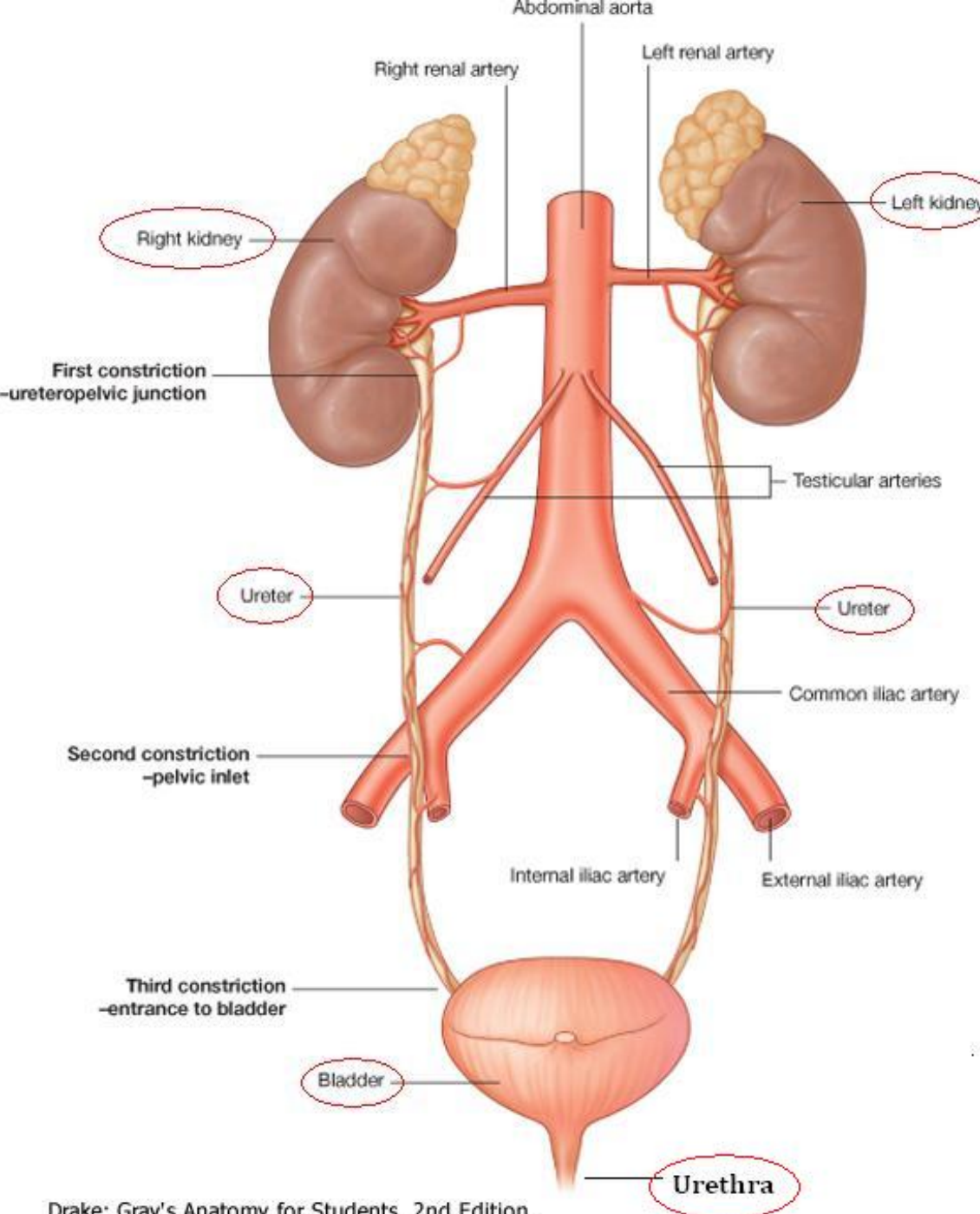




Urinary system

Sándor Katz M.D.,Ph.D.

Urinary system - constituents

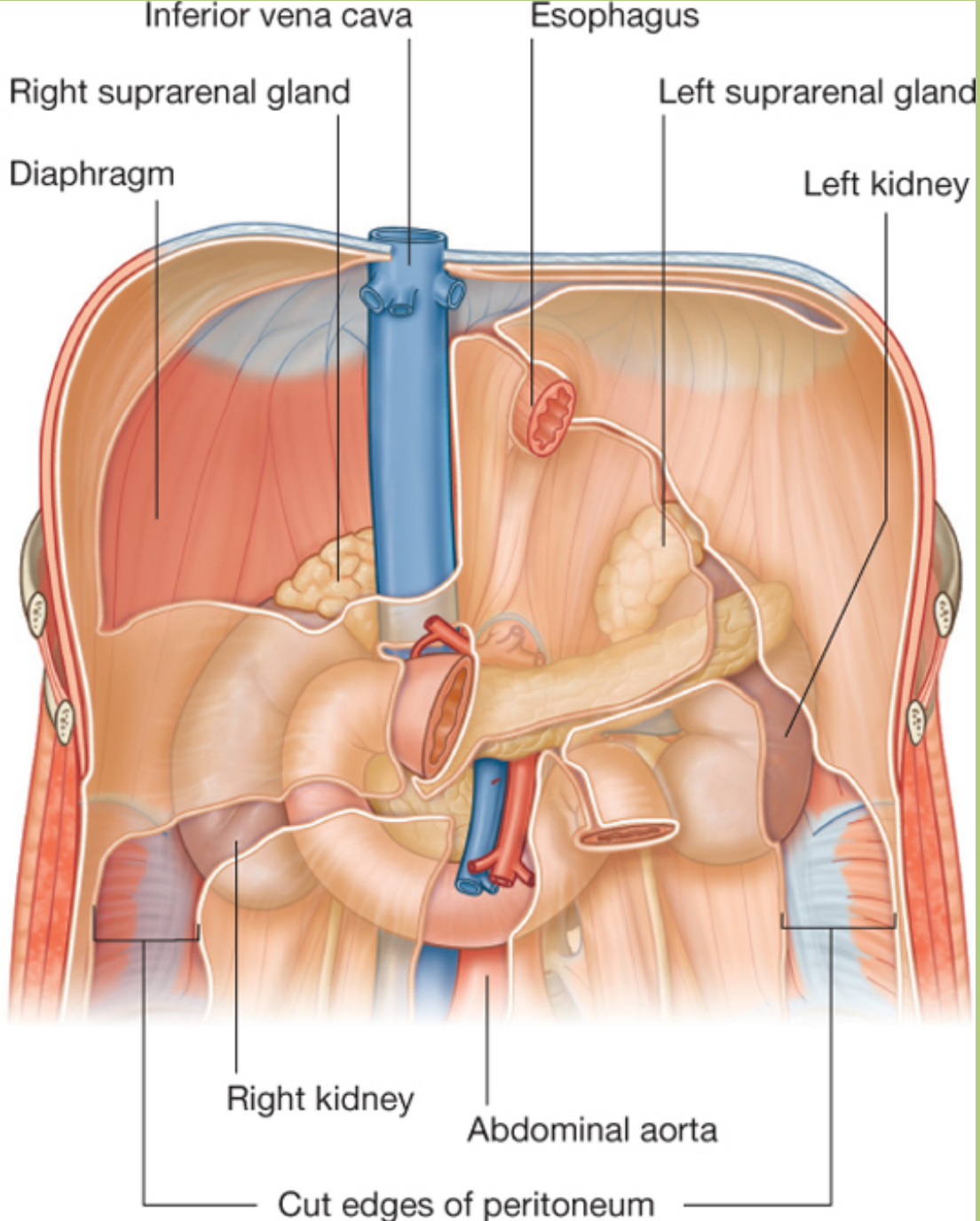


- kidneys
- ureters
- urinary bladder
- urethra

Kidney

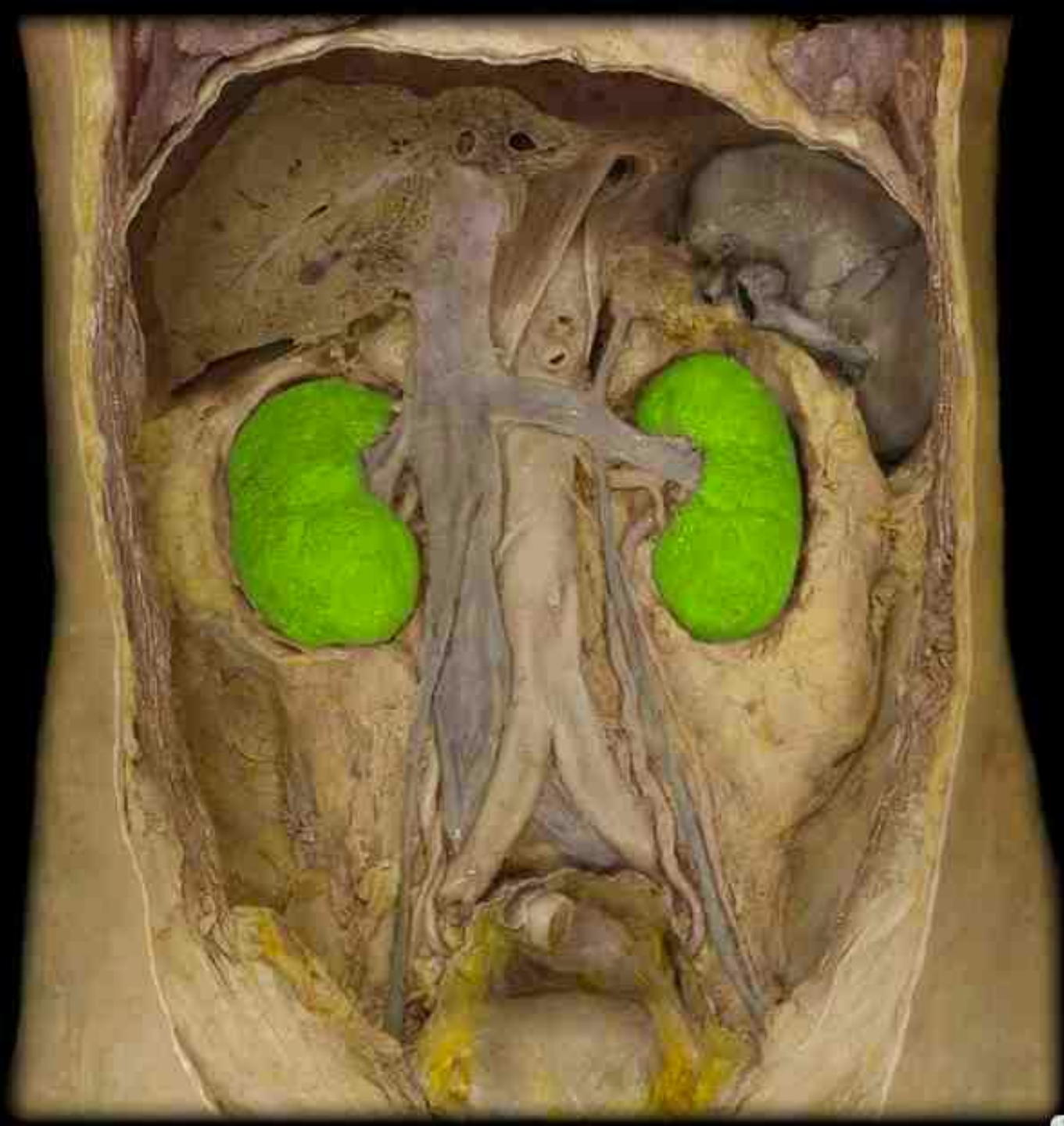


Weight: 130-140g

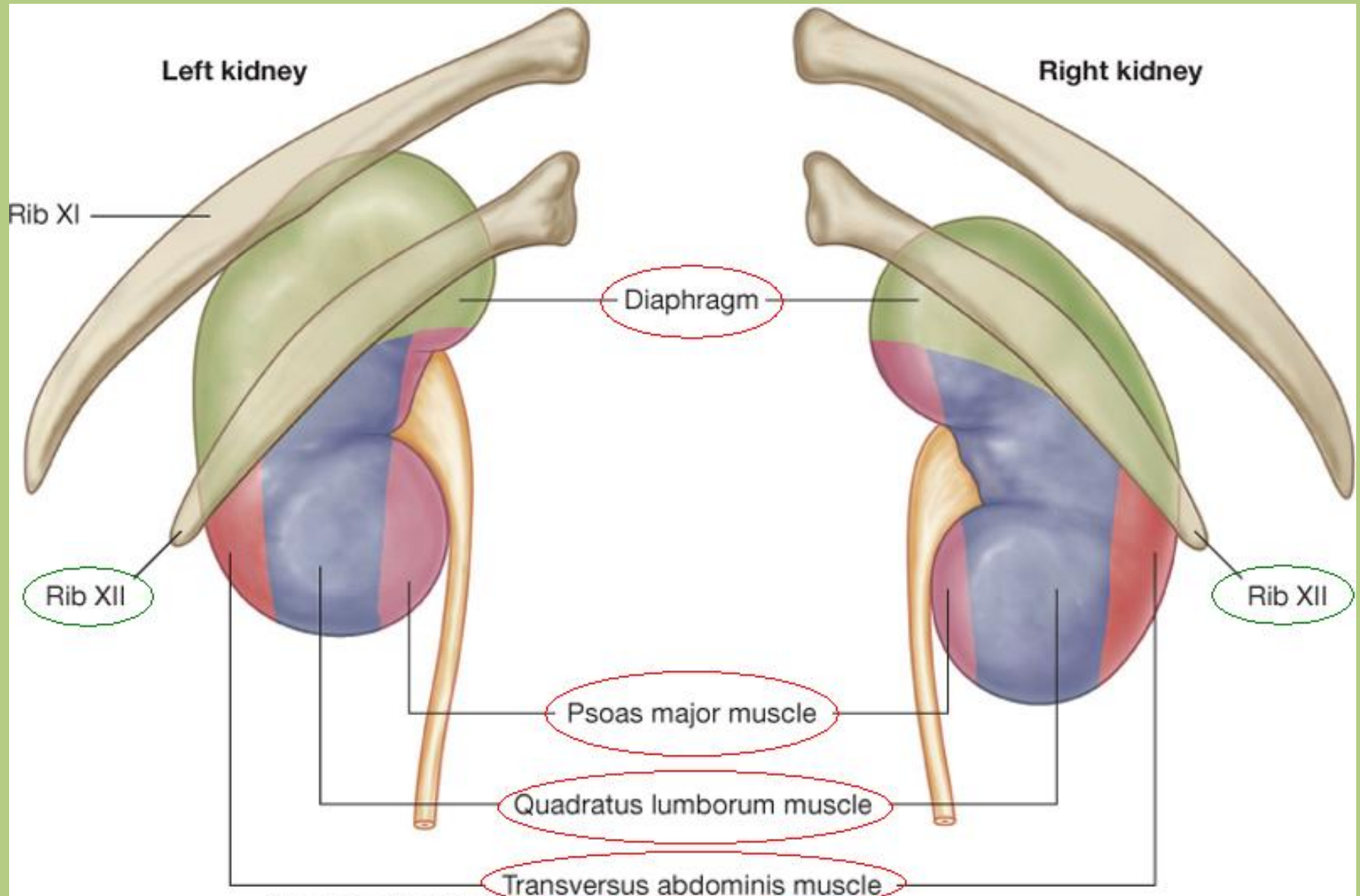


Kidneys - location

1. On the posterior body wall
2. Posterior to parietal peritoneum – *retroperitoneal organ*
3. At the level of T12-L2 (left kidney) and L1-L3 (right kidney)

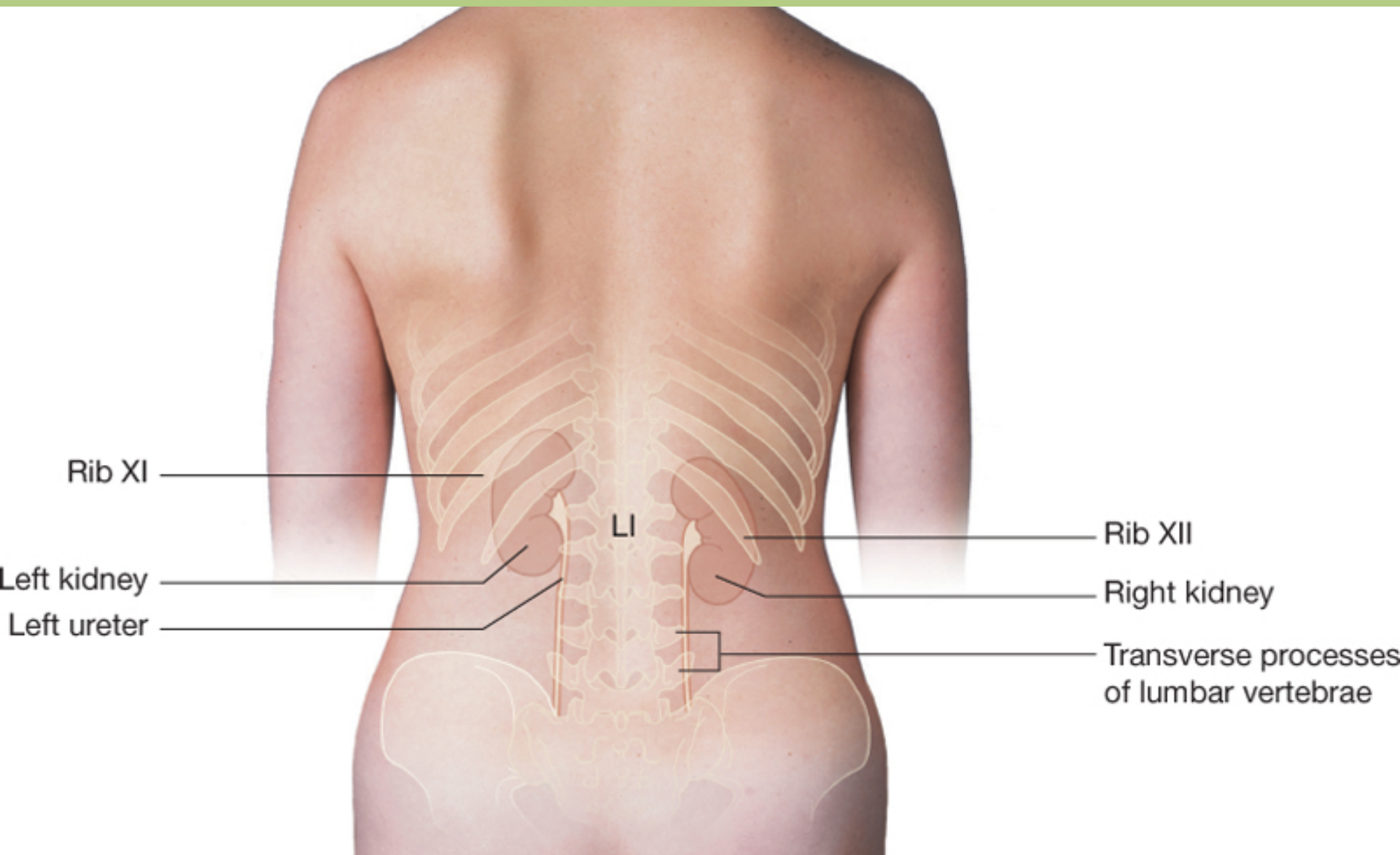


Kidneys - location



Drake: Gray's Anatomy for Students, 2nd Edition.

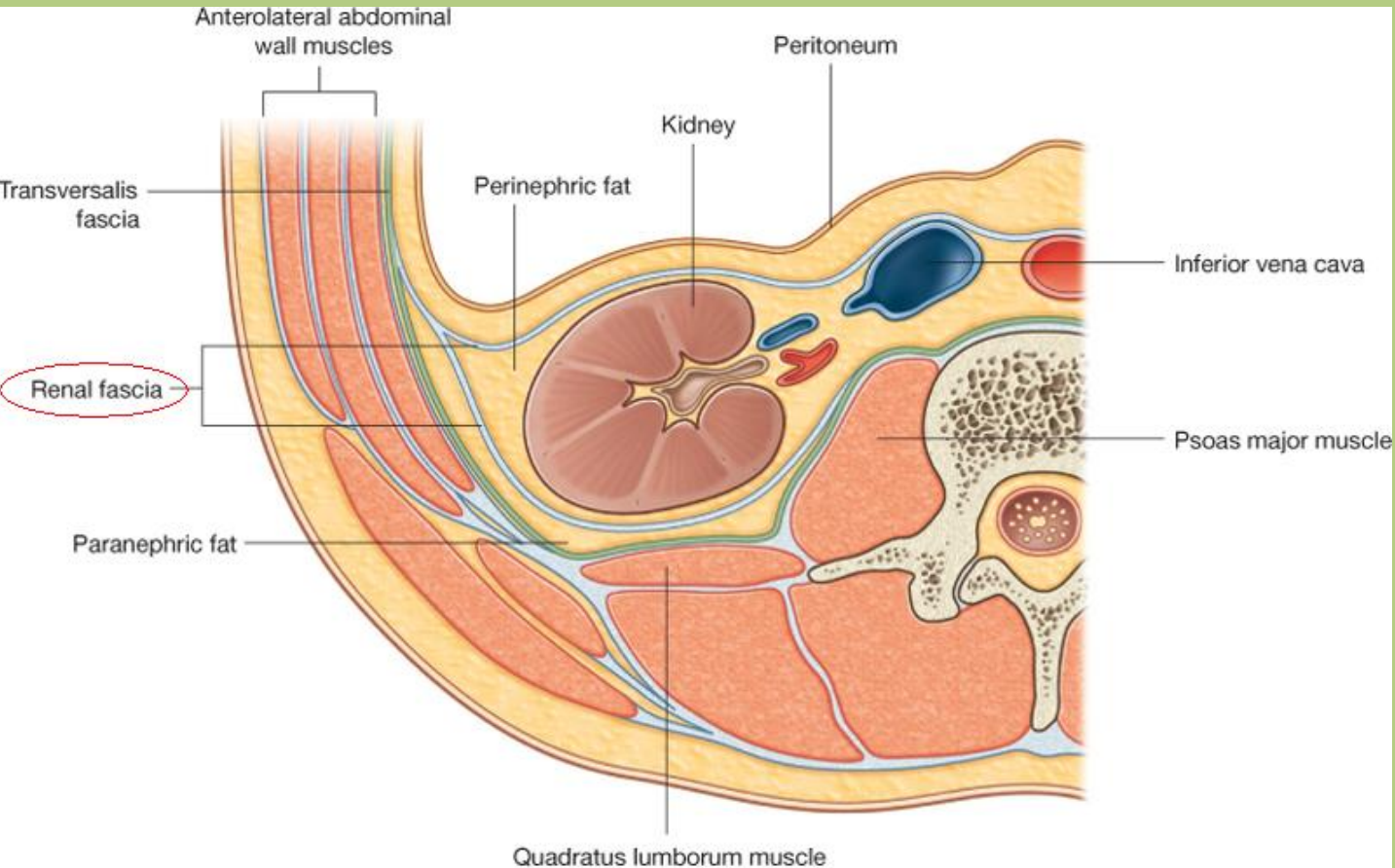
Copyright © 2009 by Churchill Livingstone, an imprint of Elsevier, Inc. All rights reserved.



Drake: Gray's Anatomy for Students, 2nd Edition.

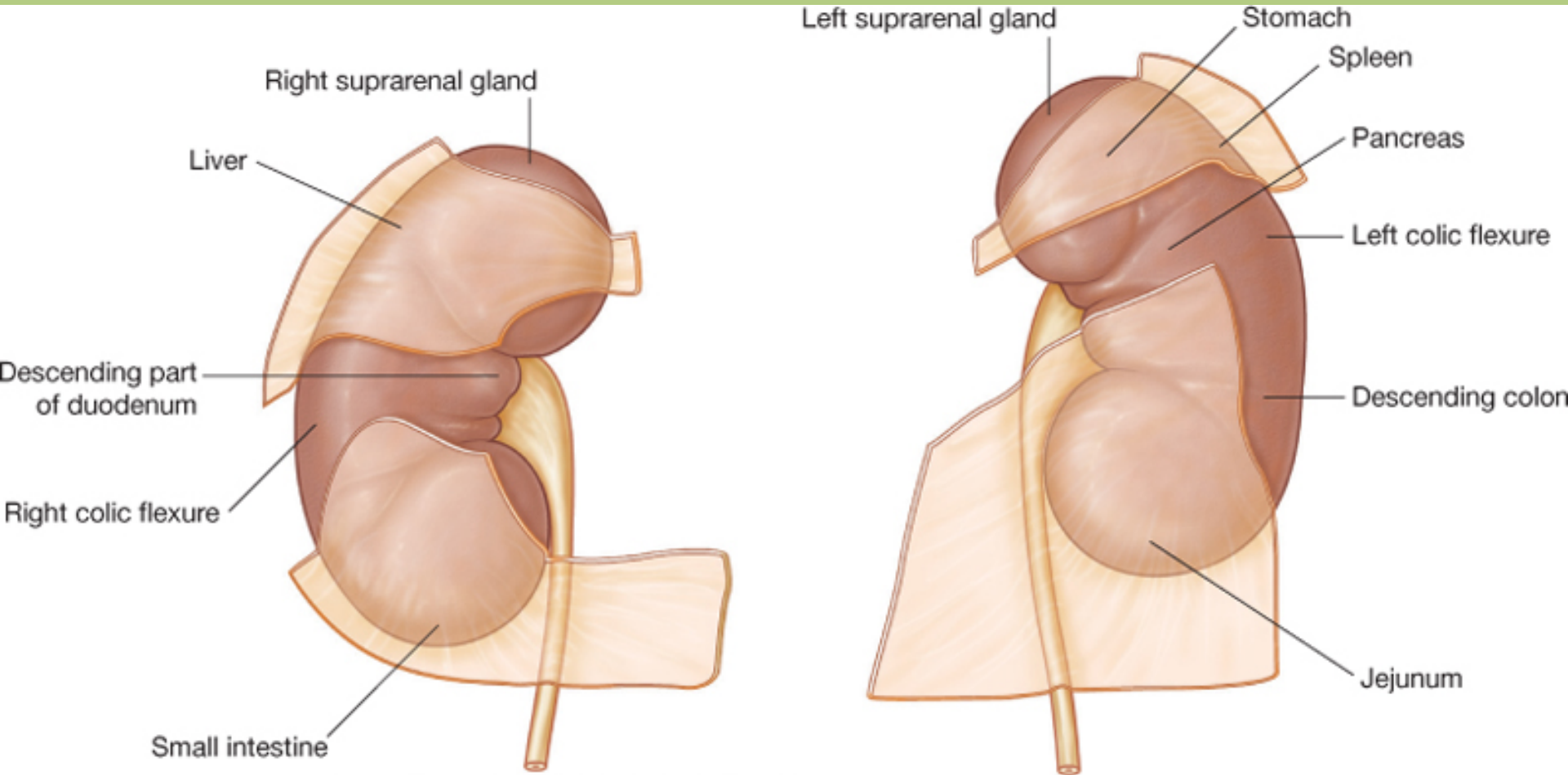
Copyright © 2009 by Churchill Livingstone, an imprint of Elsevier, Inc. All rights reserved.

Kidneys – covering structures



1. Renal (Gerota's) fascia
2. Adipose capsule
3. Fibrous capsule

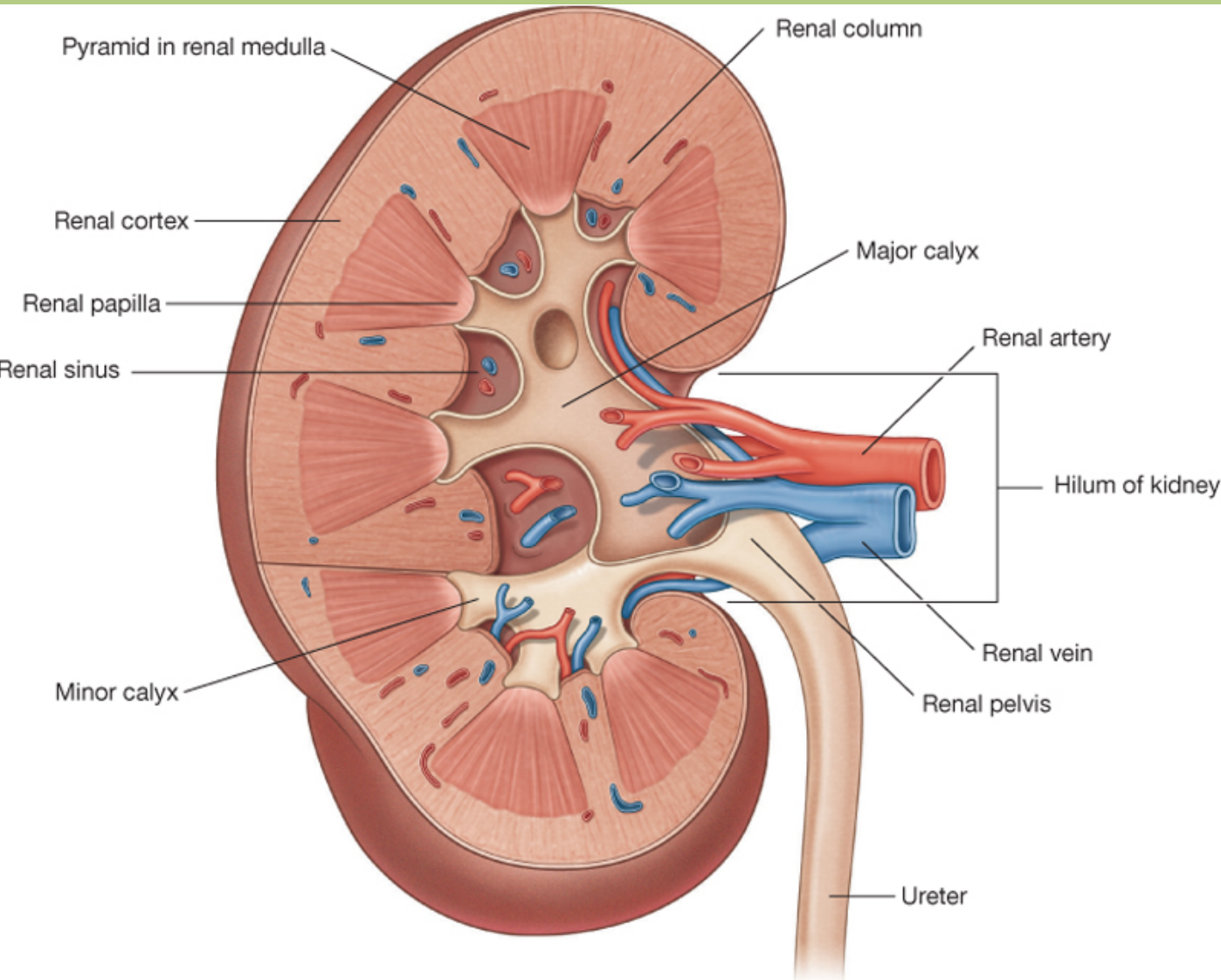
Kidneys - neighbouring organs and structures



Drake: Gray's Anatomy for Students, 2nd Edition.

Copyright © 2009 by Churchill Livingstone, an imprint of Elsevier, Inc. All rights reserved.

Kidney – gross anatomy



External structures:

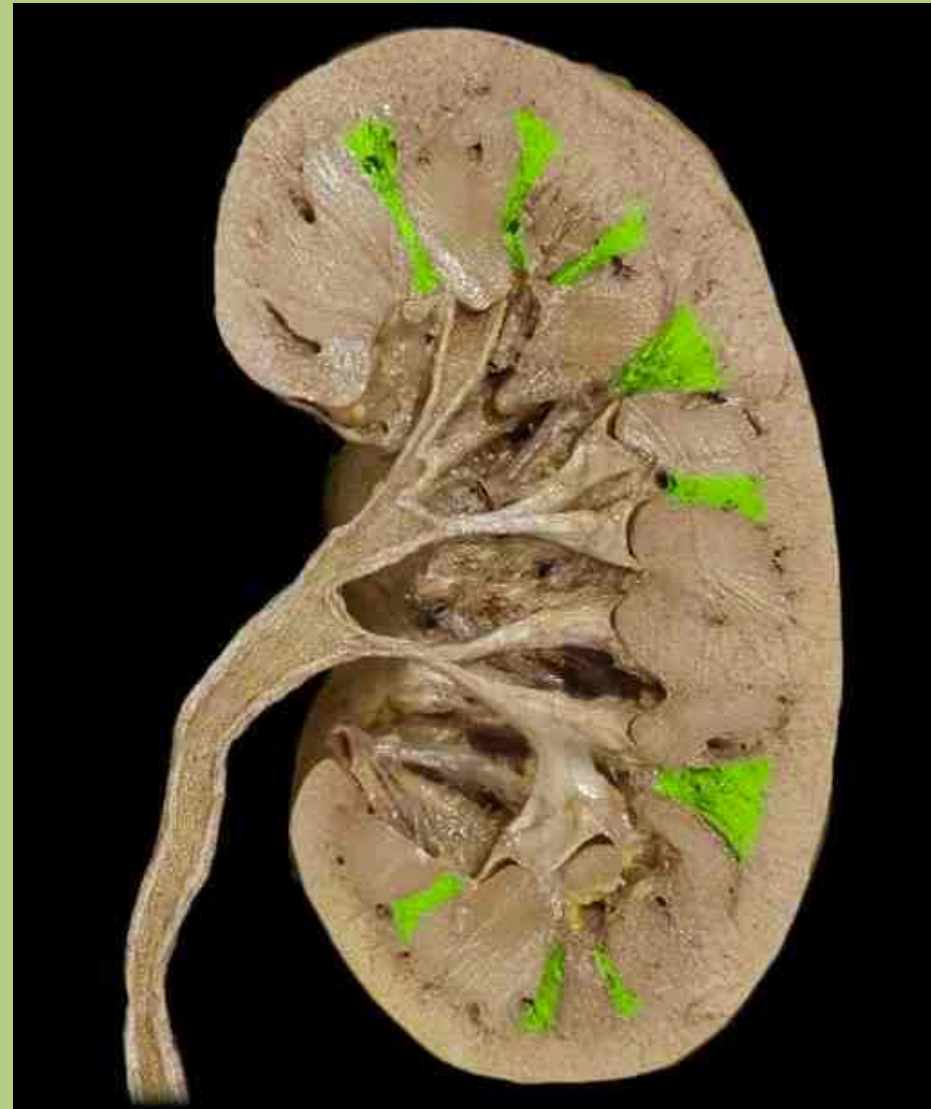
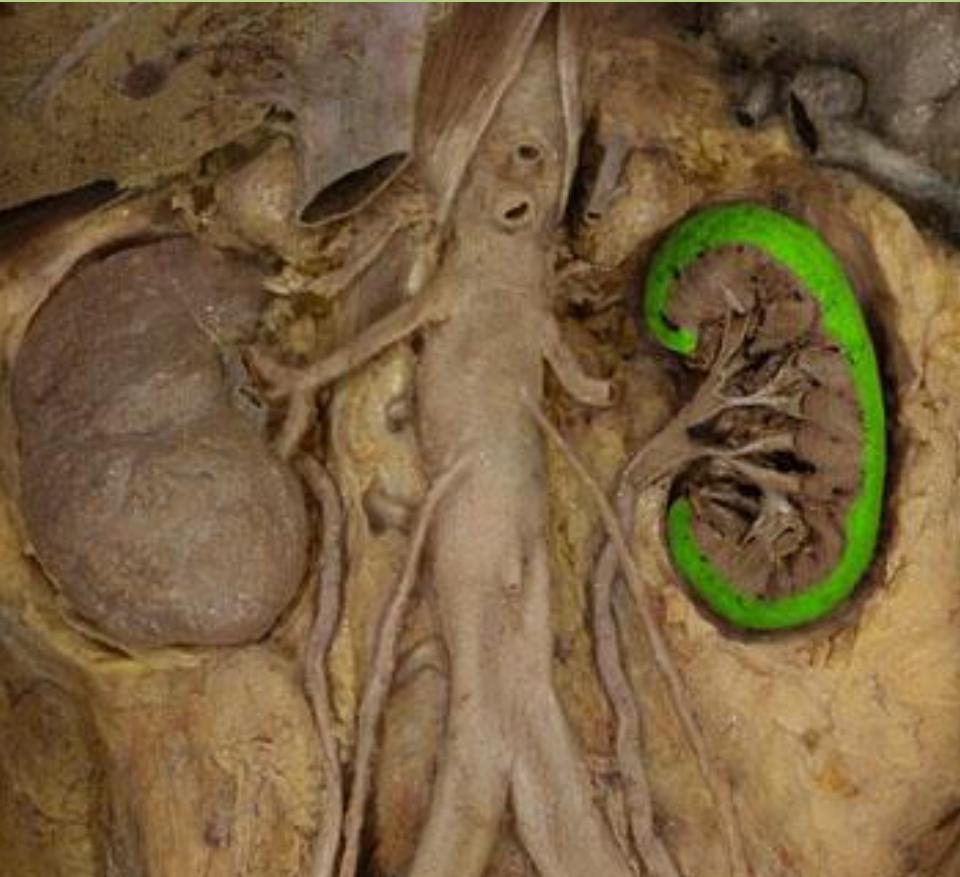
Hilum of kidney:

1. Renal vein
2. Renal artery
3. Ureter

Internal structures:

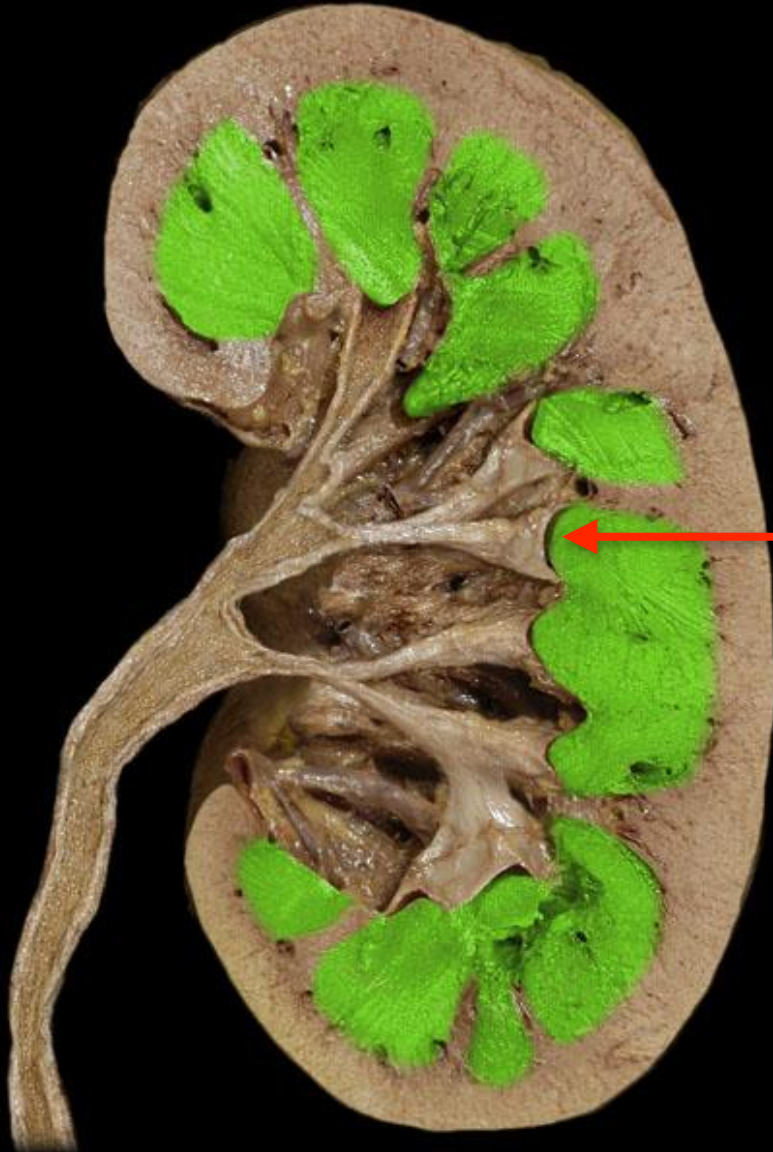
1. Cortex
2. Medulla
3. Minor calyces
4. Major calyces
5. Renal pelvis

Renal cortex



Renal columns (Bertini's columns)

Renal medulla – renal pyramids



Approximately 30 pyramids are in each kidney and many of them are fused together.

renal papilla

Minor calyces



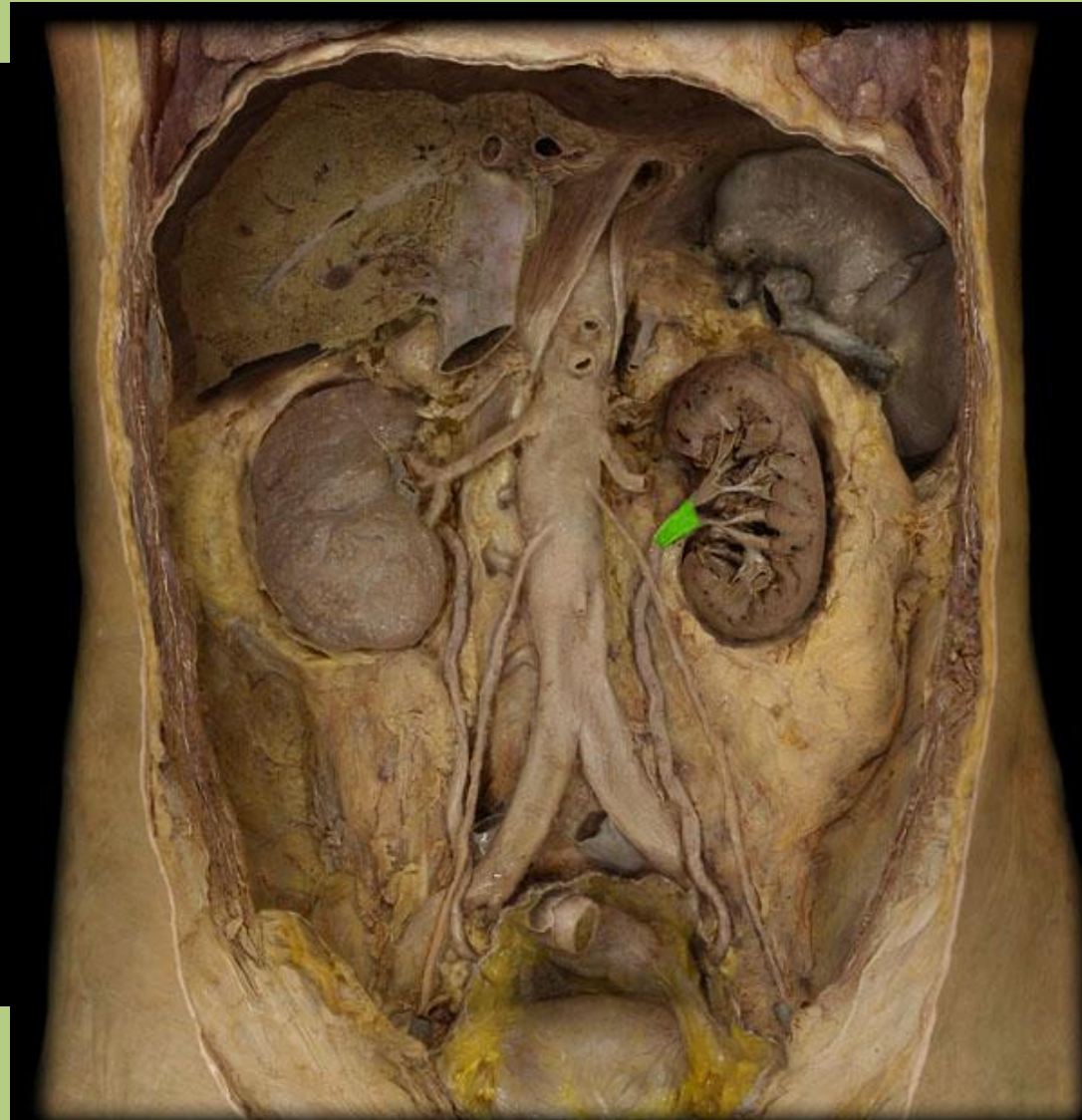
8-9 in each kidney

Major calyces

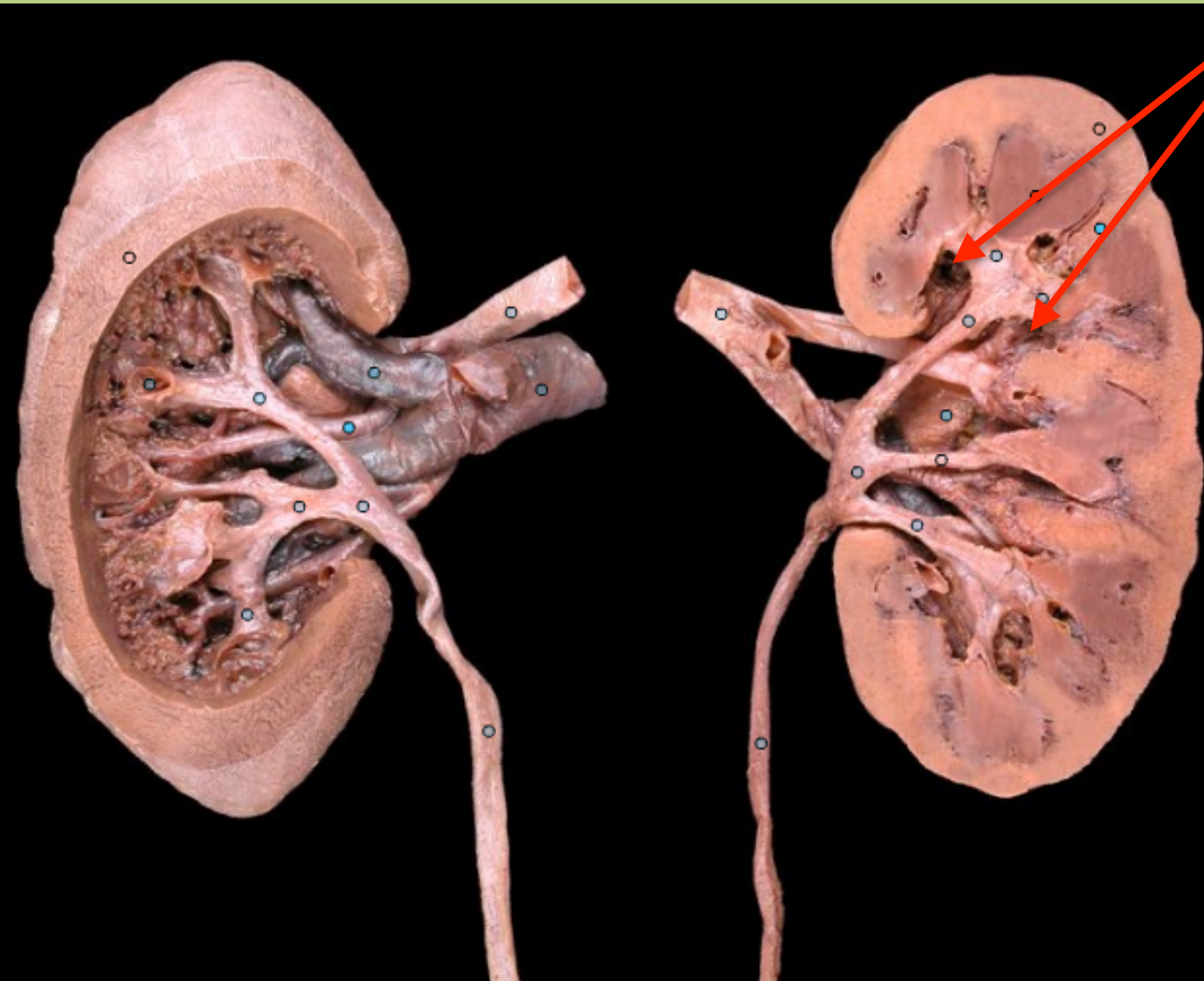


Approx. 3 in each kidney

Renal pelvis



Renal hilum - L1/L2 level



renal sinus

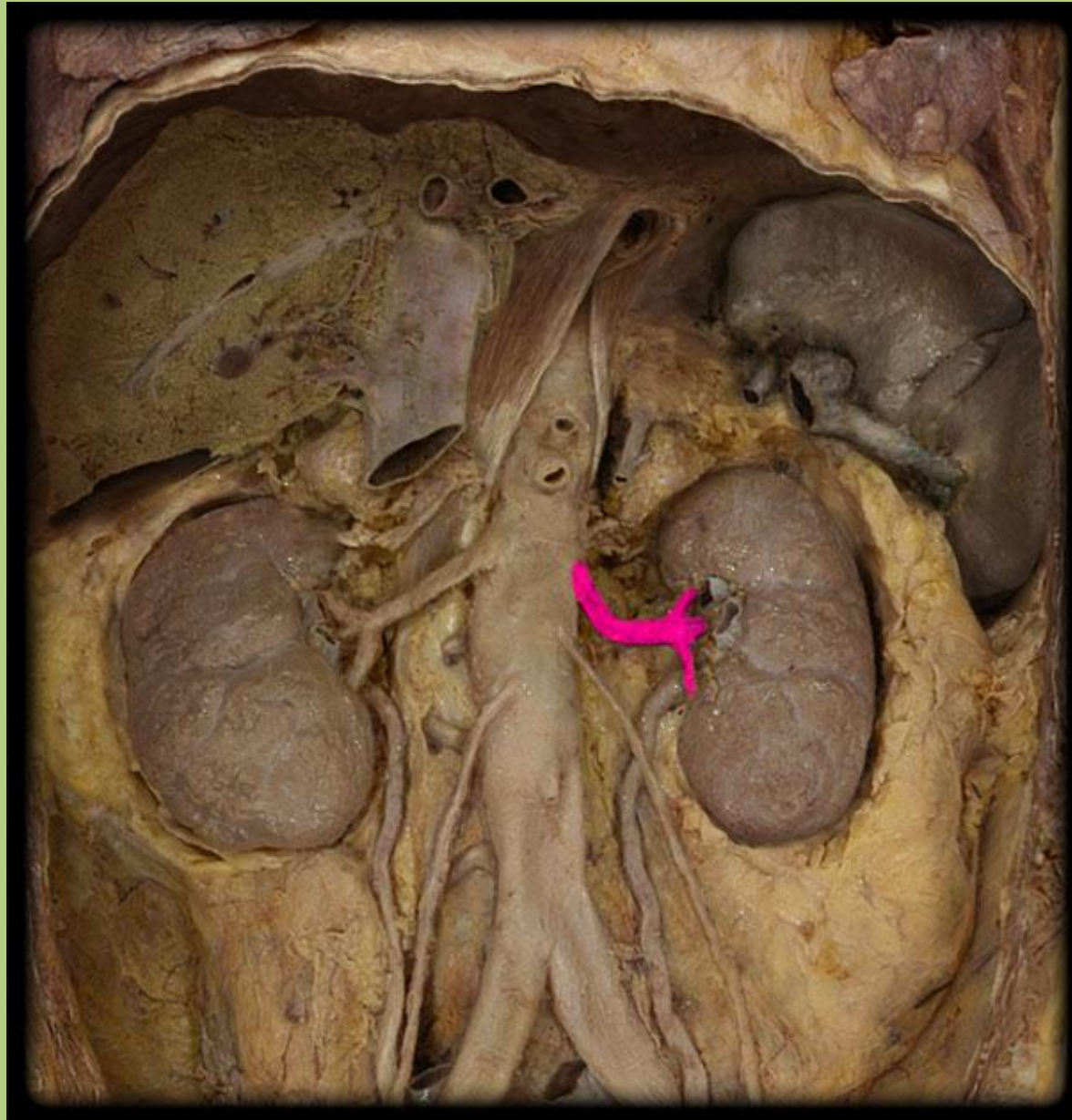
From anterior to posterior direction:

1. renal vein
2. renal artery
3. ureter

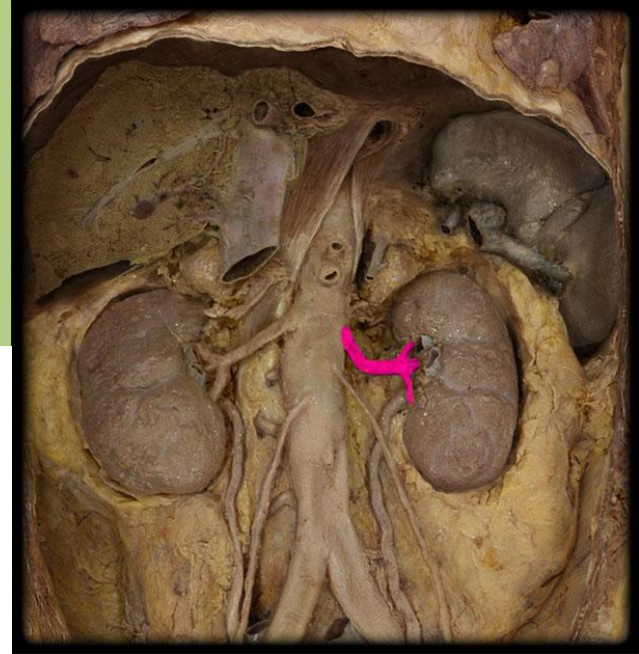
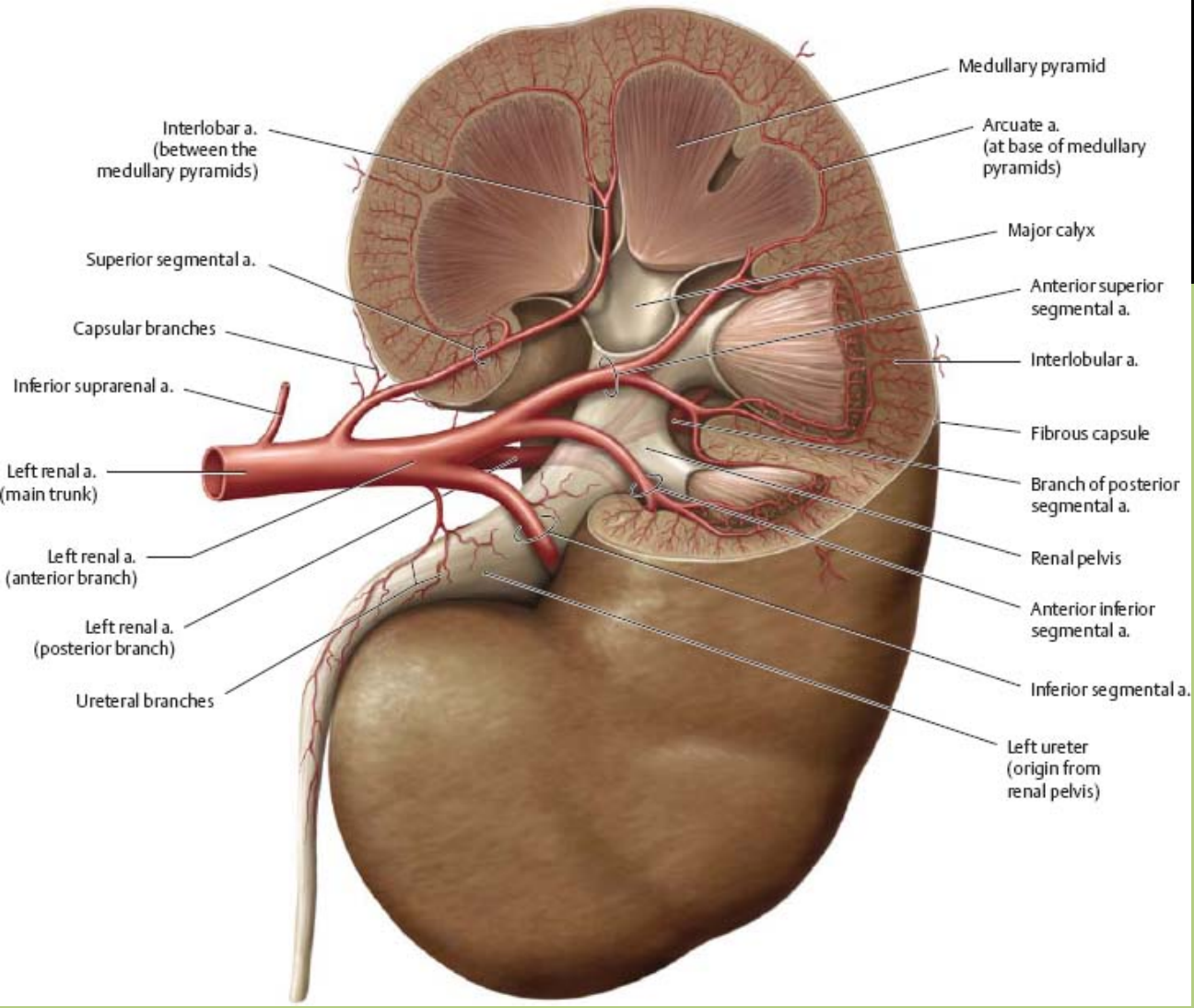
From superior to inferior direction:

1. renal artery
2. renal vein
3. ureter

Renal arteries - L1 level

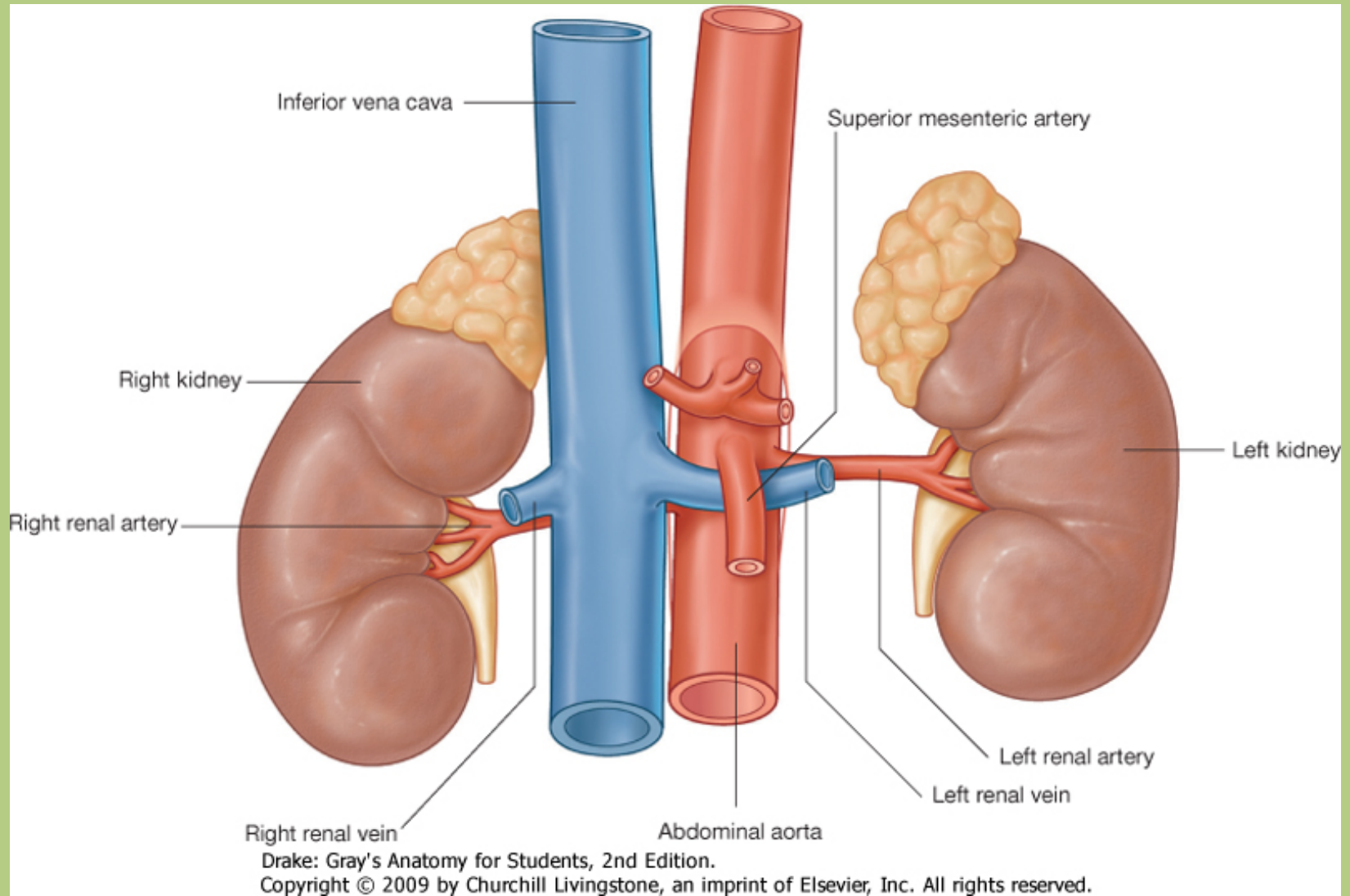


Renal artery



- segmental arteries
- interlobar arteries
- arcuate arteries
- interlobular arteries
- afferent arterioles

Renal veins



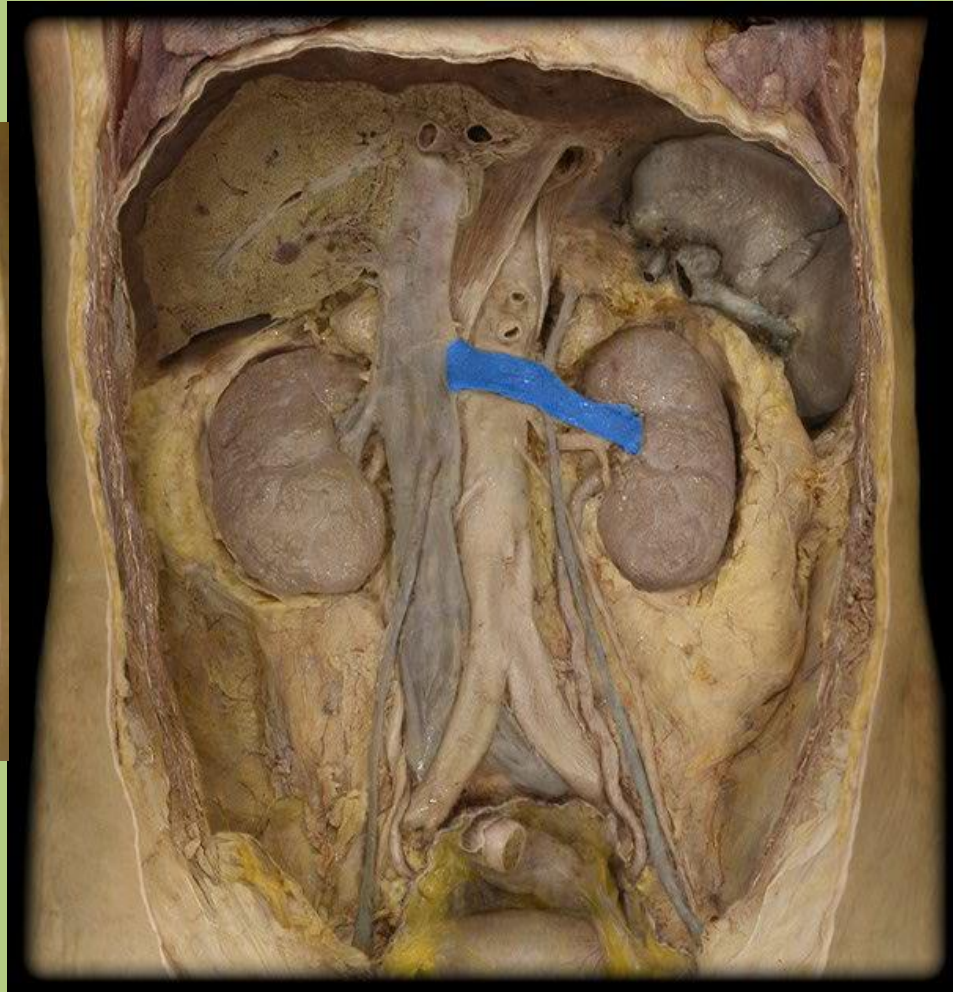
left renal vein is longer than the right one and crosses over the aorta

Renal veins



right renal vein

left renal vein is longer than the right one and crosses over the aorta

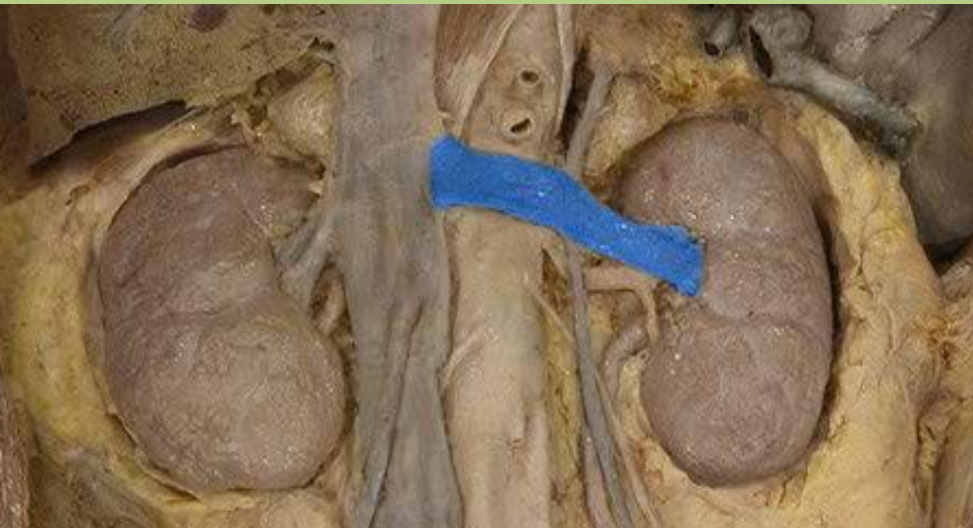


left renal vein

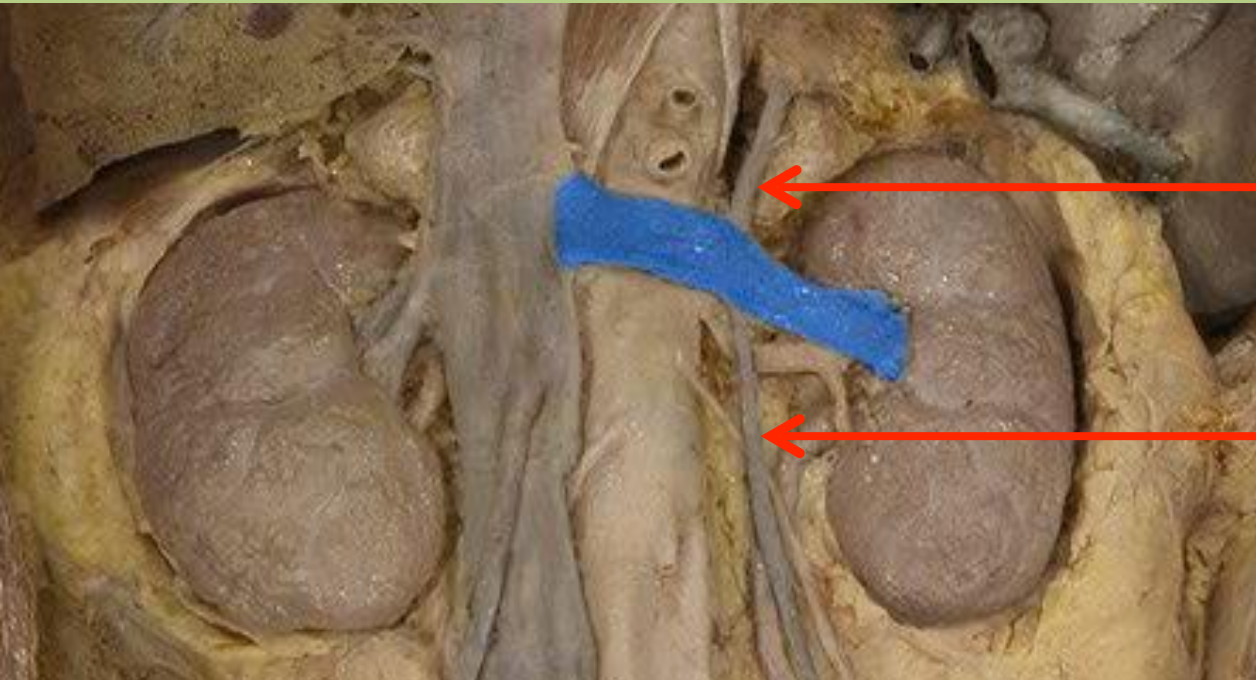
Tributaries of the renal veins



- (stellate veins – only under the fibrous capsule)
- interlobular veins
- arcuate veins
- interlobar veins
- segmental veins



Renal veins

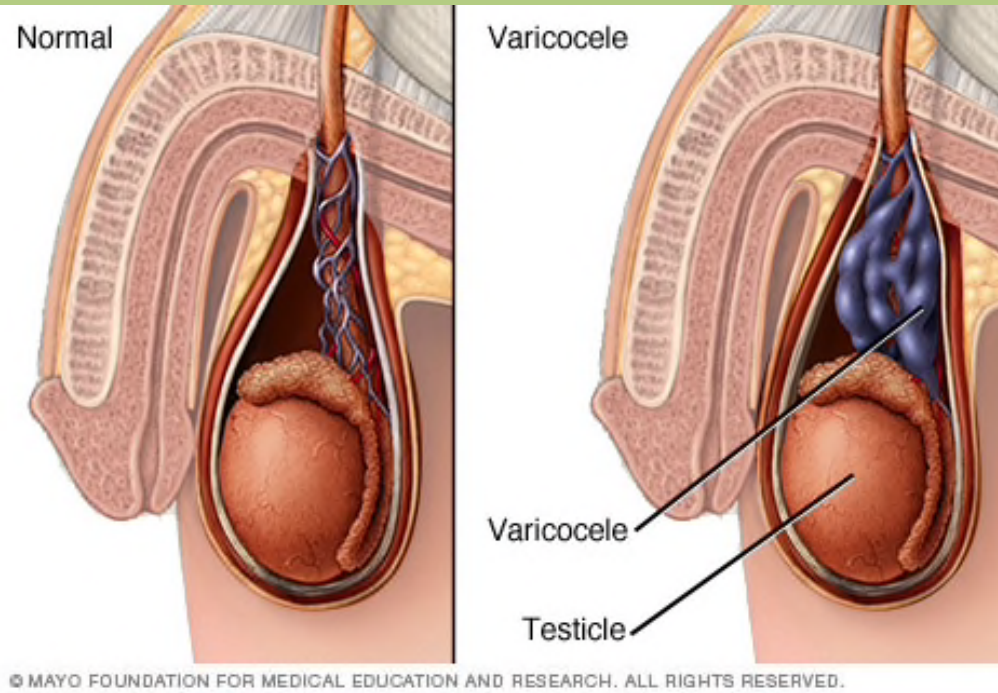


left suprarenal vein
(empties into the left renal vein)

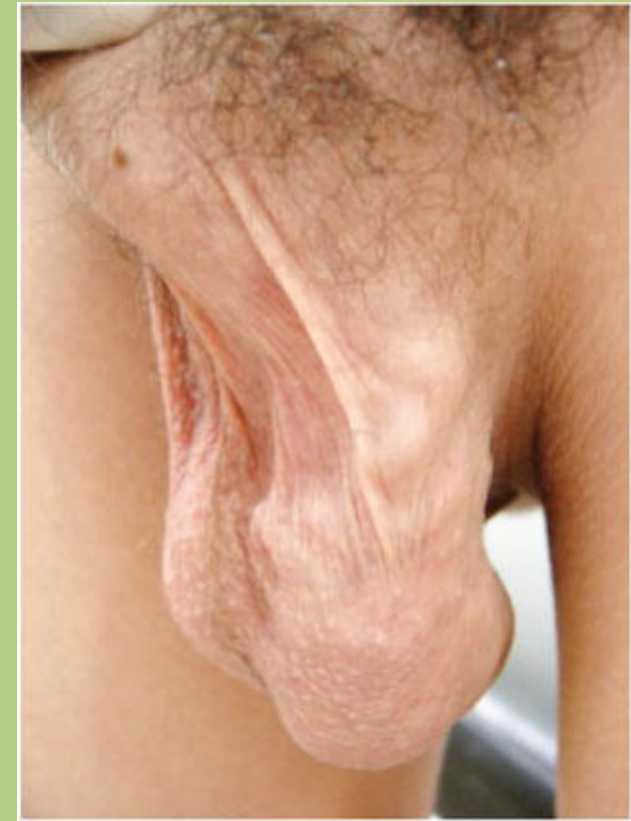
left gonadal (testicular or ovarian) vein (empties into the left renal vein)

The right suprarenal and gonadal veins empty into the IVC.

Varicocele



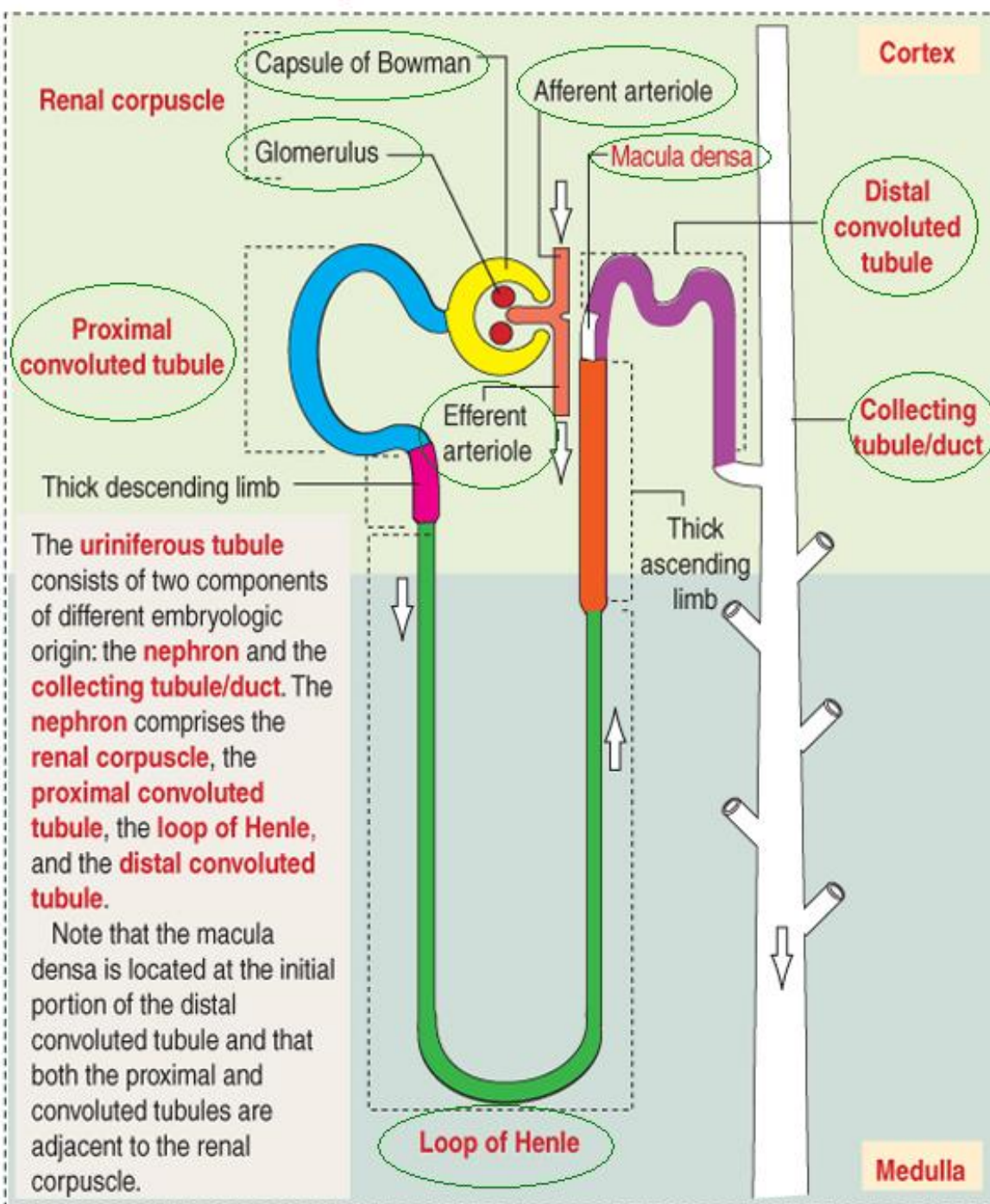
The most common cause of correctable male infertility.



The varicocele is a dilatation of the pampiniform plexus (part of the testicular vein over the testes). This may be due to the higher intravenous pressure in the left testicular vein. It heats the testes, causing infertility.

10-15% of the male population has varicocele.

Nephron



Structural and functional unit of kidney.

Components:

1. Renal corpuscle:

Bowman's capsule
Glomerulus

2. Renal tubules:

Proximal convoluted tubule
Loop of Henle
Distal convoluted tubule

Bowman's capsule, Glomerulus

Bowman's capsule:

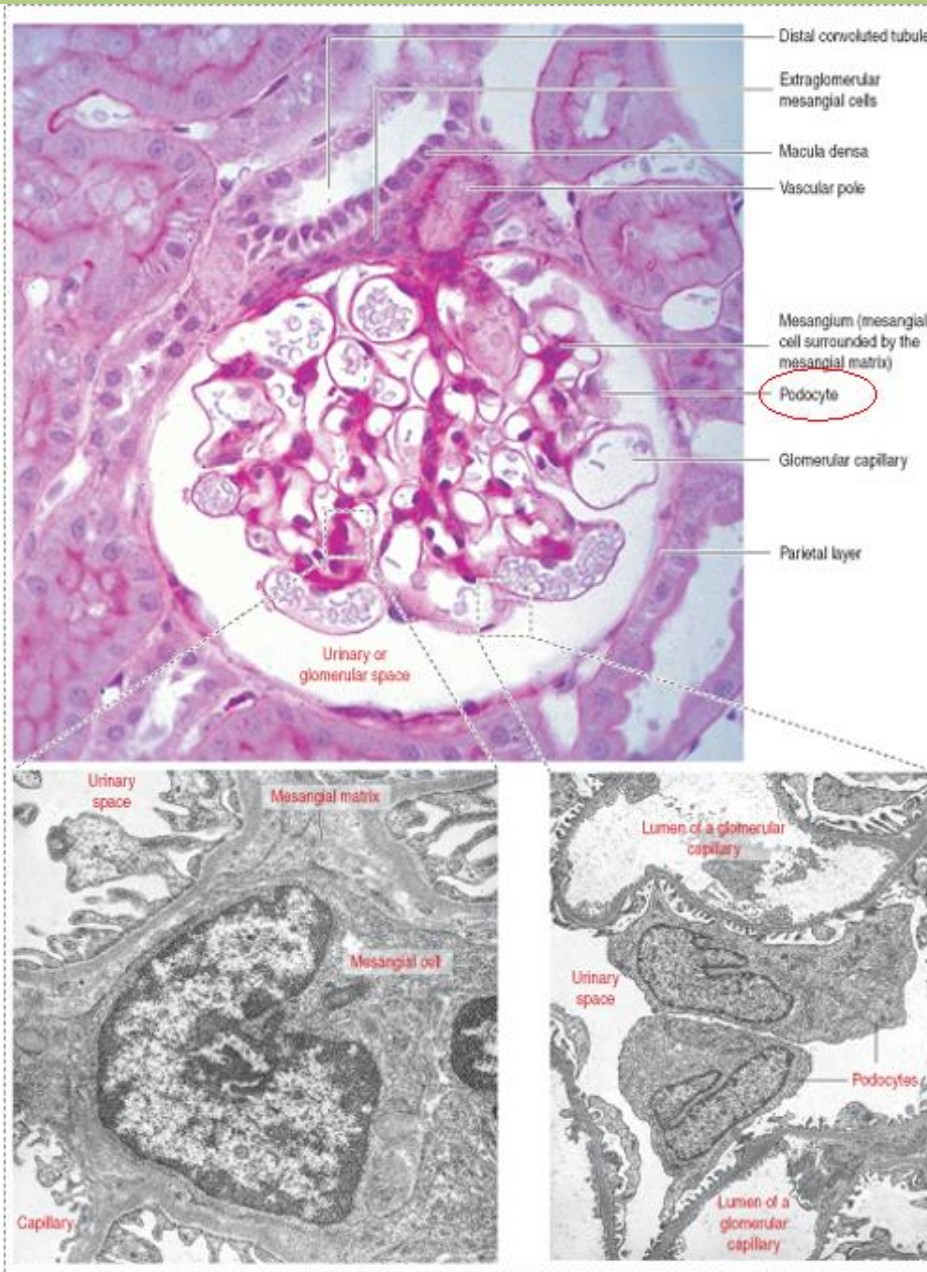
1. Parietal layer: simple squamous epithelium
2. Visceral layer: podocytes

Glomerulus: - filters plasma

1. Afferent arteriole
2. Efferent arteriole

(1200ml blood goes through the kidneys each minute.

*125ml- glomerular filtration
124ml- reabsorbed glomerular filtration
= 1ml urine/min.)*



Proximal and distal convoluted tubules

Proximal convoluted tubule:

Cuboidal cells with brush border.
(Absorption: water, glucose, amino acids, Na^+ , vitamin C)

Loop of Henle:

Squamous epithelium.
(Absorption: water, Na^+ , Cl^- , Ca^{2+} , PO_4 .
Secretion: H^+ , K^+ .)

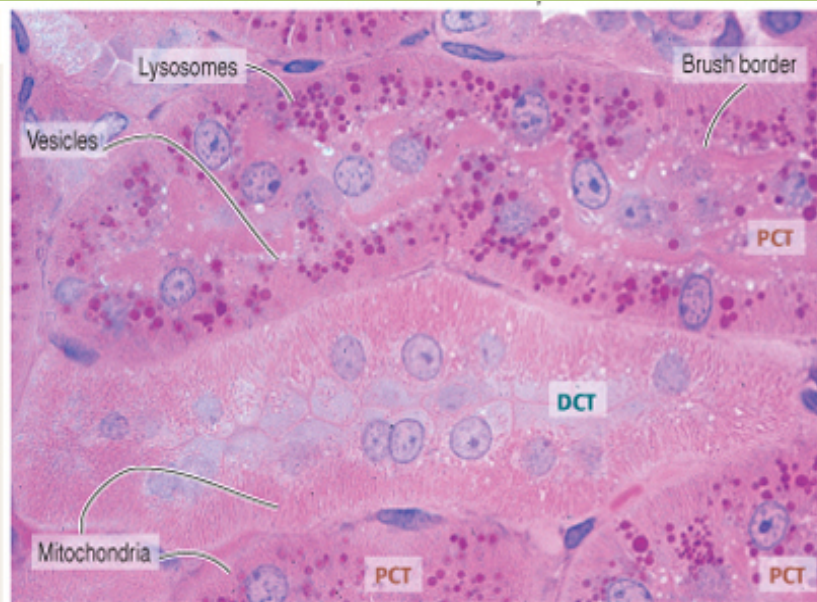
Distal convoluted tubule:

Cuboidal cells without brush border.
(Absorption: water, Na^+ , Ca^{2+} , HCO_3^- or H^+ .
Secretion: K^+ , HCO_3^- or H^+ .)

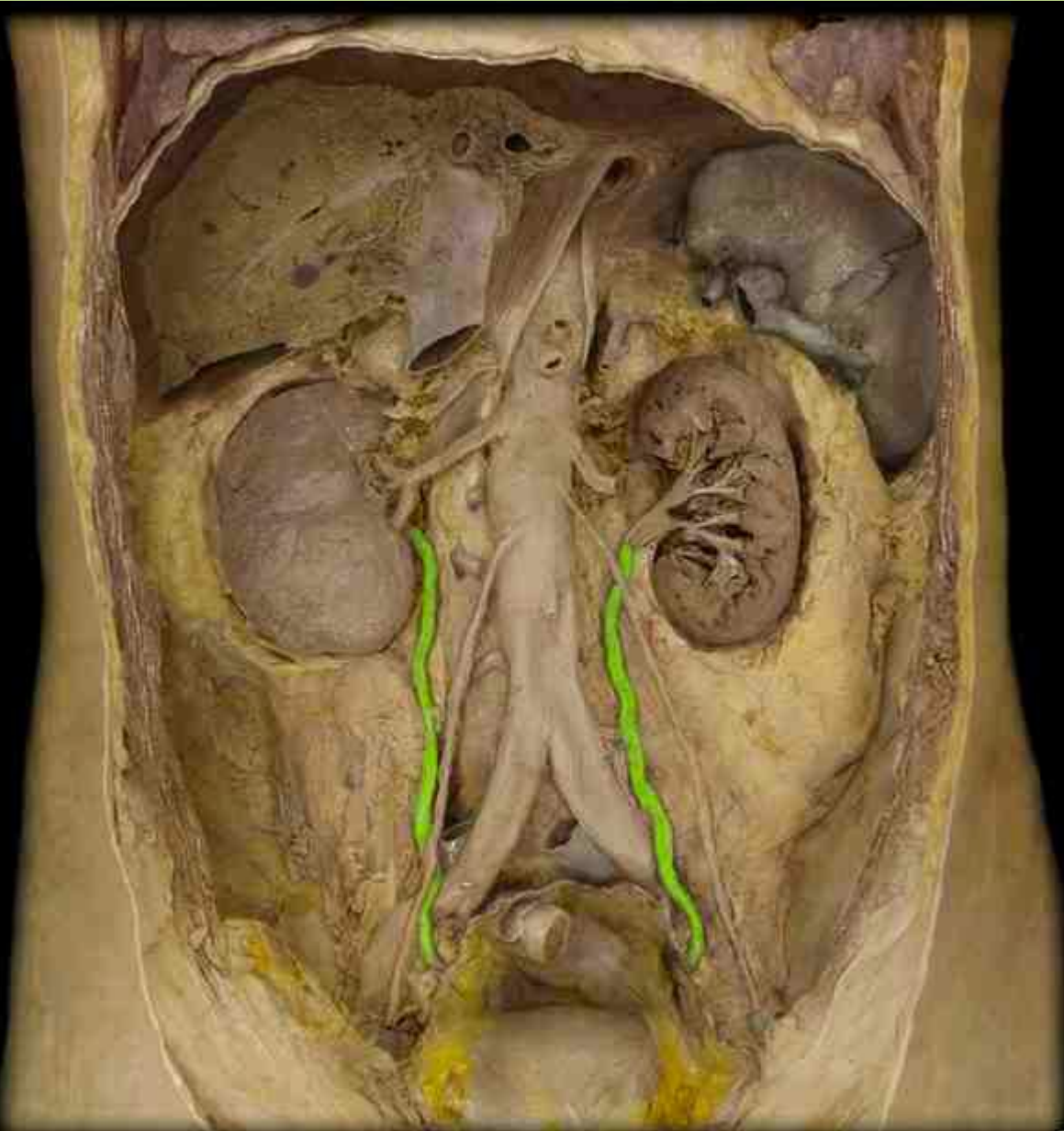
Identification parameters of PCTs and DCTs

The identification of proximal convoluted tubules (PCTs) and DCTs is facilitated by the following parameters:

1. Both are adjacent to renal corpuscles.
2. PCTs contain cells with abundant **lysosomes** (stained dark in both light microscope illustrations).
3. The **apical domain** of PCTs has a prominent **brush border (microvilli)** and **vesicles**. In contrast, the apical domain of DCTs has sparse microvilli and vesicles.
4. Cells lining the PCTs and DCTs contain abundant basally located **mitochondria**.

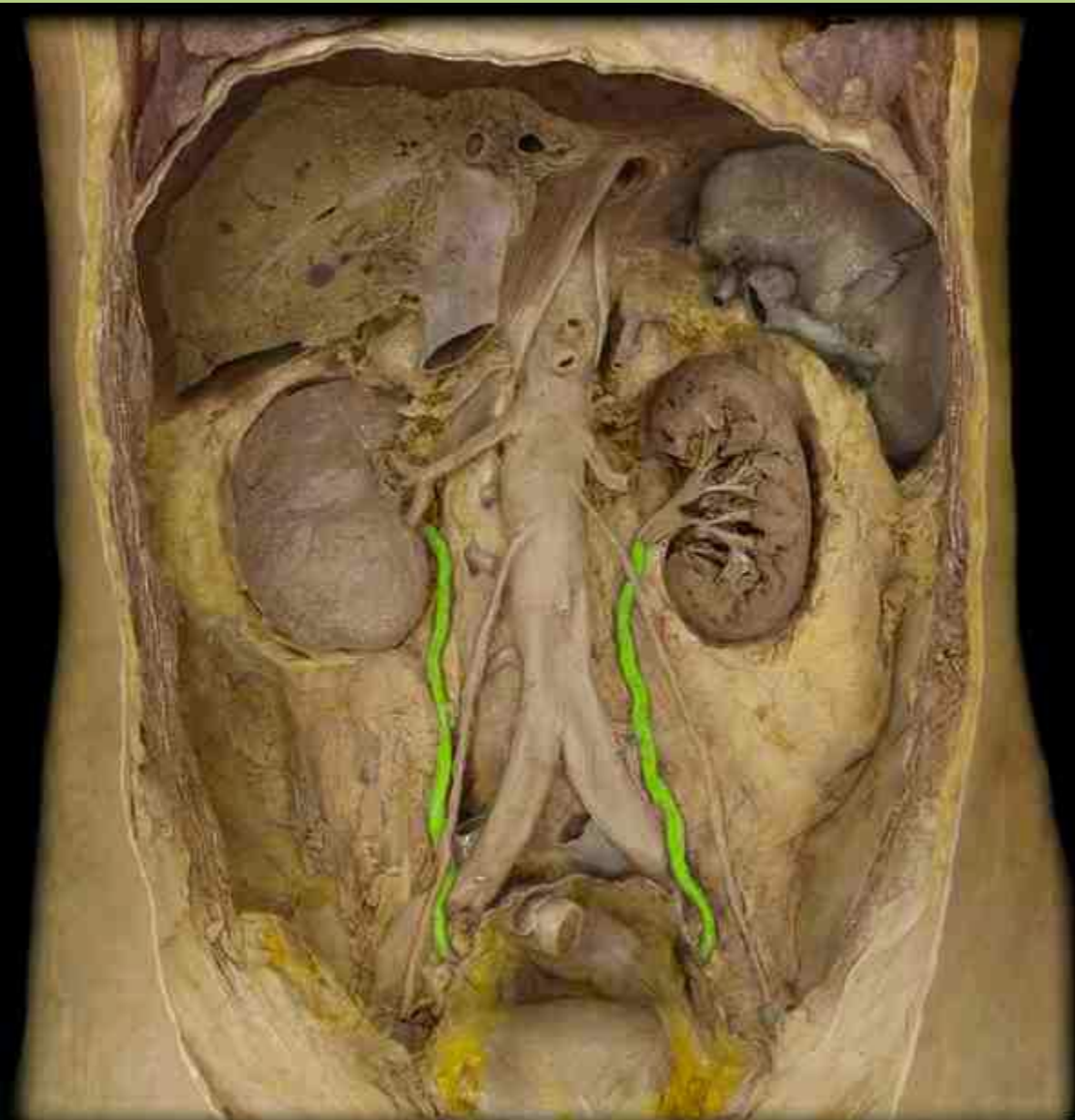


Ureter



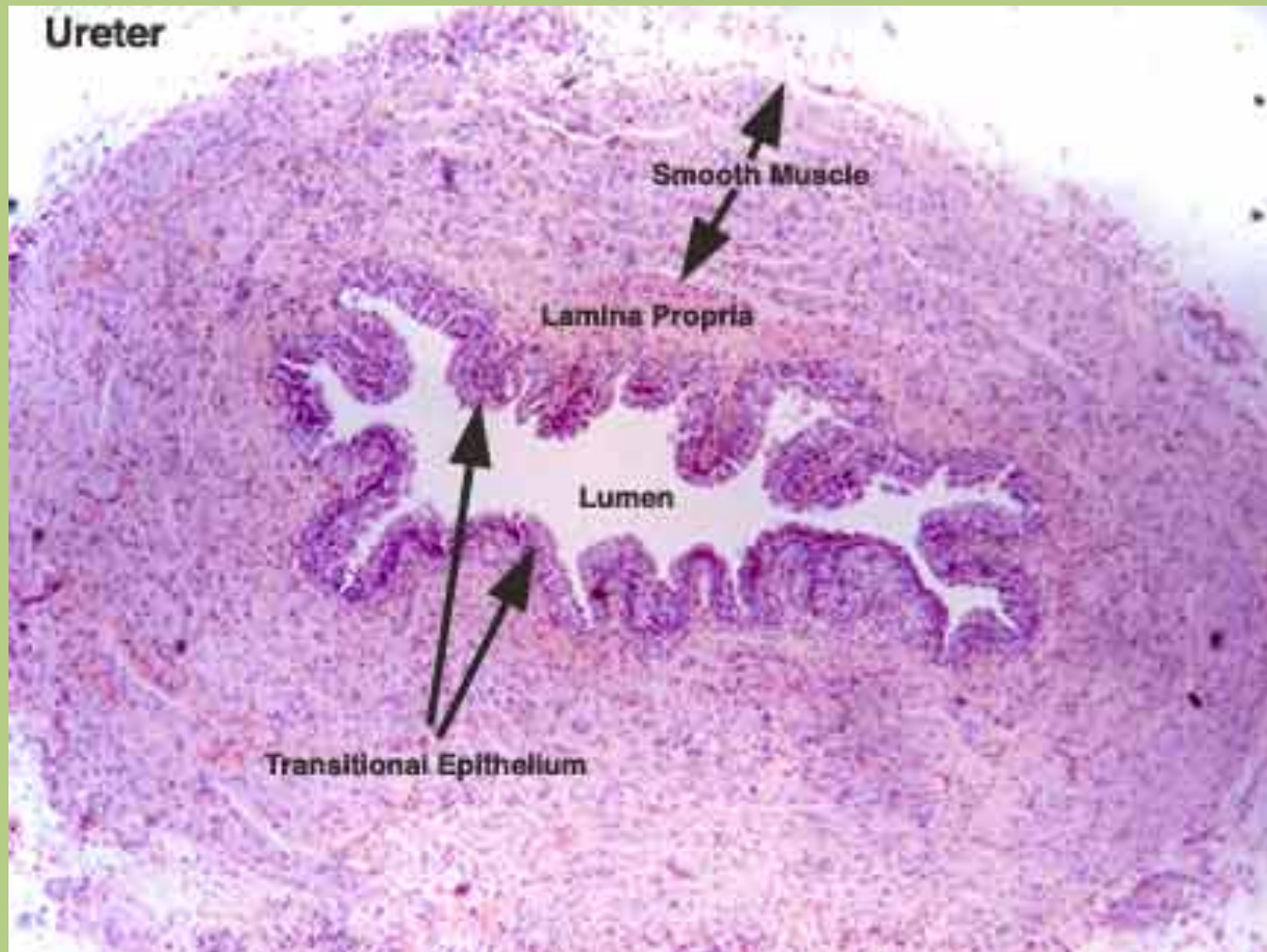
- Begins at the L1 vertebral level
- Retroperitoneal structure
- 25-30cm long
- Parts: abdominal, pelvic and intramural
- Shows frequent contractions
- Lined by urothelium
- ***Anatomical constrictions:***
 - 1: pelvico-ureteric junction,
 - 2: crossing with the common iliac artery, 3:
 - intramural part

Ureter – blood supply

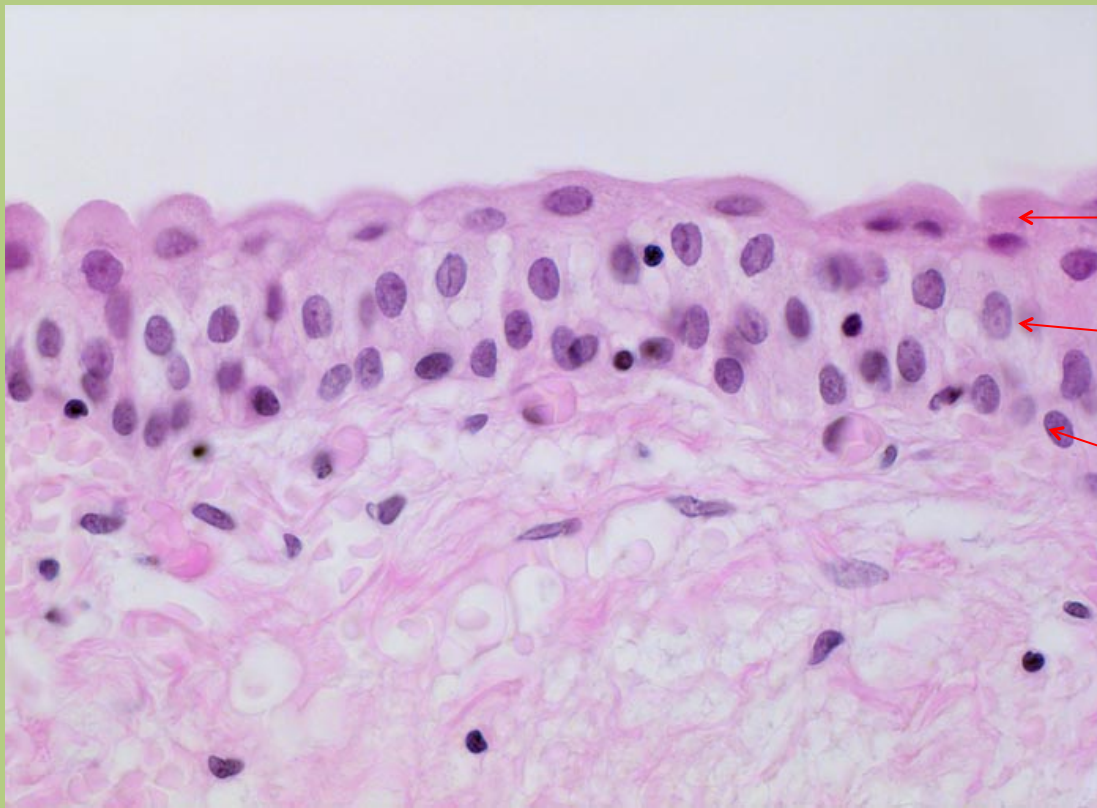


- renal artery
- gonadal artery
- common iliac artery
- internal iliac artery
- uterine artery
- superior vesical arteries

Ureter



Urothelium

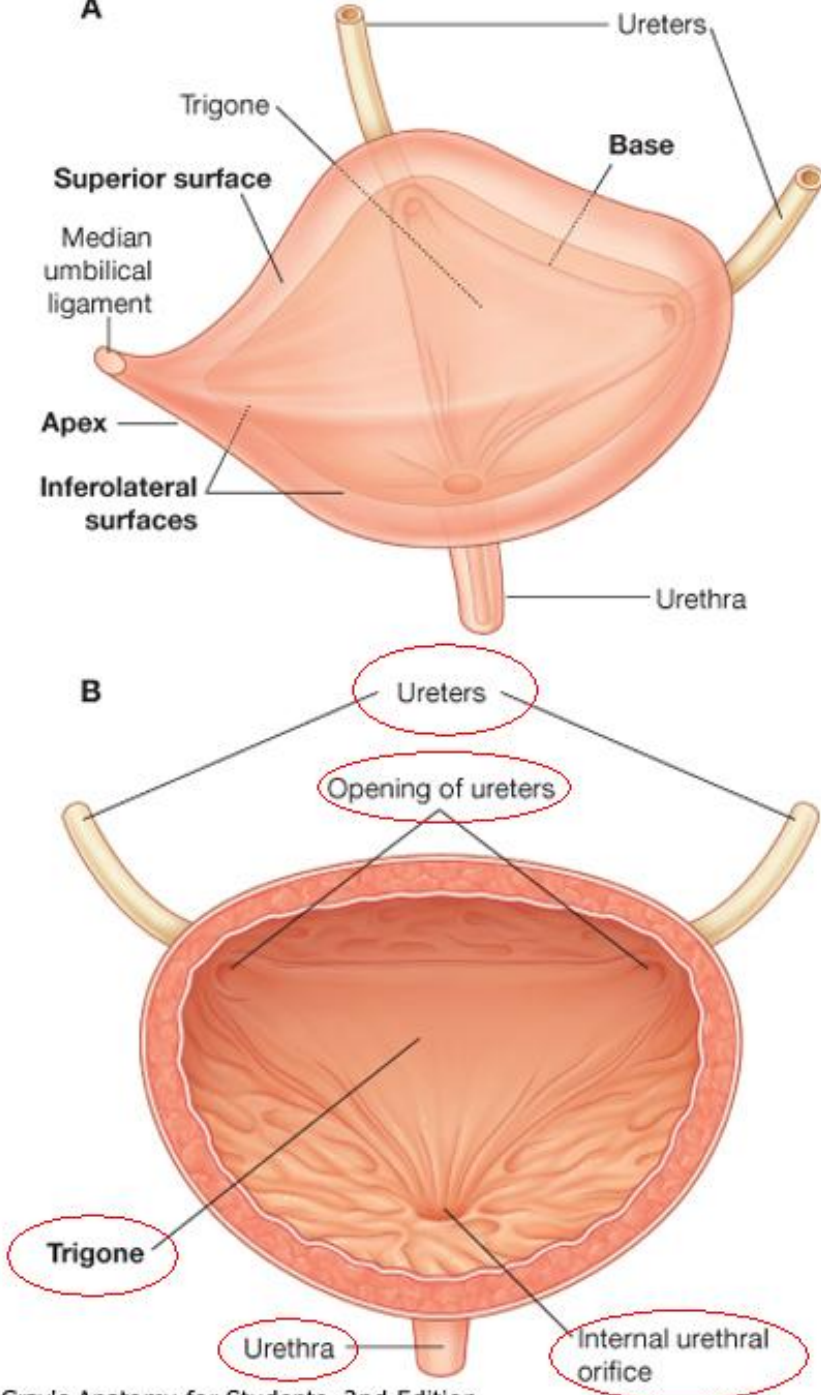


1. Umbrella cells

2. Pear shaped cells

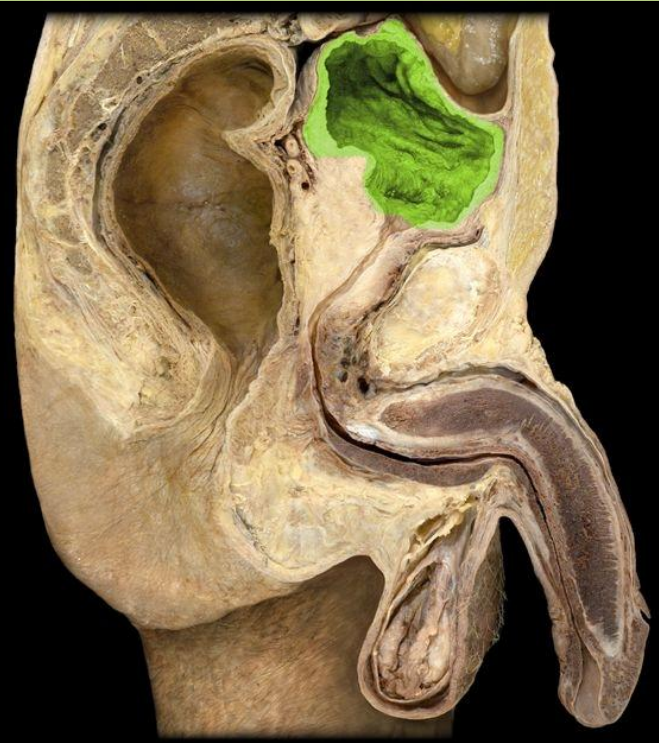
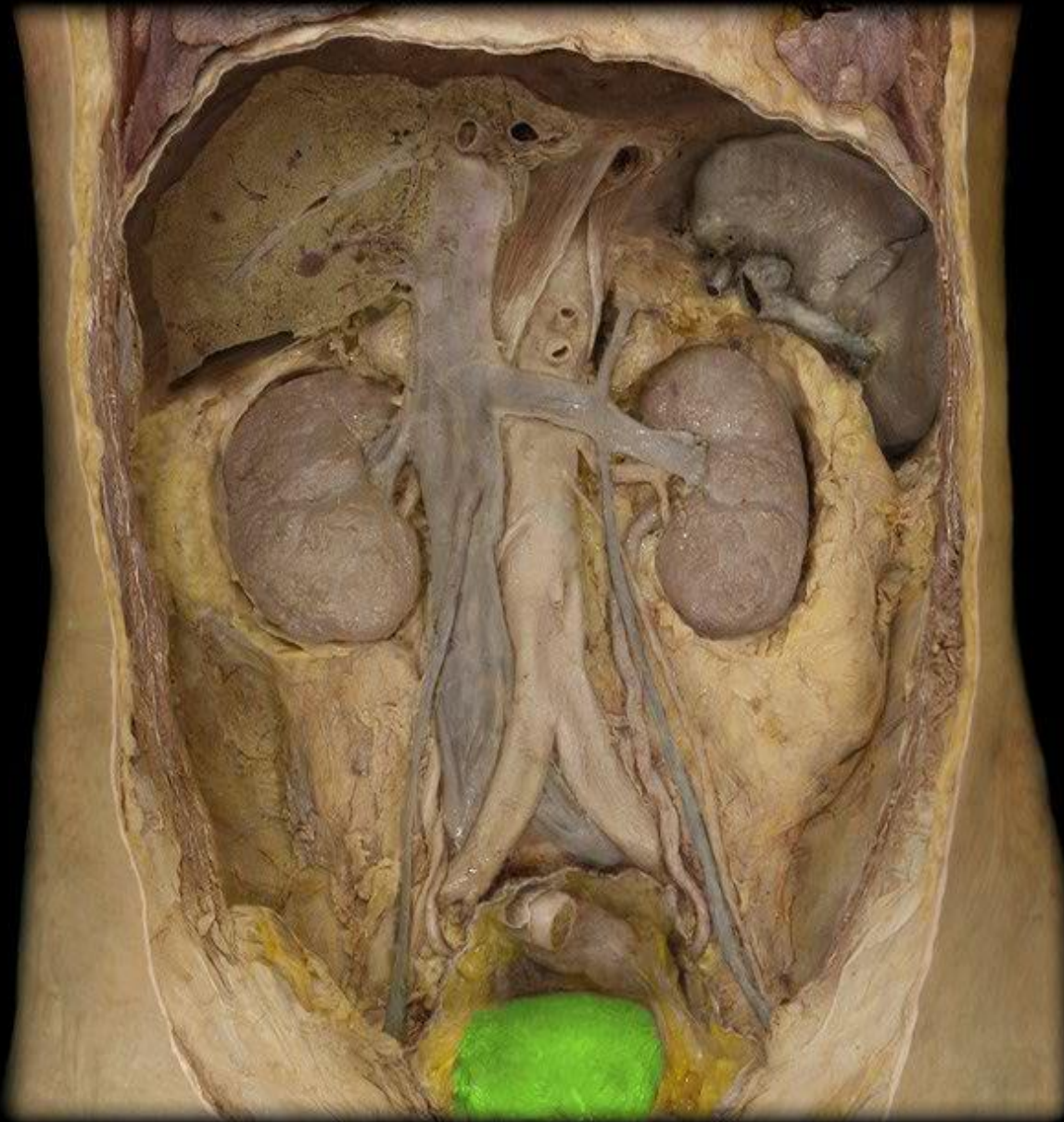
3. Basal cells

Urinary bladder



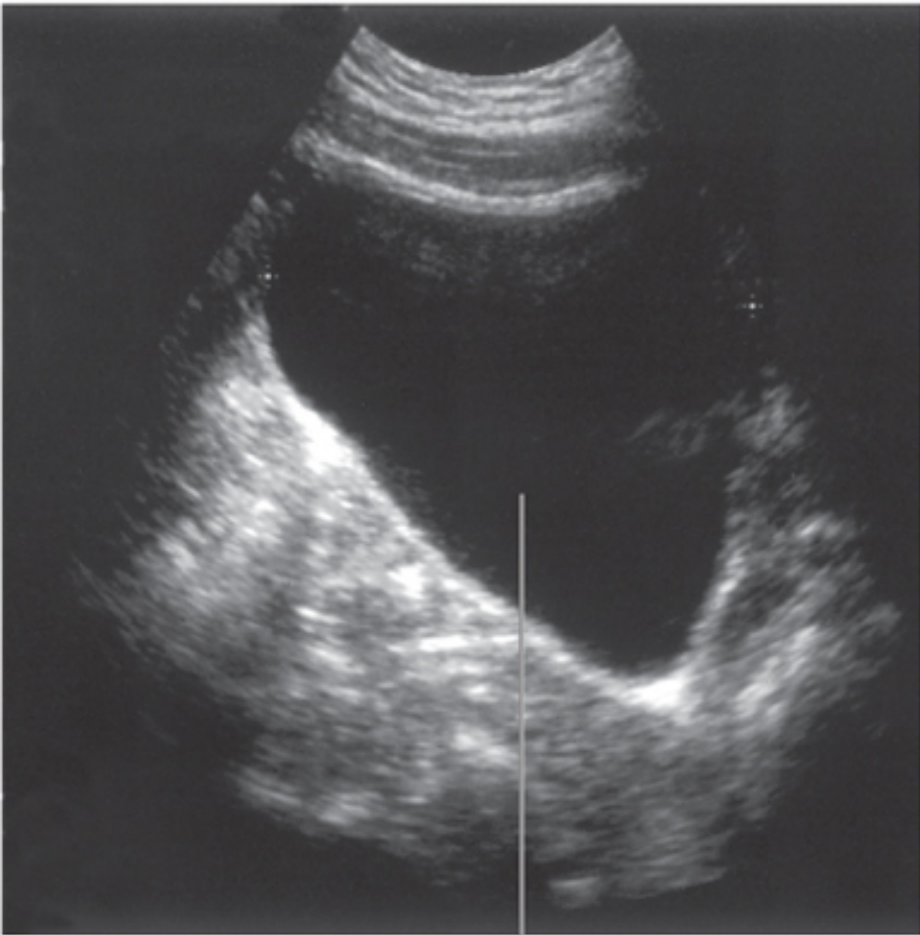
- Infraperitoneal organ
- Parts: apex, body and fundus
- Urinary trigone: *ureteric openings, urethral opening*
- Folds of mucous membrane over the openings of ureters
- Lined by urothelium
- Average capacity: 300ml
- Blood supply: superior and inferior vesical arteries

Urinary bladder



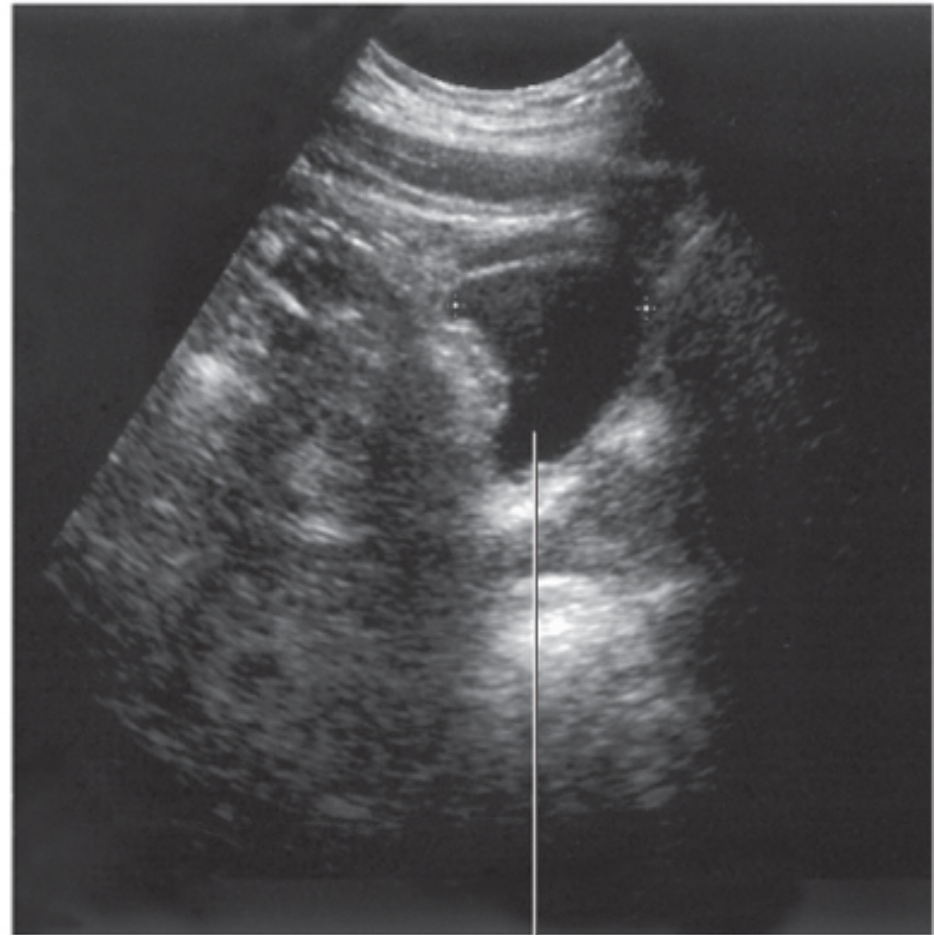
Ultrasound picture of bladder

A



Bladder

B

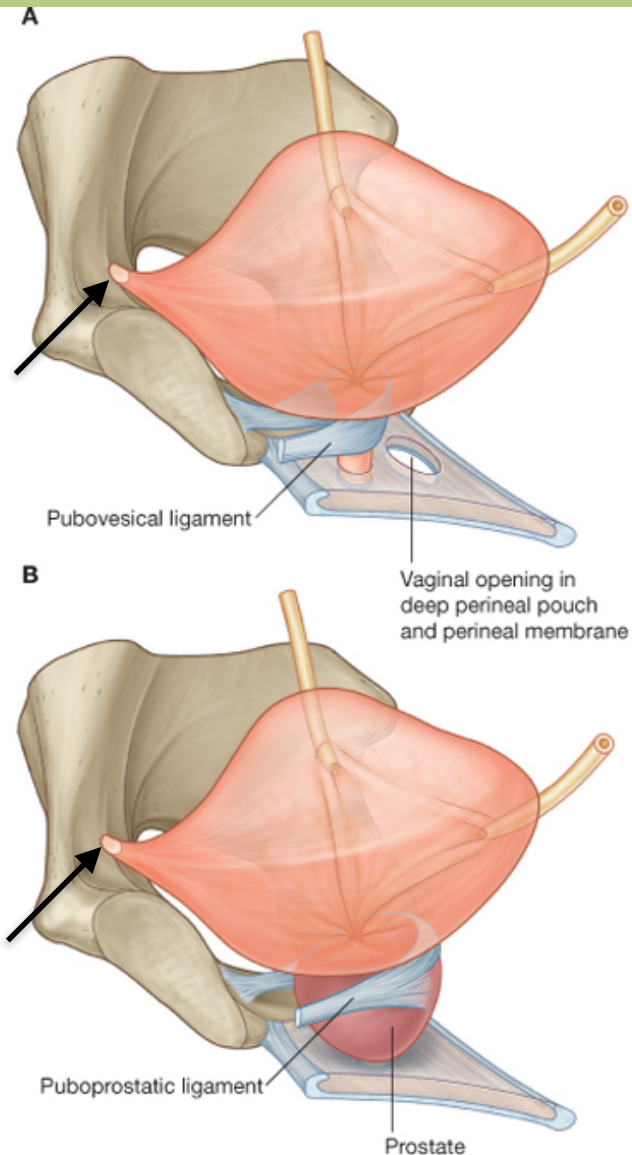


Bladder

Drake: Gray's Anatomy for Students, 2nd Edition.

Copyright © 2009 by Churchill Livingstone, an imprint of Elsevier, Inc. All rights reserved.

Urinary bladder - ligaments



The apex of the bladder is connected to the umbilicus by the remnant of the urachus, which forms the *median umbilical ligament* (arrows).

In the female, the fundus is anchored inferiorly by the pelvic fascia, and the bladder and the urethra are connected to the symphysis by the *pubovesical ligament*.

In the male, the fundus is anchored inferiorly by prostatic capsule, and the bladder and the urethra are connected to the symphysis by the *puboprostatic ligament*.

A FEMALE

■ Internal urethral sphincter

■ External urethral sphincter

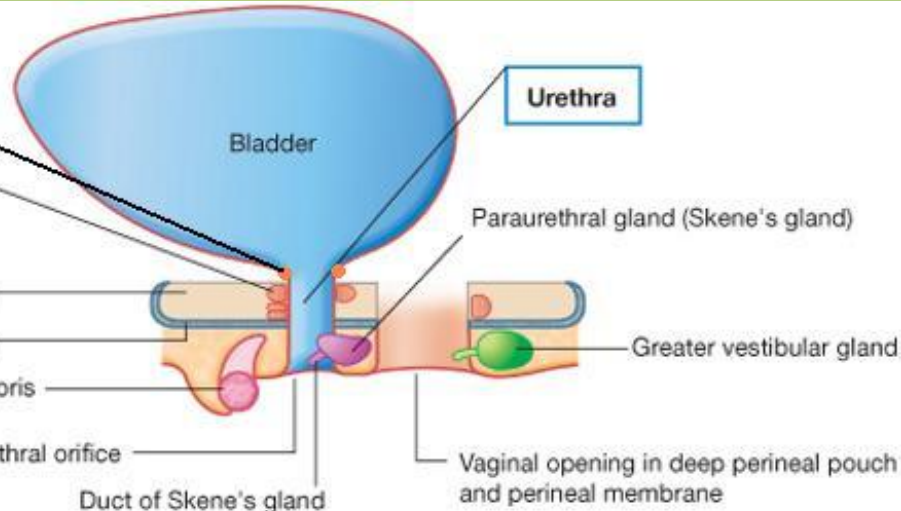
Urogenital diaphragm

Perineal membrane

Glans clitoris

External urethral orifice

Duct of Skene's gland



B MALE

■ Internal urethral sphincter (smooth muscle)

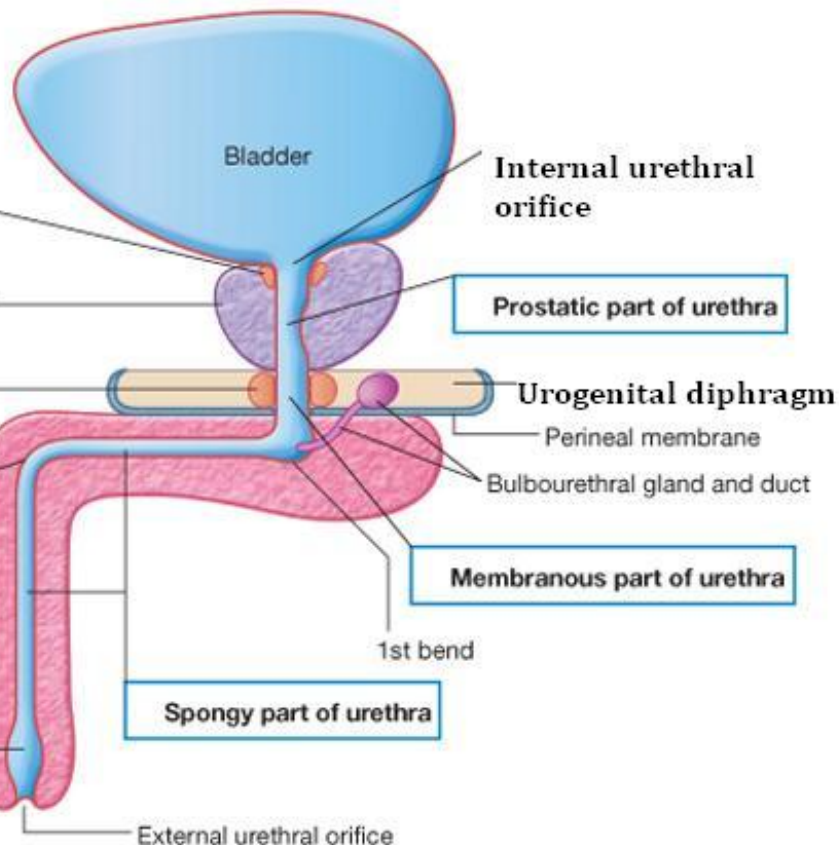
■ External urethral sphincter (skeletal muscle)

2nd bend when penis is flaccid

Penis

Navicular fossa

External urethral orifice



Urethra

Lined by stratified columnar epithelium.

Female urethra:

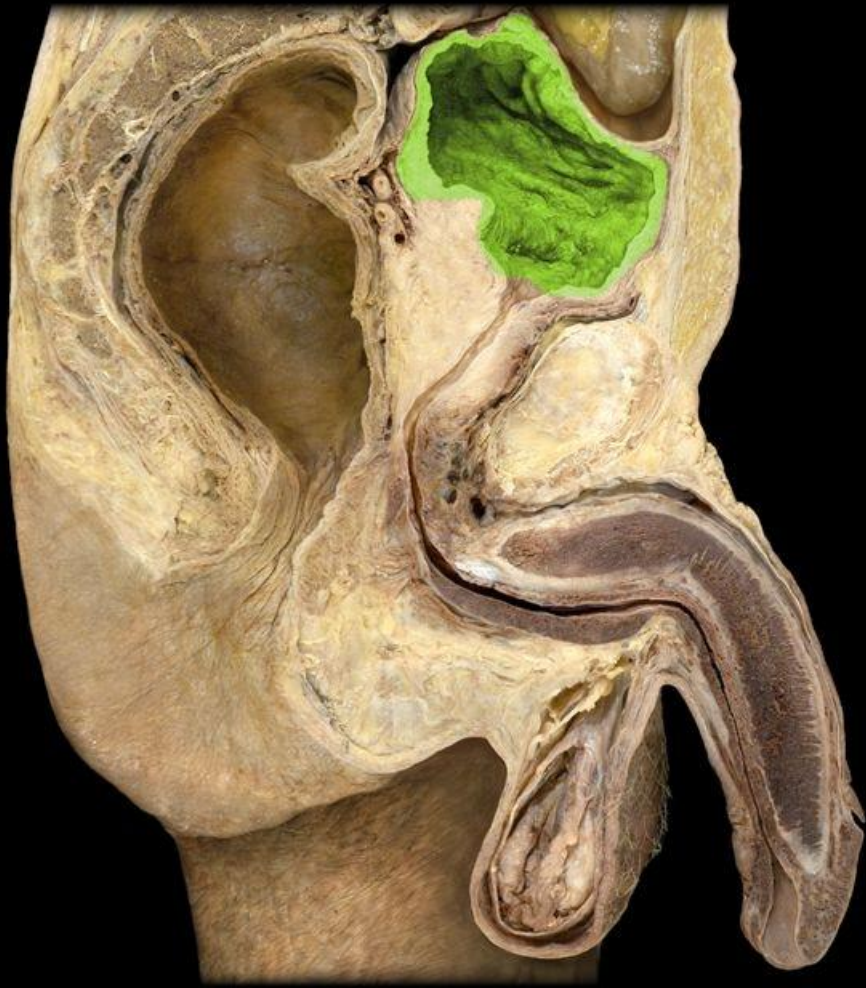
2-3cm long

Male urethra:

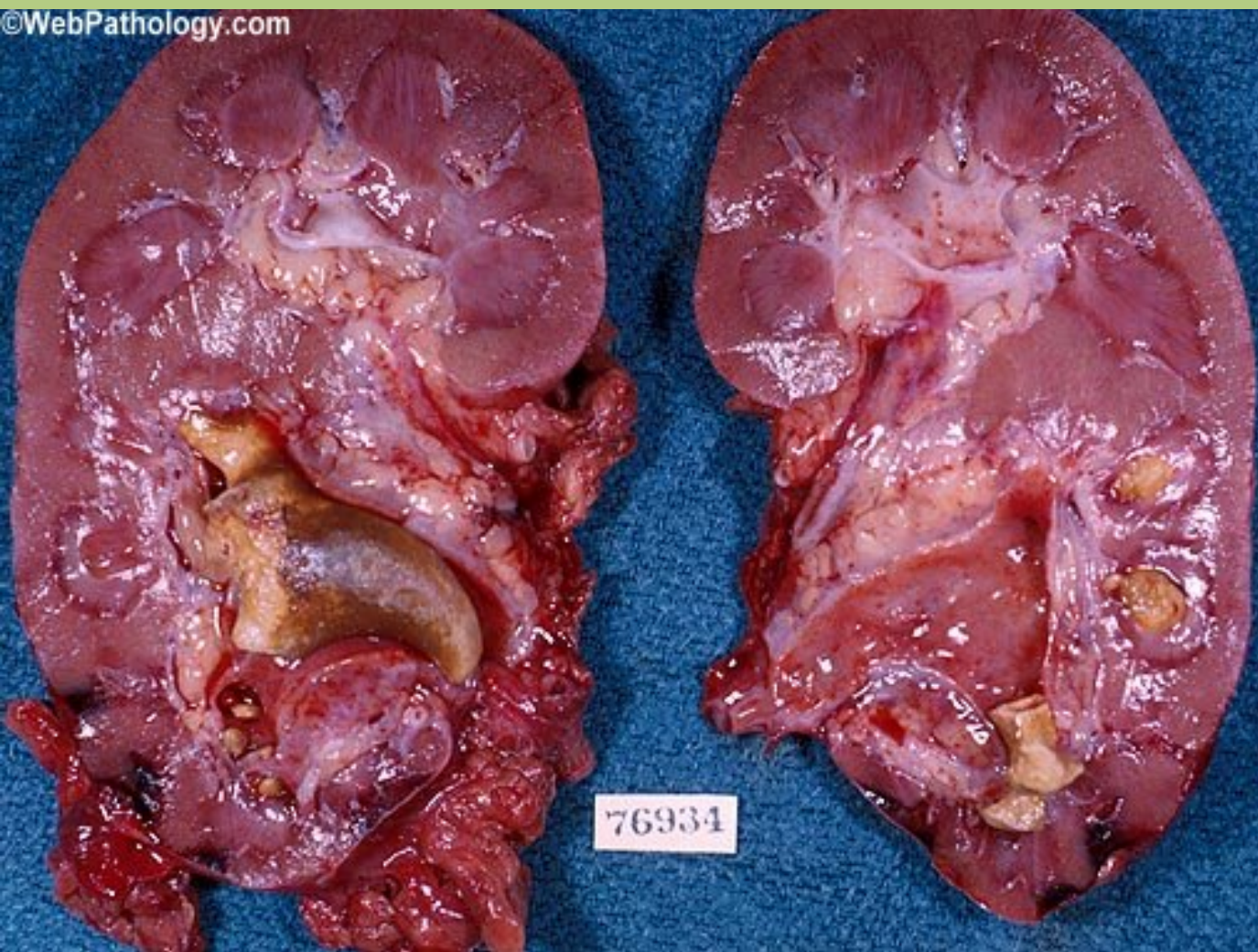
15-18cm long

Represents 3 divisions:

*Prostatic part
Membranous part
Spongy part*



Urinary stones



Common, with a lifetime incidence of up to 15%. Males are at higher risk than females (3:1).

75% of the stones is built up by calcium oxalate (spinach, rhubarb, almonds and cashews, cocoa and raspberry).



Thank you for your attention.

References: Gray's Anatomy for Students
Thieme, Atlas of Anatomy, Internal Organs
LWW: Langman's Medical Embryology
WebPathology.com
studyblue.com