

SURFACE ANATOMY OF THE KIDNEY

I- General Features

The kidneys are retroperitoneal organs that lie high up on the posterior abdominal wall. Each kidney lies obliquely with its longitudinal axis parallel to the lateral border of the psoas major muscle. The lateral border is convex while the medial one is concave and contains the hilum.

The hilum of the right kidney lies just below, while that of the left lies just above the transpyloric plane, about 5 cm from the middle line. The hilum contains the renal vein anteriorly, the renal artery in the middle, and the ureter posteriorly. (*McMinn, 1994*).

Each kidney is about 10-12 cm in length, 5 to 7.5 cm in breadth, and rather more than 2.5 cm. in thickness. The left is somewhat longer, and narrower, than the right. The weight of the kidney in the adult male varies from 125 to 170 gm., in the adult female from 115 to 155 gm. The combined weight of the two kidneys in proportion to that of the body is about 1 to 240 (*Williams et al., 1995*).

II. General Renal Structure

The internal structure of the kidney is displayed when the organ is split open longitudinally (fig.1). A dark reddish and vascular cortex lies beneath the capsule and extends towards the renal sinus between the pyramids of the medulla as renal columns.

The renal pyramids are darker striated areas, triangular in outline. Their bases are peripheral while their apices converge to the renal sinus where they project into the minor calices as papillae, each minor calyx receiving from one to three of these structures. The minor calices unite with each other to form two or three major calices, which in turn fuse together to form the renal pelvis.

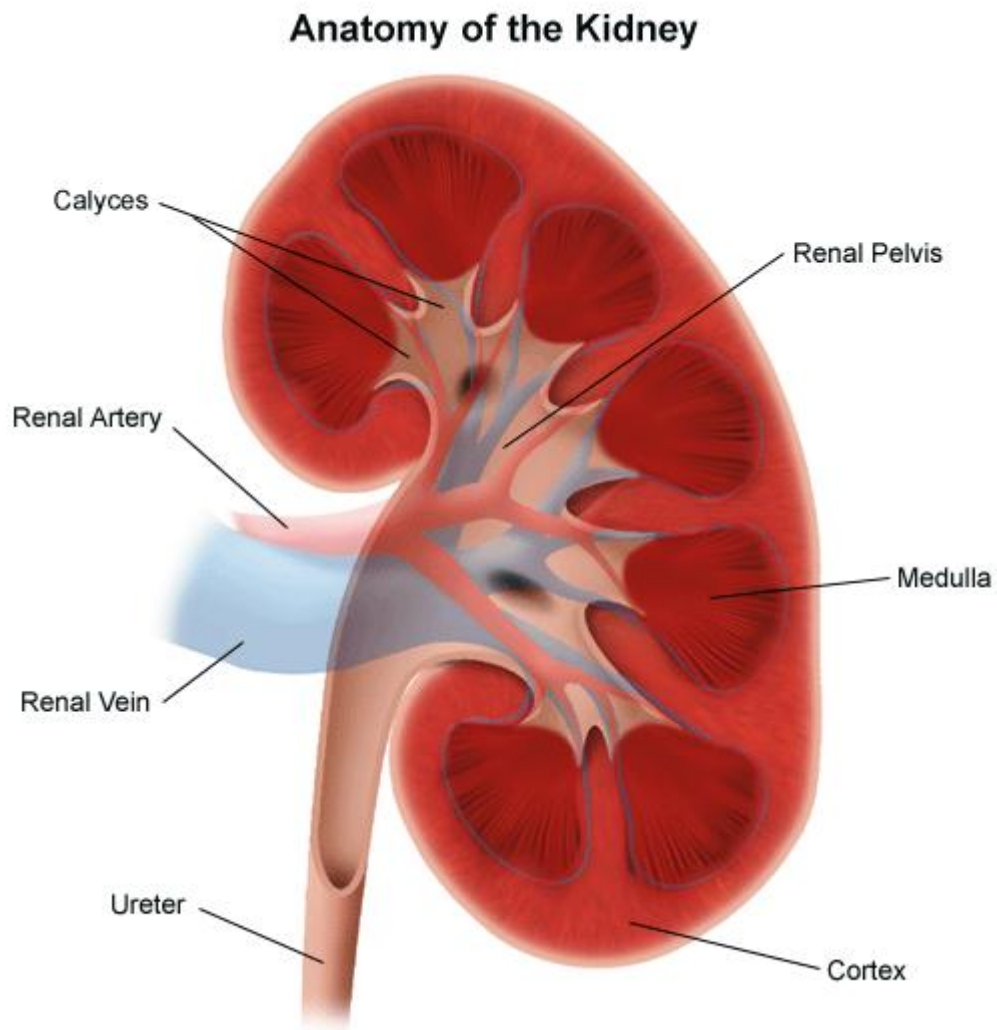


Fig. (1) The internal structure of the kidney.

Quoted from Smith's General Urology, 16th ed, 2003.

The cortex contains glomeruli and convoluted tubules. The medulla contains all the collecting tubules, the parallel arrangement of which gives the striated appearance to the pyramids. The renal sinus is formed of the pelvis of the ureter, both minor and major calices, and the renal vessels, inside the kidney (*McMinn, 1994*).

III. Renal Relations

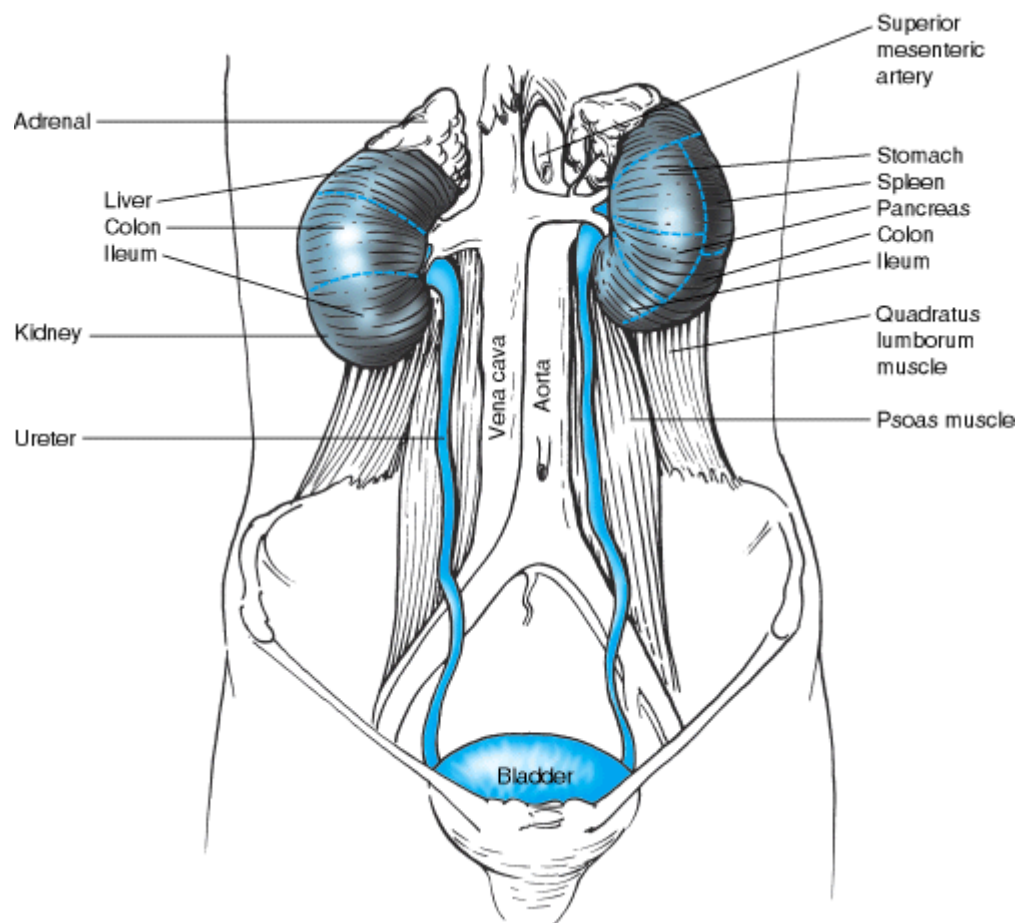
A. Anterior Relations

The convex anterior surface of the kidney faces antero- laterally. Its relations differ on both sides of the body (Fig. 2). On the right side, a small area at the superior pole contacts the right suprarenal gland. A large area below this (about three quarters) of the surface adjoins the renal impression of the right lobe of the liver, while a narrow medial area is related to the descending duodenum. Inferiorly, the anterior surface is related laterally to the right colic flexure, and medially to the small intestine.

The areas related to the small intestine and almost all those in contact with the liver are covered by peritoneum. However, the suprarenal, duodenal and colic areas are devoid of peritoneum (*Williams et al., 1995*).

As regards to the left side, a small medial area at the superior pole related to the left suprarenal gland. Approximately the upper-two thirds of the lateral half of the anterior surface related to the spleen. A central quadrilateral area lies in contact with pancreatic body and splenic vessels.

Above this area, a small variable triangular region, between the suprarenal and the splenic area in contact with the stomach. Below the pancreatic and the splenic areas, the lateral region is related to the left colic



flexure and the left descending colon, while the medial region adjoins the coils of the jejunum.

The gastric area is covered with the peritoneum of the omental bursa and splenic and jejunal areas are covered by the peritoneum of the greater sac. Behind the jejunal areas peritoneum, branches of the left colic vessels are related to the kidney. Suprarenal, pancreatic and colic areas are devoid of peritoneum (*Williams et al., 1995*).

B. Posterior Relations

Posteriorly, the relations of both kidneys are the same, composing mostly the diaphragm and quadratus lumborum muscles . The hilum of the kidney lies over the psoas muscle and the convexity of the lateral border lies on the apponeurosis of the transverses abdominis muscle. The upper pole lies on those fibers of the diaphragm, which arise from the lateral and medial arcuate ligaments, which separate the kidneys from the posterior recess of the pleura.

The subcostal vein, artery, and nerve, on emerging beneath the lateral arcuate ligament, lie behind the posterior surface of the kidney, as do the ilio-hypogastric and ilio-inguinal nerve (*Williams et al., 1995*).

C. Medial Border

The medial border is concave in the center and convex toward either extremity; it is directed forward and a little downward. Its central part presents a deep longitudinal fissure, bounded by prominent overhanging anterior and posterior lips. This fissure is named the hilum, and transmits the vessels, nerves, and ureter. Above the hilum the medial border is in relation with the suprarenal gland; below the hilum, with the ureter (*Williams et al., 1995*).

D. Lateral border

The lateral border is convex, and is directed toward the postero-lateral wall of the abdomen. On the left side it is in contact at its upper part, with the spleen (*Williams et al, 1995*).

IV. The Renal Fascia

The kidney and its vessels are embedded in peri-renal fat, which is thickest at the renal borders, and prolonged at the hilum into the renal sinus. Fibrous connective tissue surrounding this fat is condensed as the renal fascia (*Gerota's fascia*). The anterior layer of the renal fascia extends medially in front of the kidney and its vessels.

The posterior layer passes medially between the kidney and the fascia on the quadratus lumborum and psoas muscle. It also attaches to the vertebrae and intervertebral discs (*Williams et al., 1995*). Medially, the anterior and posterior layers do not form a well defined anatomic boundary, but fuse with the adventitia of the aorta and inferior vena cava. At the lateral renal borders, the two layers of renal fascia fuse to form the lateroconal fascia, which separates the peri-renal fat from the flank fat (*Lee et al., 1983*).

Superiorly, the two layers of renal fascia fuse above the suprarenal gland, while, below the kidney, the two layers are not firmly adherent together (*Williams, et al., 1995*).

The anterior pararenal space extends from the posterior parietal peritoneum anteriorly, to the anterior renal fascia posteriorly. This space contains the pancreas, the duodenum and the descending and ascending colon. The anterior pararenal spaces are continuous across the midline.

The perirenal space is bounded anteriorly by the anterior renal fascia, and posteriorly, by the posterior renal fascia. It contains a variable quantity

of fat, the kidney, adrenal, and the proximal ureter.

The posterior pararenal space extends from the posterior renal fascia to the fascia overlying the quadratus lumborum and the psoas muscle. It has a variable medial extent and is open laterally towards the flank. It contains no retroperitoneal organs (*Harell, 1985*).

V. Renal Blood Vessels and Lymphatics

The arterial supply to the kidneys is through the renal arteries which arise from the lateral side of the abdominal aorta, at the level of the second lumbar vertebra. The venous drainage is through the renal veins which drain into the inferior vena cava.

The lymphatics of the kidney drain to the para-aortic lymph nodes, at the level of origin of the renal arteries. The upper pole may drain through the diaphragm into nodes in the posterior mediastinum (*McMinn, 1994*).