RECENT IMAGING MODALITIES IN DIAGNOSIS OF RENAL ARTERY STENOSIS

ESSAY

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In Radio-diagnosis

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List of abbreviations

Abbreviations	*Meaning.*
AP	Antero-posterior.
ACE	Angiotensin converting enzyme.
CT	Computed tomography.
CTA	Computed tomographic angiography.
Cm	Centimeter.
DSA	Digital subtraction angiography.
2D	Two dimensions.
3D	Three dimensions.
ESP	Early systolic peak.
L1	First lumbar vertebra.
MIP	Maximum intensity projection.
MPR	Multiplanner reconstruction.
MRA	Magnetic resonance angiography.
MRI	Magnetic resonance imaging.
MSCT	Multislice computed tomography.
MAG3	Mercaptoacetyl triglyceride.
PSV	Peak systolic velocity.
PESDA	Per fluorocarbon exposed sonicated albumin.
PAT	Parallel acquisition technique.
PC	Personal Computer
RI	Resistive index.
RAS	Renal artery stenosis.
RSNA	Radiology society of North America
SSD	Shaded surface display.

Sec	Second.
SMA	Superior mesenteric artery.
SIR-RAGE	Selective inversion recovery rapid gradient echo.
T1	Time 1.
T2	Time 2.
T12	12th thoracic vertebra.
Tc	Techniciam.
TOF	Time of flight.
TONE	Tilting optimized non saturating excitation.
US	Ultrasound.
VR	Volume rendering.

INTRODUCTION

Hypertension is a major cause of disability and death throughout the world. Renal artery stenosis is an etiological factor for a small but significant component of this disease with varying estimation of prevalence from ١%-١٠% of patient with hypertension screened (DeCobelli et al., ١٩٩٦).

With the increase in prevalence of renal artery stenosis and ischemic nephropathy, clinicians dealing with renovascular disease need noninvasive diagnostic tools and effective therapeutic measures to resolve the problem successfully. (Bruce S Spinowitz, Joanna Rodriguez. ١٩٩٦).

AIM OF THE WORK;

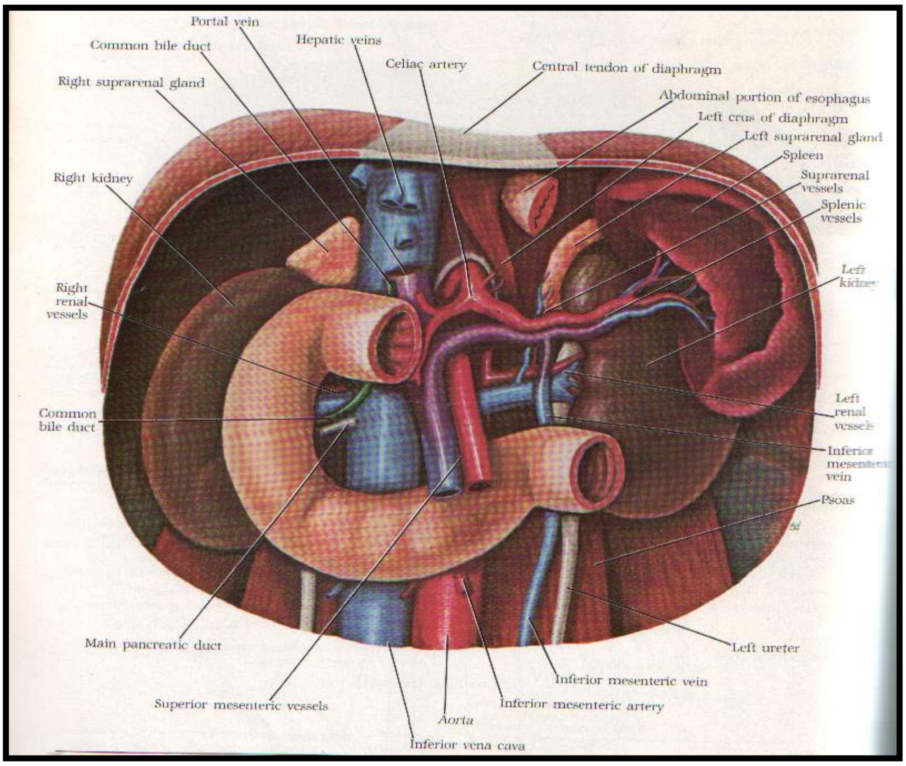
This work is Aiming at describing recent modalities in imaging of renal artery stenosis, their role in the diagnosis, illustration of the advantages and limitations in each of them.

ANATOMICAL CONSIDERATIONS

The kidneys are two in number, are situated normally in the retroperitoneal space in the loins. They line one on each side of the vertebral column, surrounded by fat and loose areolar tissue, which is known as the perinephric fat. This fat acts as a cushion helping to keep the kidney in place. Each kidney lies obliquely, with its long axis parallel to the lateral border of psoas major. The vascular pedicle lies in the paravertebral gutter, so that the hilum faces somewhat forwards as well as medially. The kidney's upper pole is at the same level as the twelfth thoracic vertebra, with the lower level being at the third lumber vertebrae. Their normal size measures approximately about ١٢x٦x٣ cm and weights around ١٣٠ grams ***(Grey et al., ١٩٨٤, Last, ١٩٨٧).***

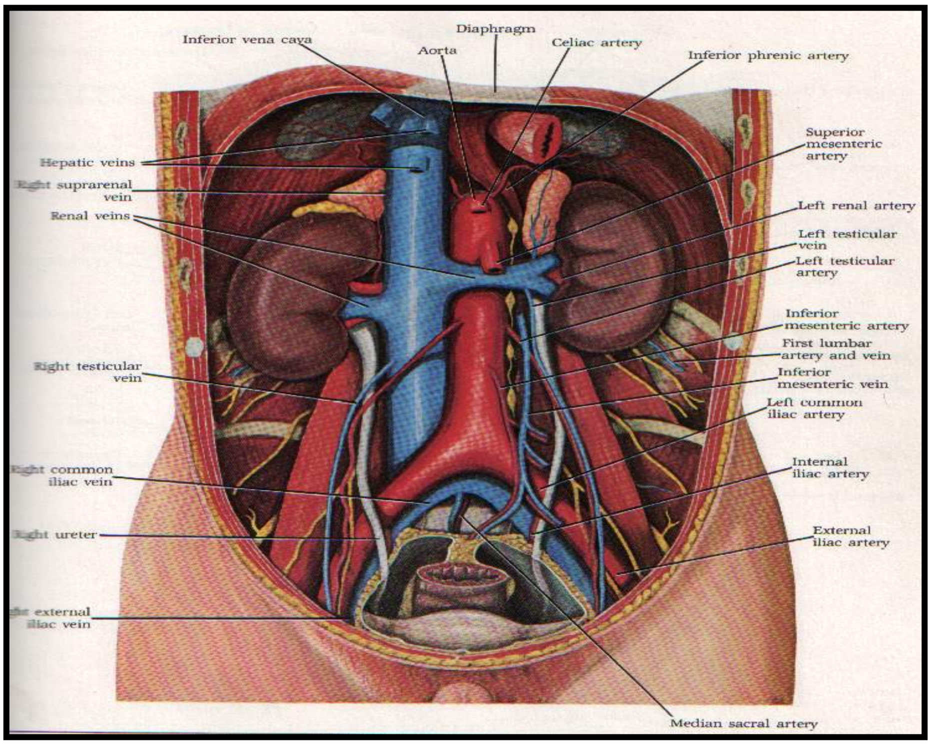
The kidney is surrounded by a capsule, which gives it a glistening appearance. It is bean shaped, concave medially and convex laterally, with flattened sides, the upper pole being larger than the lower pole. ***(Solomon et al., ١٩٨٣)***

The relations of the kidney are roughly symmetrical **(Fig. ١).** Posteriorly the relations are the same comprising mostly the diaphragm and quadratus lumborum muscles. Which overlap medially on to the psoas and laterally on the transversus abdominus muscle. The posterior recess of the pleura is posterior to the kidneys **(Fig. ٢)**. The anterior relations are: On the right side the second part of duodenum, under- surface of the liver, hepatic flexure of the colon, spleen, stomach and the lienorenal ligament, the suprarenal glands lie along side the upper part of each kidney ***(Last, ١٩٨٧).***



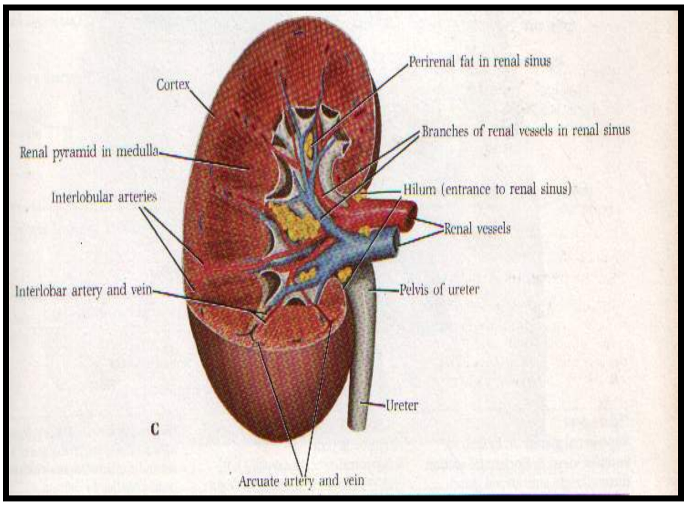
(Fig.١) ***(Quoted from Snell, ١٩٨٧)***

The suprarenal glands are somewhat asymmetrical with the right gland being pyramidal in shape and surround the upper pole of the right kidney. It lies between the inferior vena cava and right crus of the diaphragm, coming in contact with the bare area of the liver. The left gland is crescentic in shape and drags the medial border of the left kidney above the hilum. The lower pole is covered anteriorly by the tail of the pancreas and forms part of the stomach bed. It lies on the left crus of the diaphragm ***(Last, ١٩٨٧).***



(Fig. ٢) (Quoted from Snell, ١٩٨٧)

The hilum of each kidney consists of the main structures passing in and out of them, which are; the renal vein in front, which drains into the inferior vena cava, the artery in the middle, usually originating from the abdominal aorta and the ureters behind **(Fig, ٣)**. The renal vascular pedicle is a term representing both the artery and vein within the hilum. ***(Grey et al., ١٩٨٤)***



(Fig . ٣)(Quoted from Snell, ١٩٨٧)

Arterial supply

The renal arteries are two large trunks, which arise from the sides of the aorta immediately below the superior mesenteric artery at the level of the second lumber vertebra. The right renal artery often leaves at a slightly higher level than the left. They then run downwards across the crus of the diaphragm to form nearly a right angle with the aorta. The right side runs behind the inferior vena cava, right renal vein, head of pancreas and the descending part of the duodenum. The left side is of shorter course, passing behind the left renal vein, body of the pancreas and splenic vein with the inferior mesenteric vein passing anterior to it ***(Williams et al., ١٩٩٥).***

Before reaching the hilum of the kidney, each renal artery divides into four or five segmental branches. The first and most constant branch is the posterior branch, which proceeds posterior to the renal pelvis to supply a large posterior segment of the kidney. The anterior division of the main renal artery branches as it enters the renal hilum it further divides into four anterior segmental branches. These branches from superior to inferior are, apical, upper, middle, and lower anterior segmental arteries ***(Walsh et al., ١٩٩٢).***

These divisions of the renal artery are responsible for the renal vascular segmentations which are the following five segments.

١. **Apical;** involving the anteromedial region of the superior pole.

٢. **Upper (Superior);** including the rest of the superior pole and central anterosuperior region.
٣. **Middle (Anterior);** between the upper and lower segments.
٤. **Lower (Inferior);** includes the entire lower pole.
٥. **Posterior;** involving the entire posterior region between the apical and inferior segments ***(Williams et al., ١٩٩٥).***

These segmental branches pass through the renal sinus and branch further into lobar arteries, which divide again to enter the renal parenchyma as interlobar arteries pass outward between the pyramids of Ferrin to reach the capsule, where they terminate in the capillary network there. At the base of each pyramid, the interlobar arteries branch into arcuate arteries, which form an arch parallel to the renal contour at the cortico medullary junction ***(Walsh et al., ١٩٩٢).***

These arcuate arteries give multiple lateral branches, which are the afferent arterioles to the glomeruli. Blood leaves the glomerular capillary network by the efferent arteriole, which exits the glomerulus alongside the afferent arteriole. These efferent arterioles then either form a secondary capillary network around the urinary tubules in the cortex or descend as straight vascular loops into the renal medulla or "Vasa recta"***(Walsh et al., ١٩٩٢).***

In both cases these postglomerular capillaries drain into interlobular veins and thus into arcuate, lobar and segmental veins which coalesce as the main renal vein within the renal sinus. The renal parenchymal veins anastmosis freely especially at the level of arcuate vessels completely unlike the renal arteries. Also the interlobular veins communicate via a subcapsular venous plexus or satellite vein with veins in the perinephric fat ***(Walsh et al., ١٩٩٢).***

Normal variants

I Accessory Renal Arteries:

Almost one quarter to one third of individuals have variations of the main renal artery. The most common being the occurrence of supernumerary renal arteries, two or more to a single kidney. These usually arise from the lateral aorta and may enter the renal hilum or directly into the parenchyma of one of the poles of the kidney, with the upper pole being the most common. Supernumerary arteries on the right side going to the lower pole tend to cross anterior rather than posterior to the inferior vena cava. Lower pole arteries on both sides must cross anterior to the