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A Cadaveric Study of Renal Artery in North Indian Population: Its Clinical Implications

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Abstract

A thorough knowledge of the variations of the renal artery has grown importance with the increasing numbers of renal transplants, vascular reconstructions and various surgical and radiological techniques. The present study was conducted on 30 well embalmed human cadavers during routine dissection to note the normal anatomy and variations of renal artery. Accessory renal arteries in the present study were found in 10 cases (33.3%) and were more frequent on left side i.e. in 7 cases (70%) than on the right side 3 cases (30%). To plan the adequate surgical procedure and to avoid any vascular complication, Multi Detector Computer Tomography (MDCT), angiography and arteriography should be performed prior to surgery (nephrectomy). As the number of renal surgical and radiological interventions increase, a better understanding of the anatomy of renal arteries and their branches gain importance.

Keywords: Renal Artery; Nephrectomy; Angiography; Arteriography.

Introduction

More than that of any other organ in the body, the vascularization of the kidney (viscus elegantissimum of the ancient anatomists) has been the topic of repeated anatomic investigation, statistical analysis and description [1].

The renal arteries arise one on each side, about 1.5 cm below the origin of the superior mesenteric artery opposite the second lumbar vertebra [2]. Of the pair, the right artery tends to arise at a higher level than the left, though they lie at the same level in 35% of individuals. The diameter of the renal artery averages 5.8 mm (3 mm to 9 mm) [3]. The average length of right renal artery is 7.7 cm and of the left is 6.2 cm [4].

Renal artery variations are often seen and generally categorises into presence of accessory or aberrant renal arteries, polar arteries, and prehilar branches. Prehilar multiple branching pattern was described as duplicate, triplicate, fork pattern and ladder pattern by Shoja et al.,[5] and Rao et al.,[6].

Knowledge of the variations of renal vascular anatomy has importance in exploration and treatment of renal trauma, renal transplantation, renal artery embolization, surgery for abdominal aortic aneurysm and conservative or radical renal surgery [7].

An aberrant inferior polar artery of aortic organ arching around the renal vein acts as pathological agent in production of hydronephrosis by compressing the ureter. An aberrant renal artery may simultaneously produce hydronephrosis and varicocoele by compressing testicular veins and ureter [8].

We believe that awareness of variations is necessary for surgical management during renal transplantation, repair of abdominal aortic aneurysm, urological procedures and for angiographic interventions.

Material and Methods

The material for this study comprised of 30 well embalmed adult human cadavers of known sex obtained from the Department of Anatomy, Govt. Medical College, Amritsar. They were serialized from 1-30 with suffix 'M' for male and 'F' for female. The

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abdominal cavity was opened by a cruciform incision passing through the whole thickness of the anterior abdominal wall. Flaps were reflected. The abdominal viscera i.e. stomach, intestines liver, pancreas and spleen were systematically removed according to Cunningham's Manual of Practical Anatomy [9].

The Following Parameters Were Noted

1. Vertebral level of origin
2. Diameter of the artery
3. Any variation

Results and Discussion

The renal arteries vary on the two sides and in different individuals, in terms of calibre, level of origin and precise topographic relationships [10].

Impairment of the renal arterial supply caused either by disease process or by surgical manipulation, may result in the production of pressure substances by the involved kidney and subsequent development of systemic hypertension. Therefore in plastic procedures involving the renal pelvis or ureter or even in procedures involving simple ligation and severance of an accessory renal artery, familiarity with the variations in the vascular supply is mandatory [11].

Vertebral Level of Origin

In the current study in maximum number of cases (36 i.e. 60%) the renal arteries originated at the level of lower border of L_1 vertebra.

Table 1: Incidence (sidewise) of vertebral level of origin of renal artery

Vertebral level	No. of cases of renal artery		Total	%age
	Right	Left		
Lower border of L_1	20	16	36	60.0
IV disc between L_1 & L_2	6	10	16	26.6
Upper 1/3rd of L_2	3	3	6	10.0
Middle 1/3rd of L_2	1	1	2	3.3
Total	30	30	60	

Anson [3] stated that the level of origin of renal arteries is principally centered over the lower third of first lumbar vertebra (L_1), at the disc between the 1st and 2nd lumbar vertebrae or at the cranial third of L_2 vertebra and variations extending to one vertebra above and below may occur.

Diameter at Origin

In the present study, the mean diameter of renal artery on the right side was 8.5 mm (range 4mm - 13 mm) and on left side was 8.2 mm (range 6mm - 13 mm). These findings were in near consonance with Keen [12] who reported the mean diameter of renal artery to be 7.9 mm with a range of 6.5 mm– 9.2 mm.

Accessory Renal Artery

Variations of renal arteries occur more frequently, perhaps, than anomalies of any of other larger vessels; most common anomaly being the presence of accessory renal arteries [13]. The abnormalities in the renal arteries are mainly due to various developmantal positions of the kidney [14].

Accessory renal arteries in the present study were found in 10 cases (33.3%) and were more frequent on left side i.e. in 7 cases (70%) than on the right side 3 cases (30%). Out of these 10 cases a single accessory renal artery were seen in 9 cases (90%) but in two case (10%) (10 M, 25 M) triple hilar arteries derived from aorta were seen; an observation reported to be infrequent (1-2%) by Merklin and Michels [1]. Rusu reported bilateral double renal arteries on the right side as superior hilar and inferior hilar arteries and on the left side as superior hilar and inferior polar renal arteries. All these renal arteries emerged from the abdominal aorta as in our case [15].

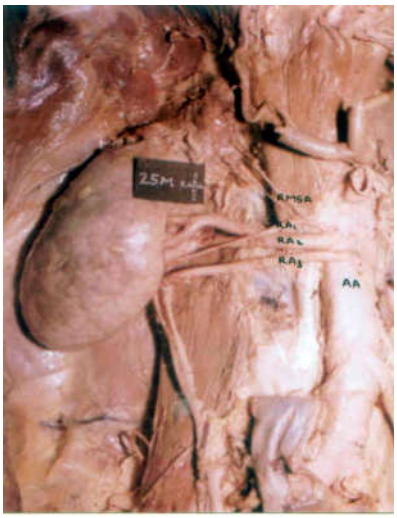

Fig. 1: Triple renal artery (RA1, RA2, RA3) on right side with superior renal artery

(RA1) taking origin in common with right middle suprarenal artery (RMSA)

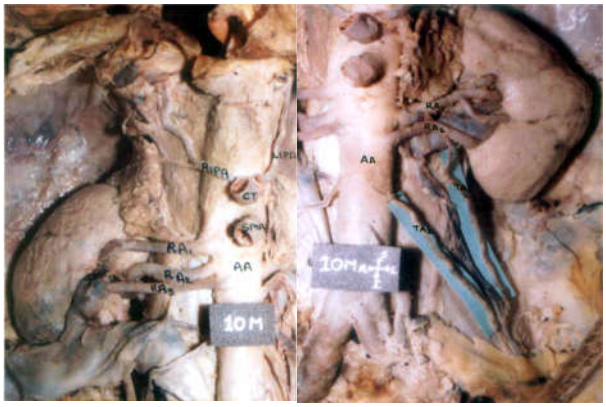

Fig. 2: Triple renal arteries on right side and double renal arteries on left side

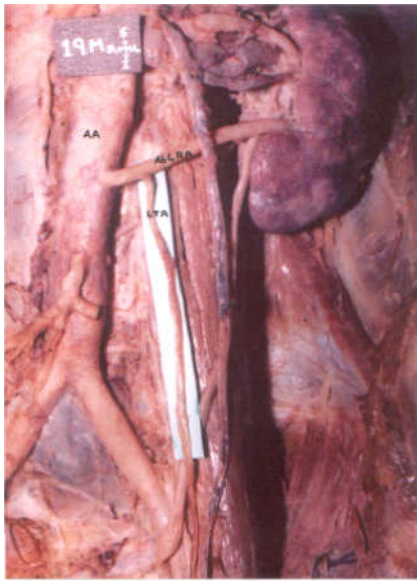

Fig. 3: Double renal arteries (RA1, RA2) seen on the left side with a distance of 4.2 cm between the origin of two arteries from abdominal aorta (AA)

According to Bayramoglu et al., the variations in the number of renal arterial divisions in the hilar region are generally associated with renal malformations in the embryo [16].

According to Novice et al., there is no definite limit to the number of accessory renal arteries; although more than three on the same side seems to be very rare [17]. Rossi et al.,[18] reported a case with seven renal arteries while Kinnunen et al., reported another case with ten additional renal arteries [19].

The anatomical knowledge of multiple arteries is essential before performing any transplantation surgeries, where microvascular techniques are employed to reconstruct the renal arteries [20]. The embryological explanation of these variations has been presented and discussed by Keibel F and Mall FP [21]. In an 18mm foetus, 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 group, the 3rd to 5th arteries as the middle group and 6th to 9th arteries as the caudal group. The middle group gives rise to renal arteries. Persistence of more than one renal arteries in the middle group results in multiple renal arteries [21].

Conclusions

The knowledge of renal angioarchitecture, whether usual or variant, is considered to be a prerequisite for successful and uncomplicated surgical and radiological procedures.

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