The Kidneys

(L., ren; Gk, nephros; hence the adjectives renal and nephric)

&

Suprarenal (Adrenal) Glands

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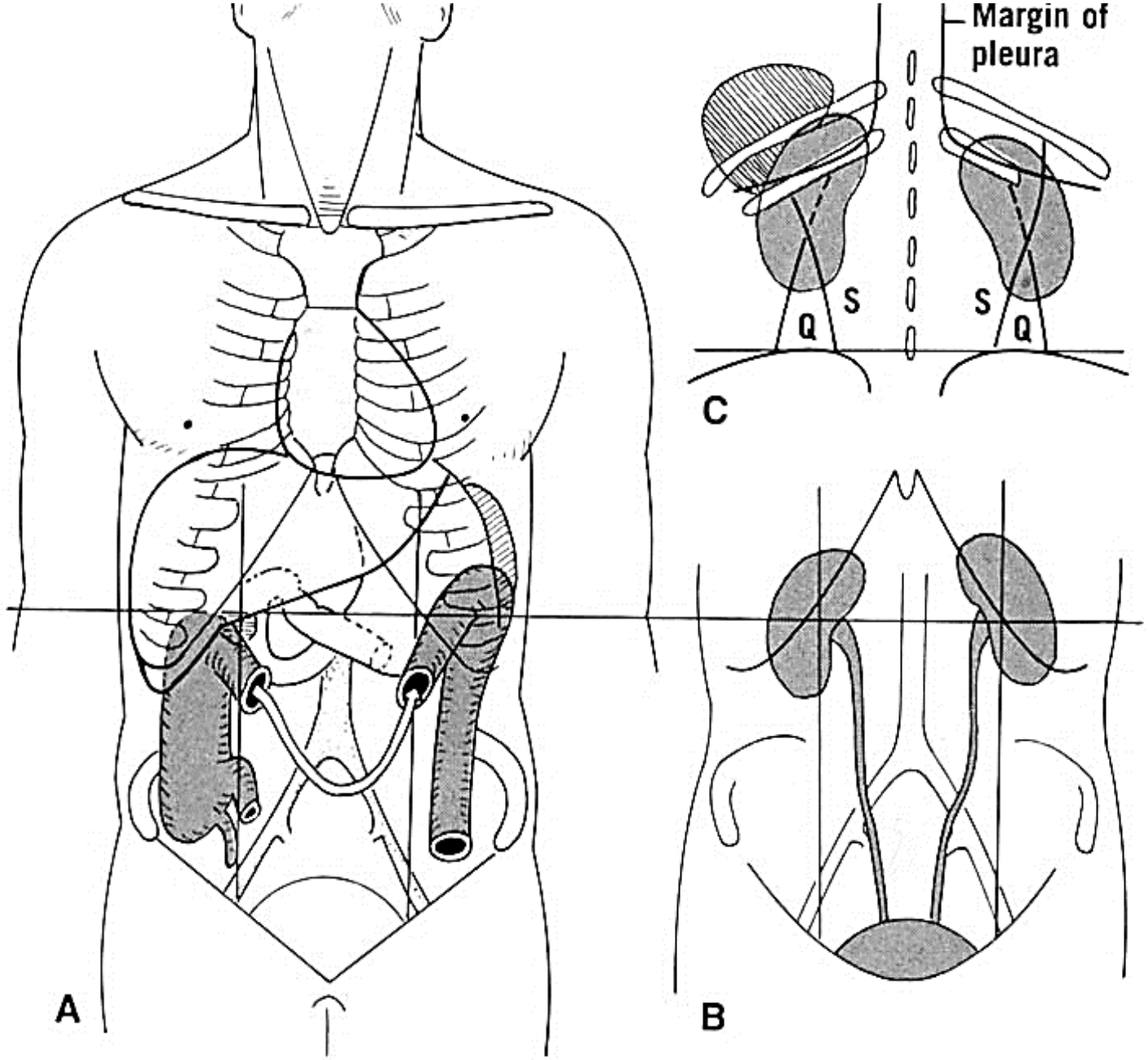
Functions of Urinary System

- **Regulate electrolytes (K+, Na+, etc)**
- **Regulate pH in blood**
- **Regulate blood pressure**
- **Regulate blood volume (removes excess fluid)**
- **Removing metabolic wastes**
  - Urea, uric acid, and creatinine
  - This is the least important of the kidney's functions. You can survive for a few weeks without excreting waste products in the urine, but hour by hour, the other functions are more important.

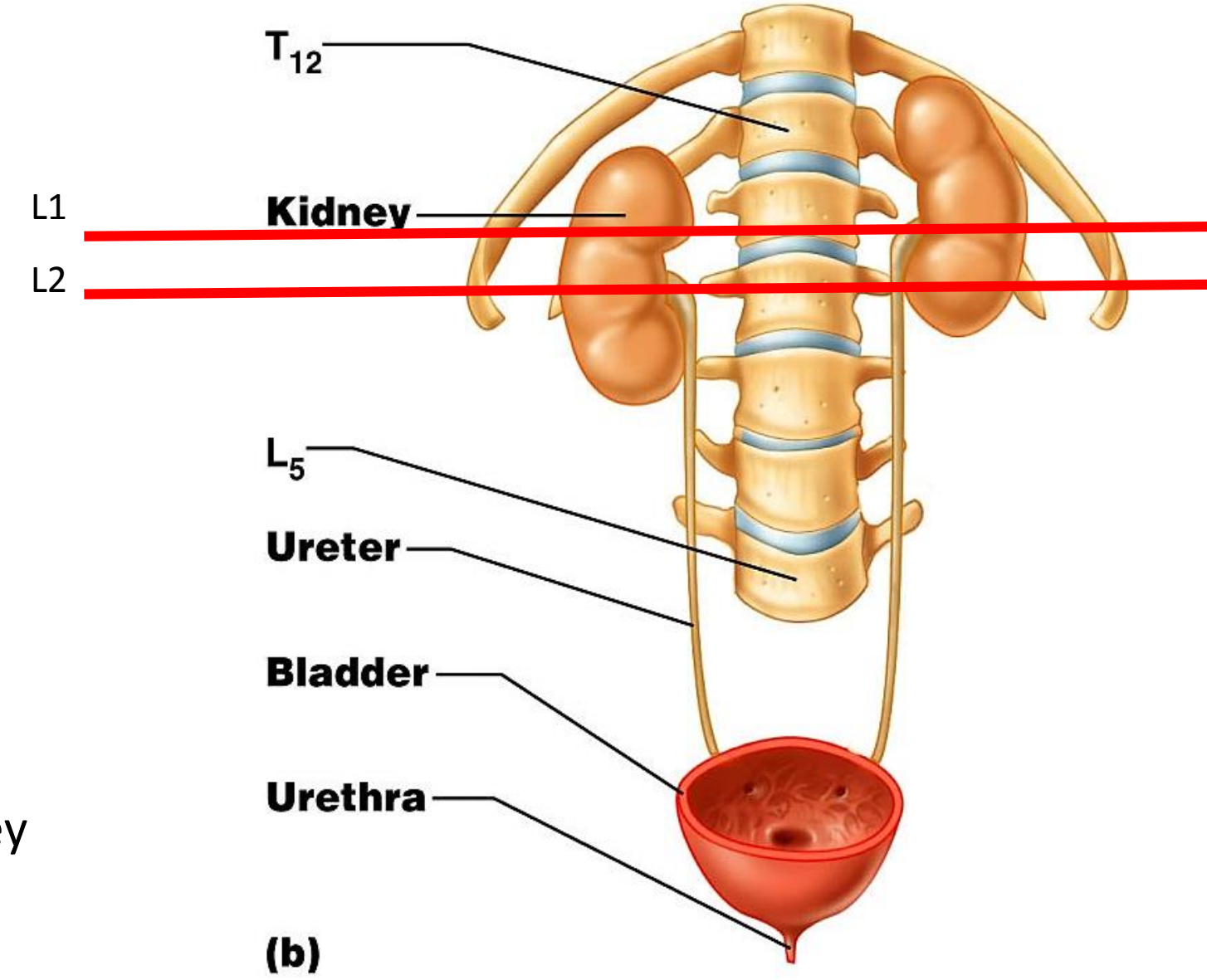
General relations of abdominal viscera

- In B, the position of the kidneys and ureters is shown.
- In C, which is a posterior view, the kidneys and spleen are represented.



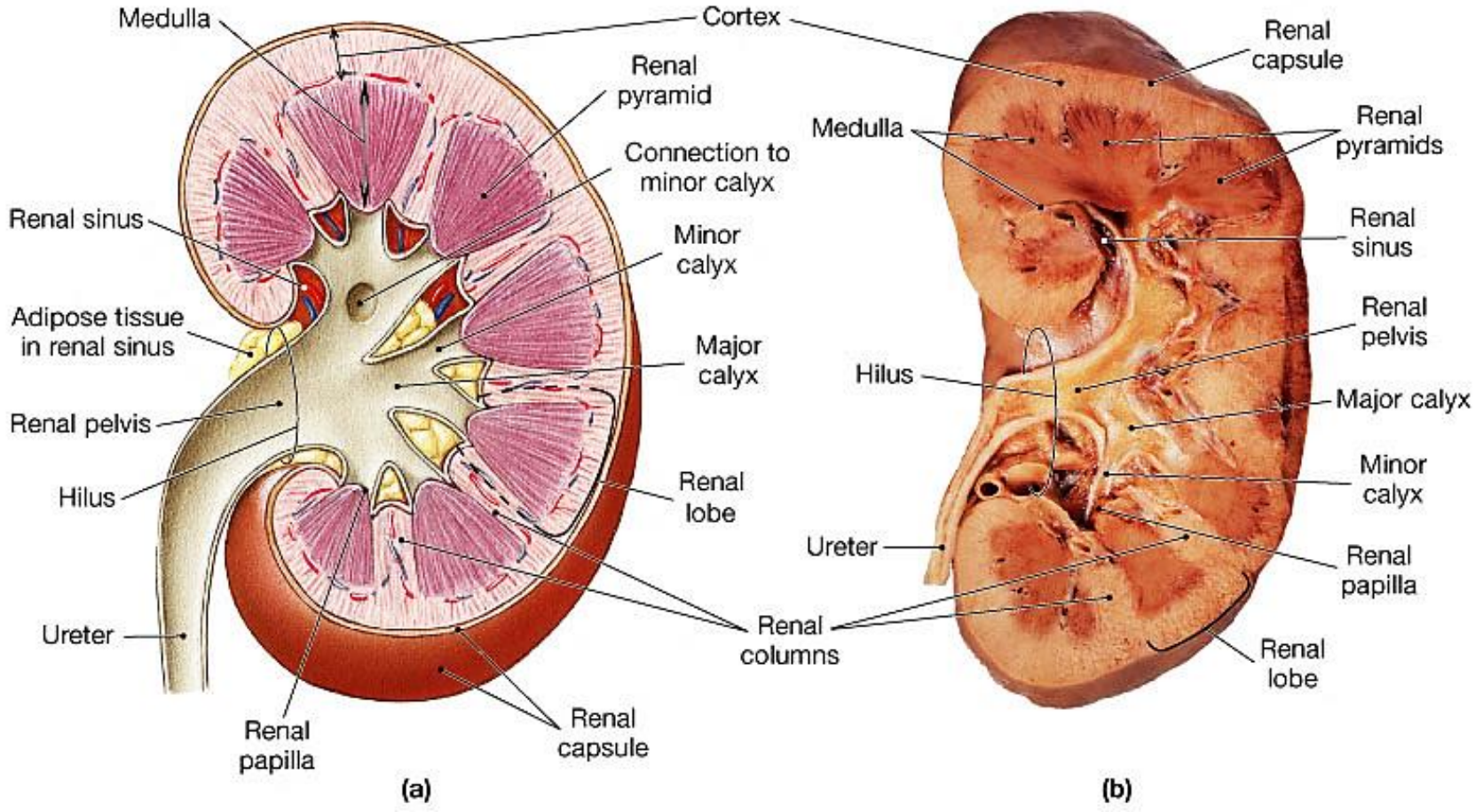
Location and External Anatomy of Kidneys

- Located **retroperitoneally**
- 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



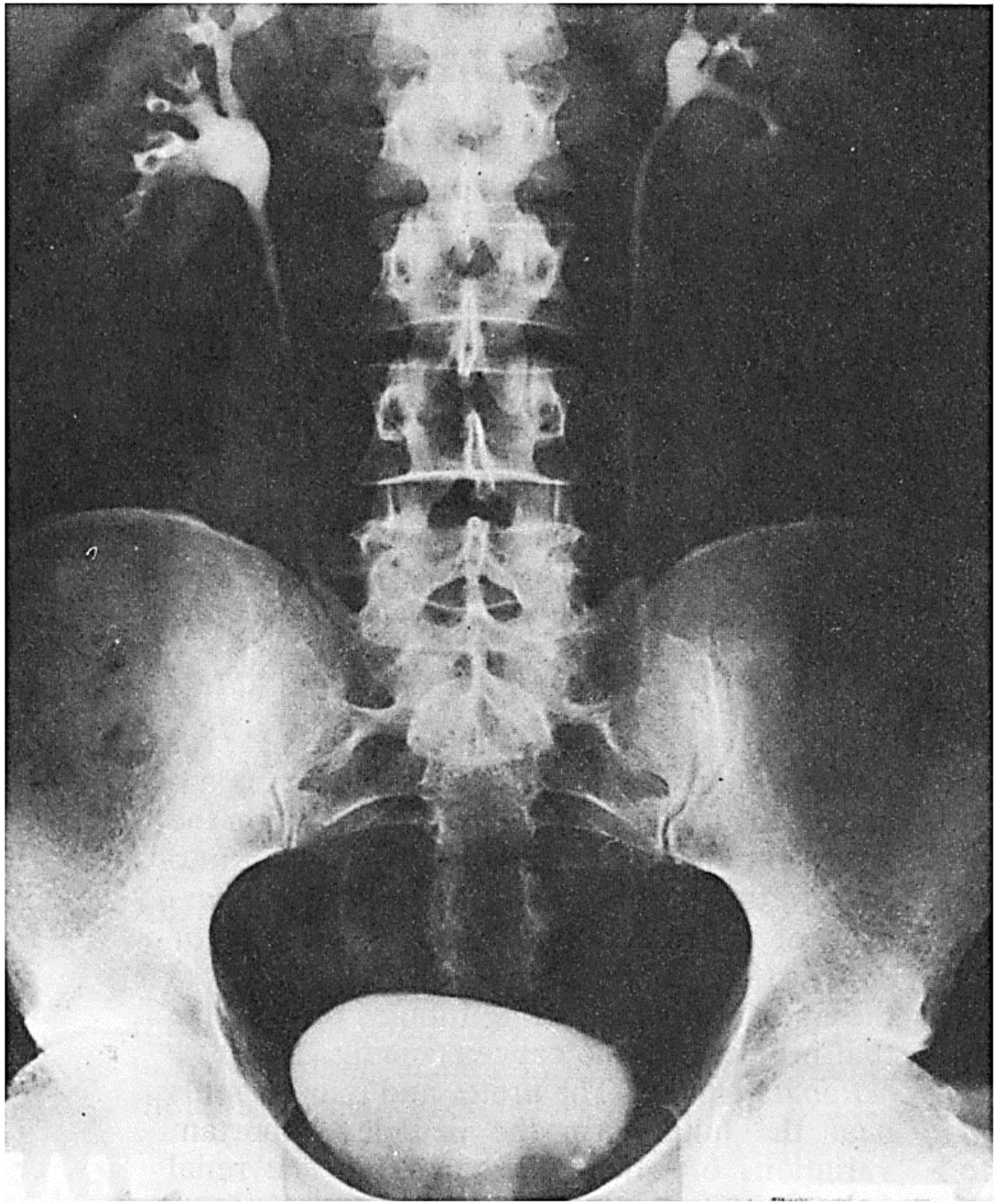
Anatomy of the kidneys

- Superficial outer cortex and inner medulla
  - The medulla consists of 6-18 renal pyramids
  - The cortex is composed of roughly 1.25 million nephrons
- Major and minor calyces along with the pelvis drain urine to the ureters



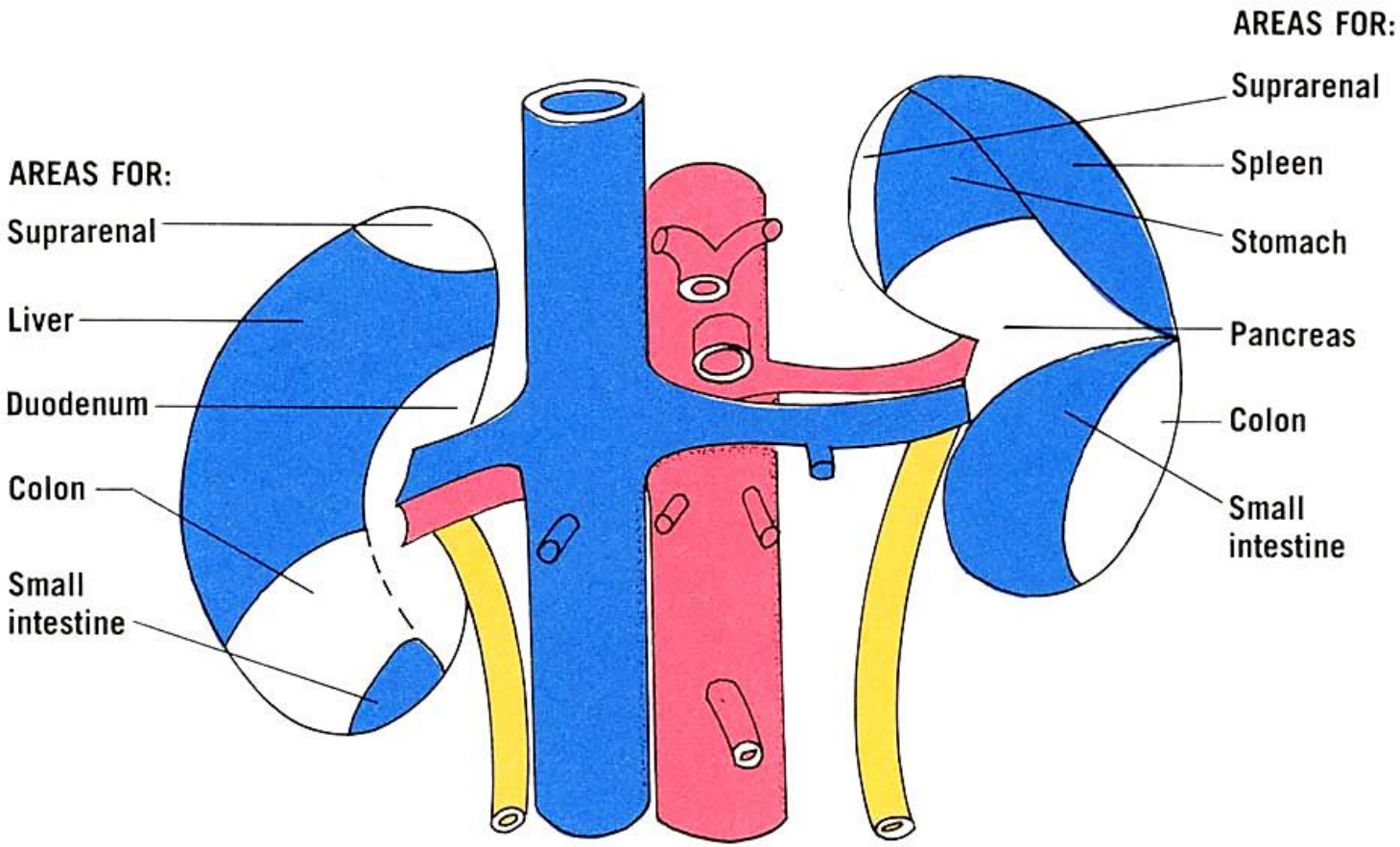
Intravenous pyelogram

Note the calices, some of which are seen from the side and others end-on, and the pelvis of the ureters, which differ in shape and level.



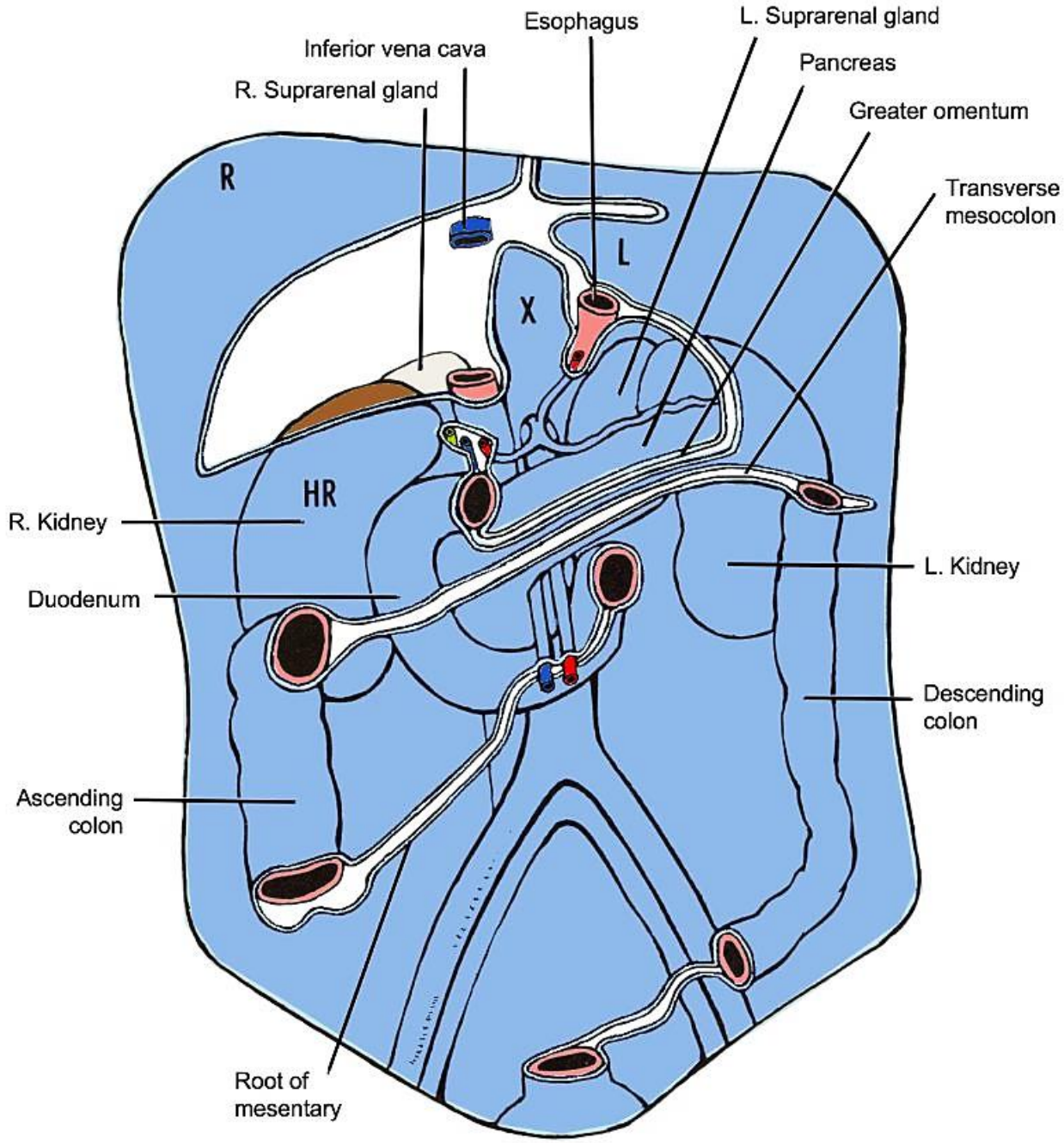
(Courtesy of Sir Thomas Lodge, Sheffield, England.)

Anterior relations of the kidneys



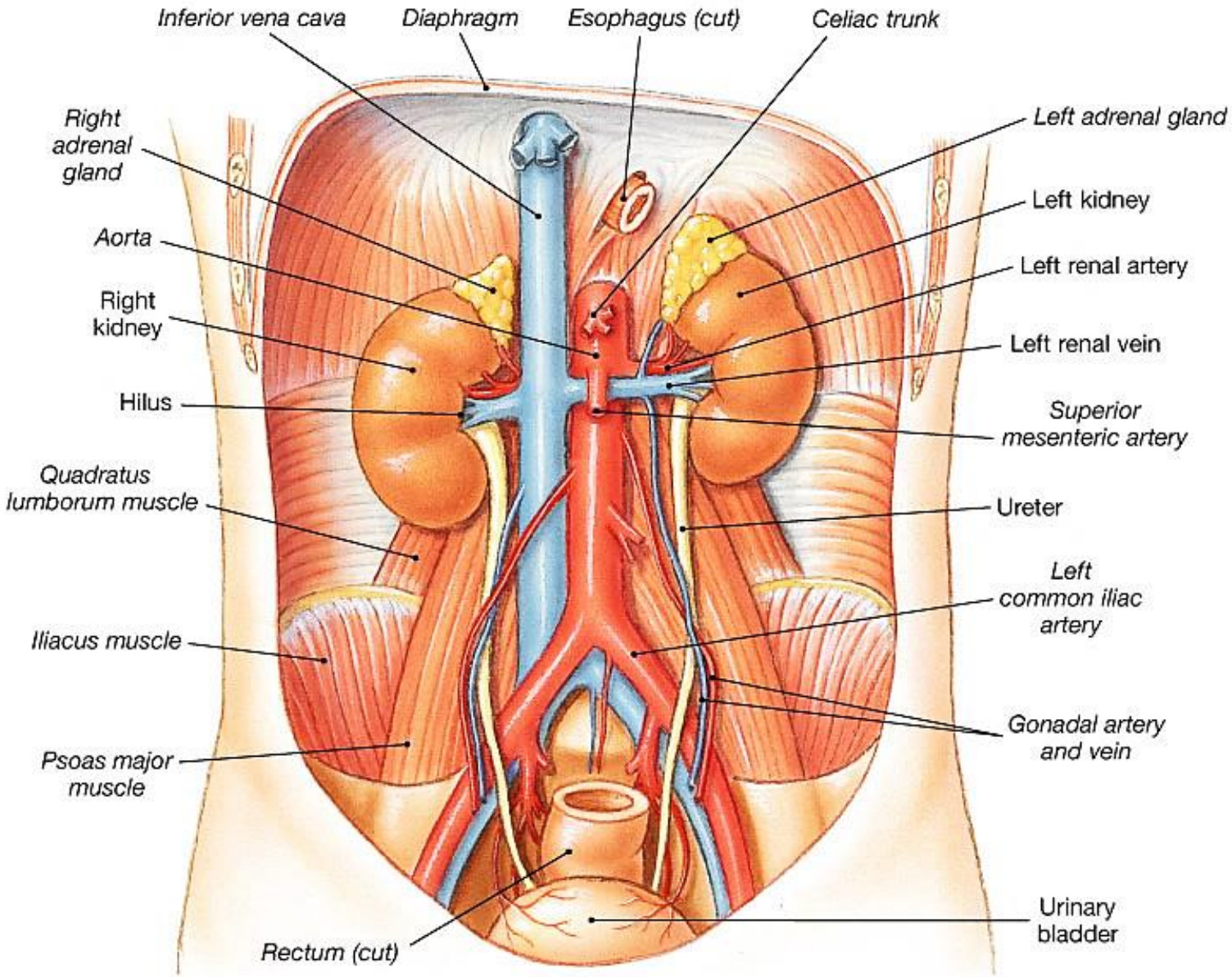
The areas covered by peritoneum are shown in blue.

The attachments of the peritoneum to the posterior abdominal wall, viewed from in front.

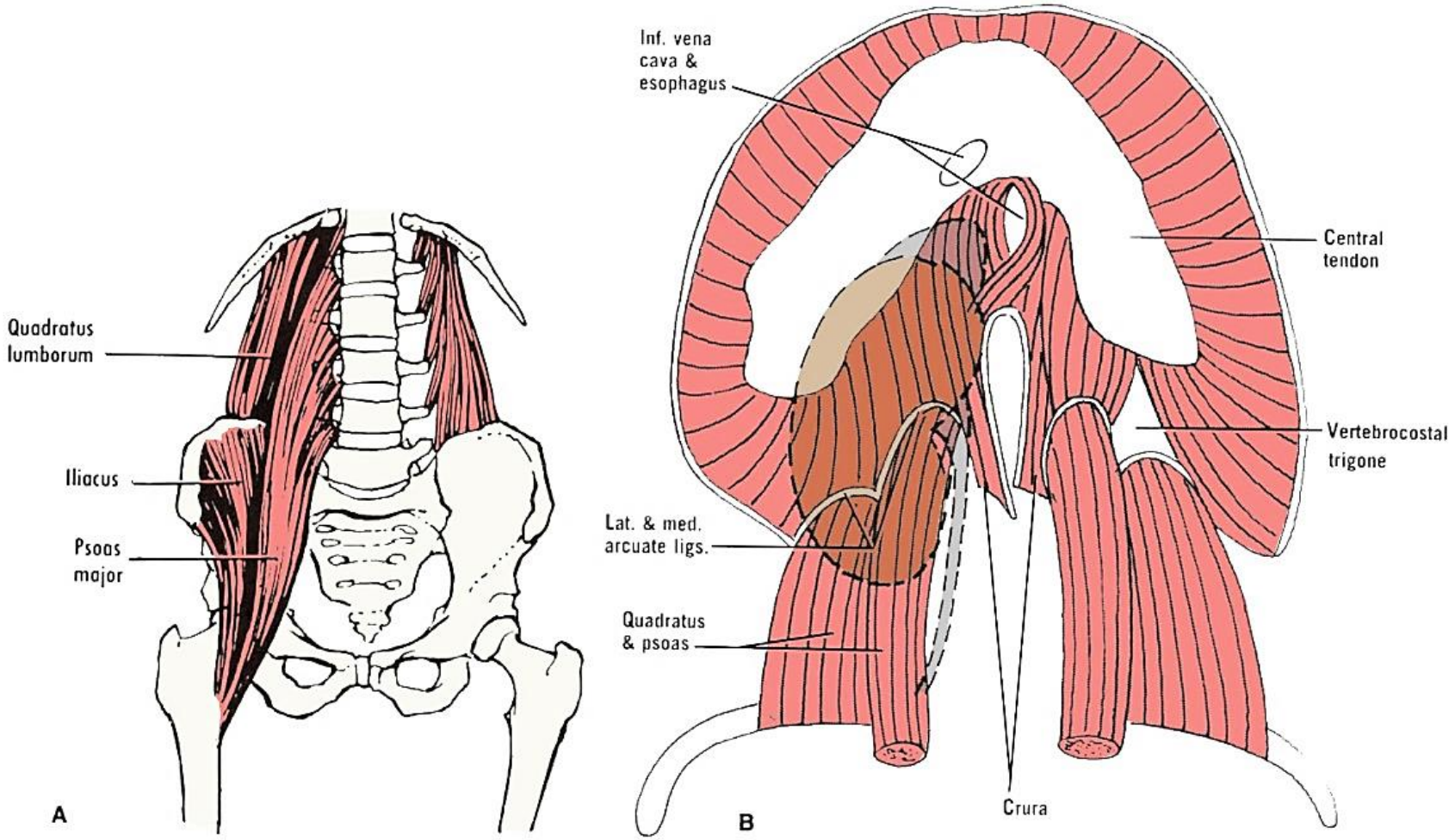


- HR, the hepatorenal pouch.
- R and L, right and left subphrenic spaces.
- X, the superior recess of the lesser sac.

Urinary System in Gross Dissection



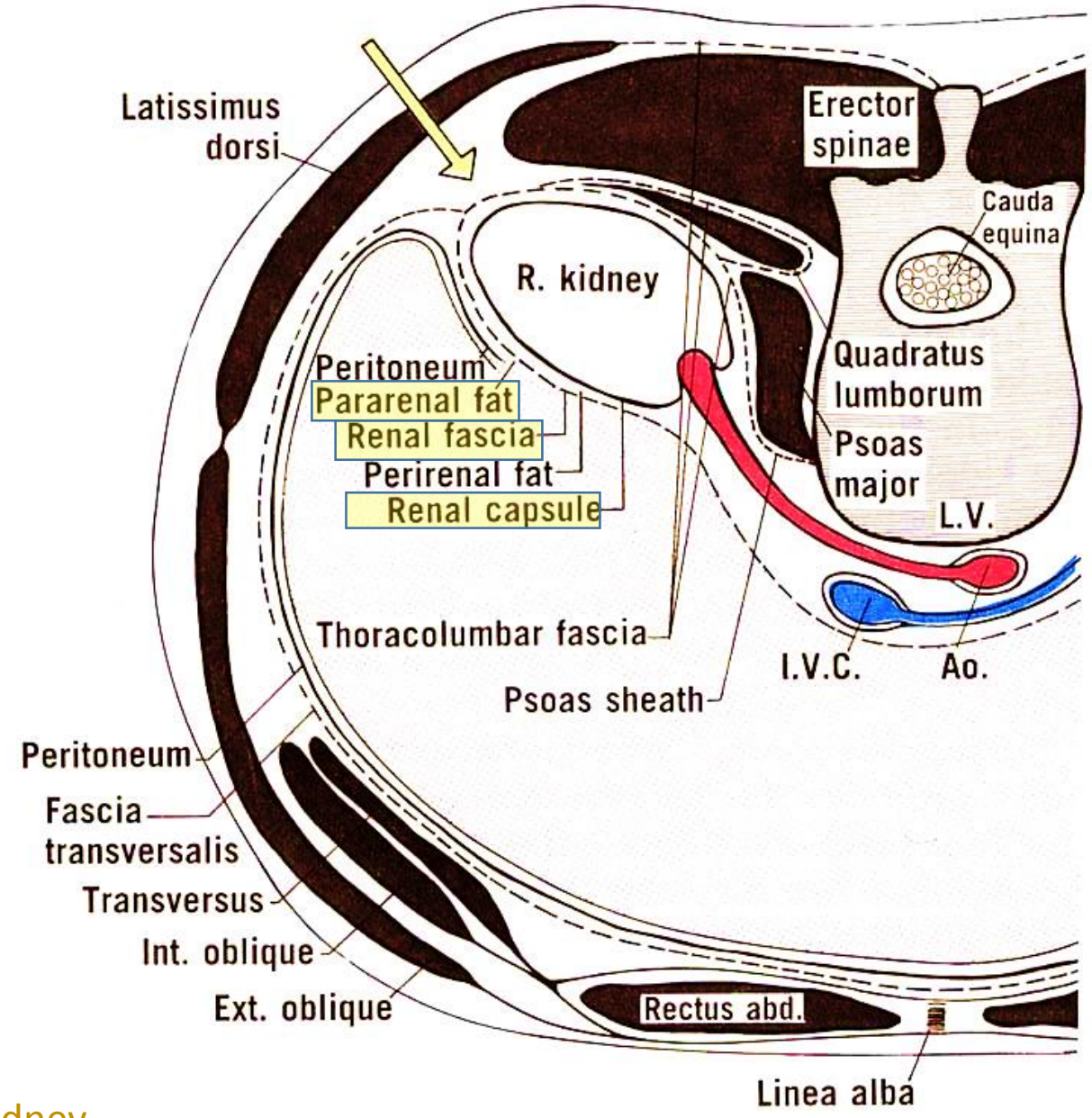
Muscles of the posterior abdominal wall



The kidneys lie obliquely along the vertebral column, abutting the psoas major muscles.

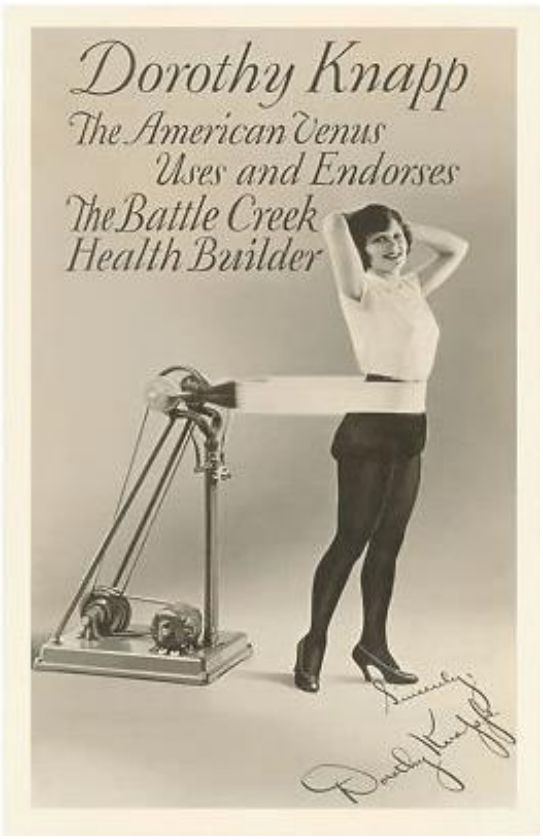
Horizontal section through the abdomen to show **renal fascia**

- The **RENAL CAPSULE** surrounds the kidney, made of dense fibrous connective tissue.
- A layer of adipose tissue surrounds the capsule, called **PARARENAL FAT (ADIPOSE)**. It cushions and protects.
- Around that is a connective tissue layer called the **RENAL FASCIA**, made of loose connective tissue. It anchors the kidney to the surrounding peritoneum and abdominal wall. It is not very strong; jumping up and down can cause tearing.



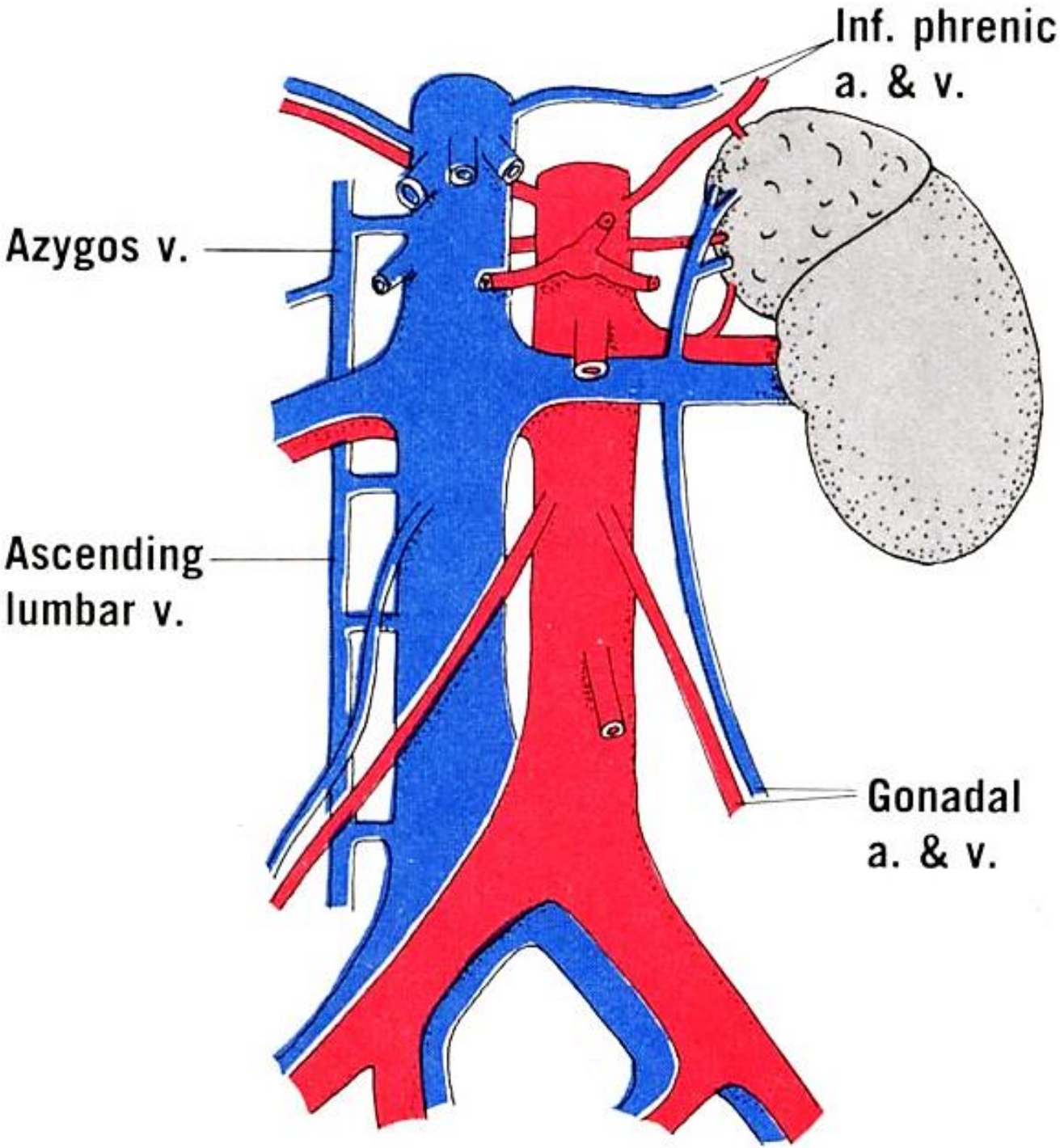
The arrow indicates the lumbar approach to the kidney.

Vibration Platform Machine:
No longer used in the USA because it damages kidneys!



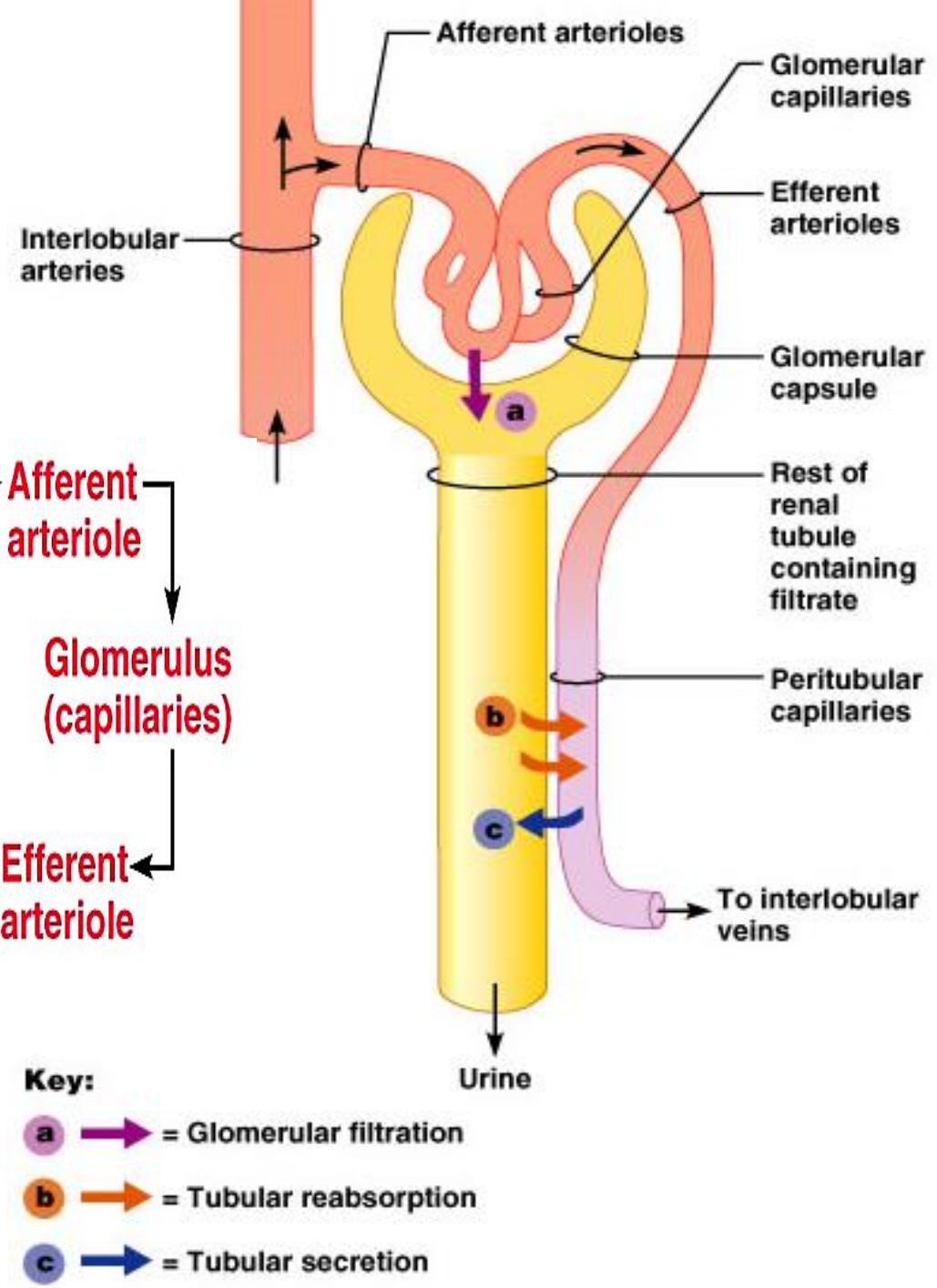
Renal vessels

A large area is drained by the left renal vein, which receives tributaries from the back, abdominal wall, diaphragm, suprarenal gland, and gonad.



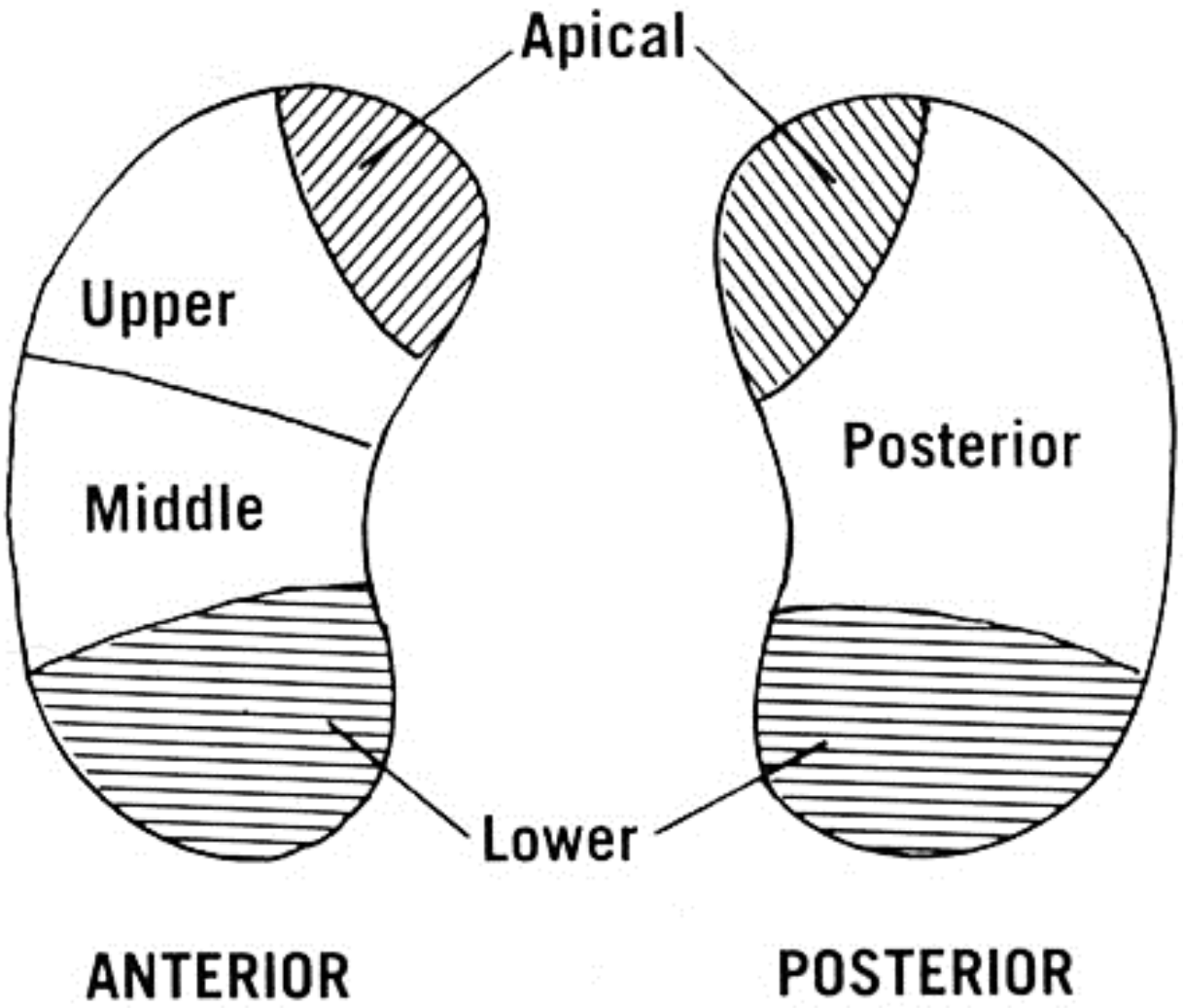
Blood Flow Through the Kidney

Aorta → Renal artery → Segmental artery → Interlobar artery → Arcuate artery → Cortical radiate artery → Afferent arteriole → Glomerulus (capillaries) → Efferent arteriole → Peritubular capillaries and vasa recta → Cortical radiate vein → Arcuate vein → Interlobar vein → Renal vein → Inferior vena cava



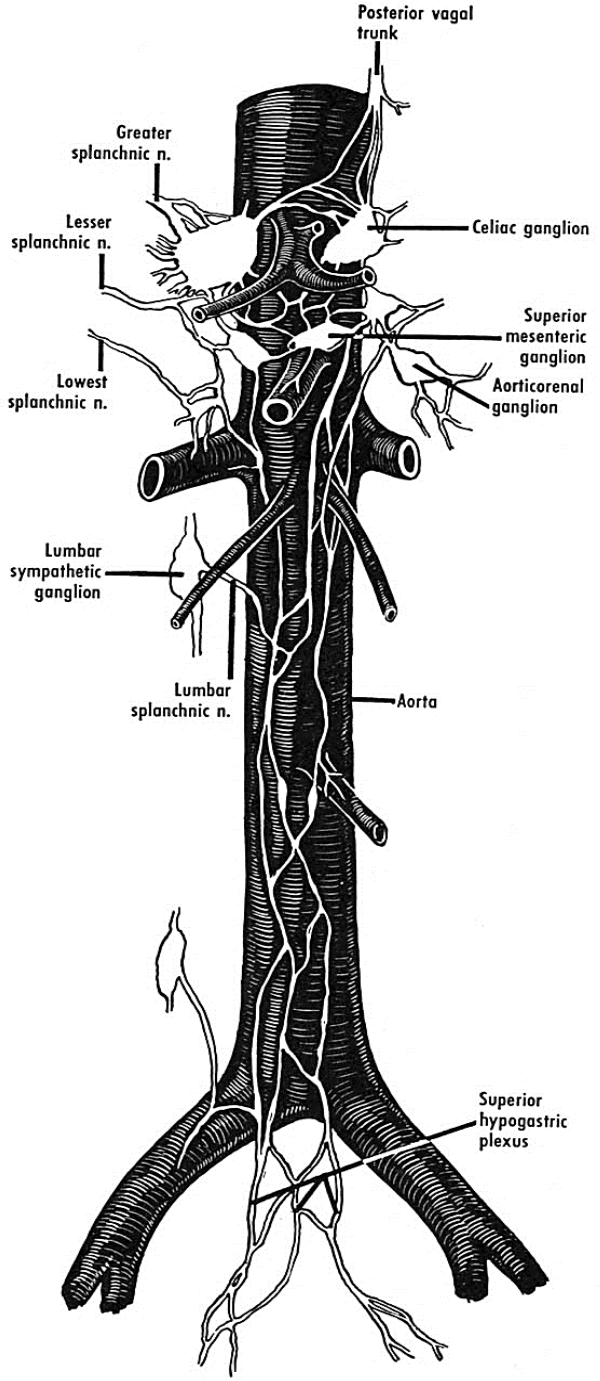
Arterial segments of right kidney.
The left is similar

- Interpretation of the posterior segment as two units (upper dorsal and lower dorsal) would provide a total of six arterial segments.

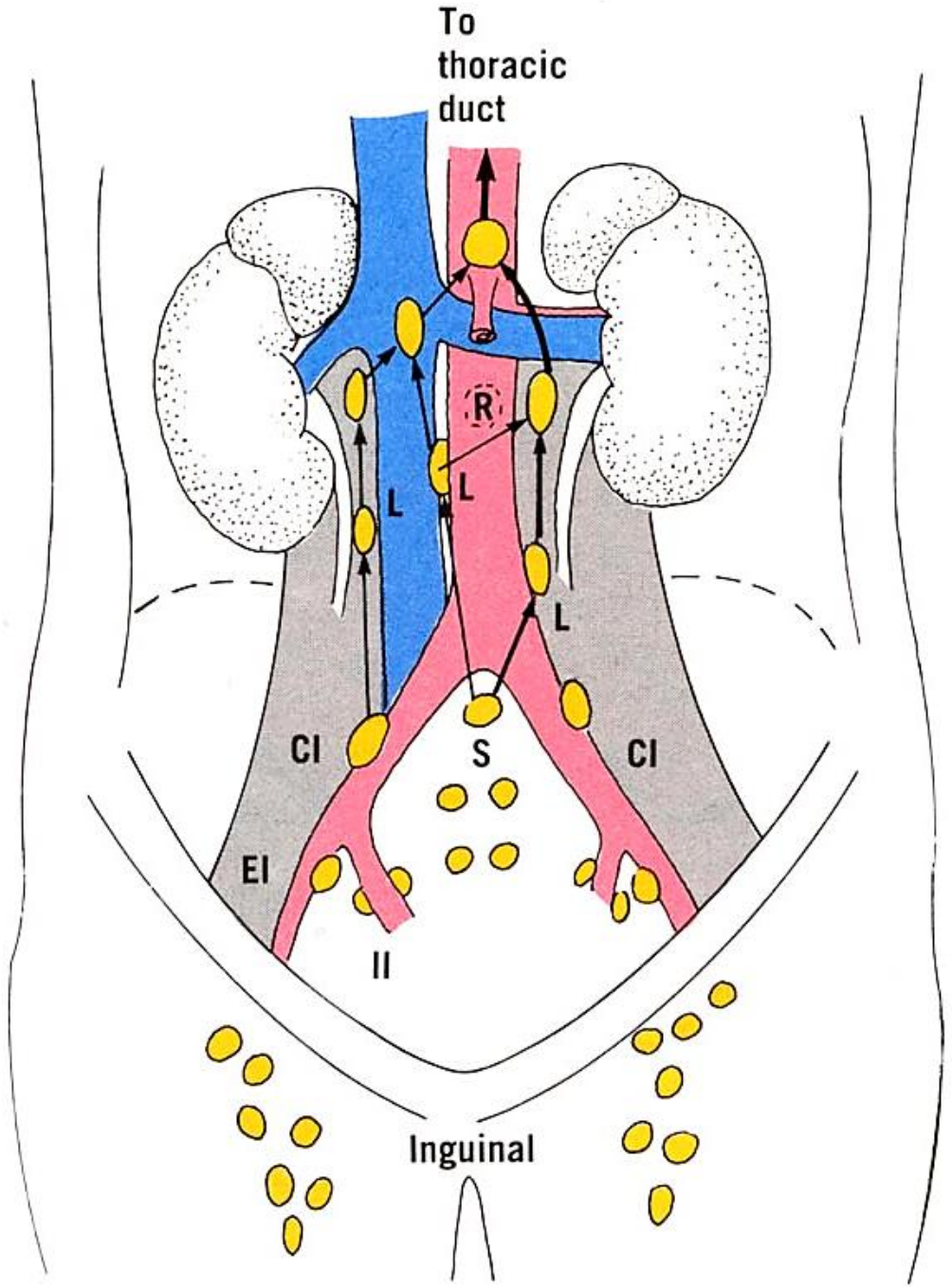


(After Fourman and Moffat.)

The prevertebral plexus and ganglia



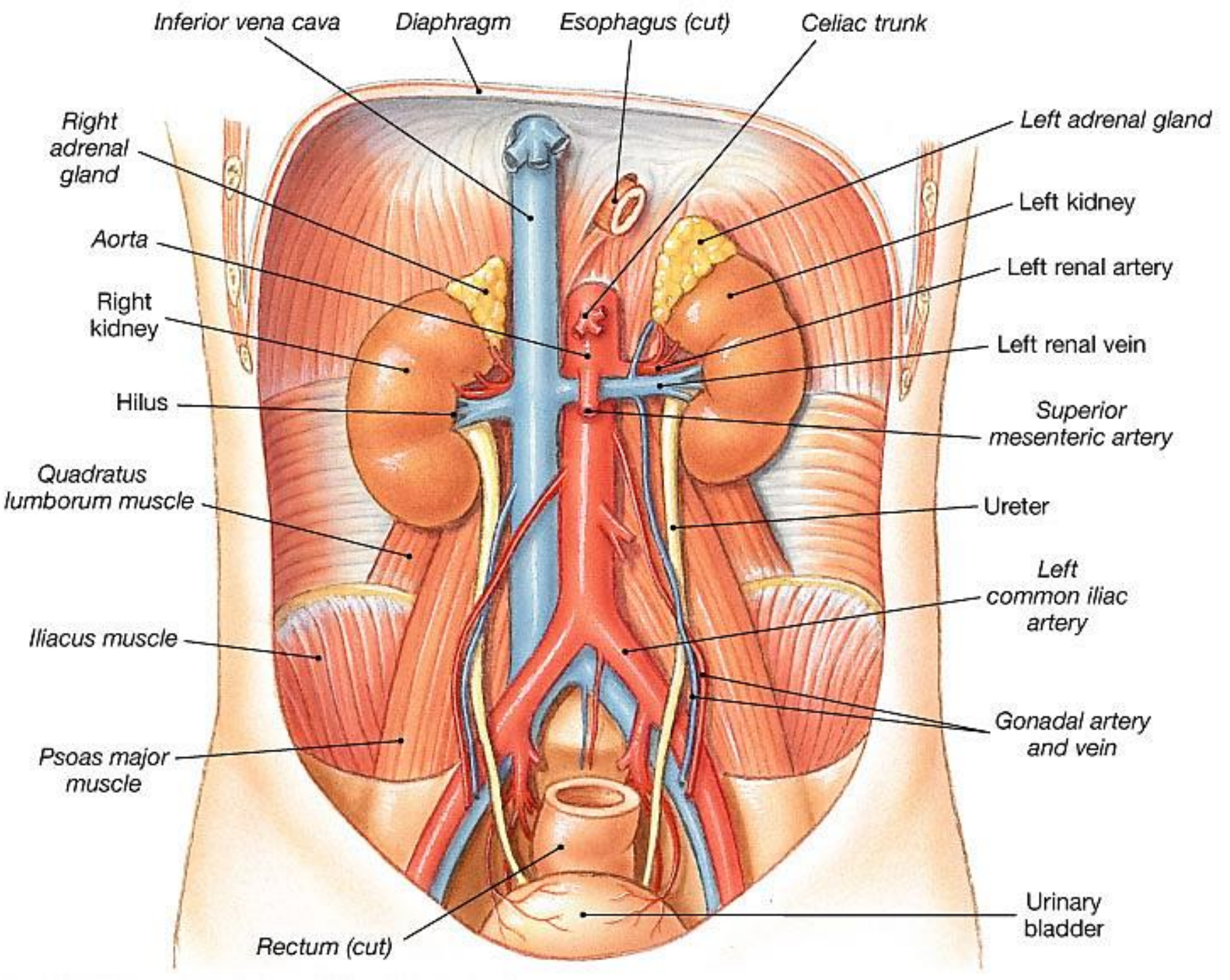
lymphatic pathways and nodes of the posterior abdominal wall



- CI, common iliac;
- EI, external iliac;
- II, internal iliac;
- L, lumbar;
- R, retro-aortic;
- S, sacral

The Ureters

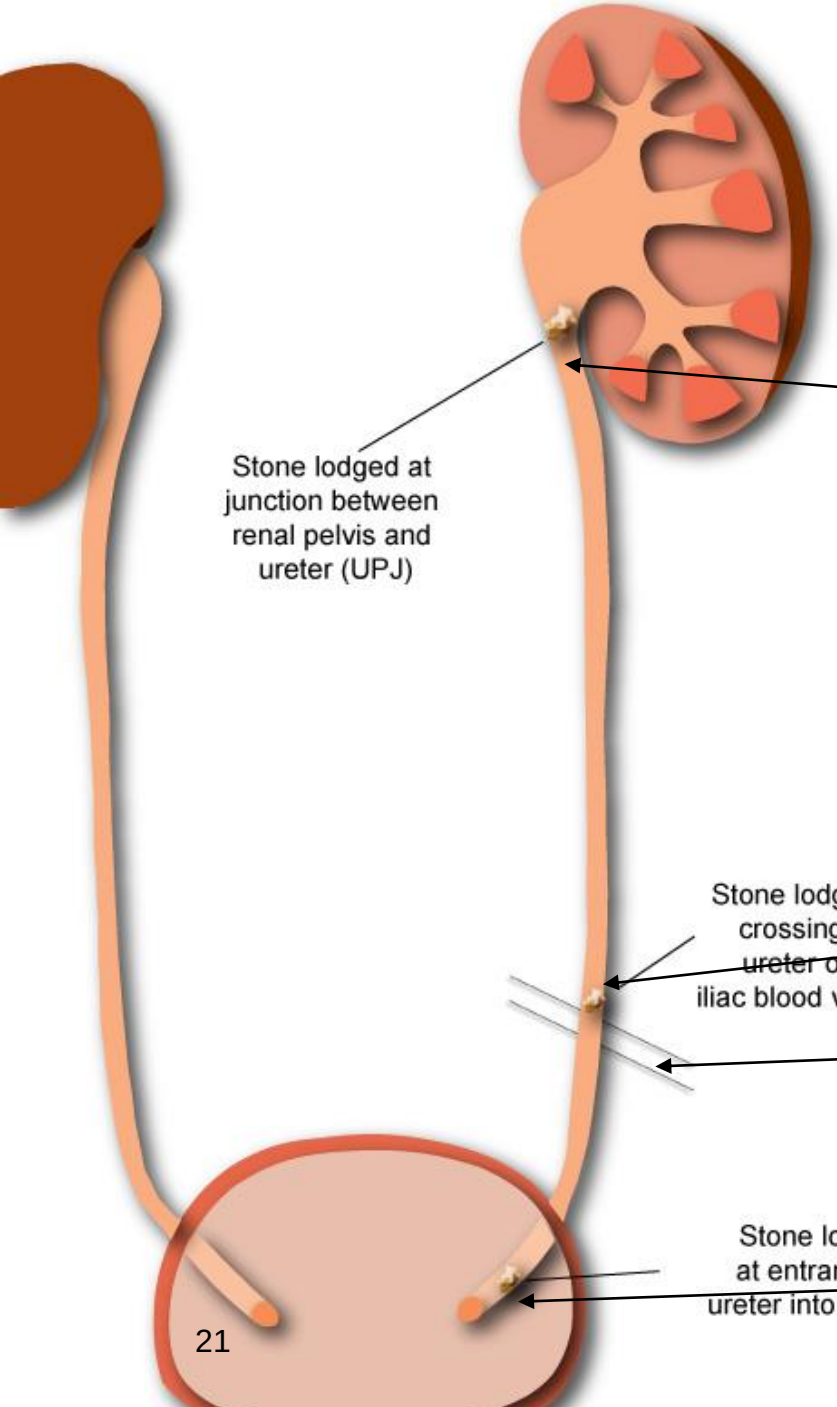
- Pair of muscular tubes
- Extend from renal pelvis to the bladder
- Peristaltic contractions force urine from the kidneys to the urinary bladder
- Oblique entry into bladder prevents backflow of urine



KIDNEY STONES

- They can block the ureter, causing the kidney to enlarge. As the kidney stretches, the capsule stretches, causing excruciating pain in cycles of hours. As pressure builds up from fluid accumulating around the stone, urine can pass, and the kidney stone moves down the urethra slowly.
- Symptomatic kidney stones may be pea sized or larger (up to 1 ½ inches).

Where kidney stones get stuck?



Renal pelvis & Ureter

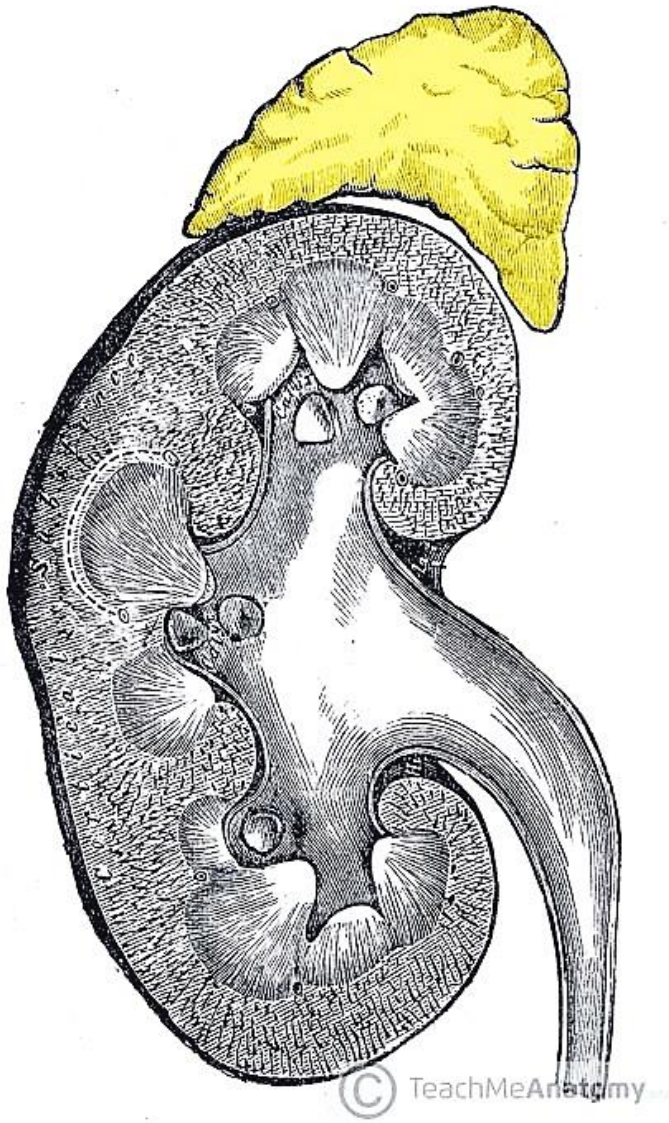
Ureter

Common iliac artery

Urinary bladder & Ureter at the Trigone

Kidney Stones

Depending on the level of obstruction, the pain of renal (actually ureteric) colic may be referred to the **lumbar or the hypogastric region or to the external genitalia.**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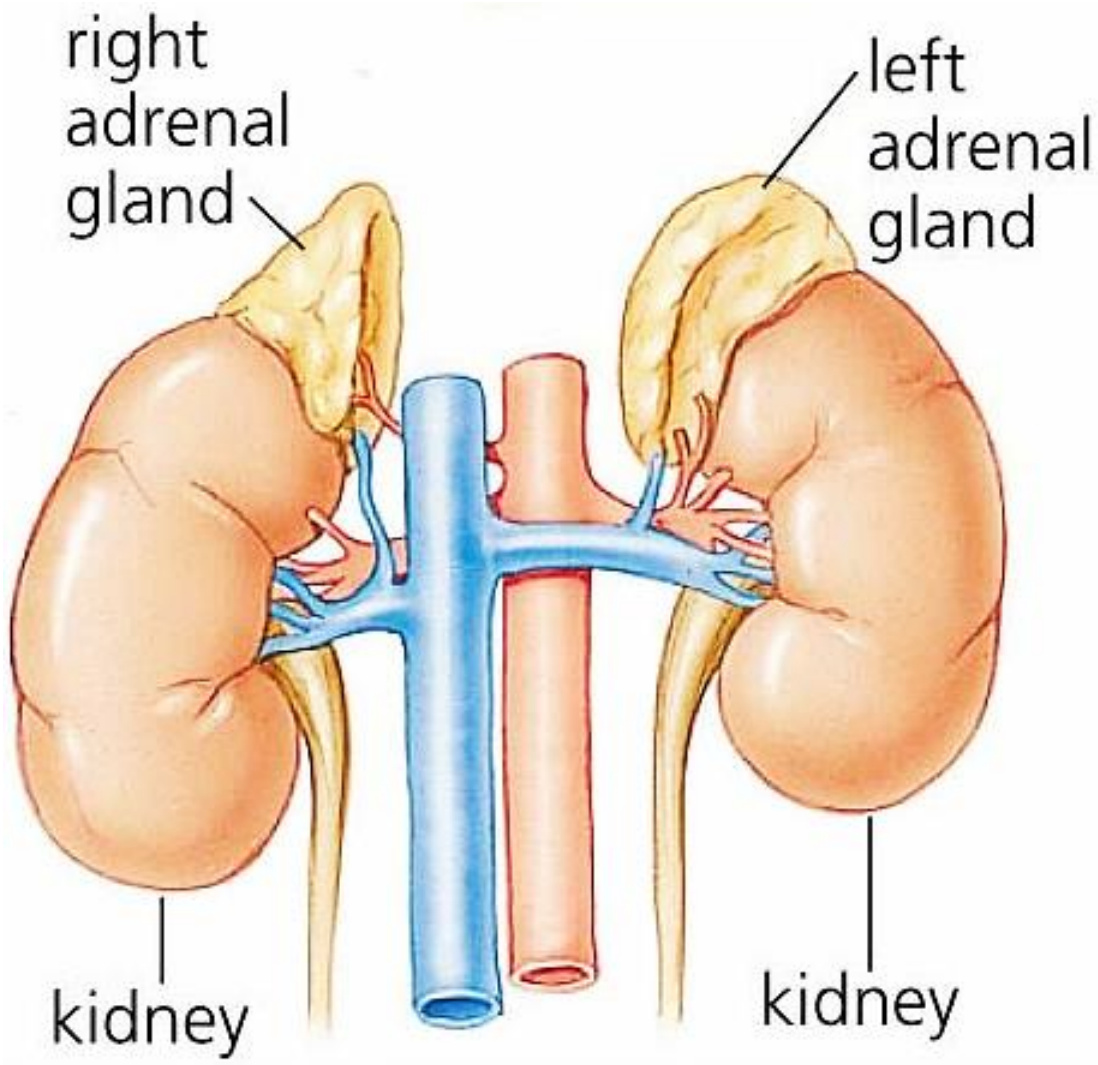
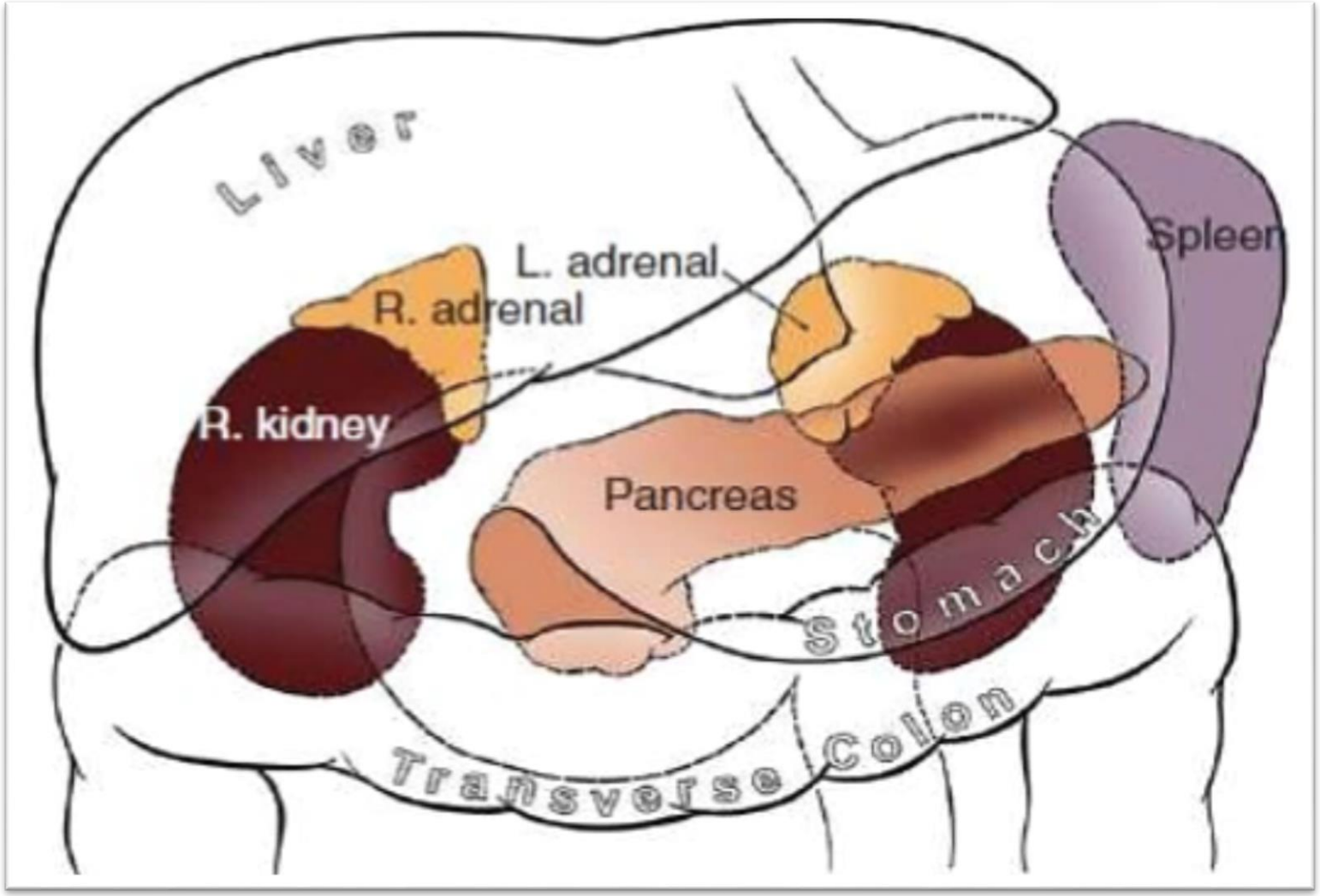
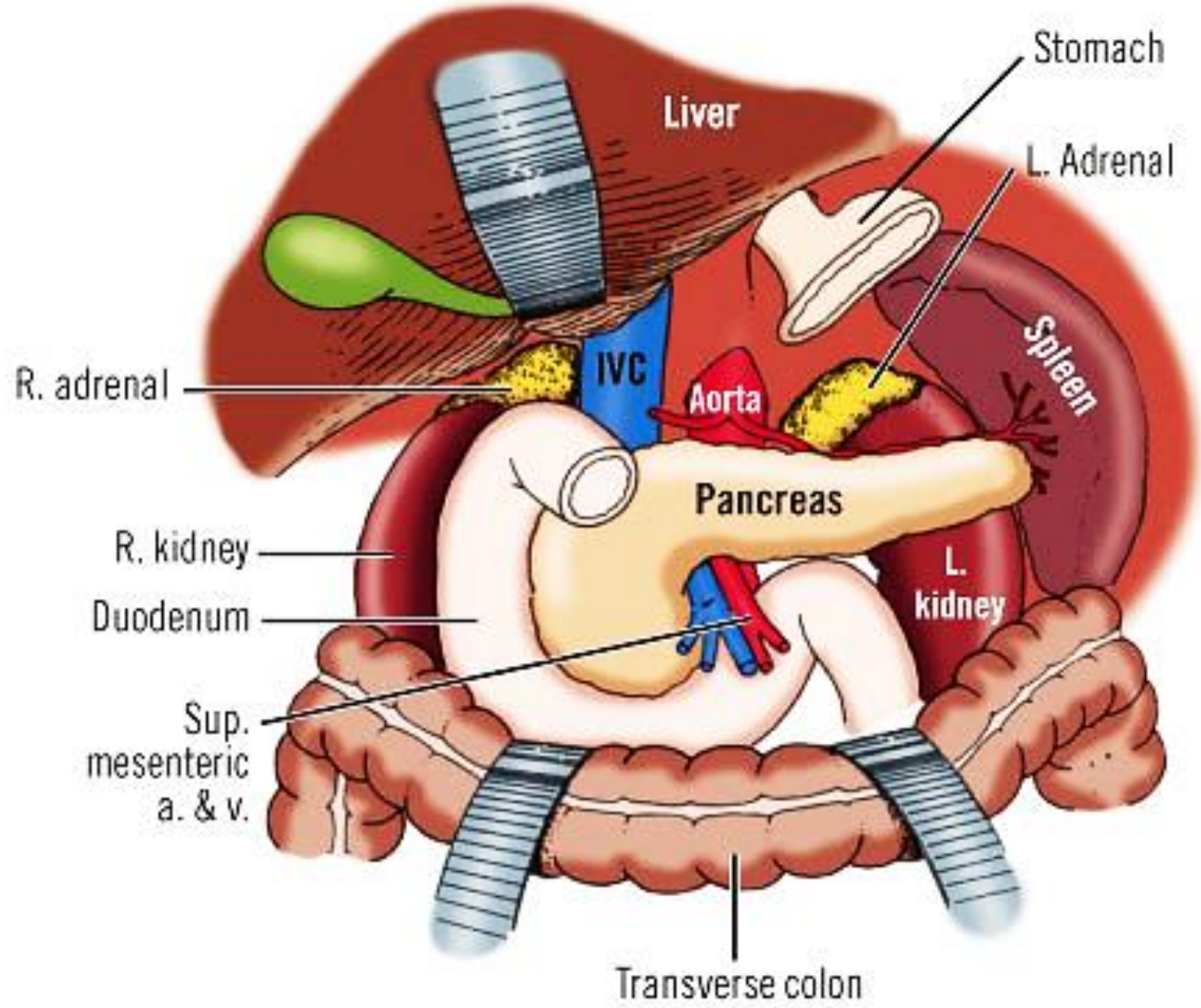
The Suprarenal Glands



Anterior Relations



Relations



Blood Supply