Urogenital Module

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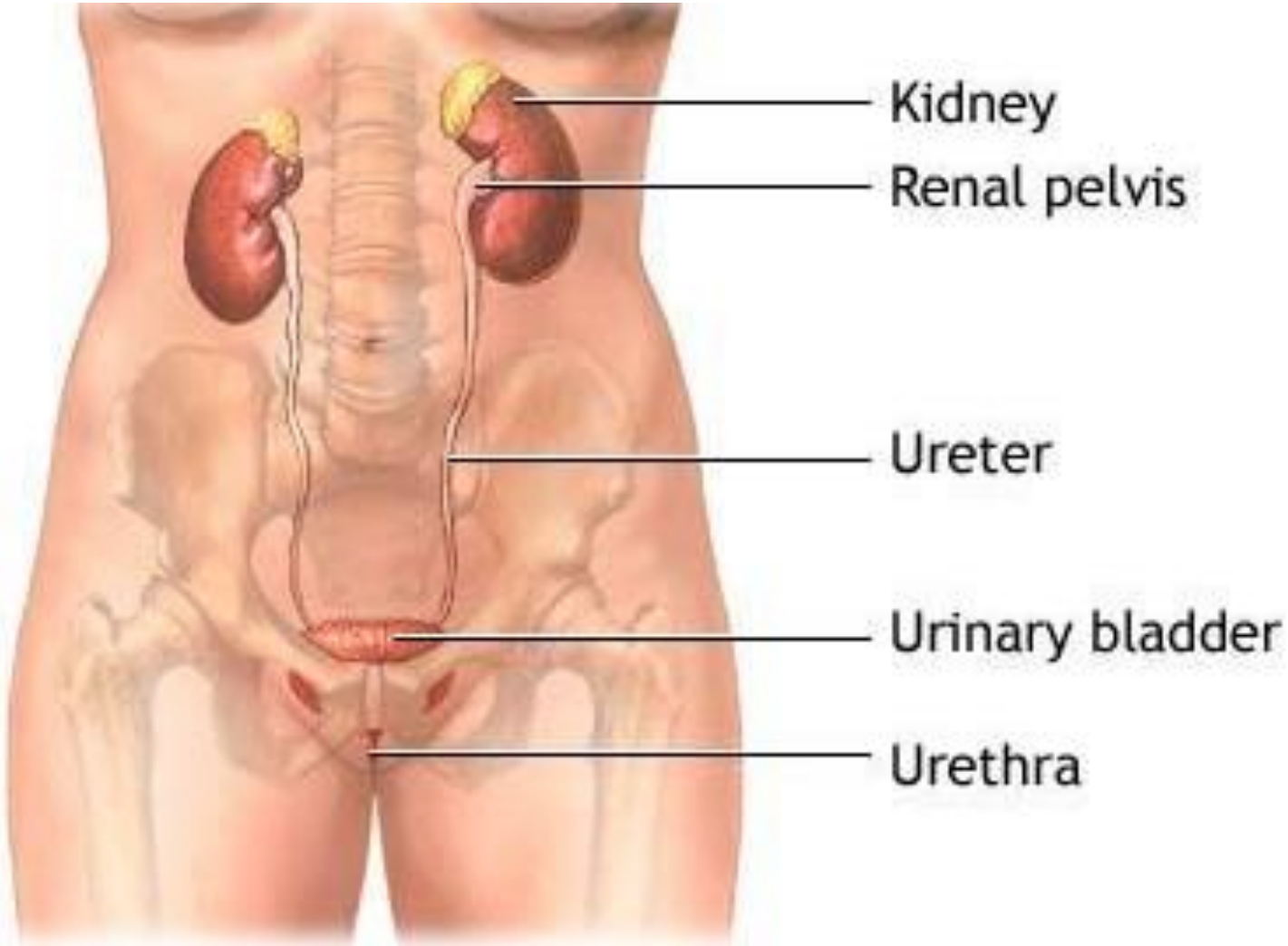
UGS An Overview

Urogenital System

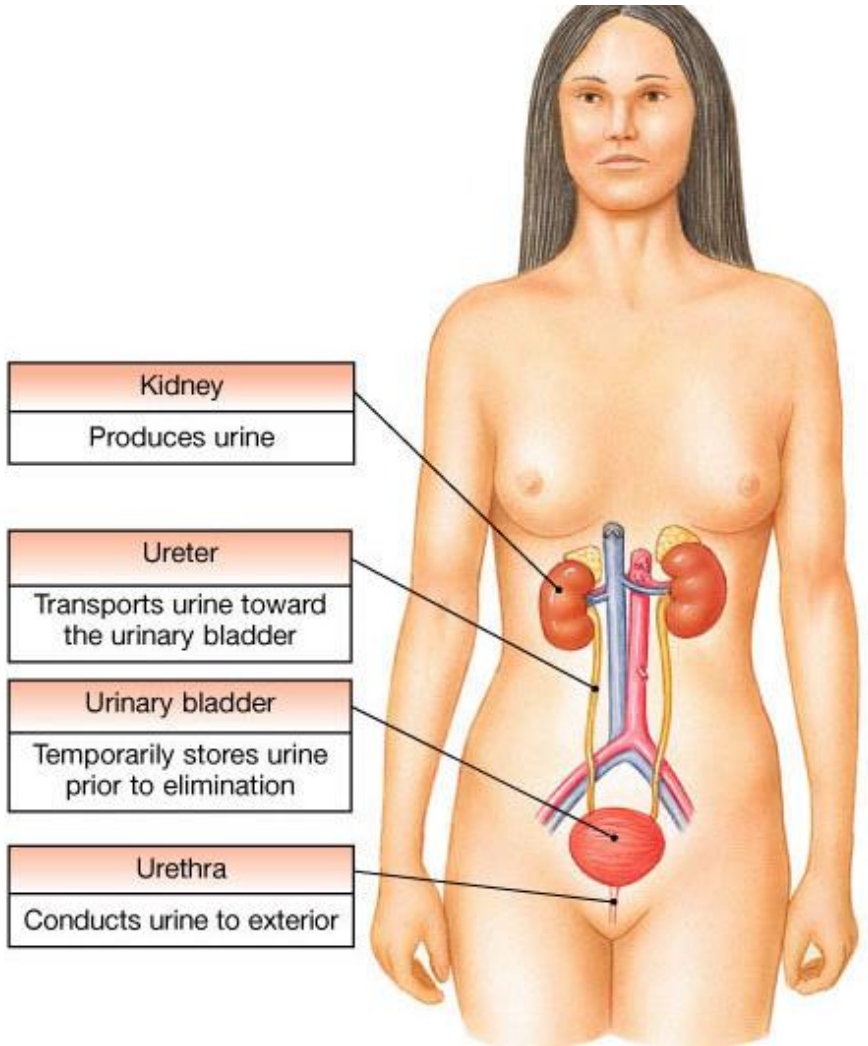
- **By the end of this session, you should be able to:**
- Know the anatomy of the kidneys
- Get a hint knowing the nephron
- Identify the blood flow (supply) of the kidney
- Recognize the anatomy of the ureters, the urinary bladder, and the urethra
- Enumerate the functions of the urinary system

Urinary system



Urinary System

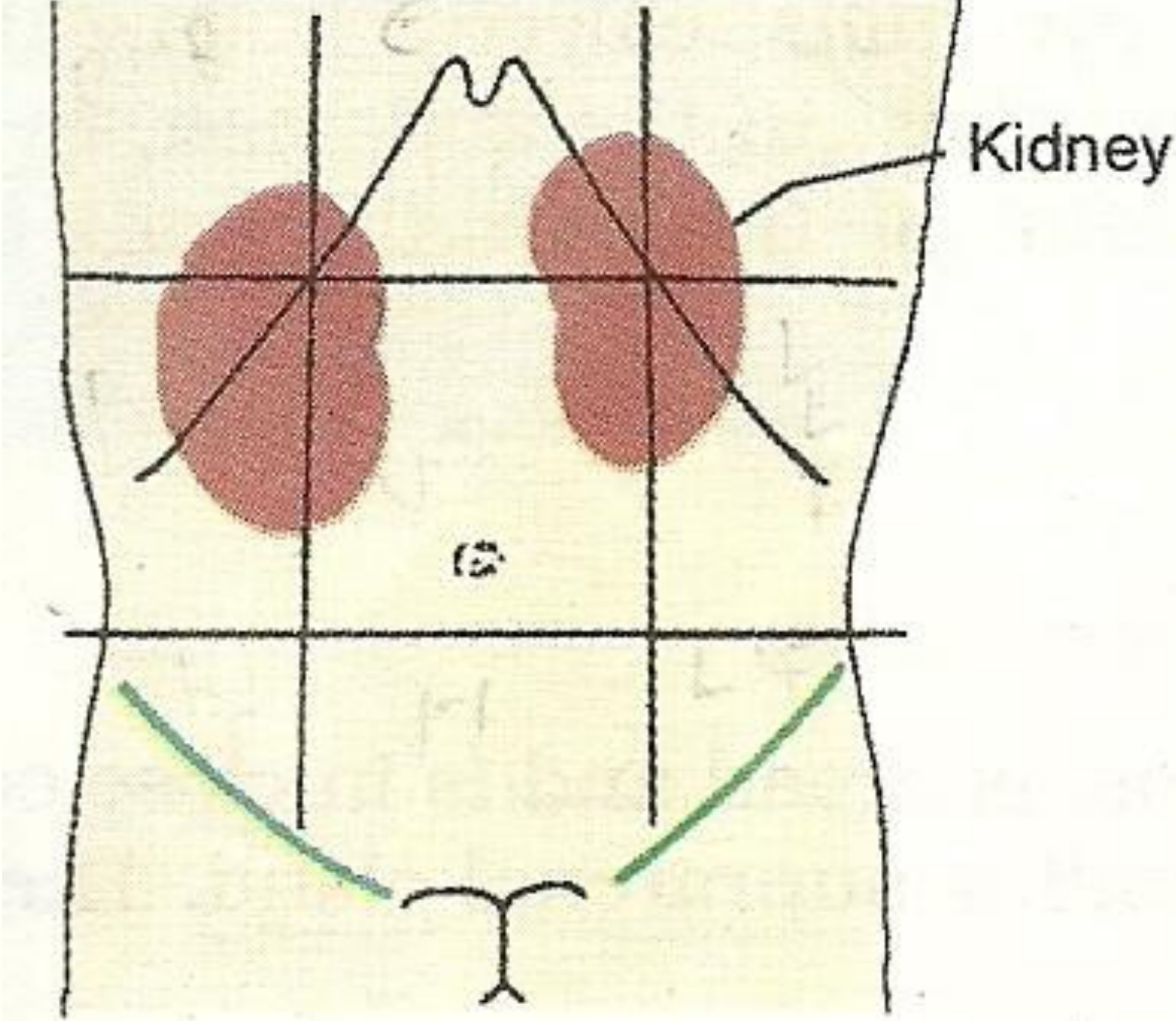
- Kidneys – produce urine
- Ureters –transport urine to bladder
- Urinary bladder - stores urine
- Urethra transports urine to exterior



The kidneys

- The kidneys are bean like retroperitoneal structures. The 2 kidneys lies on each side of the vertebral column. Each is at the size of a tightly clenched fist.

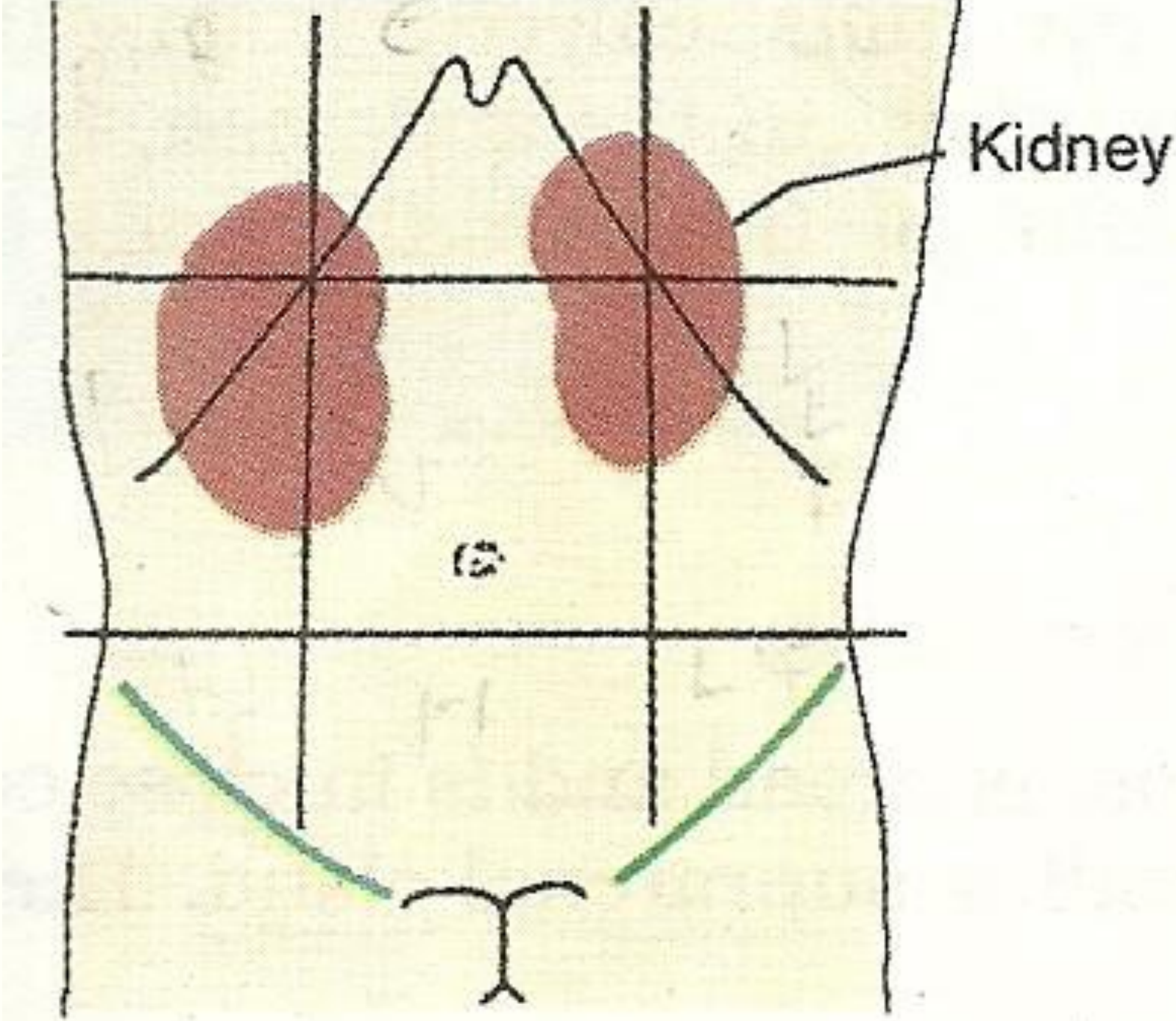
- The kidneys occupies the epigastric , hypochondrial, lumbar & umbilical regions, with the left kidney slightly nearer to the midline


Kidney

The kidneys

- Vertically they extends from upper border of twelfth thoracic vertebra towards the center of the body of third lumbar vertebra inferiorly.

- The right kidney is slightly lower than the left, & the left kidney is little nearer to the median plane than the right.

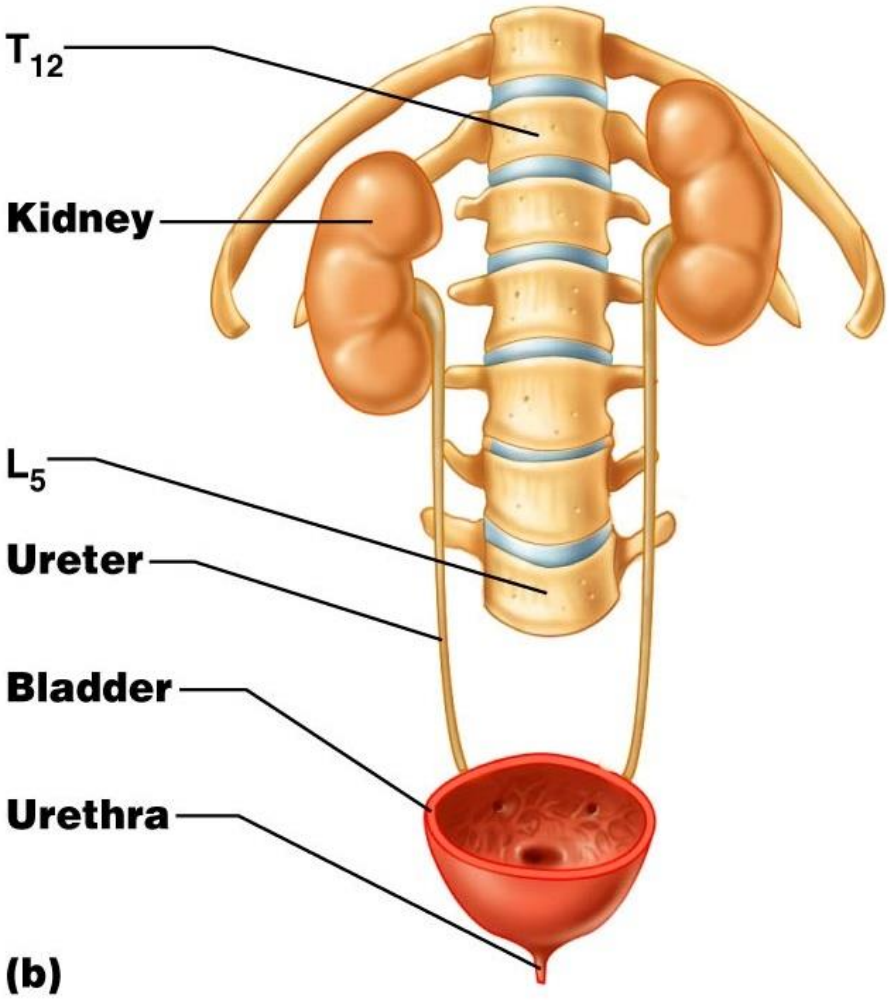

Kidney

The kidneys

- Receive 20-25% of the resting cardiac output
- Consume 20-25% of the O2 used by the body at rest
- (In fetus the kidney is lobulated & is made up of about 12 lobules. After birth the lobules fuse , so that in adults the kidney is uniformly smooth)

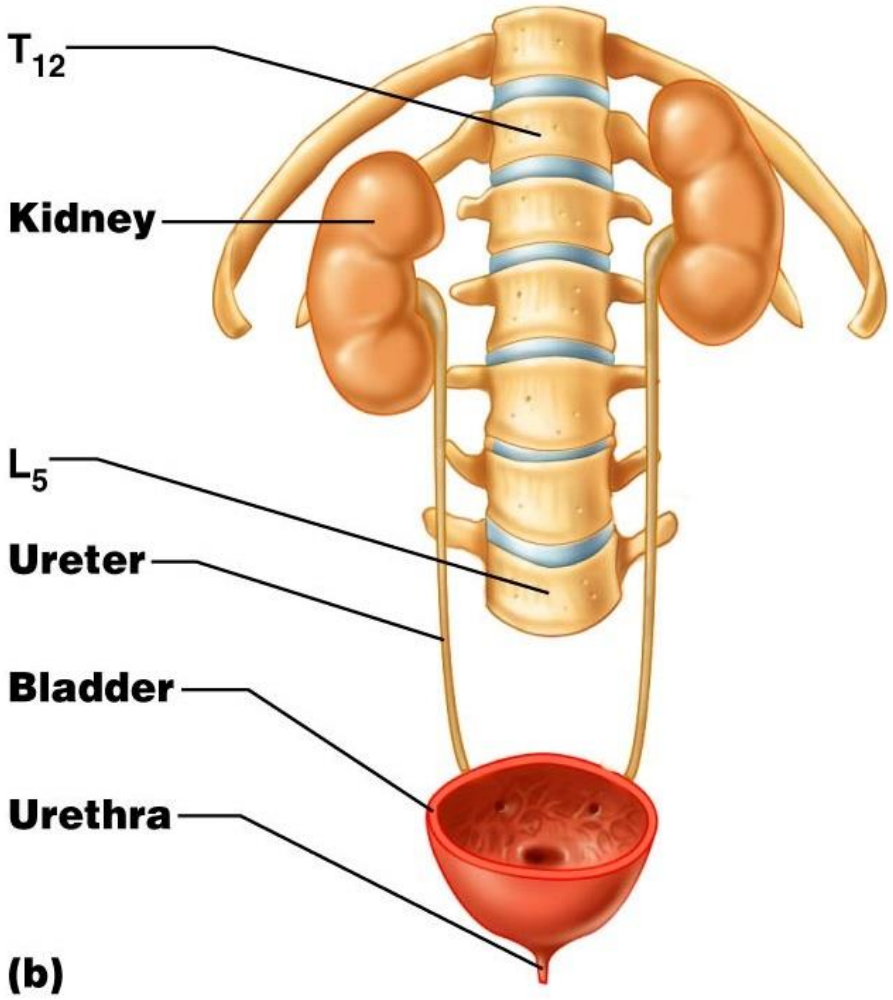
Location and External Anatomy of Kidneys

- Lateral to T_{12}–L_3 vertebrae
- Average kidney
  - 12 cm tall, 6 cm wide, 3 cm thick
- **Hilus**
  - On concave surface
  - Vessels and nerves enter and exit
- Renal capsule surrounds the kidney



Location and External Anatomy of Kidneys

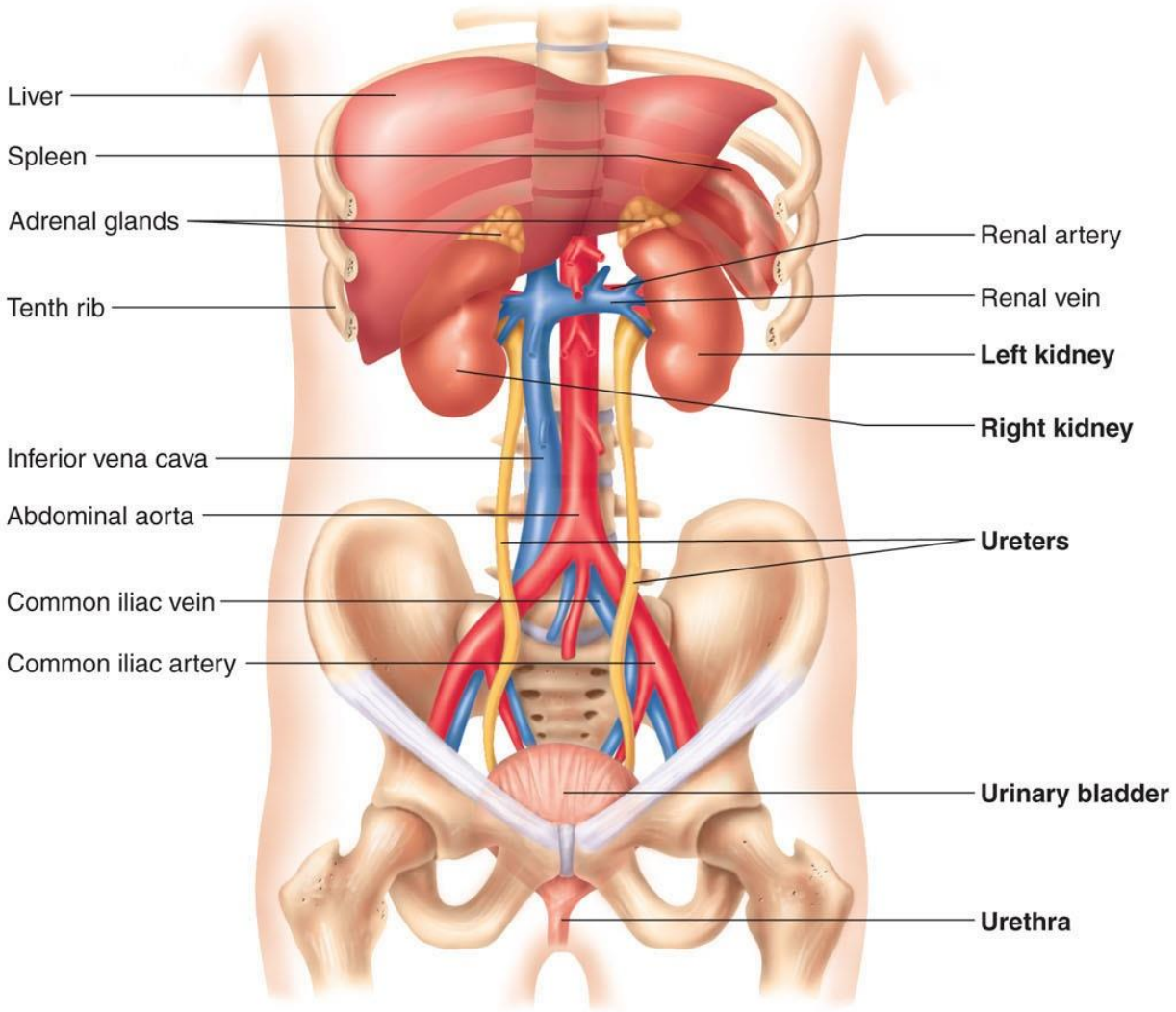
- The right kidney is slightly lower than the left due to the presence of the liver
- Attached to ureters, renal blood vessels, and nerves at renal hilus
- On top each kidney is an adrenal gland



External Features

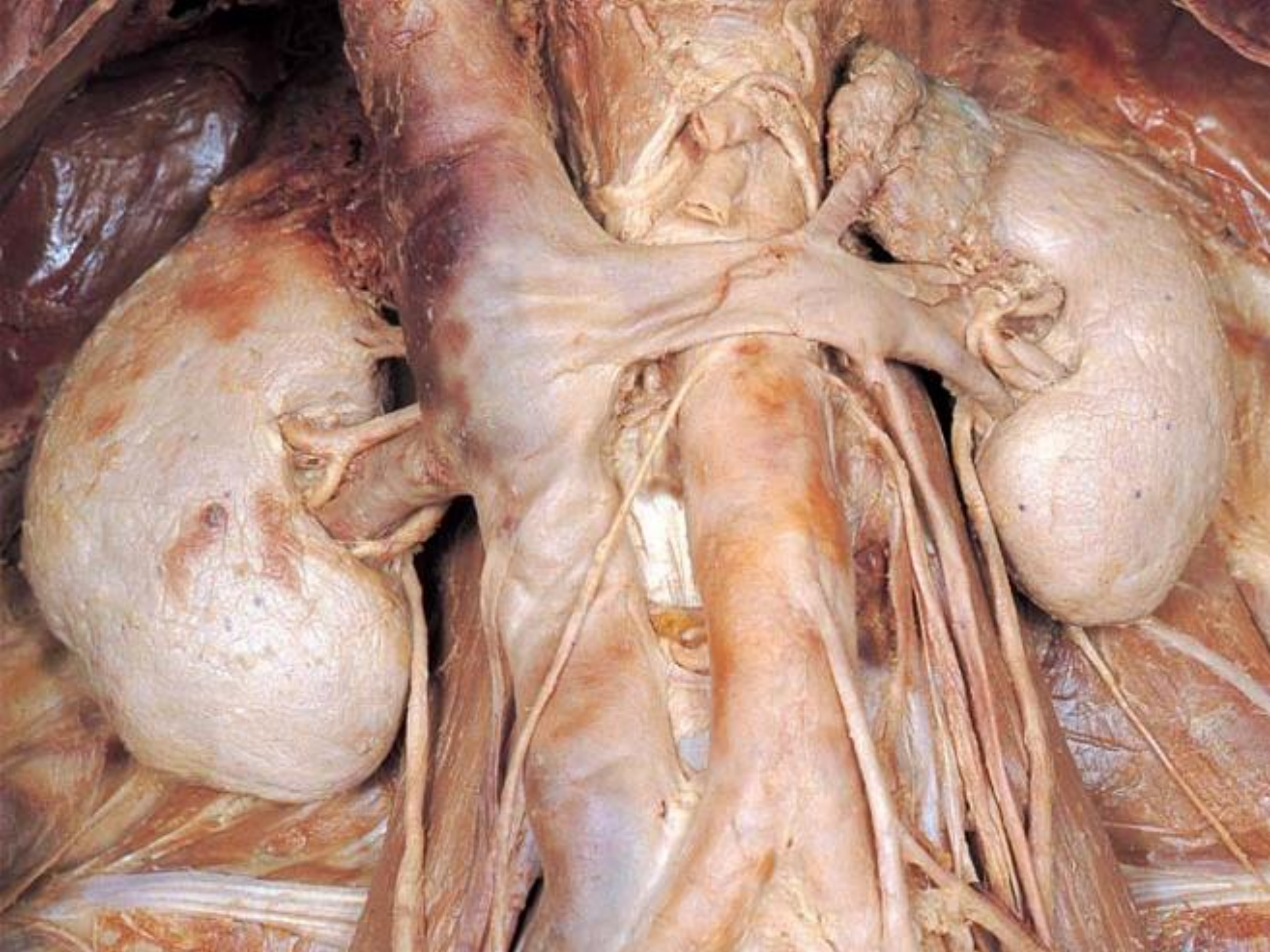
1. Each kidney is bean shaped.
2. It has upper & lower poles, medial and lateral borders, and anterior and posterior surfaces.
3. The upper pole is broad & is in close contact with the corresponding suprarenal glands.
4. The lower pole is pointed.

Anatomy of the Urinary System



Anterior view

The kidneys are located in the abdominal cavity, with the right kidney just below the liver and the left kidney below the spleen. A ureter extends from each kidney to the urinary bladder within the pelvic cavity. An adrenal gland is located at the superior pole of each kidney.



Covering of the Kidney

- ***Renal fascia (Outer most)***

- Anchors the kidneys to nearby structures. It is dense connective tissue, has anterior and posterior layers. Superiorly the two layers enclose the supra renal gland & then merge with diaphragmatic fascia, that is why the kidneys move with respiration

Covering of the Kidney

- ***Adipose capsule/Perirenal Fat (Middle layer - Sides and Back)***

  Mass of fat tissue that surrounds renal capsule

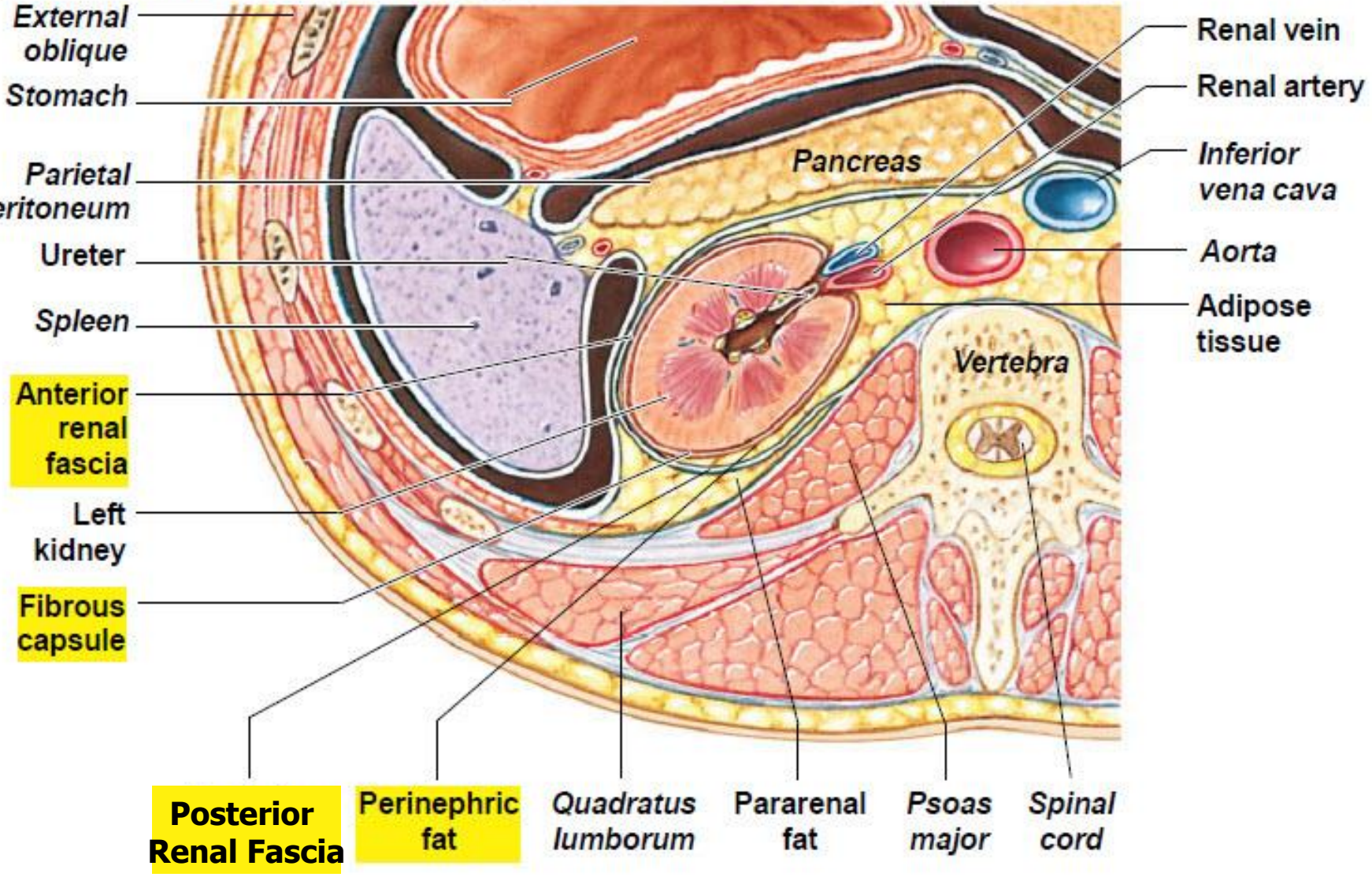
Functions

  - Keeps kidney in place
  - Provide cushion effects

- ***Renal capsule (Inner most - whole through)***

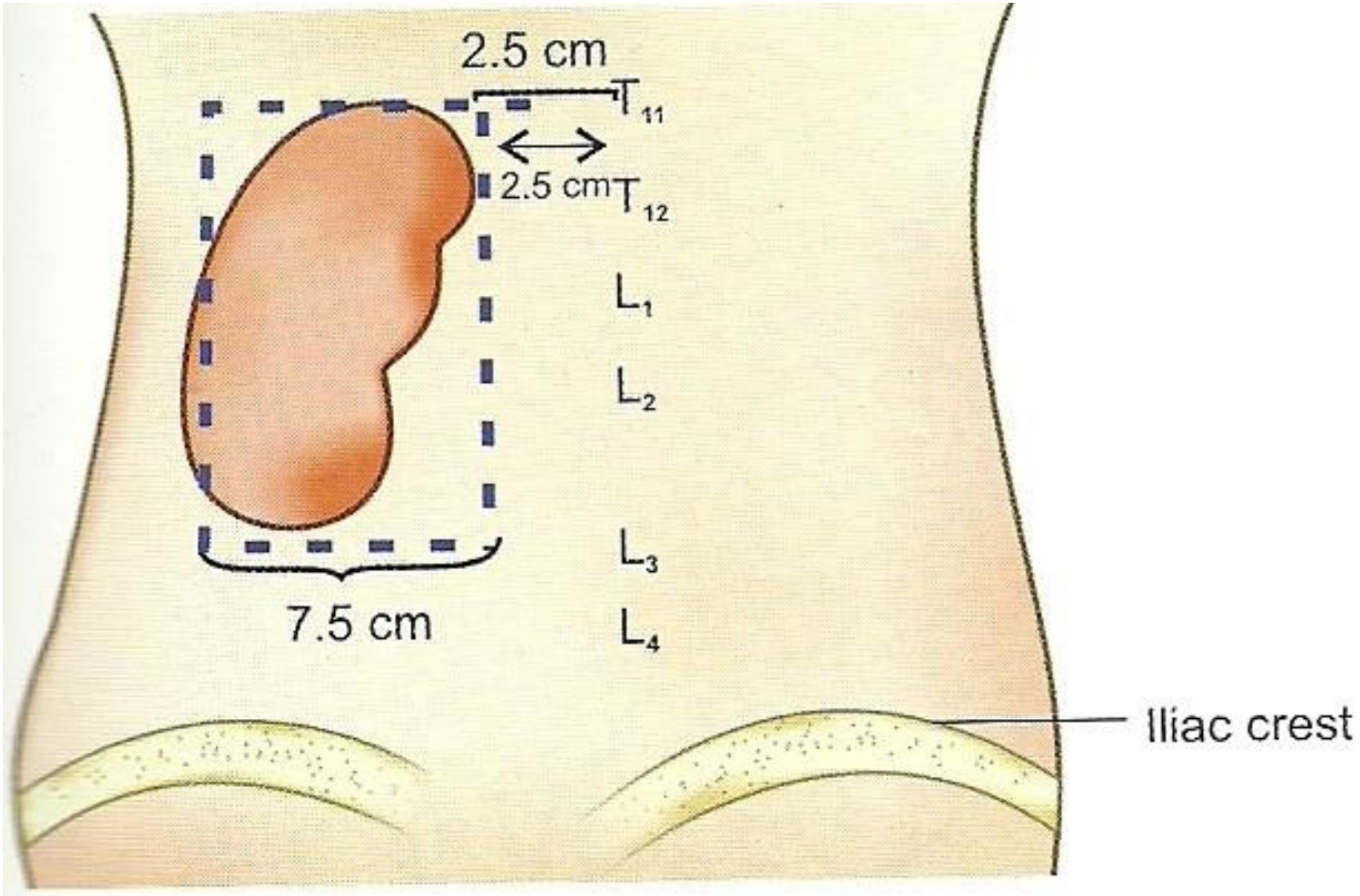
Layer of soft transparent sheet of dense fibrous connective tissue that surrounds kidney and supports the soft internal tissues giving it its shape.

Figure 26.1c An Introduction to the Urinary System



c Diagrammatic cross section, as viewed from above, at the level indicated in part (b)

Surface Anatomy – Morris Parallelogram

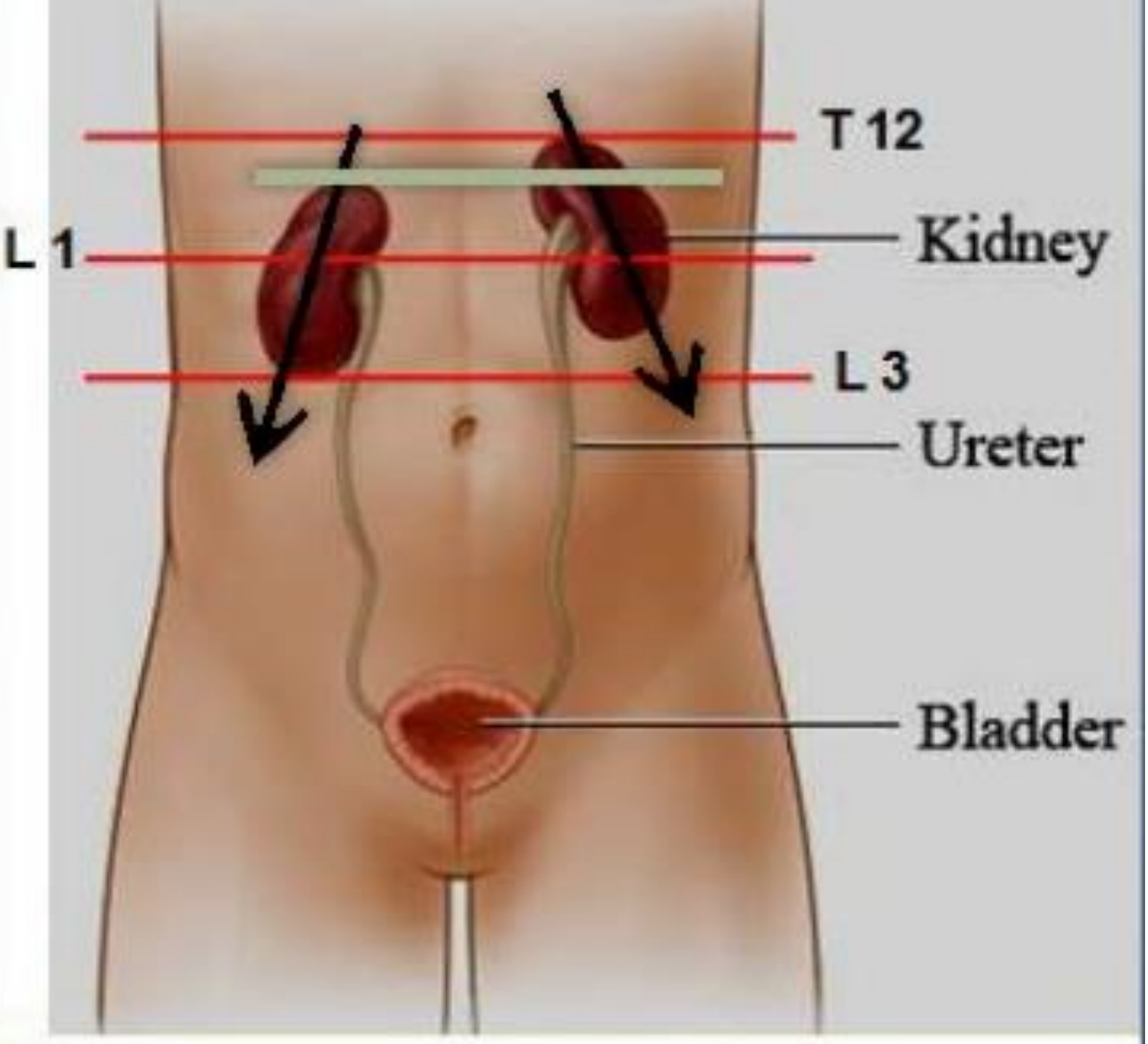


Surface Anatomy – Morris Parallelogram

- The **four points** are **joined** to delineate a parallelogram and the **outline** of **kidney** is **drawn** on each side

- The medial border of the kidney is represented by a line joining ***three points***, **first** point **2.5** cm away from midline (at **T11** on left and **T12** on right), **second** point (at **L1**) **5** cm away and **third** (at **L3**) **7.5** cm away from the midline.

- Joining the first and third points at 4.5 cm from the medial border (width of kidney) marks the convex lateral border.

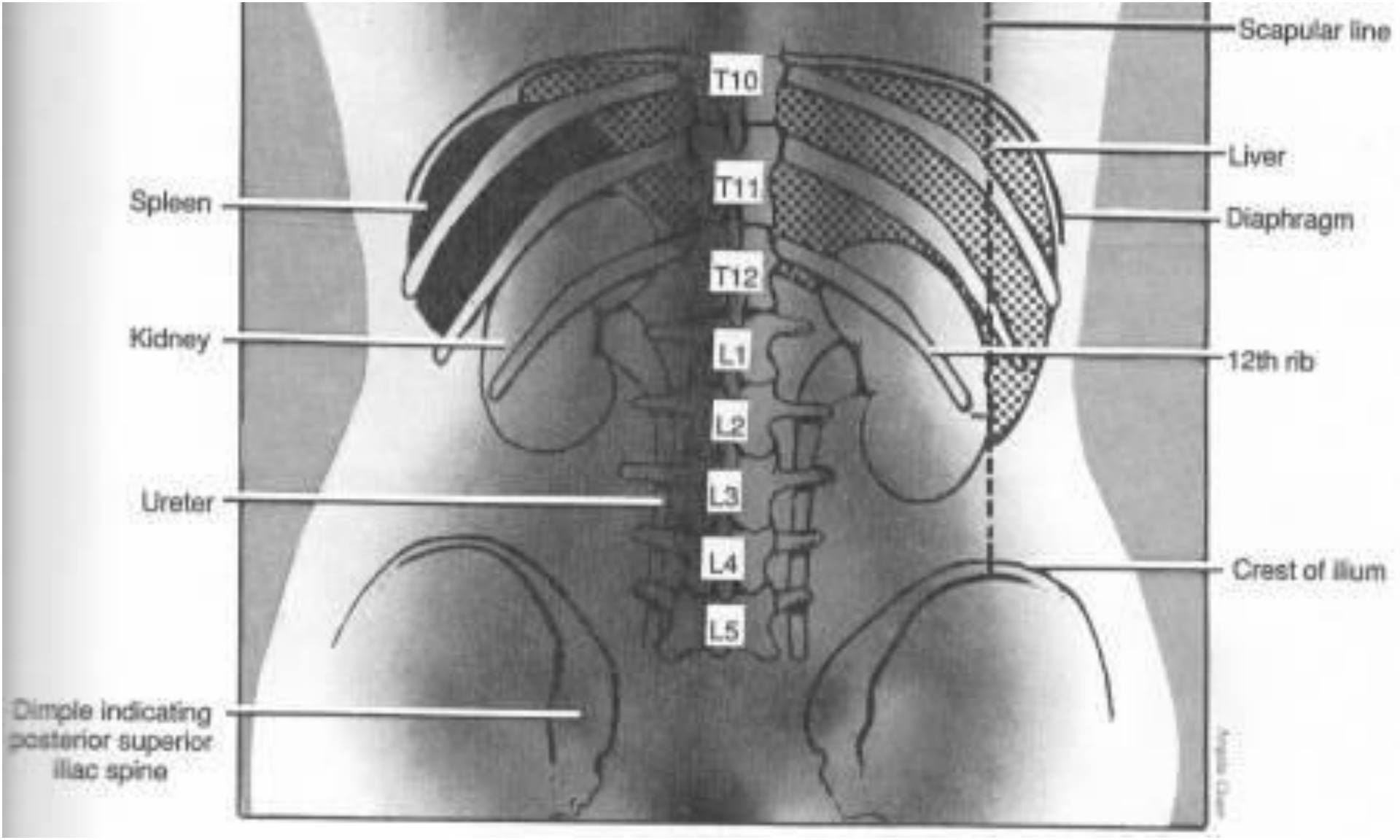

T 12
L 1
Kidney
L 3
Ureter
Bladder

Renal angle

- It is an ***angle between*** the lower margin of ***twelfth rib*** and ***lateral margin*** of ***erector spinae*** muscle. At this angle, the kidney lies close to the body surface.

Clinical Relevance of Renal Angle

- Renal pain is felt at renal angle as a dull ache.
- Perinephric abscess causes swelling and tenderness at renal angle.


Scapular line
T10
Liver
Spleen
T11
Diaphragm
T12
Kidney
L1
12th rib
L2
Ureter
L3
L4
Crest of ilium
L5
Dimple indicating posterior superior iliac spine

Relations of the Kidneys

Anteriorly the ***right kidney*** is related to the **Liver**, **duodenum** and **hepatic flexure** of ascending colon

Anteriorly the ***left kidney*** is related to **Stomach**, **Jejunum**, **Pancreas**, **Spleen** and **descending Colon**

Adrenal gland is ***superior*** and ***anterior*** to the Kidneys

Relations of the Kidneys

Posteriorly:

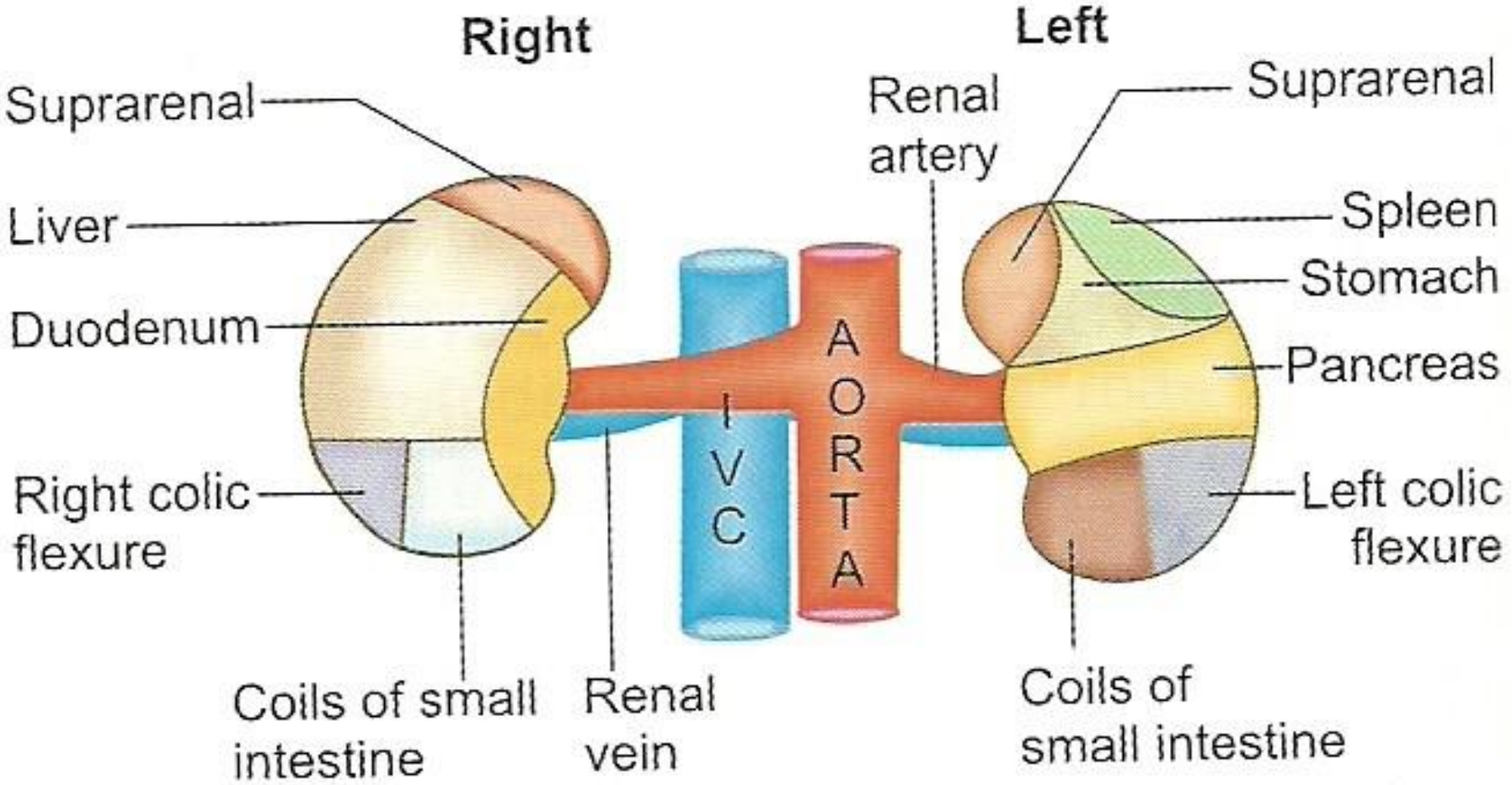
Right Kidney is related to the **12th rib** posteriorly resting on **diaphragm**

The ***left kidney*** rises to as high as the **11th thoracic rib** posteriorly, extending from T11-L3, resting on diaphragm

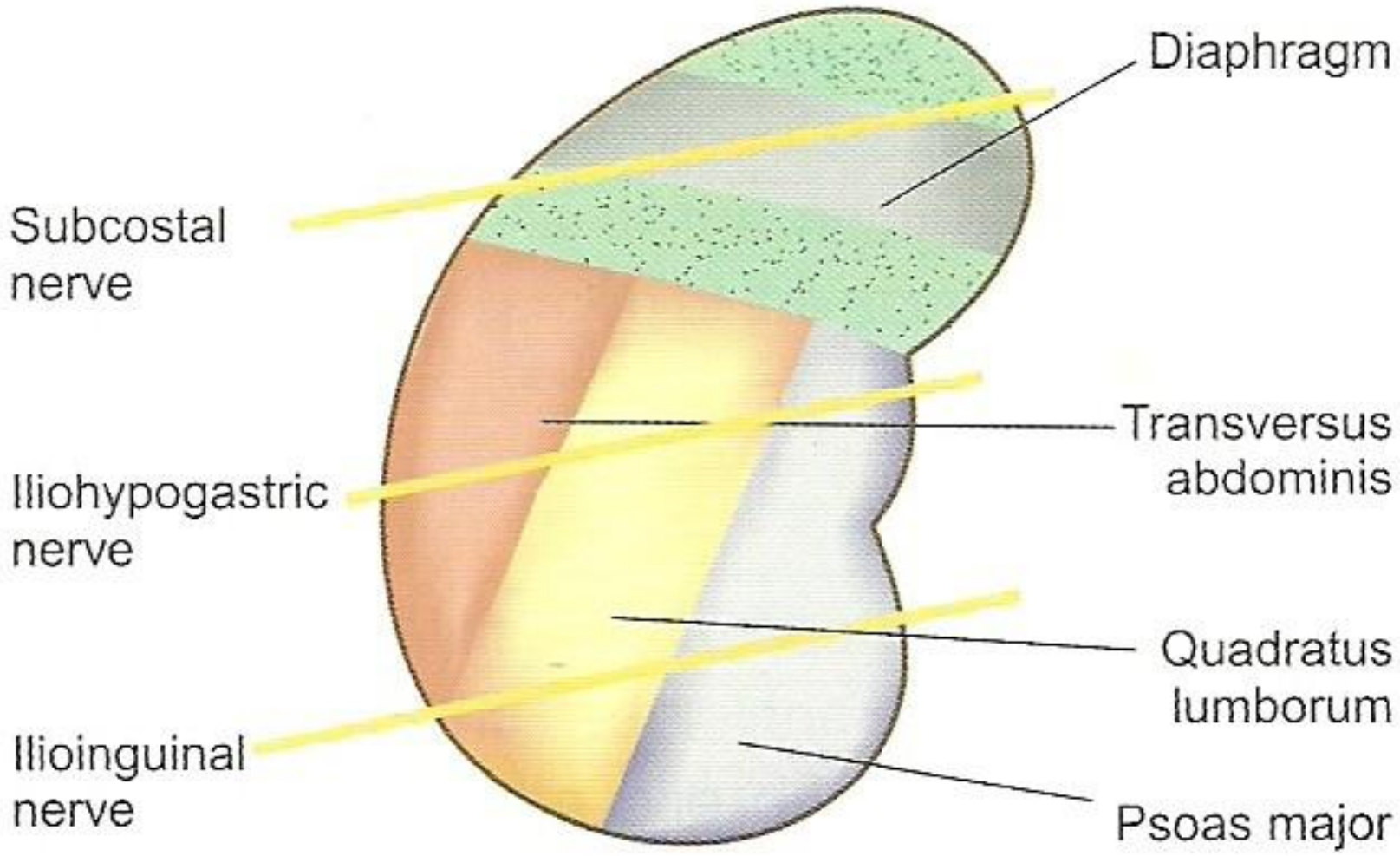
Both kidneys are related ***posteriorly*** to ***psoas major, quadratus lumborum, and transversus abdominis*** in addition to **subcostal, ilioinguinal and iliohypogastric nerves**

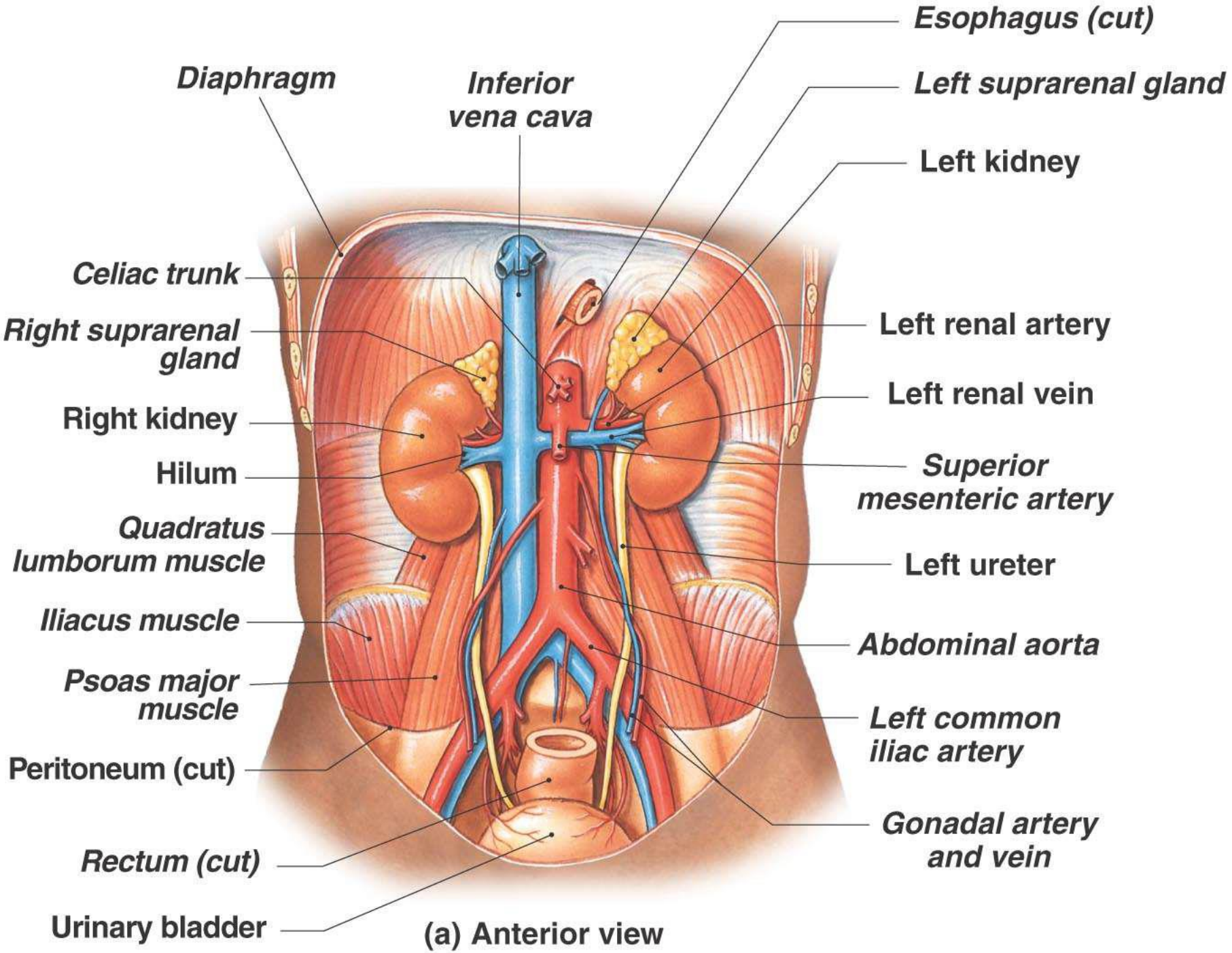
Inferiorly, **both kidneys** are related to coils of ***small intestine***

Anterior Relations



Posterior Relations





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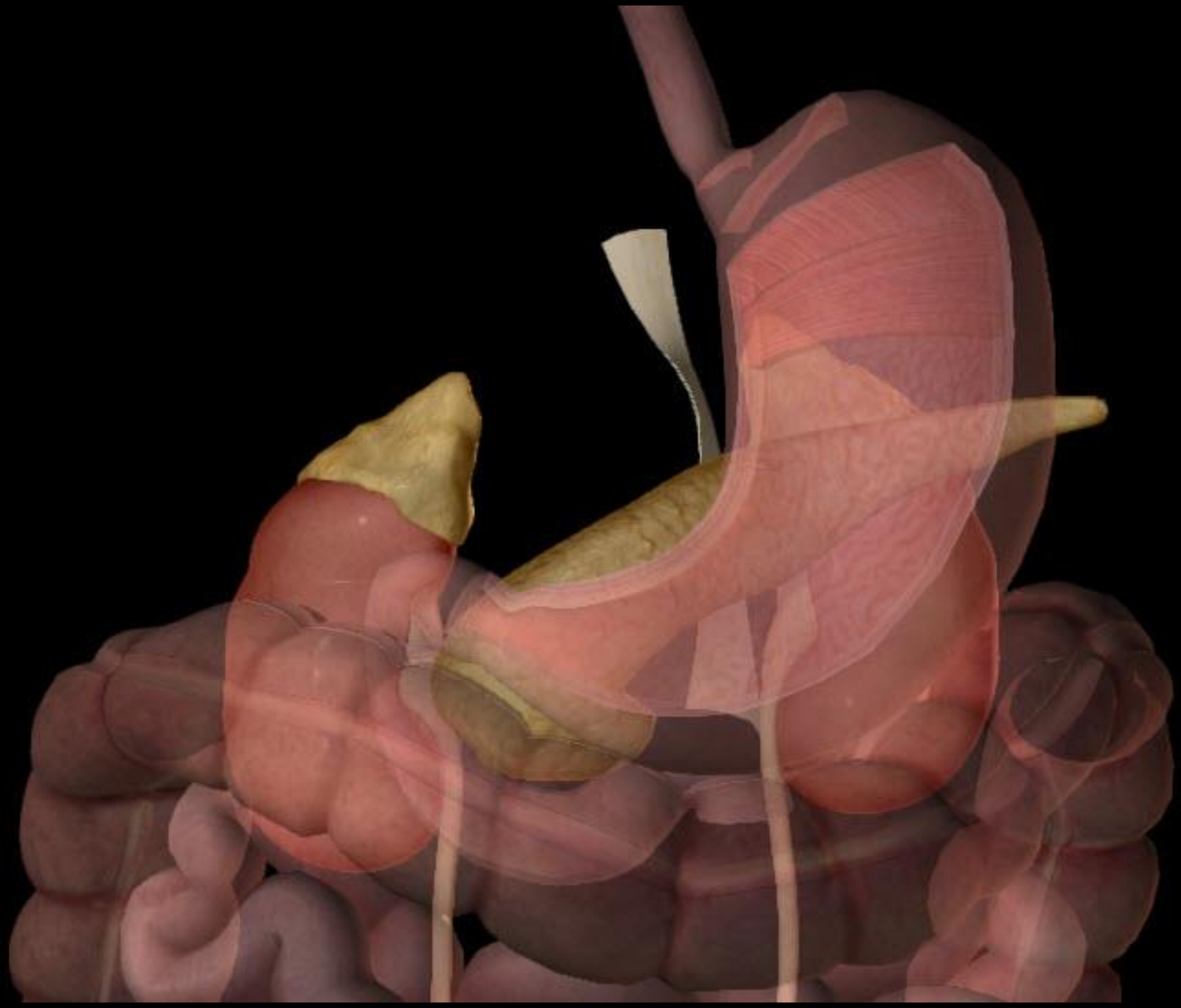
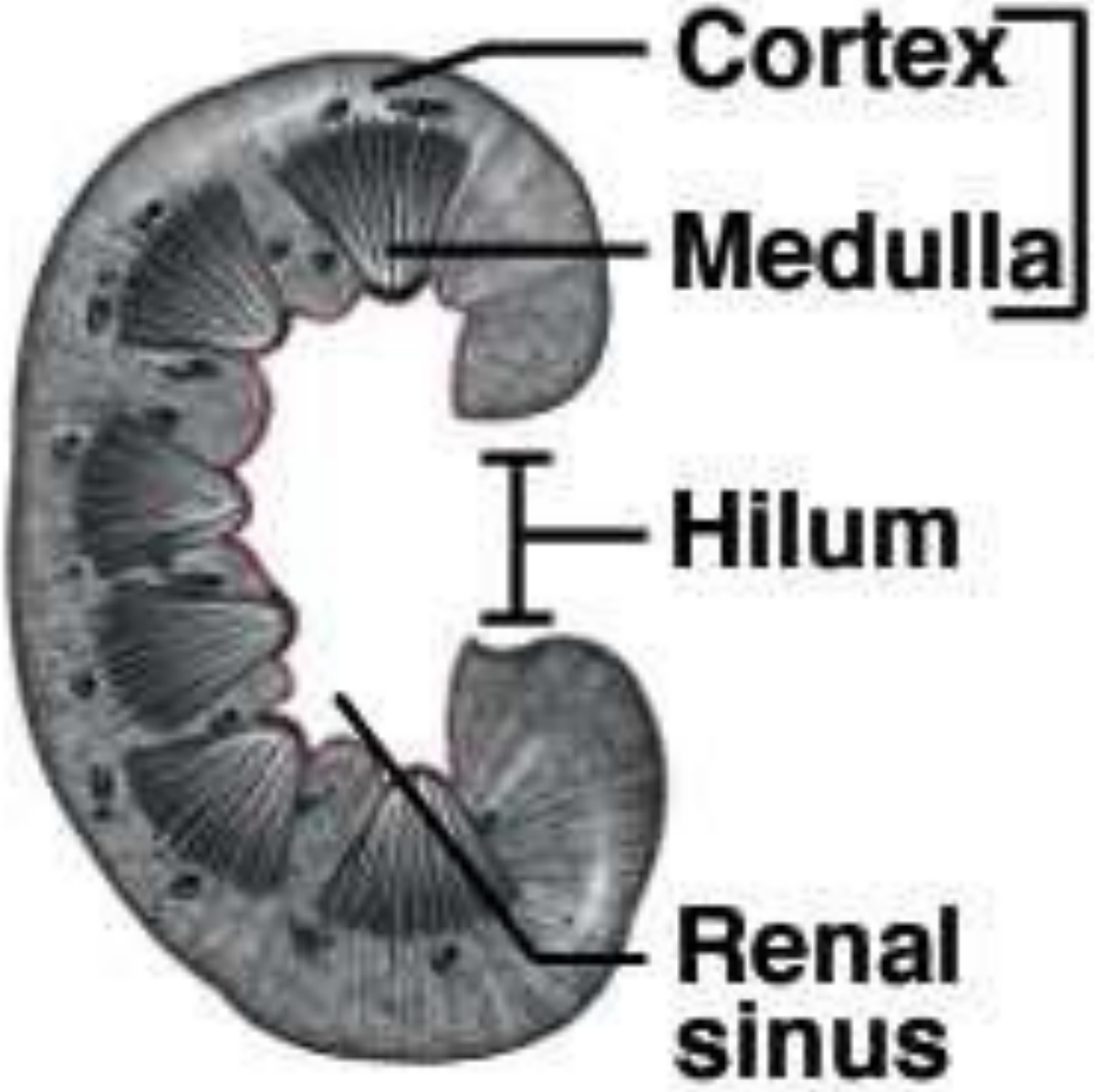


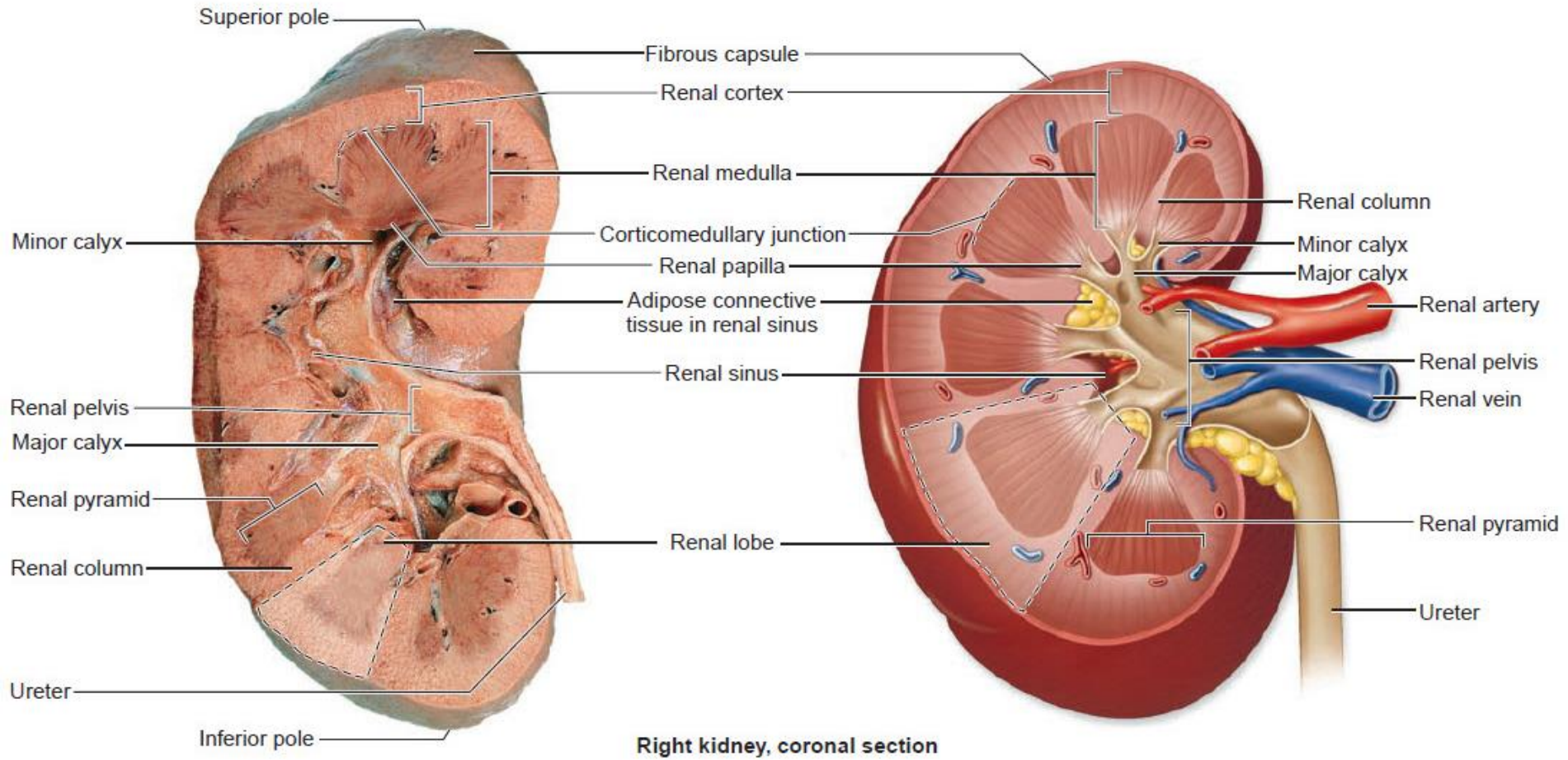
The kidneys

- On a sagittal section you can see that the kidneys is divided into *outer* ***cortex*** and *inner* ***medulla*** which surrounds the renal sinus.

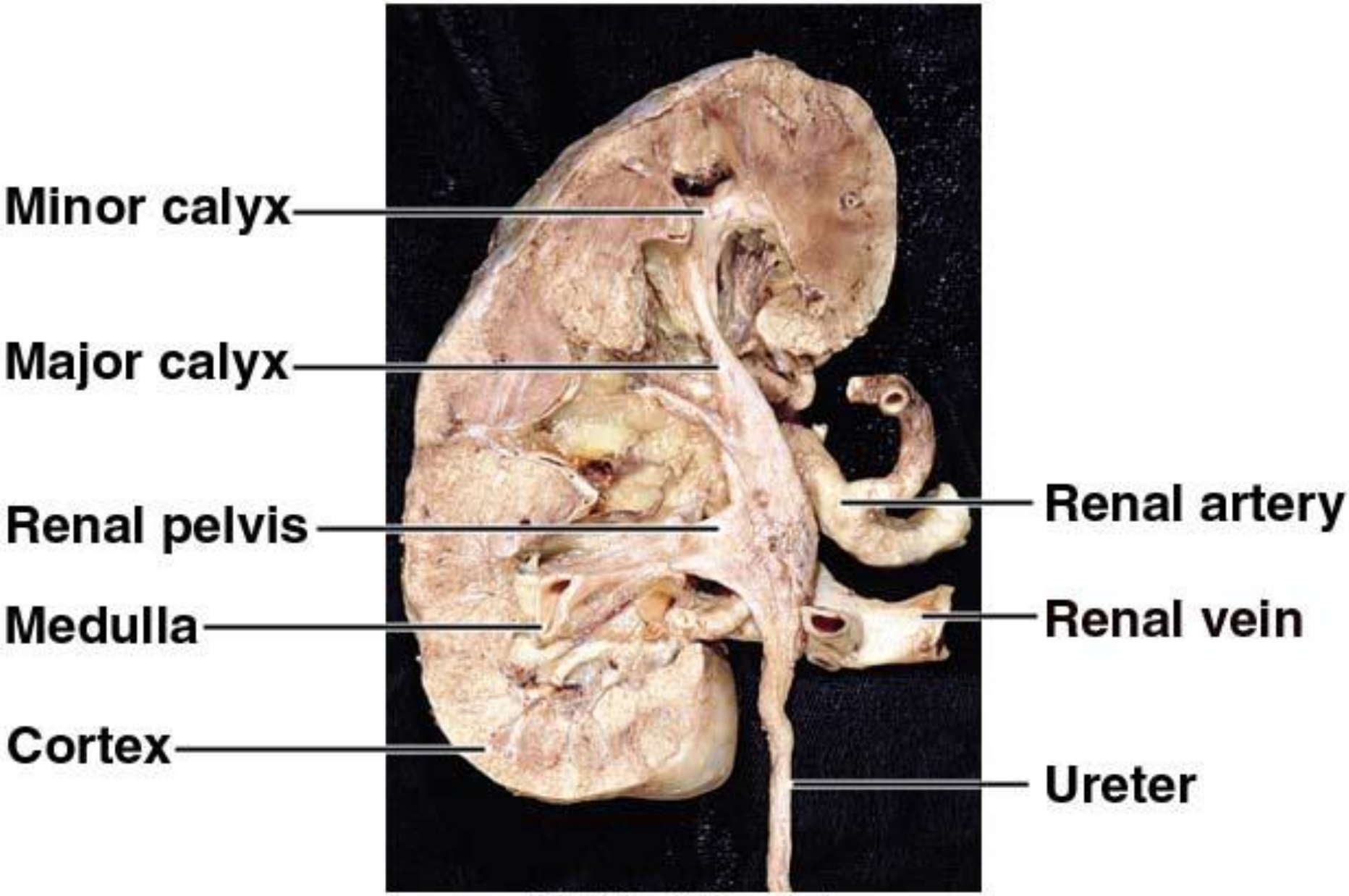
- ***Hilum:*** it is the concave medial border or deep fissure of the kidney where the renal blood & lymph vessels , ureter & nerve enters

- The ***sinus*** is a cavity within the hilum. It contains blood vessels, urine collecting chambers and fat.


Cortex
Medulla
Hilum
Renal sinus



Right kidney, coronal section



Kidney Structures

Medullary pyramids

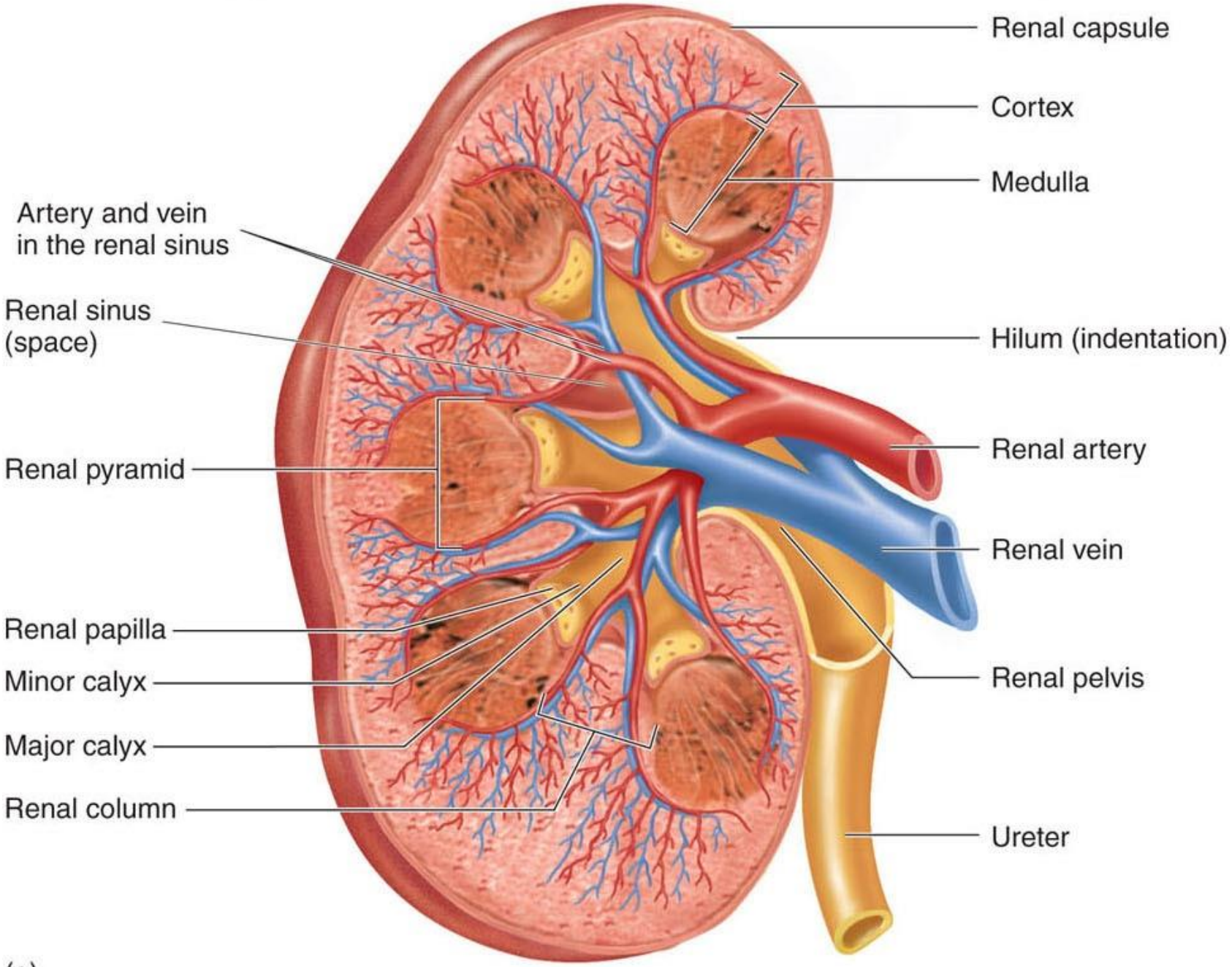
- Triangular regions of tissue in the medulla, **bases** of the renal pyramids are directed outward, toward the cortex, while the **apex** of each renal pyramid projects inward, toward the **renal sinus**.

Renal columns

- Extensions of cortex-like material inward between the pyramids

Calyces

- Cup-shaped structures that funnel urine towards the renal pelvis



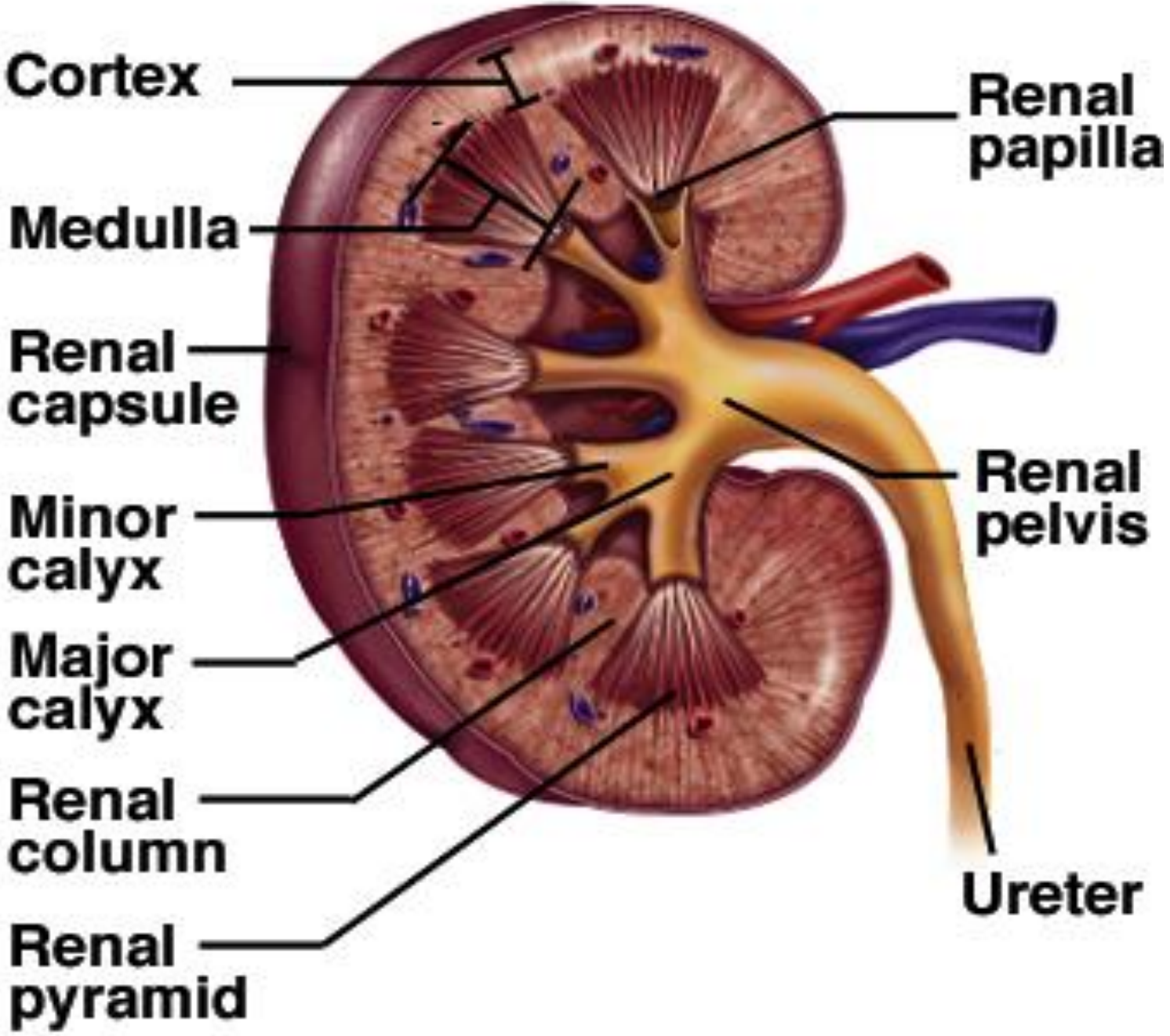
(a)

The kidneys

- The kidney contains ***minor calyces*** (***8-20*** in number) and in turn several minor calyces collect to form ***major calyces*** (***2-3*** in number)

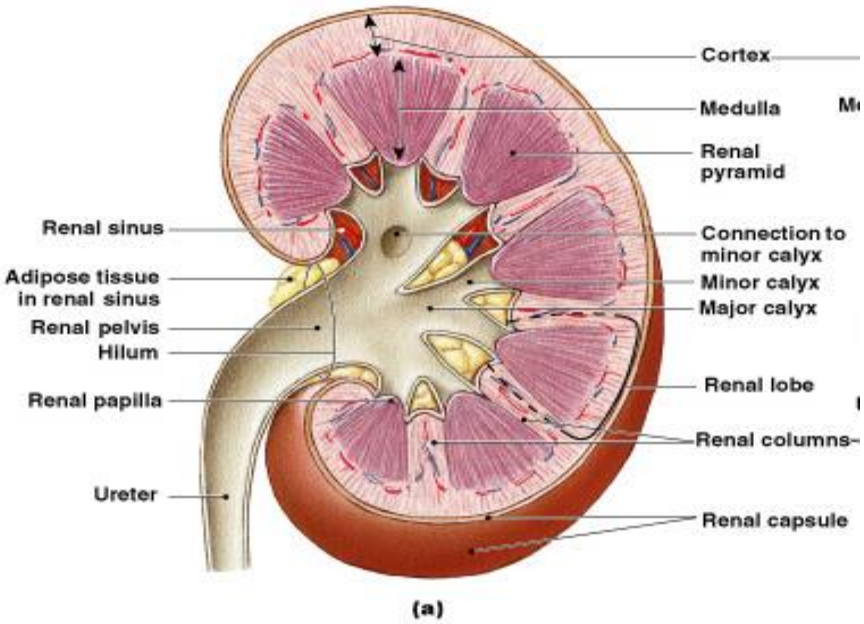
- The ***major calyces*** converge to form the renal pelvis which is surrounded by the ***renal sinus***.

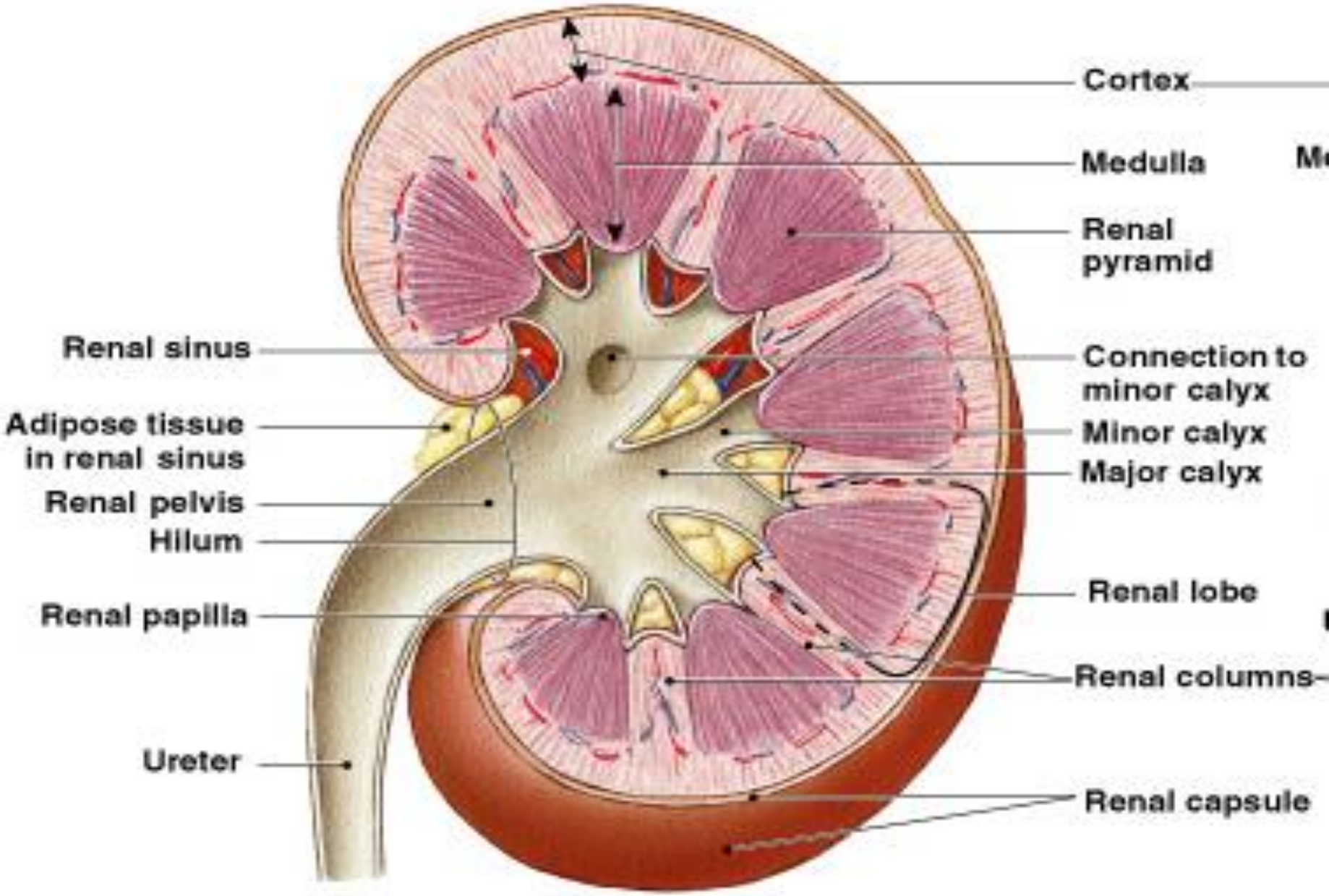
- The renal pelvis narrows into a small diameter tube that is the ureters which exit the kidney through the hilum and ends into the urinary bladder


Cortex
Medulla
Renal capsule
Minor calyx
Major calyx
Renal column
Renal pyramid
Renal papilla
Renal pelvis
Ureter

Renal Lobe

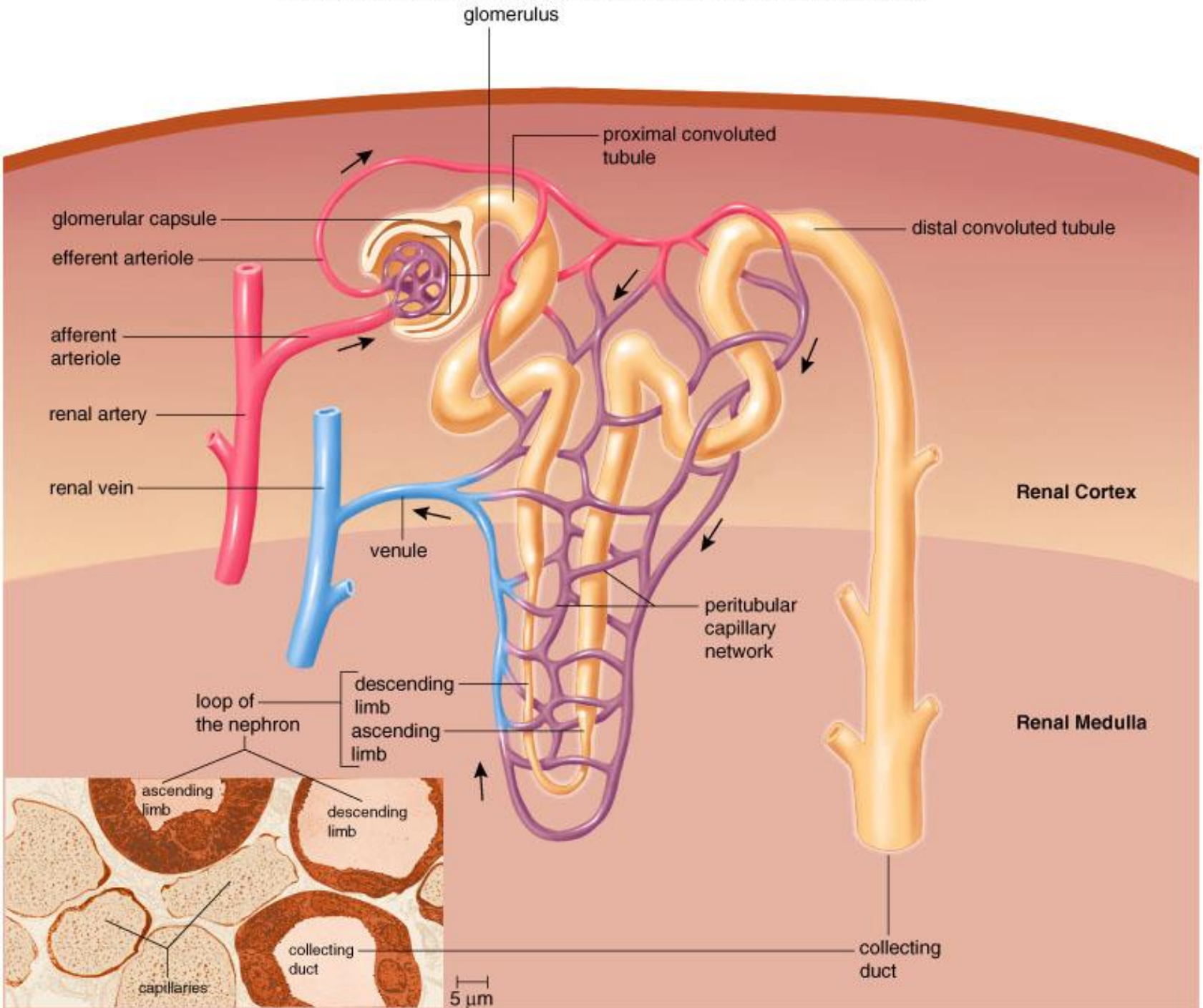
- ***Consists of:***
  - One renal pyramid
  - Overlying area of renal cortex
  - Adjacent tissues of renal columns




Cortex
Medulla
Renal pyramid
Renal sinus
Connection to minor calyx
Adipose tissue in renal sinus
Minor calyx
Major calyx
Renal pelvis
Hilum
Renal lobe
Renal papilla
Renal columns
Ureter
Renal capsule
(a)

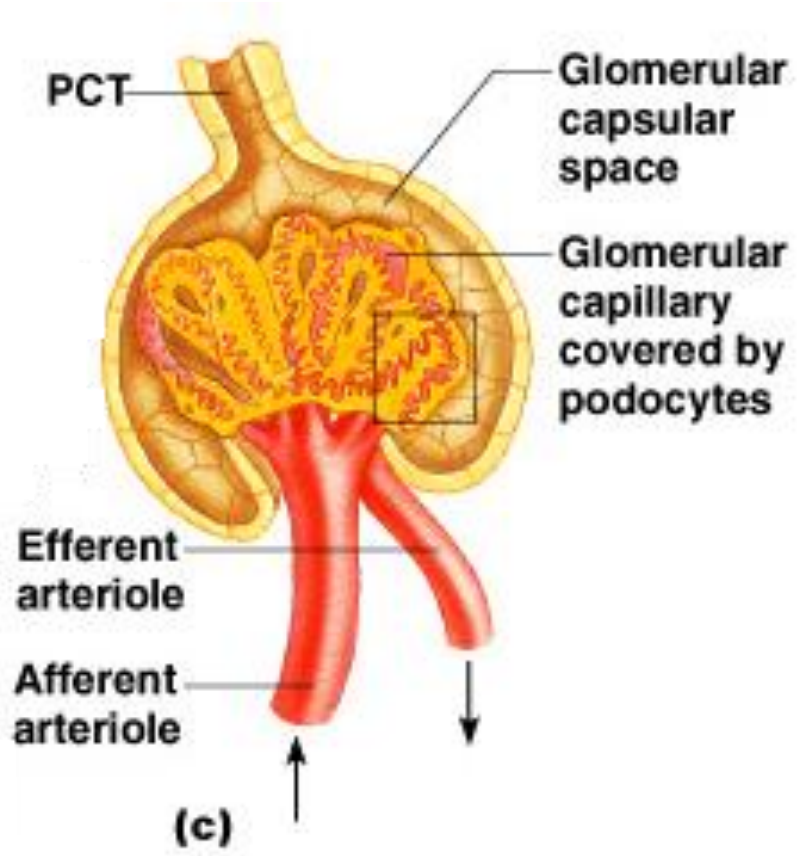
Nephrons

- The structural & functional units of the kidneys
- Responsible for formation of urine
- Main structures of the nephrons
  - Glomerulus
  - Renal tubule



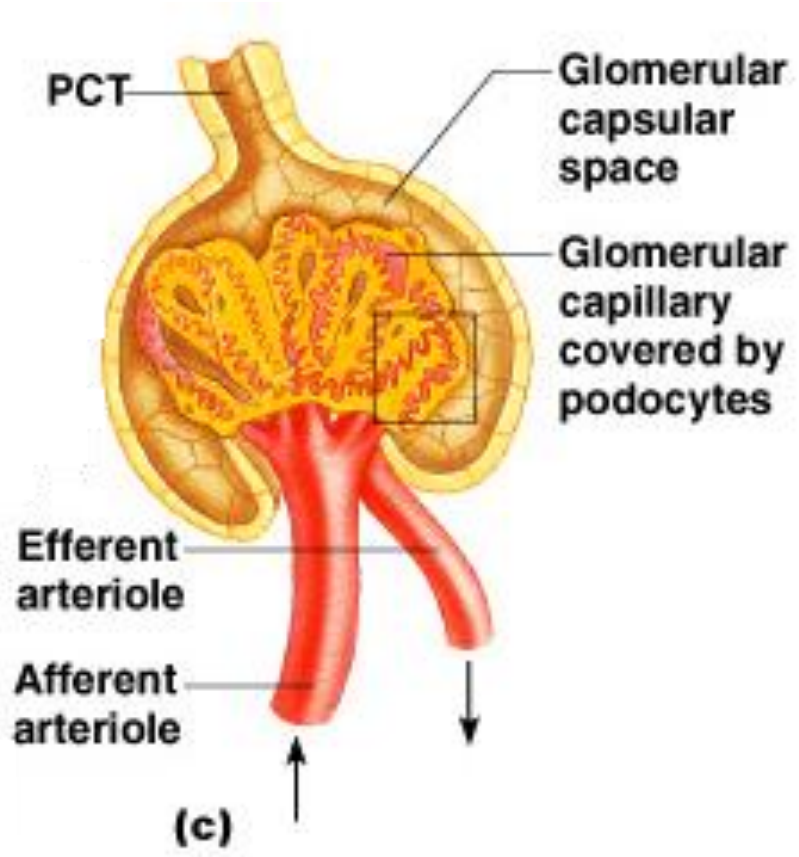
Glomerulus

- A specialized capillary bed
- Attached to arterioles on both sides (maintains high pressure)
  - Large afferent arteriole
  - Narrow efferent arteriole



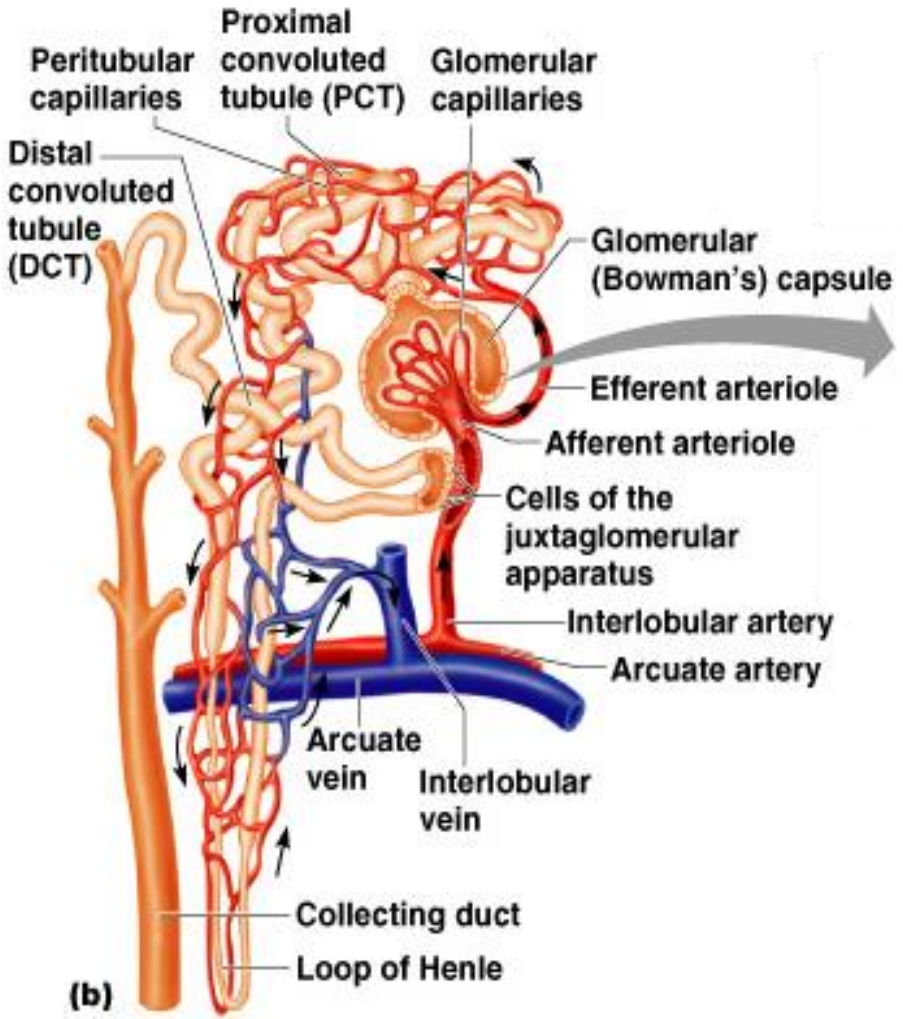
Glomerulus

- The glomerulus sits within a glomerular capsule (the first part of the renal tubule)



Renal Tubule

- Glomerular (Bowman's) capsule
- Proximal convoluted tubule
- Loop of Henle
- Distal convoluted tubule

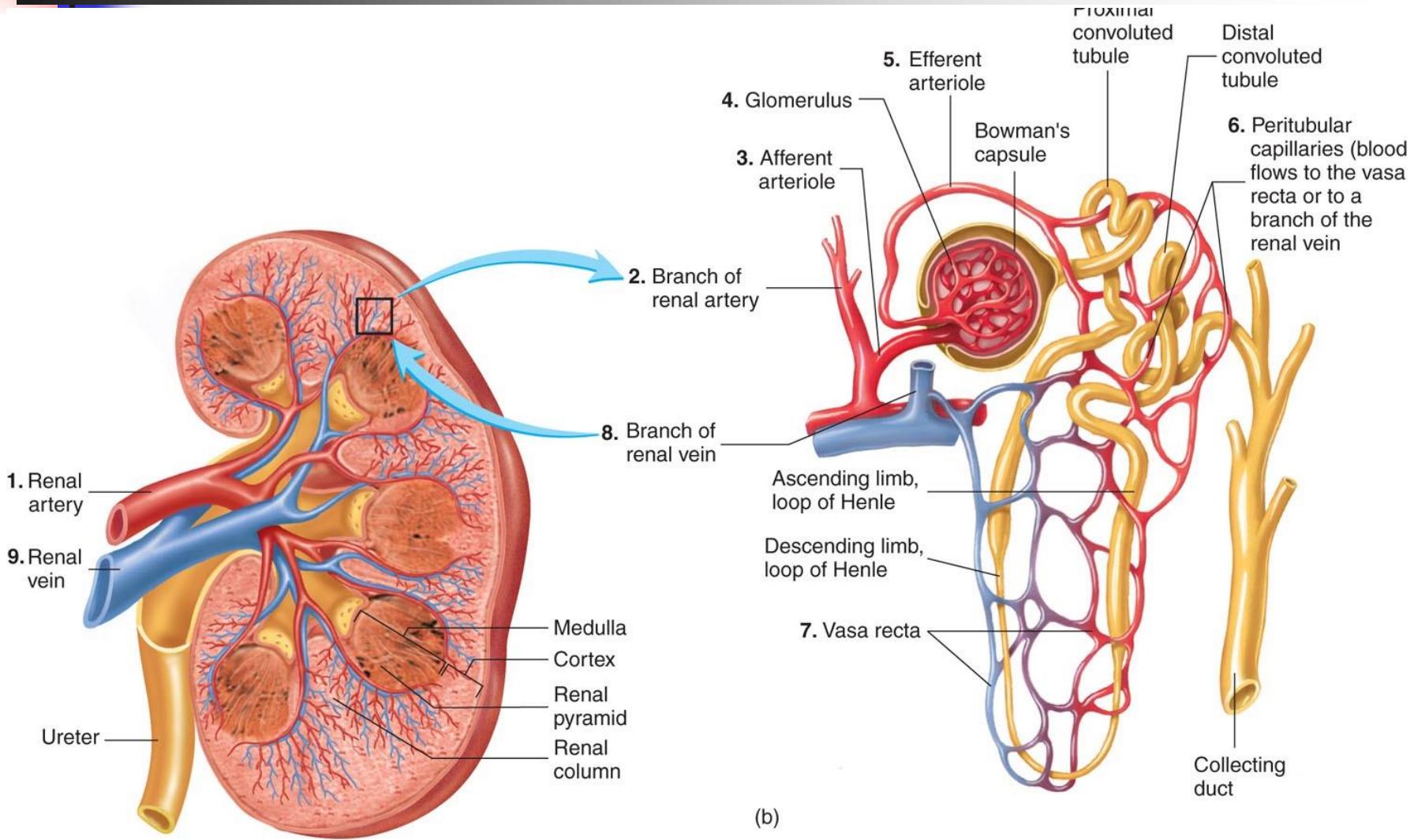


The Nephron

- ***85%*** of ***nephron*** lie in the ***cortex*** and are called ***cortical nephrons*** while ***15%*** lie at the border ***between cortex*** and ***medulla*** and are called therefore ***juxta-medullary*** nephron.

- These **JM** nephrons plays an essential role in the regulation of blood pressure

Blood Flow through the Kidney



The Blood Supply of the Kidney

- The ***renal arteries*** supply the kidneys.
- They arise from the abdominal aorta opposite L2, ***enters the hilum of the kidney between the vein anteriorly and the ureter posteriorly***.

The Blood Supply of the Kidney

- ***Renal arteries*** branches to ***give rise*** to ***afferent arterioles*** which ***break into*** renal glomerulus then ***efferent arterioles***.

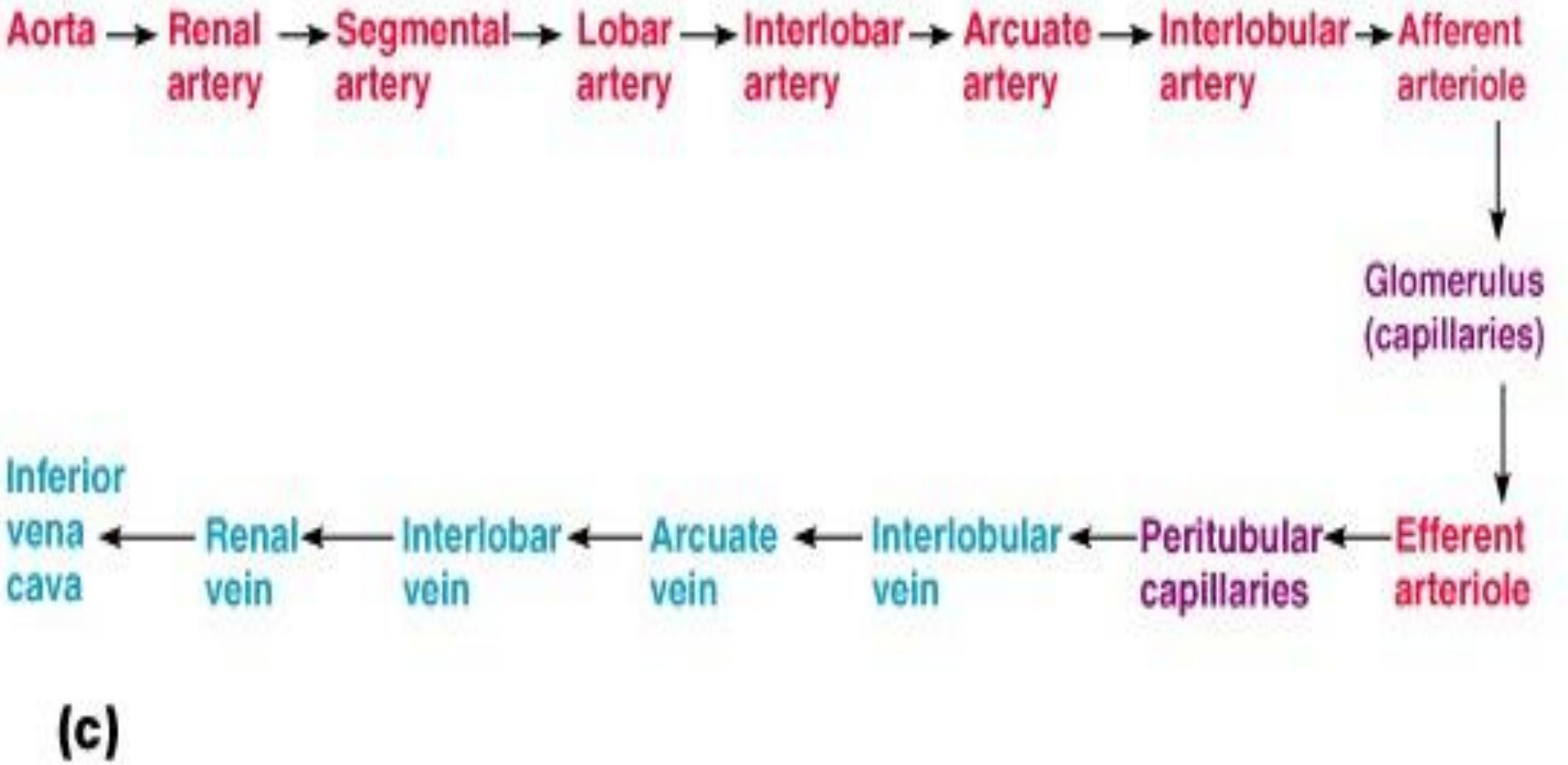
- ***Efferent arterioles gives*** rise to ***peritubular capillaries*** that surrounds proximal and distal tubules. The part that surrounds loop of Henle is called Vasa recta.

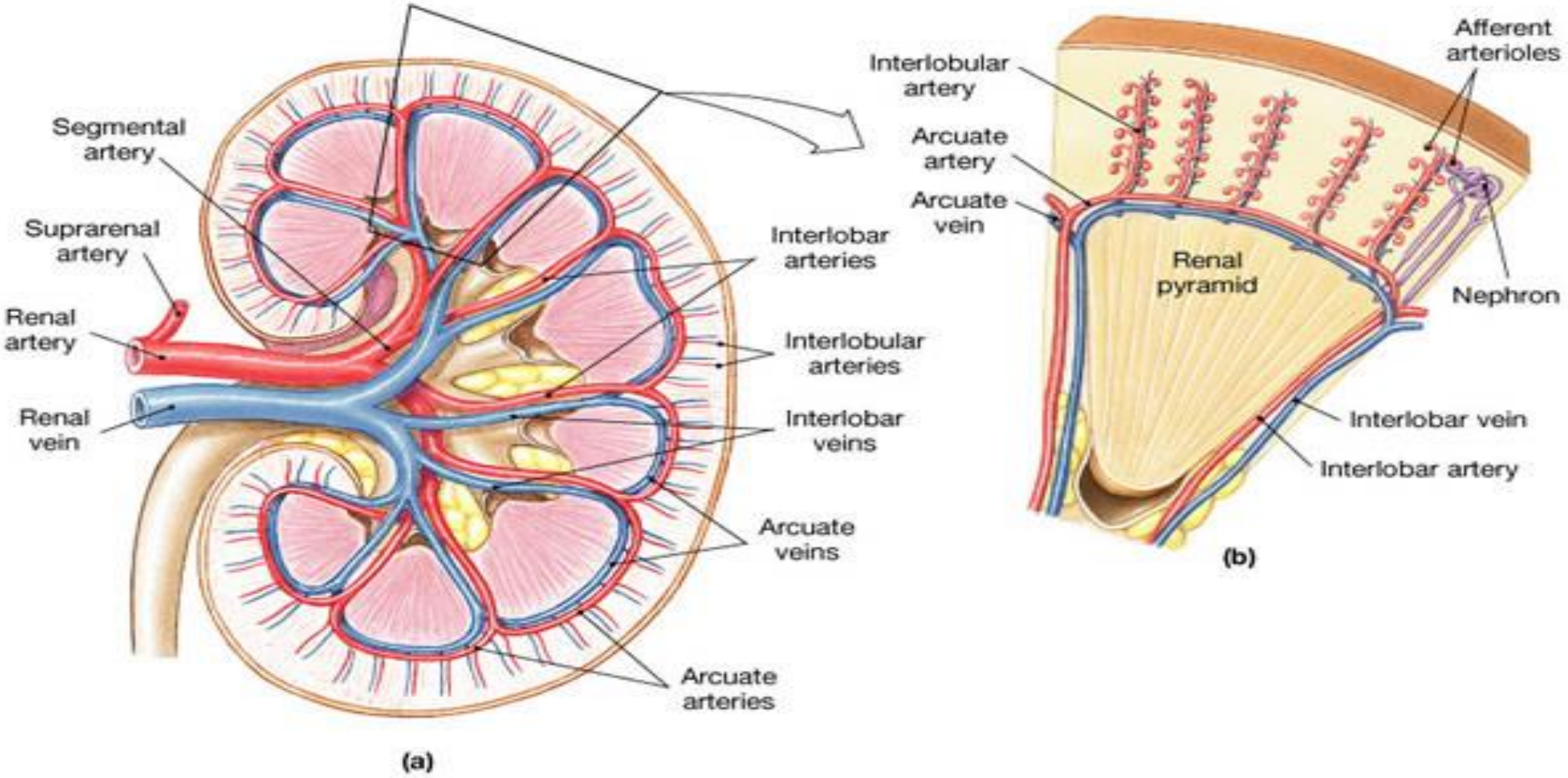
Blood Flow – Arteries & Veins

- Renal arteries
- Segmental arteries
- Lobar arteries
- Interlobar arteries
- Arcuate arteries
- Interlobular arteries
- Afferent arterioles

- From nephron
- Interlobular veins
- Arcuate veins
- Interlobar veins
- Renal vein

Blood Flow in the Kidneys



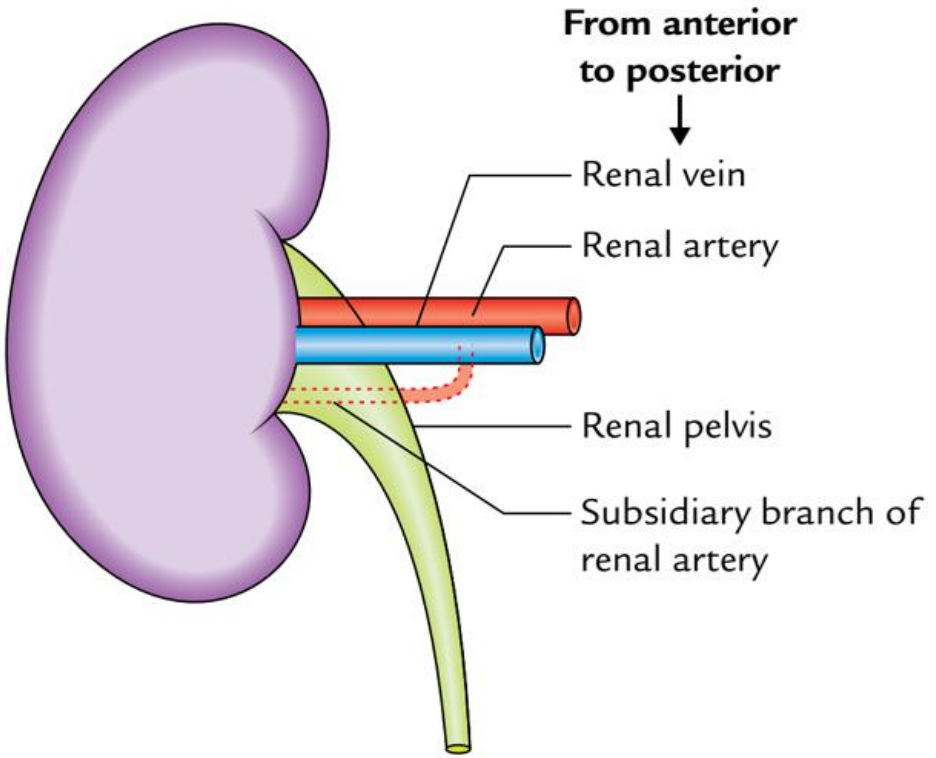


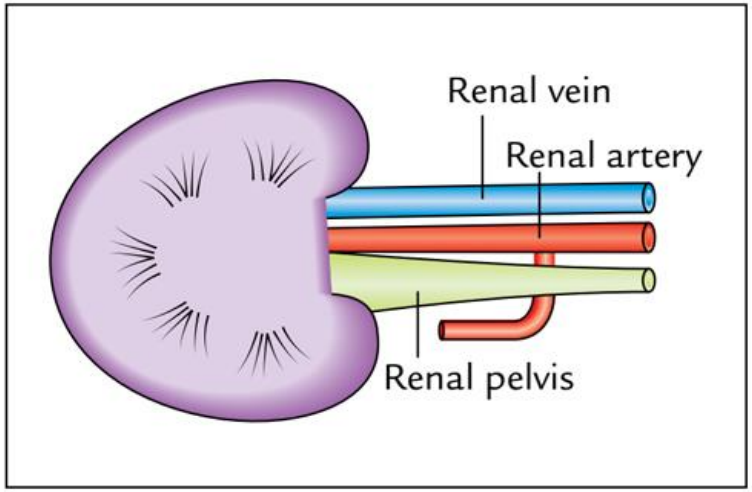
Kidney

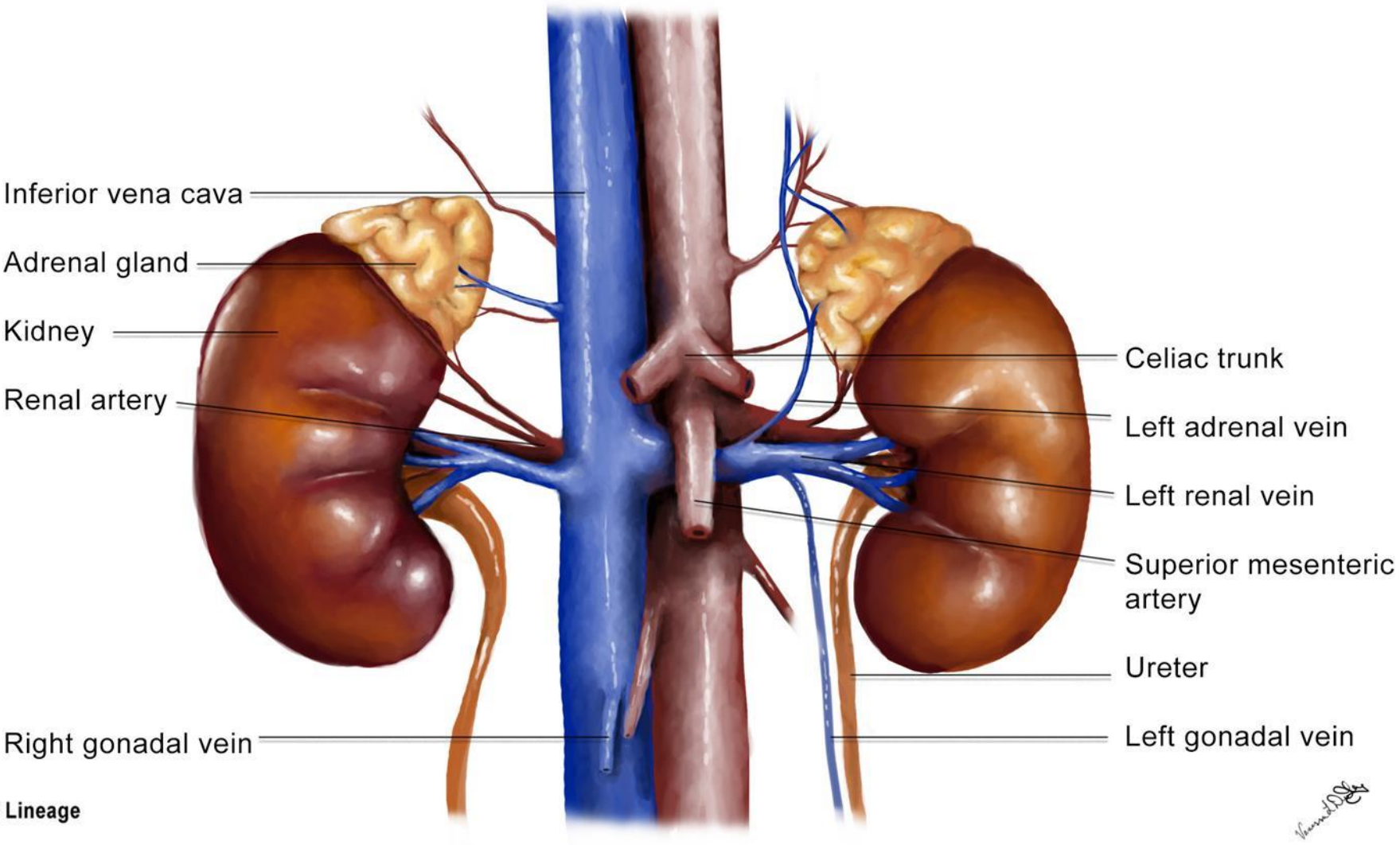
- ***Venous Drainage:*** Renal veins (***most anterior in the hilum***), ends in inferior vena cava. The left renal vein is longer than the right and receives Lt. suprarenal and gonadal veins.

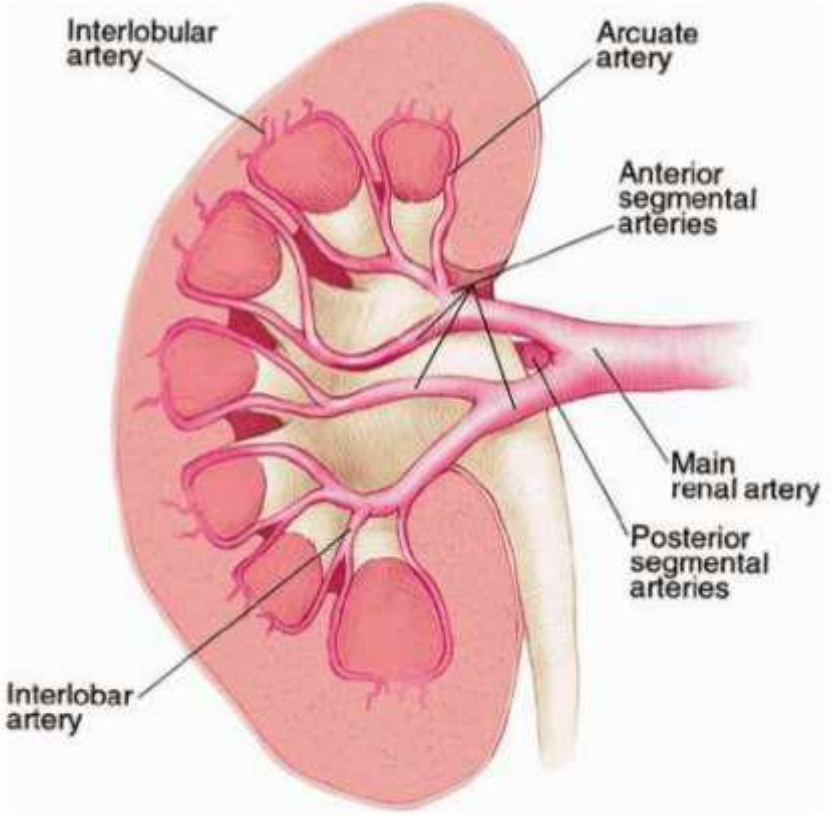
- ***Nerve Supply:*** Sympathetic fibers derived from T10,L1 segments and parasympathetic fibers from vagus nerve.

- ***Lymphatic drainage:*** into lateral aortic nodes.

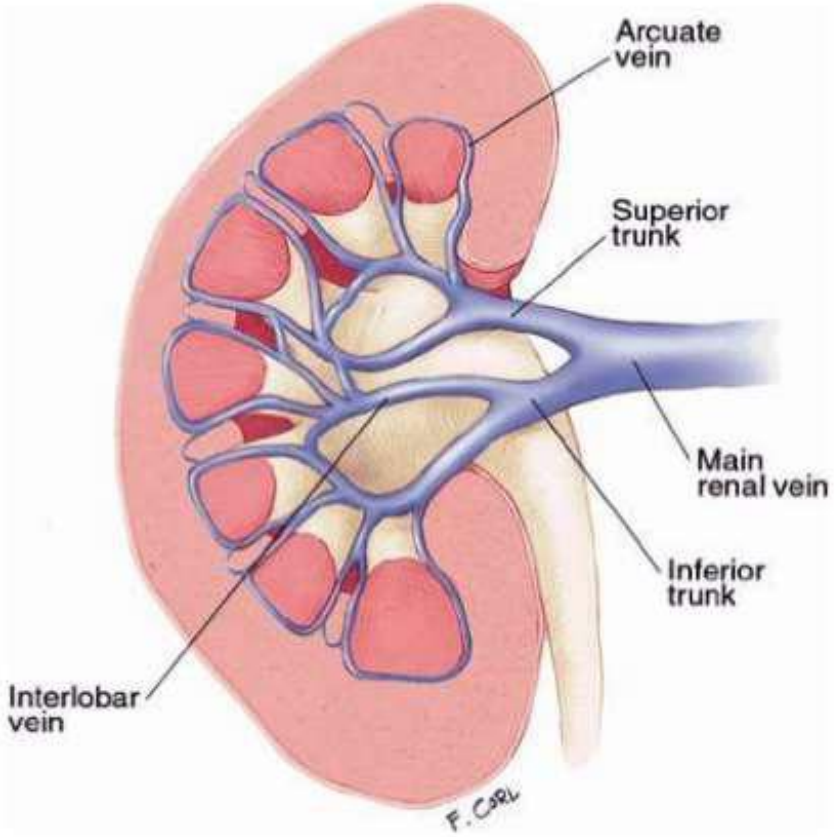

From anterior
to posterior
Renal vein
Renal artery
Renal pelvis
Subsidiary branch of
renal artery


Renal vein
Renal artery
Renal pelvis


Inferior vena cava
Adrenal gland
Kidney
Renal artery
Celiac trunk
Left adrenal vein
Left renal vein
Superior mesenteric artery
Ureter
Left gonadal vein
Right gonadal vein



Arterial supply



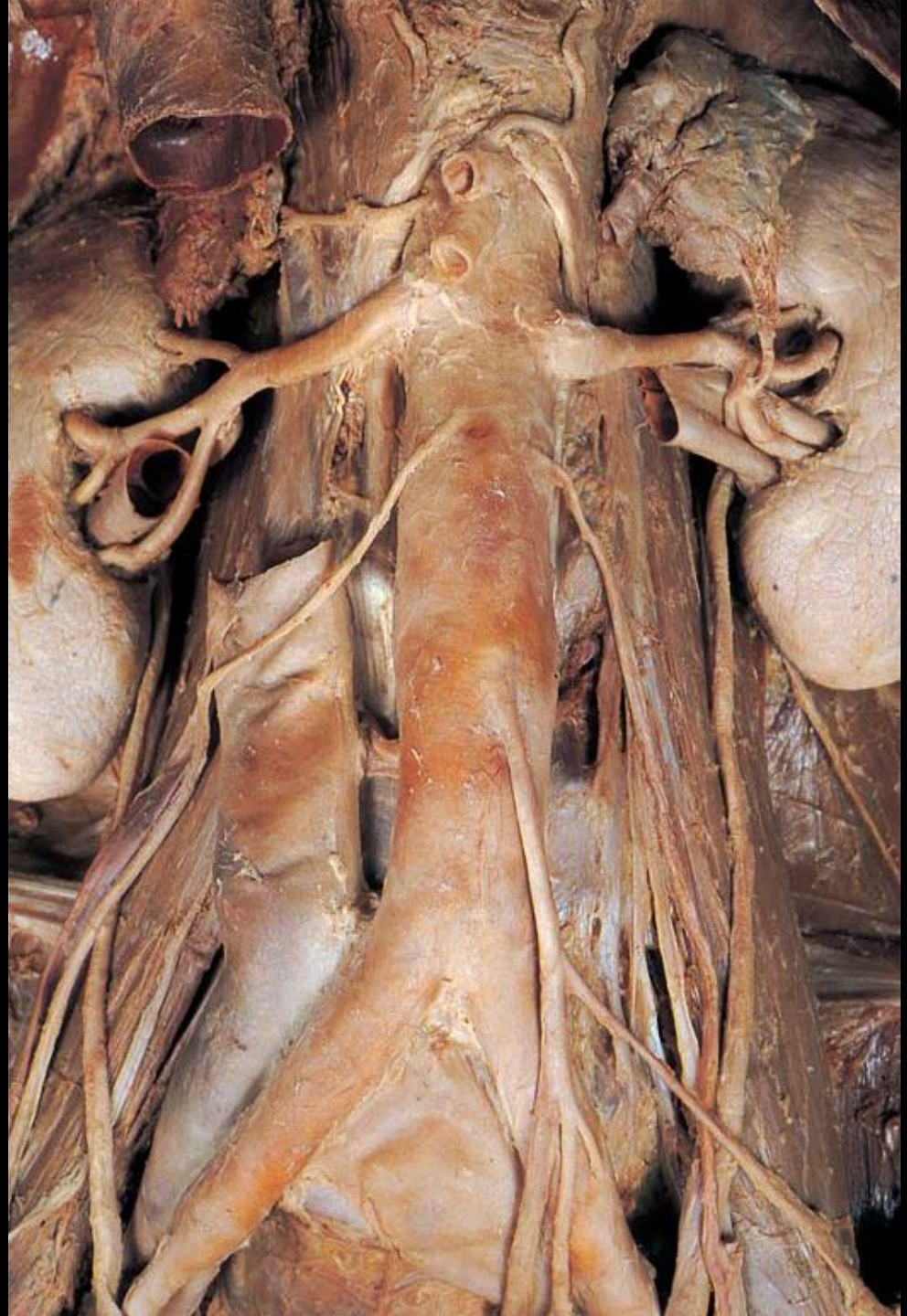
Venous drainage

Ureters and Urinary Bladder

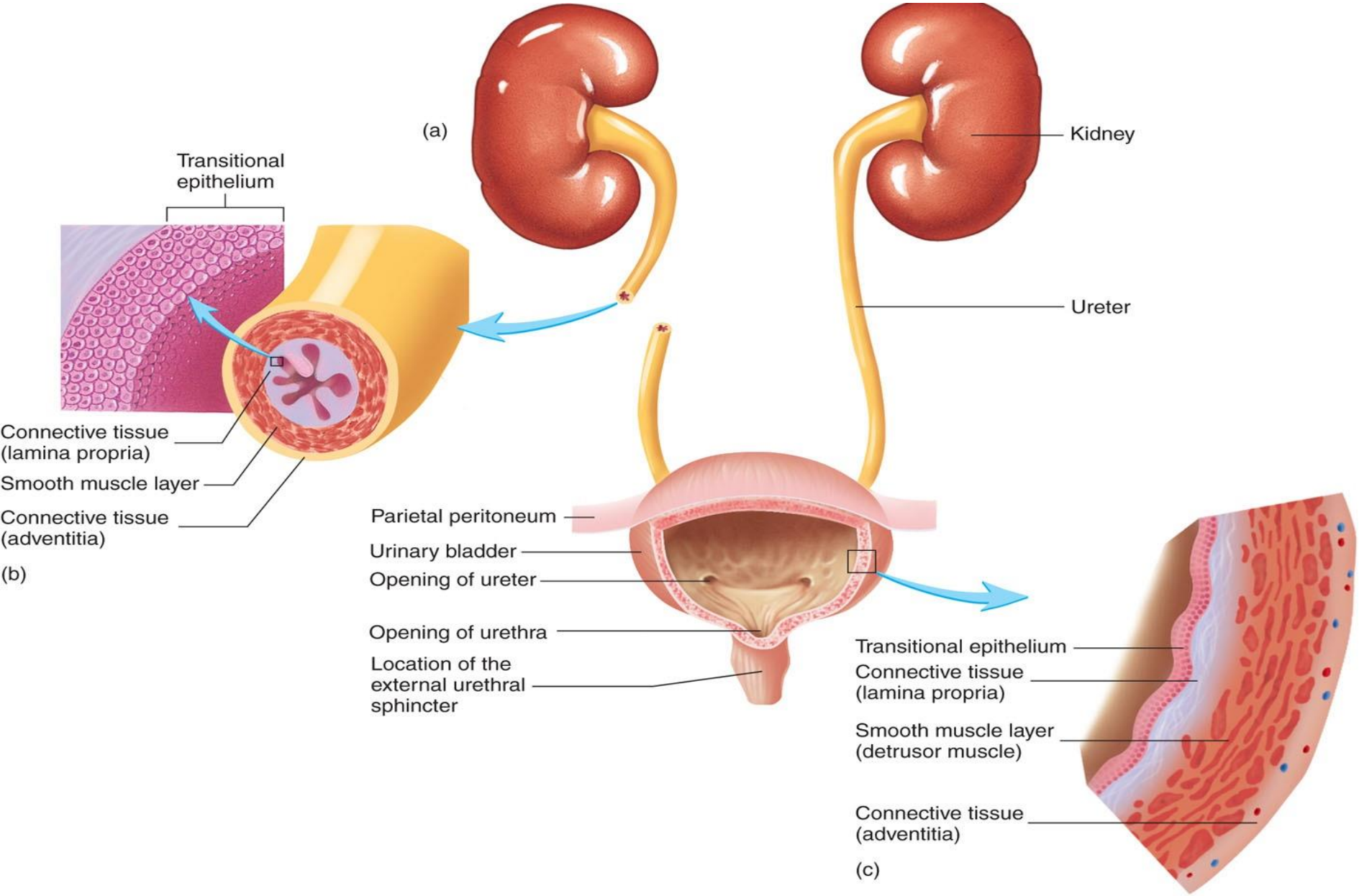
- The ureters are small tubes that carry urine from the kidneys (***most posteriorly located in renal hilum***) to the urinary bladder. They enter the bladder through the ***posterior wall***.

- The urinary bladder is a hollow muscular organ that lie in the pelvic cavity just posterior to the symphysis pubis.

- In ***males*** it ***lies anterior*** to the ***rectum*** while in ***females*** it ***lies anterior*** to the ***vagina*** and anterior and inferior to the uterus.



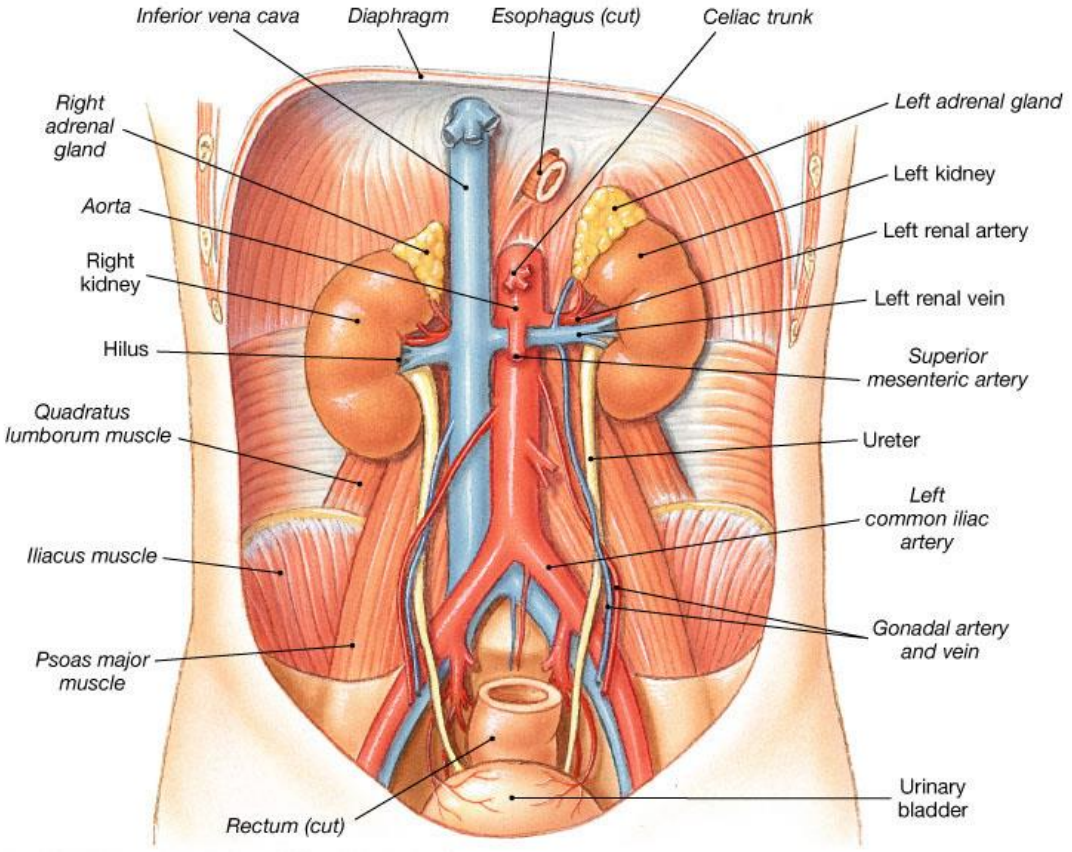
Ureters and Urinary Bladder



The Ureters

- Pair of muscular tubes – 25 cm in length, mm in diameter

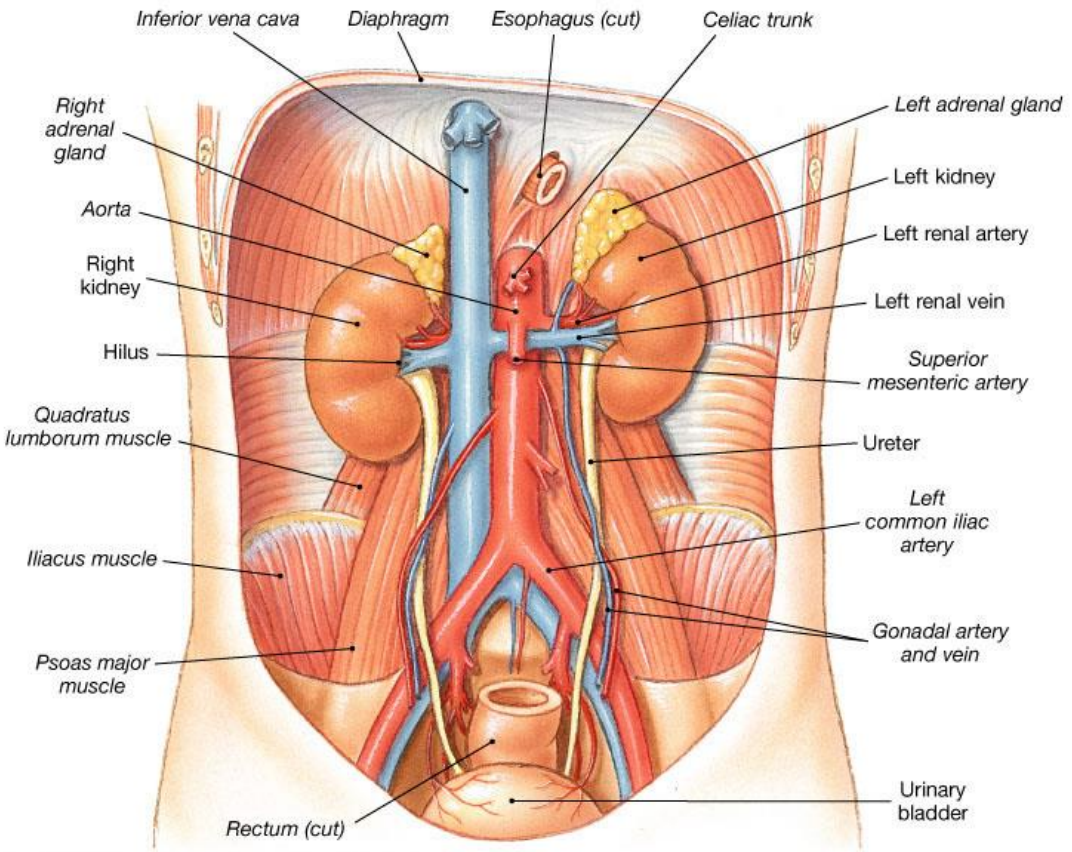
- Extend from renal pelvis to the bladder (*From the site of origin to pelvic brim - **abdominal part** - while from pelvic brim to entry into urinary bladder - **pelvic part***)



The Ureters

- Peristaltic contractions force urine from the kidneys to the urinary bladder

- Retroperitoneal in position, runs behind the peritoneum

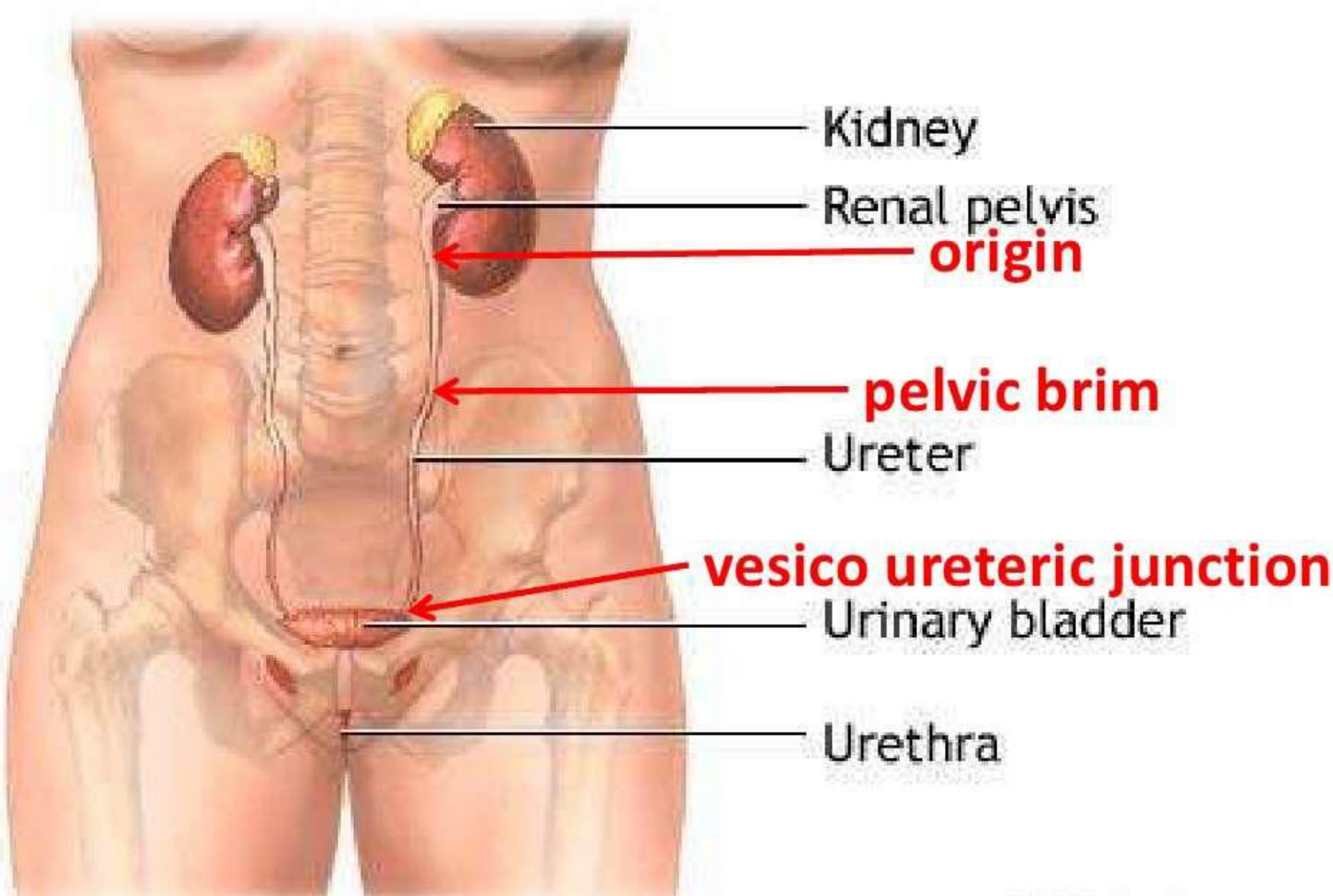


The Ureters

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

- ***It measures 3mm in diameter, but it is slightly constricted at three places.***
  1. At the pelvi-ureteric junction
  2. At the brim of lesser pelvis
  3. At its passage through the bladder wall

CONSTRICTIONS



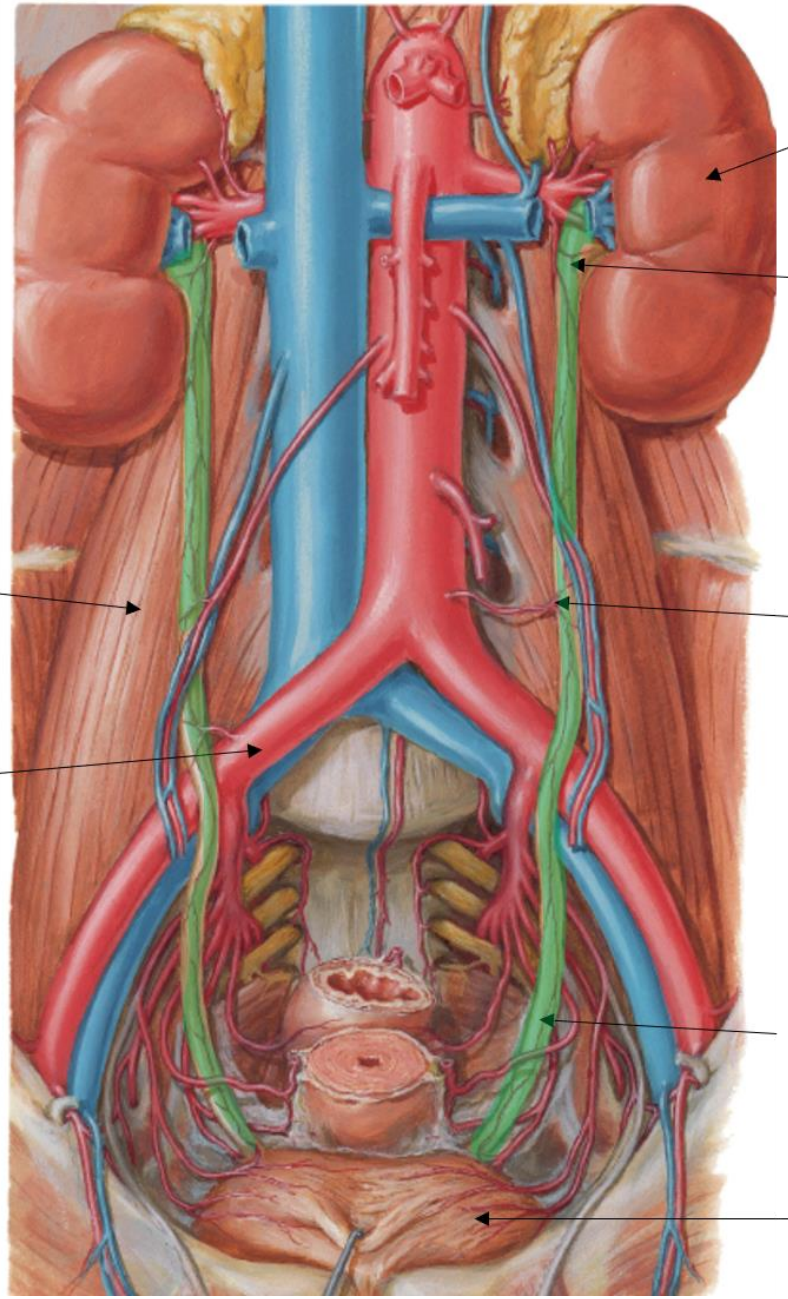
The Ureters - Relations

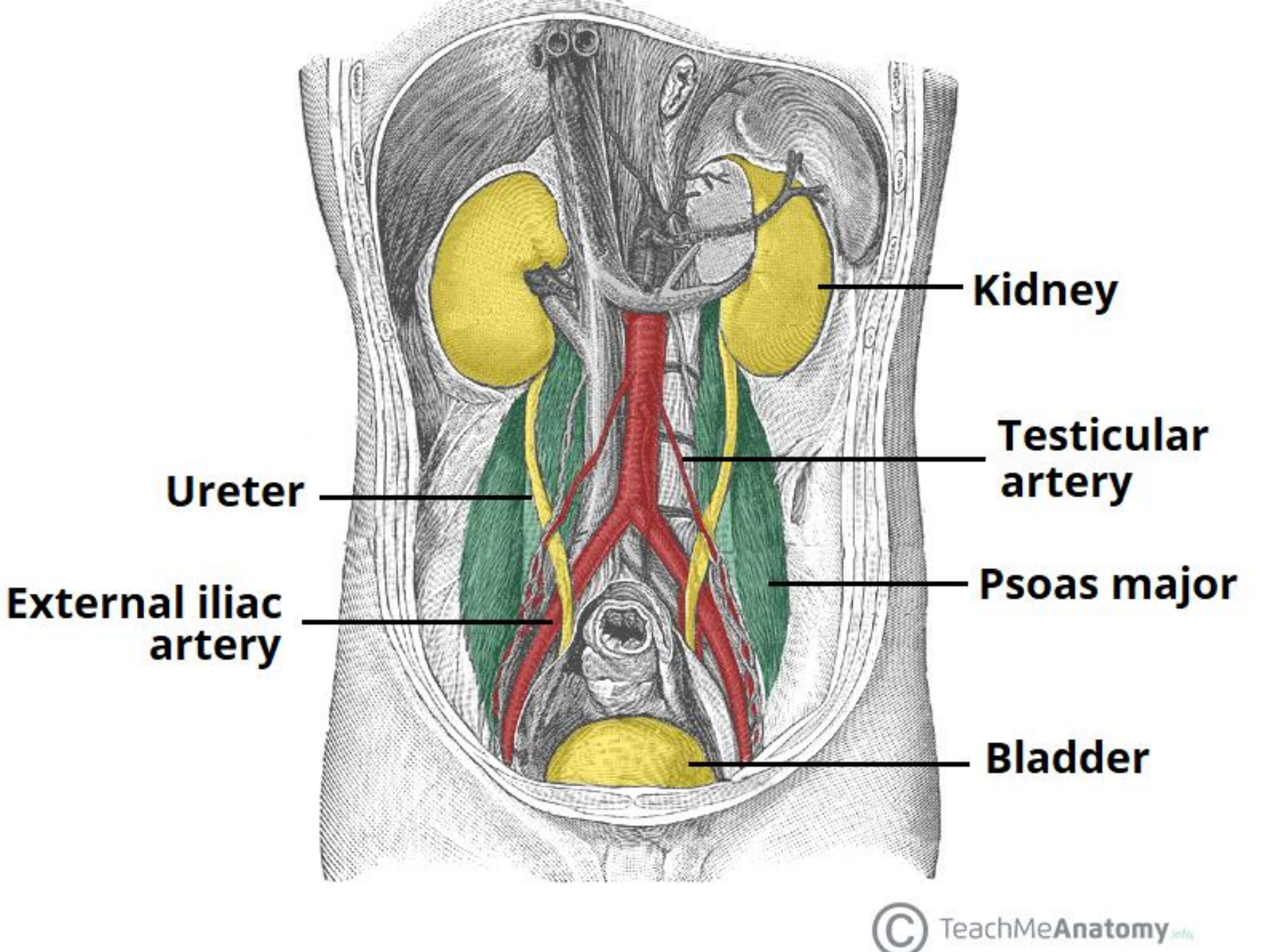
Anterior:

- Duodenum,
- Terminal part of the ileum,
- Right colic vessels,
- Iliocolic vessels,
- Right testicular or ovarian vessels.

Posterior:

- Right psoas muscle,
- Bifurcation of the right common iliac artery


Kidney
Pelvis of ureter
Psoas major muscle
Abdominal part of ureter
Common iliac artery
Pelvic part of ureter
Urinary bladder



The Ureters

- ***Ureter is supplied by branches of***

» Renal artery
» Abdominal aorta
» Gonadal artery
» Common iliac artery
» Internal iliac artery
» Inferior vesical artery

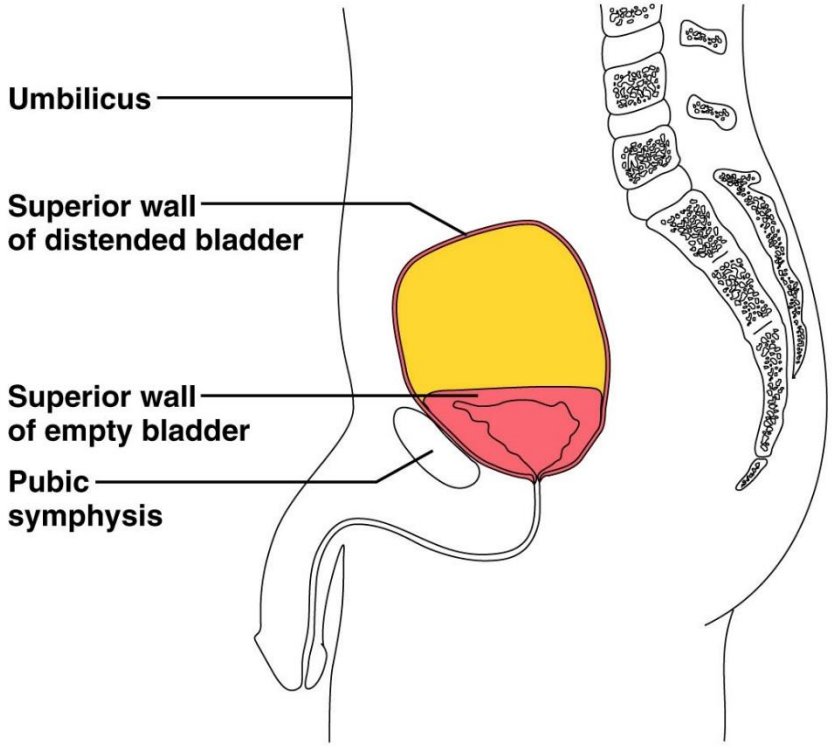
- ***Nerve Supply***

Autonomic nervous system

Urinary Bladder

- A collapsible muscular sac

- Stores and expels urine
  - Full bladder – spherical
    - Expands into the abdominal cavity
  - Empty bladder – lies entirely within the pelvis



Urinary Bladder

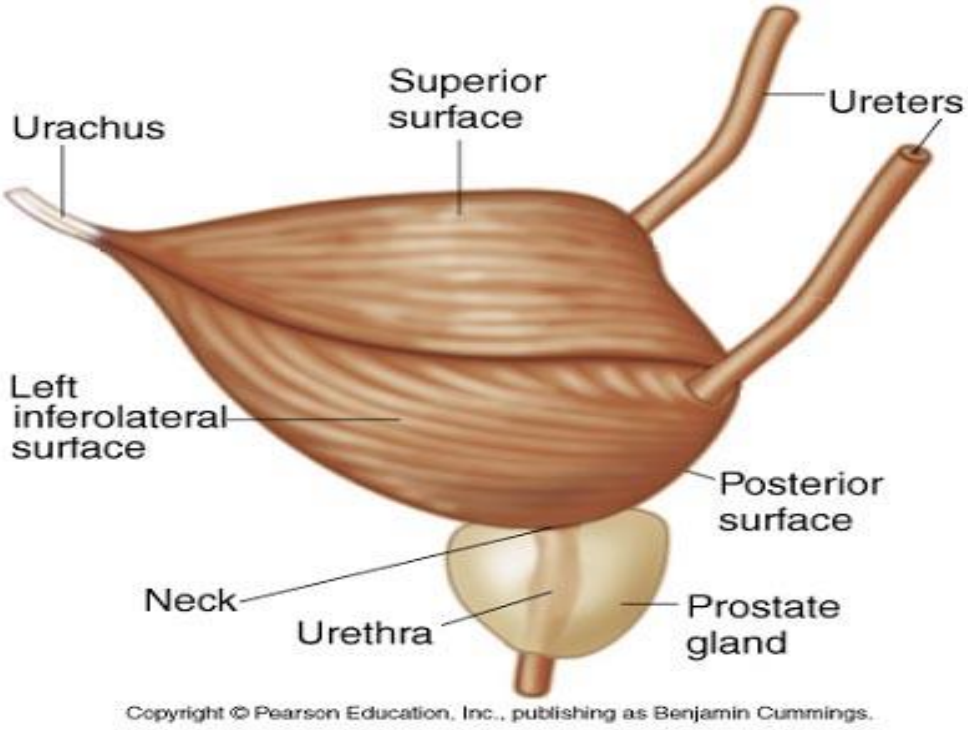
Capacity

- The mean capacity of the bladder is 220 ml, filling beyond 220ml causes a desire to micturate. Filling up to 500ml may be tolerated, but it becomes painful.

- Spontaneous evacuation occurs at 600 ml

Urinary Bladder

- **Location**
  - Pelvic floor
  - Posterior to public symphysis
  - Anterior to
    - Rectum in males
    - Vagina & uterus in females



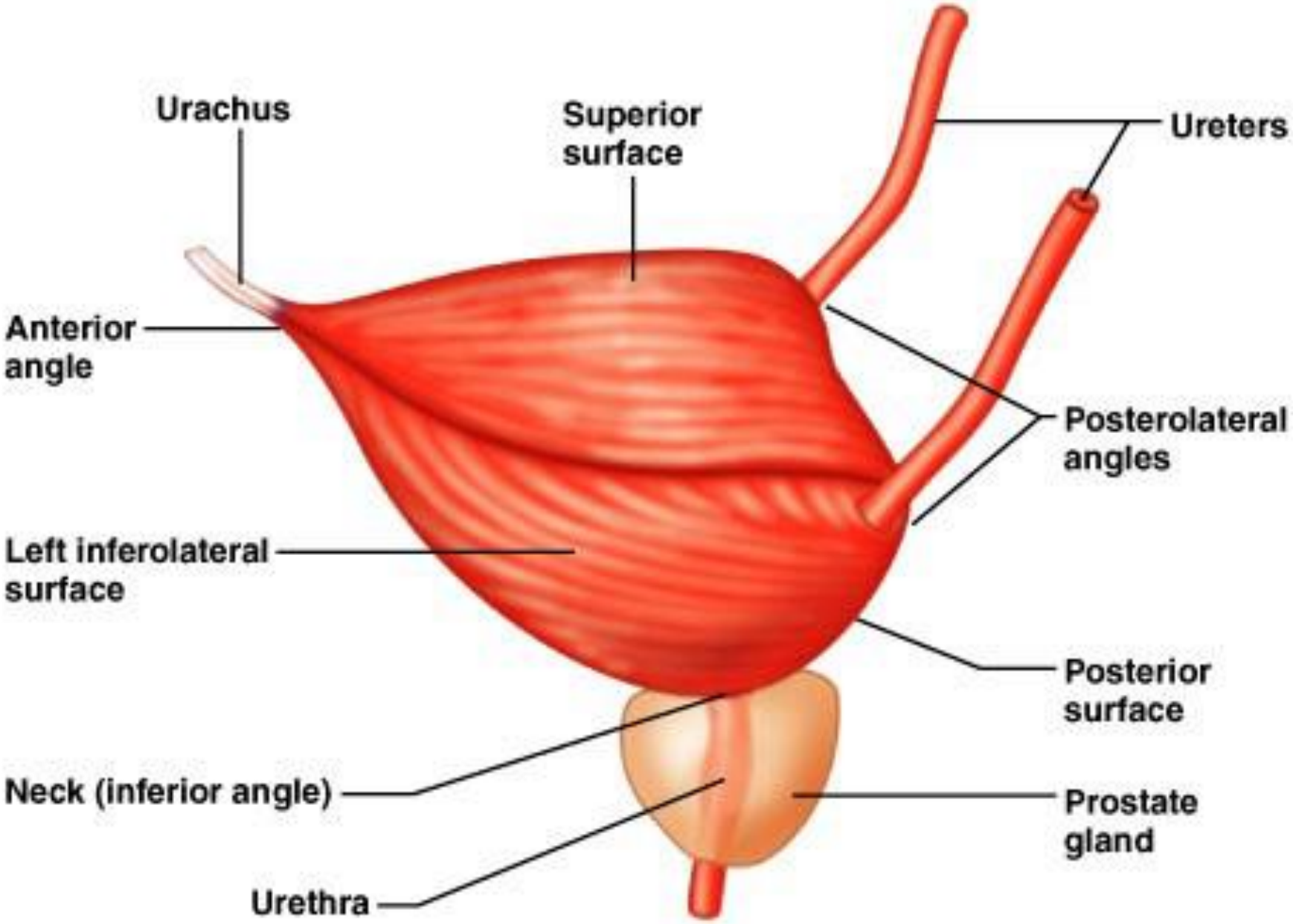
Urinary Bladder - Shape

- 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 inferolateral surfaces
- Superior surface

- When distended it is ovoid in shape

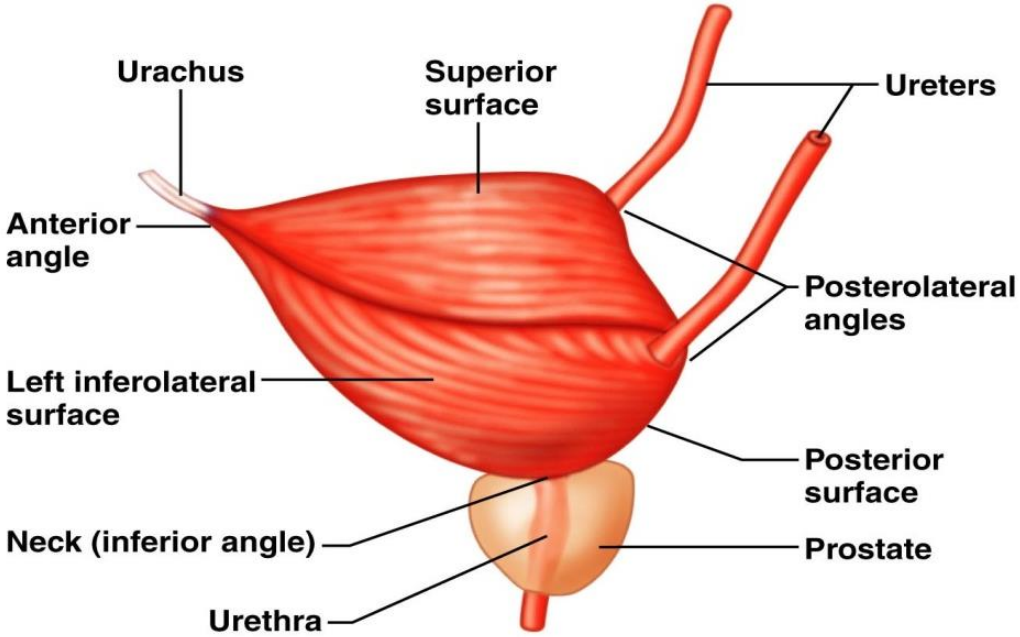

Urachus
Superior surface
Ureters
Anterior angle
Posterolateral angles
Left inferolateral surface
Posterior surface
Neck (inferior angle)
Prostate gland
Urethra

Urinary Bladder

Prostate gland:

Found in in males

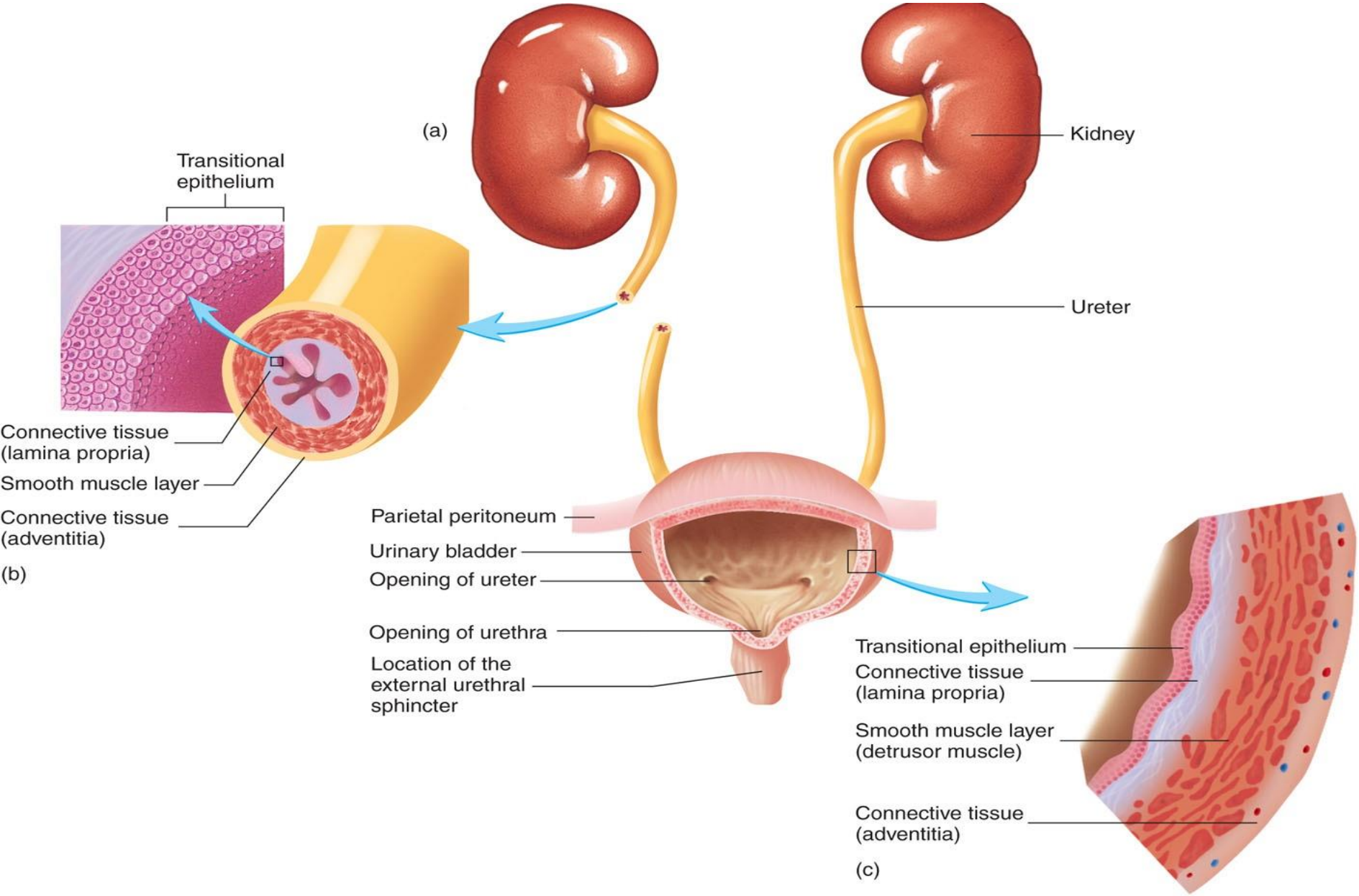
- Lies directly inferior to the bladder
- Surrounds the urethra



Urinary Bladder - Structure

- ***Outer layer:*** Loose connective tissue
- ***Middle layer:*** Smooth muscle (***detrusor muscle***) and elastic fibers
- ***Inner layer:*** Lined with transitional epithelium

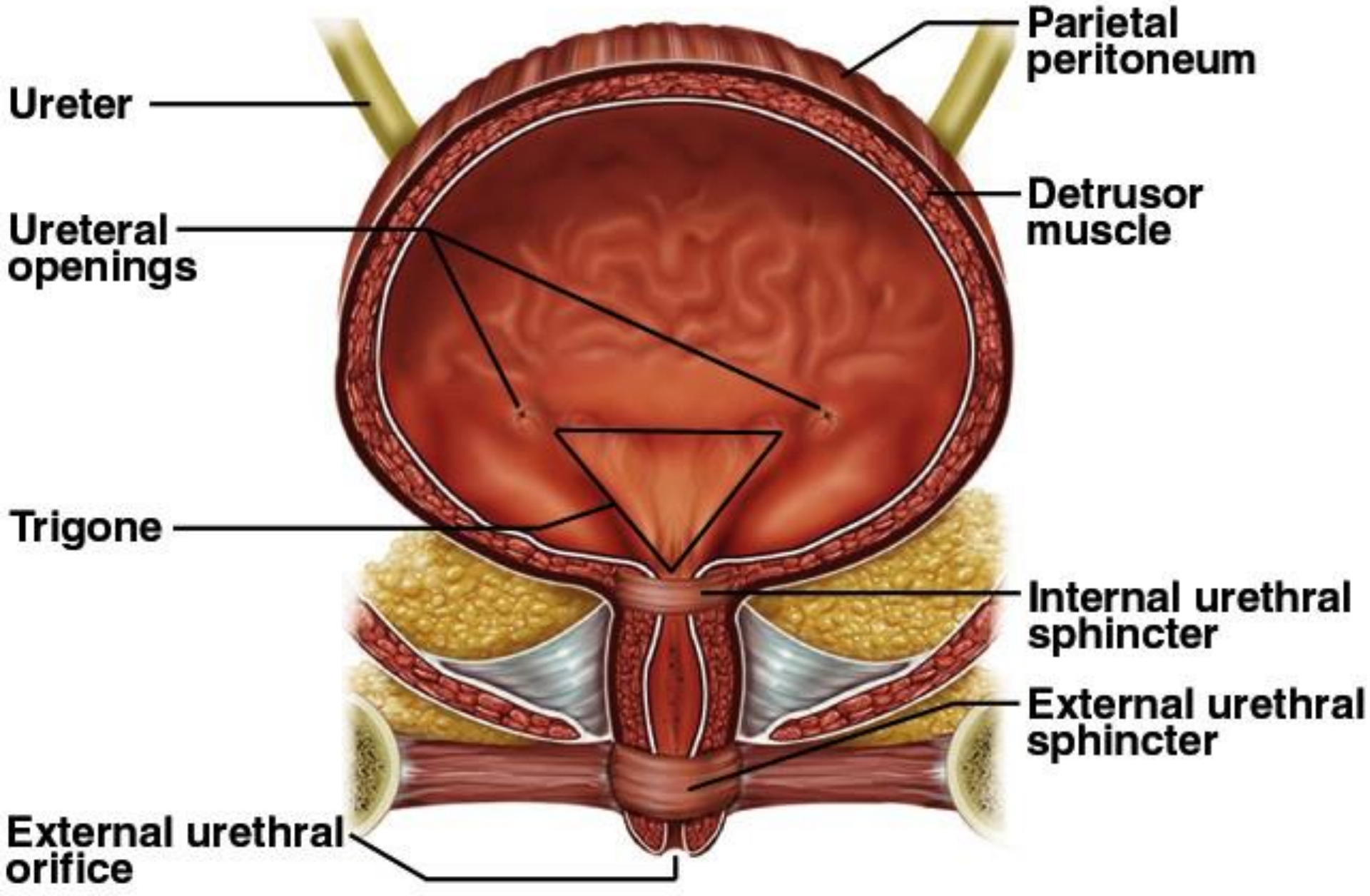
Ureters and Urinary Bladder



Urinary Bladder - Interior

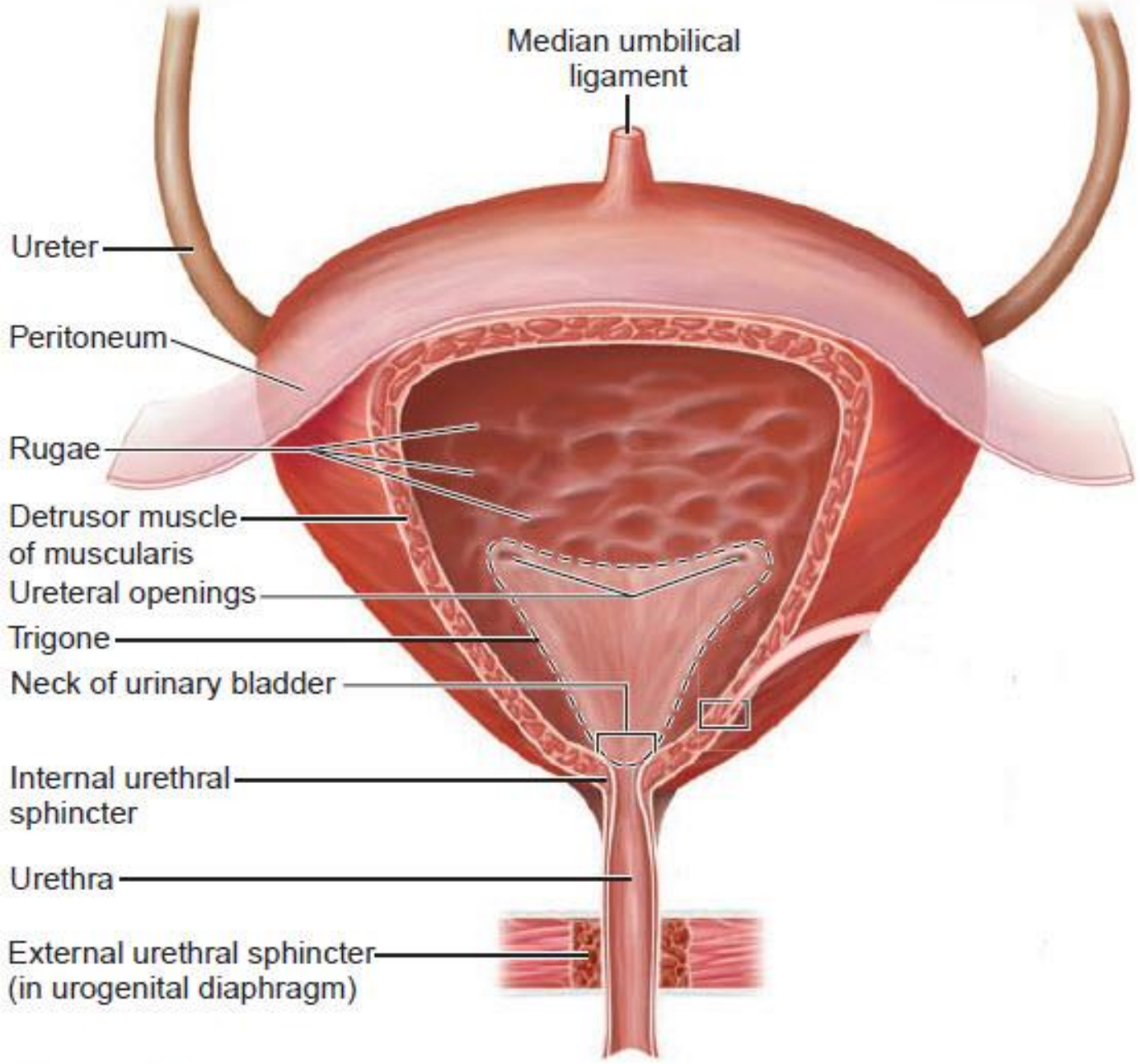
- The mucous membrane is **straw** colored & is ***thrown into folds***.
- When bladder is distended, these folds disappear.
- The posterior wall shows a ***smooth triangular*** area called ***trigone***. ***There are no mucous folds in this region.***

Urinary Bladder and Urethra, Female



Urinary Bladder - Interior

- At the upper lateral angles of the trigone are the ureteric openings.
- At its inferior angle is the internal urethral orifice
- Trigone of the urinary bladder has three openings:
  - ***Two openings*** from the ***ureters***
  - ***One opening*** to the ***urethra***



(a) Urinary bladder, anterior view

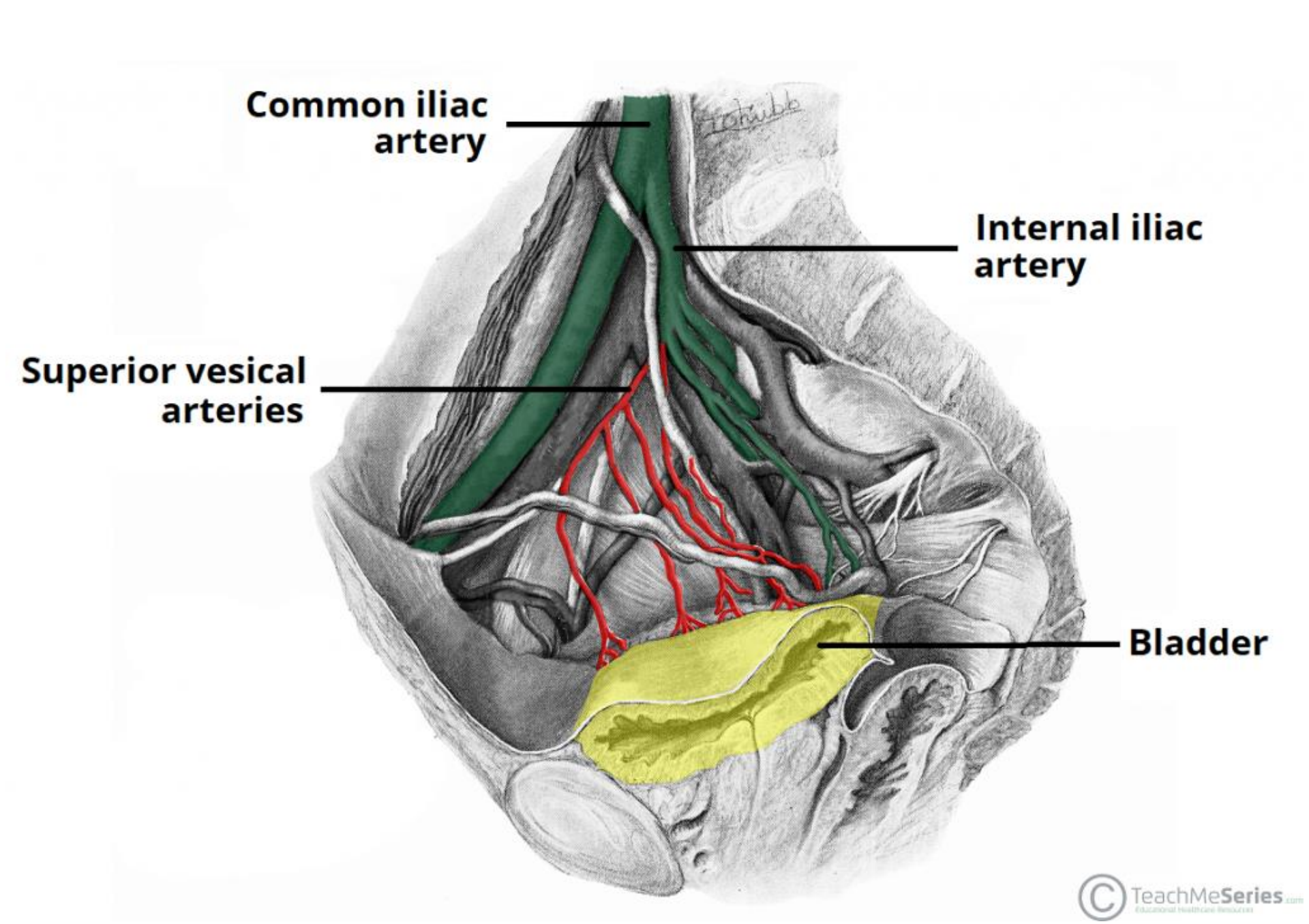
Urinary Bladder

- The vasculature of the bladder is primarily derived from the ***internal iliac*** vessels through ***superior vesical*** branch.
- In males, this is supplemented by the ***inferior vesical artery***, and in females by the ***vaginal arteries***.
- In both sexes, the obturator and inferior gluteal arteries may also contribute small branches.

Urinary Bladder

- Venous drainage is achieved by the ***vesical venous plexus***, which empties ***into*** the ***internal iliac veins***.

- The vesical plexus in males is in continuity at the retropubic space with the **prostate venous plexus** (plexus of Santorini), which also receives blood from the dorsal vein of the penis



Nerve Supply

- **Sympathetic:** ***hypogastric nerve (T12 – L2).*** It causes relaxation of the detrusor muscle, promoting urine retention.

- **Parasympathetic**: ***pelvic nerve (S2-S4).*** Increased signals from this nerve causes contraction of the detrusor muscle, stimulating micturition.

- **Somatic**: **pudendal nerve** ***(S2-4).*** It innervates the external urethral sphincter, providing voluntary control over micturition.

Urethra

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

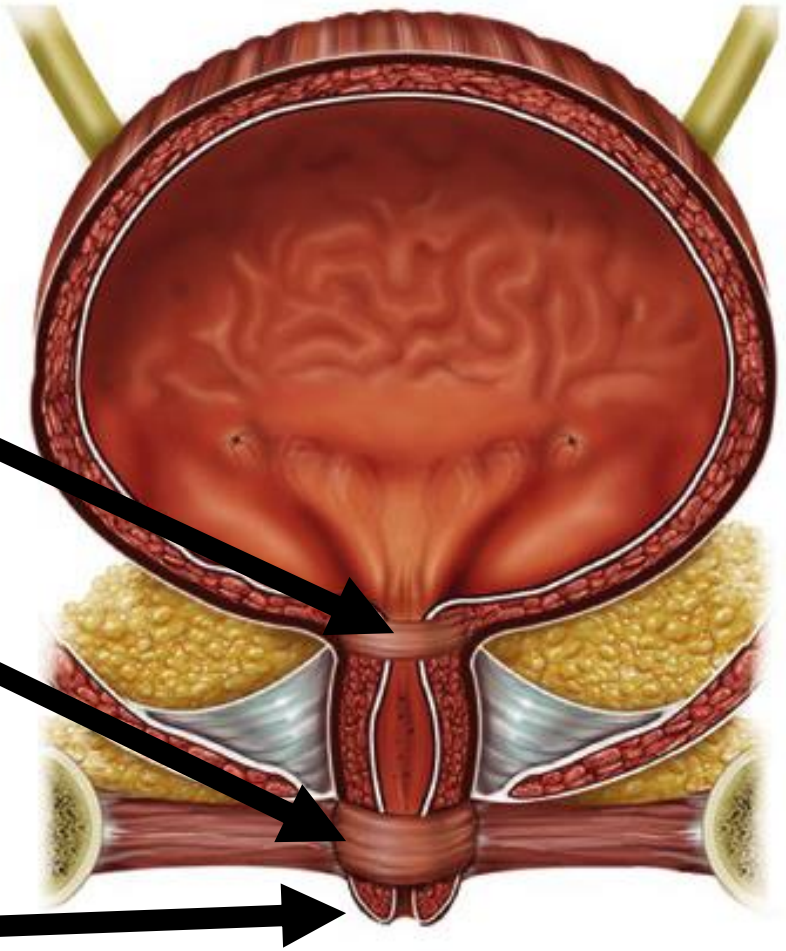
- ***Male:*** about 20 cm (8″) long (*from the bladder neck*)

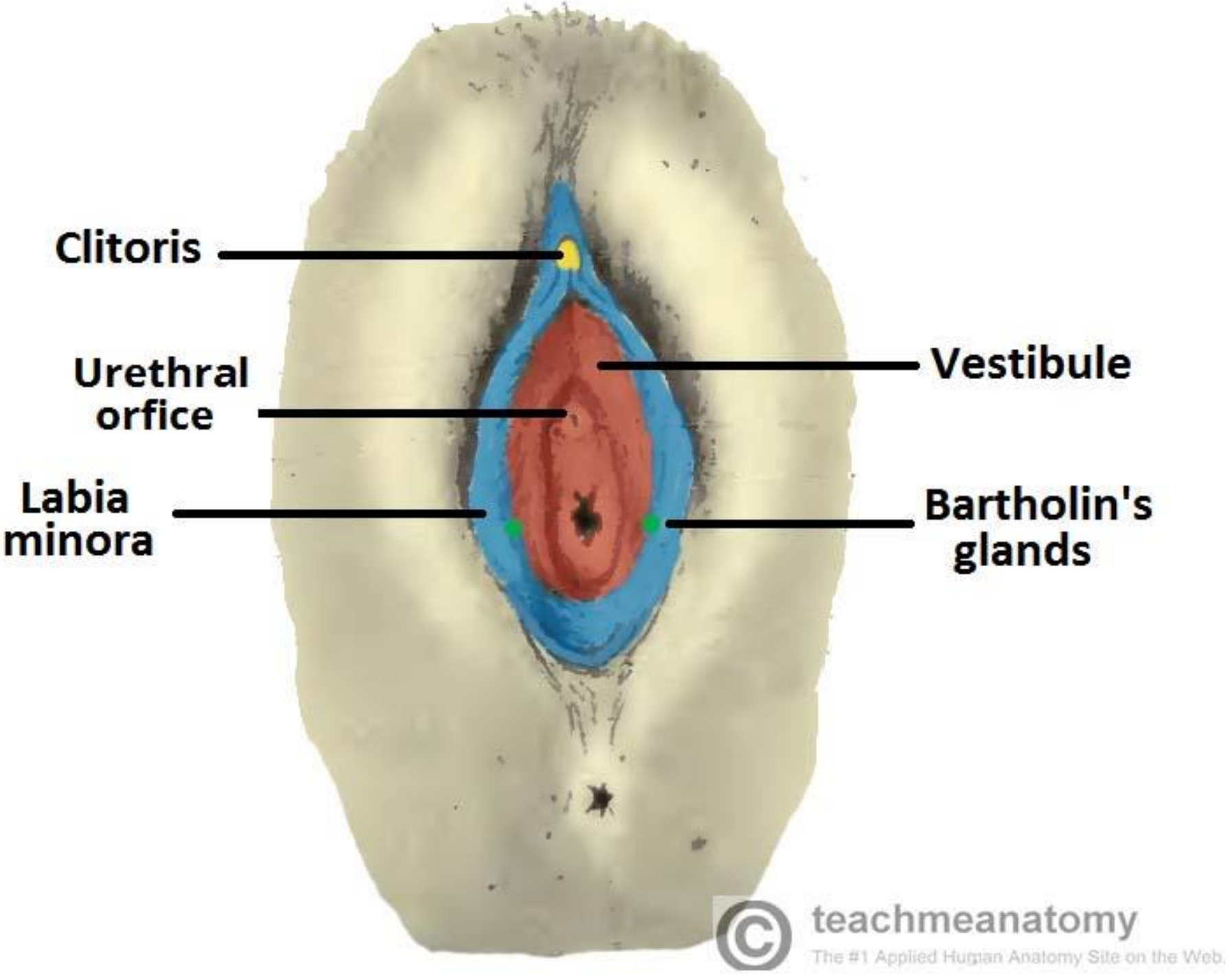
- ***Female:*** 3-4 cm (1.5″) long

Short length is why females have more urinary tract infections than males - ascending bacteria from stool contamination

Female Urethra

- Internal urethral sphincter, detrusor muscle thickened, smooth muscle, under involuntary control
- External urethral sphincter, skeletal muscle, voluntary control
- External urethral orifice, between vaginal orifice and clitoris

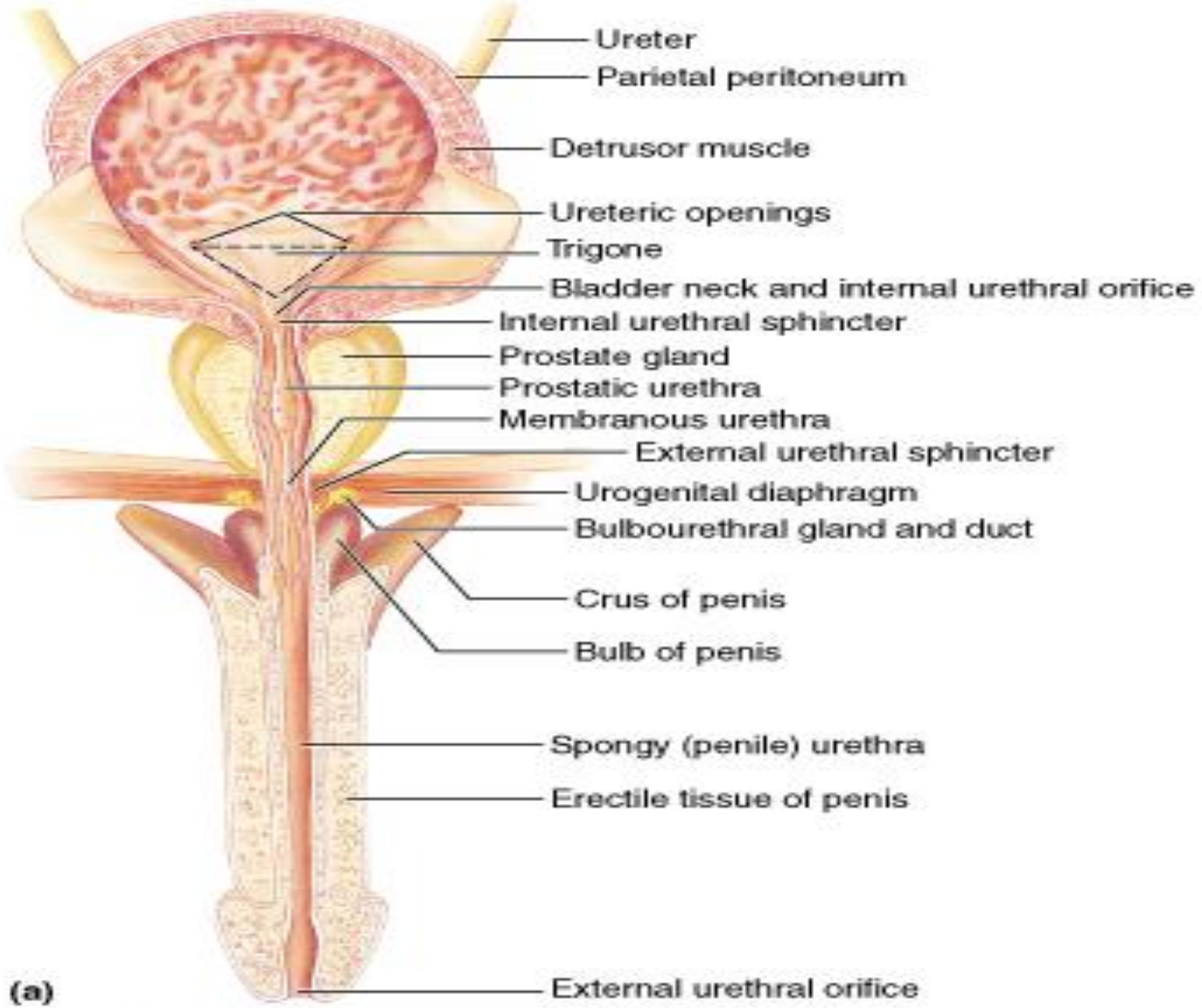




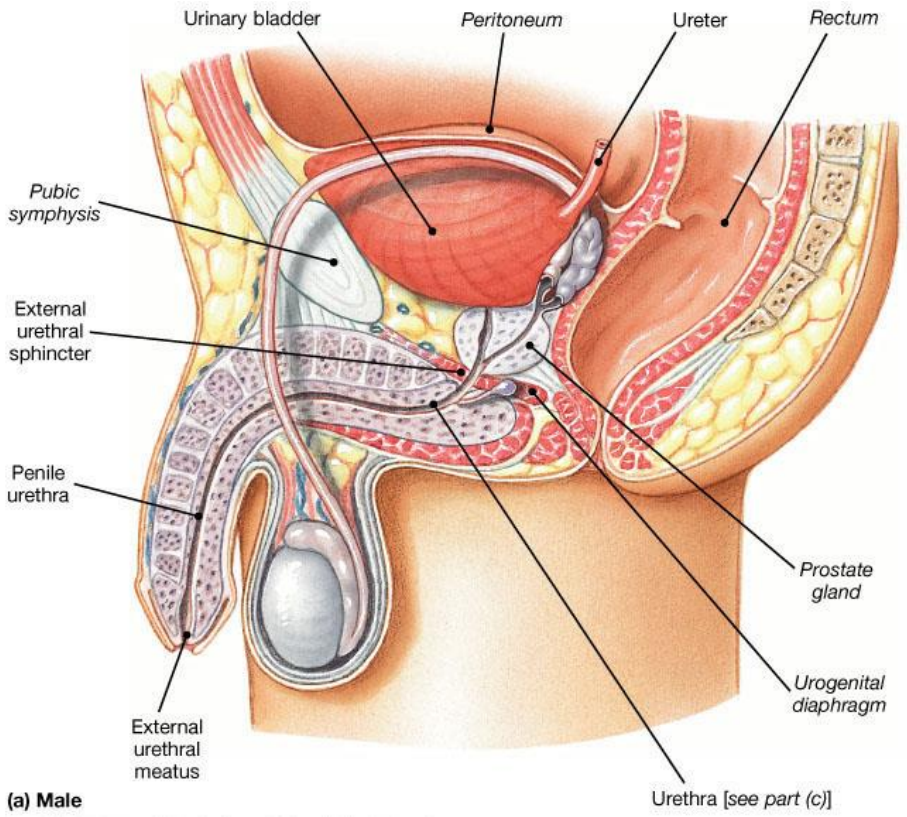
Male Urethra

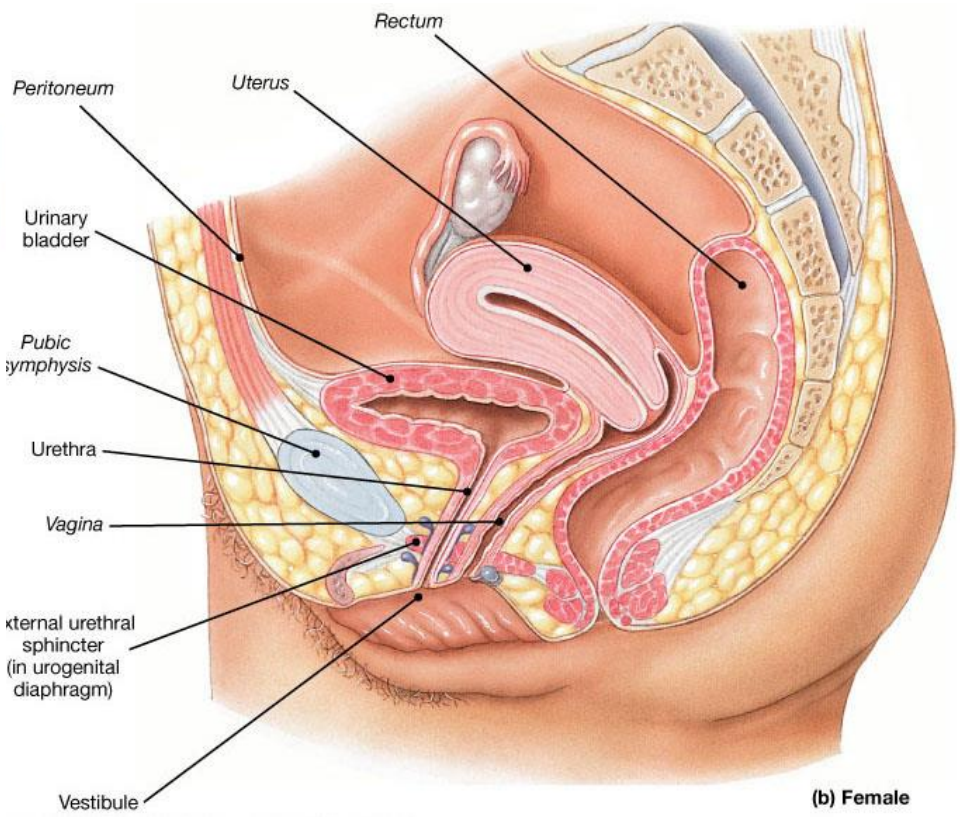
- Internal urethral sphincter
- External urethral sphincter
- ***3 regions***

1. Prostatic urethra, inside the prostate gland
2. Membranous urethra, passes through perineum
3. Penile urethra



The urethra


Urinary bladder
Peritoneum
Ureter
Rectum
Pubic symphysis
External urethral sphincter
Penile urethra
Prostate gland
Urogenital diaphragm
External urethral meatus
Urethra [see part (c)]
(a) Male

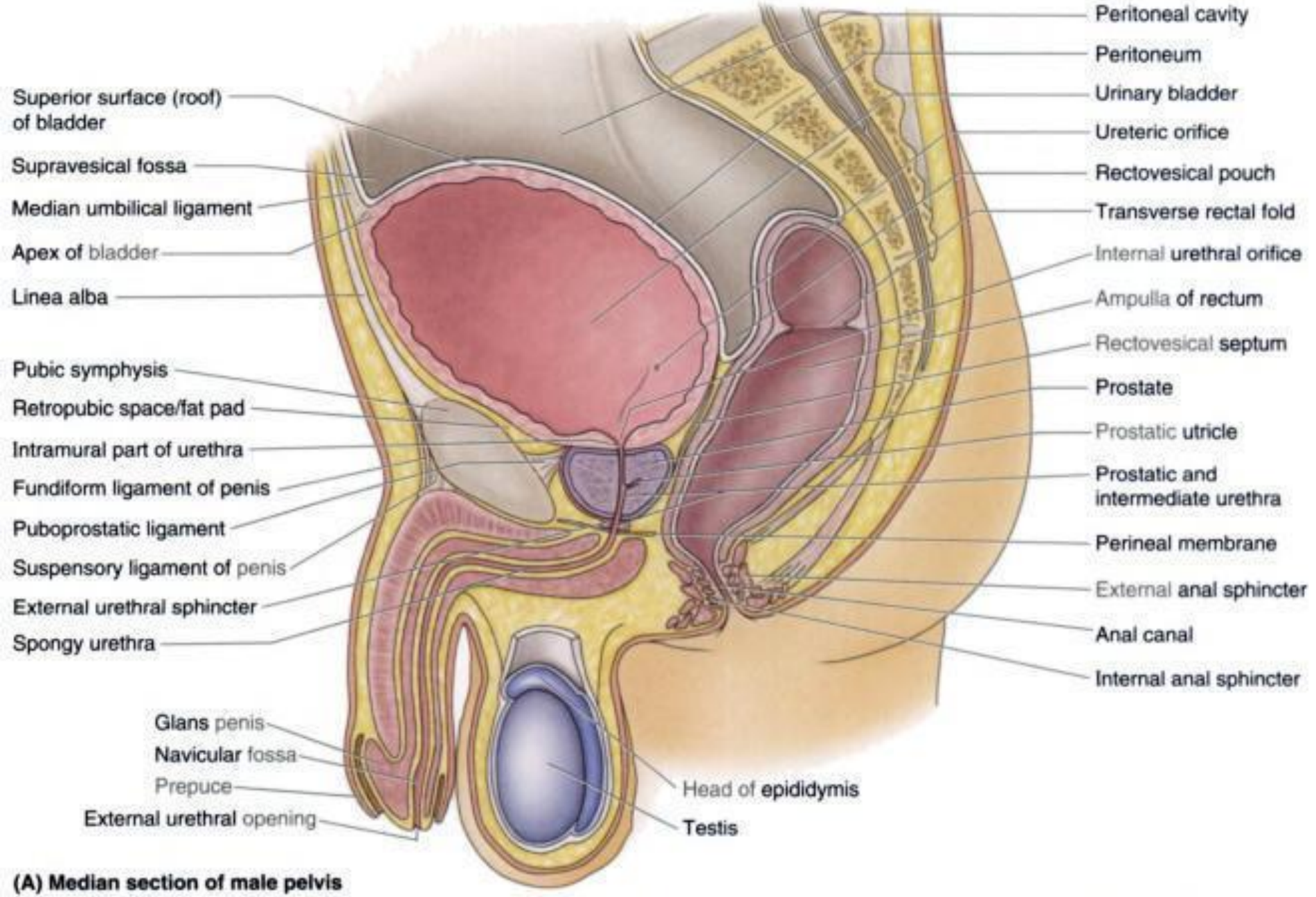

Rectum
Peritoneum
Uterus
Urinary bladder
Pubic symphysis
Urethra
Vagina
External urethral sphincter (in urogenital diaphragm)
Vestibule
(b) Female

Arrangement of Pelvic Viscera

- The human pelvic contains 3 major organs.
- The most anterior organ in any pelvis behind the pubic bone is the urinary bladder
- The most posterior organ in any pelvis is the rectum as part of the gastrointestinal tract

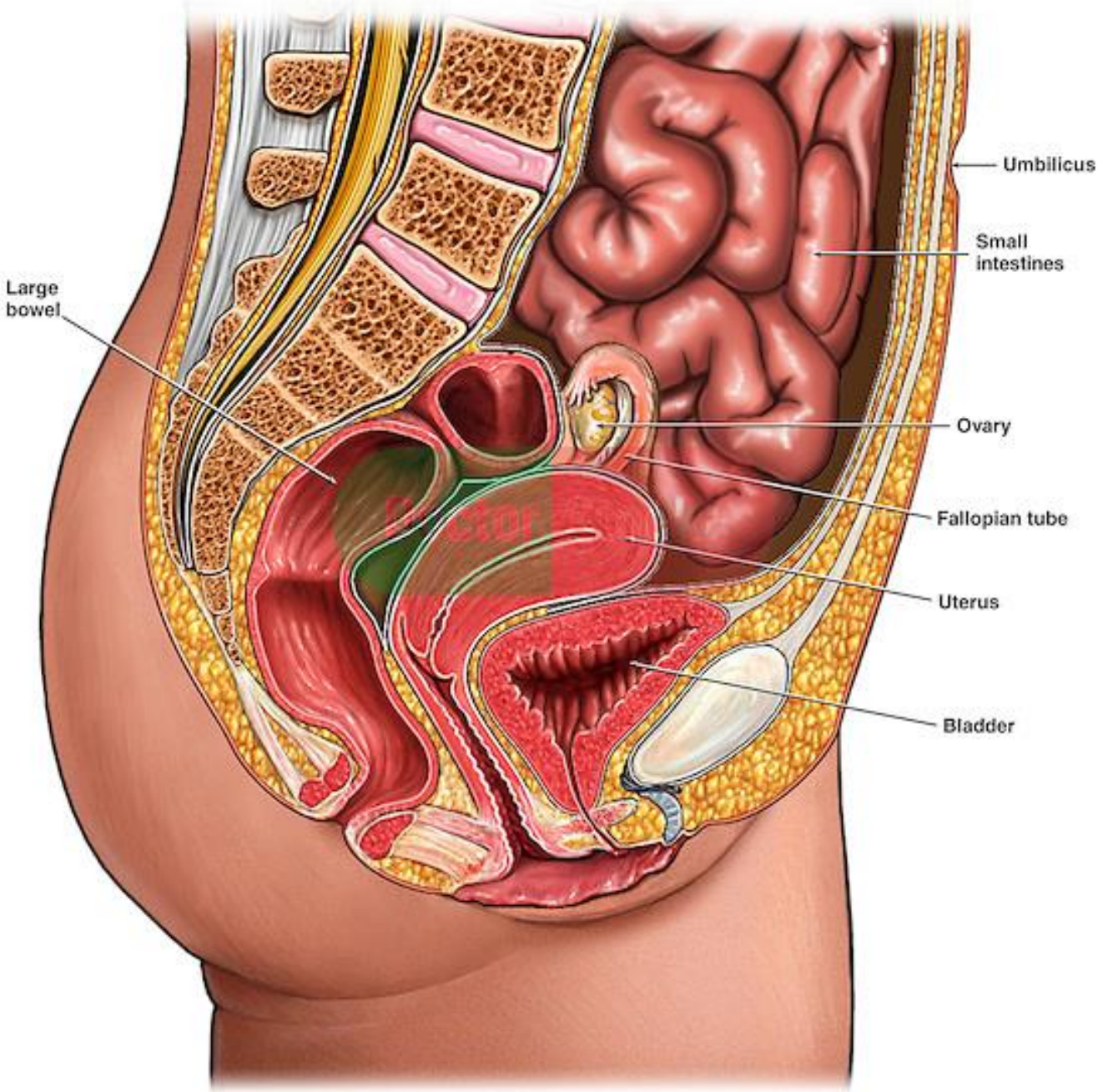
Arrangement of Pelvic Viscera

- In females, the pelvis contains the uterus and the vagina in between the urinary bladder to the front and the rectum to the back.



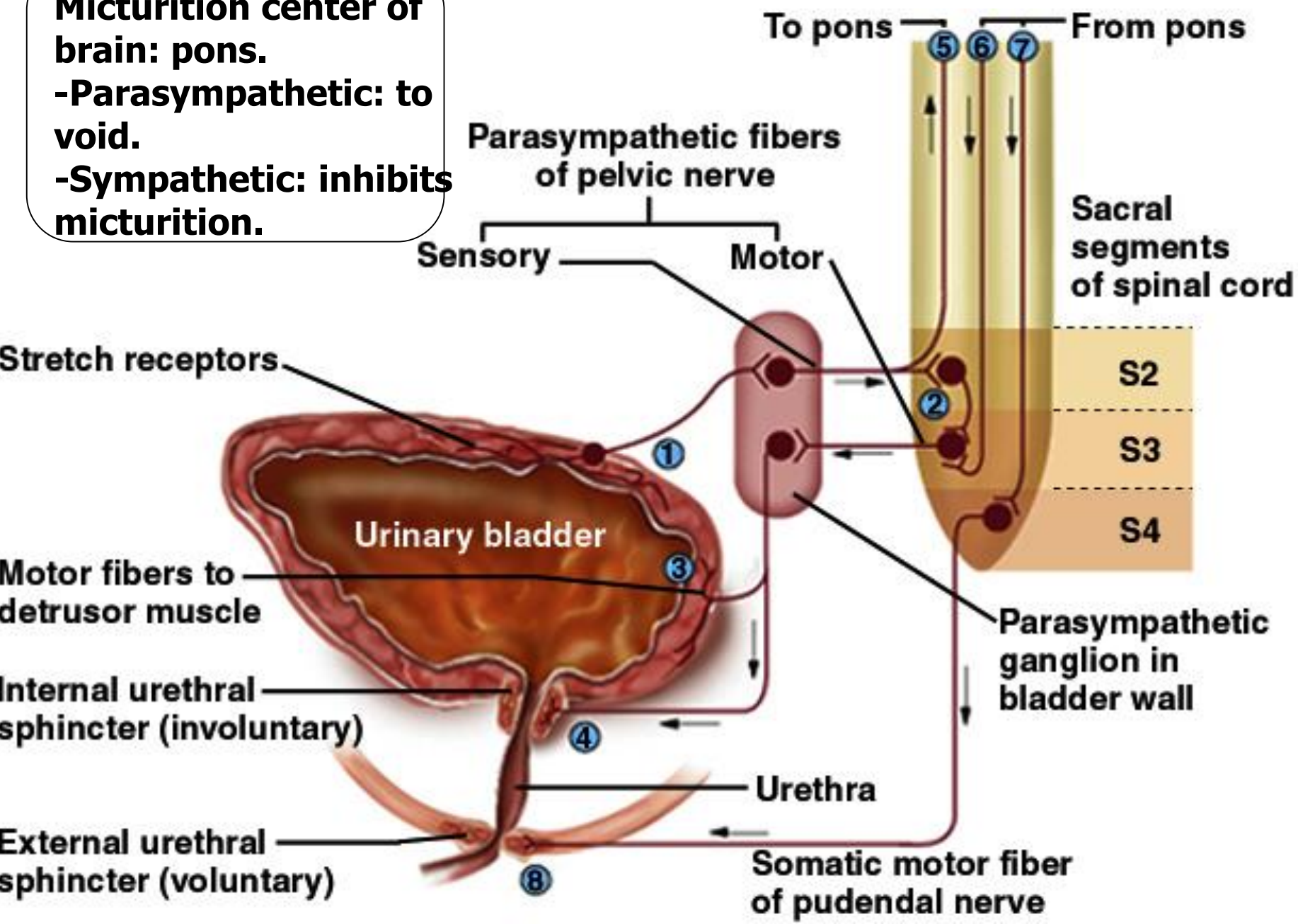
(A) Median section of male pelvis

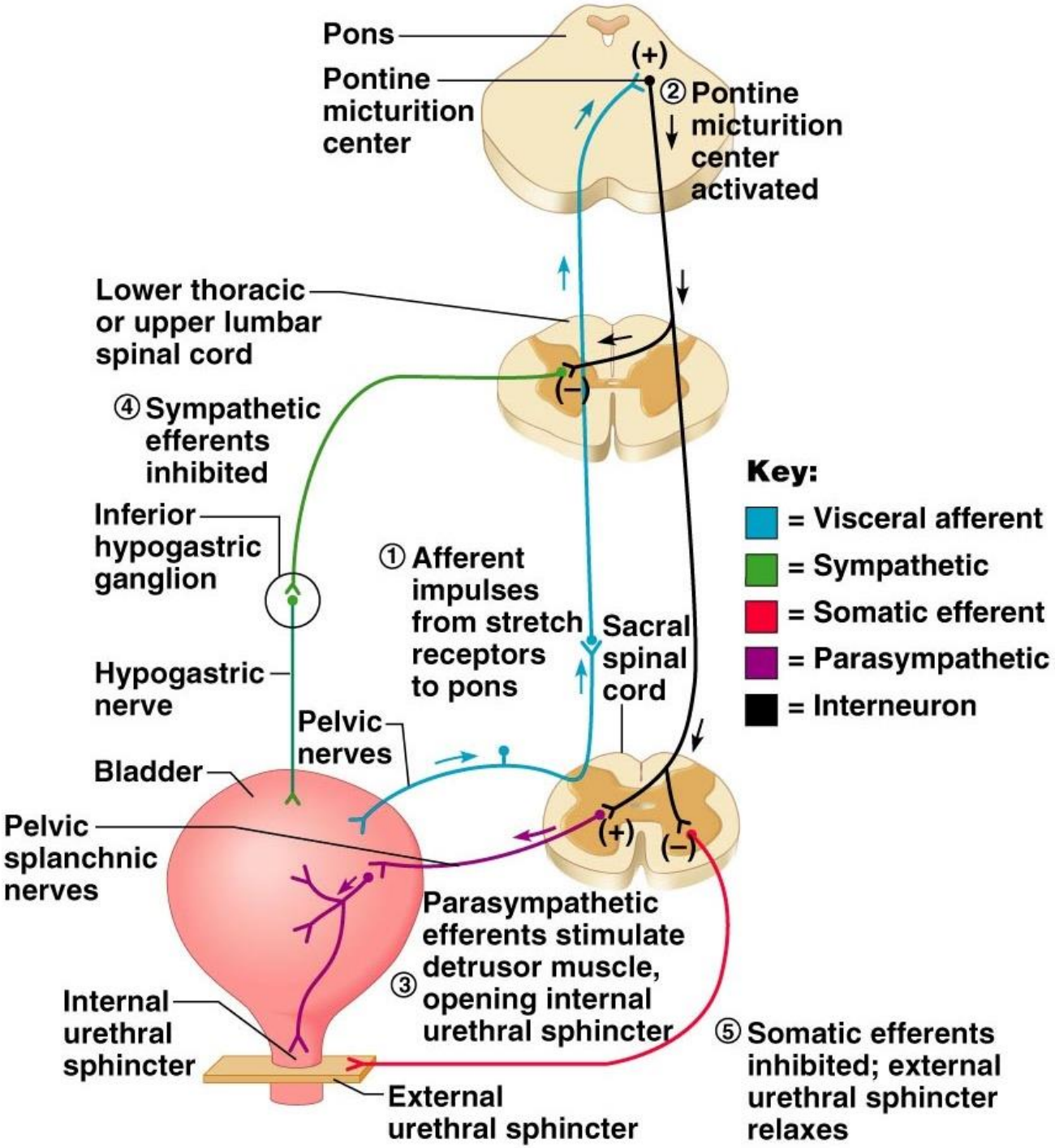
Normal Anatomy



Sagittal view

Micturition center of brain: pons.
-Parasympathetic: to void.
-Sympathetic: inhibits micturition.




Pons
Pontine micturition center
(+)
② Pontine micturition center activated
Lower thoracic or upper lumbar spinal cord
(–)
④ Sympathetic efferents inhibited
Inferior hypogastric ganglion
① Afferent impulses from stretch receptors to pons
Sacral spinal cord
Hypogastric nerve
Pelvic nerves
Bladder
Pelvic splanchnic nerves
(+)
(–)
Parasympathetic efferents stimulate detrusor muscle, ③ opening internal urethral sphincter
Internal urethral sphincter
⑤ Somatic efferents inhibited; external urethral sphincter relaxes
External urethral sphincter
Key:
= Visceral afferent
= Sympathetic
= Somatic efferent
= Parasympathetic
= Interneuron

Functions of the Urinary System

1. Excretory function through forming urine
2. Regulatory function: blood pressure, acid-base balance, water balance, electrolyte balance
3. Endocrine function: erythropoietin
4. Activation of vitamin D

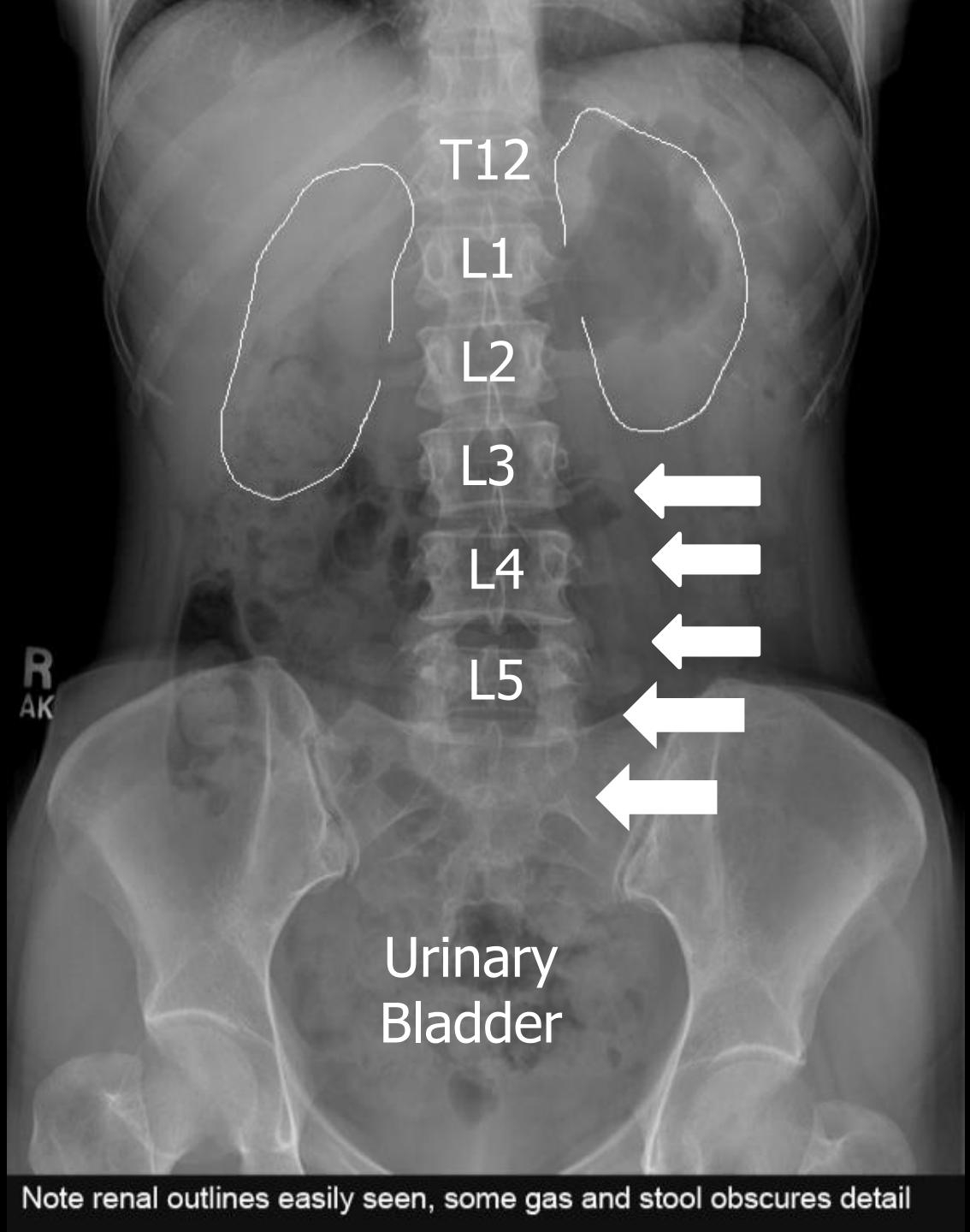
KUB

Kidney-urinary bladder X-ray


Control exposure

Figure 1

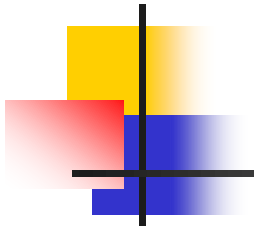

12 11:01PM
th-kandiel.com



Note renal outlines easily seen, some gas and stool obscures detail

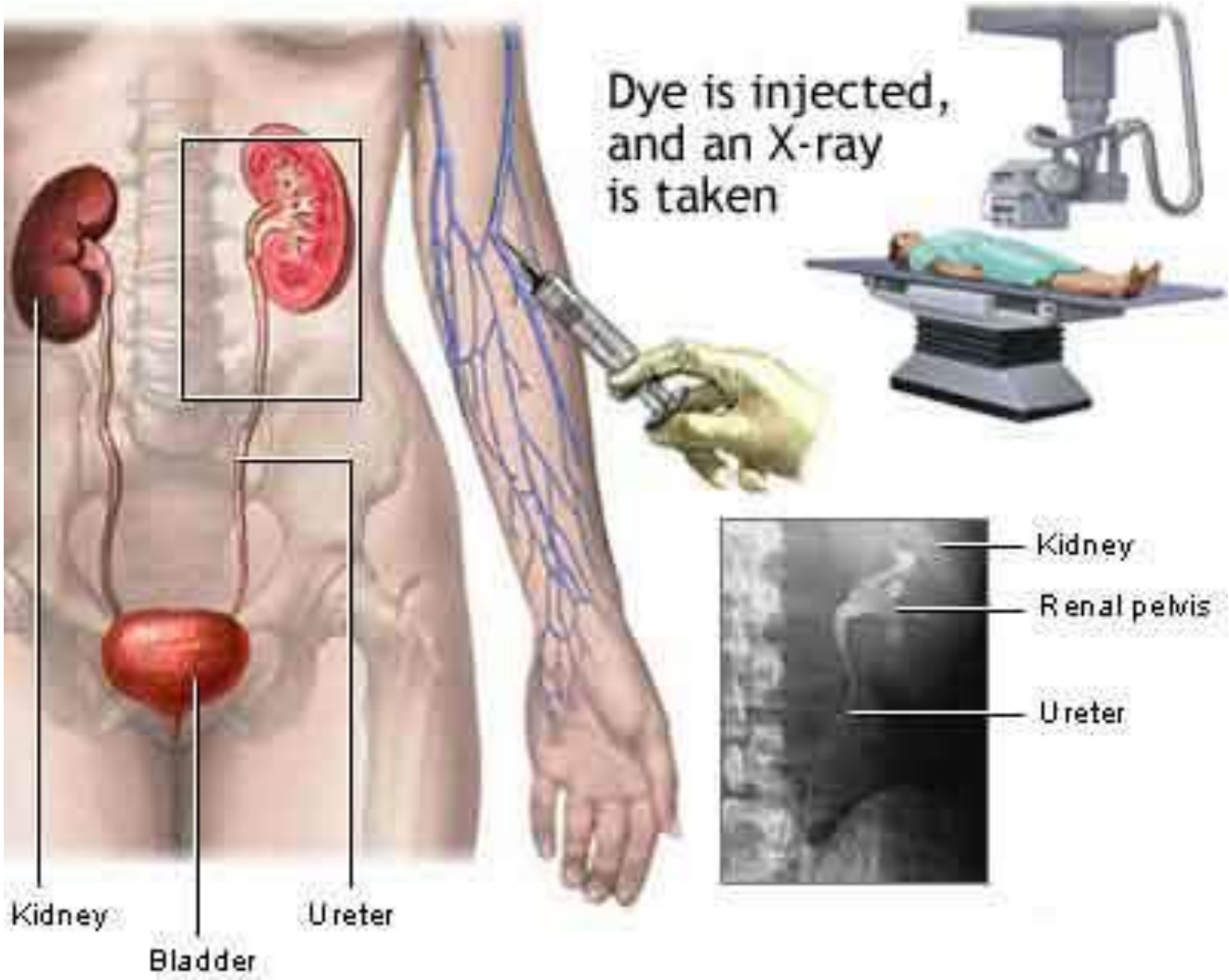

RIGHT

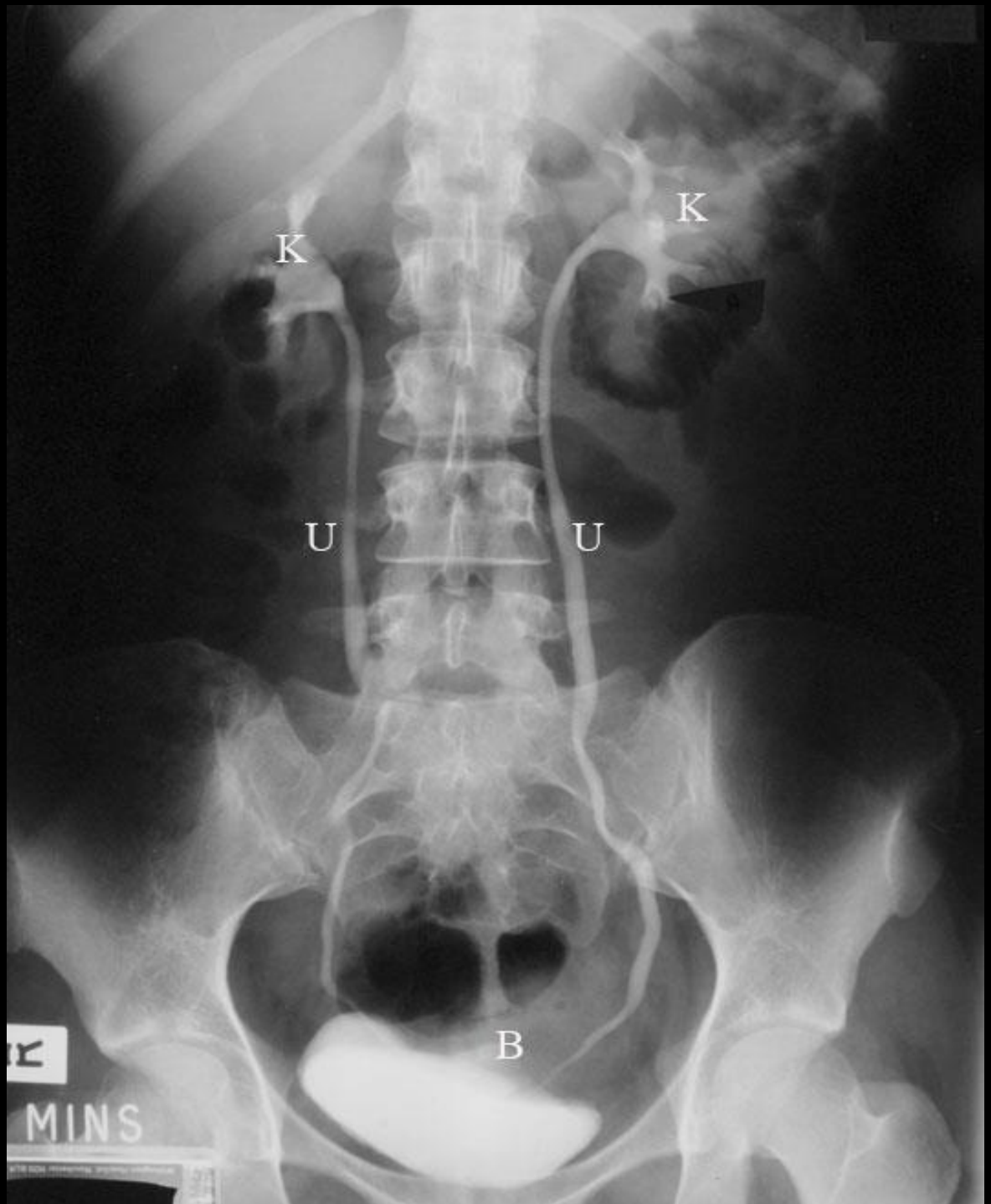

Stone

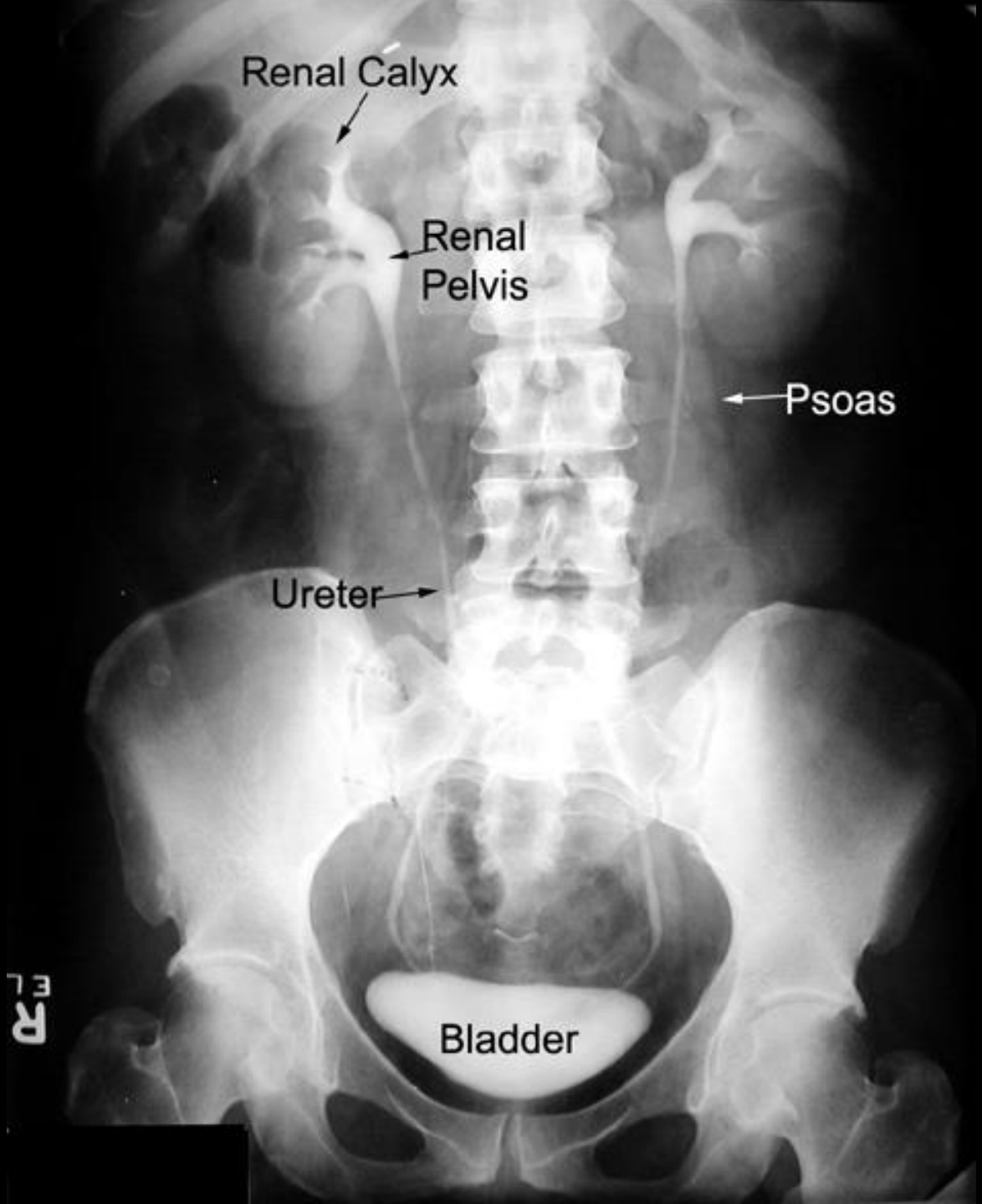


Intravenous Pyelography - IVP

Intravenous Pyelography -IVP




K
K
U
U
B
MINS


Renal Calyx
Renal
Pelvis
Psoas
Ureter
Bladder

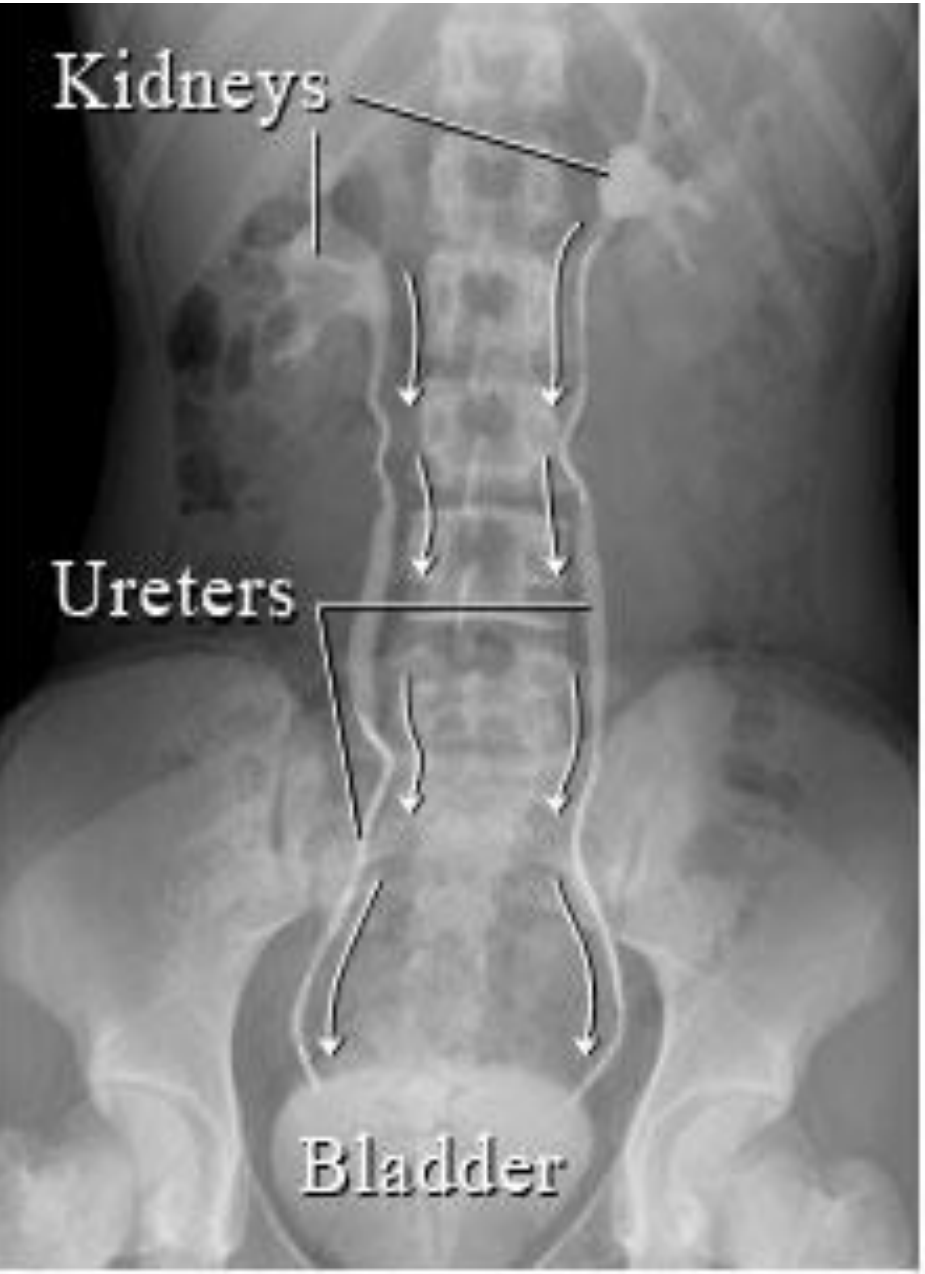
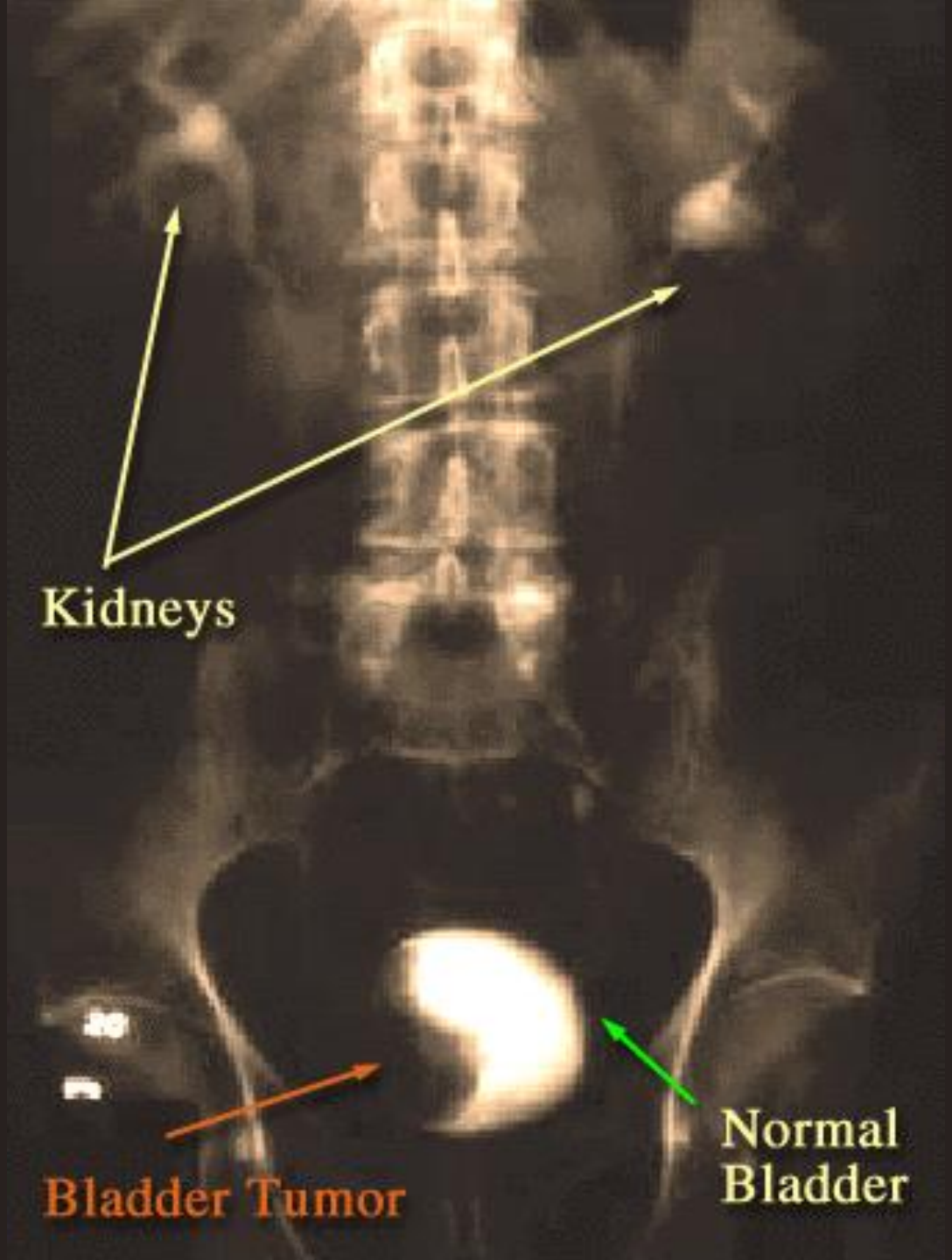


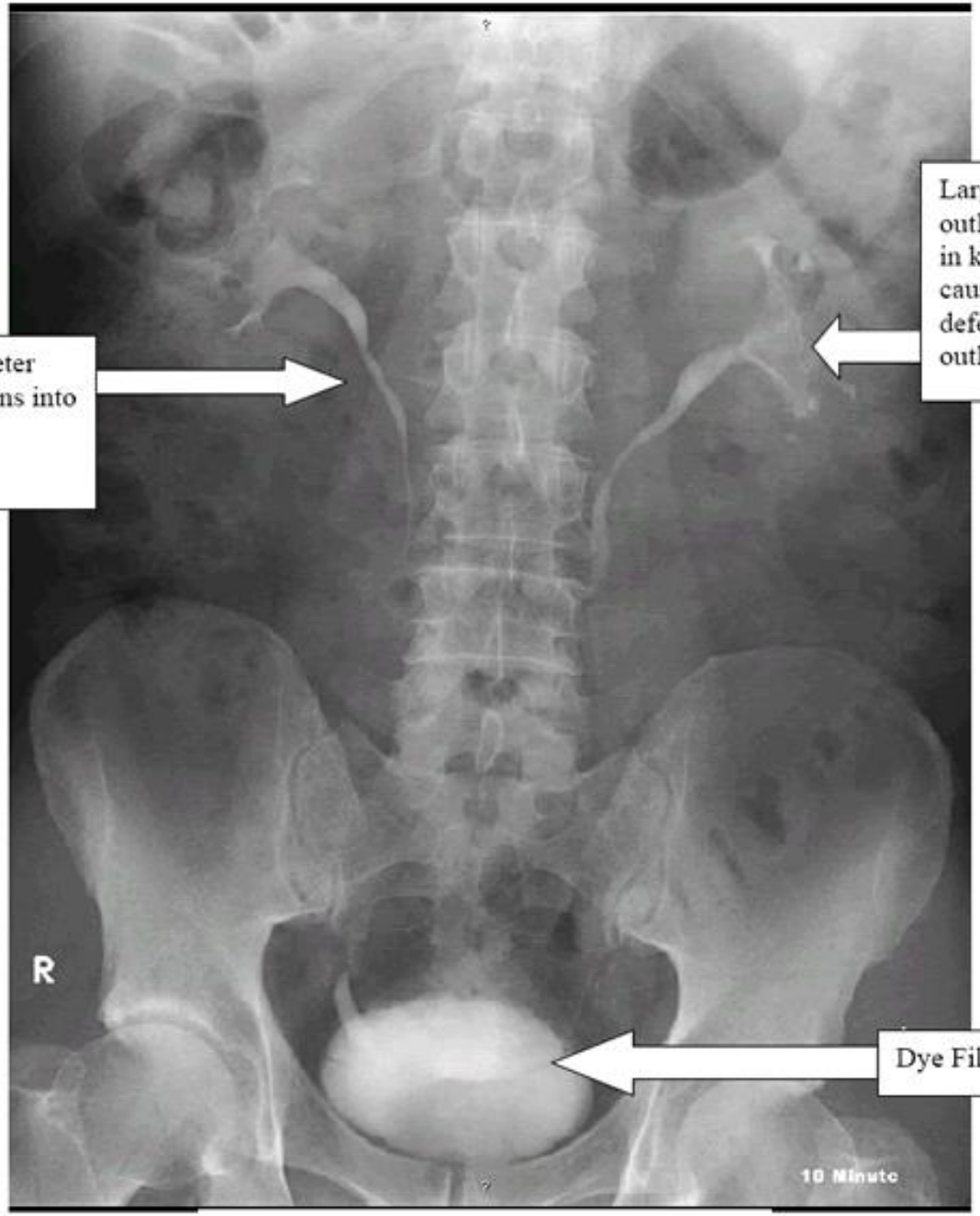
Figure 1

Figure 2


Medscape® www.medscape.com


Medscape® www.medscape.com

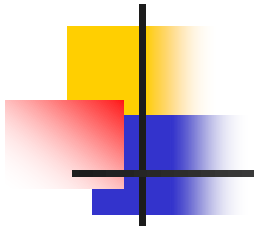

Kidneys
Bladder Tumor
Normal
Bladder


Dye in Ureter which drains into bladder.
Large staghorn stone outlined by dye seen in kidney. The stone causes a "filling defect." The dye outlines the stone.
R
Dye Filling Bladder
10 Minute

- For further inquiries ***PLZ*** feel free to contact at any time through email

gamal.abdelhady@yu.edu.jo

gamaltaha@med.asu.edu.eg



Thank You