IN THE NAME OF GOD

Urinary system

For

medicine student

By

Dr. Saeednia

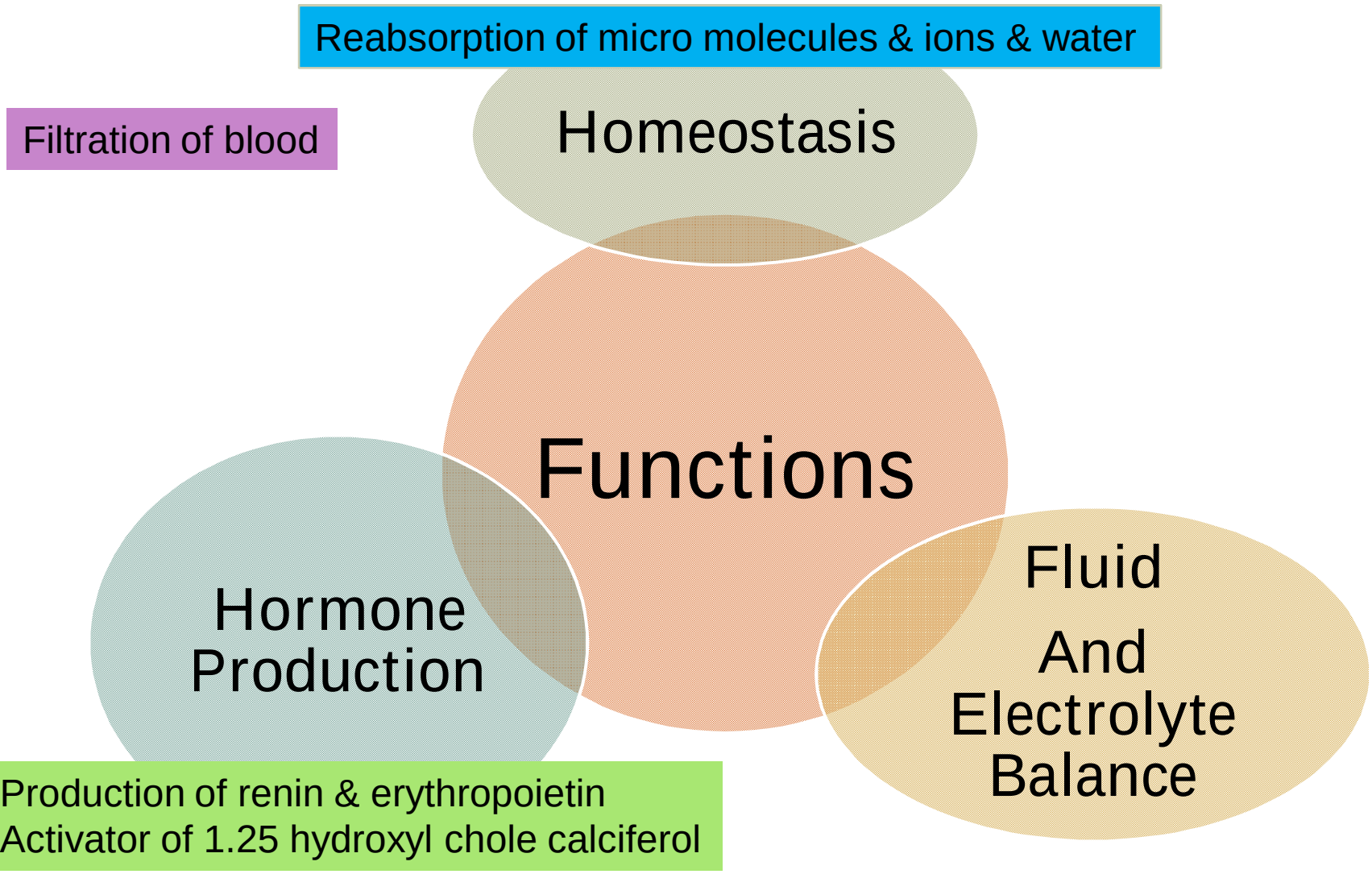
ANATOMY

Urinary Tract

Urinary System

- Kidney
- Renal pelvis
- Covering of kidney
- Ureter
- Urinary bladder
- Urethra

Urinary System functions



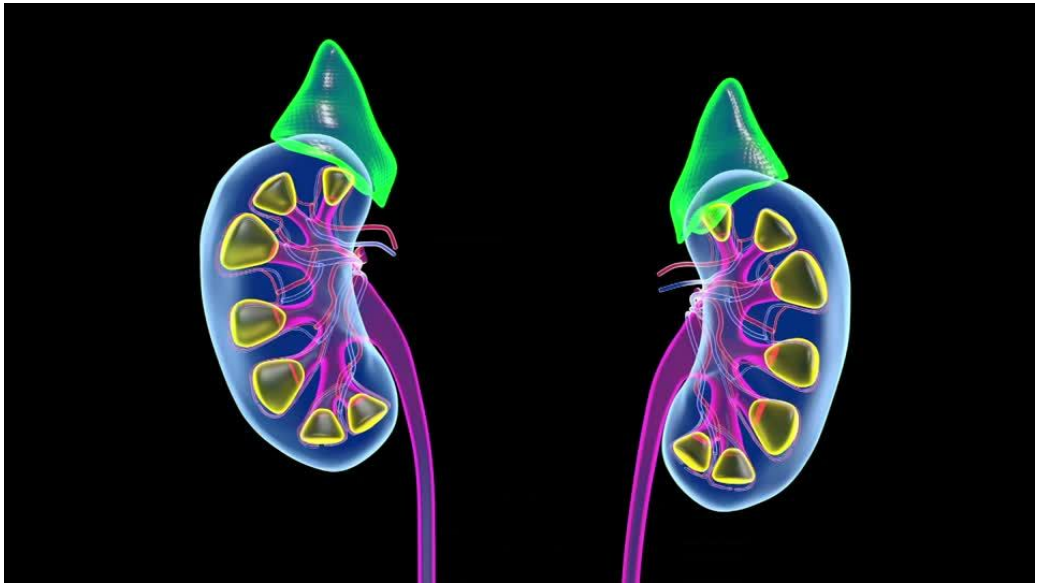
کلیه حدود 20% از COP را در دقیقه دریافت می کند. به عبارتی 1.25 لیتر خون را در دقیقه فیلتر می کند.

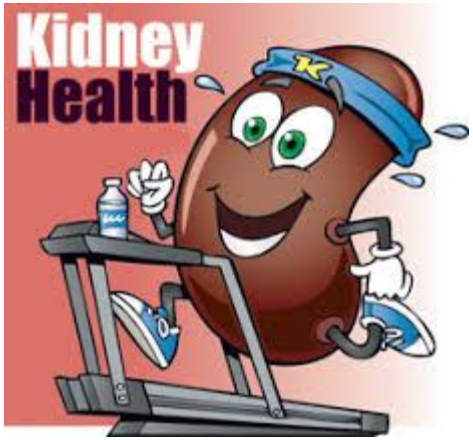
پس کل خون بدن هر 5 دقیقه از کلیه ها می گذرد.

90% از COP به کورتکس کلیه می رسد و 10% COP به مدولا میرسد.

در یک دقیقه 125 سی سی مایع فیلتره شده در کلیه درست می شود که 124 سی سی آن بازجذب شده و 1 سی سی ادرار تولید می شود.

بنابراین در 24 ساعت حدود 1500 سی سی ادرار تولید می شود.





Urinary System

Kidney

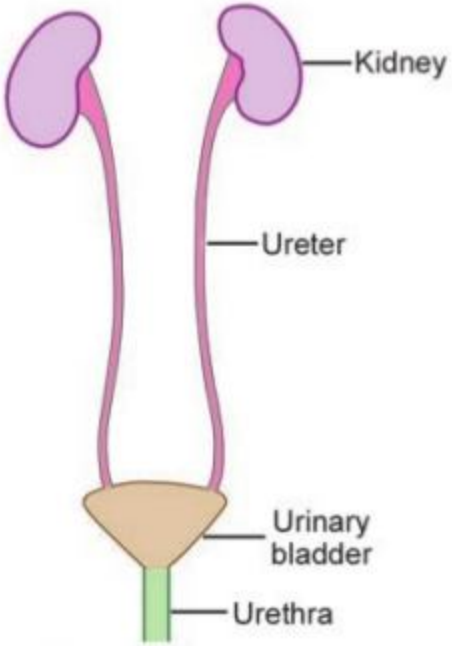
Renal pelvis

Covering of kidney

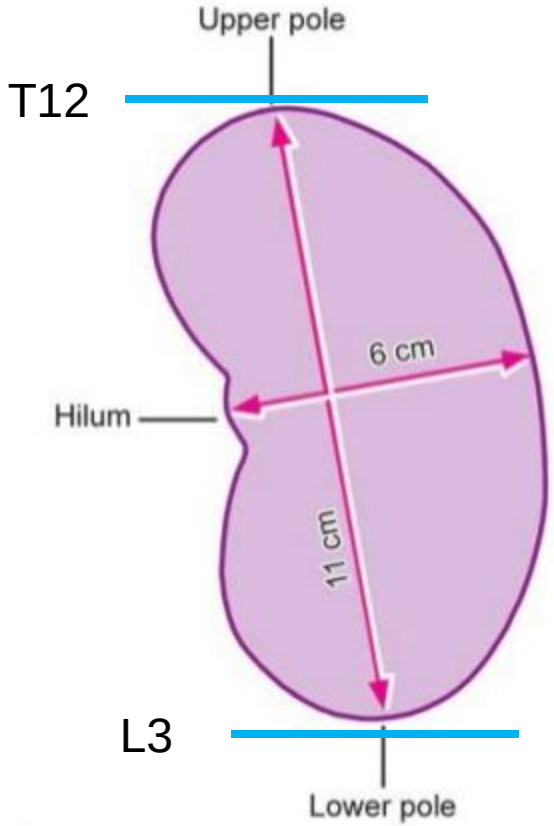
Ureter

Urinary bladder

Urethra



30.1: The urinary organs



30.2: Approximate dimensions of a kidney. The anteroposterior diameter is about 3 cm

Kidney : Retroperitoneal Position

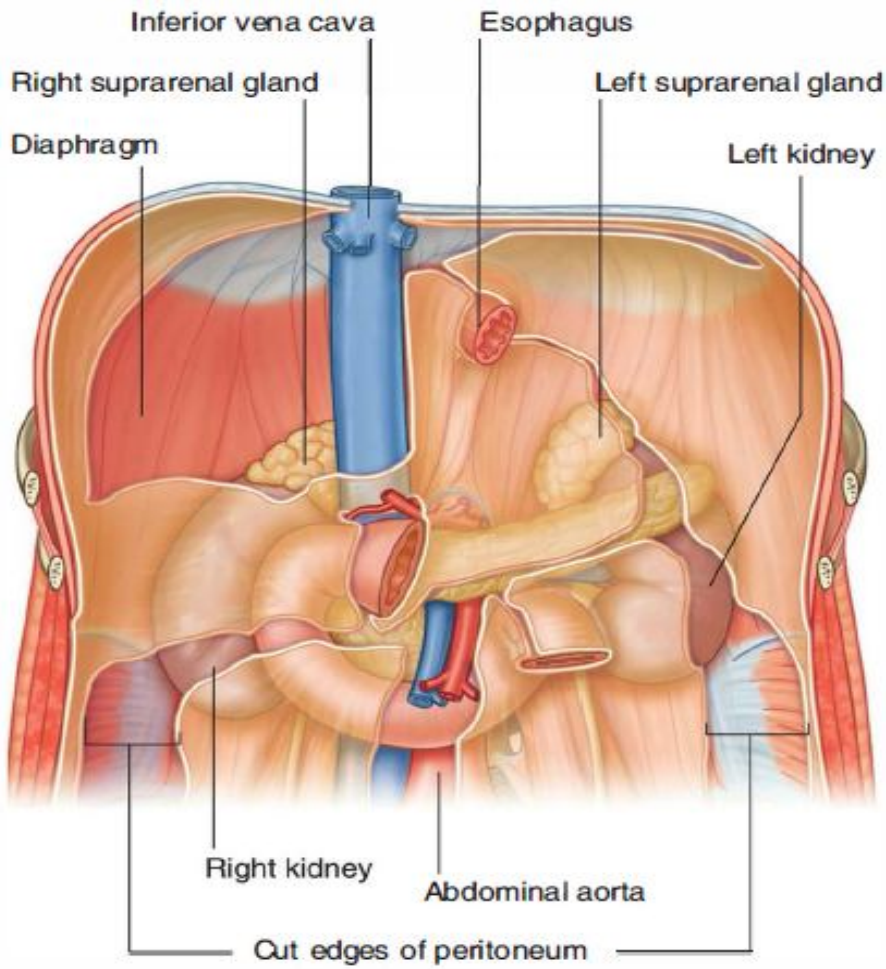
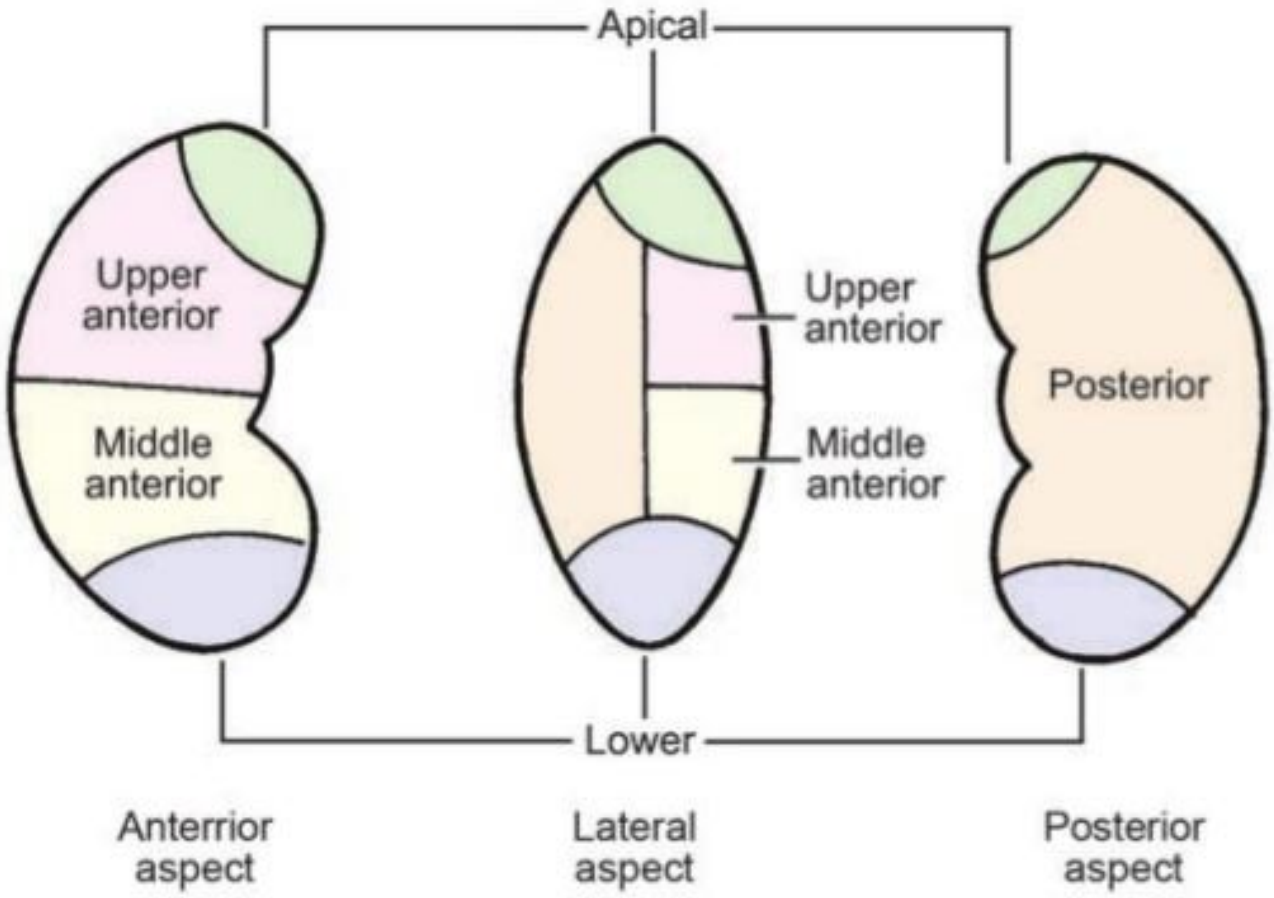


Fig. 4.137 Retroperitoneal position of the kidneys in the posterior abdominal region.

Kidney

- ***Surfaces***
- ***Borders***
- ***Poles***
- Hilume
- Relationships to other structures
- Internal structure :
  - Cortex.A
  - Medulla.B
  - Sinus.C

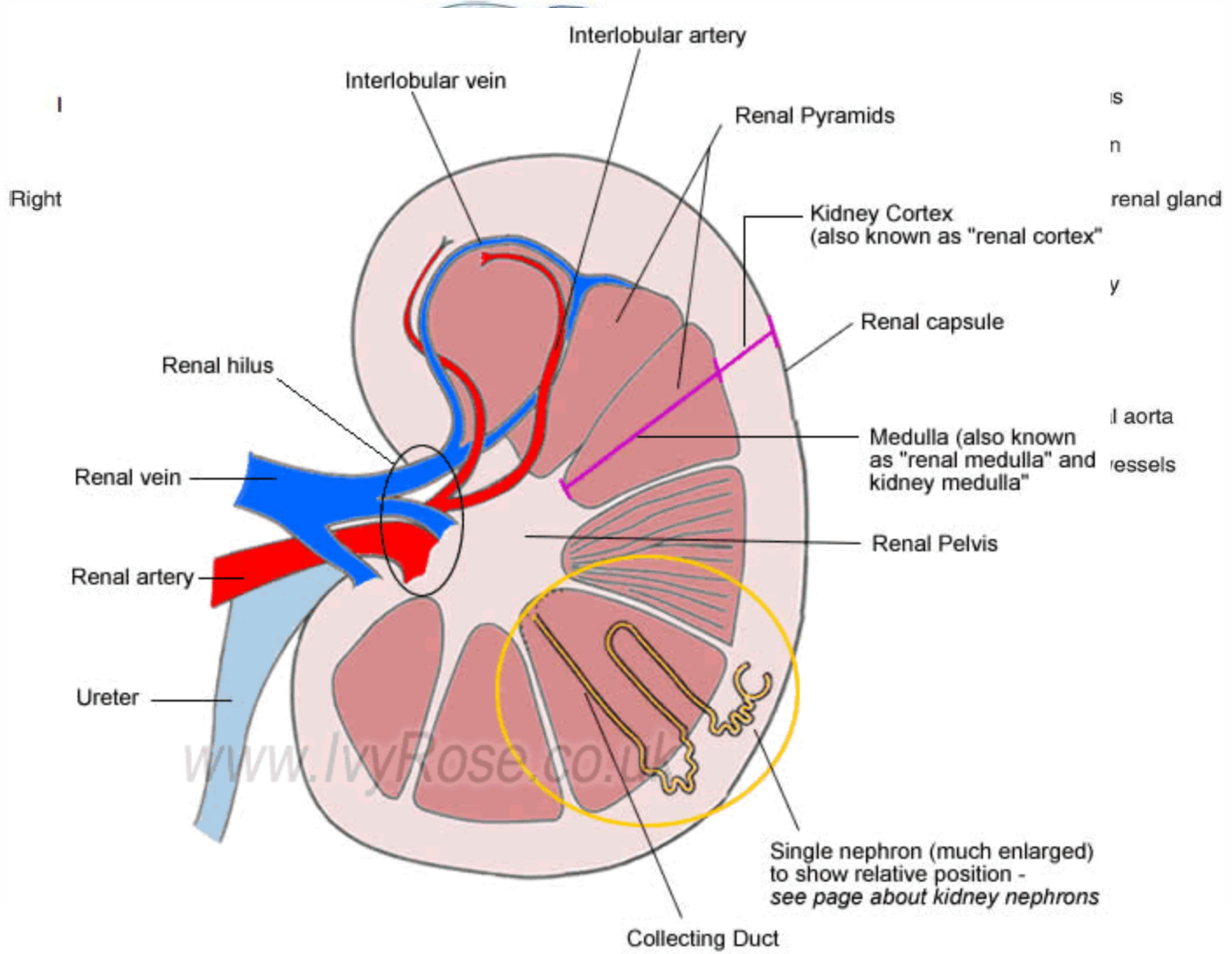


30.13: Scheme to show the segments of the kidney

Kidney

From front to behind: vein – artery - pelvis

- Surfaces
- Borders
- Poles
- ***Hilume***
- Relationships to other structures
- Internal structure:
  - Cortex.A
  - Medulla.B
  - Sinus.C



Kidney

Ant . Relationship

- Surfaces
- Borders
- Poles
- Hilume
- ***Relationships to other structures***
- Internal structure :
- Cortex.A
- Medulla.B
- Sinus.C

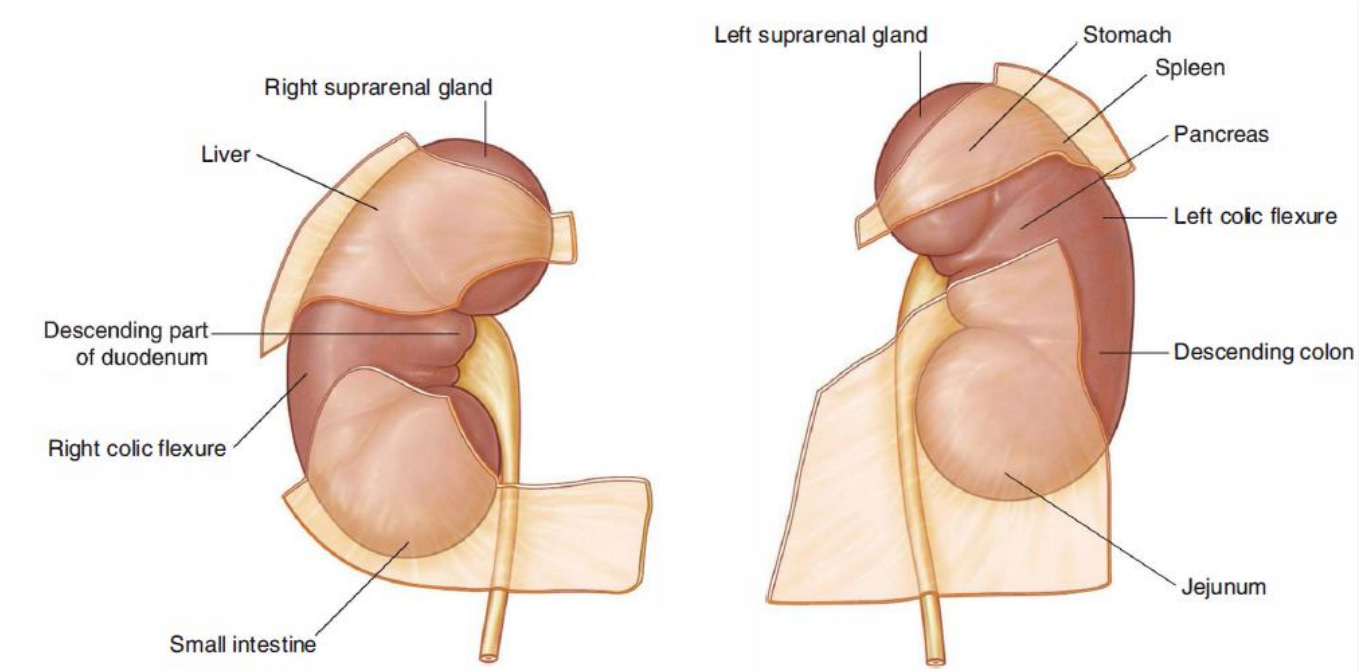
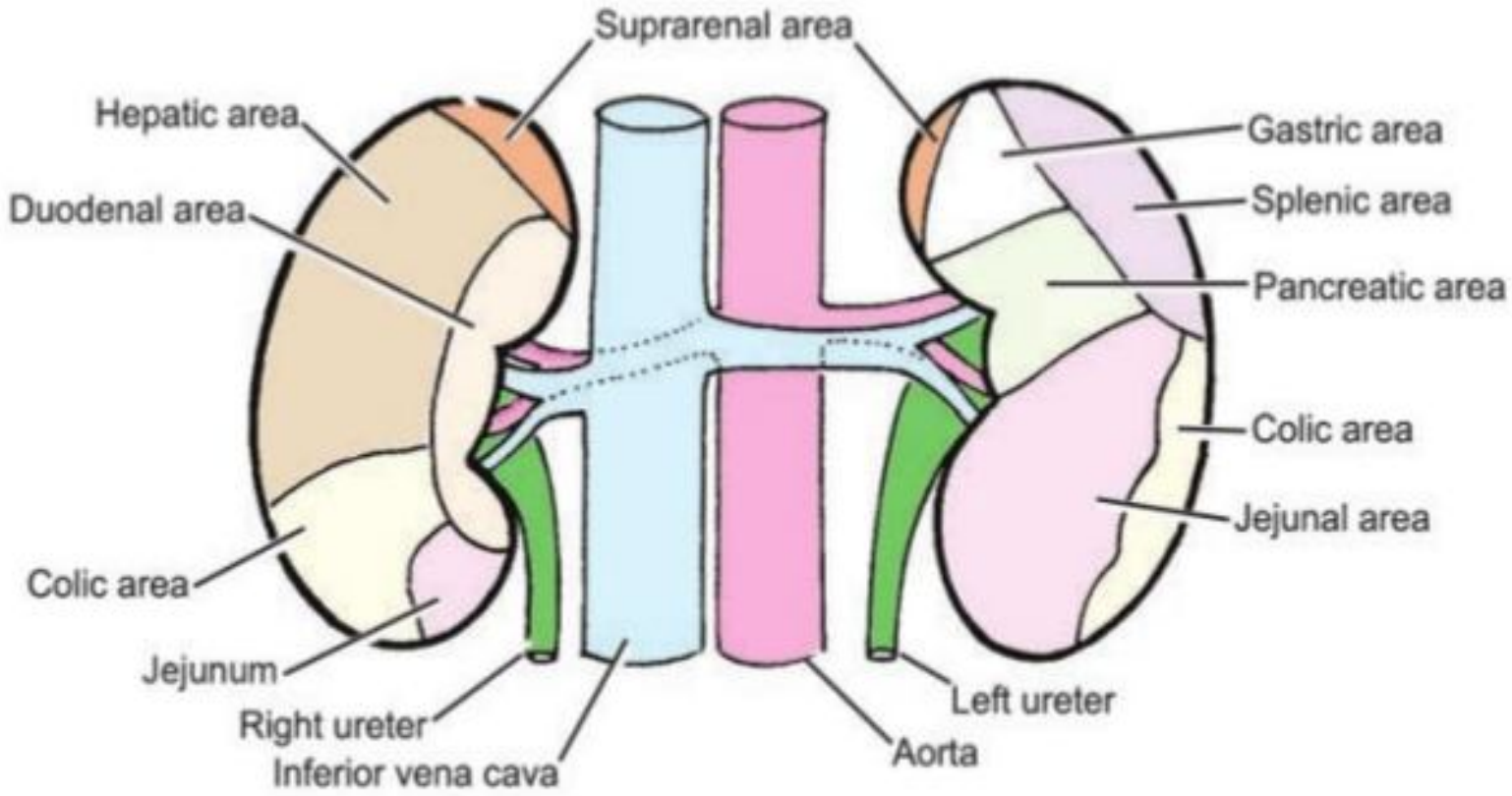


Fig. 4.138 Structures related to the anterior surface of each kidney.



30.7: Areas on anterior surfaces of right and left kidneys related to various viscera

Ant . Relationship

Kidney

Post. Relationship

- Surfaces
- Borders
- Poles
- Hilume
- ***Relationships to other structures***
- Internal structure :
- Cortex.A
- Medulla.B
- Sinus.C

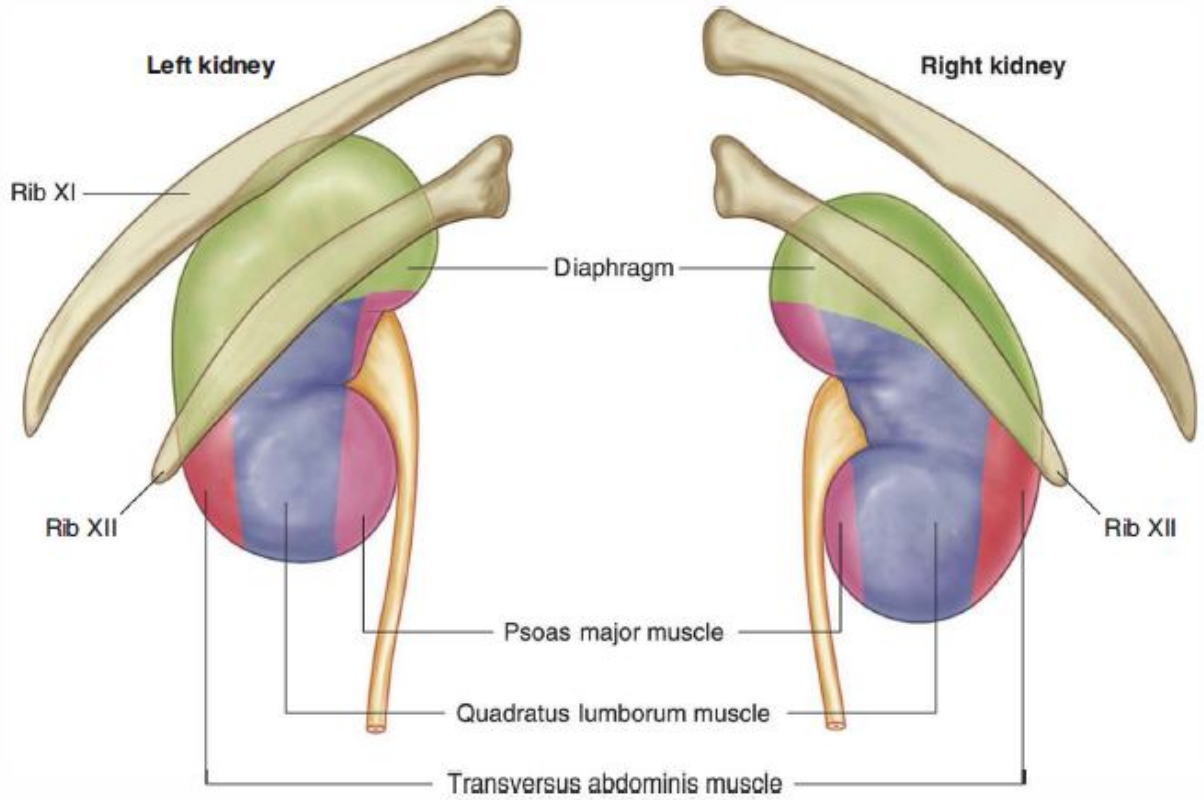
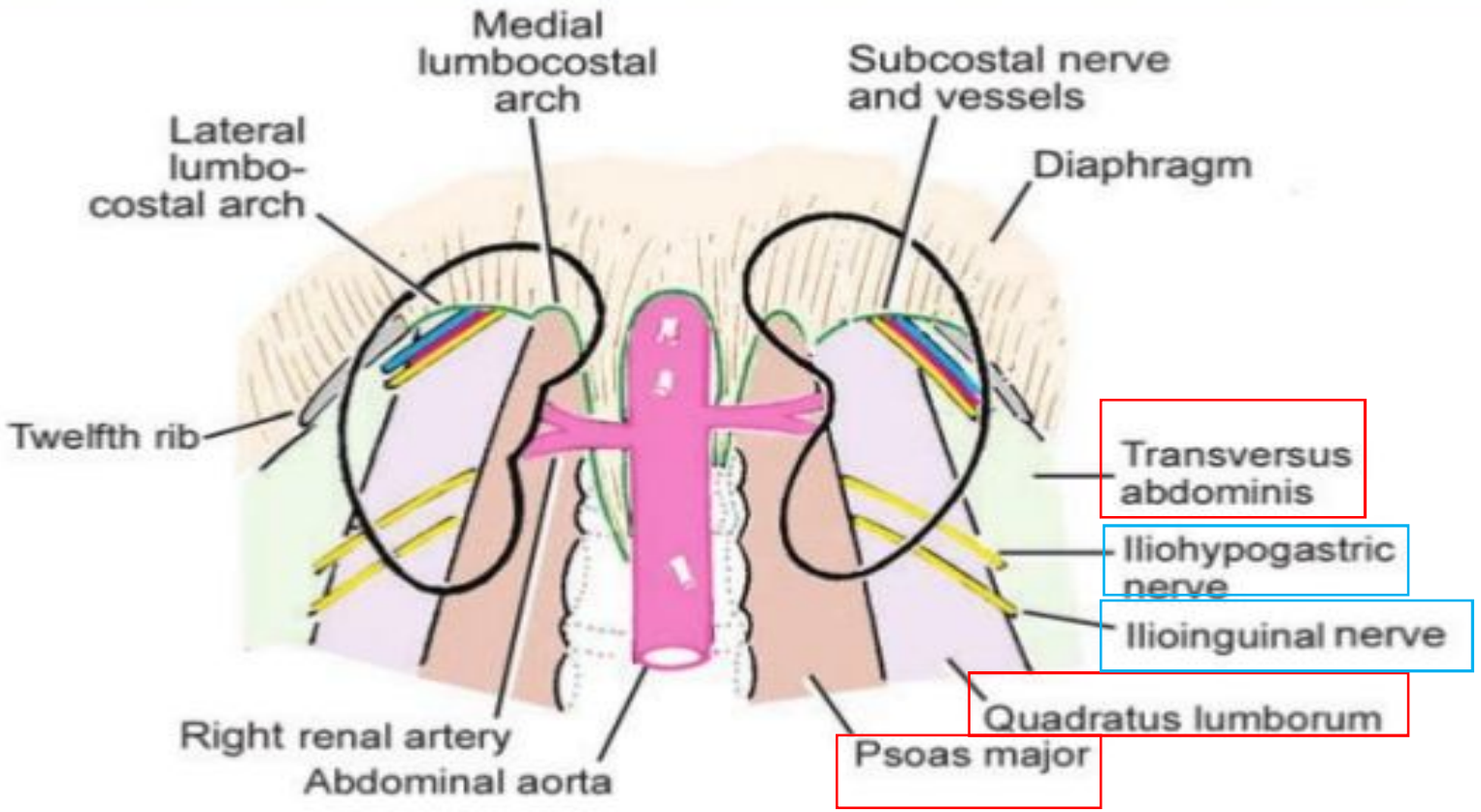


Fig. 4.139 Structures related to the posterior surface of each kidney.



30.6: Posterior relations of kidneys

Post. Relationship

Kidney

Renal column / medullary ray

- Surfaces
- Borders
- Poles
- Hilume
- Relationships to other structures
- ***Internal structure :***
  - ***Cortex.A***
  - ***Medulla.B***
  - ***Sinus.C***

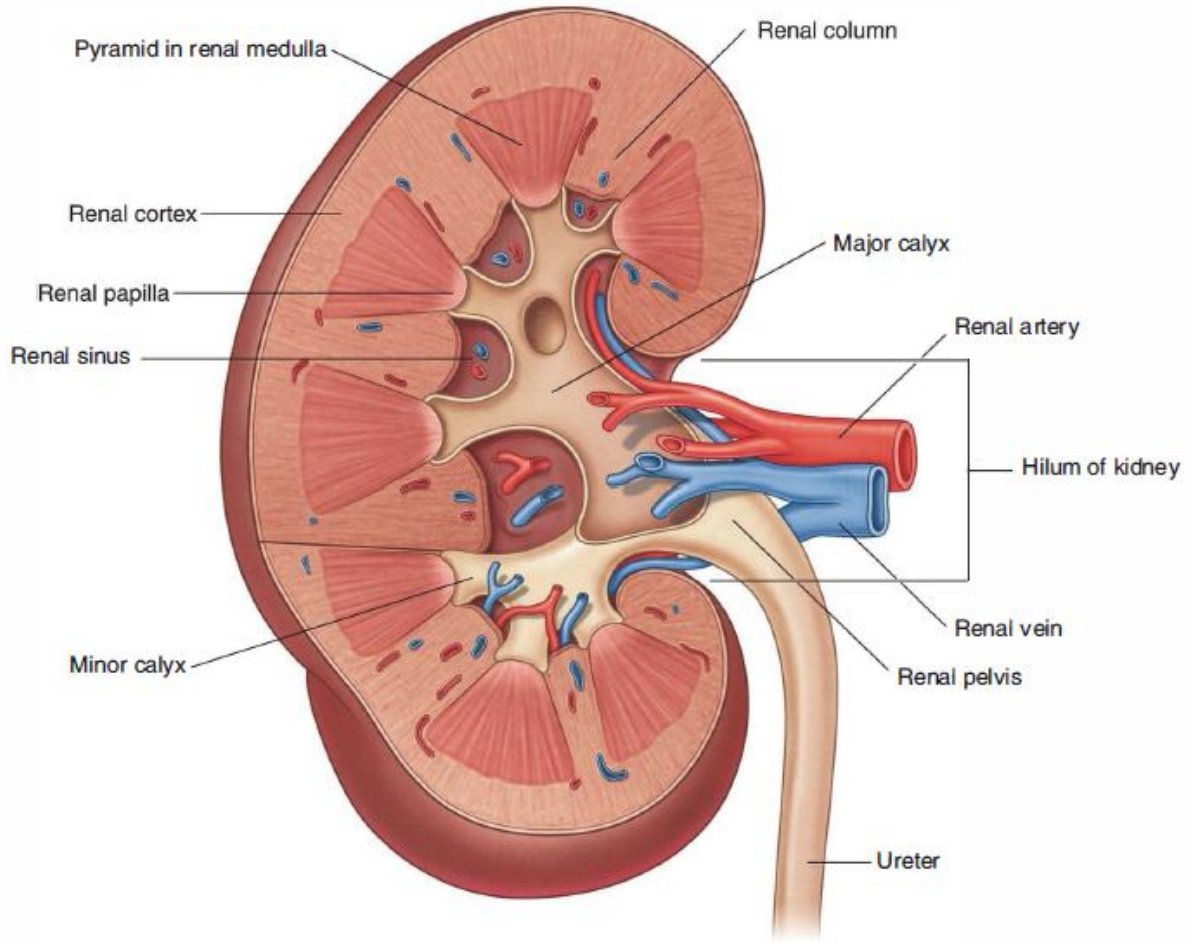


Fig. 4.141 Internal structure of the kidney.

Renal Pelvis

Major calyx / minor calyces / pelvis / ureter

Kidney

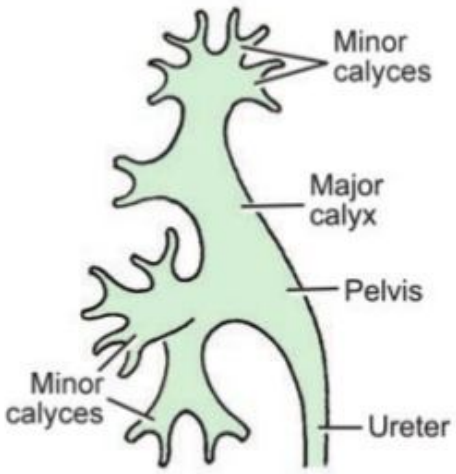
Renal pelvis

Covering of kidney

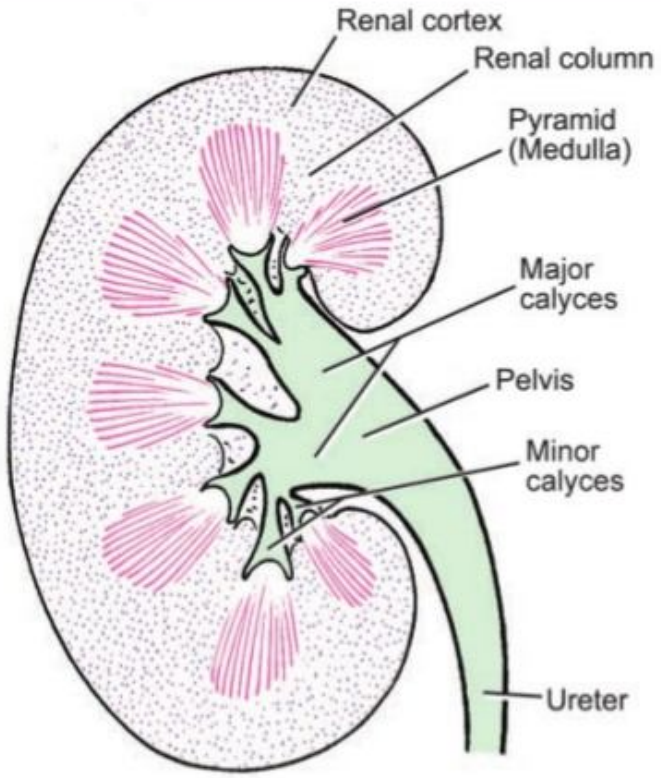
Ureter

Urinary bladder

Urethra



30.9: Scheme to show the major and minor calyces



30.10: Some features to be seen in a coronal section through the kidney

Renal Vasculature

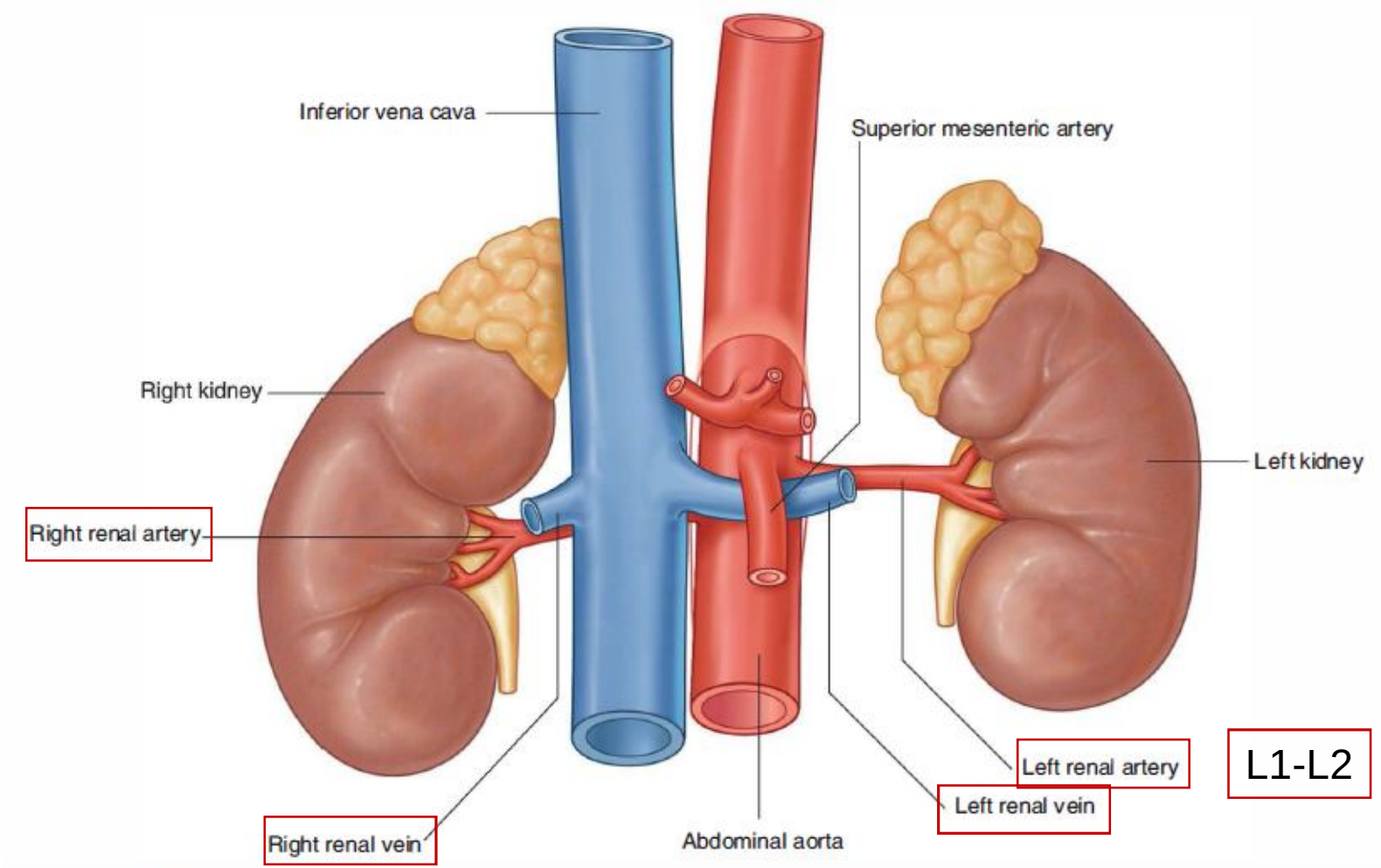


Fig. 4.142 Renal vasculature.

left renal vein

left renal vein crosses the *midline anterior to the abdominal aorta* and *posterior to the superior mesenteric artery* and can be *compressed by an aneurysm* in either of these two vessels.

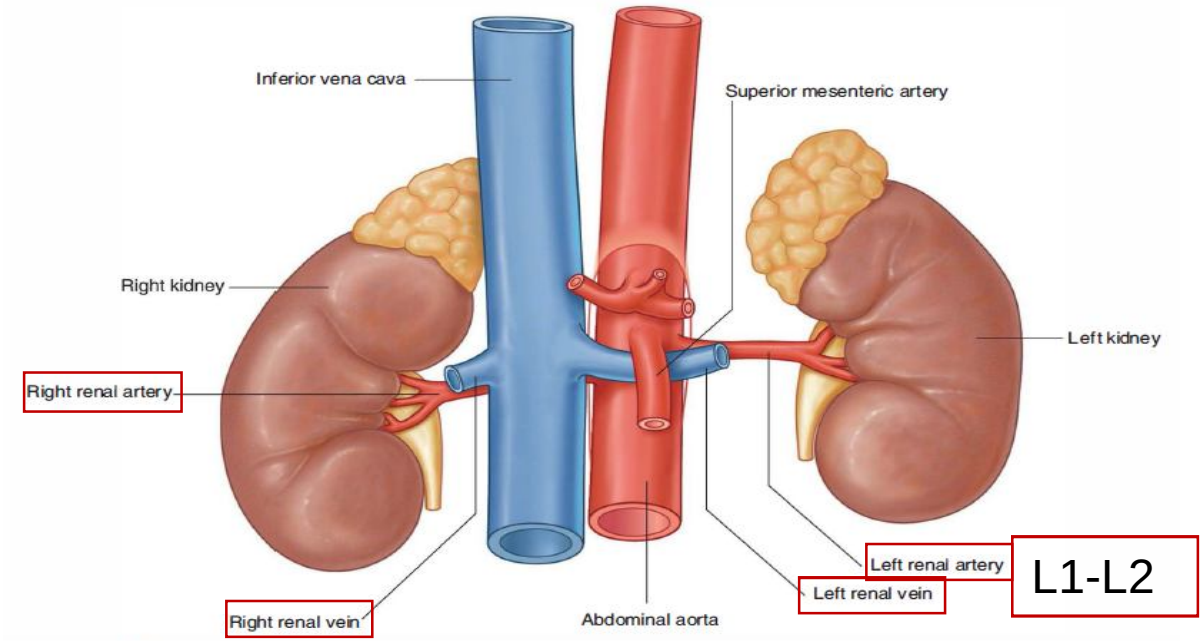


Fig. 4.142 Renal vasculature.

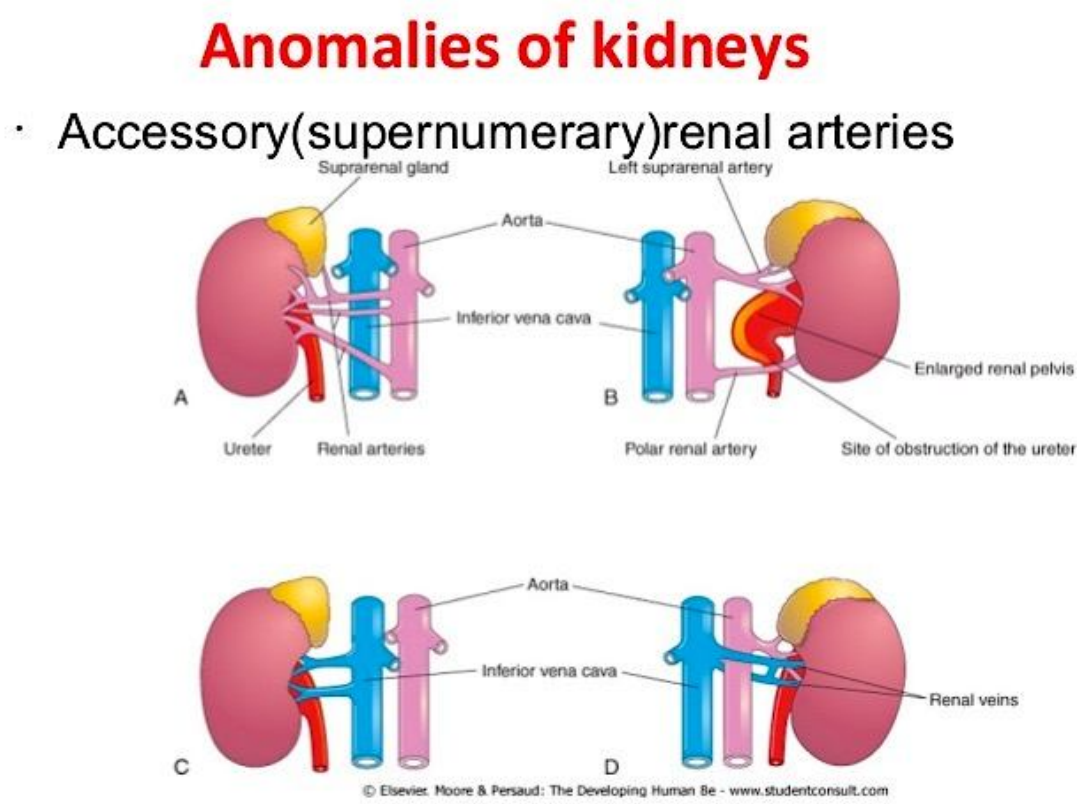
L1-L2

Accessory renal arteries (extrahilar arteries)

originate from:

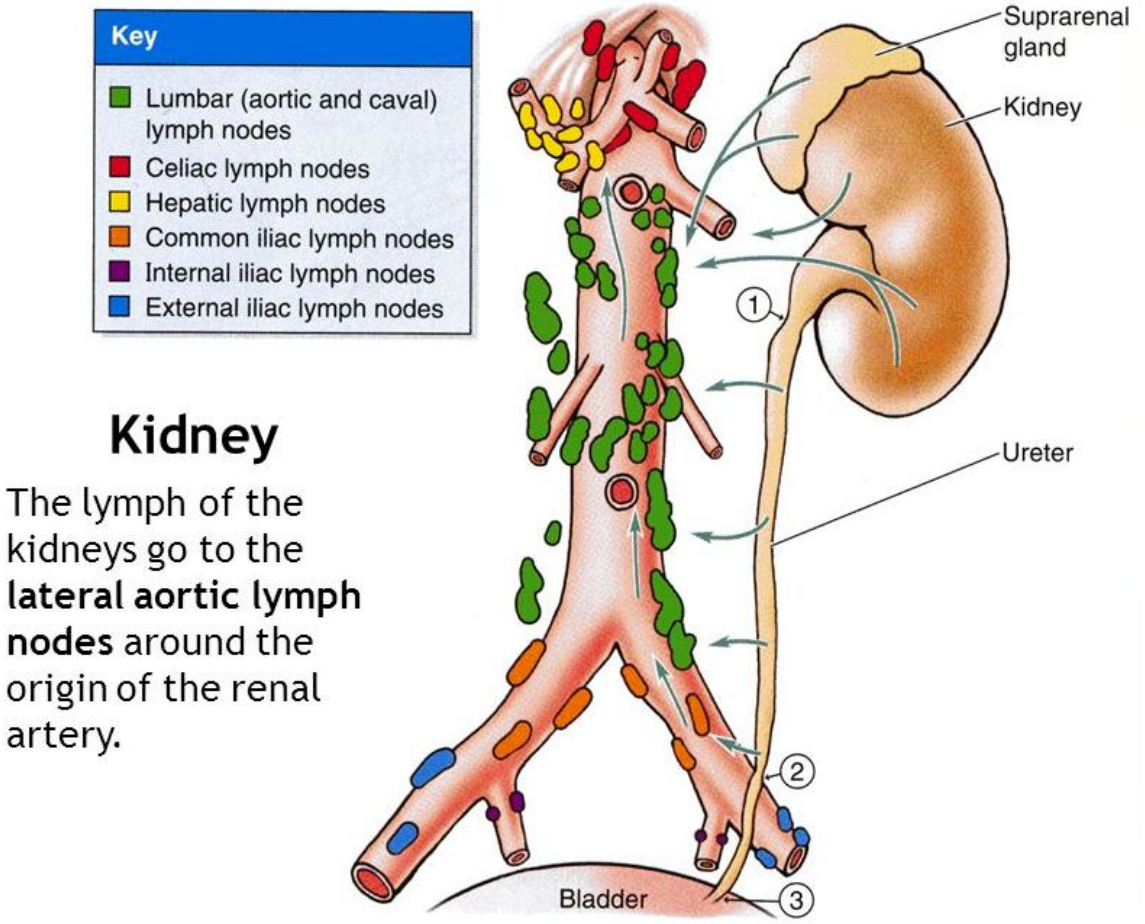
the lateral aspect of the abdominal aorta / either above or below the primary renal arteries

enter the hilum with the primary arteries or pass directly into the kidney



The lymphatic drainage

The lymphatic drainage of each kidney is to the ***lateral aortic (lumbar) nodes*** around the origin of the renal artery.



Renal capsule – perirenal fat (hilum / sinus) – renal fascia – pararenal fat

Kidney

Renal pelvis

Covering of kidney

Ureter

Urinary bladder

Urethra

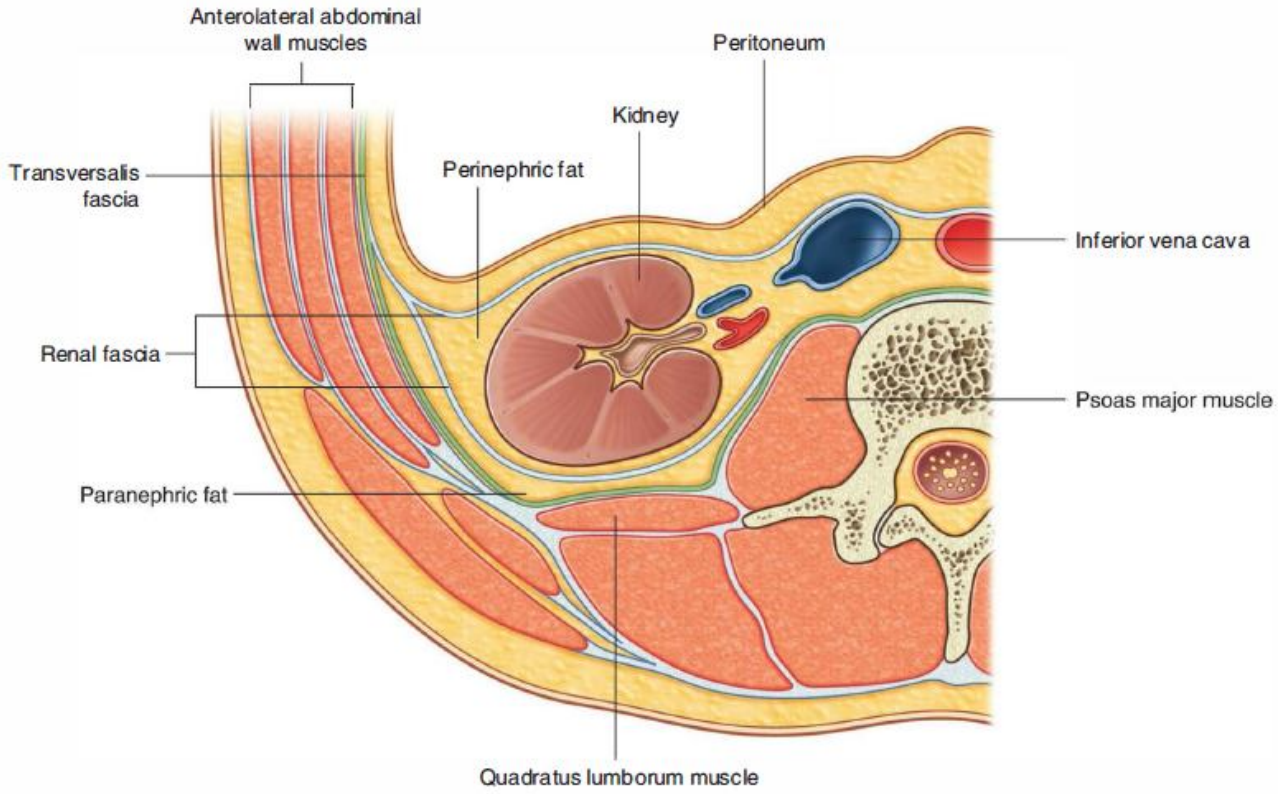
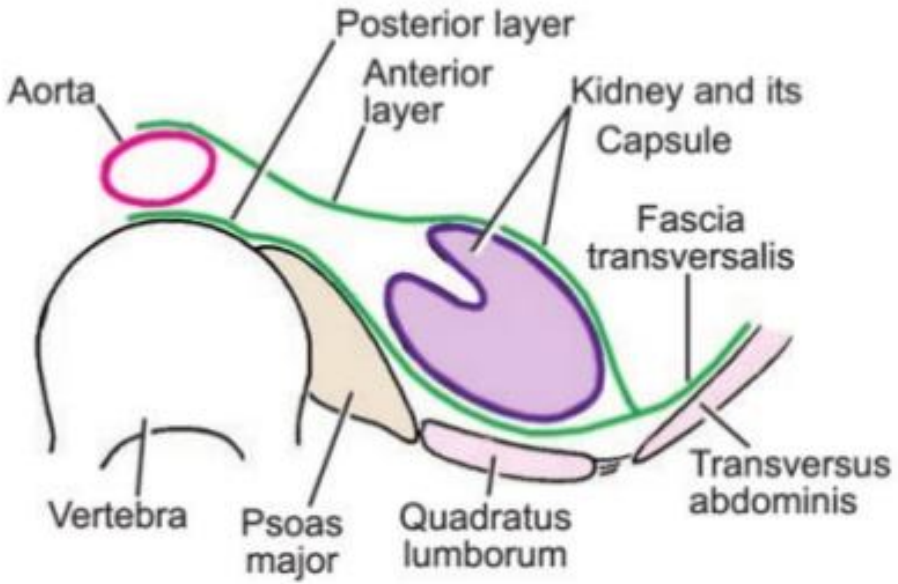
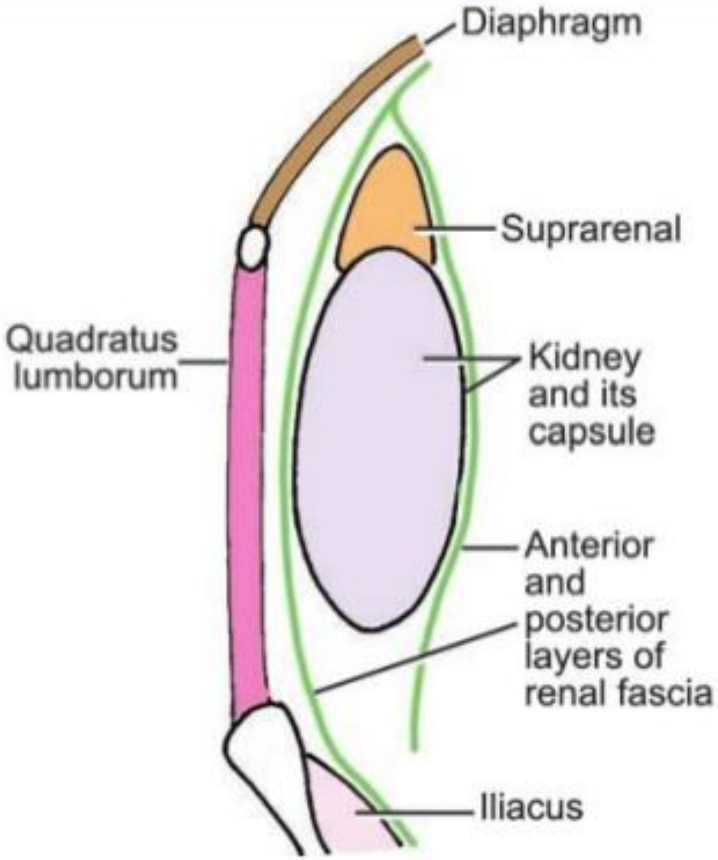


Fig. 4.140 Organization of fat and fascia surrounding the kidney.



30.11: Transverse section through kidney showing the arrangement of the renal fascia



30.12: Sagittal section through kidney to show arrangement of renal fascia

Kidney

Renal pelvis

Covering of kidney

Ureter

Urinary bladder

Urethra

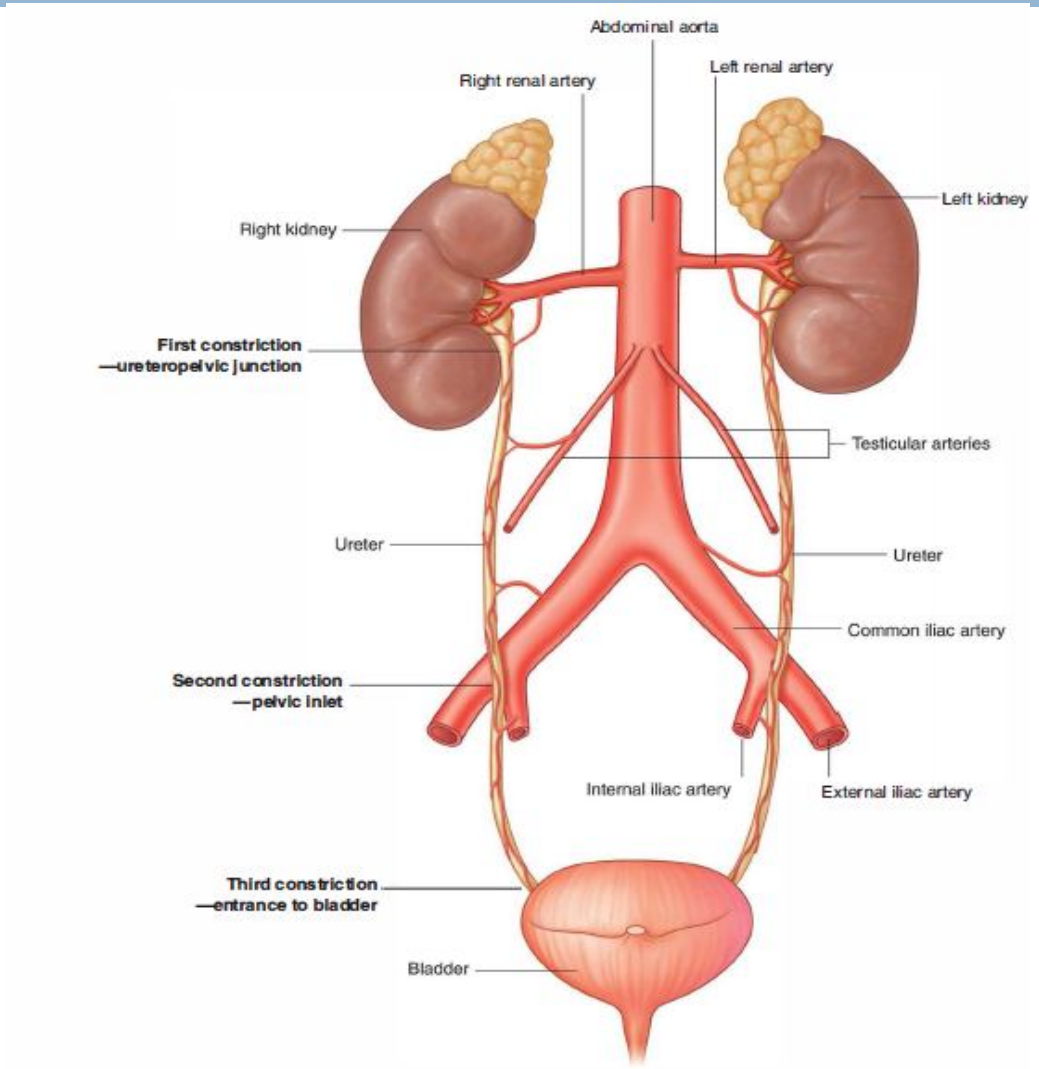


Fig. 4.143 Ureters.

Ureter relationship

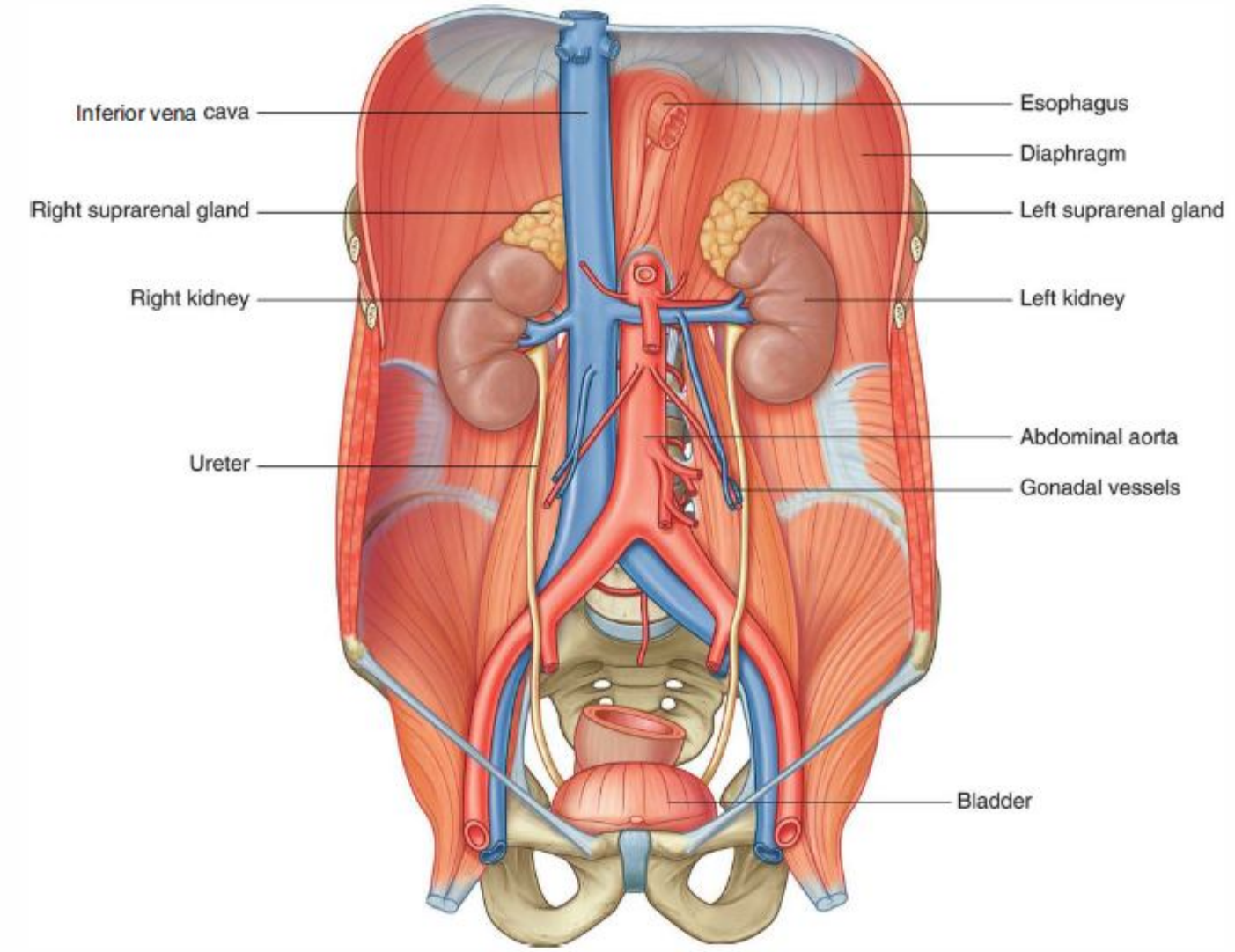
Post. :

psoas major / common iliac artery

Ant. :

Men = ductus deferens

Women = uterine artery



Ureter relationship

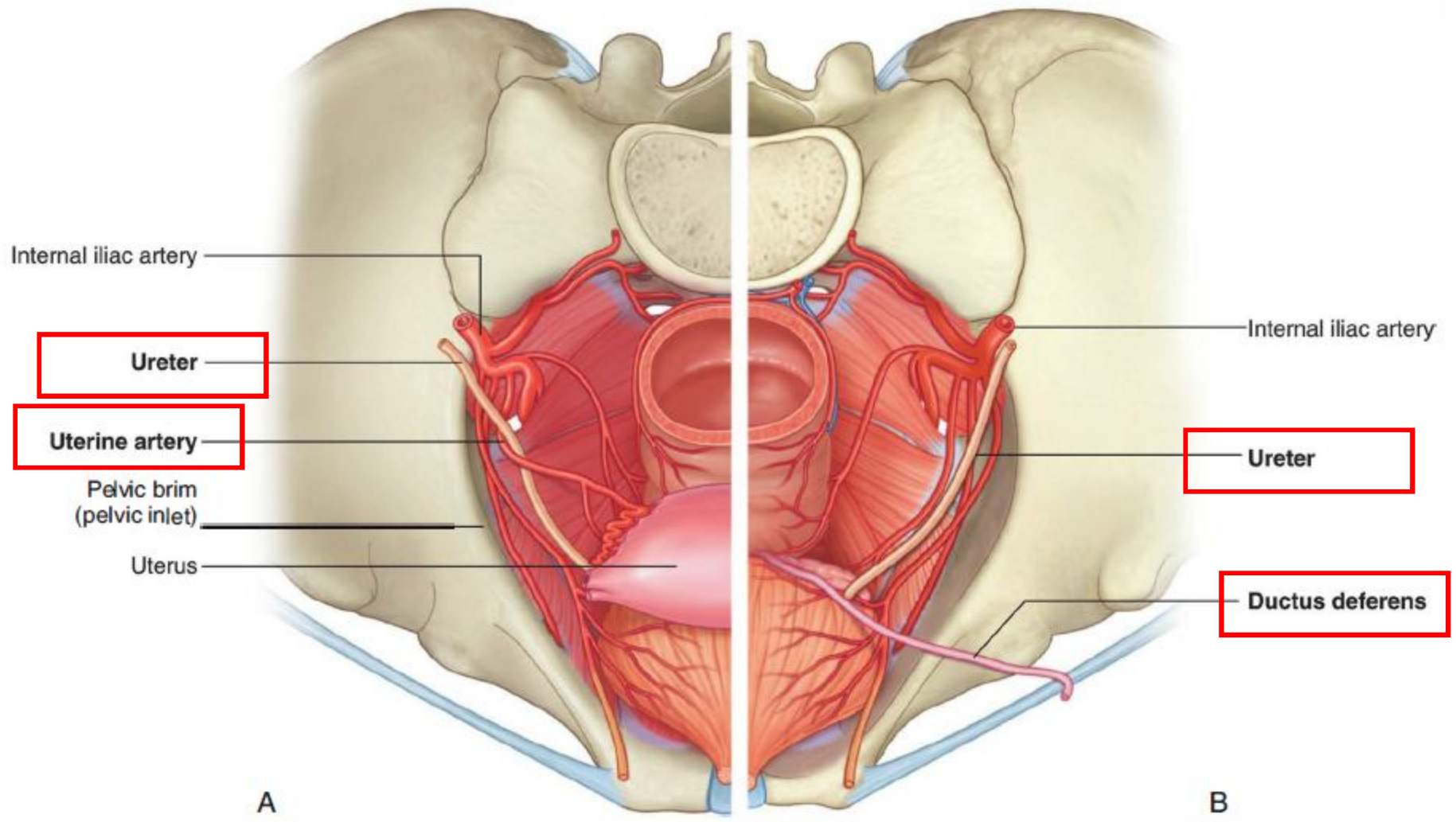
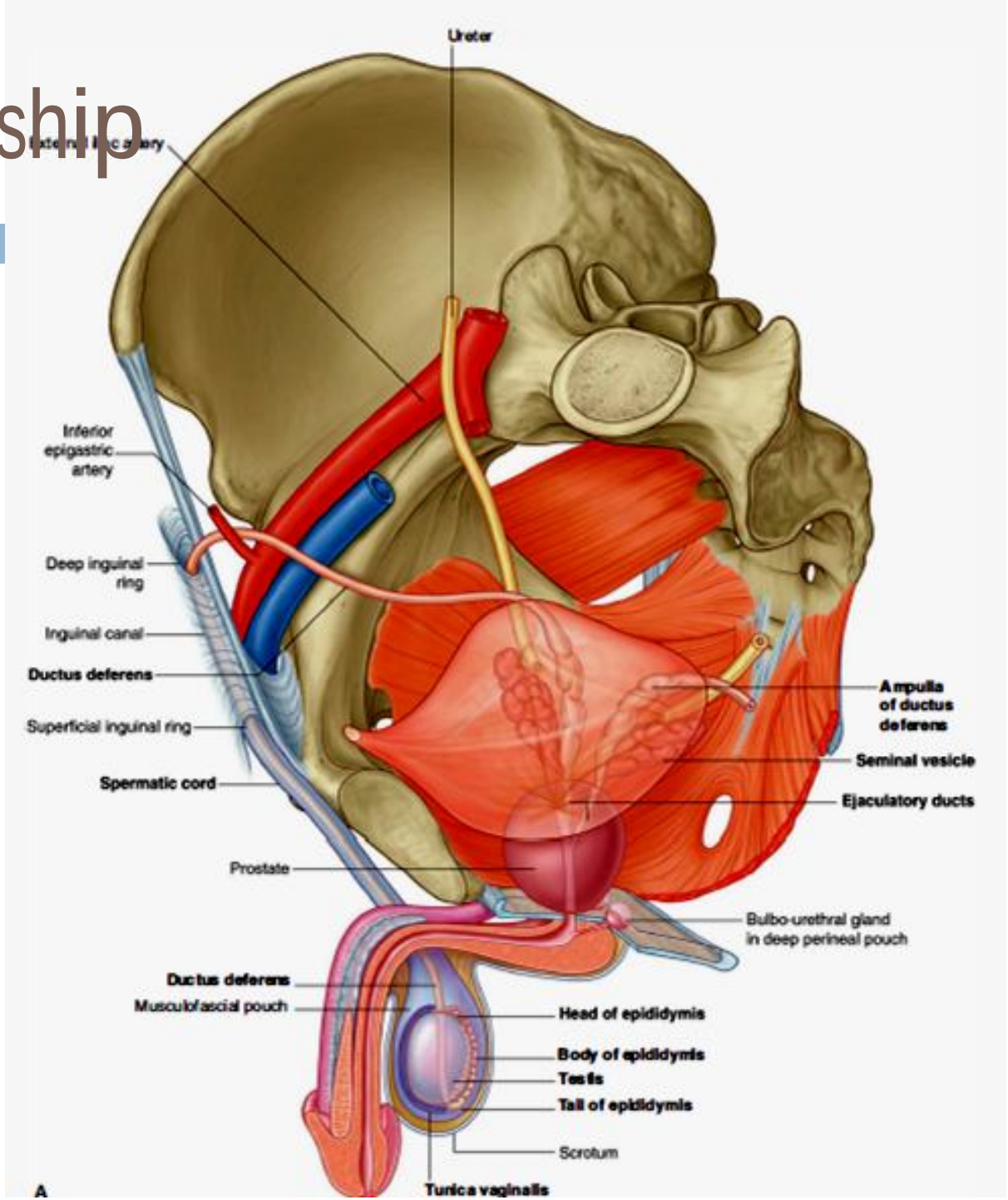


Fig. 5.12 Structures that cross the ureters in the pelvic cavity. **A.** In women. **B.** In men.

Ureter relationship



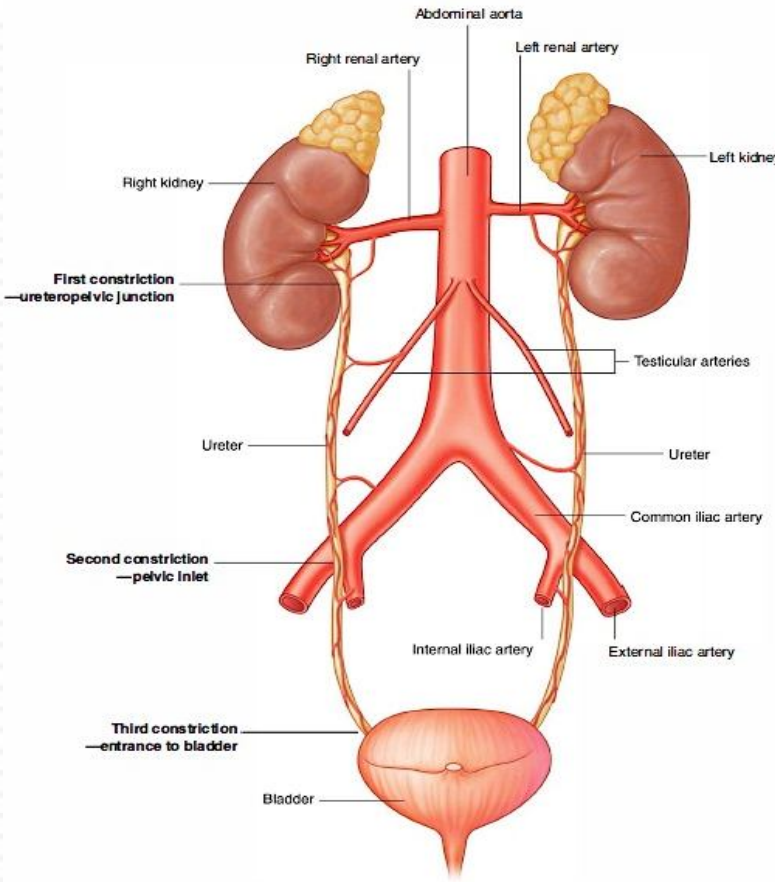
Ureters constriction

At three points along their course the ureters are con-stricted:

The first point is a t the ureteropelvic junction.

The second point is where the ureters cross the common iliac vessels at the pelvic brim.

The third point is where the ureters enter the wall of the bladder.



Ureter vasculature

Sup. Part :

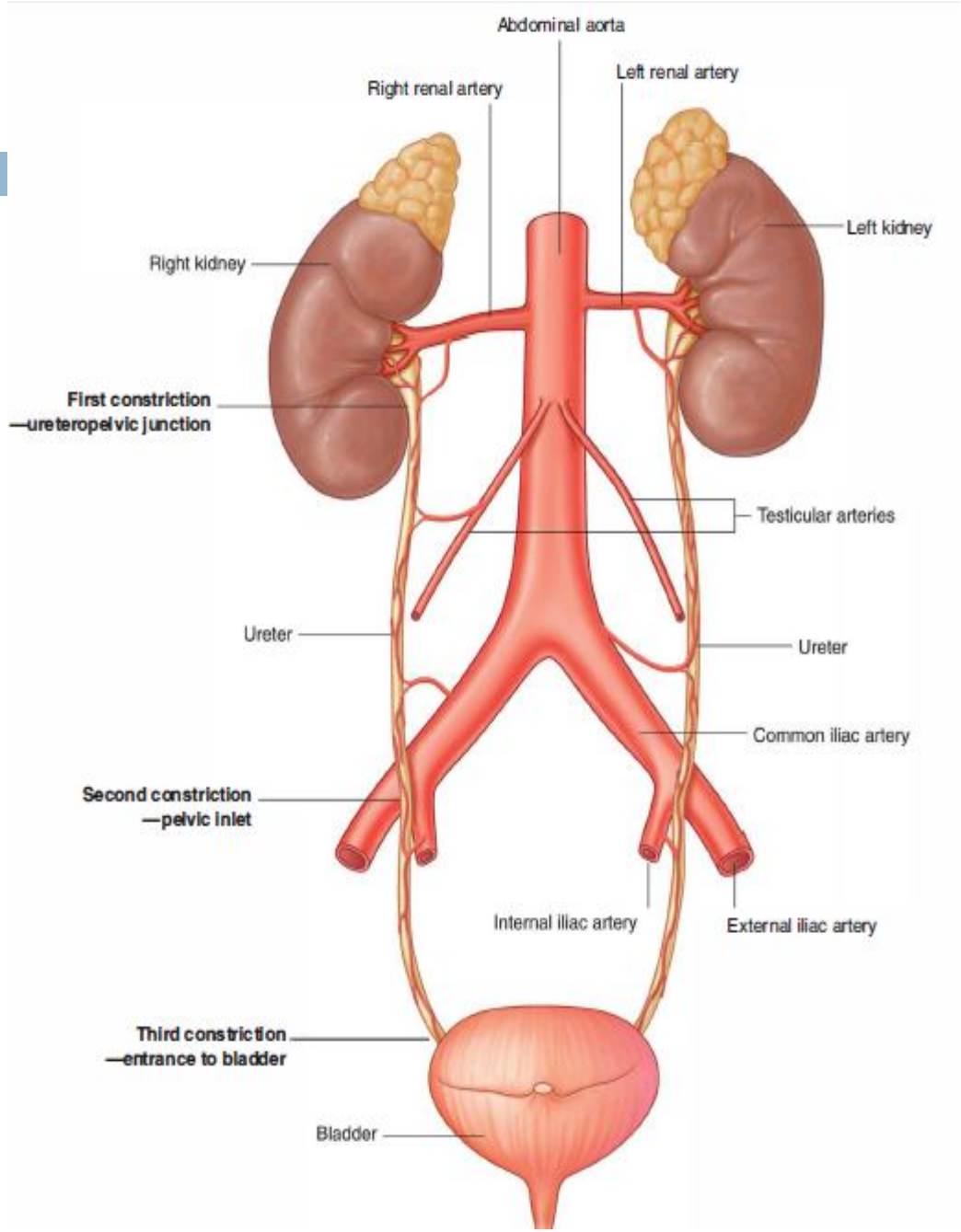
Renal artery

Middle part:

Abdominal aorta / gonadal artery / common iliac artery

Inf. Part:

Internal iliac artery



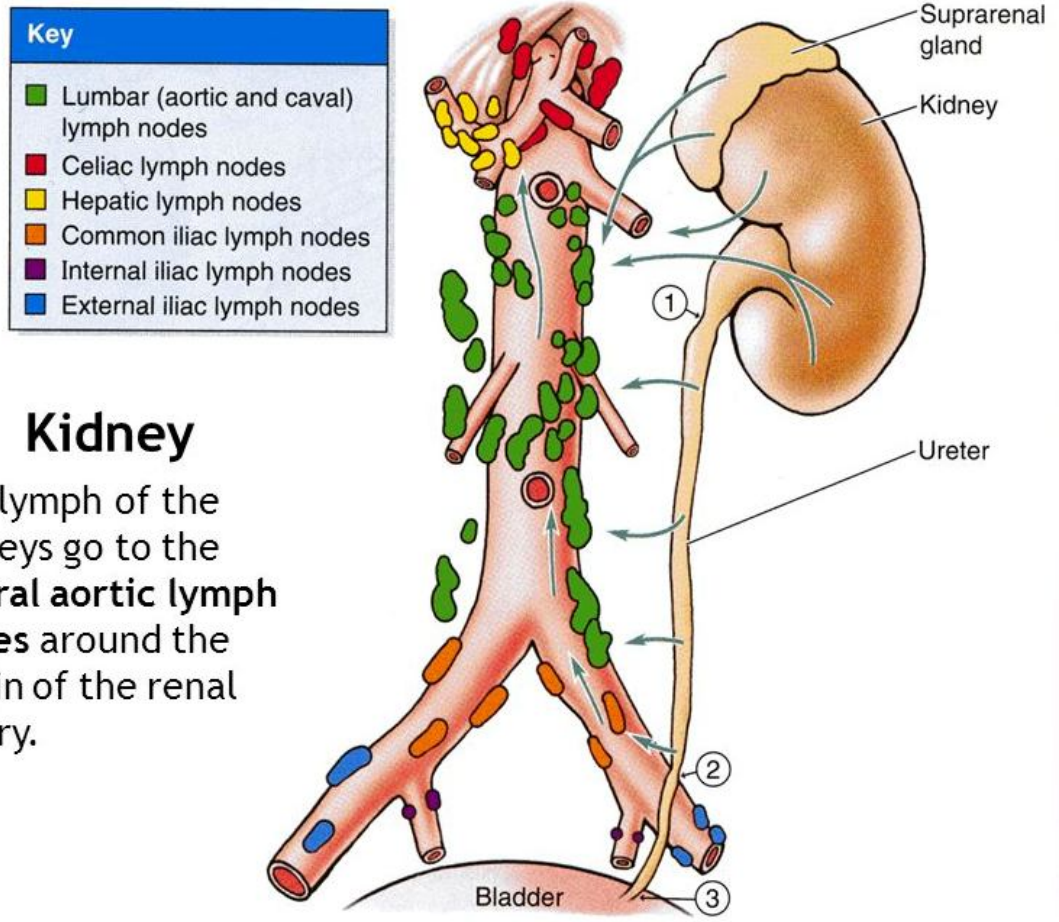
Lymphatic drainage of the ureters

Lymph from:

• the upper part:
the lateral aortic (lumbar) nodes

• the middle part:
the common iliac vessels

• the inferior part:
the external and internal iliac vessels.



Ureteric innervation

from :

renal
aortic
superior hypogastric
inferior hypogastric plexuses

through nerves that follow the blood vessels

visceral afferent fibers return to T11 to L2 spinal cord levels

Ureteric pain

referred to cutaneous areas supplied by **T l l to L2**

Include:

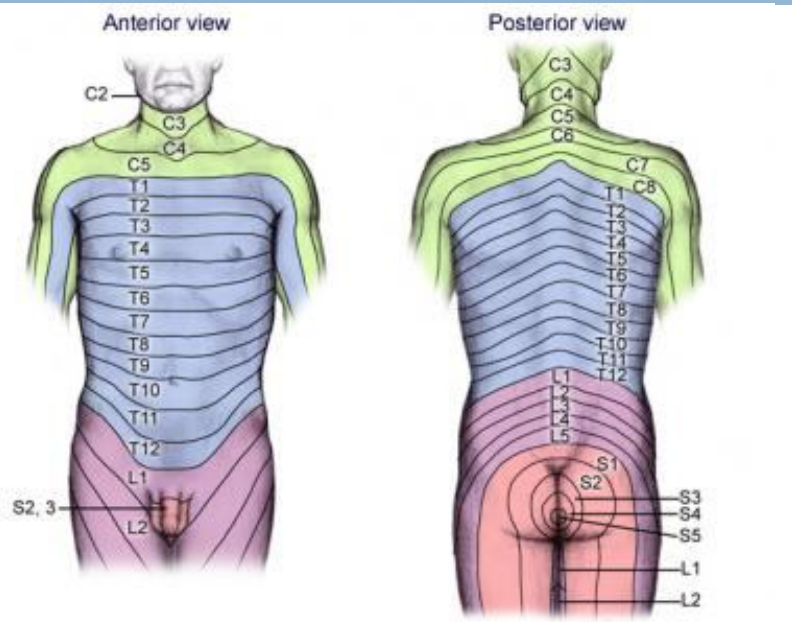
1. Posterior and lateral abdominal wall below the ribs

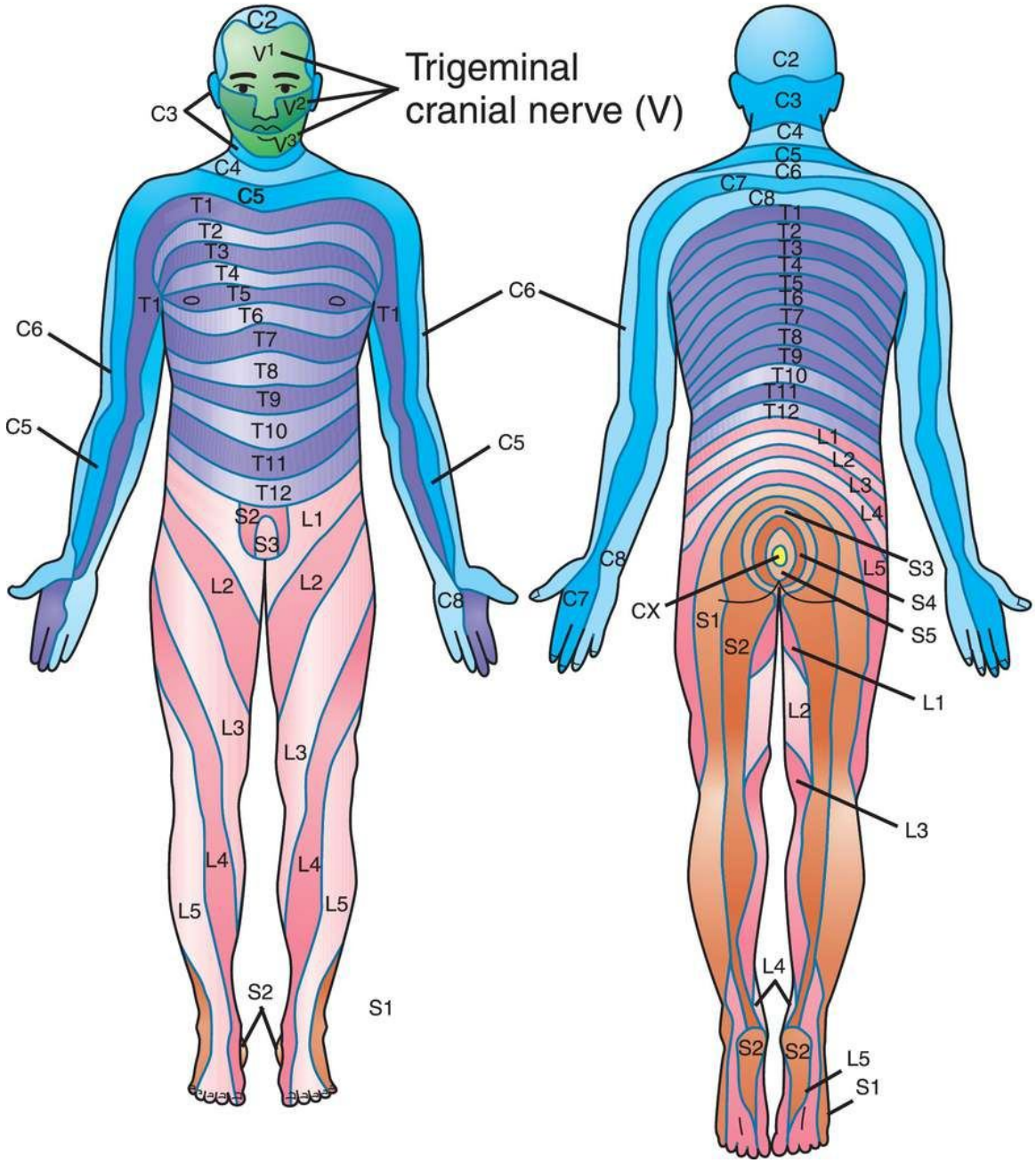
2. above the iliac crest

3. the pubic region

4. the scrotum in males, the labia majora in females

5. the proximal anterior aspect of the thigh.



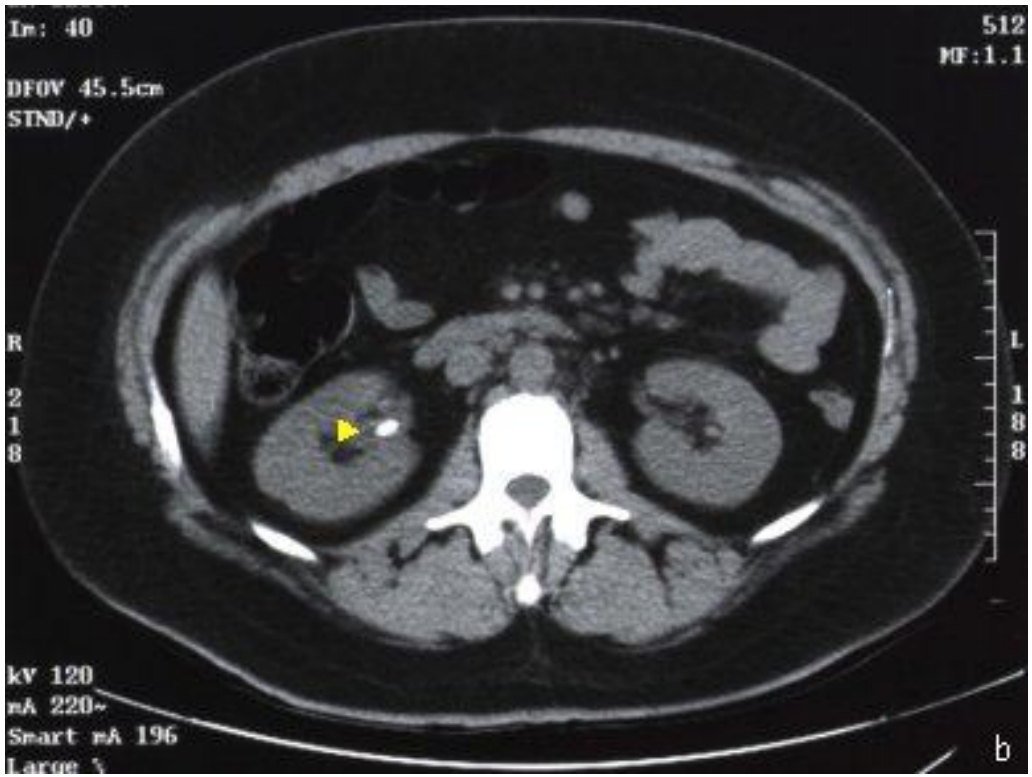

Trigeminal cranial nerve (V)
C2
V1
V2
V3
C3
C4
C5
T1
T2
T3
T4
T5
T6
T7
T8
T9
T10
T11
T12
L1
L2
L3
L4
L5
S1
S2
S3
C6
C5
C8
C7
CX
S4
S5

Urinary tract stones

↑ men than in women

aged between 20 and 60 years
usually associated with sedentary lifestyles
polycrystalline aggregates of calcium, phosphate, oxalate, urate
The urine becomes saturated with these salts
small variations in the pH cause the salts to precipitate.

Pain that radiates from the infrascapular region (loin) into the groin, and even into the scrotum or labia majora
Blood in the urine ***(hematuria)***
Infection



Urinary tract stones

The diagnosis of urinary tract stones is based upon :

History
Examination
abdominal radiographs.

Special investigations include:
ultrasound scanning, which may demonstrate the dilated renal pelvis and calices when the urinary system is obstructed
intravenous urogram, which will demonstrate the obstruction, pinpoint the exact level, and enable the surgeon to plan a procedure to remove the stone if necessary.

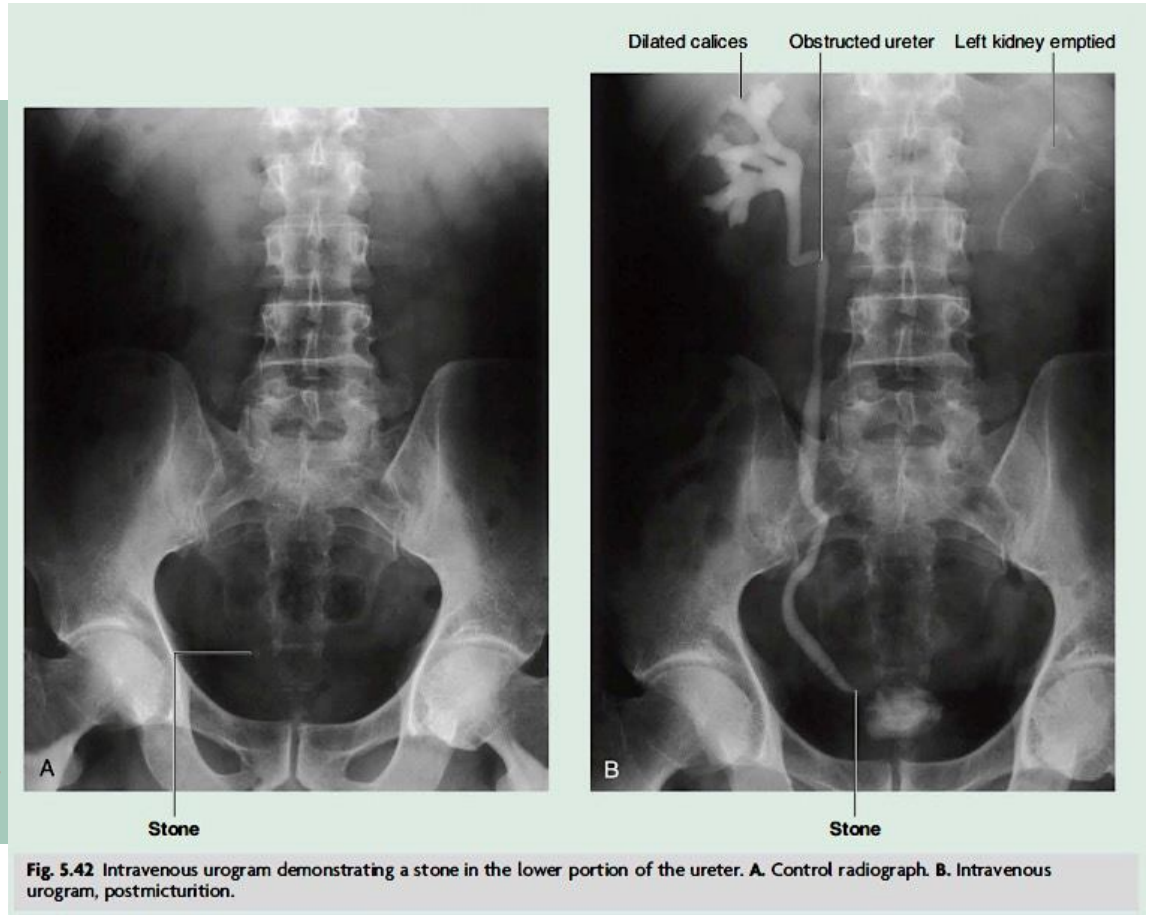


Fig. 5.42 Intravenous urogram demonstrating a stone in the lower portion of the ureter. **A.** Control radiograph. **B.** Intravenous urogram, postmicturition.

nephrostomy

tube is placed through the lateral or posterior abdominal wall into the renal cortex to lie within the renal pelvis

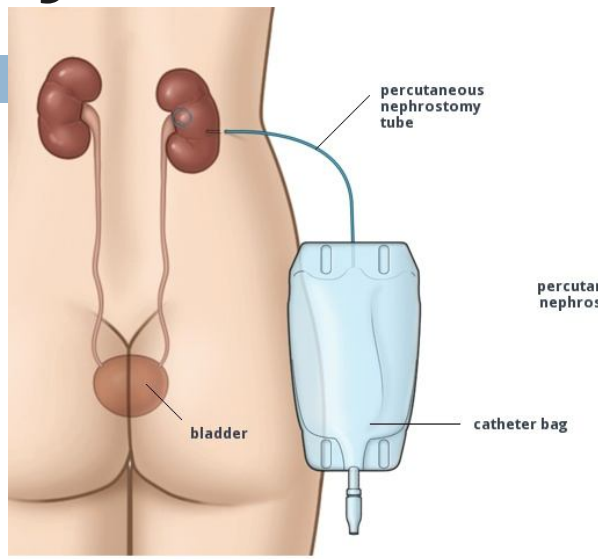
The kidneys are situated on the posterior abdominal wall

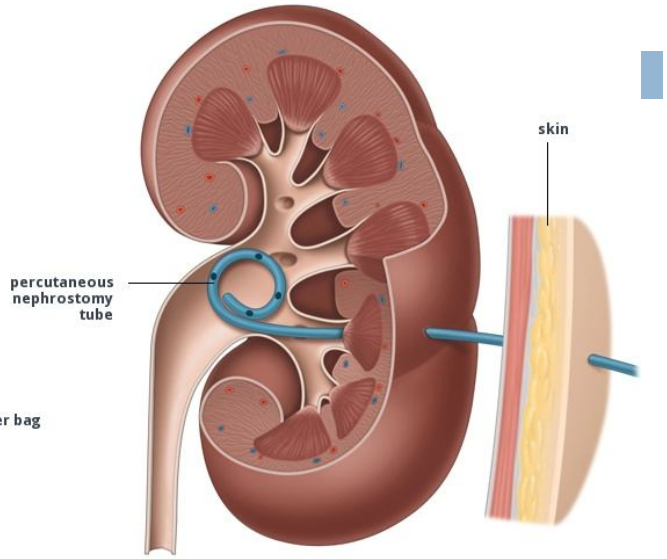
2 to 3 cm from the skin

allow drainage of urine from the renal pelvis through the tube externally

Using local anesthetic, a needle can be placed, under ultrasound direction, through the skin into the renal cortex and into the renal pelvis

Indications:
distal ureteric obstruction





Urinary tract cancer

These tumors develop from the proximal tubular epithelium

Approximately 5% of tumors within the kidney are transitional cell tumors, which arise from the urothelium of the renal pelvis

Symptoms:

(hematuria)
pain in the infrascapular region
Mass in the infrascapular region

Invading:

- the fat and fascia
- the renal vein
- the inferior vena cava (IVC)

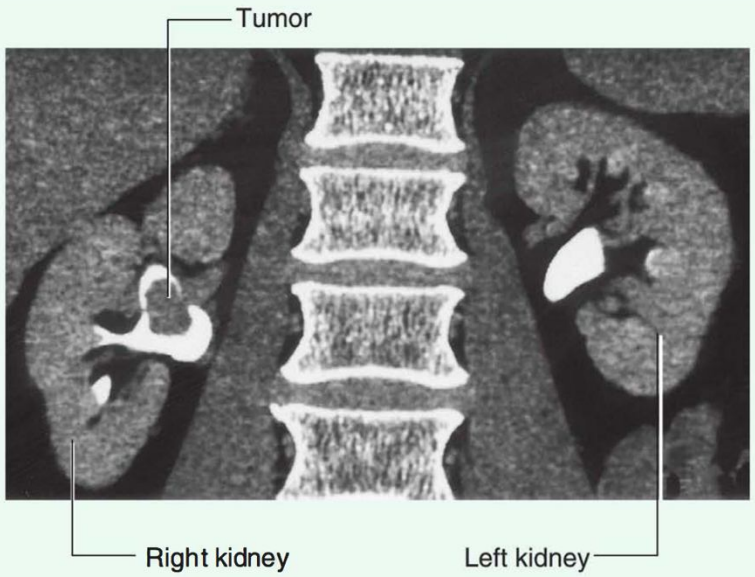


Fig. 4.146 Transitional cell carcinoma in the pelvis of the right kidney. Coronal computed tomogram reconstruction.

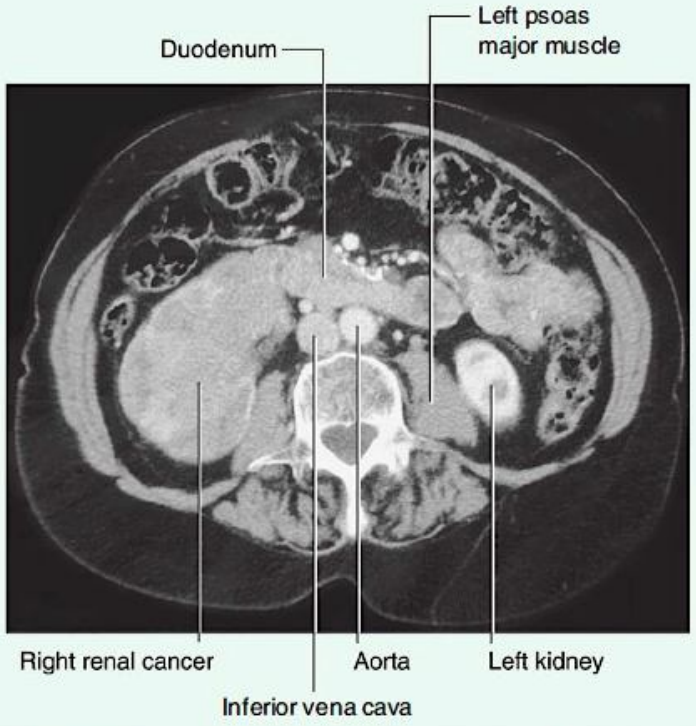


Fig. 4.144 Tumor in the right kidney growing toward, and possibly invading, the duodenum. Computed tomogram in the axial plane.

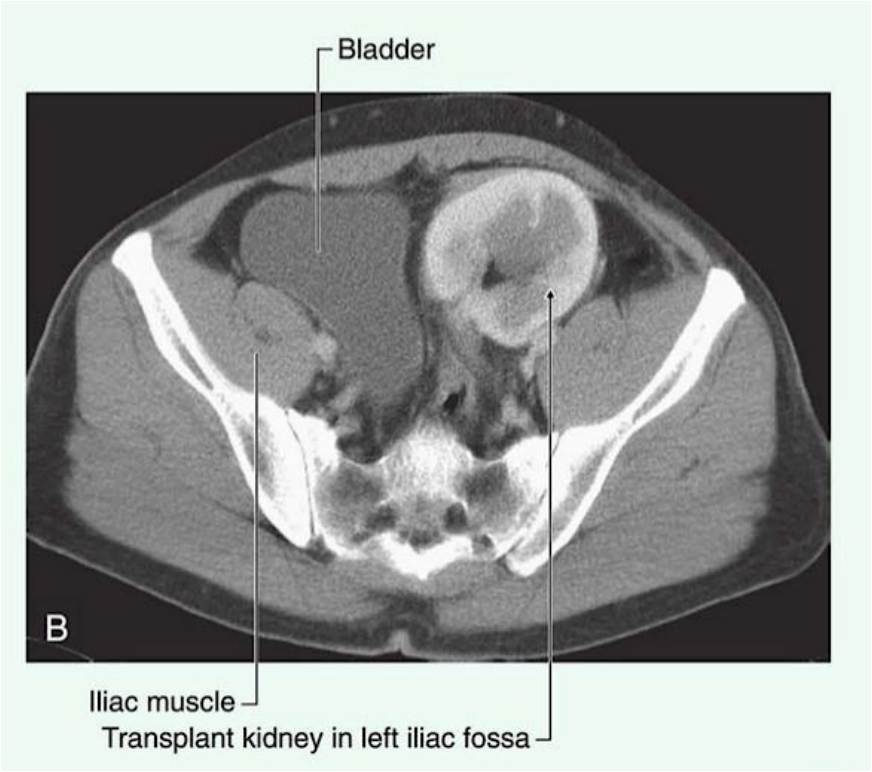
Kidney transplant

The donor kidney is harvested with a small cuff of aortic, venous tissue and ureter

An ideal place to situate the transplant kidney is in the ***left or the right iliac fossa***

A ***curvilinear incision*** is made paralleling the ***iliac crest and pubic symphysis***

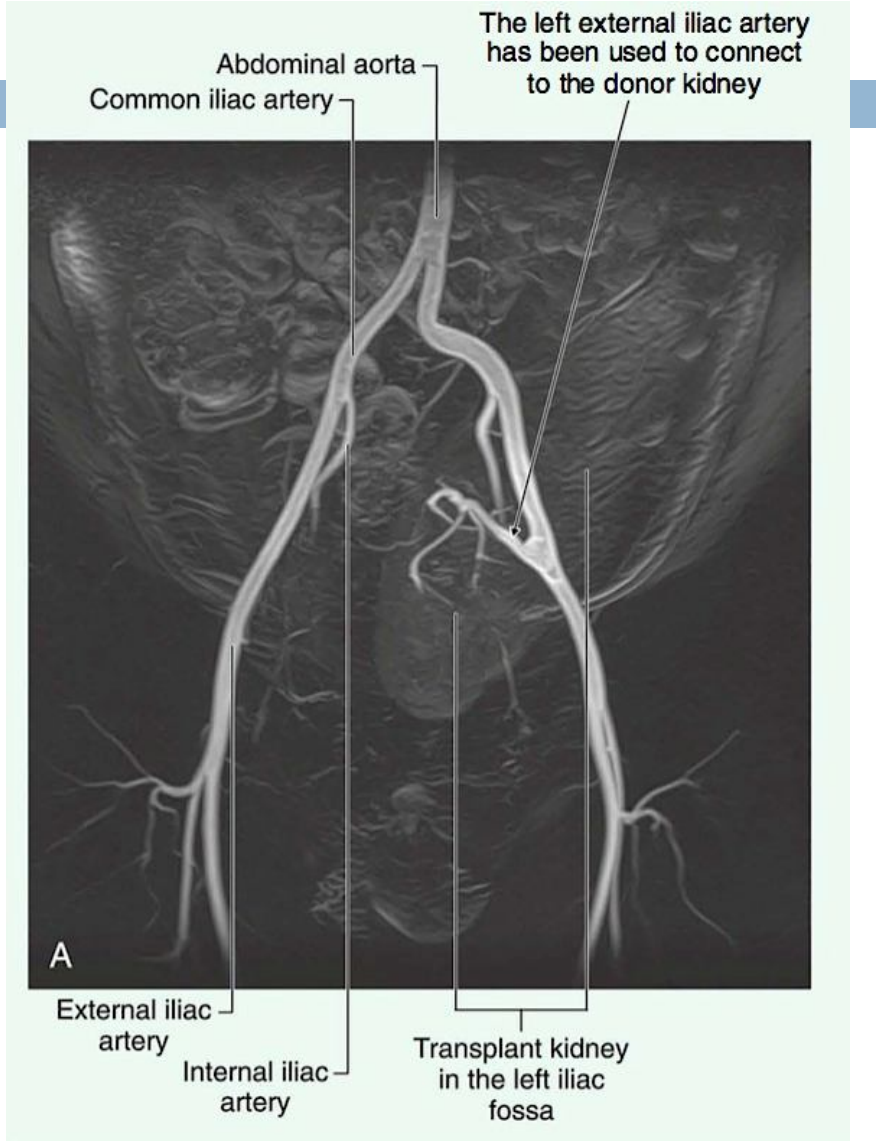
The external oblique muscle, internal oblique muscle, transversus abdominis muscle, and transversalis fascia are divided



Kidney transplant

internal iliac artery anastomosed directly as an end-to-end procedure onto the renal artery

In the ***presence of a small aortic cuff of tissue the donor artery*** is anastomosed to the recipient ***external iliac artery***



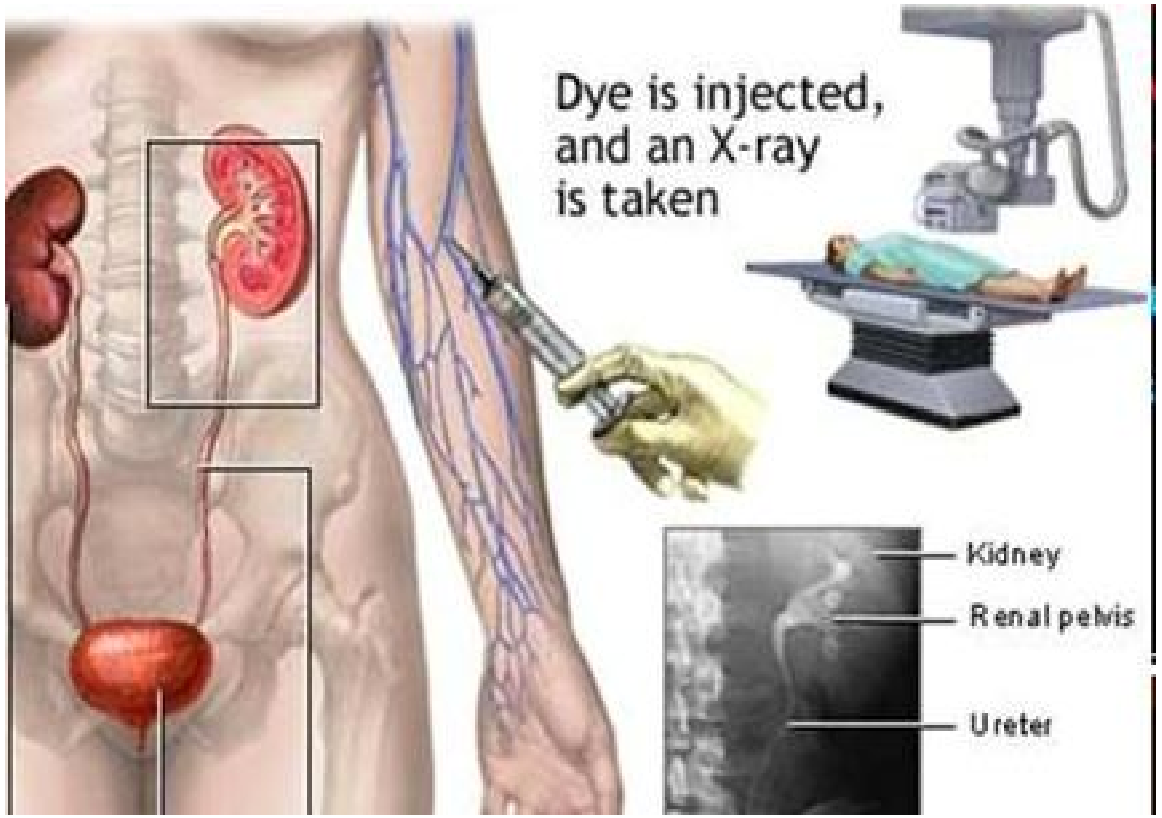
Investigation of the urinary tract

IVU (intravenous urogram)
Ultrasound
Computed tomography
Nuclear medicine

IVU (intravenous urogram)

The patient is injected with iodinated contrast medium

This allows visualization of the collecting system as well as the ureters and bladder

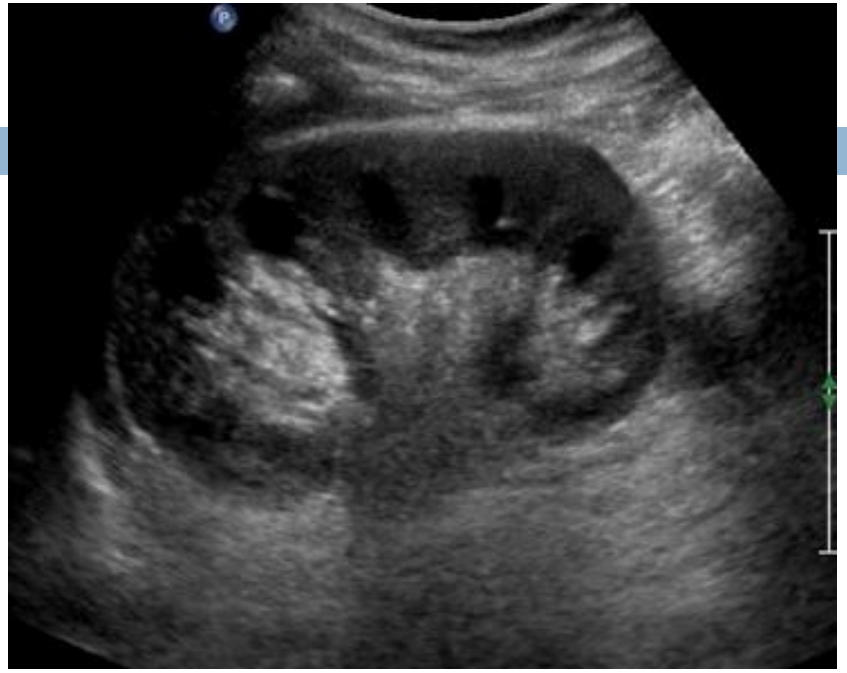


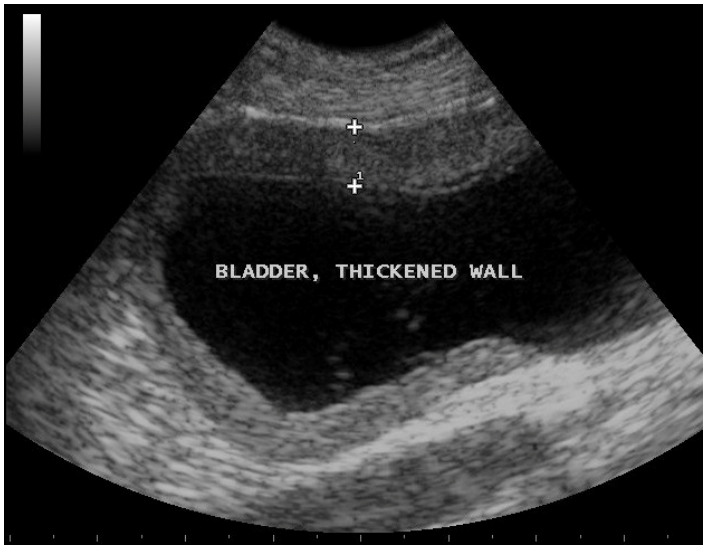
Ultrasound

used to assess kidney size and the size of the calices

ureters are poorly visualized

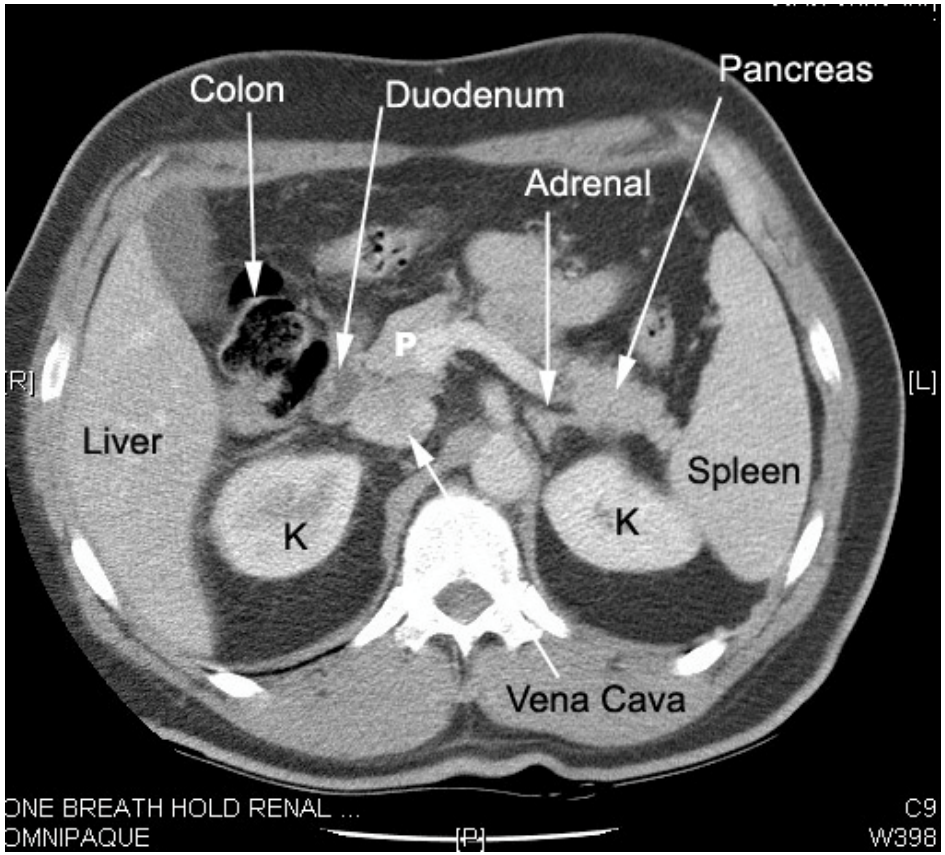
the bladder can be easily seen when full





Computed tomography

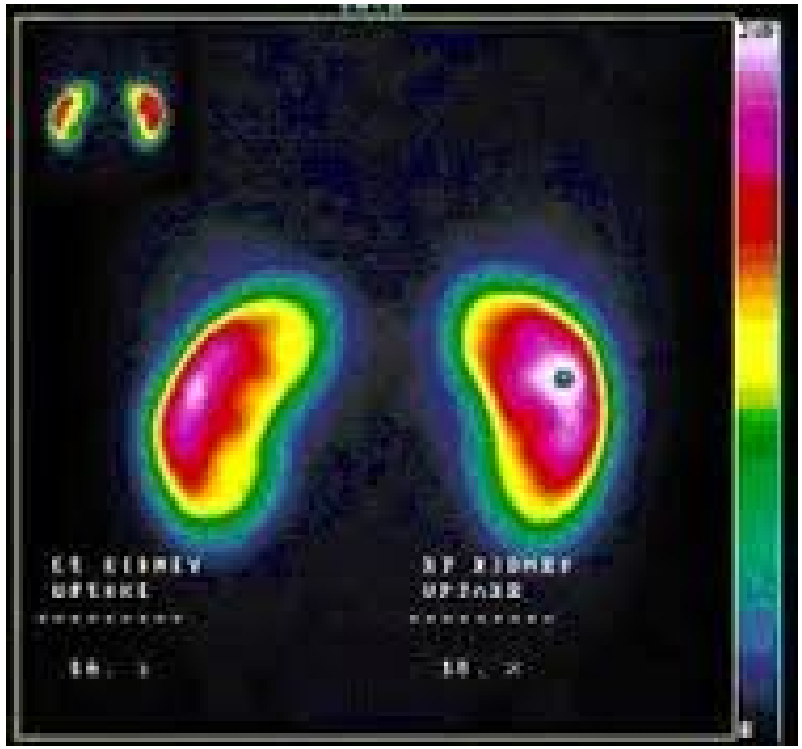
- assess the kidneys, ureters, bladder, and adjacent structures
- powerful tool **for staging of primary urinary tract tumors**



Nuclear medicine

to estimate ***renal cell*** mass and ***function*** and assess the parenchyma for ***renal scarring***

very useful in children when ***renal scarring*** and ***reflux disease*** is suspected



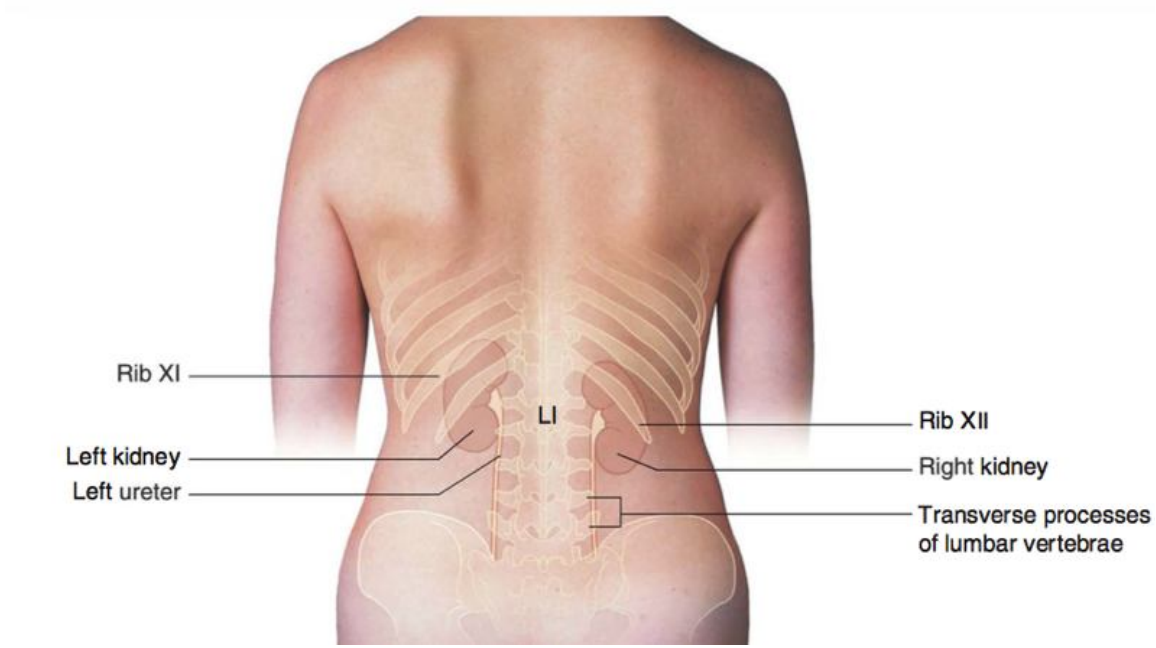
Where to find the kidneys

onto ***the back on either side of the midline***

The left kidney reaches as high as rib XI.
The right kidney reaches only as high as rib XII.

The lower poles : L3 and L4 vertebrae
The hilum : L1

The ureters descend vertically ***anterior to the tips of the transverse processes*** of the lower lumbar vertebrae and enter the pelvis



Kidney

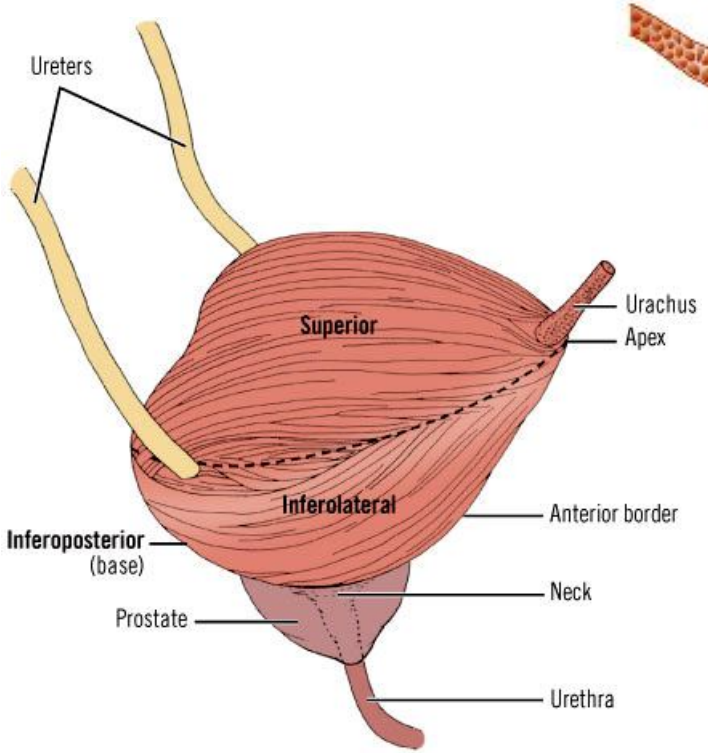
Renal pelvis

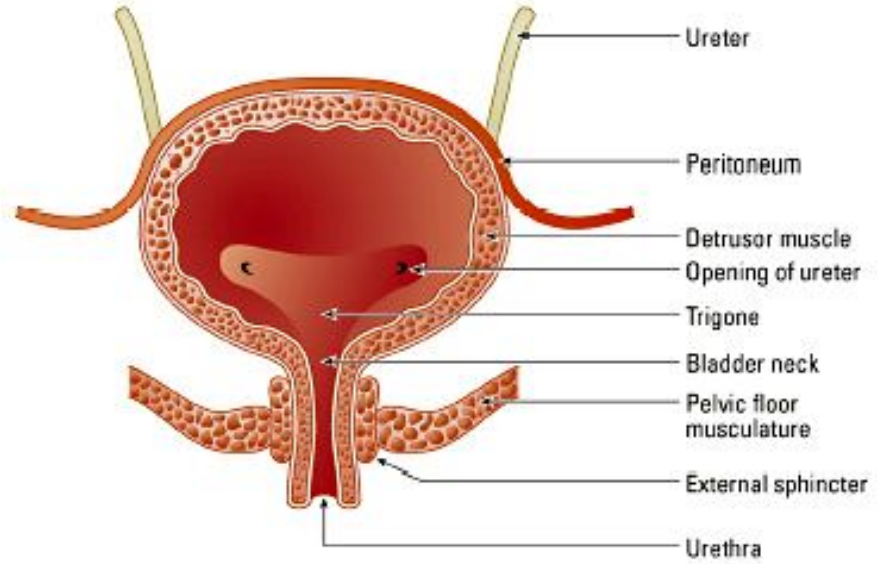
Covering of kidney

Ureter

Urinary bladder

Urethra

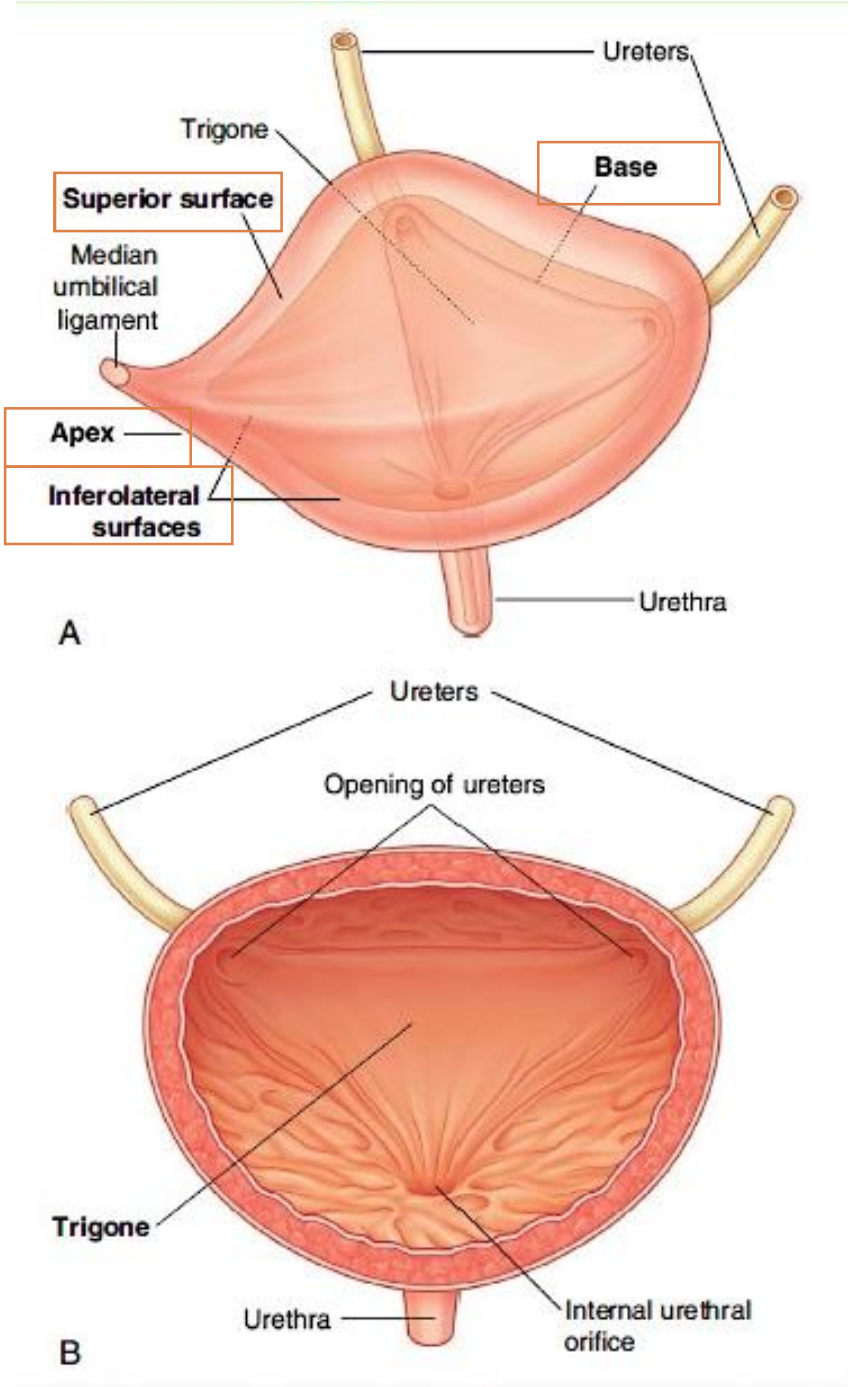




Apex: medial umbilical lig. (urachus)
Base: ureter / urethra / trigon
Inferolateral surface
Superior surface

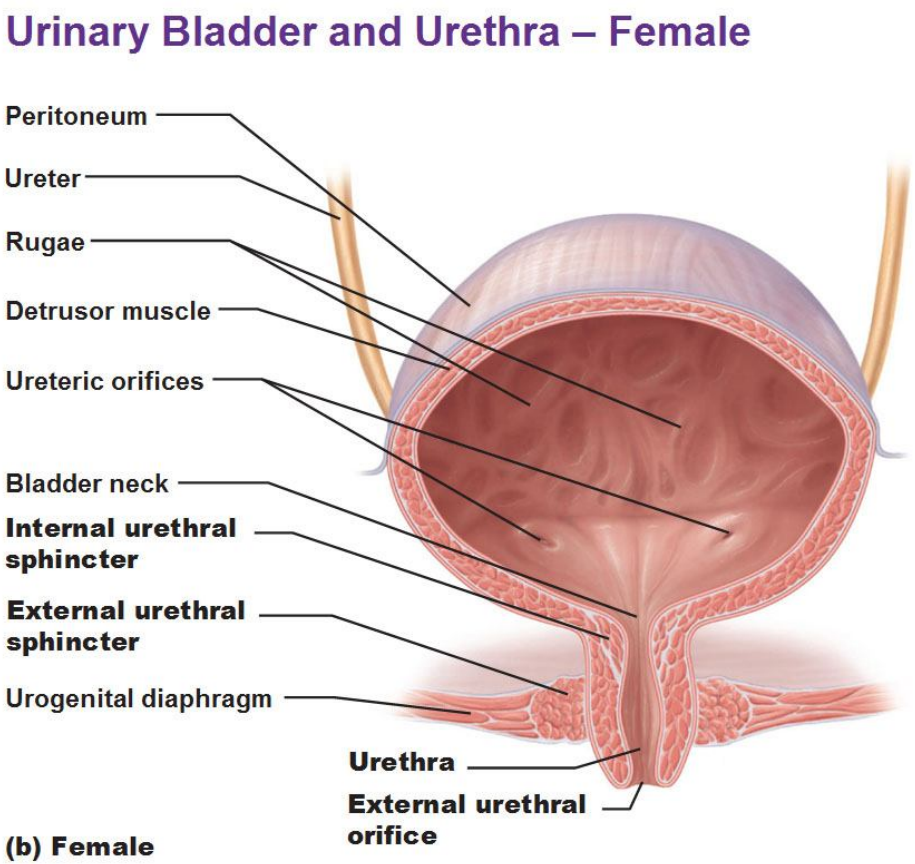
Apex: top of the pubic symphysis

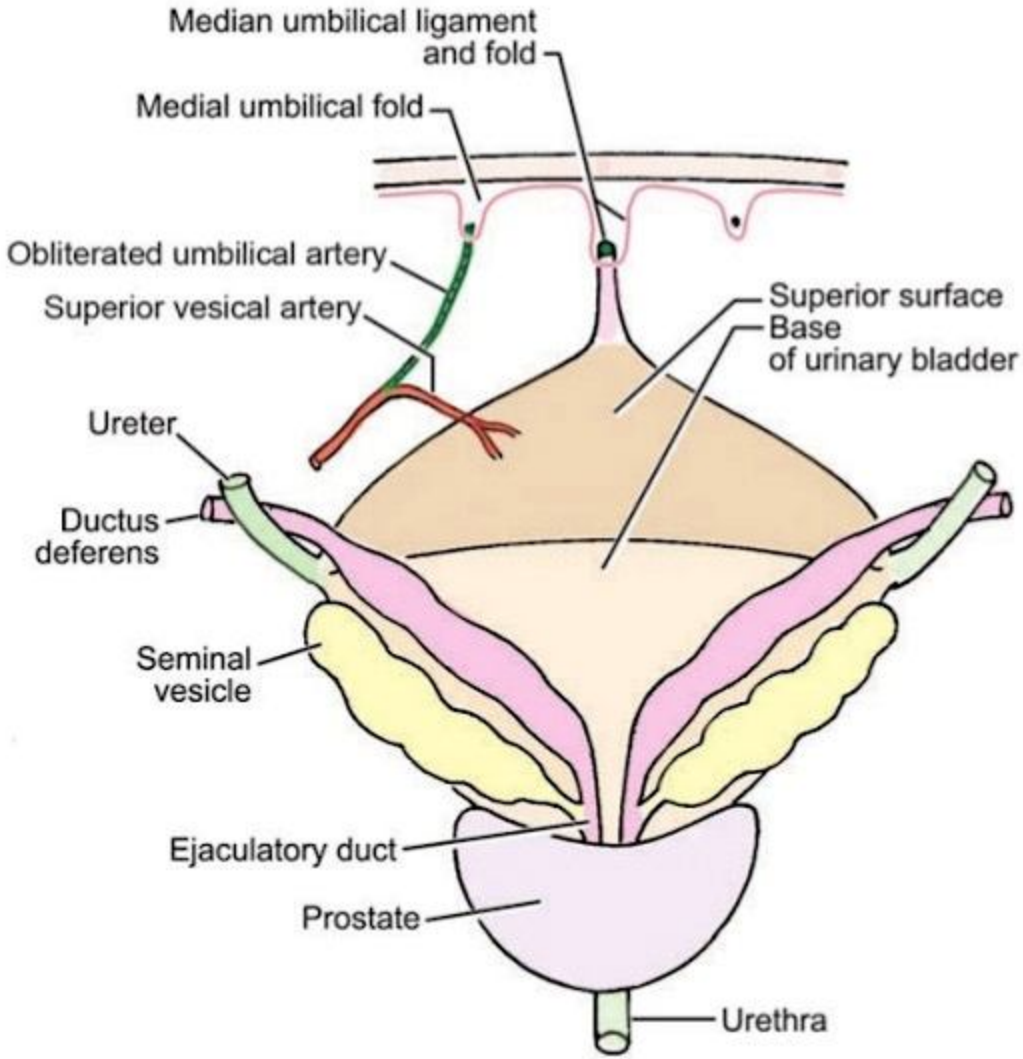
the ***urethra*** drains inferiorly from the lower corner of the base



the mucosal lining ***on the base*** of the bladder is ***smooth and firmly*** attached to the underlying smooth muscle

elsewhere in the bladder where the mucosa is ***folded and loosely*** attached to the smooth muscle





33.12: Male urinary bladder and some related structures seen from behind

Bladder is located
between the levator ani muscles
and
The obturator internus muscles

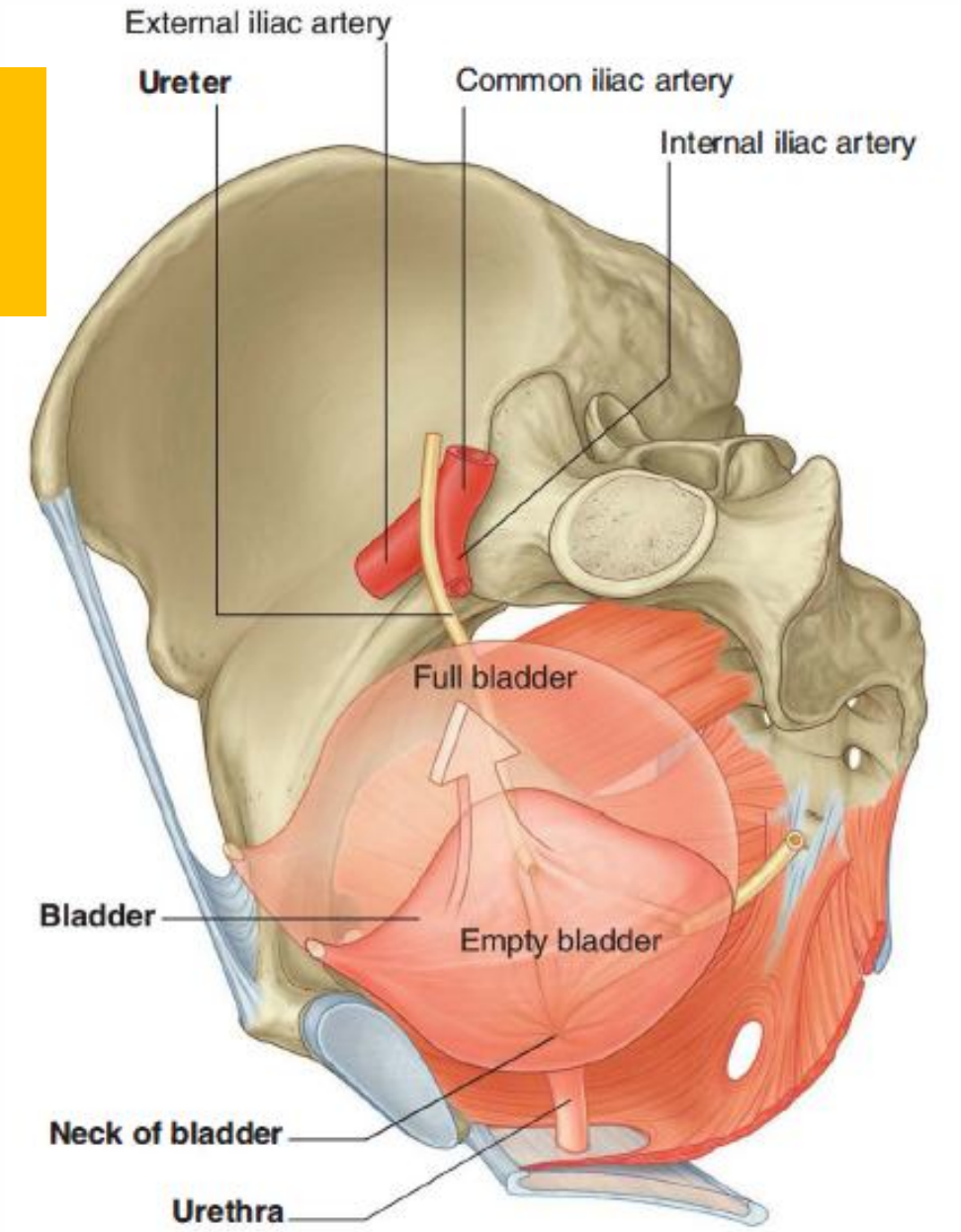


Fig. 5.39 Pelvic parts of the urinary system.

Stability Factor Of Bladder:

Pubovesical Ligament

Puboprostatic Ligament

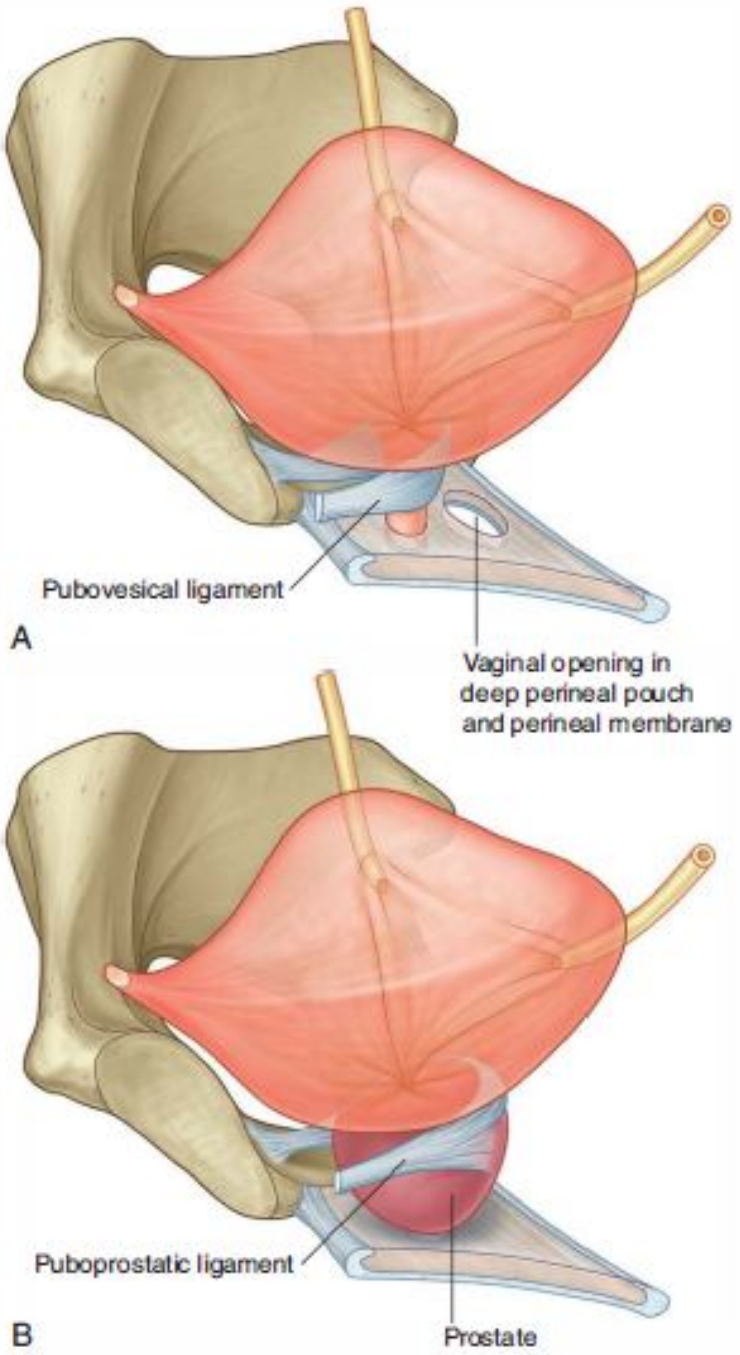


Fig. 5.41 Ligaments that anchor the neck of the bladder and pelvic part of the urethra to the pelvic bones. **A.** In women. **B.** In men.

Urinary Bladder Vasculature

Sup. Vesical artery: sup. Surface
Middle vesical artery: fondues
Inf. Vesical artery: trigone

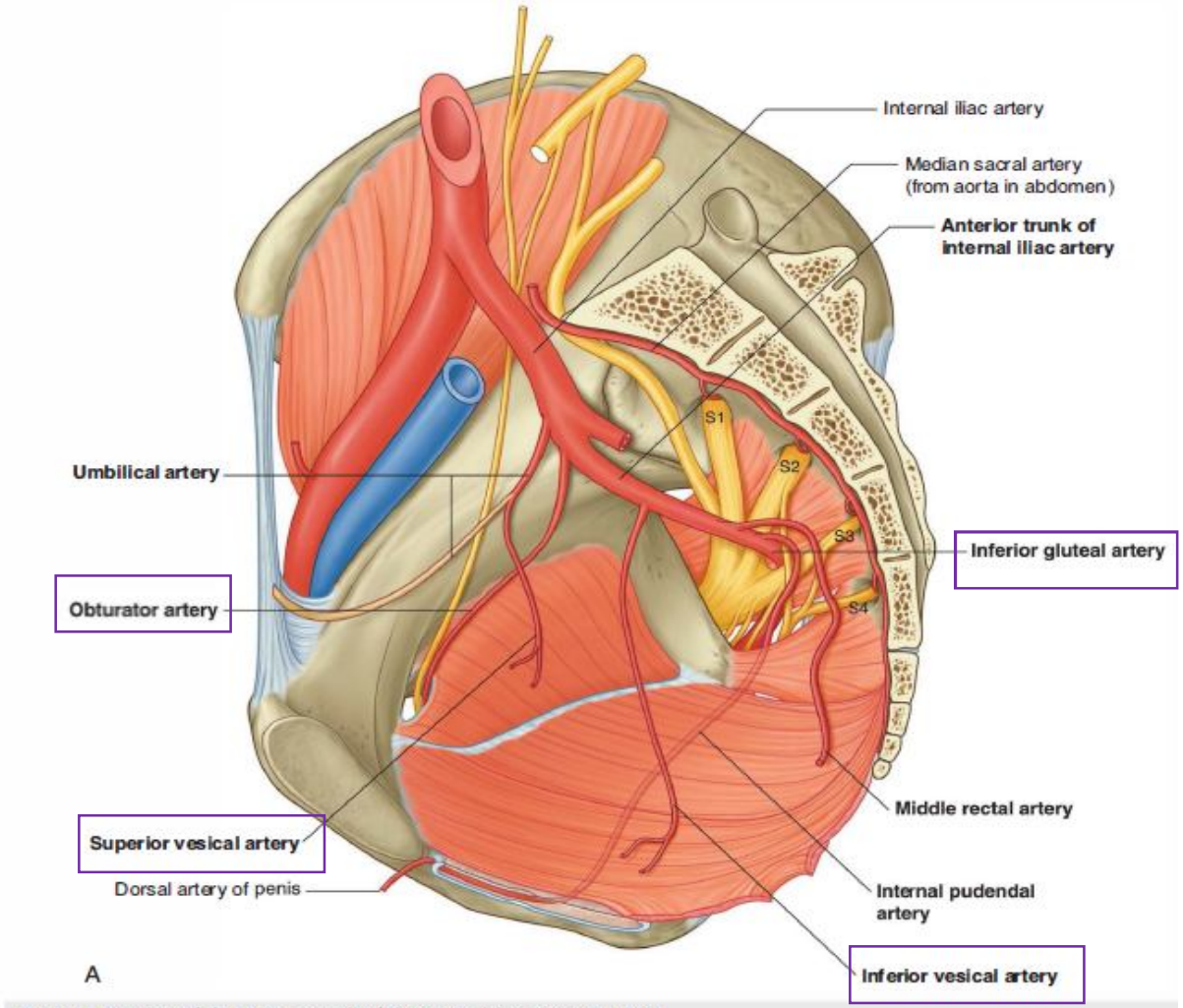


Fig. 5.64 Branches of the anterior trunk of the internal iliac artery. A. Male.

Urinary Bladder Vasculature

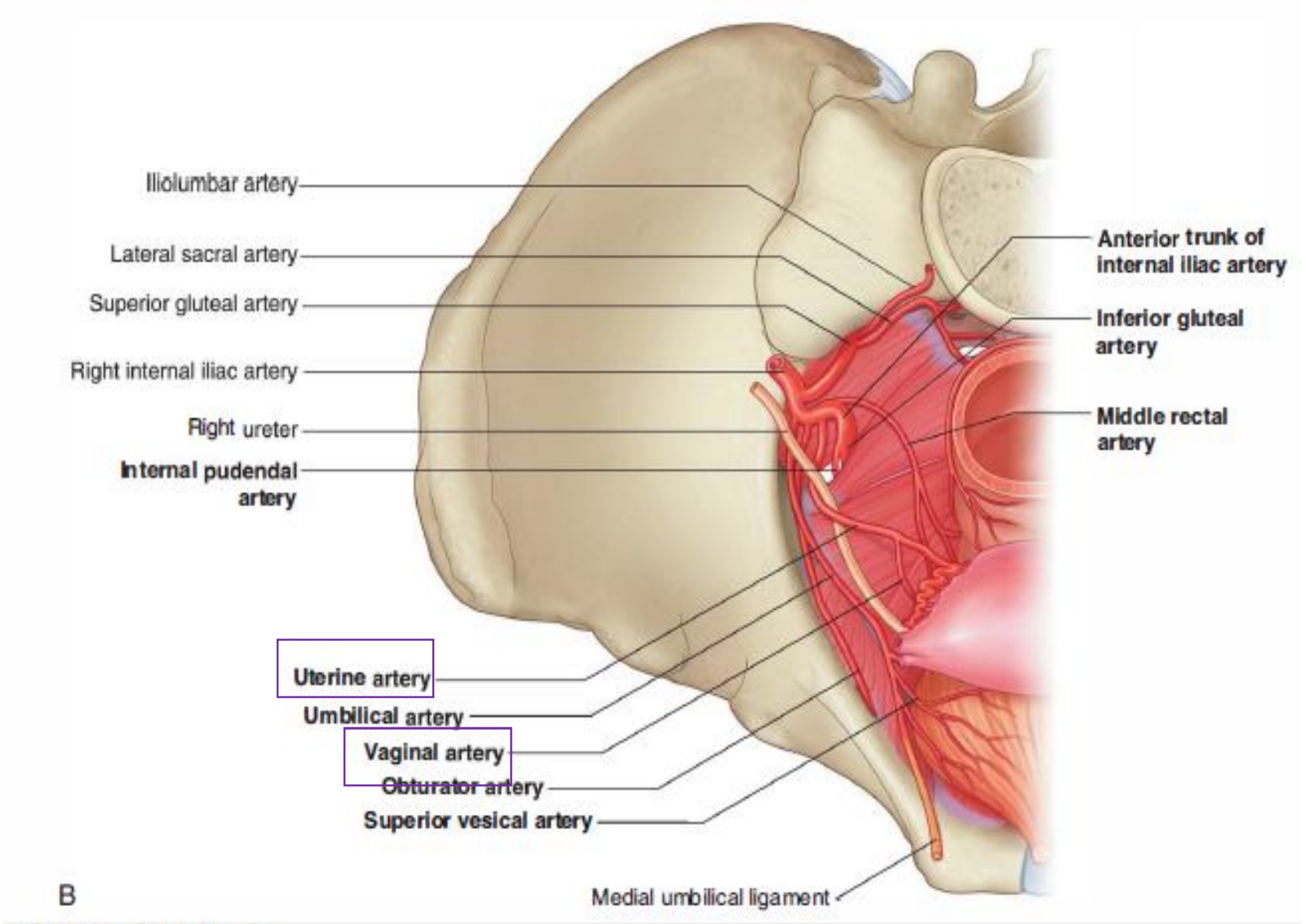


Fig. 5.64, cont'd B. Female.

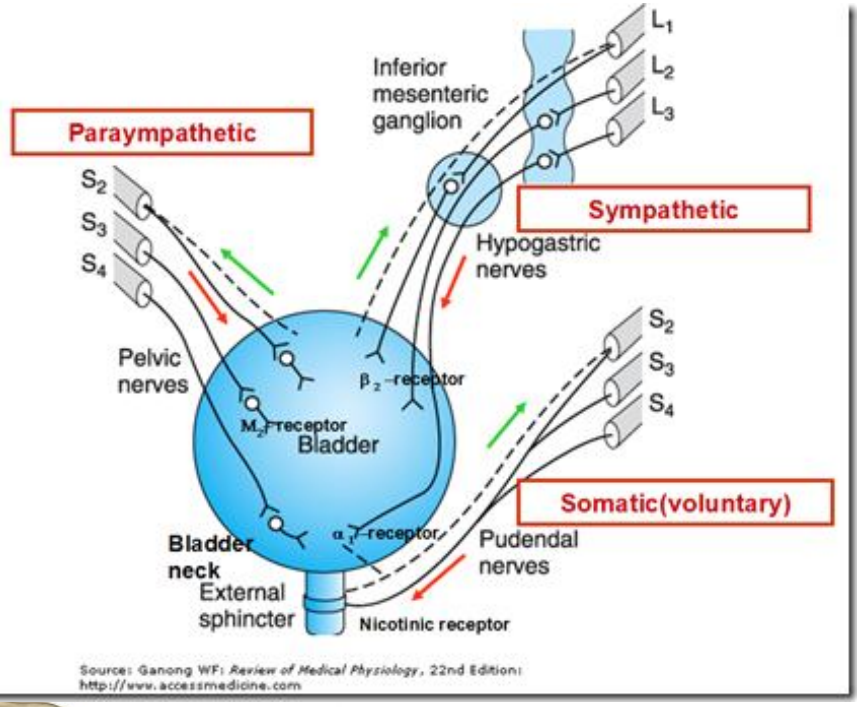
Bladder Nerves

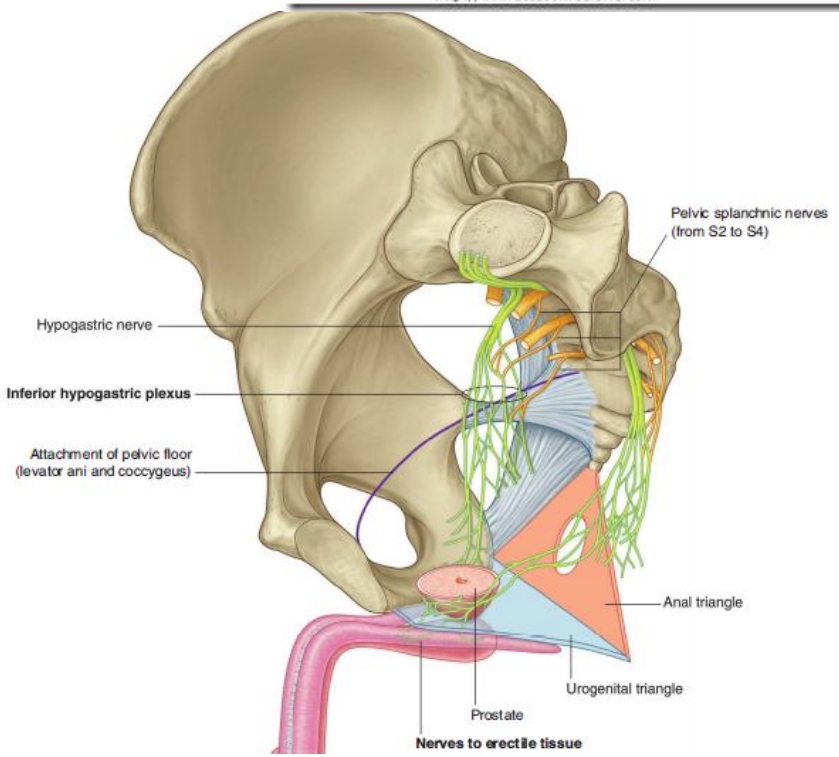
Sympatic Nerve:

Suppress of bladder contraction / contraction of sphincter

Parasympatic nerve:

bladder contraction / Suppress of sphincter contraction





Urinary System

- Kidney
- Renal pelvis
- Covering of kidney
- Ureter
- Urinary bladder
- ***Urethra***

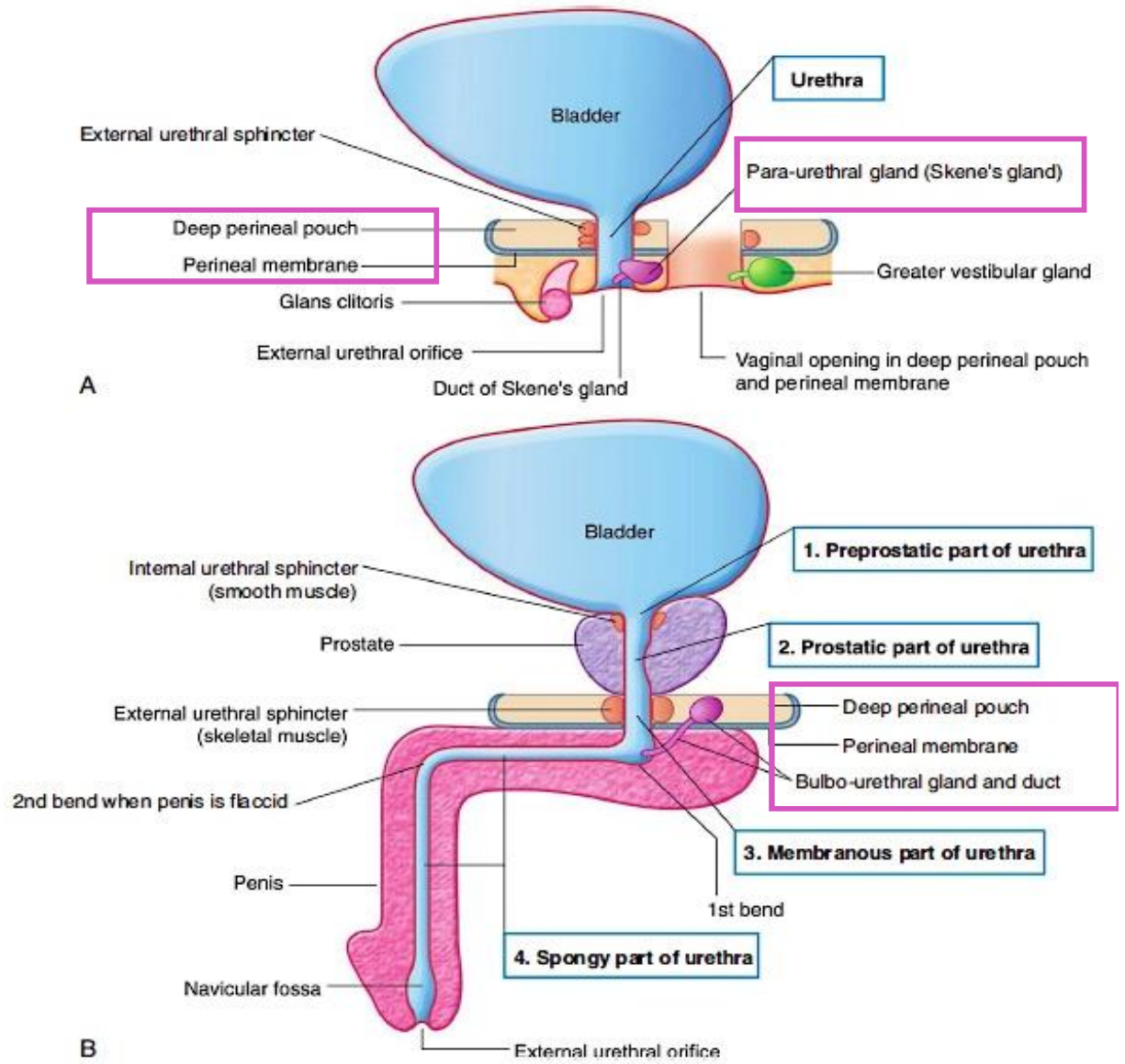


Fig. 5.44 Urethra. A. In women. B. In men.

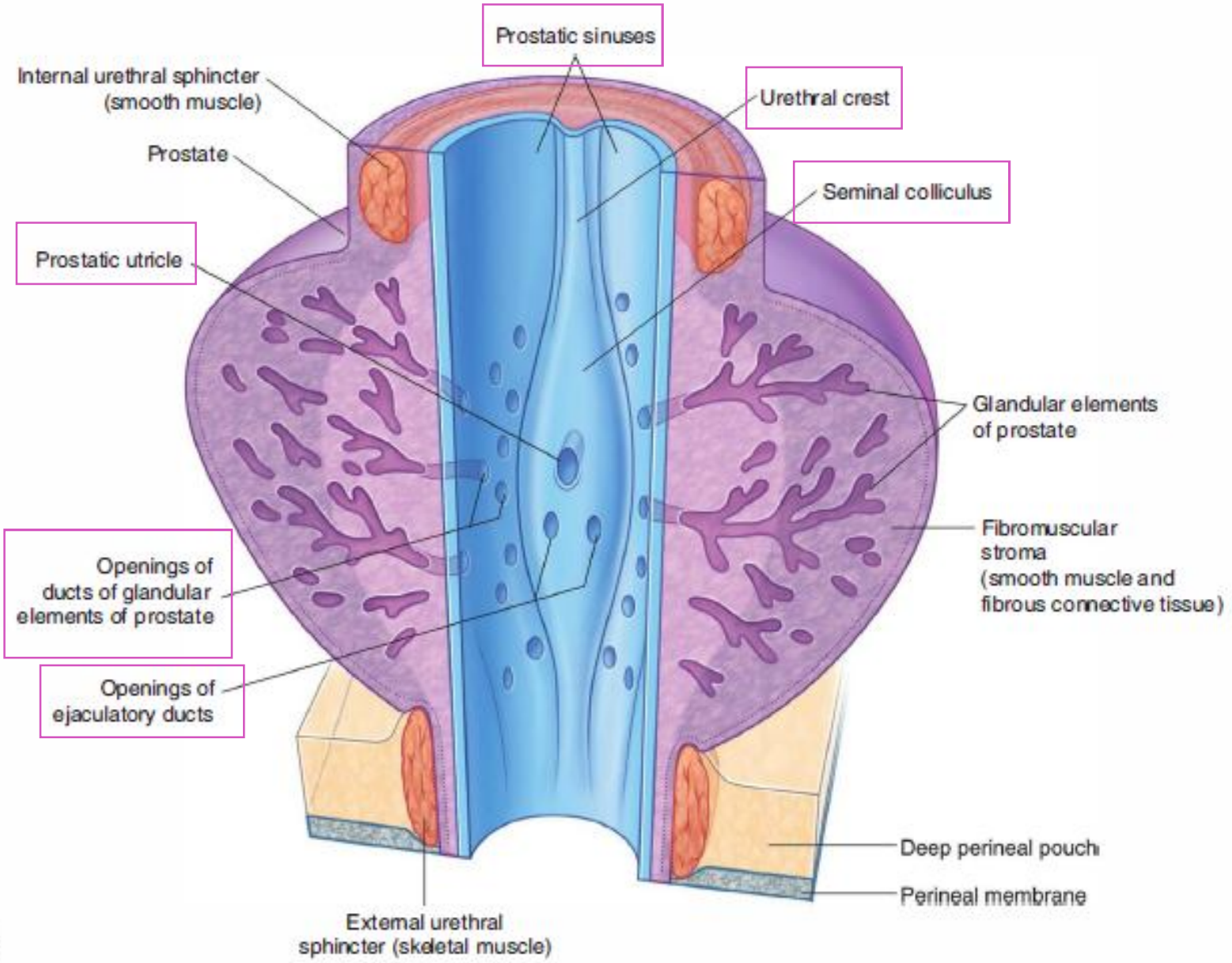
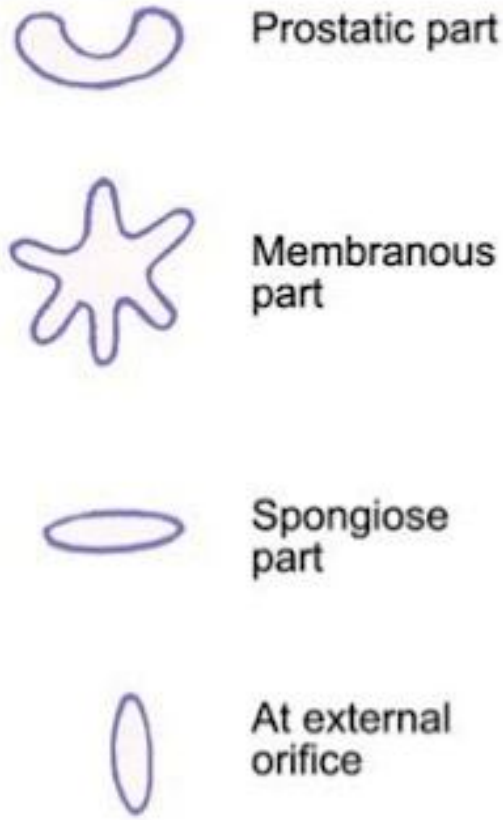
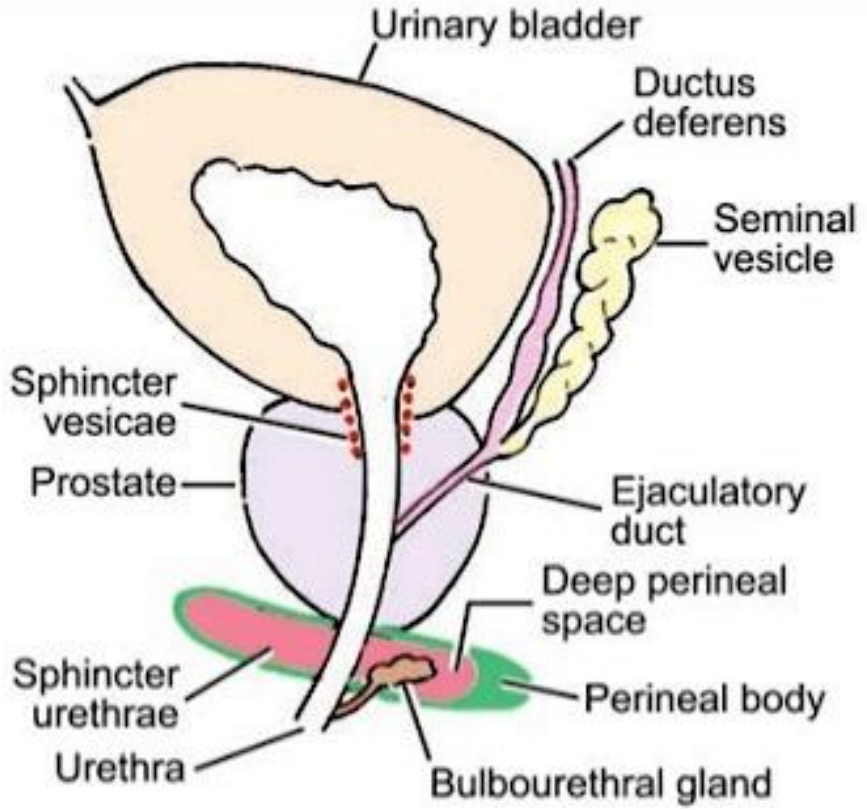


Fig. 5.44, cont'd C. Prostatic part of the urethra in men.

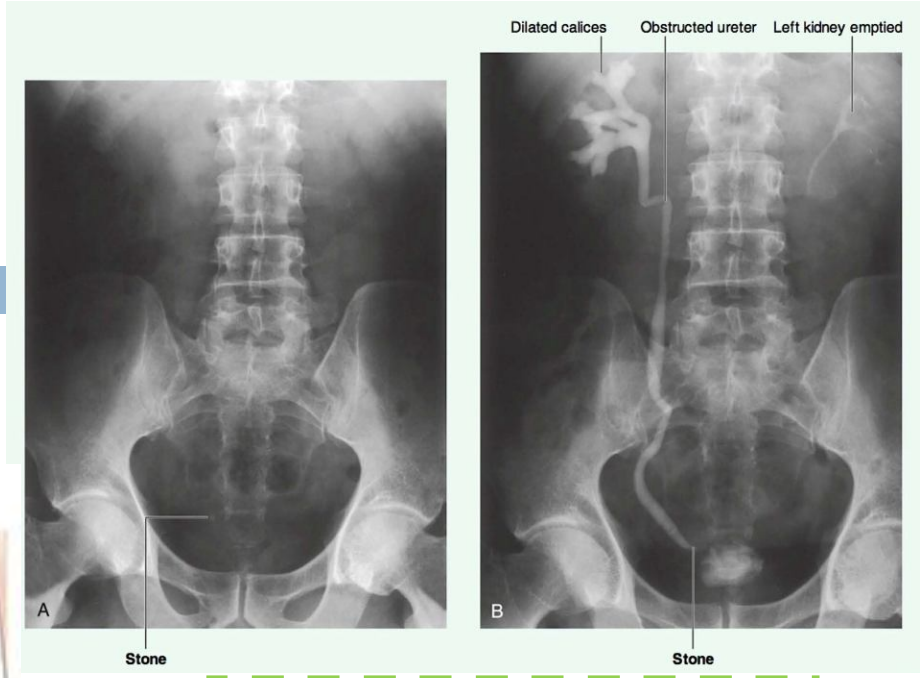


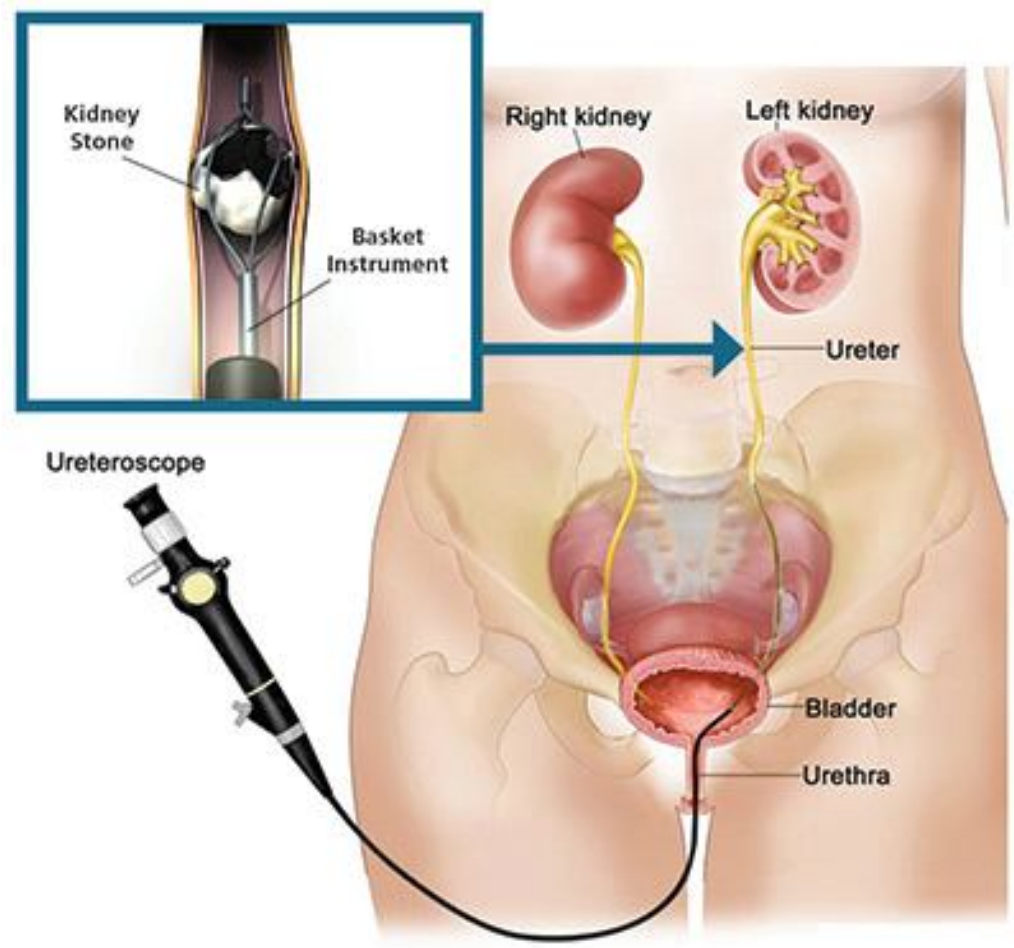
33.16: Transverse sections through various parts of the male urethra to show the shape of its lumen



33.17: Diagram showing the sphincters of the urethra, and the bulbourethral glands

Bladder stones





small calculi (stones) form in the kidneys

residual urine in the bladder / infection

Remove of stones:

a ***transurethral route*** using specialized instruments

If the stones are too big, it may be necessary to make a ***suprapubic incision***

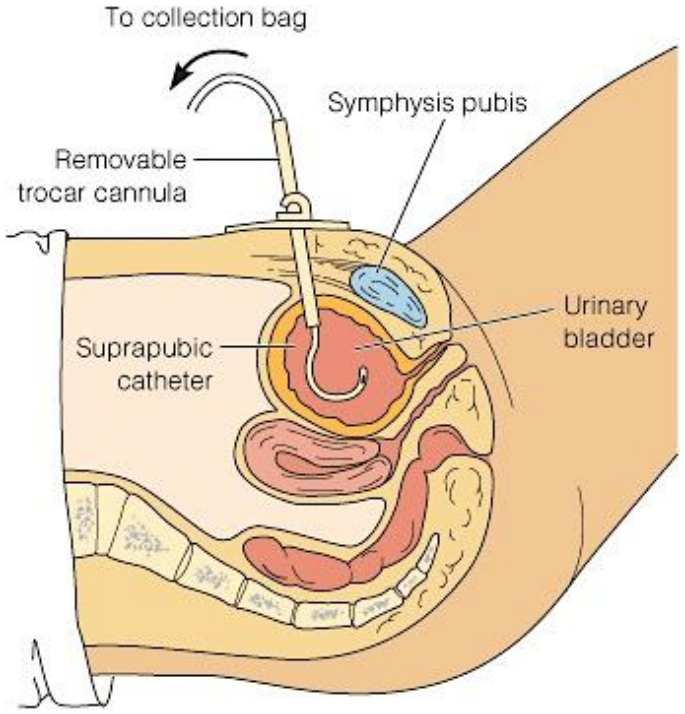
Suprapubic catheterization

when the prostate is markedly enlarged

The bladder is a retroperitoneal structure when full lies adjacent to the anterior abdominal wall

the passage of a small catheter on a needle in the midline approximately 2 cm above the pubic symphysis

The catheter passes easily into the bladder without compromise of other structures and permits free drainage



Bladder cancer

most common tumor of the urinary tract
sixth and seventh decades
Approximately **one-third of bladder tumors are multifocal**

invade local structures:

the rectum, uterus (in women), and lateral walls of the pelvic cavity & Prostate

Spread by: the internal iliac lymph nodes

Treatment:
chemotherapy
surgery

Side effect of large tumor:
obstruction of the ureters
obstruct the kidneys
induce kidney failure

Fig. 5.43 Intravenous urogram demonstrating a small tumor in the wall of the bladder.

Urinary System

Radio Anatomy

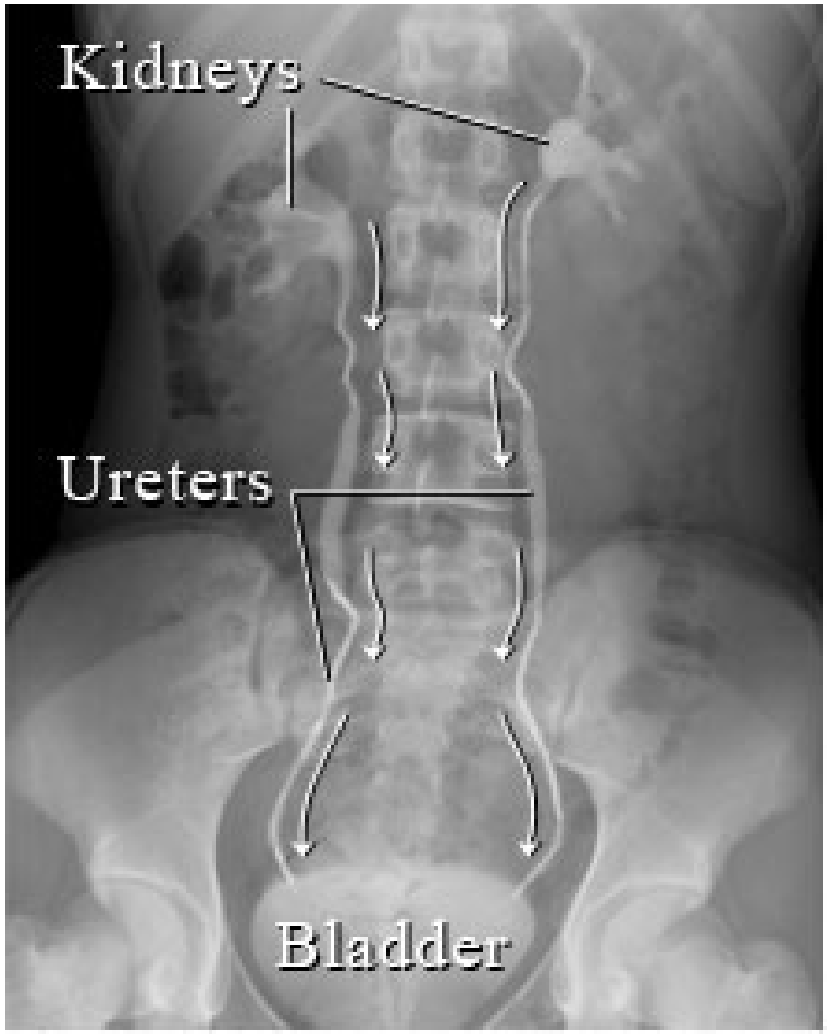


Figure 1

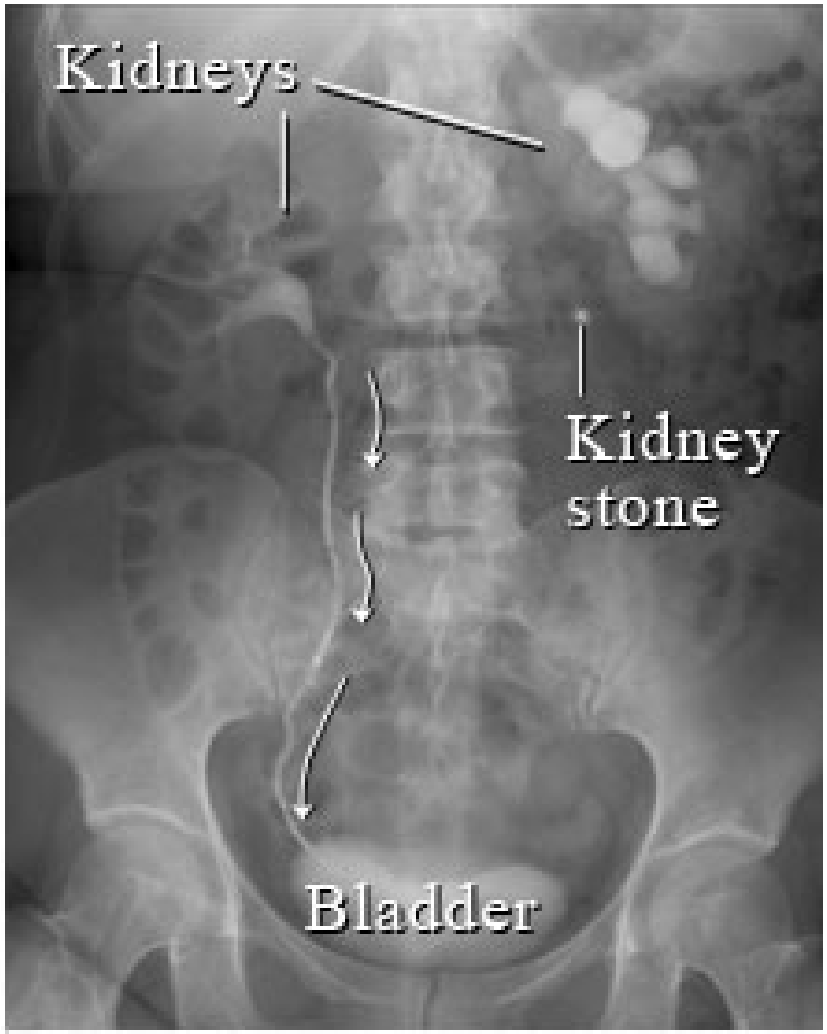


Figure 2

Kidney Ureter Bladder

IVU


R

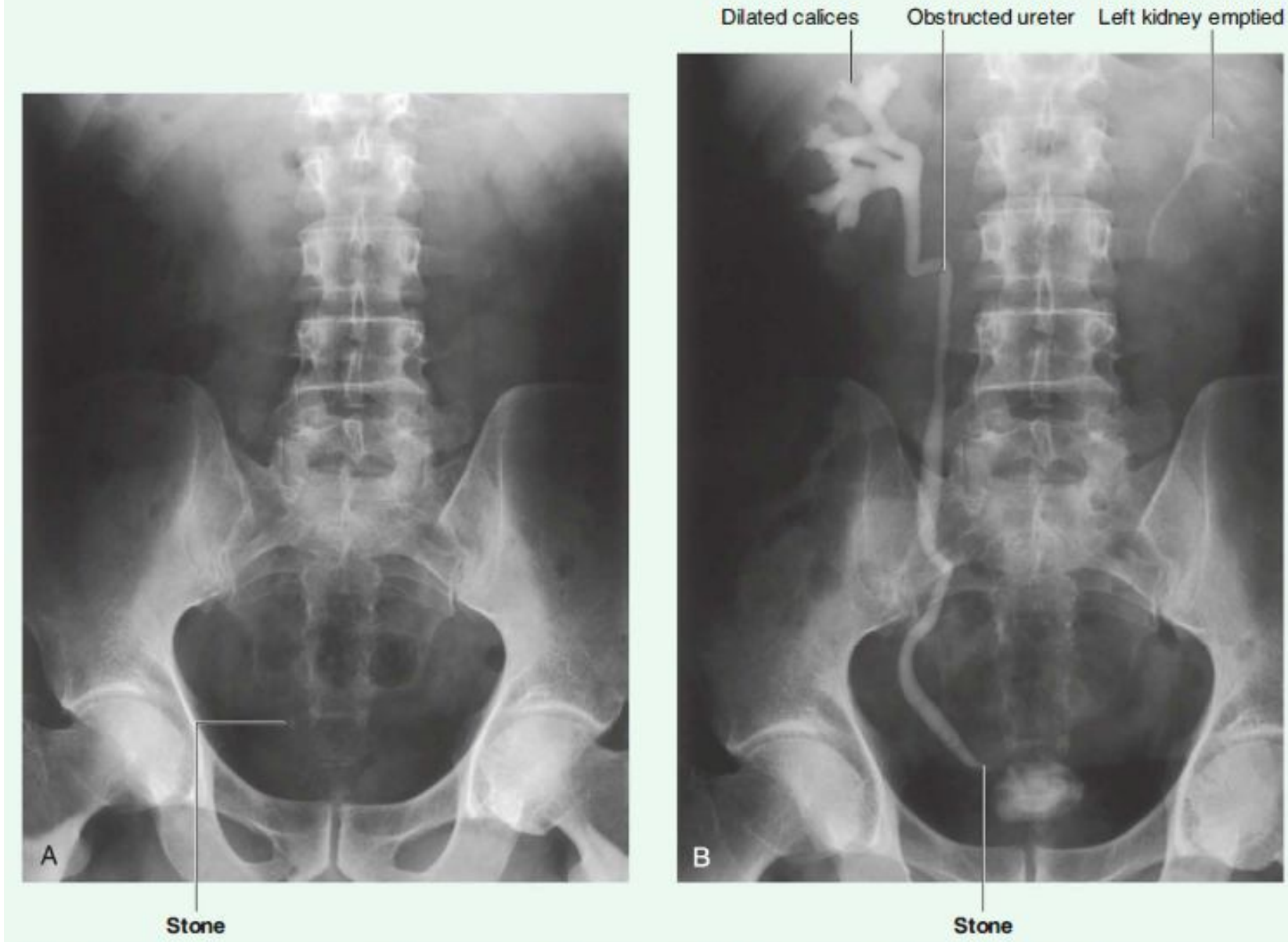


Fig. 5.42 Intravenous urogram demonstrating a stone in the lower portion of the ureter. **A.** Control radiograph. **B.** Intravenous urogram, postmicturition.

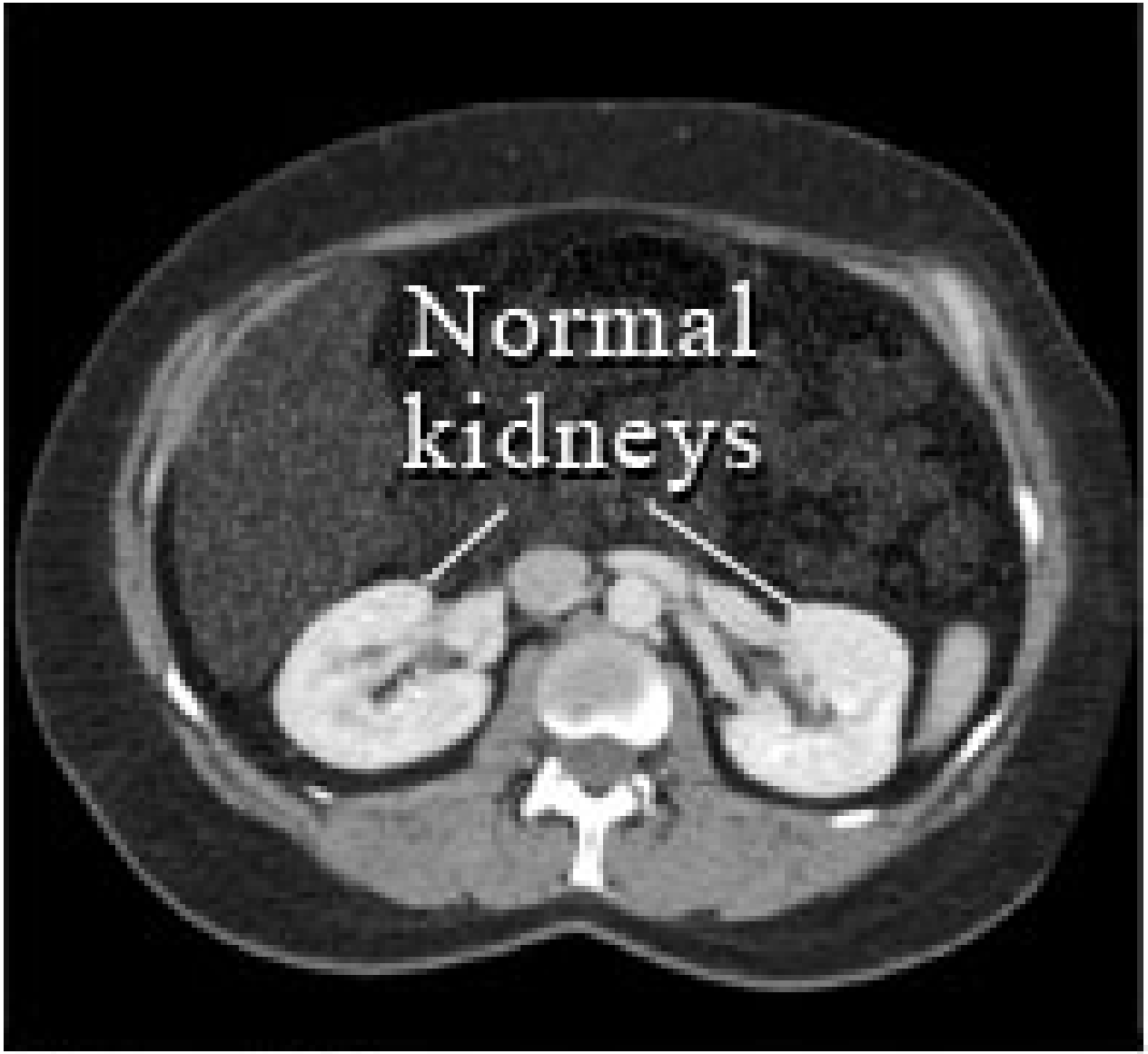
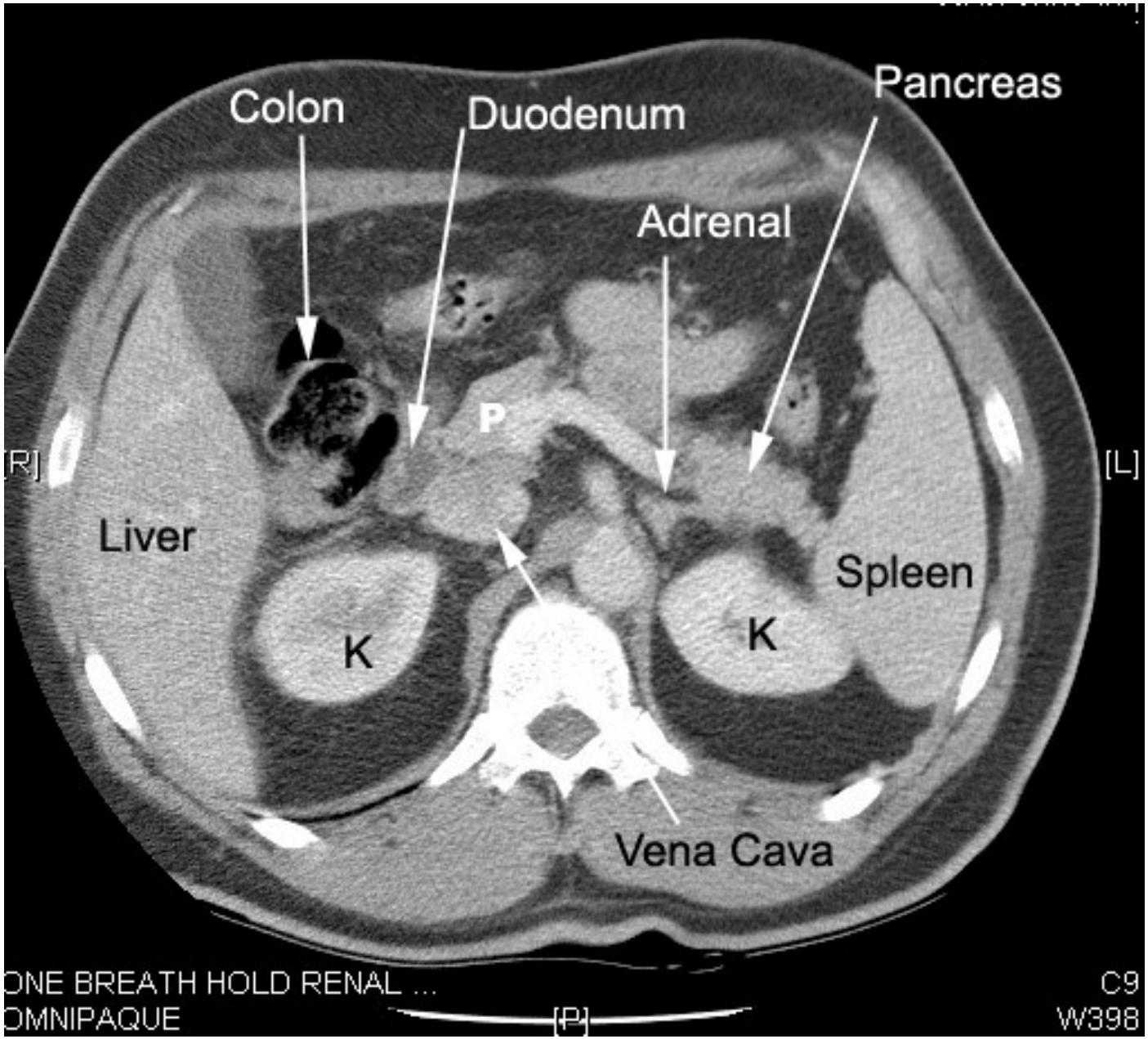
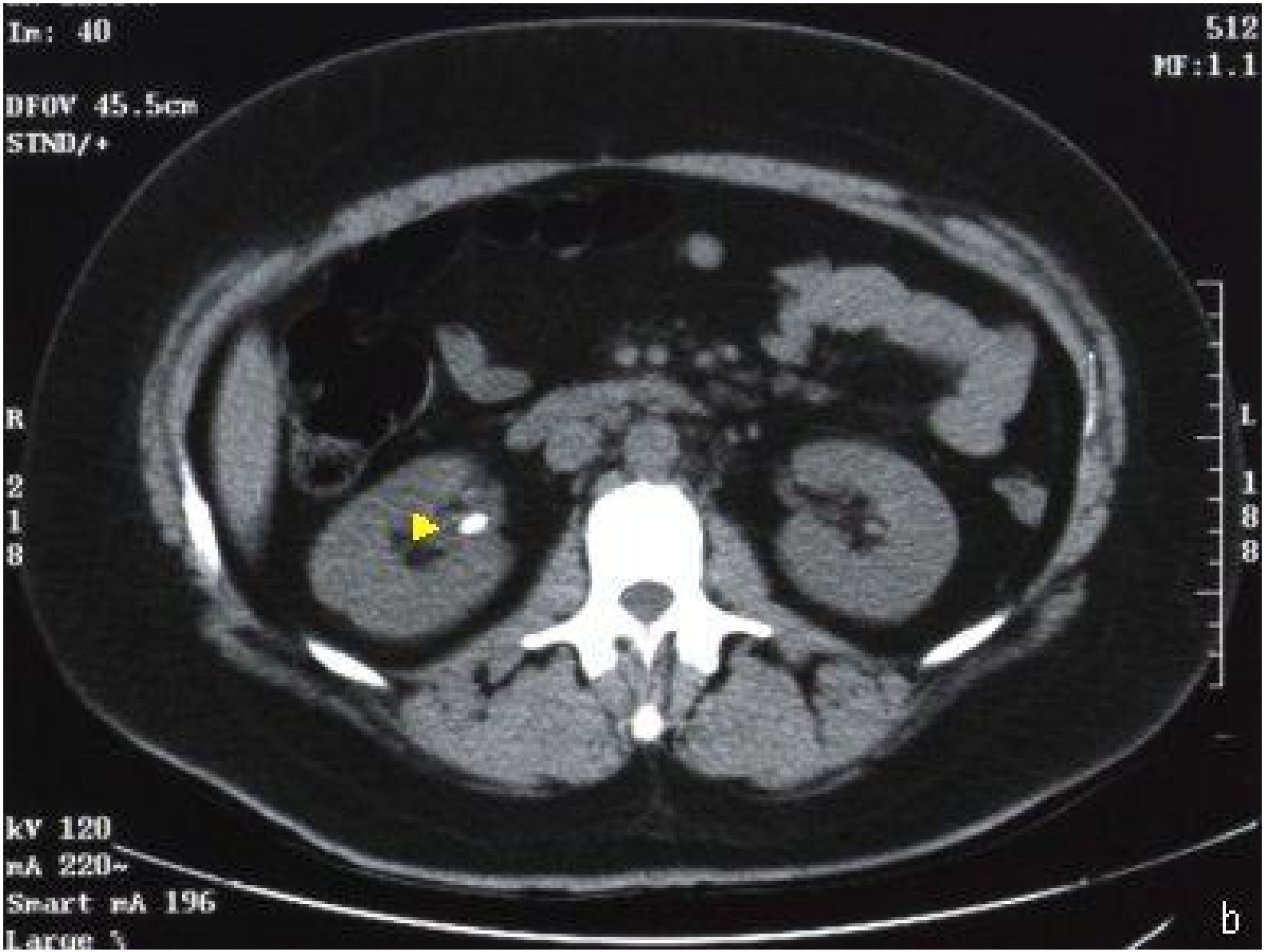
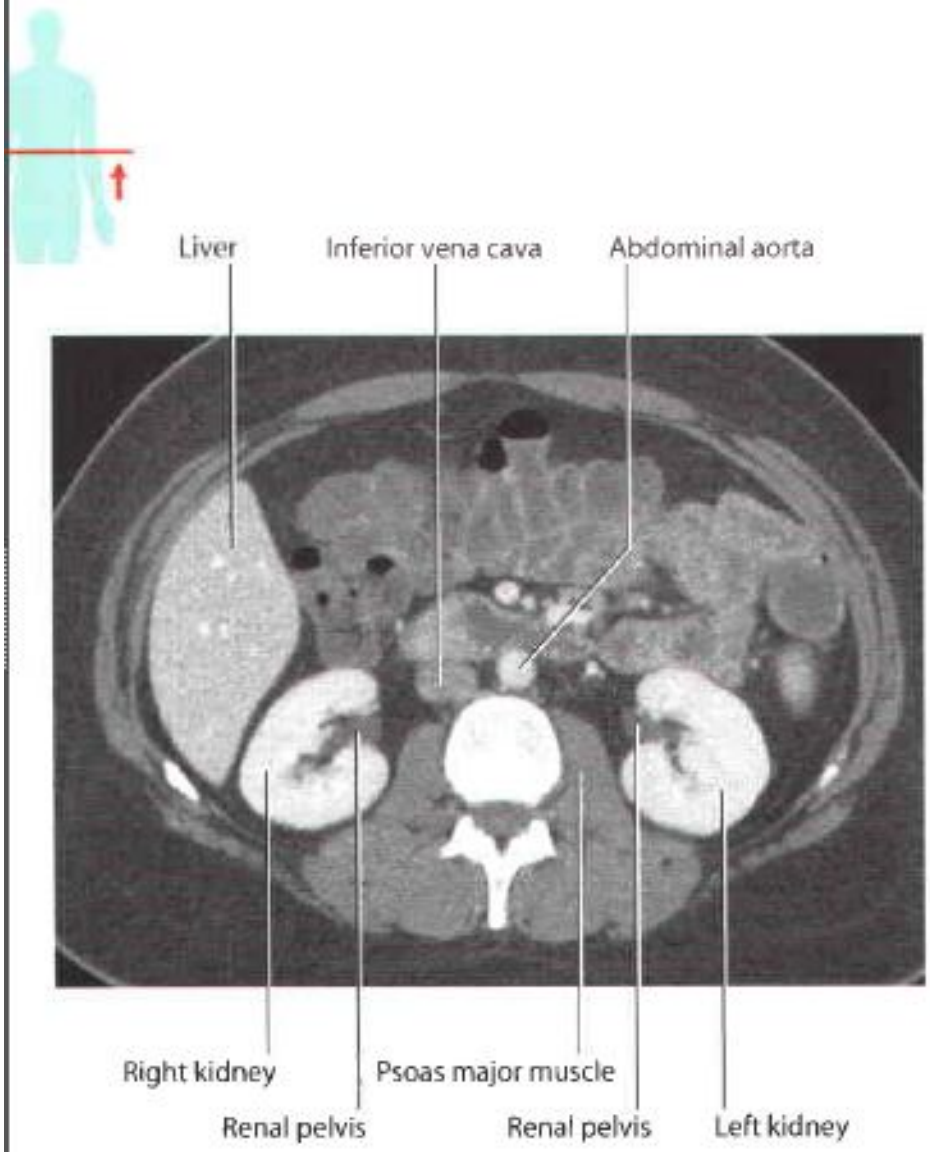


Figure 1

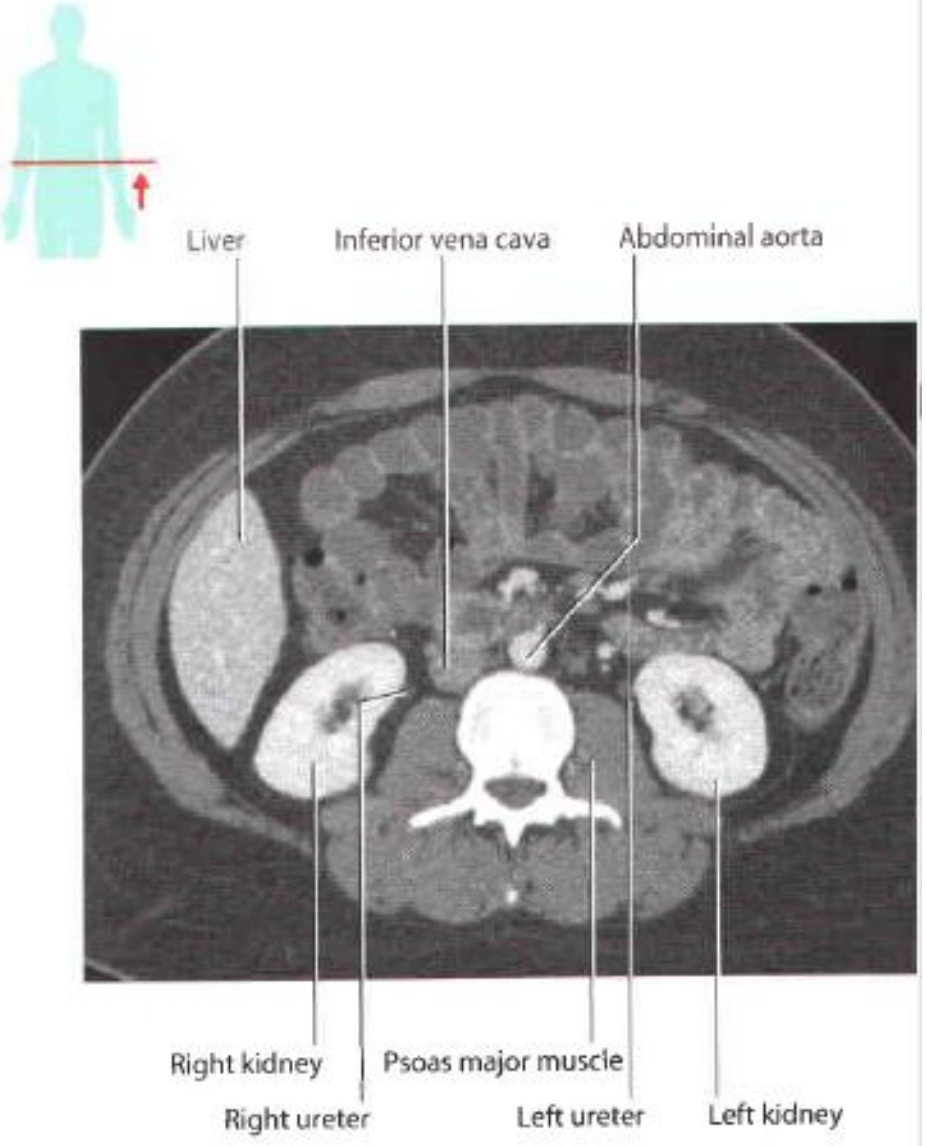

Colon
Duodenum
Pancreas
Adrenal
P
[R]
[L]
Liver
Spleen
K
K
Vena Cava
ONE BREATH HOLD RENAL ...
OMNIPAQUE
[P]
C9
W398

Renal Stone





Renal pelvis.
CT image, with contrast, in axial plane



Location of ureters.
CT image, with contrast, in axial plane

Bladder

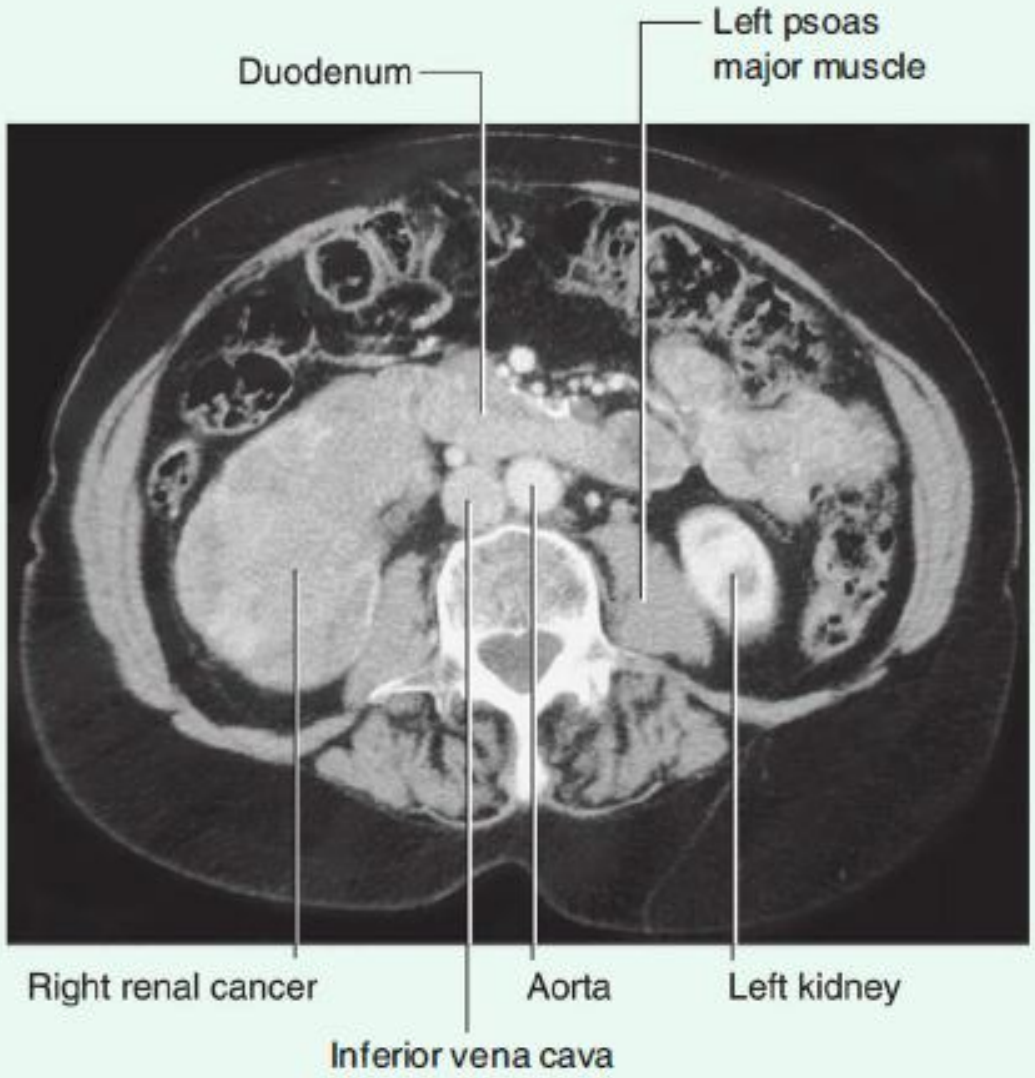
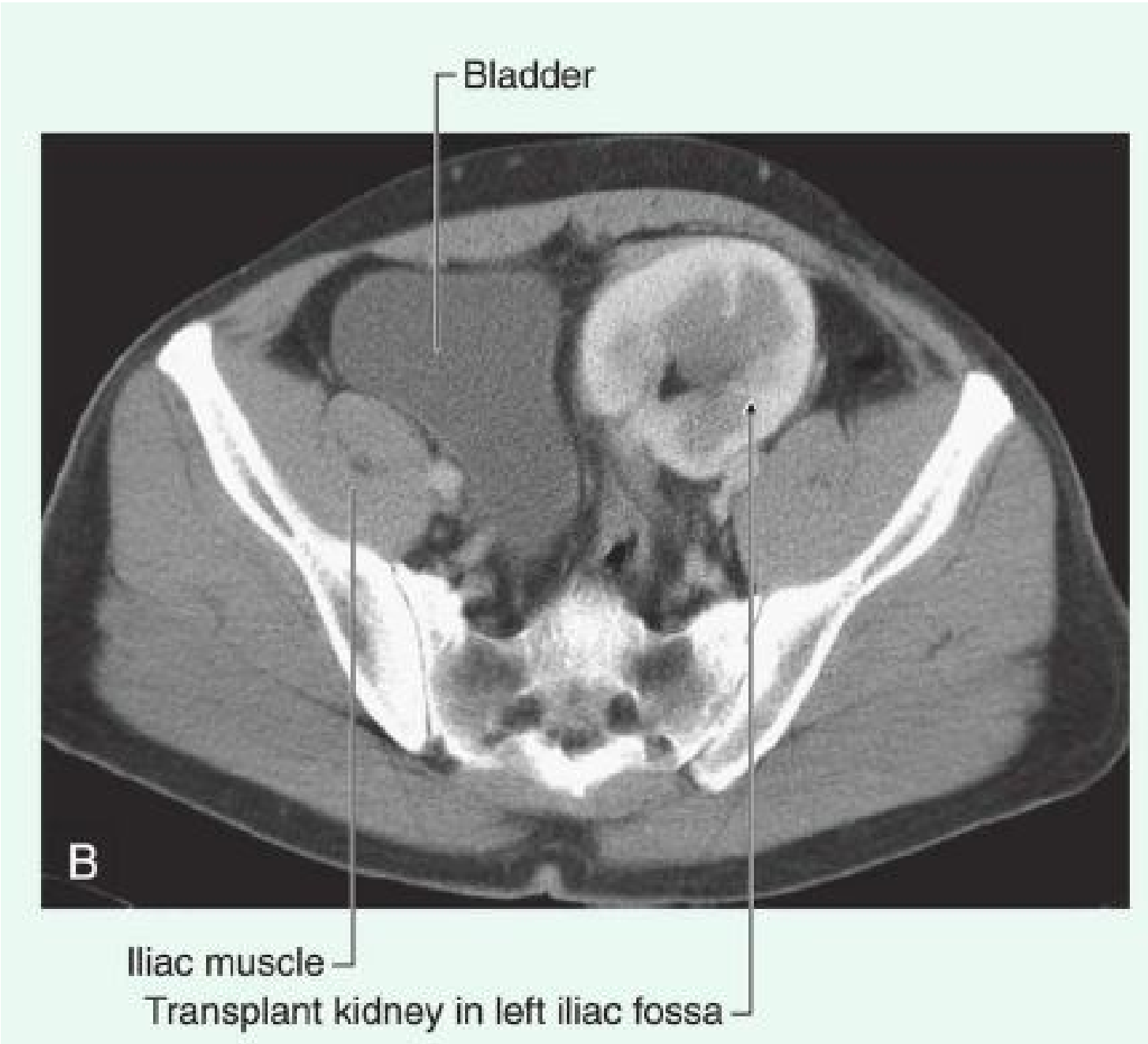


Fig. 4.144 Tumor in the right kidney growing toward, and possibly invading, the duodenum. Computed tomogram in the axial plane.


Bladder
B
Iliac muscle
Transplant kidney in left iliac fossa