



## Epidemiology of Accessory Renal Vessels Among Patients with Hydronephrosis in Albania

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### Abstract

**Purpose:** This study aimed to shed light on the prevalence and epidemiology of aberrant renal vessels in a group of patients diagnosed with hydronephrosis in Albania.

**Material and Methods:** This is a case-series study of 81 patients diagnosed with hydronephrosis and showing up at the Urology Service of the University Hospital Center "Mother Teresa", in Tirana, during the years 2010-2014. All patients were examined in order to confirm the hydronephrosis diagnosis and to potentially detect the presence of aberrant renal vessels. Basic socio-demographic data were collected and the chi square test was used to assess their distribution among patients with and without aberrant renal vessels.

**Results:** The mean age of participating patients was 27.7 years  $\pm$  13.78 years, 51.9% males, 53.1% residing in urban areas, 42% unemployed. The patients came all over the country as demonstrated by the distribution of them according to country's prefectures. The overall prevalence of aberrant vessels in patients with hydronephrosis was 42%, the prevalence of aberrant renal arteries was 29.6%, and the prevalence of aberrant renal veins was 18.5%. About 32% of patients with hydronephrosis had one type of aberrant renal vessel (artery or vein) and 9.9% had both types of aberrant renal vessel (both artery and vein). In 9.9% of cases aberrant vessels were located in the right kidney, in 30.9% of the participants they were located in the left kidney and in 1.2% of all participants the aberrant vessels were present in it both kidneys simultaneously (bilateral). No significant differences in the prevalence of aberrant renal vessels were detected by gender, age and place of residence of participants.

**Conclusions:** The epidemiology of aberrant renal vessels among patients with hydronephrosis in Albania is comparable to literature reports. The epidemiology of accessory renal vessels can help professionals in the field to suspect and seek evidence of these structures in their patients, since these health conditions are quite frequent and could interfere with the relevant surgical procedures.

**Keywords:** Albania; Aberrant Renal Vessels; Accessory; Epidemiology; Multiple

## Introduction

In 2008, the simplest definition of accessory renal artery was introduced by Mir, *et al.* [1] While “normal” renal arteries were described as entering the kidney through its hilum, the accessory renal arteries might Morphological and clinical aspects of the occurrence of accessory (multiple) renal arteries arch enter the renal artery through the hilum or through the surfaces of the kidney. Aberrant or accessory renal vessels are not considered as abnormal or redundant structures, but they should be considered as normal segmental arteries whose origin is more proximal than necessary with very pronounced morphological variations which are mainly based on the phenomena that occur during the embryonic stage of kidney development.

Aberrant (or accessory or multiple) renal vessels are a very common phenomenon. On average, the prevalence of this health condition varies between 20% and 30% in normal individuals, varying greatly between studied populations. Thus, a study among 100 kidneys reported that 82 kidneys or in 82% of cases only one renal artery was present, whereas multiple renal arteries were present in 18% of them; among these, in about 89% of cases two renal arteries were identified (two hilar arteries in 5 kidneys, one hilar and one superior polar in 3 kidneys, one hilar and one inferior polar in 5 kidneys and one superior polar and one inferior polar in 2 kidney) and in 11% three renal arteries were identified (a hilar artery with a superior and an inferior polar artery were identified in 1 kidney, and two hilar arteries with an inferior polar artery in 1 kidney).

An early study among 400 patients reported an incidence of multiple renal arteries of 25%. Whereas a meta-analysis that examined only renal venous variations reported that the overall prevalence of retroaortic renal vein was 3%, the prevalence of circumaortic renal vein was 3.5%, the prevalence of multiple renal veins was 16.7%, highest in the right kidney (16.6%) than in the left kidney (2.1%).

A systematic review of the literature to assess the frequency of the presence of accessory renal arteries reported a very wide variation in the presence of this health condition among world populations. This systematic review of the literature reported a wide variation of accessory renal arteries by ethnicity, ranging from a minimum of 4% in Malaysia to a maximum of 61.5% in

some Brazilian populations with a median of 30%; populations with a higher than average level of accessory renal arteries include the Caribbean (36.1%), Iran (43.2%), Bosnia and Herzegovina (46.2%), and certain populations in India (59.5%) whereas China, the Japanese, and Koreans have a lower-than-average level of this condition with 14.5%, 14.1% and 13% of the affected population, respectively. In populations near Albania, the frequency of accessory/multiple renal arteries was 27.4% in Greece, between 25.8% and 46.2% in Bosnia, 25.5% in Italy, 25%-27% in Turkey, 11.2%-21.1% in Poland, 19.9% in Romania.

Regarding gender differences in the frequency of accessory renal arteries, results vary across studies. For example, some authors did not report statistically significant differences between gender and the side where the accessory renal arteries are present, while some other authors have evidenced a greater incidence of these conditions in men than in women, while other researchers have reported the opposite trend (i.e. a higher incidence of accessory/multiple renal arteries in women than in men). Of course, anatomical variations can also involve veins. Also, accessory renal vessels can be found at any age.

In our country, there is extremely limited data on the frequency and epidemiology of aberrant renal vessels. In this context, the aim of this study was to shed light on the frequency and epidemiology of aberrant renal vessels in a group of patients diagnosed with hydronephrosis in Albania.

## Methodology

### Study design

This is a case-series study. The study population comprised patients with hydronephrosis presented to the Urology Service at the University Hospital Center “Mother Teresa”, in Tirana, during the years 2010-2014.

In total, during this period, 81 patients diagnosed with hydronephrosis presented to our service. This is our final study population.

### Data collection

A range of socio-demographic data was collected, including gender, age, profession and place of residence. Also, various imaging examinations were carried out to set the diagnosis of

hydronephrosis and to detect the presence of accessory renal vessels. These examinations included ultrasound, intravenous pyelography, computed tomography, renal scintigraphy, and magnetic resonance imaging when necessary. For the purposes of our study, since the diagnosis of aberrant renal vessels is easily done, we used echography, pyelography, less often scintigraphy and even more rarely CT scanner and magnetic resonance (MRI). Informed consent was obtained from all the patients for the purposes of this study.

**Statistical analysis**

Absolute numbers and corresponding percentages were used to describe categorical data. The chi square test was used to detect potential significant differences in the distribution of socio-demographic variables according to the status of accessory renal vessels' presence. All statistical analyzes were performed through the statistical package Statistical Package for Social Sciences, version 25 (IBM SPSS Statistics for Windows, version 25).

**Results**

In this study, 81 patients diagnosed with hydronephrosis and presented to our Service for evaluation and treatment/further management, during the years 2010-2014, were included. The distribution of patients according to the year of their entry into the study is presented in table 1.

In terms of gender, there was an almost equal gender distribution among patients, with 42 patients or 51.9% of all participants being male and 39 patients or 48.1% of all participants being female (Table 1).

The average age of the patients in the study was 27.7 years (± 13.78 years), ranging from a minimum age of 7 years (1 patient) to a maximum age of 78 years (1 patient). About one in ten patients (9.9%) were in the age group 7-16 years, 27.2% were 16-20 years, 21% were 21-25 years, 14.8% were 26-30 years, 9.9% were 31-40 years and 17.3% were more than 40 years old at the time of the study (Table 1).

Regarding the area of residence, over half of the participants declared that they live in urban areas, while 46.9% lived in rural areas (Table 1).

Variable	Absolute number	Frequency (%)
Total	81	100.0
Year of study entry		
2010	13	16.0
2011	19	23.5
2012	10	12.3
2013	23	28.4
2014	16	19.8
Sex		
Female	39	48.1
Male	42	51.9
Age (in years)	27.7 ± 13.78 *	
Age-group		
7-15 years	8	9.9
16-20 years	22	27.2
21-25 years	17	21.0
26-30 years	12	14.8
31-40 years	8	9.9
>40 years	14	17.3
Place of residence		
Rural	38	46.9
Urban	43	53.1

**Table 1:** Distribution of study participants by age, gender and place of residence.

\* Mean value ± standard deviation.

Table 2 shows the distribution of study participants according to their profession and the prefecture they live in. It can be noted that the most frequent category was “unemployed” with 42% of the patients in the study who declared this, followed by “student” in 19.8% of cases and student in 14.8% of cases. The self-employed accounted for 7.4% of the study participants, while manual workers represented 4.9% of the study patients. Other professions or social statuses were much less frequent. With regard to the prefectures where the patients live in, it can be noted that patients from Fieri and Elbasan accounted for 18.5% of all patients, each, followed by Dibra (16% of patients were from Dibra), Tirana (14.8% of patients) and Vlora (11.1% of patients). Meanwhile, 6.2% of patients came from Lezhë District, 4.9% from Kukës District and 2.5% from Berat, Durrës, Shkodër and Vlora Districts, each. No patients were from Gjirokastra Prefecture.

Variable	Absolute number	Frequency (%)
Profession		
Nurse	1	1.2
Invalid	2	2.5
Lawyer	1	1.2
Teacher	2	2.5
Clerk	1	1.2
Student	16	19.8
Unemployed	34	42.0
Retired	2	2.5
Worker	4	4.9
Student	12	14.8
Self Employed	6	7.4
Prefecture		
Berat	2	2.5
Dibër	13	16.0
Durrës	2	2.5
Elbasan	15	18.5
Fier	15	18.5
Korcë	9	11.1
Kukës	4	4.9
Lezhë	5	6.2
Shkodër	2	2.5
Tiranë	12	14.8
Vlorë	2	2.5

**Table 2:** Distribution of participants according to profession and prefecture.

Table 3 presents the data related to the presence of aberrant (or accessory or multiple) renal vessels in patients with hydronephrosis included in the study. The overall prevalence of aberrant vessels in patients with hydronephrosis in the study was 42%. Meanwhile, the prevalence of aberrant renal arteries was 29.6%, and the prevalence of aberrant renal veins was 18.5%.

Variable	Absolute number	Frequency (%)
Total	81	100.0
Aberrant renal vessels		
No	47	58.0
Yes	34	42.0
Aberrant renal arteries		
No	57	70.4
Yes	24	29.6
Aberrant renal veins		
No	66	81.5
Yes	15	18.5

Type of aberrant vessels		
No aberrant vessels	47	58.0
Aberrant artery or vein	26	32.1
Aberrant artery and vein	8	9.9
Localization of aberrant vessels		
Right kidney	25	30.9
Left kidney	1	1.2
Bilateral	47	58.0
No aberrant vessels		

**Table 3:** Prevalence, type and localization of accessory renal vessels among participants.

It can be noted that 32.1% of all patients with hydronephrosis had one type of aberrant renal vessel (artery or vein), while 9.9% had both types of aberrant renal vessel (both artery and vein), while of course 58% of all participants they had no aberrant renal vessels. Regarding the location of the aberrant vessels, in 9.9% of cases they were located in the right kidney, in 30.9% of the participants they were located in the left kidney and in 1.2% of all participants the aberrant vessels were present in it both kidneys simultaneously (bilateral); in total, aberrant vessels were present in the left kidney in 32.1% of cases and in the right kidney in 11.1% of cases.

Table 4 shows the comparison of the general baseline characteristics of participants between patients with and without aberrant renal vessels. It can be noted that there were no gender, age and place of residence differences in both groups of patients with hydronephrosis. In other words, similar percentages of men and women with hydronephrosis had aberrant renal vessels (41% vs., 42.9%, respectively;  $p = 1.000$ ).

Variable	Presence of aberrant renal vessels		P-value
	No	Yes	
Sex			1.000 **
Female	23 (59.0) *	16 (41.0)	
Male	24 (57.1)	18 (42.9)	
Age-group			0.744
7-15 years	4 (50.0)	4 (50.0)	
16-20 years	13 (59.1)	9 (40.9)	
21-25 years	12 (70.6)	5 (29.4)	
26-30 years	5 (41.7)	7 (58.3)	
31-40 years	5 (62.5)	3 (37.5)	
>40 years	8 (57.1)	6 (42.9)	

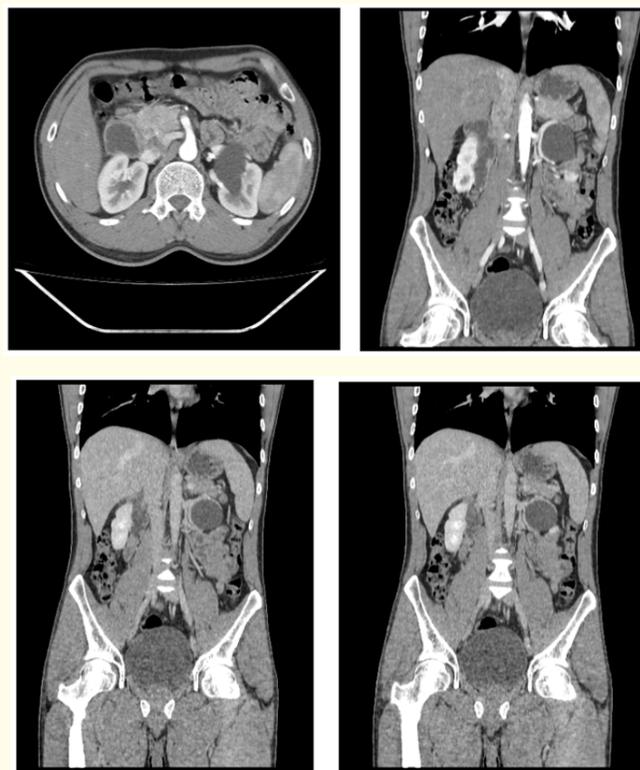
Place of residence			0.659
Rural	21 (55.3)	17 (44.7)	
Urban	26 (60.5)	17 (39.5)	
Prefecture			0.605 **
Berat	1 (50.0) *	1 (50.0)	
Dibër	7 (53.8)	6 (46.2)	
Durrës	2 (100.0)	0 (0.0)	
Elbasan	8 (53.3)	7 (46.7)	
Fier	7 (46.7)	8 (53.3)	
Korcë	7 (77.8)	2 (22.2)	
Kukës	1 (25.0)	3 (75.0)	
Lezhë	4 (80.0)	1 (20.0)	
Shkodër	2 (100.0)	0 (0.0)	
Tiranë	7 (58.3)	5 (41.7)	
Vlorë	1 (50.0)	1 (50.0)	

**Table 4:** Prevalence of aberrant renal vessels according to gender, age and place of residence in patients with hydronephrosis included in the study.

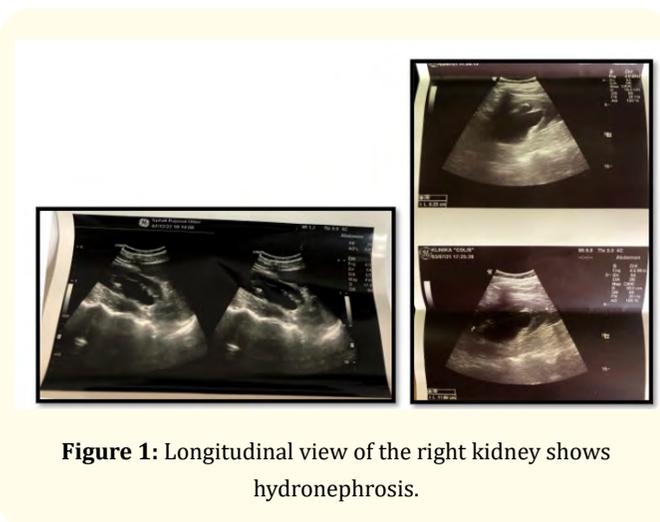
\* Absolute number and row percentage (in brackets).

\*\* The P-value according to chi-square test (Fisher’s Exact Test for 2x2 tables).

The presence of aberrant renal vessels also did not differ significantly according to the age of patients with hydronephrosis, and no definite trend was also evident, with no statistically significant differences ( $p = 0.744$ ). The percentage of patients with hydronephrosis who had aberrant renal vessels was 44.7% in those living in rural areas versus 39.5% in patients living in urban areas, but this difference was not statistically significant ( $P = 0.659$ ). No differences by prefecture ( $P = 0.605$ ) in the prevalence of aberrant renal vessels was detected as well.



**Figure 2:** A CT with contrast was organized which showed a pelviureteric junction stenosis with cortical parenchymal thinning secondary to extrinsic compression by an ectopic inferior right renal artery.



**Figure 1:** Longitudinal view of the right kidney shows hydronephrosis.



**Figure 3:** Ct scan reconstruction view of our series.

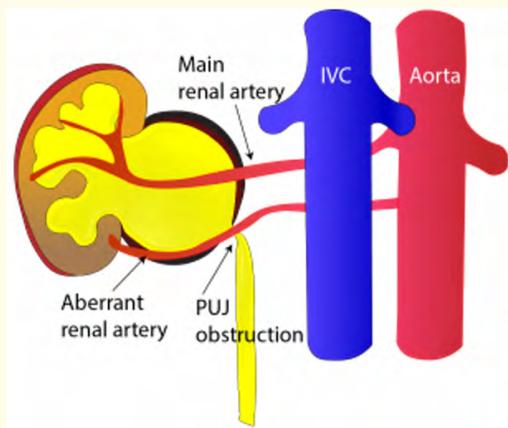


Figure 4

## Discussion

The current study included 81 patients diagnosed with hydronephrosis who presented to our service during 2010-2014. To our knowledge, this is the first study in Albania that sheds light on the epidemiology of aberrant renal vessels.

The overall prevalence of aberrant renal vessels was 42%, the prevalence of aberrant renal arteries was 29.6% and the overall prevalence of aberrant renal veins was 18.5%, without statistically significant differences related to the gender, age and residence of the patients.

The frequency of aberrant renal arteries in human populations varies between 20% and 30%, with wide variations between regions and populations of the world, ranging from a minimum level of 4% in Malaysia to a maximum level of 61.5% in some Brazilian populations. Also, in the countries near Albania, the prevalence of aberrant renal arteries varies from 11.2% in Poland to 46.2% in Bosnia. In our study we reported an overall prevalence of aberrant renal vessels of 42% in patients diagnosed with hydronephrosis, and a prevalence of 29.6% of aberrant renal arteries and 18.5% of aberrant renal veins. Thus, our data are within the reported levels of presence of aberrant renal vessels in the international literature.

For example, the frequency of the presence of accessory (aberrant) renal arteries varies between 4% [2], 18% 19.95%, 23.3%, 24%, 25%, 26.3% and, 31.3%, 43.2% and 61.5%.

Regarding the frequency of accessory (aberrant) renal veins, our findings again seem to be consistent with the international literature. For example, the results of a meta-analysis reported a prevalence of multiple renal veins of 16.7% (whereas in our study the prevalence of aberrant renal veins was 18.5%, thus very similar to the results reported by this meta-analysis. Another study reported a prevalence of accessory renal veins of 21.6% i.e. a higher level than in our study. Another study among 120 kidney donors in Ethiopia reported a total prevalence of accessory renal veins in 9.2% of cases.

Whereas another study among 30 kidneys reported a very high overall prevalence of accessory renal veins of 36.7% (11 in 30). Overall, the prevalence of accessory renal veins is reported at levels between 11% and 28% in postmortem cadaver studies. In fact, the variations of the renal veins are related to the developmental abnormalities of the inferior vena cava, and it is reported that the accessory renal veins are much more frequent in the right kidney (28%) than in the left kidney (1%), but also trends the opposite has also been evidenced.

Regarding the frequency of the presence of aberrant renal vessels between men and women, literature reports are very different, ranging from reports that do not show statistically significant differences according to gender, to studies that report a higher prevalence in men than women and studies that report the opposite, i.e., a higher prevalence in women than in men [2]. The study among 120 donated kidneys in Ethiopia reported a prevalence of total anatomical variations of renal vascularization significantly higher among males (47.5%) than among females (28.8%), 31.1% vs. 15.2%, respectively related to the accessory renal arteries but the opposite gender trend related to the accessory renal veins: 8.2% vs. 10.2%, respectively. A study in Iran among 68 males and 61 females aged 18 years and older reported a frequency of accessory renal arteries similar between males (17.6%) and females (13.1%) in the right kidney ( $P = 0.480$ ) and 20.6% vs. 13.1%, respectively, in the left kidney ( $P = 0.290$ ), thus suggesting that there is no statistically significant gender difference in the frequency of accessory renal arteries. In our study we reported a similar prevalence of aberrant renal vessels between males (42.9%) and females (41%), with no statistically significant differences. Therefore, our study ranks alongside studies that do not find statistically significant gender differences in the prevalence of aberrant renal vessels.

There is great variation regarding the presence of aberrant renal vessels in the left or right kidney, based on literature reports. For example, the study in Iran reported that aberrant renal arteries were present in 15.5% of right kidneys and 17.1% in left kidneys, a result similar to our study where the frequency of renal vessels aberrant in the left kidney (32.1%) was higher than their presence in the right kidney (11.1%). The higher frequency of accessory renal arteries in the left kidney (32.1%) than in the right kidney (20.7%) was also reported by another study.

On the other hand, a large study that included about 21 thousand kidneys reported an equal frequency of the presence of accessory renal arteries in the right kidney (49.83% of cases) and the left kidney (50.17% of cases). Meanwhile, the opposite trend is reported for the presence of accessory renal veins which are more commonly found in the right kidney. In summary, we can affirm that there is no consensus regarding the localization of aberrant renal vessels based on different studies that sometimes affirm a higher frequency in the right kidney, sometimes a higher frequency in the left kidney, and sometimes an almost equal presence of these vessels in the left and right kidney. This conclusion is in accordance with the very large variations of kidney vascularization.

In our study, bilateral aberrant renal vessels were encountered in 1.2% of all patients with hydronephrosis, a rate lower than literature reports suggesting that about 10% of accessory renal vessels are bilateral. Regarding the number of aberrant renal vessels, in our study we identified an additional accessory renal vessel (either artery or vein) in 32.1% of all patients with hydronephrosis and 2 accessory renal vessels (both artery and accessory vein) in 9.9% of patients in the study.

As we have mentioned earlier in this scientific paper, also regarding the number of renal acicular vessels, the variations are very large, not only in number but also from an anatomical point of view. The number of accessory renal arteries generally varies from 1 to 6, but in a few cases 8 accessory arteries have been identified even 10 in a single patient [3-19].

## Conclusion

The presence of aberrant renal vessels among patients with hydronephrosis in Albania is quite high, but comparable to literature reports. The epidemiology of accessory renal vessels can

help professionals in the field to suspect and seek evidence of these structures in their patients, since these health conditions are quite frequent and could interfere with the relevant surgical procedures.

## Conflict of Interest

The authors report no conflict of interest.

## Bibliography

1. Gulas E., *et al.* "Accessory (multiple) renal arteries - Differences in frequency according to population, visualizing techniques and stage of morphological development". *Vascular* 24.5 (2016): 531-537.
2. Mir NS., *et al.* "Bilateral duplication of renal vessels: anatomical, medical and surgical perspective". *International Journal of Health Sciences (Qassim)* (2008): 179-185.
3. AbdulMonamZainel M and Suhelmawloodalnajjar. "Incidence and Variations of Aberrant Renal Arteries in Kidney Donors Cases". *Medico-legal Update* 20.1 (2020): 415-421.
4. Aristotle S., *et al.* "Anatomical study of variations in the blood supply of kidneys". *Journal of Clinical and Diagnostic Research* 7.8 (2013): 1555-1557.
5. Coulier B. "Ten renal arteries found in a 51-year-old man during multidetector computed tomography (MDCT) angiography". *Anatomical Science International* 89.1 (2014): 62-63.
6. Çınar C and Türkvatan A. "Prevalence of renal vascular variations: Evaluation with MDCT angiography". *Diagnostic and Interventional Imaging* 97.9 (2016): 891-897.
7. Gebremickael A., *et al.* "Renal vascular variations among kidney donors presented at the national kidney transplantation center, Addis Ababa, Ethiopia". *Translational Research in Anatomy* 25 (2021): 100145.
8. Geyer JR and Poutasse EF. "Incidence of multiple renal arteries on aortography. Report of a series of 400 patients, 381 of whom had arterial hypertension". *JAMA* 182 (1962): 120-125.
9. Graves FT. "The aberrant renal artery". *Journal of Anatomy* 90.4 (1956): 553-558.
10. Gulas E., *et al.* "Morphological and clinical aspects of the occurrence of accessory (multiple) renal arteries". *Archives of Medical Science* 14.2 (2018): 442-453.

11. Gupta A., *et al.* "Congenital variations of renal veins: Embryological background and clinical implications". *Journal of Clinical and Diagnostic Research* 6 (2016): 1140-1443.
12. Hostiuc S., *et al.* "Anatomical variants of renal veins: A meta-analysis of prevalence". *Scientific Report* 9.1 (2019): 10802.
13. Kachlík D., *et al.* "Variant Anatomy and Its Terminology". *Medicina (Kaunas)* 56.12 (2020): 713.
14. Maleki H., *et al.* "Frequencies of accessory renal arteries in 129 Iranian patients". *American Journal of Clinical and Experimental Urology* 8.1 (2020): 38-42.
15. Miclaus GD and Matusz P. "Bilateral quadruple renal arteries". *Clinical Anatomy* 25.8 (2012): 973-976.
16. Pradhay G., *et al.* "Prevalence and Relevance of Multiple Renal Arteries: A Radioanatomical Perspective". *Cureus* 13.10 (2021): e18957.
17. Recto C., *et al.* "Renal artery variations: a 20.782 kidneys review". *Italian Journal of Anatomy and Embriology* 124.2 (2019): 153-163.
18. Urban BA., *et al.* "Three-dimensional volume-rendered CT angiography of the renal arteries and veins: normal anatomy, variants, and clinical applications". *Radiographics* 21.2 (2001): 373-386; questionnaire 549-555.
19. Yufa A., *et al.* "Accessory renal arteries involved in atherosclerotic occlusive disease at the aortic bifurcation". *Journal of Vascular Surgery Cases, Innovations and Techniques* 6.3 (2020): 425-429.