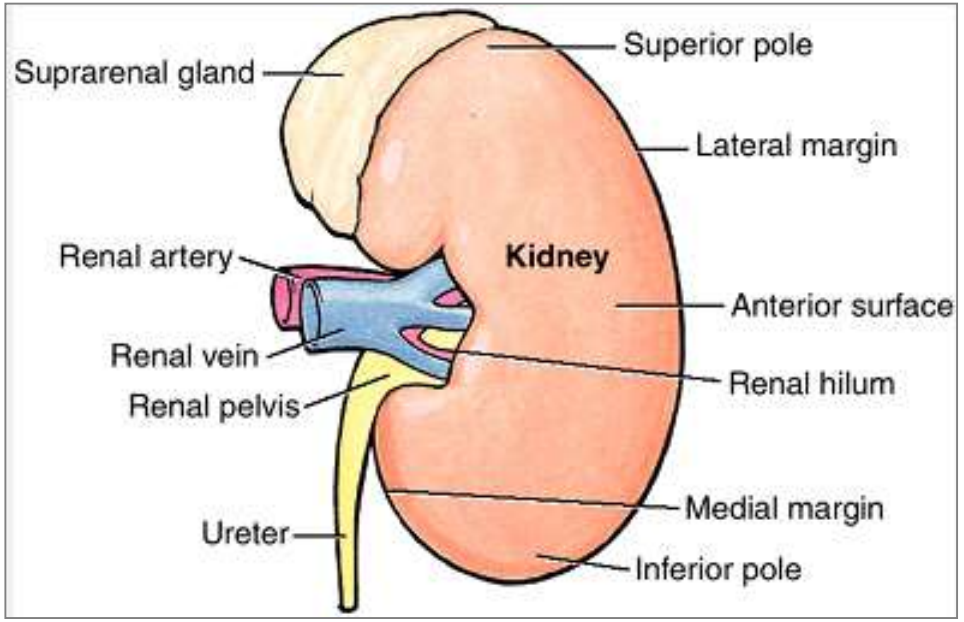


Fig.2: The kidney.

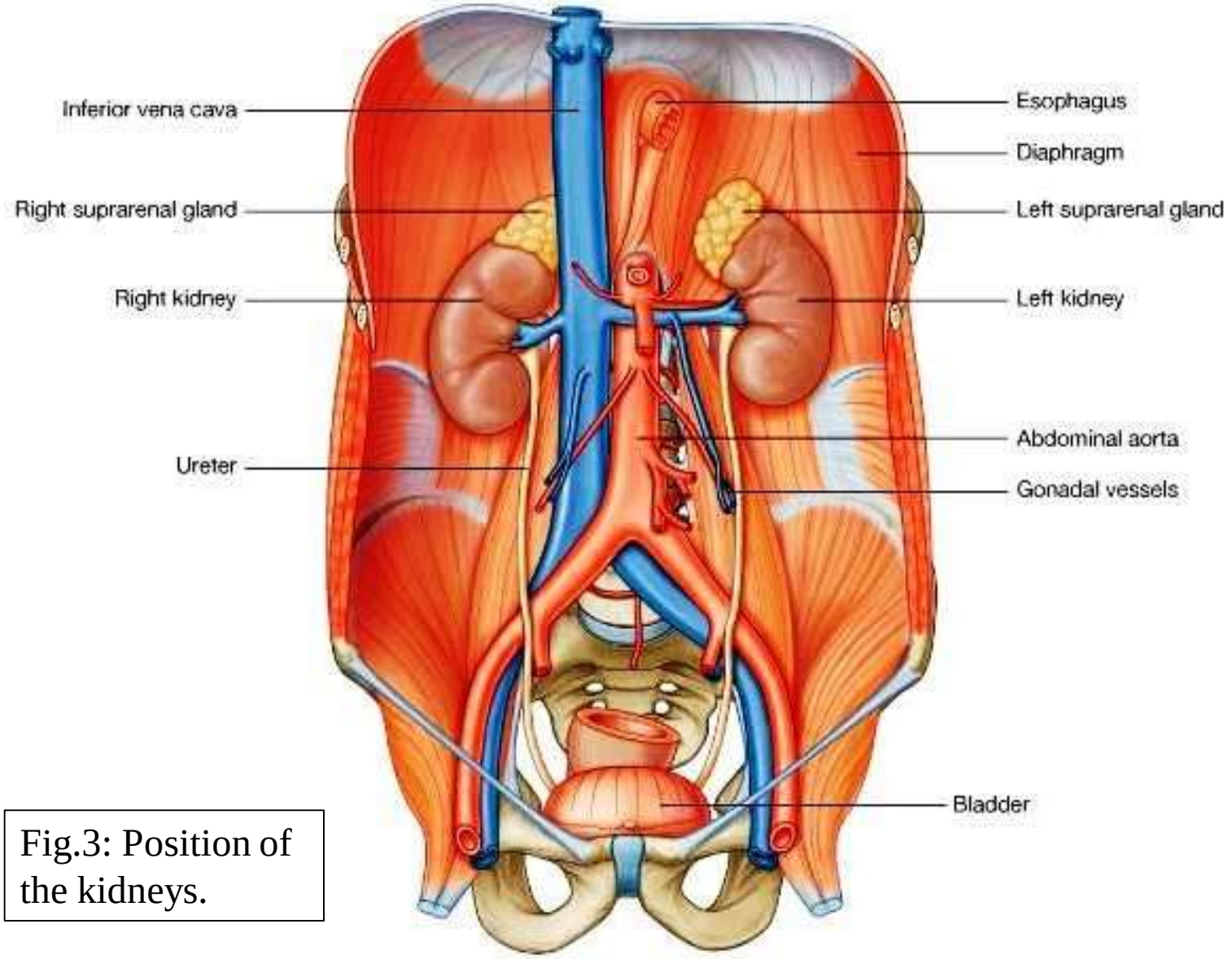


Fig.3: Position of the kidneys.

Internal Anatomy of the Kidneys

- ***Renal cortex*** – superficial
  - Outer cortical zone.
  - Renal columns – portions of cortex that extend between renal pyramids.
- ***Renal medulla*** – inner region
  - Several cone shaped renal pyramids – base faces cortex and apex (renal papilla) points toward hilum.

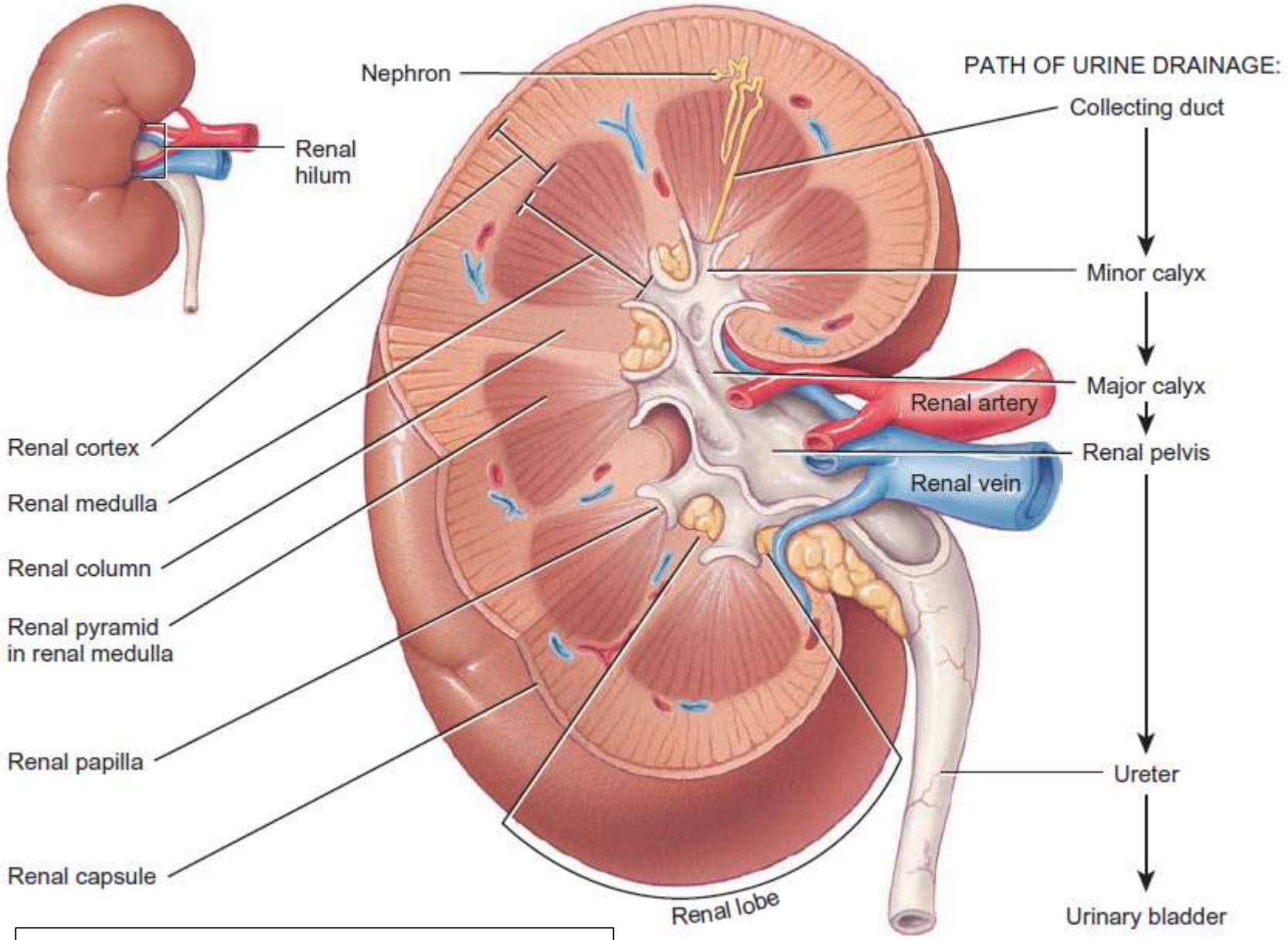


Fig.4: Internal anatomy of the kidney.

The Nephron

- Nephrons are the functional units of the kidneys.
- There are millions of nephrons in each kidney.

- They are formed of 2 parts:
  - **Renal corpuscle** – filters blood plasma.
    - Glomerulus – capillary network.
    - Glomerular (Bowman's) capsule – double-walled cup surrounding the glomerulus.
  - **Renal tubules** – where reabsorption takes place.
    - Proximal convoluted tubule (PCT).
    - Descending and ascending limbs of the loop of Henle (nephron loop).
    - Distal convoluted tubule (DCT).

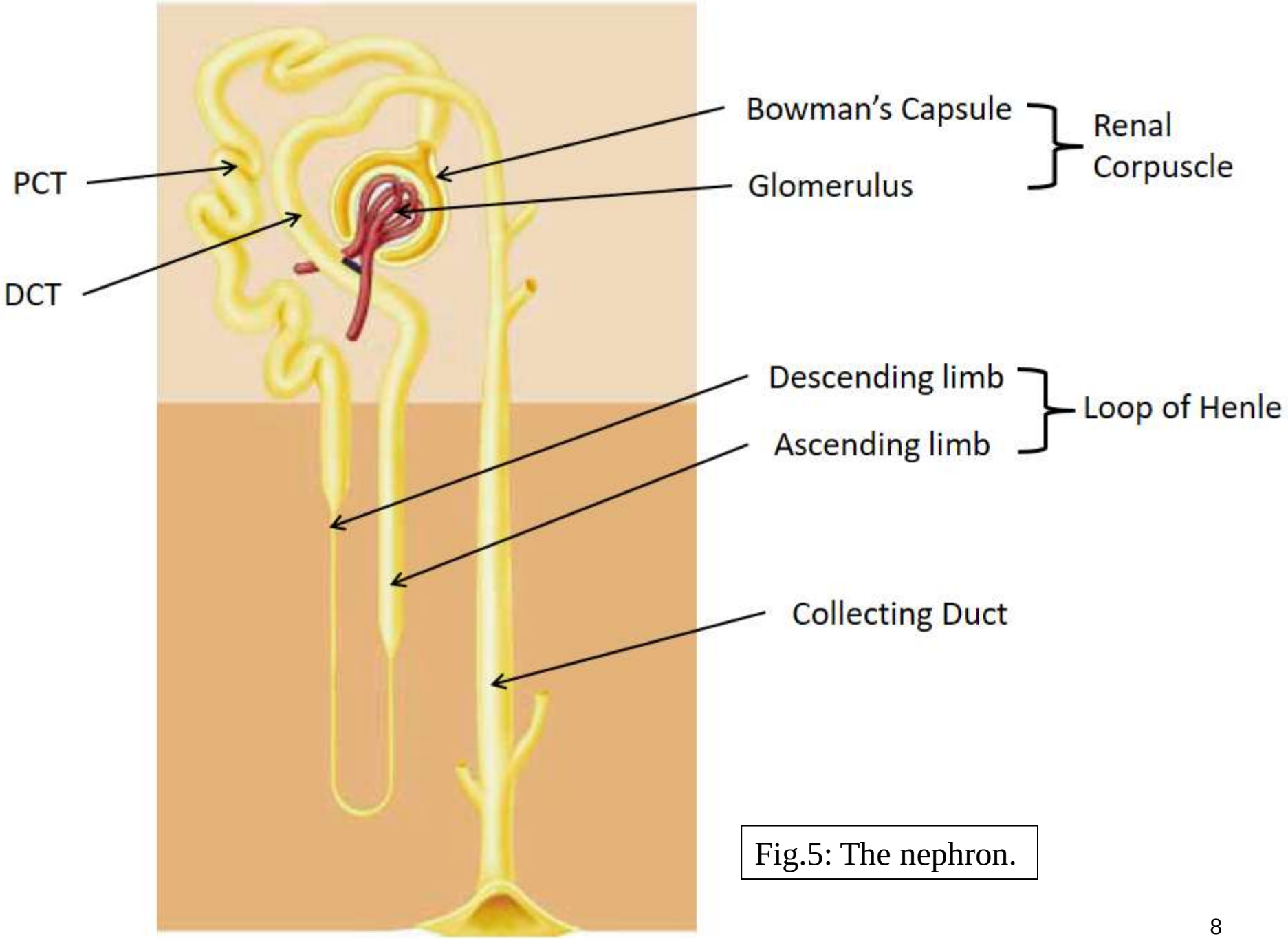


Fig.5: The nephron.

- Collecting ducts open into minor calyces. Several of these open into a major calyx. 2-3 major calyces open into the renal pelvis (the upper dilated part of the ureter).

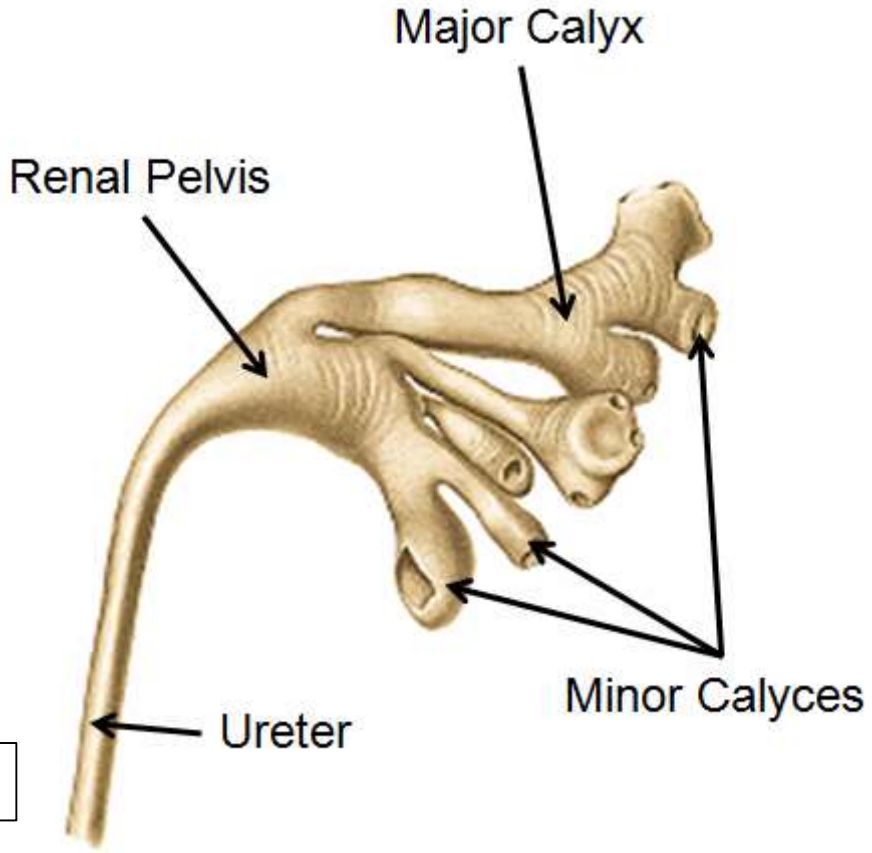


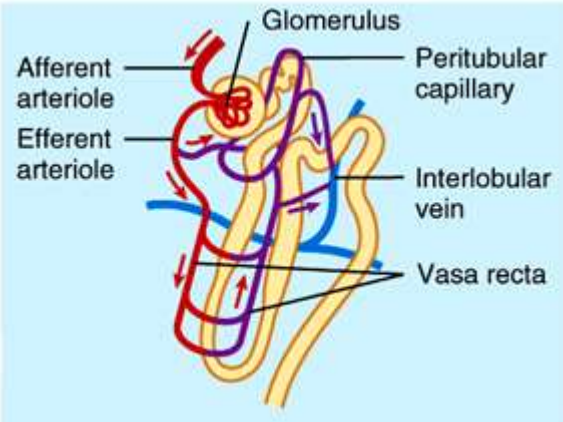
Fig.6: Minor and major calyces.

Blood supply of the kidney

- Because the kidneys function in the regulation of blood contents, they receives an abundant blood supply despite their small size.

- Blood is supplied to each kidney by the **renal artery.**
- Renal artery forms **segmental arteries.**
- Segmental arteries give rise to **interlobar arteries** (pass between lobes).
- Interlobar arteries arches near the base of the renal pyramids to form the **arcuate arteries.**
- From the arcuate arteries arise the **interlobular arteries.**
- From the interlobular arteries arise a single **afferent arteriole** for each nephron.
- Afferent arteriole forms a ball of capillaries called **glomerulus.**
- Capillaries then unite to form a single **efferent arteriole.**

- The efferent arteriole will form **peritubular capillaries** around the renal tubules.
- Blood is drained into veins corresponding to the arteries. The blood is finally collected into a single **renal vein** that exits the kidney through the hilum. The right and left renal veins drain into the **inferior vena cava.**



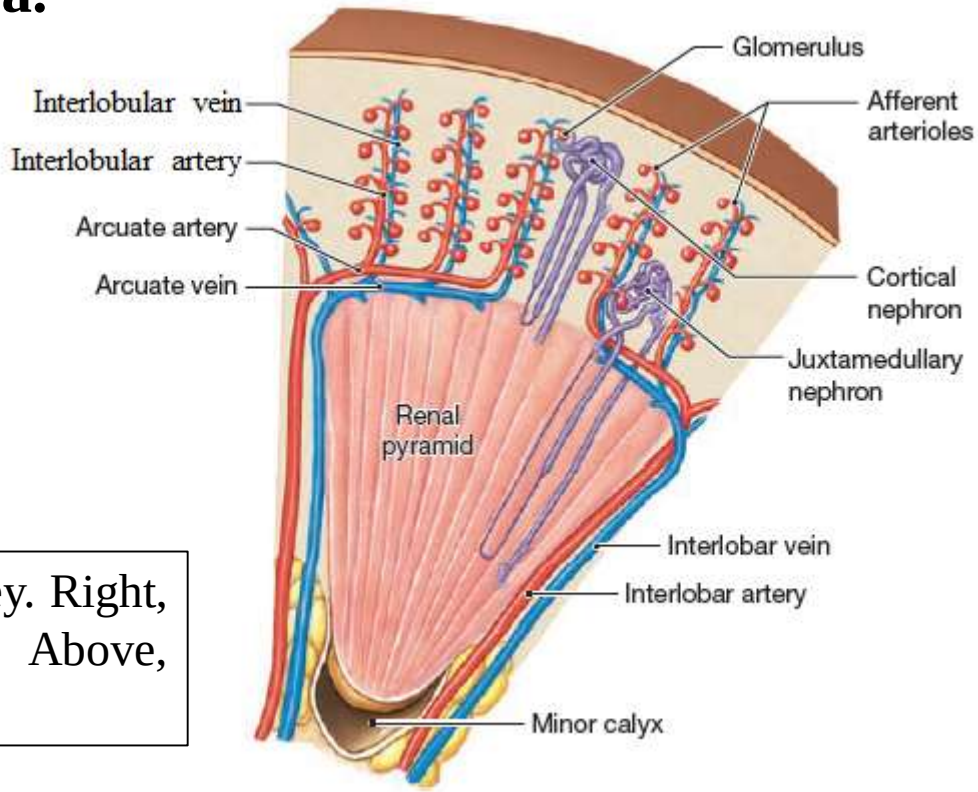
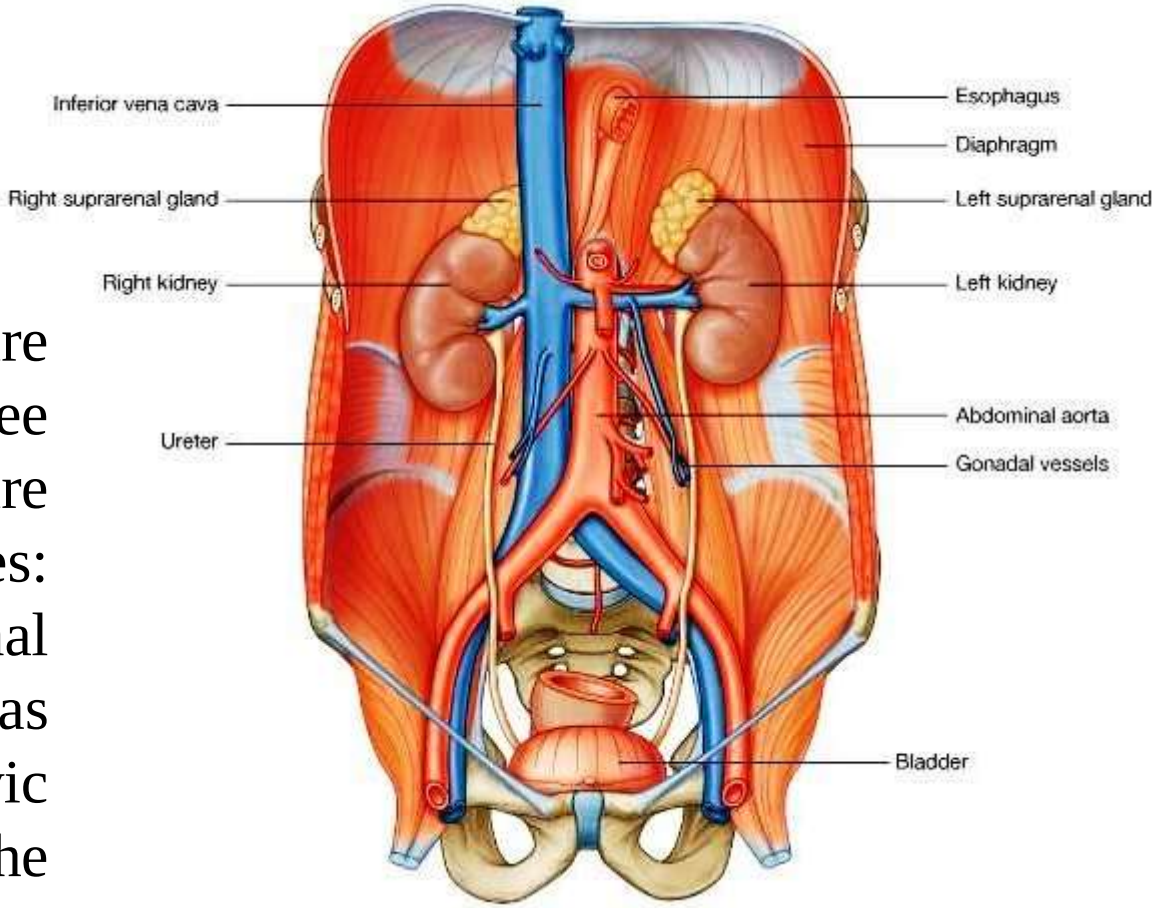


Fig.7: Blood supply of the kidney. Right, blood supply of a renal lobe. Above, blood supply of a nephron.

The Ureters

- Two long muscular tubes that transport urine from the kidneys to the bladder.
- The upper part of the ureter is dilated and forms the renal pelvis.
- ***Course:***
  - Pass inferiorly in front of the psoas major muscle.
  - Cross the bifurcation of the common iliac artery.
  - Pass down in the pelvis.
  - Enter the posterior wall of the urinary bladder.

- The ureters are constricted at three regions. These are common sites of stones: (1) junction of renal pelvis and ureter, (2) as ureter crosses pelvic brim, and (3) within the wall of the bladder



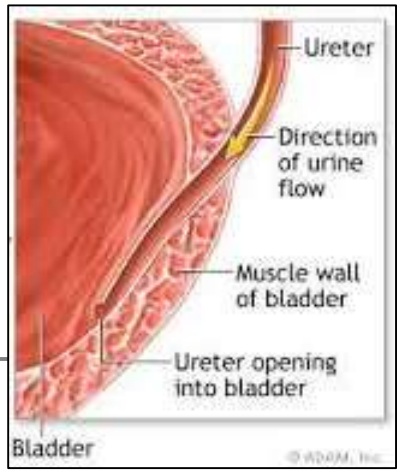


Fig.8: Course of the ureters. The small image shows the passage of the ureter within the bladder wall.

The Urinary Bladder

- The bladder is a storage site for urine. It's a pelvic organ. But, when it's filled with urine, it may reach into the abdominal cavity.
- An empty bladder is pyramidal in shape.
- It has a superior, a posterior and two inferolateral surfaces.
- The base is posterior, and its apex is directed anteriorly and related to the pubic symphysis.
- The base is shaped like an inverted triangle. The two ureters enter the bladder through the superior corners of the base. The urethra exits the bladder through the inferior corner of the base.

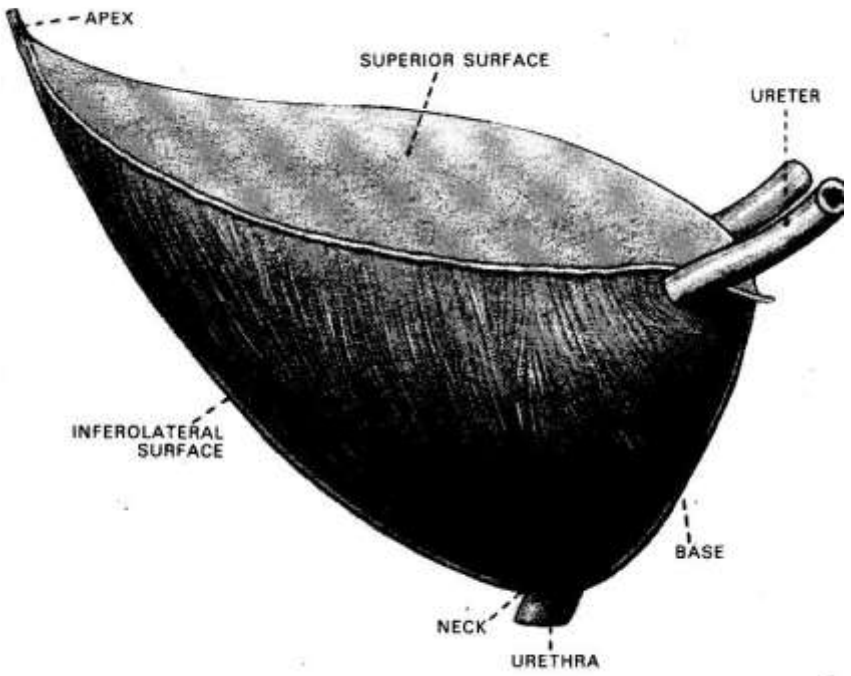


Fig.9: The urinary bladder.