

VARIATIONS OF RENAL ARTERY IN CADAVERS

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ABSTRACT

Each kidney is usually supplied by a single renal artery which is a lateral branch of abdominal aorta at the level of L1. The arteries supplying the kidneys show variation in the number, source and branching pattern which also include the presence of an accessory or additional and aberrant renal arteries. The additional renal artery towards the lower pole will cross the corresponding ureter and even cause ureteric obstruction. The segmental branches of renal and additional renal arteries are end arteries thus the accidental damage to these arteries can cause ischaemia or necrosis and other pathological conditions. The main objective of this study was to note the variations of the arteries supplying the kidneys. An observational study was conducted on thirty kidneys of fifteen cadavers which included the kidneys of both sides. The study was conducted in Department of Anatomy of Nepal Medical College Teaching Hospital during the period between July 2018 to June 2019 and the variations were recorded as (a) single main renal arteries were found in 80% specimens on both sides (b) early division of main renal arteries were found in 16.66 % on both sides (c) origin of main renal arteries were at higher level on left side in 16.66 % (d) presence of additional renal arteries were found in 20% on both sides. This study will be helpful to urosurgeons and also to radiologists performing various interventional radiological procedures.

KEYWORDS

Aberrant renal artery, accessory renal artery, additional renal artery, variation

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INTRODUCTION

The kidneys are a pair of excretory organs which excrete end products of metabolism and excess water. They are situated posteriorly behind the peritoneum on each side of the vertebral column. Each kidney is supplied by a renal artery which is a branch from the lateral side of abdominal aorta usually at the level of L1 vertebra.¹ These renal arteries show variation in the number, and also in their origin from abdominal aorta.² They consume around 20% of the total cardiac output.³

During embryogenesis, the kidneys ascend from the pelvic region to the lumbar region. During their ascent they are supplied by several segmented arteries extending from internal iliac artery to the dorsal aorta. The lower vessels usually disappear and some may persist. Persistence of those arteries will result in accessory renal arteries which will cross the corresponding ureter and may cause ureteric obstruction.⁴ There are different terminologies related with accessory and aberrant renal arteries. An accessory renal artery is one which is accessory to the main renal artery, usually arising from abdominal aorta and entering the kidney through the hilum however aberrant renal arteries enter the kidney through either pole whether derived from main renal artery, aorta or a branch from abdominal aorta.⁵

The segmented branches of renal arteries and the accessory renal arteries are end arteries. If an accessory artery is damaged or ligated accidentally, the part of the kidney supplied by it will be ischaemic or necrosed.⁶

A kidney transplantation with variation in the renal artery may cause an acute tubular necrosis, rejecting episodes and decrease graft function.⁷ In most of the cases these variations are noted only at the time of interventions.⁸ With the advancement of interventional and therapeutic urological procedures these days awareness in these variations become important for the urosurgeons to minimize the accidental bleeding during surgeries or prevention of rejection and poor graft functions.⁹ There are

scanty literatures available about the variations of renal artery amongst Nepalese population. Hence, this study was undertaken which will be helpful to urosurgeons and also to the radiologists performing various endourologic procedures and it can also be used as an important guideline for academic purposes.

MATERIALS AND METHODS

The study was started after getting the ethical approval from Institutional Review Committee of Nepal Medical College. An observational study was conducted on thirty kidneys of fifteen cadavers in the Department of Anatomy of Nepal Medical College from July 2018 to June 2019. The study was carried out during the routine dissection procedure of medical students. The kidneys of both sides were included and those having damaged renal arteries were excluded from the study. During dissection, the abdominal cavity was opened up, all the viscera were gradually taken out and were preserved in formalin. The posterior abdominal wall was exposed and the dissection was carried out to explore the vascular supply of kidney along the length of the abdominal aorta.¹⁶ The renal artery and its variations in origin and branching pattern and the presence of accessory renal arteries and their variations were noted and recorded. Photographs were taken. The frequencies of their variations were calculated.

RESULTS

Thirty cadaveric kidneys with the arteries supplying them were dissected meticulously in situ. The frequencies of variations of main renal arteries were observed on both sides and were tabulated. (a) The main single renal artery arising from abdominal aorta were found in 80% on both sides (Table 1 and 2) which have also been shown in Fig. 1. (b) early division of the main renal arteries were found in 16.66% on both sides (Table 1 and 2) and Fig. 2. (c) origin of main renal arteries were found at higher level in 16.66 % on left side (Table 2). and Fig. 3.

Table 1: Frequency distribution of variations of main renal arteries on right side

S.N.	Total no. of specimens	Total no. of single main renal artery	Level of origin		Early division (proximal to hilum)
			At the level of 12 th thoracic vertebra	At the level of intervertebral disc between L1 and L2	
1.	15	12 (80%)	None	12 (100%)	2 (16.66%)

Table 2: Frequency distribution of variations of main renal arteries on left side

S.N.	Total no. of specimens	Total no. of single main renal artery	Level of origin		Early division (proximal to hilum)
			At the level of 12 th thoracic vertebra	At the level of intervertebral disc between L1/L2	
			2 (16.66%)	10 (83.33%)	
1.	15	12 (80%)			2 (16.66%)

We also recorded the presence of additional renal arteries and aberrant renal arteries on both sides. 20 % additional renal arteries were noted on both sides (Table 3 and 4). The source of origin of additional renal arteries were from main renal artery in 66.66% on right side which were seen

were found on both sides in same cadaver (Fig.2). while on some other cadaver, there was aberrant renal artery arising from main renal artery and accessory renal artery arising from abdominal aorta in same cadaver. (Fig 3).

Table 3: Frequency distribution of variations of additional renal arteries on right side

S.N.	No. of additional renal arteries on right side	Origin of additional renal arteries on right side		Branching pattern	
		From abdominal aorta	From main renal artery	Towards the upper pole (aberrant)	Towards the hilum (accessory)
1.	3 (20%)	1 (33.33%)	2 (66.66%)	2 (66.66%)	1 (33.33%)

Table 4: Frequency distribution of variations of additional renal arteries on left side

S.N.	No. of additional renal arteries on left side	Origin of additional renal arteries on left side		Branching pattern	
		From abdominal aorta	From main renal artery	Towards the lower pole (aberrant)	Towards the hilum (accessory)
1.	3 (20%)	3 (100%)	None	2 (66.66%)	1 (33.33%)

entering the upper pole of right kidney (Fig.3) and they were aberrant arteries (Table 3). In 33.33% the source of origin of additional renal artery was from abdominal aorta on right side which was found entering the hilum and it was an accessory artery (Table 3). Similarly on left side, the source of origin of additional renal artery were from abdominal aorta in all the specimens (100%) among them aberrant renal arteries were found in 66.66% and accessory were found in 33.33% (Fig. 3 and 4).

Interestingly in some of the cadavers, the additional renal arteries arising from abdominal aorta and an early division of main renal arteries

DISCUSSION

Variations in main renal artery

According to the standard textbook of Anatomy, each kidney is supplied by a single renal artery in 70 % of individuals with the left renal artery slightly higher than the right and the accessory renal arteries are common in 30 % of individuals.¹ Many studies have been conducted in renal arteries regarding its variations in the number, level of origin and its branching pattern as the knowledge of variations of renal vascular anatomy is important during the exploration and treatment of renal trauma, renal artery stenosis and is also important during the urological

procedures. The studies have also shown that the transplantation of kidney with the single renal artery is technically easier as compared to the kidney with multiple arteries.¹⁵ Other than the cadaveric study the various other methods of studies used were renal artery angiogram and multi – detector computed tomographic angiography.

In the present study a single main renal artery was found in 80 % specimens on both sides (Table 1 and 2) which was similar with the

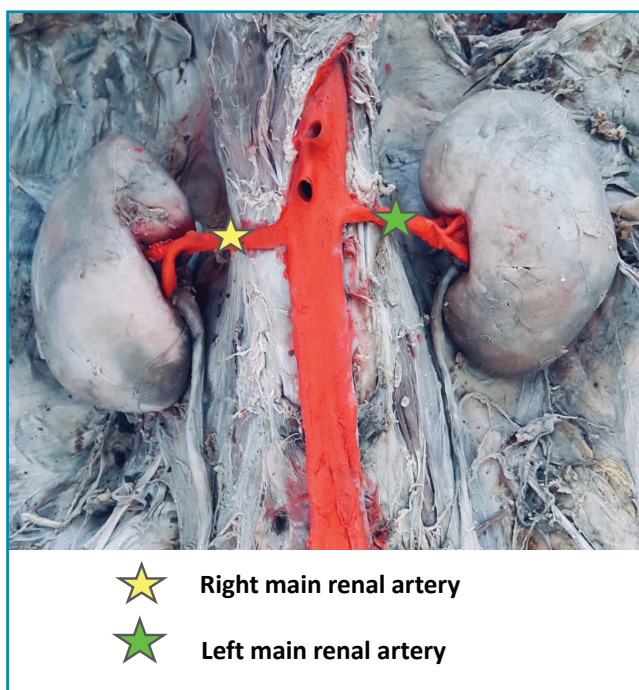


Fig 1: Shows the origin of single main renal artery from abdominal aorta with an early division on both side

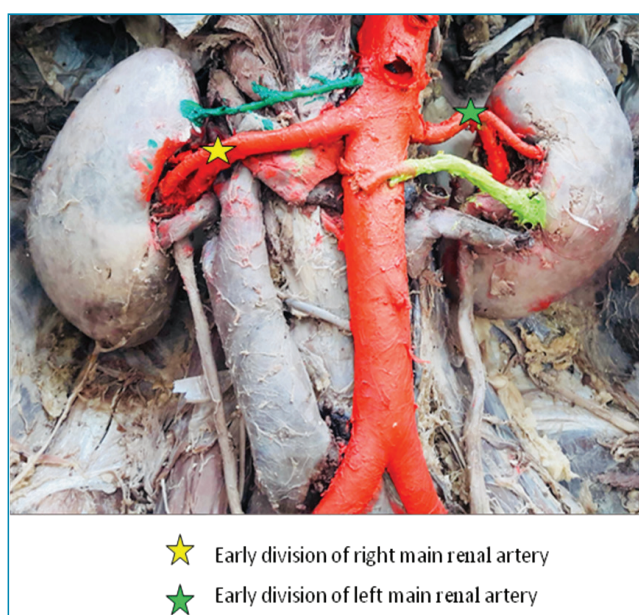


Fig. 2: shows the same level of origin of main renal artery with an early division on both side

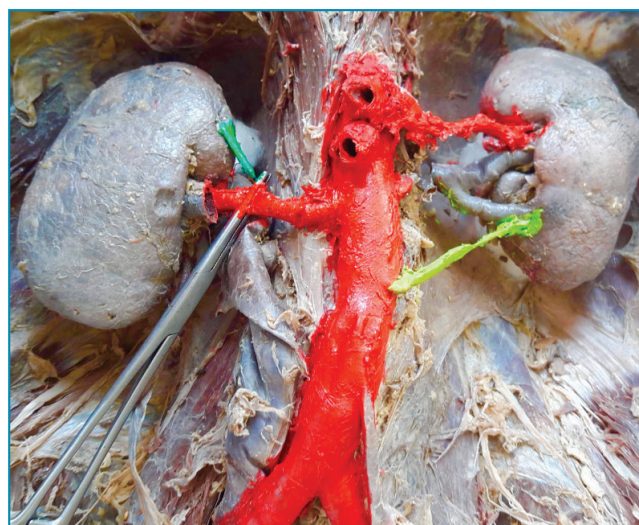


Fig. 3: shows the presence of accessory renal artery on left side arising from abdominal aorta (light green) and an aberrant renal artery arising from main renal artery on right side (dark green)

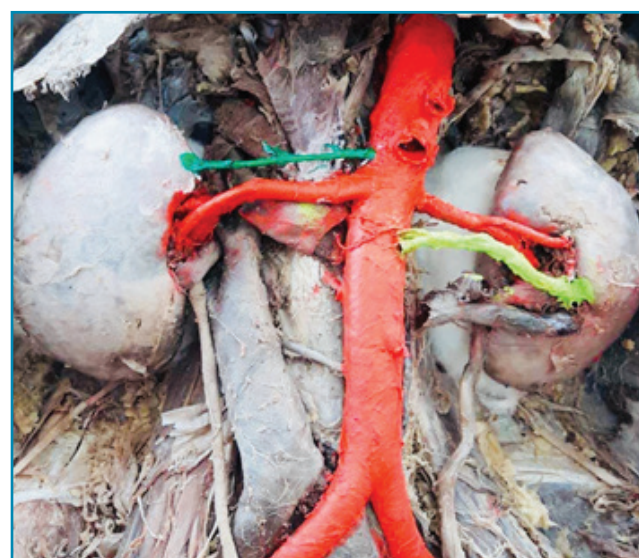


Fig. 4: shows the presence of an accessory renal artery on left side (light green) and an aberrant renal artery arising from abdominal aorta on right side (dark green)

studies by other observers conducted in various countries.^{10,18,27} The origin of left renal arteries were found to be at higher level in 16.66% (Table 2) which was similar with the studies conducted in India by various authors.^{15,16} The higher level of origin on left side has been shown in Fig.3. Branching of main renal arteries into anterior and posterior division proximal to the hilum is called early division.¹⁰ In the present study, early division was found in 16.66% on both sides (Table 1 and 2). Early division of main renal artery has been shown in Fig.2. The divisions were normal in 83.34% which was very similar with the studies conducted in India and Turkey.^{10,16}

Variations in additional renal arteries

The presence of accessory or additional renal arteries are common and are regarded as the persistent embryonic lateral splanchnic arteries. Among them the presence of inferior polar arteries are extremely important as they cross the corresponding ureter and may cause ureteric obstruction.⁴ There are different terminologies related with accessory and aberrant renal arteries. Our findings in the variations of additional renal arteries were found to be similar with the findings of other authors.^{14,16,20} but however they were found to be lower than the studies observed by angiographic method when compared on each side.¹⁰

In conclusion, the present study showed the wide spectrum of variations in the renal artery and also in the presence of additional renal arteries. The variations were noted at the level of origin and also at their division. The additional or extra renal arteries were equally common on both sides and were found arising either from abdominal

aorta or from the main renal arteries. And this variation has also occurred simultaneously on both sides in the same cadaver. Frequency of accessory renal arteries are also common on both sides. Furthermore, among the aberrant renal arteries, both superior and inferior polar were equally common on both sides. As the wide variations were observed in the renal arteries this study would be of great help to the transplant surgeons involving in donor nephrectomies, to the radiologists performing various interventional radiological procedures and can also be used as an important tool for academic purposes.

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