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Assessment of Anatomical Variation of Renal Vessels Using Multidetector Computed Tomography

Taef Alahmadi, Suhaila Alrddadi, Najd Alotebi, Samara Najdi, Safaa Mohammed*

Radiology Department, Al-Ghad International College for Applied Medical Sciences, Saudi Arabia

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***Corresponding author:** Safaa Mohammed

Abstract **Original Research Article**

Study of renal artery variations and determine the pattern and incidence of renal vessels variation in Saudi Arabia in the period from February 2021 to April 2021. The sample size of this study was 50 individuals (100 kidneys). The mean ± STD for age was 44.84± 18.38, for right kidney length and width was 8.63±1.84 and 4.62±0.71, for left kidney length and width was 8.84±2.02 and 4.89±1.53. for right renal artery length and width was 5.41±1.42 and 1.57±2.21, for right renal vein length and width was 3.92±1.47 and 1.52±1.26. for left renal artery length and width was 4.66±1.68 and 1.31±1.23, for left renal vein length and width was 7.19±1.54 and 1.51±0.69. Analysis of variance for patients age with measurements information's, were the p.value showed no significant difference between the patients age with right kidney length (p.value = 0.547), and left renal length and width (0.999) and (0.897), the right renal length for artery and vein showed no significant difference with age (0.370 and 0.405). for left renal artery length and vein length and width showed no significant difference with age where the p.value was (0.82, 0.117). while p.value show significant difference between the patients age with right kidney width, right kidney artery width, right renal vein width, left renal artery width and left renal vein width were the p.value was 0.035, 0.003, 0.000, 0.021 and 0.019. The study concluded that the renal arteries present a broad spectrum of variability in Saudi Arabia in their morphological expression regarding their length, level of ramification, diameter and entrance to the kidney parenchyma.

Keywords: Computed Tomography, Kidneys, Renal Artery, Renal Vein.

INTRODUCTION

Conventional angiography is still regarded as the gold standard in renal vascular imaging, but MDCT angiography is increasingly used since CT has the advantages of being less invasive, easily applicable and available [1]. The accuracy of CT in detecting these variations is more than 90% as demonstrated in recent studies [2]. Anatomical variations of renal arteries are quite common. In the current world, CT angiography is superior to magnetic resonance angiography especially in the evaluation of the abdominal vessels, particularly in identifying those with a diameter of less than 2 mm [3]. So, the need for a thorough CT knowledge of the prevalence and types of variations in renal vascular anatomy in various different populations is on an all-time high.

Multidetector computed tomography angiography (MDCTA) plays an increasingly important role in the evaluation of the renal vasculature [4]. Although conventional angiography is still regarded as the gold standard in renal vascular imaging, MDCTA is increasingly used as it is less invasive, easily applicable and available [5-7]. MDCTA enables precise visualization of the normal and variant anatomy of several regions including the renal vasculature [8-10]; however, the main drawbacks of MDCTA are the exposure to ionizing radiation and the use of potentially nephrotoxic iodinated contrast material. As such, its use is limited in children and pregnant women and in patients with impaired renal function.

Renal artery variations are divided into two groups as extrarenal artery (ERA) and early division (ED). ERA cases are categorized according to their course as either polar (piercing the upper or lower pole of the kidney directly) or accessory (entering the kidney at the hilum) [11, 12]. ED is a normal variant in which any branch diverges within 1.5–2.0 cm from the lateral wall of the aorta in the left kidney or in retrocaval segment in the right kidney [11, 13].

Renal artery variations show unlikeness according to society, ethnicity, and race. With renal artery variations in different regions of Turkey there is

no enough research. Renal arteries typically arise at the level of the upper margin of the second lumbar vertebral body, 1 cm below the origin of the superior mesenteric artery [14]. However, the majority of published data on renal artery anatomy are based on post-mortem observations or arteriograms [15]. It is important to be aware of the location and anatomy of the renal vascular pedicle during surgical procedures and invasive interventions. To obtain an accurate diagnosis during radiologic procedures and to perform complication-free surgery, knowledge of the individual's anatomy and potential congenital anomalies are paramount [16].

Color Doppler ultrasonography (US), computed tomography angiography (CTA), magnetic resonance angiography (MRA) and renal arteriography have been used to evaluate and image renal arteries in vivo. Multidetector scanners have advanced the imaging clarity in computed tomography, making it possible to visualize vascular structures in detail. Multidetector computed tomography (MDCT) is a reliable and non-invasive tool for diagnosing renal artery variations and pathologies [17]. The aim of our study was to assessment of anatomical variation of renal vessel using 64-channel multidetector computed tomography (MDCT).

METHODOLOGY

Material: Using 64 Slice Siemen Somatom Definition as and Phillips Brilliance 64 CT scan Machine.

Study area: The study was conducted In Al Madinah in German Saudi Hospital and Madina National Hospital CT Abdomen scan.

Sample technique and size: The sample size of this study was 50 individuals, (100 kidneys).

Questionnaire: The first part consisted of participant's biographical data, gender, age, and the second part for the method of renal artery identification, size of the kidney, and length, width of the renal artery and vein, type of variation and Accessory of renal vessel.

The Protocol: Patient Position: Supine Head or feet first, Arms elevated above head, Partial flexion of knees with spongy support applied, -Topogram: AP scout (Land mark xiphoid tip)

Start location: Above diaphragm (Lung Bases), End Location: Iliac crest, Breathing: Suspended expiration (single breath hold), -Contrast enhancement: I.V: 1ml / kg in adult patient 2ml / kg in children, (Rate 1.5-2ml/sec) (Delay75-80s scan). Slice thickness: 8-10mm, Windowing: soft tissue windowing.

Measurement Method: The sizes achieved by using measuring tool in the computer specified for CT, scan. The following parameters were evaluated: Kidney length and width, the length of main renal artery and vein) from the ostium to branching), the width of main renal artery and vein, the number of accessory arteries, if any the presence of early branching.

RESULTS

A total of fifty samples were collected from apparently Saudi Arabia in Al Madinah of age between 11-81 to determine anatomical variation of renal artery using computed tomography scan and the results presented in tables as shown below:

Table-1: Show Descriptive Statistics for patient's age and measurements information's

Variables	Mean	Std. Devi	Min	Max
Age	44.84	18.377	11	81
RK Length	8.6308	1.84589	1.23	11.33
RK Width	4.6254	.70960	3.33	6.94
LK Length	8.8446	2.02024	1.00	12.90
LK Width	4.8910	1.53852	.56	12.50
RRA Length	5.4184	1.42043	.05	8.58
RRA Width	1.5794	2.21712	.30	12.50
RRV Length	3.9182	1.47183	1.27	8.44
RRV Width	1.5248	1.25575	.17	8.10
LRA Length	4.6610	1.68033	1.42	10.70
LRA Width	1.3146	1.23052	.32	6.10
LRV Length	7.1984	1.54366	4.22	11.60
LRV Width	1.5056	.69706	.39	3.90

Table-2: Show frequency distribution for type of variations and type of accessories

Type of Variations	Frequency	Percent	Type of Accessories	Freq	Percent
No Variations	27	54.0	No Variations	39	78.0
RED	9	18.0	Upper	3	6.0
RA	2	4.0	Lower	1	2.0
LED	4	8.0	Hilum	5	10.0
LA	5	10.0	Upper & Hilum	1	2.0
RA & LA	1	2.0	Lower & Hilum	1	2.0
LED & LA	1	2.0			
RED & RA	1	2.0			
Total	50	100.0	Total	50	100.0

Table-3: show group statistic for all measurement according to the gender

Variables	Gender	Mean	Std. Deviation	Std. Error Mean
RK Length	Male	8.7812	1.95106	.33460
	Female	8.3113	1.61113	.40278
RK Width	Male	4.5571	.64509	.11063
	Female	4.7706	.83443	.20861
LK Length	Male	9.1747	2.17775	.37348
	Female	8.1431	1.45839	.36460
LK Width	Male	5.0838	1.66280	.28517
	female	4.4813	1.17734	.29434
RRA Length	Male	5.3732	1.54620	.26517
	female	5.5144	1.14754	.28688
RRA Width	Male	1.4979	1.82608	.31317
	female	1.7525	2.94528	.73632
RRV Length	Male	4.0271	1.58746	.27225
	Female	3.6869	1.20356	.30089
RRV Width	Male	1.7141	1.44631	.24804
	Female	1.1225	.54345	.13586
LRA Length	Male	4.5921	1.75831	.30155
	Female	4.8075	1.54536	.38634
LRA Width	Male	1.2744	1.26478	.21691
	Female	1.4000	1.18977	.29744
LRV Length	Male	7.2859	1.72643	.29608
	Female	7.0125	1.08288	.27072
LRV Width	Male	1.5535	.61020	.10465
	Female	1.4038	.86706	.21677

Table-4: Show analysis of variance for patient's age with measurements information's

		Sum of Squares	df	Mean Square	F	Sig.
RK Length	Between Groups	118.414	35	3.383	.976	.547
	Within Groups	48.543	14	3.467		
	Total	166.958	49			
RK Width	Between Groups	21.264	35	.608	2.495	.035
	Within Groups	3.409	14	.243		
	Total	24.673	49			
LK Length	Between Groups	83.170	35	2.376	.285	.999
	Within Groups	116.817	14	8.344		
	Total	199.987	49			
LK Width	Between Groups	69.215	35	1.978	.592	.897
	Within Groups	46.770	14	3.341		
	Total	115.984	49			
RRA Length	Between Groups	74.144	35	2.118	1.200	.370
	Within Groups	24.720	14	1.766		
	Total	98.863	49			
RRA Width	Between Groups	220.064	35	6.288	4.232	.003
	Within Groups	20.801	14	1.486		

		Sum of Squares	df	Mean Square	F	Sig.
	Total	240.865	49			
RRV Length	Between Groups	78.737	35	2.250	1.149	.405
	Within Groups	27.411	14	1.958		
	Total	106.148	49			
RRV Width	Between Groups	75.706	35	2.163	19.384	.000
	Within Groups	1.562	14	.112		
	Total	77.268	49			
LRA Length	Between Groups	115.329	35	3.295	2.004	.082
	Within Groups	23.022	14	1.644		
	Total	138.351	49			
LRA Width	Between Groups	64.917	35	1.855	2.799	.021
	Within Groups	9.278	14	.663		
	Total	74.194	49			
LRV Length	Between Groups	95.626	35	2.732	1.810	.117
	Within Groups	21.135	14	1.510		
	Total	116.761	49			
LRV Width	Between Groups	20.902	35	.597	2.876	.019
	Within Groups	2.907	14	.208		
	Total	23.808	49			

DISCUSSIONS

Variations of Renal Artery in 50 Patients Using 64-Detector CT-Angiography, were in Table 1. show descriptive statistic for all variables, presented as mean, standard deviation, minimum and maximum, where the mean ± STD for age was 44.84± 18.38, for right kidney length and width was 8.63±1.84 and 4.62±0.71, for left kidney length and width was 8.84±2.02 and 4.89±1.53. for right renal artery length and width was 5.41±1.42 and 1.57±2.21, for right renal vein length and width was 3.92±1.47 and 1.52±1.26. for left renal artery length and width was 4.66±1.68 and 1.31±1.23, for left renal vein length and width was 7.19±1.54 and 1.51±0.69.

Table 2. show frequency distribution for type of variations and type of accessories, for type of variables the patients with no variables were dominant with 54 percent for all patients then the patients with right early division was 18%. For type of accessories the patients with no variables were 39 patients with 78% then the patients with upper was 6%.

Table 3 show group statistic for all measurement according to the gender, were the data presented as mean ± STD, for right kidney length for male was 8.78±1.95 for female 8.31±1.6, for right kidney width for male was 4.55±0.64 for female was 4.77±0.83, the left kidney length the mean for male was 9.17±2.17 and for female was 8.14. for left kidney width the male was 5.08±1.66 for female was 4.48±1.17. the mean for male in right renal artery length and width was 5.37±1.54 and 1.49±1.82 and for female was 5.51±1.14 and 1.75. for right renal vein length and width for male was 4.02±1.58 and 1.71±1.44 and for female was 3.68±1.20 and 1.12±0.54.

The measurements of left renal artery length and width for male was 4.59±1.75 and 1.27±1.26 for female was 4.80±1.54 and 1.40±1.189. the left renal vein length and width for male was 7.28±1.72 and 1.55±0.61 and for female was 7.01±1.08 and 1.40±0.86.

Table 4. show analysis of variance for patients age with measurements information's, were the p.value showed no significant difference between the patients age with right kidney length (p.value = 0.547), and left renal length and width (0.999) and (0.897), the right renal length for artery and vein showed no significant difference with age (0.370 and 0.405). For left renal artery length and vein length and width showed no significant difference with age where the p. value was (0.82, 0.117). while p.value show significant difference between the patients age with right kidney width, right kidney artery width, right renal vein width, left renal artery width and left renal vein width were the p.value was 0.035, 0.003, 0.000, 0.021 and 0.019.

CONCLUSION

Study of renal artery variations and determine the pattern and incidence of renal vessels variation in Saudi Arabia in the period from February 2021 to April 2021. The sample size of this study was 50 individuals. (100 kidneys). The mean ± STD for age was 44.84± 18.38, for right kidney length and width was 8.63±1.84 and 4.62±0.71, for left kidney length and width was 8.84±2.02 and 4.89±1.53. for right renal artery length and width was 5.41±1.42 and 1.57±2.21, for right renal vein length and width was 3.92±1.47 and 1.52±1.26. for left renal artery length and width was 4.66±1.68 and 1.31±1.23, for left renal vein length and width was 7.19±1.54 and 1.51±0.69.

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