IMAGING OF NORMAL KIDNEY BY DIFFERENT MODALITIES

ESSAY
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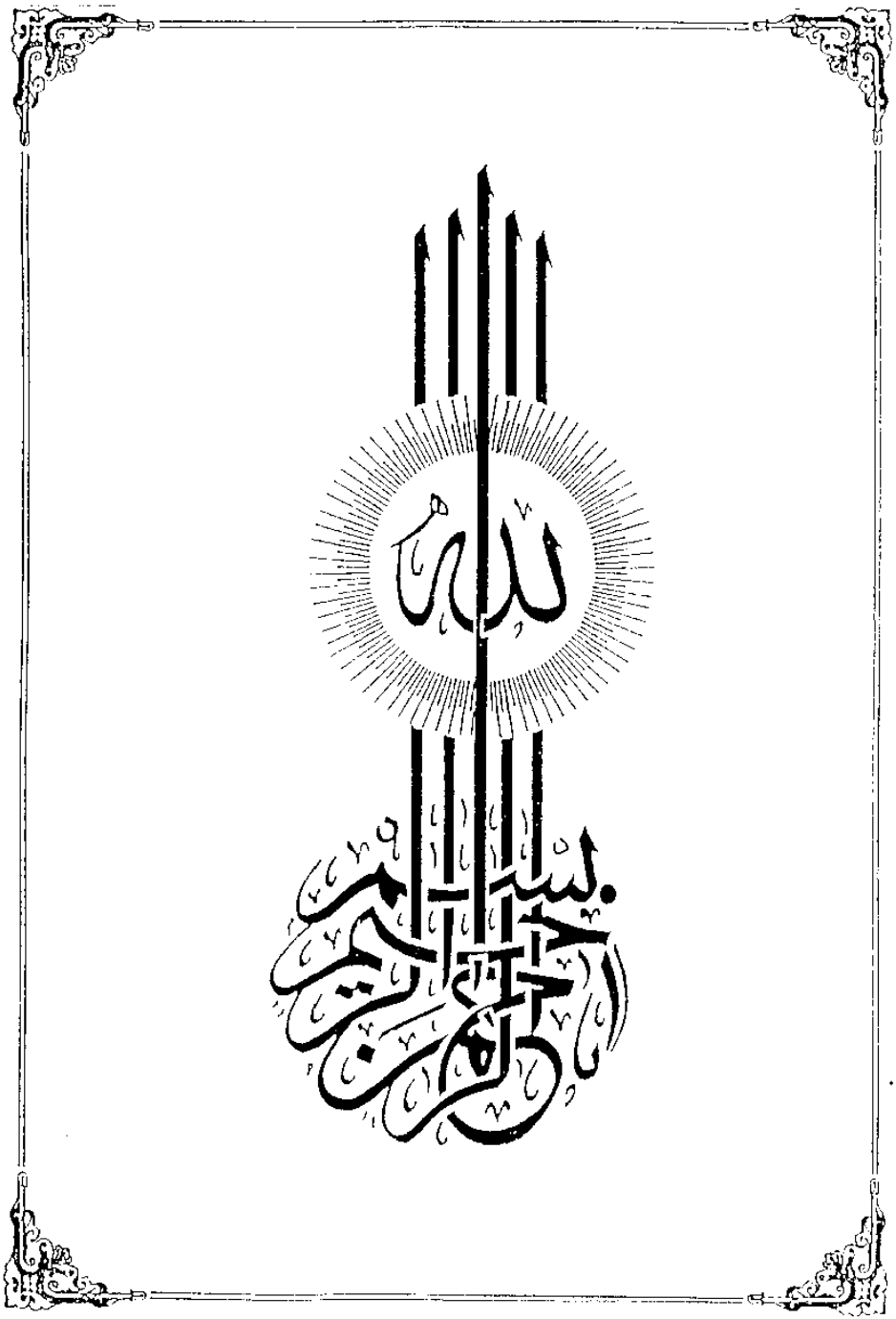

INTRODUCTION AND AIM OF THE WORK

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The developments during the last few decades of imaging techniques is tremendous.

The availability of such techniques may lead to unnecessary applications. Thus the value and limitations of the different techniques should be clearly assessed.

Probably the best way to assess this value is the normal. The normal anatomical structure of the kidney is to be studied using the different imaging modalities aiming to classification of the normal imaging anatomy by the different techniques as well as comparing and assessing the value of these techniques.

Therefore we study:

- Normal gross anatomy of the kidney.
- Normal renal radiological anatomy in P.U.T. & I.V.U.
- Normal renal vascular anatomy.
- Normal renal sonographic anatomy.
- Normal renal CT anatomy.
- Normal renal scintigraphy

GROSS ANATOMY OF THE KIDNEYS

ANATOMY OF THE NORMAL KIDNEY

Position:

The kidneys are two reddish-brown organs situated in the posterior part of the abdomen one on each side of the vertebral column, behind the peritoneum. They are surrounded by fat and some areolar tissue, ***[Olsson, 1986].***

They lie in the lumbar region extending from the twelvth thoracic vertebral body to the upper two or three lumbar bodies, ***[Roman's, 1975].***

The upper pole lies more medially than the lower pole, the long axis making an angle of about 20^{o} with the midline and follows the line of the psoas muscle. The kidney lies obliquely at an angle of about 45^{o} with the pelvis lying antero-medially and the calyces postero-laterally, ***[Simon & Hamilton, 1978].***

The right kidney is slightly inferior to the left, probably on account to its relationship to the liver. The left is little longer and narrower than the right and is slightly nearer to the median plane, ***[Gray, 1984].***

Size of the kidneys:

The kidneys are usually about the same size. In adults, the length varies between 10 and 15 cms, and 5 to 7.5 cm. in width and 2.5 to 3.5 cm. in thickness and weighs from 115 to 170 gms, ***[Emmet and Witten, 1971].***

Shape of the kidney:

The kidneys are ovoid in outline, the lateral borders are convex, but medially they are deeply indented and concave at their middle, ***[Romane's 1975].***

In the middle there is a deep vertical fissure opening anteromedially termed the hilum which is bounded by an anterior and posterior lips and contain the renal vessels and nerves and the funnel shaped continuation of the upper end of the ureter: the renal pelvis.

The relative position of the main hilar structures are as follows: The renal vein infront, the renal artery in the middle and the pelvis of the kidney behind.

The hilum leads to a central recess named the renal sinus which is lined by a continuation of the capsule of the kidney and is entirely filled by the pelvis of the kidney and

the renal vessels. Numerous nipple like elevations termed the renal papillae indent the wall of the sinus. The renal pelvis extends outside the hilum to become continuous with the ureter. ***[Fig. 1]***

Within the sinus, the pelvis devides into 2 and sometimes 3 large branches which are named the major calyces and each of these devides again into several short branches named the minor calyces. In all, there are usually from 7 to 13 of these minor calyces. Each expands as it approaches the wall of the renal sinus and the expanded end is indented and moulded around from 1 to 3 renal papillae. The wall of the expanded end of each calyx is firmly adherent to the capsule lining the renal sinus. It is performed by the collecting tubule which open on the summits of the renal papillae, ***[Gray, 1984].***

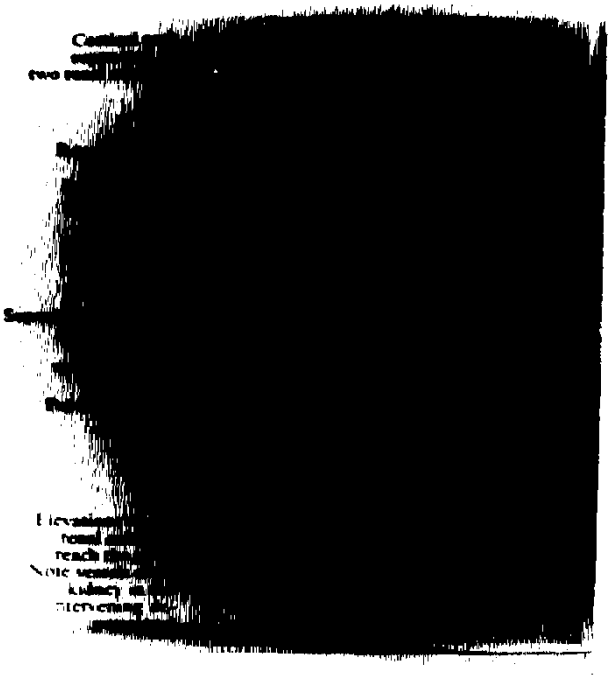

Fig. (1)
Internal structure of the kidney
(Quoted from Urologic Radiology, 1984)

The Kidney in Longitudinal Section:

The kidney is surrounded by a thin fibrous capsule which can be easily striped off from the kidney substance. The kidney tissue is differentiated into:

Cortex:

It lies under the capsule. The cortical tissue extends between the pyramids of the medulla to form the renal columns. The cortex contain the glomeruli and portions of the tubules.*[Fig. 2] , [Morley et al., 1983].*

Medulla:

It is composed of 10 to 18 conical masses which are called the renal pyramids. The bases of the pyramids are directed towards the renal cortex, while their apices, are directed towards the renal sinus. The apices of the pyramids, the renal papillae, are surrounded by the commencement of the minor calyces. Each pyramid with the overlying cortex constitutes a renal lobe. Lobulation of the kidney is distinct during foetal life but disappears in the adult human life. *[Gray's 1984].*

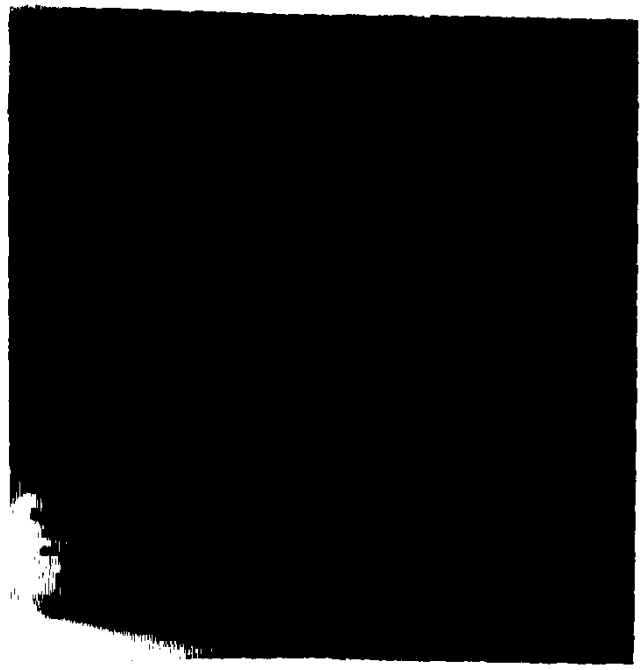

Fig. [2]
Slab cut from kidney to show texture of cut surface.
(Quoted from urologic Radiology, 1984)

ANATOMIC RELATIONS OF THE KIDNEYS

The anterior surface of the normal kidney is convex and it actually faces anterolaterally. Its relation to adjacent viscera differ on the two sides of the body.*[Fig. 3]*

Anterior relations of the right kidney:

A small area of the superior pole is in contact with the right suprarenal gland which may overlap it. A large area just below this and involving about 3/4 of the surface lies in the renal impression; which lies in the right lobe of the liver. A narrow area near the medial border is in contact with the descending part of the duedenum. Inferiorly the anterior surface is in contact laterally with the right colic flexure and medially with part of the small intestine.

The area in relation with the small intestine and almost the whole area in contact with the liver are covered with peritoneum.

Anterior relation of the left kidney:

A small area along the posterior pole of the medial border is in relation with the left suprarenal gland. About the upper 2/3 of the lateral half of the anterior surface is in

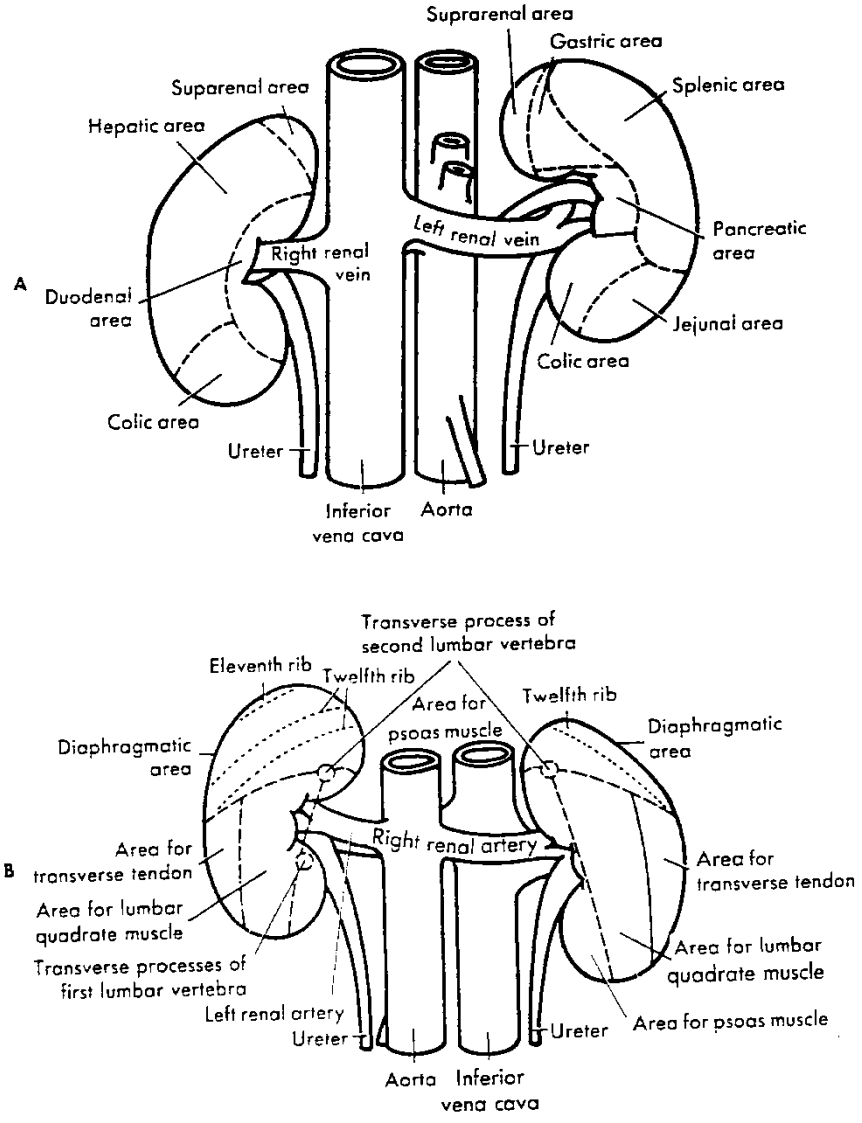

Fig. (3)

Anatomic relations of the kidneys.

(Quoted from Computed tomography of the whole body 1983).

contact with the renal impression of the spleen. A somewhat quadrilateral field about the middle of the anterior surface is incontact with the body of the pancreas and the splenic vessels.

Above this there is a small triangular region between the suprarenal and the splenic areas which is incontact with the stomach.

Below the pancreatic and the splenic areas the lateral part is in relation with the left colic flexure and the commencement of the descending colon. And the medial part with the first coils of jujenum.

The area adjacent to the stomach, spleen and jujenum are covered with peritoneum.

Posterior relations of the right and left kidneys:

The posterior surface of both kidneys are devoid of peritoneal covering.

The kidney lies upon the diaphragm, the medial and lateral arcuate ligaments, psoas major, quadratus lumboram and aponeurotic tendon of the transversus abdominus muscles, the subcostal nerve and vessels, iliohypogastric and ilioinguinal nerves.