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ORIGINAL ARTICLE

Clinical Significance of Anatomical Variations in Renal Vasculature among Pakistani Population with Normal Renal Functions

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ABSTRACT

Background: Anatomical variations in renal vasculature provide optimal patient care and minimize the complications during surgical procedures and interventional radiology.

Objective: To assess the clinical significance of anatomical variations in renal vasculature among Pakistani population with normal renal functions.

Study design: Cross-sectional analytical study

Place and duration of study: Shaikh Zayed Hospital, Lahore from 15th March 2021 to 14th March 2023.

Methodology: One hundred and fifty cases were examined belonging to both gender within the age group of 18 to 65 years which were advised renal imaging as per protocol for evaluating potential donor for renal transplant surgery or any other reason for which renal CT angiography scan was performed. The protocol for renal scan included patients to be empty stomach for at least 6 hours. In patients where more than one artery was identified the vessel with maximum diameters was taken as the renal artery with other classifies as accessory arteries. Within the accessory artery further division were made as superior or inferior polar/hilar group depending upon their site as polar or hilum. Early pre-hilar branching was termed as branching from main renal-artery as 1.5 cm far from hilum.

Results: The mean age of the patients was between 55.6±2.2 years with 56.6% males and 43.4% females. There was obvious variation observed in the diameter of renal arteries within male and female cases. The frequency of accessory artery within genders presented highest number of cases of males with accessory renal artery. The percentage of left renal artery was 7% in males and 4% in females. The association of laterality with accessory renal artery presented highest number of superior polar branching in accessory renal artery followed by inferior polar artery in females. There was no superior polar or inferior polar branching was observed in the right renal artery. Majority of the male cases presented with single renal artery with prehilar branching being presented In 45.18% cases. The dual renal artery was also presented in few cases.

Conclusion: The variation of renal vascularity with existence of accessory renal arteries. The pre-hilar branching was presented highest and was associated with left renal artery in it the knowledge of such variation before renal surgery is important to get the best results

Keywords: Significance, Anatomical variation, Renal vasculature, Renal function

INTRODUCTION

Anatomical variations in renal vasculature are common and can have significant implications for surgical procedures, interventional radiology, and kidney transplantation. The renal Artery Variations as multiple renal arteries are presented in 20-30% of individuals having more than one renal artery, which can arise from the aorta, iliac arteries, or other nearby vessels. Other than this the accessory renal arteries can also be observed. These arteries supply the lower pole of the kidney and can arise from the aorta, iliac arteries, or other nearby vessels. Polar renal arteries which supply the upper or lower pole of the kidney and can arise from the main renal artery or other nearby vessels.[1-3]

The left renal vein duplication is observed in the 10-20% of individuals which have a duplicated left renal vein. This can drain into the inferior vena cava or other nearby veins. The Retro aortic left renal vein: 2-5% of individuals have a left renal vein that passes behind the aorta instead of in front of it. Circumarctic left renal vein is presented in 5-10% of individuals having a left renal vein that surrounds the aorta instead of passing in front of or behind it.[4-6]

The clinical implications of variations in renal vascularity include benefits during the kidney transplantation as anatomical variations can affect the surgical approach and outcome. Similarly, within the interventional radiology these variations can impact the success of procedures like renal artery stenting or embolization.[3,7] During the surgical procedures the renal vascular variations can upsurge the risk of complications like nephrectomy or kidney repair.[8]

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There are various imaging and diagnosis methods including the CT angiography which provides the detailed imaging of renal vasculature and helps identify anatomical variations. Other methods may include MRI angiography applying non-invasive imaging of renal vasculature and helps diagnose variations while ultrasound can assist to identify some anatomical variations, but may not provide detailed images.[9,10]

The present study was performed for assessing the clinical significance of anatomical variations in renal vasculature among Pakistani population with normal renal functions. The results of this study present authentic data on the anatomical variations in renal vasculature which seem to be very significant and beneficial for healthcare professionals in provision of optimal patient care and minimizing the complications during surgical procedures and interventional radiology.

MATERIALS AND METHODS

The study was based on consecutive sampling technique with cross sectional analytical study type and conducted at Shaikh Zayed Hospital Lahore. A total of 150 cases were examined belonging to both gender patients within the age group of 18 to 65 years. The sample size was generated using the WHO sample size calculator which used 80% power of test, 95% confidence of interval and 5% margin of error. Each patient that was selected was already planned for CT angiography either as per pre imaging protocols for potential renal transplant donors or any other reason that required such imaging and was willing to volunteer for the participation in the study. A written informed consent was taken from each participant. The renal functioning of each patient was completely analyzed through using the ultrasonographical imaging, complete urine examination and renal function test by withdrawing

3cc blood and analyzing the renal function values through automated analyzer. The ejection fraction was also calculated using Modification of Diet in Renal Disease (MDRD) equation. Those patients having any indications of renal infection, kidney disease, ectopic kidney or impaired renal function were excluded from this research. Those patients having severe comorbidities, autoimmune disease or pregnant were also excluded from the study. Renal CT angiography scan was performed as per the standard protocol. The protocol for renal scan included patients to be empty stomach for at least 6 hours. The CT scan was contrast requiring the intravenous contrast placement in the antecubital vein at a dosage of 2ml per kg per body weight and at a rate of 4ml per second. The imaging was done from the coastline of diaphragm till the iliac crest wherein the data extraction was initiated post 10-15 seconds of the injected-dye. The image data was then interpreted through the assistance of specialized radiologist which used three-dimensional structuring for complete assessment of the renal vascularity of kidney. Multi planar reconstruction imaging was used for evaluation of renal vascularity. Mean diameters of renal artery were assessed within initial segments starting from 1.5 cm from the origin site. In patients where more than one artery was identified the vessel with maximum diameters was taken as the renal artery with other classifies as accessory arteries. Within the accessory artery further division were made as superior or inferior polar/hilar group depending upon their site as polar or hilum. Early pre-hilar branching was termed as branching from main renal-artery as 1.5 cm far from hilum. A well-structured questionnaire was designed for documenting all the data collected form the study. Data was entered and analyzed using SPPS-26.

RESULTS

The mean age of the patients was between 55.6±2.2 years with 56.6% males and 43.4% females. There was obvious variation observed in the diameter of renal arteries within male and female cases. The diameter of left and right renal artery of males was bigger than the females (Table 1). The renal arteries were assessed for main-luminal diameter, was conducted. The evidence of initial perihilar-branching as well as presence of accessory renal arteries on the two sides in both genders was also observed. The frequency of accessory artery within genders presented highest number of cases of males with accessory renal artery. The percentage of left renal artery was 7% in males and 4% in females. While it was 6% right renal artery in males and 5.3% in females respectively (Table 2).

The association of laterality with accessory renal artery presented highest number of superior polar branching in accessory renal artery followed by inferior polar artery. There was no superior polar or inferior polar branching was observed in the right renal artery (Table 3). Further branching of the main renal artery into segmental branches which were 1.5 cm far away from hilum were taken as early prehilar-branching. Majority of the male cases presented with single renal artery with prehilar branching being presented In 45.18% cases. The dual renal artery was also presented in few cases (Figs. 2-3).

Table 1: Variation of re9+nal diameter within genders

Renal Diameter	Gender				P value
	Male		Female		
-Dm (mm)	85	6.572±1.4	65	6.278±1.3	0.215
Lt-Dm (mm)	85	6.740±1.5	65	6.310±1.5	

Fig. 1: Renal artery diameter (left and right)

Table 2: Frequency of accessory renal arteries (n=150)

Artery	Gender				P value
	Male (n=85)		Female (n=65)		
	No.	%	No.	%	
Accessory renal artery	19	12.6%	14	9.3%	0.084
Right renal artery	9	6%	8	5.3%	0.541
Left renal artery	11	7.3%	6	4%	0.055

Table 3: Association of laterality with Accessory renal artery

Variable	Accessory renal artery (n= 33)		Right renal artery (n= 17)		Left renal artery (n= 17)	
	Male	Female	Male	Female	Male	Female
Superior Polar	13 (39.3%)	10 (30.3%)	--	--	3 (5.8%)	--
Hilar	13 (39.3%)	08 (24.2%)	1 (5.88%)	1 (5.88%)	1 (5.8%)	--
Inferior Polar	6 (18.1%)	18 (54.5%)	--	--	1 (5.8%)	2 (11.7%)

Fig. 3: (A) Perihilar Branching (B) Dual renal artery

Fig. 2: The frequency of single and dual artery

DISCUSSION

There are various methods for assessing the renal vascular anatomy including conventional method of angiography. The computed tomography as well as magnetic resonance index is also equally important emerging techniques for the assessment of the renal vascularity variations. In various research it has evidently be proven that Angio CT scan is much more advanced technique and permits high resolution allowing scanning up to or less than 1 mm thickness. Renal vascularity refers to the blood supply to the kidneys, including the renal arteries and veins. Evaluating renal vascularity is important for diagnosing and managing condition related to kidney as well as within renal surgeries and transplants.[11,12]

Rydberg et al[13] elaborated that 71% of kidneys have one artery while 24% had two arteries. In the present study there was also higher number of single renal artery, but the frequency was much lower as reported in the aforesaid mentioned research. It was further reported that within the branching 12% were having two hilar arteries while 7% were having one hilar while one superior polar artery and 5% only contained one hilar and one inferior artery. This was almost similar to the present study findings.[13-16]

In the current study more accessory arteries were observed which could be as a result of variation in patient creed and geographical background. In a few studies triple veins has also been identified however in the current study there was no such case presented. It was pertinent to mention that the current study results were more advanced and better resolution due to the application of renal; CT scan which had higher imaging technology, non invasive and less time taking.[14,17,18]

CONCLUSION

The variation of renal vascularity with existence of accessory renal arteries and the prehilar branching was so prevalent in our study and this provides the details of importance of knowledge of vascular variations and its significance during renal surgeries to get the best results.

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