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Original Research

Morphological and Morphometric Analysis of the Renal Artery Using Computed Tomographic Angiography

Rabia Taşdemir[1], Cansu Öztürk[1], Rukiye Çiftçi[1], Ömer Faruk Cihan[2]

[1] Department of Anatomy, Faculty of Medicine, Gaziantep Islam Science and Technology University, Gaziantep, Turkey
[2] Department of Anatomy, Faculty of Medicine, Gaziantep University, Gaziantep, Turkey

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Correspondence

Rabia Taşdemir, Phd, Assist. Prof.
Address: Department of Anatomy, Faculty of Medicine, Gaziantep Islam Science and Technology University, Gaziantep, Turkey
E-mail: rabiatsdmr@gmail.com

ABSTRACT

Objective: The anatomical features of the renal arteries are important for the diagnosis of various diseases affecting the kidneys and the renal arteries (RA), as well as for preoperative planning of surgical interventions. The objective of this study was to conduct a comprehensive analysis of the morphological and morphometric parameters of renal arteries specific to the Turkish population.

Methods: RA diameter, angle, and distance to other vessels were performed on computed tomography angiography images of 299 patients (156 women, 143 men), considering their branching variations and the level of origin from the abdominal aorta.

Results: The frequency of RA variations was 16.5%. The right RA was observed to arise between the lower T12 level and middle L4 level, most commonly (25.39%) at the L1-2 disc level. The left RA was found to originate between the upper T12 level and lower L3 level, mostly (27.44%) at the L1-2 disc level. The mean diameter of the right RA was 5.49±1.24 mm in females and 6.01±1.69 mm in males, while the mean diameter of the left RA was 5.96±1.44 mm in females and 6.45±1.74 mm in males. The mean exit angle of the right RA from the abdominal aorta was 57.06±17.27° in females and 57.65±16.62° in males, and that of the left RA was 67.05±18.13° in females and 70.37±17.42° in males. The distance of the right RA to the celiac trunk was 3.1±1.29 cm, and its distance to the aortic bifurcation was 9.56±1.52 cm. The distance of the left RA to the celiac trunk was 3.27±1.25 cm, and its distance to the aortic bifurcation was 9.38±1.41 cm. Analysis of the relationship of the study parameters with age showed statistically significant correlations between age and the left RA diameter and between age and the distance of both the right and left renal arteries to the celiac trunk.

Conclusion: This study could contribute to the literature on renal artery morphology and morphometry in the Turkish population and provide guide clinicians.

Keywords: Angle, Computed tomography angiography, Diameter, Renal artery, Variation

INTRODUCTION

Knowledge of the morphological and morphometric characteristics of the renal arteries (RAs) is of paramount importance in the planning and execution of both open surgical and endovascular interventions on the kidneys and their vasculature [1]. Numerous studies have focused on the anatomical structure of the RA, primarily examining its variations [2-7]. In contrast to the classic anatomy knowledge that depicts RAs as singular structures on the left and right sides, variations are observed with an incidence ranging from 7.8% to 39% [8, 9]. Variations are explained as the failure of successful regression of several renal arteries that are present during the embryological period [10].

Renal artery variations have been investigated in diverse populations. However, comprehensive studies involving morphometric analyses are limited in number [11-13]. The branching angle of the RA from the abdominal aorta affects the hemodynamics of the blood supply to the kidney [12]. Furthermore, there are studies demonstrating that the diameter of the renal artery affects on the glomerular filtration rate [13].

For physicians performing open surgical or endovascular treatments on the renal artery or the kidney, minimizing complications and achieving a successful operation requires knowledge not only of renal artery variations but also of its exit point from the abdominal aorta, diameter, angle, and distance to other branches originating from the abdominal aorta. The objective of this study was to conduct a comprehensive analysis of the morphological and morphometric parameters of renal arteries specific to the Turkish population.

MATERIALS AND METHODS

Patient Population

This study was conducted retrospectively on archived images of patients who underwent Abdominal Computed Tomography Angiography (CTA) for various reasons at Gaziantep University Faculty of Medicine Hospital between 2015 and 2023. Approximately 2000 patient images identified through archive screening were examined. Images with a slice thickness >5 mm in which the structures were not visible in three-dimensional reconstruction, images affected by motion artifacts, or images with insufficient distribution of contrast material within the artery, compromising image assessment, were excluded. Images from patients who underwent any surgical and/or interventional procedures, those with known kidney disease, and images where the RA and neighboring vessels were not present in the field of view were also excluded from the study. There were no age- or sex-related restrictions for participation in the study. Ultimately, a total of 299 patients meeting the criteria were included in the study. Among them, 156 were female, and 143 were male. The mean age of the patients was 49.85 ± 18.74 years.

Main Points;

- The rate of branching variation of the renal artery was found to be lower than most of the studies in the literature.
- Before the open or endovascular surgical intervention to this area, the origin level, diameter, angle and distance of the renal arteries should be evaluated.

Image Processing

To prepare for the study measurements, two-dimensional CTA images were reconstructed into three-dimensional (3D) images using the open-source software program Horos v.4.0.0 (https://horosproject.org/). Measurements were performed on the coronal plane for angles and on the transverse plane for diameters using the 2D images. Additionally, RA exit levels were determined and distances were measured on the 3D images. Simultaneously, renal artery variations were also noted.

Determination of the vertebral level and morphometric measurements of the renal arteries

The exit point of the renal arteries from the abdominal aorta, and the corresponding point on the vertebral column were identified. To establish the level of the vertebra, four planes were defined that included the lumbar vertebra and intervertebral disc structures: upper (above the pedicle level of the vertebra), middle (at the pedicle level of the vertebra), lower (below the pedicle level of the vertebra), and disc level (intervertebral disc level) (Fig. 1,2). Based on these levels, the levels of the right and left renal arteries (RRA-LRA) and any accessory renal arteries were established separately.

In addition, the exit angles of the renal arteries, their anteroposterior diameters immediately after leaving the abdominal aorta, and distances from the celiac trunk (CT) above and the aortic bifurcation (AB) below were measured. All these measurements were performed separately for the right and left renal arteries, as well as any accessory arteries, if present (Fig. 3).

Statistical Analysis

The descriptive statistics of the study data were presented using mean and standard deviation for numerical variables, and frequency and percentage for categorical variables. Normality of the distribution of renal artery measurements was assessed using the Shapiro-Wilk test. The independent samples t-test or Mann-Whitney U test was used to compare the categorical variables between two groups as appropriate. The differences between the data for categorical variables were analyzed using the chi-square test. Additionally, relationships between the numerical variables were analyzed using Pearson correlation analysis or Spearman correlation analysis. All statistical analyses were conducted using the SPSS 22.0 (IBM Corp., Armonk, NY), and the significance level was set at $p < 0.05$.

RESULTS

This study was conducted on images from 299 individuals (female, n=156, male, n=143). The age range of the patients was 5-89 years, with a mean age of 49.85±18.74 years. Consistent with classic anatomy knowledge, a single right RA and a single left RA were found in 83.5% of the patients. The frequency of RA variations was 16.5%. Images of the renal artery variations are presented in Fig. 4, and the frequency and percentage of their occurrence in Table 1.

Table 1. Prevalence of variations of the right and left renal arteries.

Number of Right-Left RAs	Number (n=291)	Percentage (%)
1-1	243	83.5
1-2	18	6.3
1-3	1	0.3
2-1	16	5.5
2-2	10	3.4
3-1	3	1.0

RAs: renal arteries

When evaluating the origin of the renal arteries according to the vertebral levels, the right RA was found to arise most commonly at the L1-2 disc level (n=81, 25.39%). This was followed by L1 lower 69 (21.63%), L1 middle 59 (18.5%), L2 upper 47 (14.73%), L1 upper 23 (7.21%), L2 middle 6 (1.88%), T12-L1 disc 5 (1.57%), T12, L3 upper, L3-L4 disc 2 (0.63%). L2-L3 disc, L3 lower, L4 middle level were seen in at least 1 individual (0.31%) each. On the left side, the RA originated mostly from the L1-2 disc level (n=87, 27.44%). This level was followed by L1 lower (56 individuals, 17.67%), L1 middle (51 individuals, 16.9%), L2 upper (43 individuals, 13.56%), L2 middle (24 individuals, 7.57%), L1 upper (22 individuals, 6.94%), T12-L1 disc and L2 lower (11 individuals, 3.47%), L2-L3 disc and L3 upper (4 individuals, 1.26%). 94%), T12-L1 disc and L2 lower (11 individuals, 3.47% each), L2-L3 disc and L3 upper (4 individuals, 1.26% each), T12 upper, T12 lower, L3 middle, L3 lower (1 individual, 0.32% each).

For LRA (left renal artery), Considering the findings from the RA diameter measurements, the mean diameter was 5.6±1.57 mm for the RRA and 6.06±1.64 mm for the LRA. When the RA diameters were analyzed according to sex, statistically significant differences were found in both the right and left renal arteries. The RA diameters were higher in male patients than in females (p=0.001) (Table 2).

For the angular values of the renal arteries, measurements could be performed on 308 arteries for RRA, showing an average angle of 58.04° ± 17.18°. For LRA, angle measurements were obtained from 323 arteries, with a mean angle of 68.51° ± 17.69°. When angular values were evaluated according to sex, no statistically significant difference was observed (p=0.112) (Table 2).

Analyses of the distances of the RA origin to the celiac trunk (CT) above and the aortic bifurcation (AB) below were conducted separately for the right and left renal arteries. The distance between the origin of RRA and CT could be measured in 321 arteries, showing an average distance of 3.1 ± 1.29 cm (p=0.040). The distance between the RRA origin and AB was measured in 320 arteries, with a mean value of 9.56 ± 1.52 cm (p=0.001). In LRA, the mean distance to CT measured in 325 arteries was 3.27 ± 1.25 cm (p=0.168), and the mean distance to AB measured in 324 arteries was 9.38 ± 1.41 cm (p=0.001). Comparing the measured distances between sexes showed a statistically significant difference for all distances, except for the distance between LRA and CT. In all measured distances, the mean distance was greater in males than in females (Table 2).

Lastly, correlations of RA diameter, angle, and distance measurements among each other and with age were analyzed. Only the LRA diameter, RRA-CT distance and LRA-CT distance showed statistically significant correlations with age. A very high positive correlation was observed between LRA-AB distance and RRA-AB distance (p=0.001, r=0.832), as well as a high positive correlation between LRA-CT distance and RRA-CT distance (p=0.001, r=0.712) (Table 3). Due to the limited number of patients in some age groups, the differences in parameters could not be analyzed according to age groups.

Table 2. Distribution of the right and left renal artery diameters, angular values, distance from the origin of the right and left renal arteries to the celiac trunk and aortic bifurcation by sex

	Female		Male		Total		p
	Mean ± SD	Median (Min-Max)	Mean ± SD	Median (Min-Max)	Mean ± SD	Median (Min-Max)	
RRA diameter (mm)	5.49±1.24	5.53 (4.8 -6.29)	6.01±1.69	6.21 (4.97 -7.26)	5.6 ±1.57	(1.08-9.77)	0.001*§
LRA diameter (mm)	5.96±1.44	6.07 (5.11 -6.92)	6.45±1.74	6.67 (5.37 -7.69)	6.06 ±1.64	(0.91-9.91)	0.002*§
RRA angle (°)	57.06±17.27	53.93 (42.89-70.01)	57.65±16.62	56.54 (46-7.78)	58.04±17.18	(12.24-04.43)	0.769‡
LRA angle (°)	67.05±18.13	68.23 (56.77-6.89)	70.37±17.42	70.37 (58.26-1.96)	68.51±17.69	(15.27-22.08)	0.112‡
RRA-CT distance (cm)	2.79±0.78	2.74 (2.21-3.33)	3.03±1	2.99 (2.39-3.55)	3.1±1.29	(0.93-10.36)	0.040*§
LRA- CT distance (cm)	3.03±0.85	3.06 (2.48-3.55)	3.17±0.95	3.2 (2.5-3.83)	3.27±1.25	(0.76-10.83)	0.168‡
RRA-AB distance (cm)	9.45±1.13	9.55 (8.74-10.29)	9.99±1.28	10.04 (9.22-10.88)	9.56±1.52	(1.71-13.45)	0.001*§
LRA-AB distance (cm)	9.18±1.15	9.2 (8.44-10.1)	9.86±1.32	9.85 (9.03-10.76)	9.38±1.41	(3.91-13.37)	0.001*‡

* Significant difference ($p<0.05$); **§:** Mann-Whitney U test; **‡:** Student's t-test; **RRA:** Right renal artery; **LRA:** Left renal artery; **CT:** celiac trunk; **AB:** aortic bifurcation; **SD:** standard deviation; **Min:** minimum; **Max:** maximum

Table 3. Correlations of the measured parameters with age and among themselves

		Age	RRA diameter	LRA diameter	RRA angle	LRA angle	RRA-CT distance	LRA-CT distance	RRA- AB distance
RRA diameter	r	0.083							
	p	0.153							
LRA diameter	r	**00.444**	**0.605****						
	p	**00.001***	**0.001**						
RRA angle	r	00.111	**-0.130***	**-0.137***					
	p	00.060	**0.023**	**0.020**					
LRA angle	r	00.087	-0.084	-0.099	**0.259****				
	p	00.136	0.144	0.079	**0.001**				
RRA-CT distance	r	**00.478**	-0.055	0.066	**0.158****	-0.031			
	p	**00.001***	0.332	0.252	**0.006**	0.596			
LRA-CT distance	r	**00.277**	0.071	0.091	0.145*	0.088	**0.712****		
	p	**00.001***	0.219	0.105	0.014	0.117	**0.001**		
RRA-AB distance	r	00.045	**0.163****	**0.209****	-0.053	0.094	**-0.452****		
	p	00.448	**0.004**	**0.001**	0.361	0.107	**0.001**		
LRA-AB distance	r	-00.065	0.085	**0.150****	-0.013	-0.001	0.029		
	p	00.268	0.138	**0.007**	0.830	0.979	0.612		

*Significant difference ($p<0.05$); Pearson and Spearman correlation analyses; RRA: Right renal artery; LRA: Left renal artery; CT: celiac trunk; AB: aortic bifurcation; r: correlation coefficient

Table 4. Correlations of the measured parameters with age and among themselves

		Age	RRA diameter	LRA diameter	RRA angle	LRA angle	RRA-CT distance	LRA-CT distance	RRA- AB distance
RRA diameter	r	.083							
	p	.153							
LRA diameter	r	**0.444**	**.605****						
	p	**0.001***	**.001**						
RRA angle	r	0.111	**-.130***	**-.137***					
	p	0.060	**.023**	**.020**					
LRA angle	r	0.087	-.084	-.099	**.259****				
	p	0.136	.144	.079	**.001**				
RRA-CT distance	r	**0.478**	-.055	.066	**.158****	-.031			
	p	**0.001***	.332	.252	**.006**	.596			
LRA-CT distance	r	**0.277**	.071	.091	.145*	.088	**.712****		
	p	**0.001***	.219	.105	.014	.117	**.001**		
RRA-AB distance	r	0.045	**.163****	**.209****	-.053	.094	**-.452****	-.016	
	p	0.448	**.004**	**.001**	.361	.107	**.001**	.778	
LRA-AB distance	r	-0.065	.085	**.150****	-.013	-.001	.029	**-.352****	**.832****
	p	0.268	.138	**.007**	.830	.979	.612	**.001**	**.001**

*****Significant difference ($p<0.05$); Pearson and Spearman correlation analyses; **RRA:** Right renal artery; **LRA:** Left renal artery; **CT:** celiac trunk; **AB:** aortic bifurcation; r: correlation coefficient

DISCUSSION

In this study, which aimed to make a comprehensive analysis of the morphological and morphometric parameters of the renal arteries specific to the Turkish population, the frequency of RA variations was 16.5%. The right RA was observed to arise between the lower T12 level and middle L4 level, most commonly (25.39%) at the L1-2 disc level. The left RA was found to originate between the upper T12 level and lower L3 level, mostly (27.44%) at the L1-2 disc level. The mean diameter of the right and left RA was narrower in women than in men. While the mean exit angle of the RRA from the abdominal aorta was close in women and men, the LRA was narrower in women than in men.

Since variations of the renal arteries are clinically important, there are numerous studies conducted both on cadavers and using imaging techniques [1, 3, 5-8, 14, 15]. CTA has been reported as a reliable method for studying the arteries, and therefore, measurements of the origin levels, diameters, angles of RA, and distances to other blood vessels have been performed on patients undergoing CTA imaging for various reasons [11].

Variations of Renal Artery

In a retrospective study of renal artery variations in 610 patients, Mihaylova et al. [10] reported that they found a single renal artery on both sides in 46.3% (n=260) and a wide of renal artery variations in 53.7% (n=301). In a postmortem study, Garcia-Barrios et al. [4] observed arterial variations in 75% of 8 cadavers, while Bouzouita et al. [2] reported arterial variations in 9.85% of 71 cadavers. In studies on kidney donors, Aremu et al. [3] reported that 32% of the observed renal artery variations (50%) were multiple renal arteries, while O'Neill et al. [16] found multiple renal artery variations in 45.6% of the patients. Considering RA variations in different populations, the presence of at least one accessory renal artery was reported at a frequency of 36.1% in the Caribbean population by Johnson et al. [15], with variations of renal artery branching reported in 11.2% of the Greek population by Natsis et al. [14], 38.31% of the Polish population by Sośnik and Sośnik [8], 22% of the Australian population by Tardo et al. [6], and 53.7% of the Bulgarian population by Mihaylova et al. [10]. In the current study, the prevalence of RA branching variations was 16.5%, which is comparable to the results observed in the Greek and Australian populations.

Vertebral Levels of The Origin of The Renal Arteries

Among the published studies investigating the origin levels of the renal arteries, which are crucial for surgical interventions, Fataftah et al. [5] found that both right and left renal arteries originated between the T12-L1 and L2-L3 intervertebral disc levels, most commonly at the L1 vertebral level at a frequency of 41% on both sides. Lee et al. [17] reported that the right renal artery emerged between the T12-L1 intervertebral disc level and the upper margin of L2 vertebra, most commonly at the L1-L2 intervertebral disc level (52%). Mihaylova et al. [10] reported that the renal arteries arose between the T12 and L5 vertebrae, most frequently between the L1-L2 intervertebral disc and the L2 vertebral level. In a study comparing normal renal artery anatomy between sexes, renal arteries were observed to originate between the middle part of the T12 vertebral corpus and the lower part of the L2 vertebra in males, while they emerged between the lower part of the T12 vertebra and the L2-L3 intervertebral disc level in females. In that study, the most common RA origin level in both sexes was found to be between the L1-L2 intervertebral disc [18]. In a study examining the renal artery morphology of 820 patients using computed tomography scans, the authors reported that these arteries, including accessory renal arteries, emerged between the T12 vertebral level and the L3-L4 intervertebral disc level, most commonly at the L1 vertebral level [19]. There are also studies reporting that renal arteries, especially the right renal artery, originate from the thoracic aorta (T10-T12 vertebral levels), albeit rarely [20, 21]. In the present study, both the right and left renal arteries were observed to emerge between the upper part of the T12 and the lower part of the L4, most frequently at the L1-L2 intervertebral disk level on both sides. The most frequently observed origin level is consistent with the literature.

Renal Artery Diameters

It has been reported that the renal artery diameter can be used as a biomarker for estimating the kidney volume, which is one of the key donor parameters assessed in the case of kidney transplantation [22]. As reported in the literature, a RA diameter exceeding the normal value may be associated with potentially fatal aneurysms; in turn, a RA diameter that is below the normal range may be associated with chronic diseases [13, 23, 24]. Identification of the normal RA diameter will be useful in the diagnosis of kidney diseases or in the preoperative evaluation for kidney surgery.

Majos et al. [11] compared RA diameters among variations in a study of 248 patients. They found a significant difference in RA diameter between sexes, with a mean diameter of 5.90 ± 1.1 mm in females and 6.34 ± 1.3 mm in males. In a study of donors, Kesevan et al. [22] reported that the diameter of the right RA was 4.86 ± 0.91 mm and the diameter of the left RA was 5.14 ± 0.85 mm. A study by Aytaç et al. [9] examined the relationship between the renal artery diameter and accessory renal artery reported a mean diameter of 5.86 ± 1.11 mm in renal arteries with normal anatomical branching and noted a reduction in the diameter of the main renal artery in the presence of an accessory renal artery. In a study involving hypertensive patients, measurements showed a left RA diameter of 5.4 ± 1.2 mm and a right RA diameter of 5.2 ± 1.2 mm. The authors reported that the difference was statistically significant, and also noted that patients with lower glomerular filtration rates had significantly reduced RA diameters [13]. In a study on individuals with or without thoracoabdominal aortic aneurysms, the mean diameter of the right RA was 5.4 ± 1.2 mm and that of the left RA was 5.2 ± 0.9 mm. The study found no significant difference between the two groups [25]. In a study involving individuals without any renovascular disease, it was found that the mean diameter of the right RA was 4.59 ± 0.84 mm in females and 5.06 ± 0.99 mm in males. The corresponding figures for the left RA were 4.66 ± 0.84 mm in females and 5.14 ± 0.93 mm in males. Thus, a statistically significant difference was found between sexes in RA diameter on both sides [18]. In a study evaluating renal artery morphometry, a significantly lower main RA diameter was found in the group with an accessory renal artery, with a mean RA diameter of 0.64 ± 0.12 mm in the group without an accessory renal artery versus 0.60 ± 0.11 mm in the group with an accessory renal artery [26]. In the current study, the mean diameter of RRA was 5.6 ± 1.57 mm, and that of LRA was 6.06 ± 1.64 mm, with a significant difference between females and males, which is consistent with literature data.

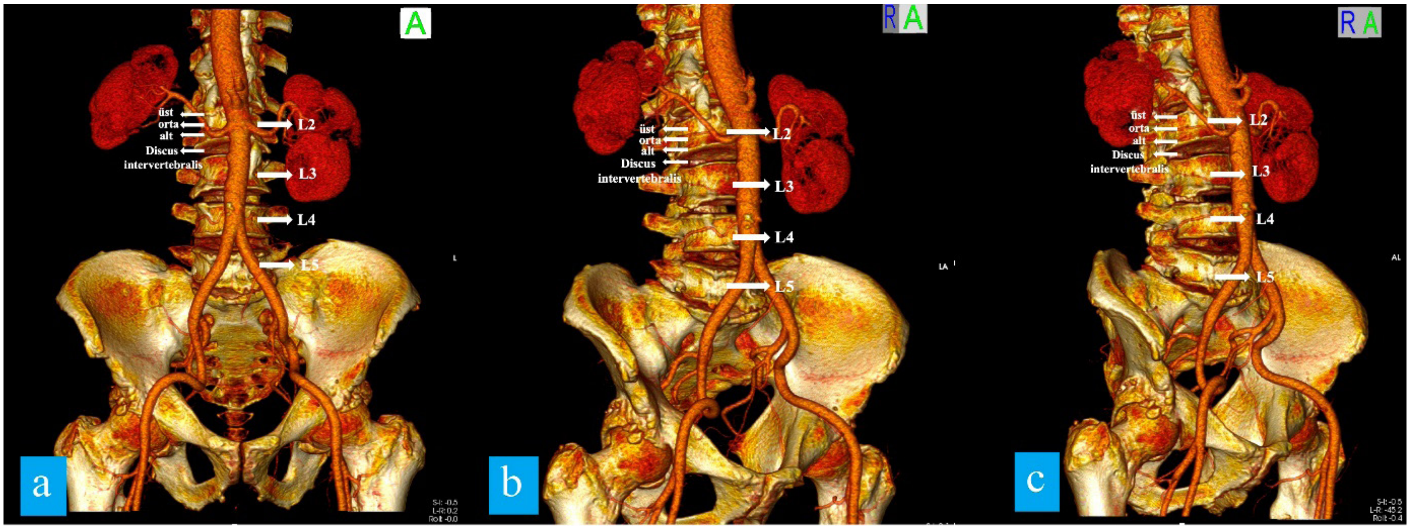

Figure 1. Determination of the origin levels of the right renal arteries concerning the vertebrae. (a) anterior plane, (b) 30° anterolateral plane, (c) 45° anterolateral plane

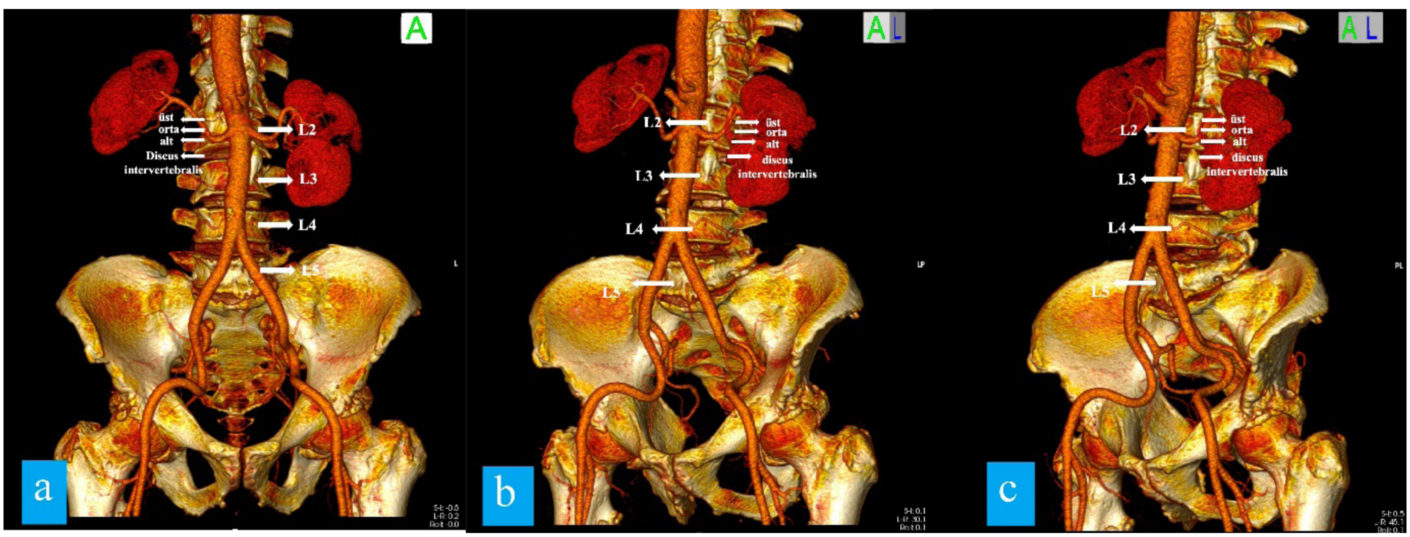

Figure 2. Determination of the origin levels of the left renal arteries concerning the vertebrae. (a) anterior plane, (b) 30° anterolateral plane, (c) 45° anterolateral plane

Figure 3. (a) Measurement of diameters of the right (blue line) and left (red line) renal arteries in the transverse plane, (b) Measurement of the take-off angle of the right renal artery from the abdominal aorta (green line) in the coronal plane, (c) Measurement of the take-off angle of the left renal artery from the abdominal aorta (green line) in the coronal plane, (d) Measurement of the distances from the origins of the right and left renal arteries to the celiac trunk and aortic bifurcation in the coronal plane on 3D image.

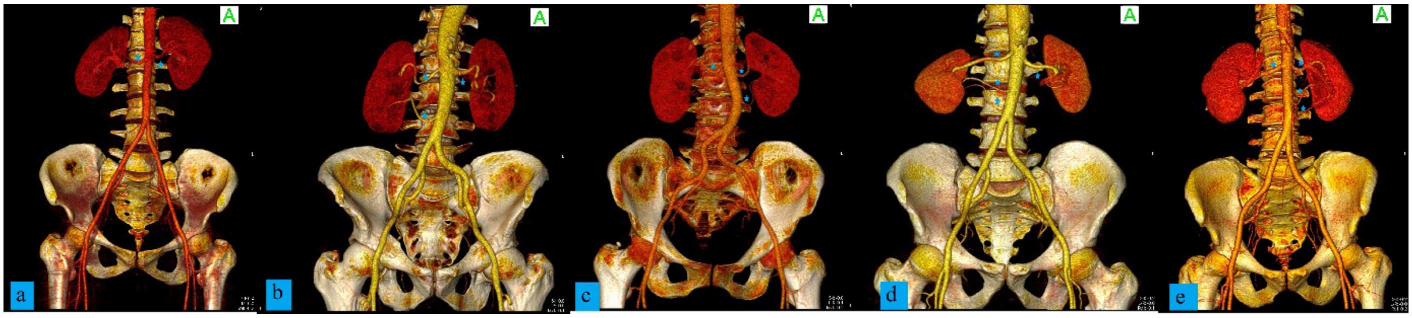

Figure 4. Images of renal artery variations. (a) one right RA and one left RA, (b) two right RAs and one left RA, (c) two left RAs and one RA, (d) two right RAs and two left RAs, (e) three right RAs and one left RA, (f) three left RAs and one right RA.
*: represents the renal arteries.

Renal Artery Angulation

The anatomical angulation formed by the renal arteries when they take off from the aorta is important for the optimal blood supply to the kidney as well as plaque formation and hemodynamics [12, 27]. In the literature, measurements of renal artery angulation have been taken in three different planes including coronal, transverse, and sagittal [12, 18, 25, 27, 28]. Since measurements were obtained in the coronal plane in the current study, a direct comparison with studies measuring in transverse and sagittal planes cannot be made. Csonka et al. [12] reported that the angulation between the renal arteries and the aorta should be between 58° and 78° to maintain constant volume flow and velocity and to avoid changes in turbulence, emphasizing that surgeons should maintain this range of angulation during kidney transplantation to preserve hemodynamic flow. In a study comparing individuals with or without renal artery plaques, Yang and Yang [27] reported that the mean angulation of the right RA was 54.53° ± 17.07° in the group without plaques versus 60.14° ± 14.70° in the group with plaques. For the left renal artery, the group without plaques had a mean angulation of 53.98° ± 15.59° versus 62.79° ± 15.19° in the group with plaques. As such, they reported a significant difference in the renal artery angulation between the control group and the patient group on both sides. In the current study, the mean angulation values were 58.04° ± 17.18° for RRA and 68.51° ± 17.69° for LRA. While these values fall within the limits of normal flow hemodynamics as noted by Csonka et al., they contradict with the findings of Yang & Yang's study. This discrepancy might be explained by the inclusion of individuals without any renovascular disease as well as accessory renal arteries in this study.

Distances of Renal Arteries to CT and AB

Successful endovascular repair (EVAR) requires a thorough understanding of the morphology of the abdominal aorta and its branches [25, 29-31]. Mazzaccaro et al. [25] reported that the distance between RRA and AB was 101.6 ± 19.2 mm, and the distance between LRA and AB was 98.7 ± 20.1 mm. They showed that these distances were significantly longer in the groups with aneurysms compared to healthy individuals. A study investigating infrarenal aortic morphometry in older individuals reported a distance of 90.44 ± 9.82 mm between the lowest renal artery and AB [32]. In a study comparing patients of Asian or Caucasian origin with abdominal aortic aneurysms, the mean RA-AB distance was 143.6 mm in Asians and 116.0 mm in Caucasians [30]. Another study conducting morphometric measurements in individuals with abdominal aortic aneurysms reported a range of 93–210 mm for the distance from the lowest RA to AB [29]. In a study involving individuals with abdominal aortic aneurysms in the Asian population, the distance between the lowest level of the RA and AB was 116.9 ± 13.0 mm [31]. In addition, an anatomical study on cadavers reported that the mean distance between the left RA and CT was 31.9 ± 8.4 mm [33].

In a study on 204 computed tomography images, Arazińska et al. [34] reported a mean RA-CT distance of 25.53±6.59 mm. On the other hand, measurements performed in males aged 18 to 45 years showed that the distance between RA and CT was 16-129 mm (mean, 33 mm) and the distance between RA and AB was 66-123 mm (mean, 97 mm) [35]. These data demonstrate the diversity and variability of renal artery morphometry in different populations and age groups.

In this study, the distances of the right and left renal arteries to the CT were measured separately. The mean RRA-CT distance was 3.1 ± 1.29 cm, RRA-AB distance was 9.56 ± 1.52 cm, LRA-CT distance was 3.27 ± 1.25 cm, and LRA-AB distance was 9.38 ± 1.41 cm, all of which are in line with literature data.

Limitations

It was performed on individuals who applied to the hospital with any complaint but did not have any pathology in terms of renovascular structures and kidneys.

Since this study was designed as a retrospective, demographic information and the presence of another disease that could affect the morphometry of the renal arteries could not be obtained.

CONCLUSIONS

In this study, variations of renal arteries were examined based on their vertebral levels, and their diameters, take-off angles, and distances to CT and AB were measured, contributing to the literature on renal artery morphology and morphometry. The anatomical insights gained through this study can guide preoperative assessments in kidney transplantation, and endovascular or open surgical procedures, potentially leading to interventions with fewer complications and successful outcomes.

Conflict of Interest: The authors declare that they have no conflicts of interest.

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