



Prevalence of Accessory Renal Artery and its Clinical Implications: A Cadaveric Study

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ABSTRACT

Variations of arteries not only have anatomical interest but also have physiological and pathological significance such as flow dynamics, atherosclerosis and aneurysm. To facilitate the surgical approach, we studied the prevalence of accessory renal artery in 100 kidneys. We found the presence of accessory (multiple) renal arteries in 29%. To avoid complications due to accessory renal arteries radiological examination of renal vessels should be done before renal surgery.

KEYWORDS : – Renal artery, kidney, variations.

INTRODUCTION

Awareness of the possible variations of the renal vasculature is necessary for adequate surgical management such as renal transplantation, urological operation and interventional radiologic procedures. Usually the kidney is supplied by a single renal artery but the presence of multiple renal arteries are very common.^{1,2} These multiple arteries do not only alter the geometry but it also effect the hemodynamic. Such anomalies may have to be thoroughly investigated for any vascular malformation to avoid any inadvertent injury.

Renal arteries take origin at right angles from the abdominal aorta just below the superior mesenteric artery at the level of intervertebral disc between L1 and L2 vertebra.^{3,5} The paired renal arteries take about 20% of the cardiac output to supply the kidneys.⁶ Each renal artery divides at or very close to the hilum of the kidney. Further it divides into segmental arteries to supply the respective segments of the kidney being themselves the end arteries.⁷

Presence of accessory renal arteries is well documented. These appear on an average from 25%-35% and they have different origin, course and termination in the renal parenchyma compared to the main renal artery.⁸ The fact that these arteries may be neglected during surgical procedures on the kidney or its environment is an important morphological element, which has not only theoretical but also of practical importance. Angiographic evaluation of the renal arterial supply in the living potential kidney donor is performed routinely at most institutions before donor nephrectomy.⁹ However the percentage of multiple renal arteries are higher in the cadaveric dissection method, as the radiographic assessments result in a high percentage of false negative findings.¹⁰ The negatives are difficult to read and smaller polar arteries are neglected being smaller and often mistaken for the lumbar or capsular arteries. Especially upper polar arteries originating from aorta represent a huge risk from the surgical point of view, due to the high place of separation from the main renal artery and they are masked during surgical procedures. Walker et al. in 1988 confirmed the angiographic findings in the donor kidney in 76 patients. Three patients had findings at surgery that were not identified on the preoperative arteriogram.¹¹

The embryological development of urogenital system is highly complicated the congenital anomalies or variations of these organs are relatively higher when compared with the other systems. The common variations in the blood supply to the kidney reflect the manner in which the blood supply continually changes during embryonic and early fetal life. As the kidneys ascend

from the pelvic to the lumbar region, they receive their blood supply from vessels that are close to them.¹² During development the metanephric kidney lies in the pelvic cavity and receives the arterial supply from the lateral sacral artery.^{13, 14} Gradually the kidney ascends and reaches the iliac fossa, here it receives its nutrition from the common iliac artery. When the kidneys attain their adult position by the ninth week they receive the blood supply from the lowest suprarenal artery and this branch persists after birth as the permanent renal artery.¹⁵ This continuously changing blood supply of the kidneys and those persistent arteries that do not disappear during the ascent of the kidneys explains the high incidence of the variations in the blood supply to the kidneys.

This cadaveric study is focused on the existence of multiple renal arteries which are becoming more important due to increase in interventional radiological and urological procedures.

MATERIALS AND METHOD

The study was performed in the Department of Anatomy of Medical College of Navi Mumbai. Fifty human cadavers (preserved in 10% formaldehyde) irrespective of sex were dissected. A total of 100 kidneys with their renal arteries were surveyed. The presence of accessory renal arteries was noted. Materials used for dissection were scalpel with a sharp blade, forceps, scissors, dissection table retractor, brush, cotton, gloves. The institutional ethical clearance was obtained for the study. The method of dissection was done according to the "Cunningham's Manual of Practical Anatomy".¹⁶

RESULTS

Out of 100 specimens, we observed the anomalous ARA in 29 kidneys (n = 29 %). Out of these 16 kidneys exhibited an ARA on the left side while 9 kidneys exhibited an ARA on the right side.

Table.1: Percentage of Presence of Accessory Renal Artery.

S.N.	Side	Number	Percentage
1.	Left unilaterally	16	55.17%
2.	Right unilaterally	9	31.03%
3.	Bilaterally (Left and Right)	4	13.79%

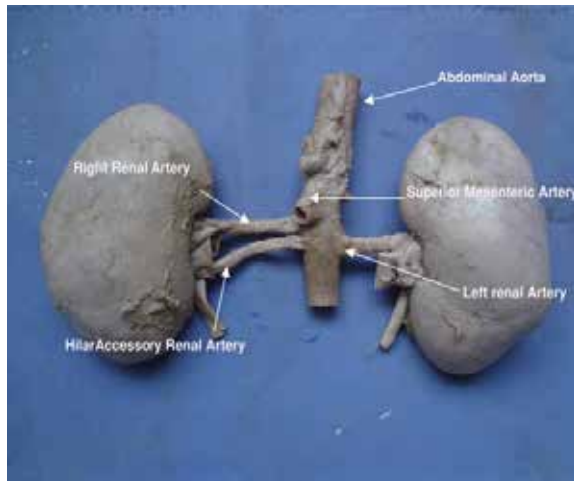
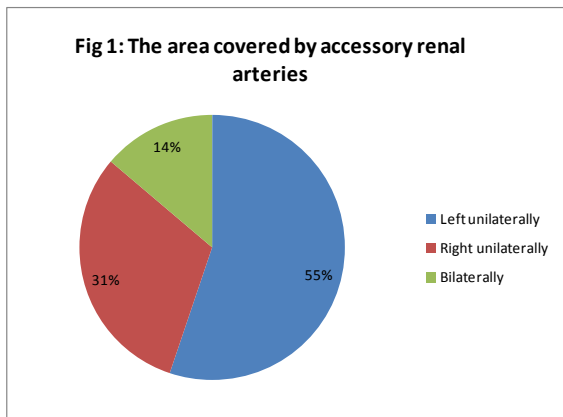


Fig.4: Right Hilar Accessory Renal Artery.

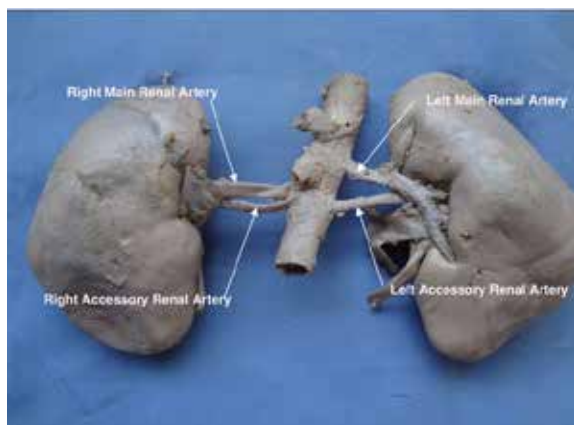


Fig.5 : Bilateral Presence of Accessory Renal Arteries.

DISCUSSION

The majority of the variations of the renal arteries are the presence of accessory renal arteries. The generally accepted and precise terminology for these arteries has not been unified by majority of the authors. In literature there are reports for multiple renal arteries stating as a supernumerary, accessory and aberrant renal artery.¹⁸⁻²³ Many call them as extra blood vessels, especially in the earlier literature. Whatever the names given the multiple renal arteries are not extra, because they occupy certain vascular areas within the kidney and there is no anastomosis either with the branches of the main or with branches of the segmental arteries. The interest in multiple renal arteries has increased recently due to the increase in the frequency of kidney transplantation and the need for living kidney donors.²⁴ The development of the methods in urological surgery, as well as the development of new radiological techniques have enhanced the interest in renal artery anatomy. Kidney transplantation is a permanent and safe treatment for patients with chronic kidney failure. However, the presence of multiple renal arteries increases the complexity of the procedure of kidney transplant.²⁵ The existence of multiple renal arteries is a challenge for the surgeons performing the kidney transplant, as each renal artery is a terminal blood vessel and its injury causes segmental ischemia with delayed hypertension and leads to a direct link between essential hypertension and the presence of multiple renal arteries, without the existence of other pathological changes.²⁶

In the material we analyzed, we frequently found accessory arteries originating from the aorta. In the dissected preparations we found 29 % cases. This data is agreed with that reported by Geyer et al. in 1962, and Coen et al. in 1992 which was 32 %.^{27,28} The other similar reports were 32 % (Pick and Anson in 1940 and Harison et al. in 1978) and 25% (Saldarriaga et al⁵ in 2008).²⁹⁻³¹ But, there are some reports in the literature which are quite higher than the above frequencies. Talovic

Photographs for multiple renal arteries.

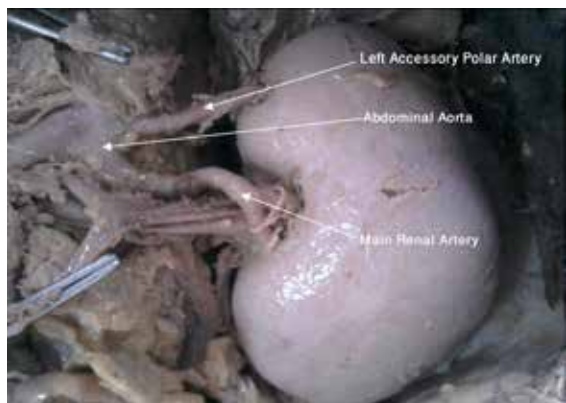


Fig.1: Left Upper Polar Accessory Renal Artery.

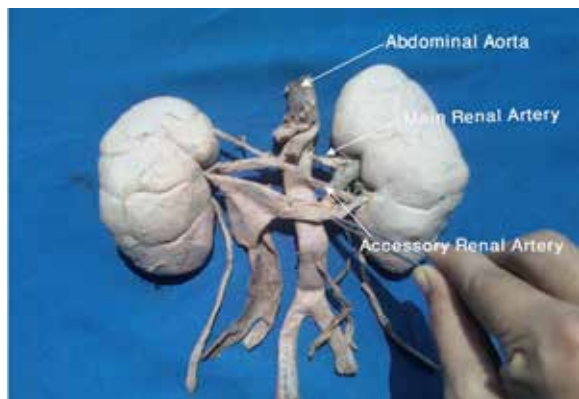


Fig. 2: Left Hilar Accessory Renal Artery

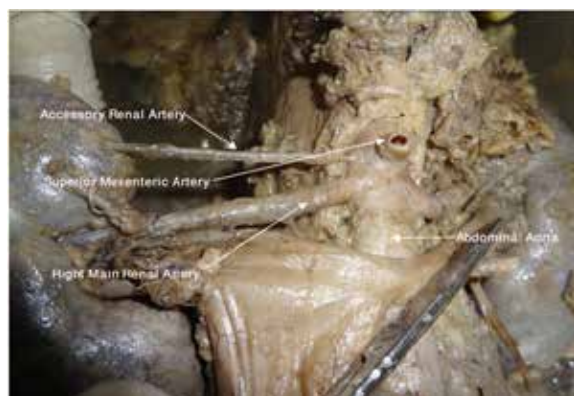


Fig. 3: Right Upper Polar Accessory Renal Artery.

et al. in 2007, Glodny et al. in 2000, Palmieri et al. in 2011, reported the frequency of multiple renal arteries as 46 %, 53 %, and 61.5 % respectively.^{17,32,33} These findings show that the presence of accessory renal arteries is extremely frequent. In the present study, the accessory renal arteries have been divided into left unilateral, right unilateral and bilateral. A discrepancy was presented regarding the most frequent side for presenting a multiple renal arteries; greater predominance of the left side was found (55.17% on left and 31.03 % on right) in our study, agreeing with the result of Palmieri et al in 2011(67 % on left & 56 % on right). There were others reports mentioning the accessory arteries more frequently on left side than the right: Nathan in 1958, Saldarriaga in 2008, Satyapal in 2000.^{21,31,34}

The presence of bilateral double renal arteries in the present study is 13.79%, similar to that reported by Satyapal in 2000, (10.21%).³⁴ There were other cases of bilateral double renal arteries reported by Gurscs in 2009, and M. C. Rusu in 2006, Abolhassan B in 2006.^{35,36,18}

There were reports of the presence of three arteries supplying the same kidney. Lipshutz and Hoffman in 1926 and Erol Sener in 2005, found bilaterally triple renal arteries.^{37,38} A single renal artery on one side and multiple (two, three or four) renal arteries on the other side is not unusual. There were no reports on sex or race related differences. Raheem in 2008 found a three multiple renal arteries arising directly from the aorta, which was a similar report by Nayak B. S. in 2008.³⁹ The presence of four renal arteries on one side is rare. Madhyasthal in 2001 during routine dissection found the right kidney had four accessory renal arteries.⁴⁰ A similar report was presented by Libshitz in 1972.⁴¹ However, in this study no more than two renal arteries supplying the same kidney was found.

CONCLUSION

In many of the cases the kidney is nourished by single artery but presence of multiple renal arteries is not uncommon. The variation of renal arteries in our study was 29% and more on the left than on the right. The upper polar arteries were encountered more than the lower polar arteries. To avoid any vascular complication, during surgical procedure 'computerized tomography' (CT scan), angiography, X-ray should be performed prior to every renal surgery. Considering the increase in incidence of the multiple renal arteries, the anatomical knowledge of such may be important for academic, surgical as well as radiological procedures.

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