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ANATOMICAL VARIATION OF RENAL ARTERIES AND VEINS IN PROSPECTIVE LIVING RENAL DONORS

Radio-Diagnosis

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ABSTRACT

Background: Renal anatomy and vasculature evaluation is important for screening kidney donors. This is required for pre laparoscopic donor nephrectomy evaluation. The aim of the study was to assess the occurrence of renal artery (RA) and renal vein (RV) variations, the distribution of these variations with respect to gender and the types on multi-detector computed tomographic (MDCT) angiography. **Methods and Materials:** Study population included 65 patients referred to Radiology department, Amrita Institute of Medical Sciences, Kochi to assess vascular anatomical appropriateness for renal donation. Important parameters which can lead to surgical complications were taken into consideration. Quantitative data were expressed as mean ± SD and the qualitative data was expressed as proportions and percentages. **Results:** In this study 49% patients had accessory renal arteries, more numbers seen on right side. Hilar and polar types was prominent on the right side and polar type on the left. Early segmentary bifurcation was seen in 41% patients and 7.7% of the patients on the right and left renal arteries respectively. With respect to renal veins 31 % of the study population exhibited variations mostly on the right side. Renal vein confluence was seen in 12.3% and 10% of patients on the right and left side. Diameter <3mm was seen in 41% arteries and 11% of the veins. Variations observed in females were more than in males. **Conclusions:** Use of appropriate scan protocol and post-processing methods are necessary for accurate image interpretation. Therefore, to avoid potential injuries, bleedings, and ischemia of the grafts in the donor, knowledge of vasculature differences, precise position of renal vessels as well as their number, origin, length, diameter, confluence and bifurcation is essential.

KEYWORDS

Renal arteries and veins variation, MDCT angiography, laparoscopic donor nephrectomy, confluence, segmentary bifurcation.

INTRODUCTION:

End-stage renal insufficiency is treated primarily with kidney transplantation, with an increasing number of patients needing this procedure. According to research conducted in the previous years, kidney transplants from living donors, whether related or unrelated have a greater graft survival rate than transplants from cadavers [1,5,11]. Laparoscopic nephrectomy has quickly advanced to become the main method for using kidneys from living donors. [4,7,]

In many instances, there are accessory renal veins and arteries [2]. Multidetector computed tomography (MDCT) angiography helps locating accessory vessels. [4]. Surgeons can choose their surgical options by determining the kind and degree of bifurcation on the renal vessels [6]. Small diameter arteries are quickly thrombosed [7,8]. The main purpose of this study is to investigate the prevalence of variations in renal arteries and renal veins and the distribution of these variations in prospective living renal donors using MDCT method.[3]

METHODS:

This is a prospective observational study with diagnostic test evaluation done at Amrita Institute of Medical Sciences. A total of 65 patients comprising 21 males and 44 females were evaluated. MDCT abdominal angiography scans were performed on prospective live renal donors. The parameters studied included number of renal arteries on either side, diameter, length and early segmentary bifurcation of main and accessory renal arteries. Classification of accessory arteries as hilar/polar, number of renal veins on either side, distance of confluence of the right renal vein to IVC, and distance of confluence of the left renal vein to IVC and from aorta was also assessed.

RESULTS:

Variations in Renal Arteries:

Variations were observed in 49% of the study population. Variations were significantly more on the right side. All the accessory renal arteries were seen to arise from the abdominal aorta. Hilar and polar types was seen on the right side and polar type was common on the left side. Out of the patients with accessory arteries one donor had an extra second accessory artery on both sides. Right renal artery segmentary bifurcation was seen in 27 subjects and left renal artery segmentary bifurcation was seen in 5 participants.

Variations in Renal Veins:

Out of 65 potential kidney donors, accessory renal veins present in 31% of the study population. 85% patients had accessory renal vein on the right kidney and 15 % patients had accessory vein on the left kidney. Late right renal vein confluence was seen in 8 patients. Late left renal vein confluence was seen in 7 patients.

Diameter of Renal vessels less than 3mm

For right and left accessory renal arteries 41.6 % and 30% of the potential donors had less than 3mm diameter. For right and left accessory renal veins 11.7 % and 0% of the potential donors had less than 3mm diameter respectively.

TABLES AND FIGURES:

Table 1.1: Prescence Of Accessory Renal Arteries On Right And Left Kidney

Gender	Presence of ARA n=32	
	Right Kidney n=12 (%)	Left Kidney n=20 (%)
Female	9 (75)	13 (65)
Male	3 (25)	7 (35)

Table 1.2 : Early Segmental Bifurcation Of Renal Arteries

Gender	Early bifurcation of RA n=32	
	Right Kidney n=27 (%)	Left Kidney n=5 (%)
Female	20 (74.1%)	3 (60%)
Male	7 (25.9%)	2 (40%)

Table 1.3: Prevalence Of Accessory Renal Veins On Right And Left Kidney

Gender	Presence of ARV n=20	
	Right Kidney n=17(%)	Left Kidney n=3(%)
Female	10 (58.8%)	2 (66.7%)
Male	7 (41.2%)	1 (33.3%)

Table 1.4 Late Confluence In Renal Veins

Gender	Presence of Late confluence	
	Right Kidney n=8 (%)	Left Kidney n=7 (%)
Female	5 (62.5%)	6 (85.7)
Male	3 (37.5%)	1 (14.3)

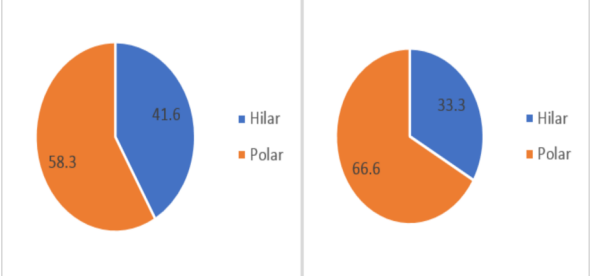

Figure 1.1 Prevalence of hilar and polar types on the right and left kidney

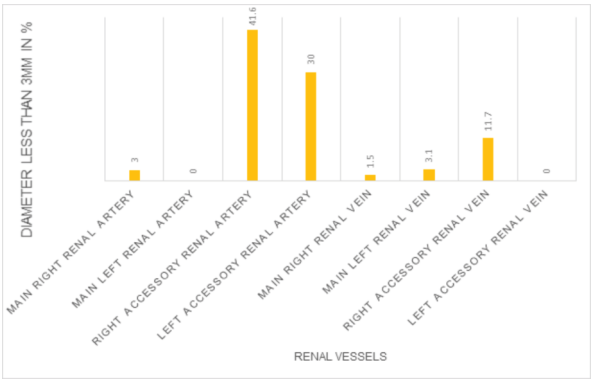

Figure 1.2 Percentage of renal vessels with diameter less than 3mm.

DISCUSSION:

MDCT is a non-invasive modality that clearly detects renal vessel variations. A considerable number of donors had accessory renal vessels in our study as well as in published studies [1,2,3,7,8,12,13], which implies that about 30-40% of the donor population have some variations in renal vasculature. Having information about the details of the vessels as mentioned below will prevent potential injuries, bleedings and ischemia of the grafts.

- number of main and additional arteries on both right and left kidney
- orthogonal diameter and length of main and accessory renal arteries,
- polar or hilar designation for extra arteries
- gap from the origin of the left main renal artery's segmentary bifurcation.
- number of main and additional renal veins on both right and left kidney
- orthogonal length and diameter of accessory veins
- Percentage of renal vessels with diameter less than 3mm
- percentage of confluence of the right renal vein to IVC
- percentage of confluence of the left renal vein to IVC and from aorta.

Presurgical evaluation is important to know which kidney can be used for transplant. In arteries smaller than 3 mm, anastomosis is difficult, and there is a high incidence of thrombosis. For the safety of the recipient arterial graft anastomosis is to be done. In the right kidney, early segmentary arterial branching is defined as segmental branching behind the IVC (retrocaval branching). Surgical procedures done behind the IVC are difficult because of the chances of injuring a large vessel is high. On the left side, the definition of early segmentary arterial branching is a segmental branching less than 1–1.5 cm from the origin of the left renal artery.

Surgeons require at least one cm of main renal artery in order to clamp and properly anastomose the artery in the recipient. If there are accessory arteries, the length of the arteries before the segmentary bifurcation and the distance between the arteries and from the main artery should be reported. The renal artery incision should be done 1.5 - 2 cm distal from the aortic origin to make anastomosis suitable. In addition to knowing the distance from the arterial bifurcation to the aorta, the radiologist's report must have information about intra or extra hilar arterial segmental bifurcation [6,11].

Pre-operative diagnosis and localization of the insertion sites into IVC is important. Duplication of left renal vein is also seen, when one of the venous trunks is pre-aortic while another one is retro-aortic and the configuration is called circum-aortic. In patients with duplication of renal veins, it is important to measure the exact luminal calibre of the veins in the proximal segments. If there is significant discrepancy between the calibres of these veins or if one of the veins is significantly small, then the surgeon may even decide to completely ligate the smaller vein without any major risk to the transplanted kidney.

For right renal vein late segmental confluence is when the confluence is less than 1–2 cm from the IVC. Because this vein is usually short, the left kidney is preferred for donation because its main vein is longer. Late segmental confluence occurs less than 1.5–2 cm from the left aortic margin for left renal vein. Veins are connected and supportive; if one segmental vein or double renal vein is cut and ligation performed, small collateral vessels develop between the veins and redirect the flow, thus preventing the occurrence of renal infarct. Henceforth the number, course, and length of main renal veins and their tributaries must be detailed in the radiologist's report [3,4].

CONCLUSIONS:

Renal vessel variations was prominent in the study population. The number and course of renal arteries and veins are well portrayed by MDCT. This information should be assessed in detail by radiologists for successful transplant procedures.

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