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Research Article

Renal vascular morphology and their significance in predicting accessories

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ABSTRACT

Background: Renal arteries presented great morphological variations in their emergence, frequency, and ramification pattern. Therefore, this study was aimed to establish the possible relationship between the caliber of the renal artery and existence of the accessory renal arteries.
Methods: Fifty kidneys obtained from fresh cadavers were subjected for corrosion cast to determine the diameter of main and accessory renal arteries.
Results: In our study, we found that the incidence of single accessory renal artery (24%) was higher than the presence of two or more accessory arteries (4%) from the aorta. However, no significant difference was observed in the number of accessory renal arteries with respect to right and left side. Superior polar type of accessory renal artery was seen only on the left side in 2% of the specimens, and inferior polar arteries were found in 6% of the specimens on both the sides. The hilar type of accessory renal arteries were found in 8% and 6% of the cases on right and left sides respectively.
Conclusion: The diameter of the main/principle renal artery in kidney presenting the accessory renal arteries was significantly less than that of the kidney with single renal artery.

Keywords: Renal artery, Accessory renal arteries, Diagnostic imaging techniques, Corrosion cast, Renal transplant

INTRODUCTION

Knowledge in the field of urology has undergone revolutionary changes in the last 20 years with the availability of modern diagnostic imaging techniques which provides an accurate display of the regional anatomy and renal vascular pattern. The anatomic nomenclature describing renal arteries other than the main artery is confusing and controversial. In fact, sometimes the term "main" is used for clarification.[1] According to Graves, any artery arising from the aorta in addition to the main renal artery should be named 'accessory' and the renal arteries arising from sources other than the aorta should be called 'aberrant'.[2] However, identifying the main artery is again confusing. Earlier, the incidence of accessory renal arteries in kidneys of Indian origin revealed a bilateral single main renal artery in 80% of the specimens and in remaining 20% of the cases multiple (accessory) renal arteries were observed. Further, presence of unilateral accessory renal artery (in 15%) being more commonly encountered than bilateral (in 5%).[3]

Such high incidence certainly warrants proper understanding of variations in the vascular pattern and lack of such information may leads to vascular accidents both during and after surgical and radiological intervention of the kidney. Presence of additional renal arteries and their pattern of course, entry into the kidney and their distribution is definitely a considerable factor

during surgical or radiological intervention of the kidney. In the literature, very little information is available about the diameter of the main renal artery and accessory arteries. Therefore, the present study is designed to find out the caliber of the main renal artery and its importance in predicting the presence of the accessory renal arteries, which could be helpful to urologists and sonologists before attempting any interventions.

METHODS

A total of 50 fresh adult kidney specimens with its vessels from aorta were procured from forensic and anatomy departments of our institution careful dissection was carried out to approach the retroperitoneal structures. Fasciae covering the kidney along with suprarenal glands were dissected and removed. Renal vessels originating from the nearby arteries were identified and meticulously delineated. Variations in the origin, course and relations to nearby structures were observed and noted. Since we found that the renal arteries were arising only from the abdominal aorta, with the renal and accessory renal arteries intact, the segment of aorta (from above the superior mesenteric artery to 7 cm below the origin of renal arteries) was taken out and incised aorta longitudinally to locate the renal ostium. Then, these fresh kidneys along with their capsule were washed in running tap water for about 30 min to 1 hour. The blood from arteries and veins were washed off by injecting warm saline till a clear fluid comes out of it. The washed kidneys were then allowed to drain out the fluid completely. The narrow end of the silicon gun was tightly kept in the stem of renal arteries and slowly silicon material was injected till complete resistance occurs. The gun was then removed from the artery and the stem of the artery was tightly tagged, kept overnight for drying and immersed in low concentrated hydrochloric acid for 6 hours.[4] After soft tissue corrosion was complete, the resulting silicon cast was washed in running tap water and kept for drying. Specimen was numbered and parameters regarding the number of renal arteries, length and diameter of renal arteries proximal to aorta were noted. A digital vernier caliper was used for taking the measurements.

RESULTS

Majority of the renal arteries (45 out of 50 specimens) ramified before entering the hilum, whereas only few divided within the hilum. On an average, renal artery divided into branches 2.1 cm before their entry into the hilum in the right side and before 2.2 cm in the left side. However this difference was not statistically significant.

In our study, we found that the incidence of single accessory renal artery (24%) was higher than the presence of two or more accessory arteries (4%) from the aorta (Table 1). However, no significant difference was observed in the number of accessory renal arteries with respect to right and left side (Table 2).

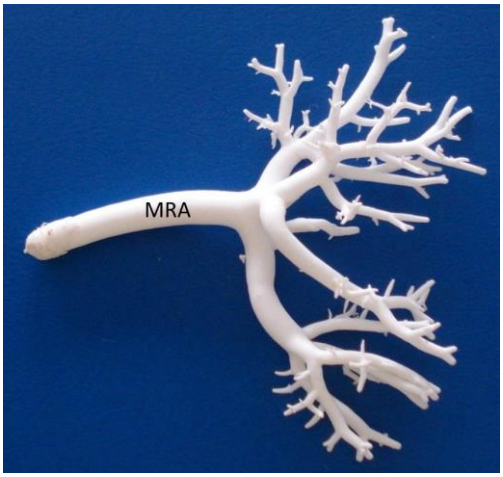

Figure 1: Main renal artery (MRA) and its segmental branches seen after corrosion cast.

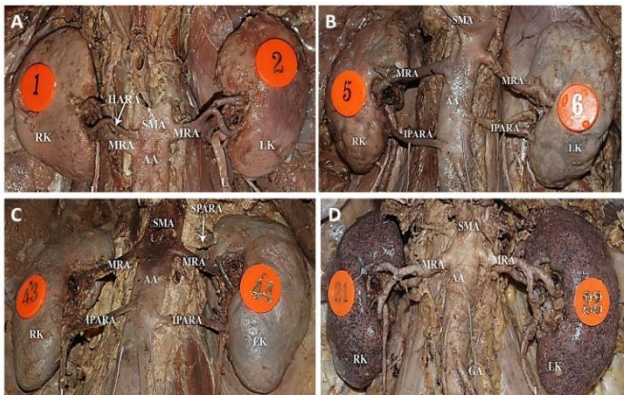

Figure 2: Showing types of accessory renal arteries (A: HARA-Hilar type, B: IPARA-Inferior polar type, C: SPARA-Superior polar type and D: Early ramification of main renal artery).

Table 1: Occurrence of unilateral and bilateral accessory renal arteries.

Author	Unilateral (%)	Bilateral (%)
Eduardo Mazzucchi (2005)	25	10
Saldarriaga B et al. (2008)	22.3	2.6
Bindu S et al. (2010)	15	5
Present study	20	4

Table 2: Incidence of accessory renal arteries.

Author	Right side (%)	Left side (%)
Janschek EC et al. (2004)	20.2	19
Nayak BS (2008)	23	6.7
Present study	12	12

Superior polar type of accessory renal artery was seen only on the left side in 2% of the specimens, and inferior polar arteries were found in 6% of the specimens on both

the sides. The hilar type of accessory renal arteries were found in 8% and 6% of the cases on right and left sides respectively (Table 3).

Table 3: Type of accessory renal arteries.

Type of accessory renal artery	Right side		Left side		Total	
	No.	%	No.	%	No.	%
Superior polar ARA	-	-	1	2	1	2
Hilar ARA	4	8	3	6	7	14
Inferior polar ARA	3	6	3	6	6	12

The length of the renal artery was ranging from 3 to 8.5 cm on the right side and 3.2 to 7 cm on the left side. The average length of right renal arteries (5.7 cm ± 1.2 SD) was greater than the left side arteries (5cm ± 0.09 SD), which is statistically significant. The main renal arteries showed their early ramification at 4.8 cm from the point of its origin from the aorta on both sides.

The main renal artery without any accessory arteries measured an average diameter of 4.7 mm ± 0.004 SD and the main renal artery with no accessories presented an average diameter of 5.7 mm ± 0.09 SD. This difference in diameter was statistically significant. The average caliber of the superior polar accessory renal artery was 2 mm; the same was 3 mm in hilar polar type and inferior polar accessory renal arteries.

DISCUSSION

Palmer in his book "works of John Hunter" quotes that the venous system presents greater and more numerous anomalies in its distribution than the arterial.[5] This observation is undoubtedly true with regard the superficial and smaller vessels, but not for the deep-seated large trunks. Variation in the number and distribution of the renal arteries are perhaps more frequently found than any other larger arterial trunks in the body.

Different studies indicating varying incidences of accessory renal arteries ranging from about 11% to 61%.[6,7] In the present study the incidence of accessory renal artery was 24% which was nearer to the value found in the study by Saldarriaga (2008).[8]

Earlier studies show the higher incidence of presence of accessory renal artery on the right side in comparison with the left side.[7,9] However, in our study, the incidence of bilateral accessory renal artery was found in 20% of the cases and unilateral accessory renal artery was found only in 4% specimens. This finding correlates with the earlier studies indicating that bilateral accessory renal arteries is most common than unilateral.[9] Therefore a cautious observation is must on the opposite side, if an accessory renal artery is spotted on one side during the surgery.[7,10]

Present study shows that, the length of the right renal artery from the aorta was ranging from 4.4 cm to 5.7 cm, which is slightly longer than the left renal artery (5 cm). However, earlier, it has been shown that the right renal artery can measure from 4 to 10.1 cm.[11]

Early ramification of the main renal artery was found to be in about 12% of the cases studied previously.[7] This refers to the segmental arteries reaching the hilum of kidney from the main renal arteries. However, in the present study, we found the early ramification in about 90% of the specimens, indicating that the renal artery divides into segmental arteries before its entry into the hilum more commonly than its division within the hilum.[12] This knowledge may help while performing the diagnostic imaging as these branches may be misread as additional or accessory renal arteries. In surgical terms, early division of the renal artery is considered to be equivalent to the arterial supply by multiple arteries. Such morphological characteristics are important to consider while performing a renal transplant.

The average diameter of the main renal artery in this study was 5.7 mm, which in correlation with previous angiographic studies.[13,14] Data from the present study indicates that, a probability of presence of accessory renal artery was more frequent when the diameter of the main renal artery was lower than 4.5mm. Additionally, kidneys with main renal artery having greater diameter than 5.7 mm, did not possess the accessory renal arteries. Therefore, if the diameter of the renal artery was less than 4.5mm, due to haemodynamic insufficiency to the developing kidney, leads to retention of the old renal artery (which usually degenerates as new higher renal artery develops) or influence to develop new additional renal artery cranial to the original renal artery.

CONCLUSION

Date obtained from this study indicates that, the diameter of the main renal artery could be used as a factor to predict the presence of additional renal arteries. As found in our study, the early division of the main renal artery is more frequent and should be considered as equivalent to multiple renal arteries. Such aspects are important when considering a surgical approach and interpreting diagnostic images.

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