

## DETECTION OF ACCESSORY RENAL ARTERIES IN NORTH INDIAN POPULATION: A CT STUDY

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### ABSTRACT

Presence of supernumerary renal artery (accessory renal artery) is the most common anatomical variation of renal arterial system and is seen with varying frequencies among different ethnic and racial groups. Prior knowledge of these variations is of great surgical importance as it influences the selection of donor kidney, partial nephrectomy and other urological procedures.

Aim of the present study was to observe the prevalence of accessory renal artery (ARA) and their distribution pattern with relation to gender and side in adult North Indian population.

One hundred normal healthy adult (16 males and 84 females; mean age of 43.5±10.42 years) who were prospective voluntary kidney donors underwent MDCT and CT angiography evaluation for the presence of accessory renal artery.

Accessory renal artery (ARA) was present in 25.0% kidneys. The prevalence of ARA in males and females was similar (25.0%) respectively. On the right side the prevalence of ARA was 26.0% and on left side it was 24.0%. In males 25% kidneys had unilateral single ARA. In females 14.3% of left kidneys and 16.7% of right kidneys had a single unilateral ARA. In 9.5% female subjects bilateral ARA was present in the kidneys.

The prevalence of ARA in our North Indian population was 25.0%, which is similar to studies from other Asian countries. The distribution pattern was not affected by gender and side. These findings need further validation in a larger cohort of subjects.

**KEYWORDS:** Accessory Renal Artery, Kidney, Main renal artery.

### INTRODUCTION

The arterial supply of the kidney show a wide range of anatomical variations. In two-thirds of the cases each kidney is supplied by a single renal artery which arises laterally from the wall of the abdominal aorta just below the origin of the superior mesenteric artery at the level of intervertebral disc between L1 and L2 vertebra (1). These anatomical variations in the arterial supply of the kidney relates to number, level of origin, site of origin and the branching pattern (2, 3). Presence of an additional or supernumerary renal artery is the commonest and clinically most important variation. These additional arteries are referred to as accessory renal arteries (ARA). These accessory arteries usually originate from the aorta above or below the main renal artery and follow it to the renal hilum. They may enter the upper pole or lower pole of the kidney directly and are known as superior or inferior renal polar artery respectively. The prevalence of accessory renal arteries ranges from 9% to 76%, with an average of 0% (4-6).

Laparoscopy has become the preferred surgical technique for harvesting the donor kidney, partial

nephrectomy and management of renal artery stenosis. Surgeons prefer donor kidneys with a single renal artery because it is associated with less surgical complications and risk of renal artery thrombosis. The presence of inferior polar renal artery is associated with potential risk of pyeloureteral damage. Presence of accessory renal artery also presents a challenge during endovascular repair of aortic aneurysms. Therefore prior knowledge of variations in renal arterial supply is of great importance for the surgeons to avoid serious surgical complications or even life-threatening events (7, 8).

The aim of the study was to observe the prevalence of accessory renal arteries in our healthy adult North Indian population and evaluate its distribution pattern according to gender and side.

### MATERIAL & METHODS

#### SUBJECTS

In this prospective study one hundred consecutive normal healthy adult voluntary kidney donors (16 males and 84 females) in age group 21-61 (mean 43.5±10.42) years were evaluated with MDCT and CT angiography for the presence of accessory renal artery (ARA). The

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donors were screened clinically and with laboratory investigations to rule out any pre-existing medical illness, Ultrasonography evaluation of abdomen was performed in all the potential kidney donors prior to CT-Scan evaluation to rule out any abdominal pathology. Informed consent was taken from all the subjects as per the institute hospital guidelines.

**CT PROTOCOL**

The voluntary kidney donors were subjected for evaluation of renal vascular anatomy as per the radiological guidelines of the institute. The subjects were imaged with 128-slice MDCT (Somatom Siemens). After initial scannogram of the abdomen was performed it was followed by non-contrast CTscan of abdomen (including kidney, ureter and bladder region). Subsequently arterial and venous phase study was performed.

**Post processing and Image analysis**

All images obtained were independently analysed by the radiologist in random order. Axial, multi-planar reformatted image (MPR), volume rendered images (VRI) and maximum intensity projections (MIP) were reviewed. Maximum intensity projection (MIP) was obtained using various thicknesses (5-10 mm).

For analysis the kidneys were identified in both axial and volume rendered images and observed for arteries entering and supplying them. The number of renal arteries entering the kidney on each side recorded. When a kidney had two or more arteries with a separate origin, the vessel with the greatest diameter was considered to be the main renal artery and others were considered to be accessory arteries (8).

**RESULT**

In the present study it was observed that 150 of the total 200 kidneys (75.0%) were supplied by a single renal artery. In 75.0% of the kidneys both in males and females the kidneys were supplied by a single renal artery. Single renal artery was in 76% of the kidneys on left side and 74% of kidneys on the right side.

Supernumerary renal artery i.e. accessory renal artery (ARA) was observed in 50 of the 200 (25.0%) kidneys. These 50 kidneys had a total of 57 accessory renal arteries. The prevalence of ARA in males was 25.0% (8 of 32 kidneys) and in females it was also 25.0% (42 of 168 kidneys). On the right side the overall occurrence of ARA was 26.0% (26 of 100 kidneys). In males, on right side ARA was present in 25% (4 of 16) kidneys and females the prevalence of ARA was 26.2% (22 of 84 kidneys). On the left side, overall 24 of the 100 kidneys (24.0%) had ARA. In females the prevalence was 23.8% and in males it was 25.0%. On comparing the data statistically, neither gender wise nor side wise significant differences were observed (p>0.05) (table 1).

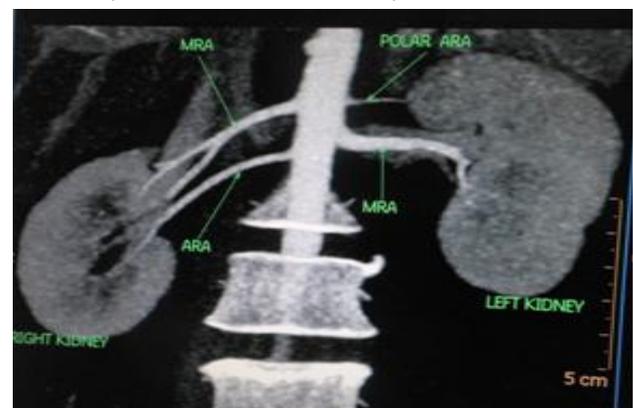
Accessory Renal Artery (ARA)	Male (n=16)		Female (n=84)		Total ARA
	Left Kidney	Right Kidney	Left Kidney	Right Kidney	
<b>Unilateral ARA</b>					
+ 1 ARA	4	4	12	13	33
+ 2 ARA	0	0	0	1	2
<b>Bilateral ARA</b>					
+ 1 ARA	0		5		10
+ 2 ARA	0		3		12
					57

**Table 1: Distribution Of Accessory Renal Arteries (ARA) According To Gender And Side**



**Fig 1. CT (MIP) Image Showing The Presence Of Single Accessory Renal Artery On The Right Side.**

In males, four kidneys (25.0%) on the left and right side each had one unilateral accessory renal artery. In females 12 (14.3%) left kidneys and 14 (16.7%) right kidneys had a single unilateral accessory renal artery. In one female donor the right kidney had 2 accessory renal arteries. Eight female subjects had bilateral accessory renal arteries. In 5 of these subjects both the kidneys had a single accessory renal artery (figure 2) in other 3 subjects the kidneys had bilateral 2 accessory renal arteries.



**Fig 2. CT (MIP) Image Showing The Presence Of Single Accessory Renal Artery On The Right Side And One Single Accessory Renal Artery (polar Artery) Entering The Pole Of Left Kidney.**

## DISCUSSION

Anatomical variations of the renal arteries are common in general population with different frequencies among several ethnic and racial groups (9). Accessory renal artery is the most common anatomical renal variation. ARA is an additional artery that passes along with main renal artery through hilum. Aberrant arteries are those which enter the kidney by piercing the substance of kidney, either through upper or lower pole as polar arteries. The knowledge of normal as well as variations in the vascular anatomy of the kidney has become essential because laparoscopic nephrectomy has become the preferred technique for harvesting donor kidney. It is associated with limited operative visibility and surgical exposure, thereby making details of renal vessel anatomy difficult to appreciate (10, 11). The knowledge of presence and distribution of ARA is of great importance in renal transplantation. The presence of more than two ARA in a donor kidney is usually considered to be a contraindication to its use in transplant surgery (7). Since ARA are end arteries, they must be re-implanted and this would require several anastomoses prolonging the ischemic time, leading to a theoretically higher incidence of renal failure, graft rejection and reduced graft function (7).

Hence, comprehensive preoperative knowledge of kidney and its vasculature is crucial for selecting proper donor, successful renal transplant surgery and avoiding surgery related complications (7, 11, and 12)

The prevalence of single renal artery has been reported to range from 69% to 75% (13, 14). In the present study single renal artery was present in 75.5% and ARA. The prevalence of ARA has been reported to range from 24.5% to 32% (15-17). Zagyapan et al (18) reported a higher prevalence of ARA (42%) in their study. A lower prevalence rate of 18.0% has been observed in Thai population (19). ARA has been observed to be present in 24.7% ARA of Iranian subjects which is similar to our study (20). (Table 2).

Author (Reference no.)	Population	Type of study	Prevalence of ARA (%)
Ozakan et al (5)	Turkish	Conventional Angiography	14.5
Johnson et al (9)	West Indian	MDCTA	36.1
Chai et al (15)	Korean	MDCTA	28.2
Patil et al (16)	Indian	CTA	25.5
Khamanarong et al (19)	Thai	CTA	18.0
Tarzamni et al (20)	Iranian	MDCTA	24.7
<b>Present study</b>	<b>Indian</b>	<b>MDCTA</b>	<b>25.0</b>

**Table 2: Comparison Of Prevalence Of Accessory Renal Arteries In Different Population.**

In the present study, single ARA was found in 21.5% cases and two ARA in 3% of the kidneys. Saldarriaga et al (21) who performed a cadaveric study found presence of single ARA in 22.3% cases and two ARA in 2.6%. Other studies also have reported similar findings, the frequency of occurrence of single ARA has ranged around 24%, two ARA 2.5 to 4% and three or more ARA in less than 1% cases (15,22). There is no limit for the number of renal arteries (23). Cases with 7 to 10 ARAs have been reported (24, 25). Case of seven renal arteries. Miclaus and Matuz (26) have reported a case of bilateral quadruple renal arteries.

In present study no gender or side preference was observed as far as prevalence of accessory renal artery was seen. A high prevalence in males has been reported in some studies (27, 28). Few studies reported a higher incidence of ARA on the right side (29, 30). In contrast, few other studies have reported a higher incidence of ARA on the left side (9, 18, and 21). However, in the present study the prevalence was almost same on both the sides.

## CONCLUSION

In the present study single renal artery was present in 75.5% of the kidney. The prevalence of ARA was 24.5% in the present study and is similar to other studies. The prevalence of ARA in males and females was same (25.0% and 24.4% respectively). The prevalence of ARA was similar on both left and right side (24.0% and 25.0% respectively). Prevalence of bilateral ARA was seen in 8% of kidneys.

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