Original Article

A study of anomalies of renal arteries

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Abstract

Background: Variations in the origin and course of unilateral and/or bilateral renal arteries are common. But thoracic renal artery, originating in thorax above the diaphragmatic dome at the level of T_{11} vertebral body is rare. However knowledge of renal artery variations are important in vascular and interventional radiological procedures and in renal transplantations. **Material and Method:** The study was performed on 72 sides of 36 embalmed cadavers, which were used for routine dissection for medical students, over a period of two years in the department of anatomy, in Narayana Medical College, Nellore, in Guntur Medical College, Guntur and R.V.M. Institute of medical sciences and research centre, Siddipet, Telangana, India. Exposure of kidneys and renal arteries done following standard dissection procedure. The observations are noted and photographed. **Results and Discussion:** supernumerary Renal arteries were present in 23/36 (63.8%) cases (50% of Aortic origin and 13.8% of renal origin) on the right side and 21/36 (58.3%) cases (47.2% of Aortic origin and 11.1% of Renal origin) on the left side. An anomaly of the renal artery is presented in which the renal trunk supplying the left kidney arises from the Descending thoracic aorta. **Conclusion:** Variation in the course of renal arteries are common and are known causes of iatrogenic injuries. A thoracic origin of renal artery is rare and posses a greater risk during thoracic endovascular surgical interventions.

Key Words: Descending thoracic aorta, Renal artery, supernumerary renal artery, anatomical variation.

Abbreviations: Supernumerary Renal Artery (SRA), Renal Artery (RA), Thoracic Renal Artery (TRA). Thoracic Aorta (TA).

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INTRODUCTION

Renal arteries arise from the Abdominal Aorta, divide into Anterior and Posterior divisions and supply the kidneys. But variations in the origin and course of renal arteries are common. Hence knowledge of renal artery variations are crucial for the vascular surgeons and Radiologists as it has clinical value in surgical procedures and diagnostic endovascular procedures and kidney transplantation surgeries. This study has been undertaken to identify variations of renal arteries in humans by cadaver dissection method.

MATERIAL AND METHODS

The present work had been undertaken on 36 cadavers (72 sides) which are kept for medical students for routine dissection over a period of two years at Narayana Medical college, Nellore, and Guntur Medical college, Guntur and R.V.M. Institute of medical sciences and research centre, Siddipet, Telangana, India. Abdomen was opened by routine procedure. The Renal vessels were dissected, observed carefully, recorded, photographed and preserved.

OBSERVATIONS

Table 1: Number, percentage, and types of supernumerary renal arteries

Number of renal artery	Right kidney (%)	Left kidney (%)	Total (%)
One artery	13/36 (36.1%)	15/36 (41.6%)	28/72 (38.8%)
Supernumerary renal artery	23/36 (63.8%)	21/36 (58.3%)	44/72 (61.1%)

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Table 2

	Right kidney (%)	Left kidney (%)	Total (%)
Aorta origin	18/36 (50.0%)	17/36 (47.2%)	35/72 (48.6%)
HAS	09/36 (25%)	08/36 (22.2%)	17/72 (23.6%)
UPSA	06/36 (16.6%)	04/36 (11.1%)	10/72 (13.8%)
LPSA	03/36 (08.3%)	05/36 (13.8%)	08/72 (11.1%)

Table 3

	Right kidney (%)	Left kidney (%)	Total (%)
Renal origin	05/36 (13.8%)	04/36 (11.1%)	09/72 (12.5%)
HAS	03/36 (08.3%)	03/36 (08.3%)	06/72 (08.3%)
UPSA	01/36 (02.7%)	01/36 (02.7%)	02/72 (02.7%)
LPSA	01/36 (02.7%)	0/36 (0%)	01/72 (01.3%)

HSA: hilar supernumerary renal artery, UPSA: upper polar supernumerary renal artery, LPSA: lower polar supernumerary renal artery

The supernumerary Renal arteries entered the kidney through hilum as hilar supernumerary renal arteries (Fig. 2,4,5,6),through upper pole as upper polar supernumerary renal artery (Fig. 1,2,3,6,7) and through lower pole as lower polar supernumerary renal artery (Fig. 3). We also found one supernumerary renal artery originating from thoracic aortal above the crus of diaphragm (Fig. 7)

DISCUSSION

Variations in the number, position, origins of renal arteries are common, there is no generally accepted and precise terminology for these arteries by the majority of authors, although many use the terminologies like accessory, additional, supplementary, and aberrant. As these arteries are segmental and occupy certain vascular area within the kidney and since they are end-arteries we prefer the terminology supernumerary for these arteries and classify them in accordance with Merklin and Michels[1]

1. Supernumerary renal arteries originating from the aorta;
2. Supernumerary renal arteries originating from main renal arteries;
3. Supernumerary renal arteries that can come from other sources.

Supernumerary Renal arteries were present in 23/36 (63.8%) cases (50% of Aortic origin and 13.8% of renal origin) on the right side and 21/36 (58.3%) cases (47.2% of Aortic origin and 11.1% of Renal origin) on the left side. An anomaly of the renal artery is presented in which the renal trunk supplying the left kidney arises from the Descending thoracic aorta.

Thoracic Renal Artery: An anomaly of the renal artery is presented in which the renal trunk supplying the left kidney arises from the Descending thoracic aorta. The left Renal artery originating from the lateral aspect of the Descending thoracic aorta, 2cms above the Coeliac trunk pierces the left crus of the diaphragm, passed through the medial arcuate ligament deep to the Inferior phrenic artery, at the level of T_{11} vertebra. With an 'S' shaped course and a total length of 86 mm, this artery had an intra-thoracic portion of 26 mm. Left SRA arises for the upper pole of Left kidney 0.25 cm above the hilum. In the same cadaver, Right RA arises from the abdominal aorta below the origin of the Superior mesenteric Artery at the level of L_2 vertebra. Right SRA for upper pole arises from right RA 0.5 cm above the hilum. Talovic *et al*.[2] reported that in 30.76% cases supernumerary renal arteries originated from aorta and in 12.82% originated from renal arteries. In the present study the supernumerary arteries originated from abdominal aorta in 48.6% cases and from the main renal artery in 12.5% cases. Transplantation of kidney with one renal artery is technically easier than with multiple renal arteries and postsurgical rates of complication and kidney loss are lower[3] there have been variations regarding side on which the SRA were seen. Some authors have reported a higher frequency on the left side[4,5,6,7], where as others have found it to be more frequent on the right side[8,9]. In the present study SRA were observed more on the right side [63.8%] than on the left side [58.3%]. Embryological explanation of these variations has been presented and discussed by Felix[10]. In an 18 mm fetus, the developing mesonephros, metanephros, suprarenal glands, and gonads are supplied by nine pairs of lateral mesonephric arteries arising from the dorsal aorta. Felix divided these arteries into three groups as follows: the 1st and 2nd arteries as the cranial, the 3rd to 5th arteries as the middle, and the 6th to 9th arteries as the caudal group. The middle group gives rise to the renal arteries. Persistence of more than one artery of the middle group results in multiple renal arteries[10]. Thus, the multiple renal arteries in our study are a result of persisting lateral mesonephric arteries from the middle group.

CONCLUSION

Knowledge of the prevalence of supernumerary renal arteries and their ectopic origins is mandatory for urologists, radiologists and vascular surgeons as they encounter these situations during segmental resection, partial nephrectomy and renal transplantation. Prior identification of these variations is crucial in order to prevent possible complications. Renal artery entrapment by the diaphragmatic crus was first described by D' Abreu[11] who reported two cases proven by surgery in 1962.

Figure 1

Figure 2

Figure 3

Figure 4

Figure 5

Figure 6

Figure 7

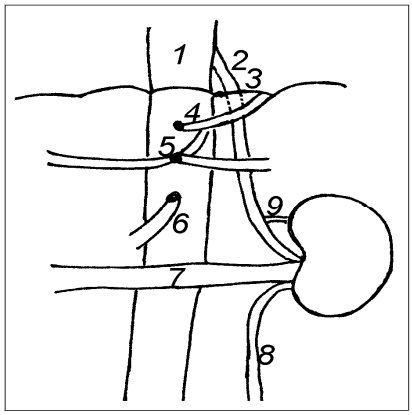

Figure 8

Figure 1: Right kidney showing upper polar SRA originating from renal artery
Figure 2: Left kidney showing hilar SRA and upper polar SRA originating from abdominal aorta
Figure 3: Right kidney showing upper polar and lower polar SRA originating from abdominal aorta
Figure 4: Left kidney showing hilar SRA originating from abdominal aorta
Figure 5: Left kidney showing hilar SRA originating from abdominal aorta. Upper renal artery crossing renal vein superficially.
Figure 6: Left kidney showing hilar SRA originating from abdominal aorta, upper polar artery originating from renal artery.
Figure 7: Photograph taken during dissection shows left renal artery and supernumerary renal Arteries 1: Descending thoracic aorta; 2: left renal artery; 3: left crus of the Diaphragm; 4: left inferior phrenic artery; 5: celiac trunk; 6:superior mesenteric artery;7:left renal vein 8; left ureter; 9: left UPSA.
Figure 8: Schematic diagram showing variations found in present case 1: Descending thoracic aorta; 2: left renal artery; 3: medial arcuate ligament of the Diaphragm; 4: left inferior phrenic artery; 5: celiac trunk 6: superior mesenteric artery; 7: left renal vein 8; left ureter; 9: left UPSA

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