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A Study of blood vessel patterns of kidneys and its implications in the surgical management.

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Abstract:

Background:
Blood supply to the kidneys has to be thoroughly studied because it is very peculiar and also the fact that almost one liter of blood flows through both the kidneys per minute makes it very important to know the structure and distribution. One wrong step during surgical procedure can be catastrophic so this has to be studied before any surgeries and planned out thoroughly. This study puts in an effort to find the common varieties and also the variations that has to be known to the operating surgeons.

Materials and Methods:

Thirty patients who would be operated for different renal pathologies would be made to undergo the HR-CT renal angiography and the different types of variations were reported.

Result:

In the upper extra polar group the apical segment was observed to be having dual arterial supply.

In the lower polar one had a single artery which supplied the inferior segment and the other one had two. One supplied the inferior segment and the other one supplied the middle segment which crossed each other.

Conclusion:

The arterial variations is successfully identified and discussed. The operating surgeon should know the most commonly encountered arterial variations.

Keywords: CT Renal Angiography, Arterial Pattern, Partial Nephrectomy.

Introduction:

The Kidneys are supplied by a pair of renal arteries which are in turn the branches of the abdominal aorta. The aorta lies on the left side of the vertebral column so the right renal artery is a bit longer than the left one. The kidneys are

known to have a very rich blood supply. Approximately about one liter of blood passes through the kidneys per minute. There have been cases where some accessory renal arteries have been reported to supply the kidneys.

Renal arteries divides into segmental arteries which are 5 in number are end arteries [1,2]. Some variations are also reported [3,4]. Some authors in their studies [5,6] have successfully described the branches of the renal arteries and their corresponding veins. [3] on the other hand, in his observation of corrosion casts of human kidney, found variation in the branching pattern of the renal artery. The middle segmental artery has been described on the anterior surface in the lower central part [7,8]. The posterior segmental artery was present on the posterior surface [9]. If there are any mid-portion lesions, either the enucleating technique or partial nephrectomy is indicated, [10].

There is a distribution pattern of renal artery. The Renal artery reach the hilum by passing in between the Renal vein and Pelvis of ureter, divinding into Anterior and posterior trunks. The Pattern of division of Anterior trunk is such after passing through the pelvis, it subdivides into four segmental arteries namely apical upper and anterior,middle and anterior, inferior. While the posterior trunk continues as posterior segmental artery. Further the segmental arteries divide into lobar branches, each of which subdivide into two interlobar artery divides into arcuate artery to interlobular arteries.Contents of renal sinus are supplied by segmental artery. Interlobar arteries pass between adjacent pyramids and the arching arteries over base of pyramids that is arcuate arteries arise at the junction of the cortex and medulla. The interlobular arteries arising from arcuate arteries form the divides and for subcapsular plexus. Further these arteries give rise to afferent arterioles and efferent arterioles. Afferent arterioles form glomerular plexus which in turn forms efferent arterioles. Efferent arterioles supply the blood for the extensive network of capillaries that surround the cortical and medullary tubular system of the kidneys, known as the peritubular capillary network. The efferent arterioles leads to peritubular plexus around proximal and distal convulated tubules. Blood then passes to inferior venacava through interlobular veins, arcuate, interlobar, lobar, and renal veins. Renule is the part of kidney supplied by lobar artery. Renal blood passes through two sets of capillary plexus namely glomerular and peritubular plexus. These are connected by efferent glomerular arterioles [11].

This study puts in an effort to find the common varieties and also the variations that has to be known to the operating surgeons.

Aims and Objectives:

To study the common varieties and also the variations that has to be known to the operating surgeons.

Materials and Methods:

This study was done in the Department of Urology, K.S.Hegde Medical Academy, Mangalore. The sample size of the study was 30.

Thirty patients who were admitted for various renal pathologies and were supposed to go undergo the surgery were selected randomly and were made to undergo the CT renal angiography so as to study the pattern and variations if any.

The patients who underwent were explained the procedure and the written consent were taken. Then the patient was shifted to the Department of Radio-diagnosis where he was made to undergo the CT renal angiography. After taking the patients history, consent was taken again and I V cannulation was accessed. The dye was checked for sensitivity and then was injected.

The common patterns were noted and any other variations were checked.

Results:

Graph 1: Age Distribution

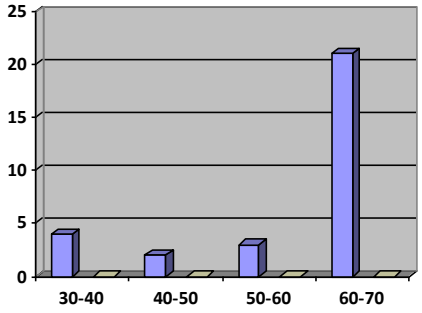

Table 2: Sex Distribution:

Male	Female
19	11

Image 1 and 2: Showing extra branches from the aorta to the lower poles of the kidney

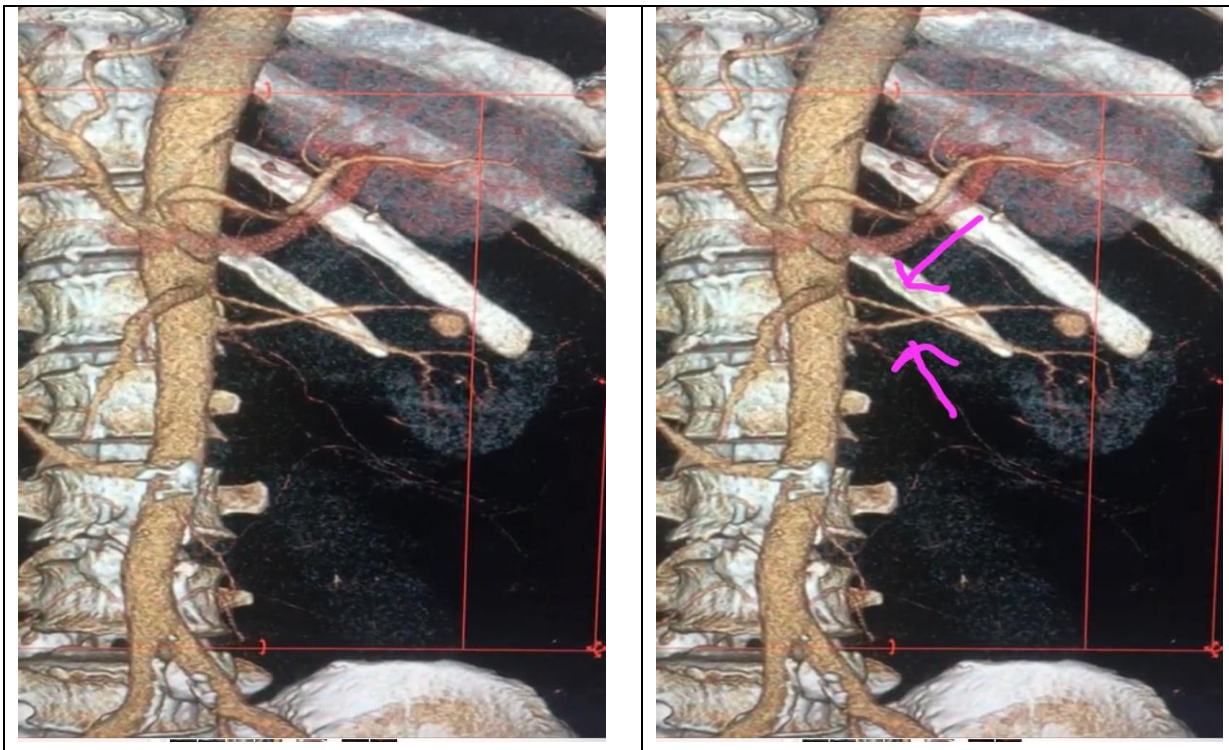

Table 4: Accessory Renal Arteries that supply the Kidneys (These were found to be extra apart from the normal hilar artery)

Condition	Frequency
Arteries supplying the lower pole	2
Arteries supplying the upper pole	1

Table 5: Variants of the main trunk observed:

Hilar Artery (Artery which goes into the hilum)	26
Upper Extra Hilar (Artery from the hilar artery goes to the upper pole)	2
Lower Extra Hilar (Artery from the hilar artery goes to the lower pole)	1
Early Bifurcation	1

Inner Arrangements:

Out of thirty, twenty seven showed the textbook described pattern of subdivision of the artery into one posterior and one anterior branches. Then the segmental arteries from the anterior branch showed the apical, superior, middle and inferior distribution. These were found in the Hilar Artery (Artery which goes into the hilum) group in 23 cases, Upper Extra Hilar (Artery from the hilar artery goes to the upper pole) group in 2 cases and the Lower Extra Hilar (Artery from the hilar artery goes to the lower pole) group in one case.

In the bifurcation group the inferior was supplied by the posterior division.

In the upper extra polar group the apical segment was observed to be having dual arterial supply.

In the lower polar one had a single artery which supplied the inferior segment and the other one had two. One supplied the inferior segment and the other one supplied the middle segment which crossed each other.

Discussion:

The causes of the following deviations may be answered by the embryological development and also the molecular biology of the development.

The collecting and the excretory part of the developing metanephros first join together in the pelvic cavity. Here it receives the arterial supply from the median sacral artery. Gradually the kidney ascends and reaches the iliac fossa. Here it gets its blood supply from the common and the internal iliac artery. Then it ascends again to reach its final destination, the under-surface of the diaphragm. The further ascent is checked by the developing supra-renal glands. Here it draws its blood supply from the lowest supra-renal arteries. This branch persists as the permanent blood supply. Along with embryology molecular biology lays the foundation to the possible answers for such variations. Vasculogenesis is a process whereby the vessels are developed from islands of blood that has the capacity to form small vessels. Angiogenesis is a process where in the blood vessels come into existence by the previous precursor blood vessels. Vasculogenesis is induced when fibroblast growth factor 2 (FGF-2) binds to its receptors on the

mesodermal cells which have the specific capacity to form blood vessels. So in short, differentiation of mesoderms into hemangioblasts are induced by FGF-2 . These hemangioblasts are differentiated into angioblasts which further proliferates and subsequent coalescence of endothelial cells forms the wall of primitive blood vessels. Subsequently sprouting of new blood vessels from angioblasts is mediated by vascular endothelial growth factor (VEGF). Final modeling and stabilization is accomplished by platelet derived groth factor (PDGF) and transforming growth factor beta (TGF β).

Implications:

Multiple renal vessels pose a challenge in the field of Urological practice. They might be a source of bleed post PCNL during which the embolization might be difficult to achieve. Multiple renal arteries make the transplant surgeries challenging which need a meticulous planning and Surgery. The surgical procedure should be precise so that graft kidney should function well post transplantation.

Conclusions:

The renal artery pattern should be well studied before any surgery of the organ. Before any Transplantation surgery there should be a good understanding of the vascular integrity of the organ. Also some of the variations that are mentioned above may pose a threat in nephrectomy especially partial when considered.

Roles in the study:

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References:

1. Brodel M. Intrinsic blood vessels of the kidney and their significance in nephrectomy. Bull John Hopkins Hosp. 1901;10:118.
2. Grave FT. The anatomy of intrarenal artery and its application to segmental resection of the kidney. Brit J Surg. 1954;42:132.
3. Logia GS, Kumar V, Saxena SK, Gupta CD. Surface projection of arterial segments in human kidney. J Anat. 1982;113:145–50.
4. Di-Dio LJA. Anatomici-surgical vascular segments of human kidney. Anat Rec. 1961;139:299.
5. Anson BJ, Richardson GA, Mnear WL. Variations in the number and arrangement of renal vessels. J Urol. 1936;36:211–19.
6. Hodson CJ. The renal parenchyma and its blood supply. Curr Probl Diagn Radiol. 1978;7:1.
7. Hunter J. Vasculature of the body. Brit J Surg. 1794;38:1–8.
8. Kher GA, Indra B, Makhaniz JS. Intrarenal branching of renal arteries. Int J Surg. 1960;12:263–69.

9. Verma M, Chaturvedin RP, Pathak RK. Anatomy of the renal vascular segments. J Anat Soc. 1961;10:12–14.

10. Raghavendra V, Manjappa P, Anjana Telkar T. Renal apical segmental artery variations and its surgical importance's. J of Clin and Diag Res. 2012;6(4):561–63.

11. A.K.Dutta, Essentials of Human Anatomy, 2019; (1): 321-332.