

Analysis of Intra Renal Arterial Pattern in Kidney Donors Using 64-slice Computed Tomography Angiography

M. Kumaresan¹, A. Sangeetha², J. Vijayakumar¹,
Yuvaraj Maria Francis¹, T. Siva³ and K. Balaji¹

¹Department of Anatomy, Saveetha Medical College Hospital, Thandalam, Chennai India.

²Department of Physiology, Saveetha Medical College Hospital, Thandalam, Chennai India.

³Department of Anatomy, Sri Ramachandra Medical College and research institute, Chennai, India.

*Corresponding author E-mail: kumaresan1204@gmail.com

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The renal artery when it reaches close to the hilum of kidney where it cleaves into anterior and posterior divisions were receives around 75% and 25% of blood respectively. Further these branches divide into many segmental branches. These segmental arteries does not have collateral system, so when there is any occlusion of these arteries which results in the ischemia of the particular segment of kidney. Anatomists believe that knowledge of presence of lower polar artery is essential for polar nephrectomy. Prior knowledge of variations in the renal vessels is required for urological surgery for pre-surgical investigations in order to minimize the surgical complications which include enormous haemorrhage. In this study we analyzed the different variations in the intra renal branch of inferior segmental artery. The present studies were done to analyze the intra renal arterial pattern of inferior segmental artery in kidney donors. In this study a total 99 CT angiogram images were analyzed in work station. The study group was drawn from kidney donors who approached the scan centre had no diseases related to kidney. In the 99 donors (198 kidneys) of the present study the inferior segmental branch shows, type 1 is seen in 66 kidneys on right side and 66 on left side, type2 is seen in 6 kidneys on right and 3 on left, type3 is seen in 11 kidneys on right and 12 on left, type 4 is seen in 12 kidneys on right side and 13 on left side. Type5 is seen in 1 kidney on right and 1 on left. In some kidneys we found inferior segmental arteries arising from common iliac and from middle segmental branch of renal artery. In this study, we analysed the results statistically. The precise knowledge of intra renal arterial branches will provide a significant contribution for urologist in performing conservative renal surgeries like partial and segmental resection of renal tissue instead of going for radical nephrectomy.

Keywords: Inferior segmental artery, Renal artery, Nephrectomy, CT angiogram and kidney donors.

The renal artery is one of the lateral branches of abdominal aorta, as it reaches closer to the kidney it splits into anterior and posterior division were it receives around 75% and 25% of blood respectively. Further these branches divide into many segmental branches. These segmental arteries does not have collateral system, so when there is any occlusion of these arteries which results

in the ischemia of the particular segment of kidney¹. If lower polar accessory renal artery is present in the infant, it should be noted to be in close relation to main renal artery and not to ureter.

In later part of life the poles of kidney are separated from the main artery in such a case it could obstruct the ureter². Interestingly, a recent study result tells the reality about the galactosemia

patients should be monitored for anomalies of renal vessels³. Anatomists believe that precise knowledge of presence of lower polar artery is essential for polar nephrectomy. Prior awareness of anomalous of renal artery is needed for the urologist in preoperative findings as there are reports surgical complications which enormous haemorrhage⁴. There are very less reports of additional renal artery to poles of kidney. Arrival of renal artery into the kidney other than usual route is considered as infrequent findings⁵. The entire accessibility rate for inferior segmental artery rate was 88.5% from an anterior and 66.7% from a posterior surgical approach^{6,7,8}. This present study is to analyze the intra renal arterial pattern of inferior segmental artery in kidney donors. This study results not only gives information to intra-renal surgeries but also for renal transplantation.

MATERIALS AND METHODS

In this study 99 CT angiogram images were analyzed in work station of specialized scan centre in Chennai after getting approval from the Institutional Human Ethics Committee, Saveetha Medical College - IHEC No. 001/09/2015/IEC/SU. The CT machine used was light speed VCTXTe, ADW 4.5 Version, 64 slice Computed Tomography Angiography. The study group was drawn from kidney donors who approached the scan center had no diseases related to kidney. Out of 99 donors there were 54 male, and 45 were female. Inferior segmental branch of renal artery is

classified into four types depending upon the mode of its origin [kher *et al*]. They are

Type I – Inferior segmental branch arises from the anterior division of renal artery.

Type II – Inferior segmental branch arises from the posterior division of renal artery.

Type III – Inferior segmental branch emerges from the main renal artery.

Type IV – Inferior segmental branch arises either above or below the main renal artery from aorta.

Observation and results

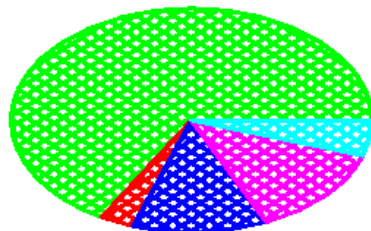
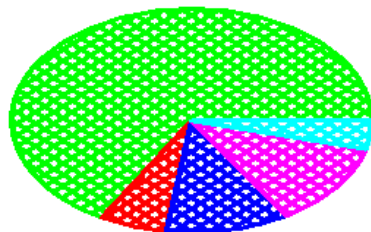
Percentage of occurrence of pattern of origin of inferior segmental artery is given below. Among the 99 donors (198 kidneys), type 1 is seen in 66 kidneys on both sides, type 2 is seen in 6 kidneys on right side and 3 on left side, type 3 is seen around in 11 kidneys on right and 12 on left, type 4 is seen in 12 kidneys on right side and 13 on left side. Other patterns are seen in 4 kidneys on right and 5 on left side. In few kidneys we found an inferior segmental artery emerges from common iliac and middle segmental branch of renal artery.

Chart 1: Showing the distribution of inferior segmental artery.

There is no association between the pattern of inferior segmental branch between right and left side, $\chi^2 = 1.195$; $P = 0.879$.

DISCUSSION

This present work reported that the inferior segmental artery type 1 arises from anterior division of renal artery found to be more frequent



which is similar to previous studies by servo *et al*⁹ reported in 47% of cases, Raghavendra *et al*¹⁰ reported in 51.66%, Chandra Girish *et al*¹¹ reported in 59% of cases and Fine H *et al*¹² study not observed the type 1 inferior segmental artery. Results obtained in our study shows different percentage in compare to other results (Table2).

And this is the only angiographic study to find out the variations in inferior branch of renal artery in live donors, so compare to the previous study the results shows great significance. We also compared not only the variations in the sides but we found the gender differences. In this current study, type I and type II are more frequent in male on both

Table 1. Values given in parenthesis are percentage. Statistical values are given in the below chart

Pattern	Right		Left	
	Male (n=54)	Female(n=45)	Male(n=54)	Female(n=45)
Type 1	37(68.5%)	29(64.4%)	37(68.5%)	29(64.4%)
Type 2	4(7.4%)	2(4.4%)	3(5.5%)	Nil
Type 3	5(9.2%)	6(13.3%)	6(11.1%)	6(13.3%)
Type 4	6(11.1%)	6(13.3%)	5(9.2%)	8(17.7%)
Others	2(3.7%)	2(4.4%)	3(5.5%)	2(4.4%)

Table 2. Comparison of inferior segmental branch with previous workers

Type	Verma <i>et al</i> 1961	Raghavendra <i>et al</i> 2007	Chandra Girish <i>et al</i> 2014	Present study 2018
Kidneys studied	98	60	100	198
Type I	88%	51.66%	59%	66.6%
Type II	1.02%	8.33%	6%	4.5%
Type III	3.06%	10%	28%	11.6%
Type IV	-	28.33%	2%	12.6%
Other pattern	-	-	-	4.5%

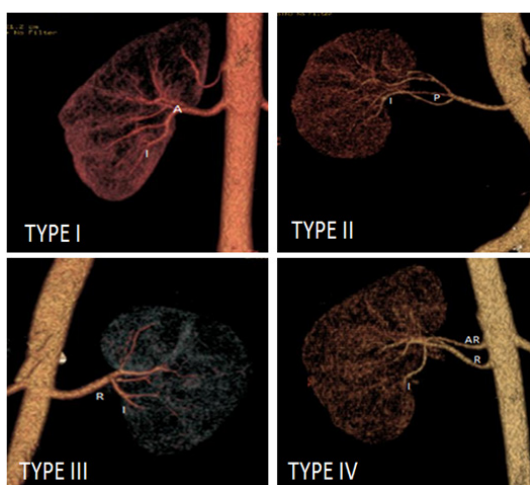


Fig. 1. Showing the classification of Inferior Segmental artery depending upon its origin

sides whereas Type III and IV are more frequent in female on both sides. There is no association within the pattern of inferior segmental branch of renal artery between right and left side $c2 = 1.195$; $P = 0.879$. The presence of accessory lower polar

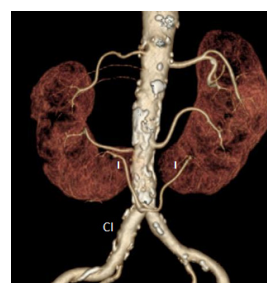


Fig. 2. Showing the origin of inferior segmental artery from common iliac artery

artery prevail as the kidneys ascend upwards they are nourished by a succession of momentary aortic sprouts that emerge at gradually higher levels. Such arteries will not elongate to follow the ascending kidney but instead dissipated and are replaced by recent arteries. The final pair of arteries forms in the lumbar region and becomes the definitive renal arteries. Rarely, a inferior pair of arteries persistent as additional inferior polar arteries. Additional renal arteries can emerge from the abdominal aorta aloft the main branch or as low (inferiorly) as the internal iliac artery¹³. Diverse origins may be from ventral branches of abdominal aorta such as, celiac, superior and inferior mesenteric and also from middle colic, lumbar, middle sacral and opposite side renal arteries have been reported¹⁴.

The presence of such anomalies may be important from the academic, anthropological and radiological point of view¹⁵.

CONCLUSION

The precise knowledge of intra renal arterial branches will provide a informative benefaction for surgeons in performing more conservative renal surgeries like partial and segmental resection of renal tissue instead of going for comprehensive nephrectomy.

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