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Variant Anatomy of Blood Supply Sources of Human Kidney Segments

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ABSTRACT

Introduction: the purpose of this study was to review the sources of blood supply to human kidney segments.
Methods and Methods: the materials for the study were 116 corrosive preparations of the arterial system of the human kidney, which were subjected to 3D scanning followed by a three-dimensional morphological analysis of the structure and branching variants of the renal arteries of various orders.
Results: as a result of the study, the most common variant of the division of A. renalis (I) was identified, where the artery branched against the frontal plane into ventral and dorsal arteries (II) (54.3% of cases). In the selected 63 preparations, 4 variants of intra-organ branching of the child branches of A. renalis (I) were identified, and an analysis of the level organization of the links of the renal artery system based on counting the number of segmental arteries in 4 variants was carried out (7 ± 1; 9 ± 1; 6 ± 1; 7 ± 1). In addition, the blood supply sources to the 5 kidney segments were determined: namely, the superior and inferior segments of the kidney were supplied with blood from the ventral artery system; the posterior segment was supplied with the dorsal artery system blood, and the polar segments had different sources of blood supply.
Conclusion: based on the results of the study, it was concluded that the arterial system of the human kidney had a rather complex and variant structure.
Keywords: Kidney; Renal artery; Segment of the kidney; 3D modelling.

Introduction

Many scientific works are devoted to the anatomy of renal vessels. In the works of some authors, the blood supply features to the renal parenchyma were investigated, namely, the variants of the formation of isolated blood supply zones and the location of low-vascular zones in the kidneys. Knowledge of the presented areas of the kidney is of sufficient importance when performing organ-preserving operations on kidneys[1-8].

In global practice, it is customary to distinguish 5 segments of the kidney: the superior anterior, superior, inferior, anterior inferior, and posterior segments[9,10]. However, studies by Russian and foreign authors provide evidence that there may be from 3 to 6 segments in the kidneys (Table 1). T. Pestemalci *et al*.[11] in their study indicate that in kidneys with fewer than five segments in 17% of cases there was no inferior polar segment, in 15% of cases no superior segment; in 14% of cases no anterior pelvic segment (the union of the superior and inferior segments)[11].

At the moment, there are no generally accepted criteria for dividing the renal parenchyma into isolated areas of blood supply, as well as no clear definition of the term "segmental arteries" in the hierarchy of renal vessels. The presented facts cause discrepancies in the understanding of the lobular, zonal, and segmental structure of the human kidney[14,15]. Following the above, there is a need for a detailed study of the hierarchy of arterial renal vessels with the allocation of arteries that play a key role in the formation of isolated areas of blood supply in the kidneys (segments).

The study aimed to study the blood supply sources to various segments of the human kidney.

Table 1. The number of segments in the kidneys according to some authors.

Scientific research [source]	5 segments identified (%)	6 segments identified (%)	4 segments identified (%)
L. A. Olofinskii[6]	72.6 %	23.9 %	3.5 %
Sh. R. Sabirov[11]	38.5 %	26.5 %	35 %
G. S. Longia[13]*	53 %	-	46 %
F. J. Sampaio[14,15]	61.2 %	-	38.8 %

*in 1% of cases, 3 segments in the kidneys were identified.

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Materials and Methods

The material for the study was 116 corrosive preparations of the human kidney's arterial system[2,5]. These preparations were subjected to 3D scanning. Subsequently, virtual 3D patterns of the arterial kidney system were created in a computer program through three-dimensional graphical reconstruction. Then polychrome corrosive preparations of the arterial system of the kidney were partially decomposed until the main major arterial trunks were exposed, which were subsequently also subjected to 3D scanning. As a result of the actions carried out, a database was created containing 3D patterns of various variants of branching of main major arterial trunks, as well as variants and types of structure of kidney segments.

Subsequently, a three-dimensional anatomical analysis of the created database was carried out in the computer programs Mimics-8.1 (Materialise NV, Belgium) and 3DS-max (Autodesk, USA), including the determination of the most common variant of division of A. renalis (I) against the frontal, horizontal and sagittal planes; determination of variants of intra-organ branching of the child branches of A. renalis (I); analysis of the level organization of the links of the renal artery system with counting the number of segmental arteries; and an analysis of blood supply sources of 5 segments of the kidney.

In the statistical processing of the results obtained, a licensed package of applied statistical programs MedStat (Medstat, Germany) was used to calculate the main indicators of the distribution of random variables (medians, averages, quartiles, confidence interval, minimum and maximum values, variances, mean quadratic deviations, mean errors, median errors)[16].

Results and Discussion

Three-dimensional anatomical analysis of 116 patterns of the renal arterial system revealed several variants of division of A. renalis (I) against the frontal, horizontal and sagittal planes. In 54.3% of cases (in 63 out of 116 preparations), A. renalis (I) was dichotomically divided against the frontal plane into ventral and dorsal child branches (II). This group of kidneys was selected for subsequent analysis.

In 63 isolated preparations, 4 variants of intra-organ branching of the arteries of the second order (ventral and dorsal arteries) were identified. In the 1st variant, the ventral branch was divided according to the dispersal type, and the dorsal branch was divided according to the magistral type (46.2% of cases); in the 2nd variant, both branches were divided according to the dispersal type (23.8% of cases); in the 3rd variant, both arteries had the magistral type of branching (19.4% of cases); and in the 4th variant, the ventral branch was divided according to the magistral type, and the dorsal branch was divided according to the dispersal type (11.1% of cases). Then, in the above 4 variants of intra-organ branching of the ventral and dorsal arteries (II), the analysis of the level organization of the subsequent links of the renal artery system was performed with the calculation of the number of arteries of the III order (segmental arteries). Thus, in the 1st variant, the number of A. interlobares – 1 (III) averaged (X ± m) 7 ± 1; in the 2nd variant 9 ± 1; in the 3rd variant 6 ± 1; and in the 4th variant 7 ± 1 (Table 2).

The next step was the analysis of the blood supply sources to the 5 kidney segments in each isolated variant of intra-organ branching of the arteries of the second order (ventral and dorsal arteries).

1. Blood supply sources to the 5 kidney segments in the 1st variant of branching of the ventral and dorsal renal arteries

In the predominant 1st variant (46.2% of cases), when the ventral renal artery (II) branched according to the dispersal type, and the dorsal (II) artery according to the magistral type, 4 types of blood supply of the superior polar segment (Table 3) and 3 types of blood supply to the inferior polar segment (Table 4) were observed. The blood supply of the superior and inferior anterior segments involved 1 segmental artery A. interlobares – 1 (III), which originated from the ventral artery (II). Blood supply to the posterior segment was carried out through 1 A. interlobares – 1 (III), branching off from the dorsal artery (II).

1.1. Blood supply types to the superior polar segment in the 1st variant of branching of the ventral and dorsal renal arteries

In the 1st variant of branching of the ventral and dorsal renal arteries, 4 blood supply types to the superior polar segment were observed. In type 1 (41.2% of cases), the superior polar segment's blood supply was carried out through 1 interlobular artery of the 1st order (III), originating from the ventral artery (II). In type 2 (32.3% of cases), 2 interlobular arteries of the 1st order (III) participated in the superior polar segment's blood supply, one of which originated from the ventral artery (II), and the other one from the dorsal artery (II).

Table 2. Variant anatomy of renal vessels of the II and III orders.

Variants	% of cases	Type of ventral artery branching (II)	Type of dorsal artery branching (II)	Number of A. interlobares – 1 (III) (X ± m)
Variant 1	46.2 %	dispersal	magistral	7 ± 1
Variant 2	23.8 %	dispersal	dispersal	9 ± 1
Variant 3	19.4 %	magistral	magistral	6 ± 1
Variant 4	11.1 %	magistral	dispersal	7 ± 1

Table 3. Blood supply types to the superior polar segment in the 1st variant of branching of the ventral and dorsal renal arteries.

Type 1	Type 2	Type 3	Type 4
41.2 % of cases	32.3 % of cases	21.2 % of cases	5.3 % of cases
A. ventralis (II) ↓ 1 A. interlobares – 1 (III) ↓ **superior polar segment**	A. ventralis (II) ↓ 1 A. interlobares – 1 (III) ↓ **the ventral half of the superior polar segment** **dorsal half of the superior polar segment** ↑ 1 A. interlobares – 1 (III) ↑ A. dorsalis (II)	A. renalis (I) ↓ 1 artery ↓ **superior polar segment**	A. dorsalis (II) ↓ 1 A. interlobares – 1 (III) ↓ **superior polar segment**

Table 4. Blood supply types to the inferior polar segment in the 1st variant of branching of the ventral and dorsal renal arteries.

Type 1	Type 2	Type 3
68.3 % of cases	27.4 % of cases	4.3 % of cases
A. ventralis (II) ↓ 1 A. interlobares – 1 (III) ↓ **inferior polar segment**	A. ventralis (II) ↓ 1 A. interlobares – 1 (III) ↓ **ventral and dorsal halves of the inferior polar segment** **posterior sections of the inferior polar segment** ↑ 1 A. interlobares – 1 (III) ↑ A. dorsalis (II)	A. renalis (I) ↓ 1 artery ↓ **inferior polar segment**

In the presented type A. interlobares – 1 (III) formed 2 blood supply zones of the segment, the ventral and the dorsal ones, respectively. In type 3 (21.2% of cases), the superior polar segment's blood supply was carried out through 1 artery branching from the main renal artery – A. renalis (I). In type 4 (5.3% of cases), the blood supply to the superior polar segment was performed through 1 interlobular artery of the 1st order (III), originating from the dorsal artery (II).

1.2. Blood supply types to the inferior polar segment in the 1st variant of branching of the ventral and dorsal renal arteries

In the 1st variant of branching of the ventral and dorsal renal arteries, 3 types of blood supply to the inferior polar segment were observed. In type 1 (68.3% of cases), the inferior polar segment's blood supply was carried out through 1 interlobular artery of the 1st order (III), originating from the ventral artery (II). In type 2 (27.4% of cases), 2 interlobular arteries of the 1st order (III) participated in the blood supply of the inferior polar segment, one of which branched from the ventral artery (II), and the other one from the dorsal artery (II). In the presented type, A. interlobares – 1 (III) branching from the ventral artery (II) supplied blood to the ventral and dorsal halves of the inferior polar segment, and A. interlobares – 1 (III) branching from the dorsal artery (II) supplied blood to the posterior parts of the inferior polar segment. In type 3 (4.3% of cases), the inferior polar segment's blood supply was carried out through 1 artery branching from the main renal artery – A. renalis (I).

2. Blood supply sources to 5 segments of the kidney in the 2nd variant of branching of the ventral and dorsal renal arteries

In the 2nd variant (23.8% of cases), where the ventral and dorsal renal arteries (II) branched according to the dispersal type, 4 types of blood supply to the superior polar segment (Table 5) and 3 types of blood supply to the inferior polar segment (Table 6), as well as 2 types of blood supply to the superior and inferior anterior segments (Table 7) were observed. Blood supply to the posterior segment was carried out through 1 or 2 A. interlobares – 1 (III) (58.5 and 41.5% of cases, respectively), originating in both cases from the dorsal artery system (II).

2.1. Blood supply types to the superior polar segment in the 2nd variant of branching of the ventral and dorsal renal arteries.

Table 5. Blood supply types to the superior polar segment in the 2nd variant of branching of the ventral and dorsal renal arteries.

Type 1	Type 2	Type 3	Type 4
36.2 % of cases	31.4 % of cases	24.3 % of cases	8.1 % of cases
A. ventralis (II) ↓↓ 2 A. interlobares – 1 (III) ↓ **superior polar segment** (ventral and dorsal halves)	A. ventralis (II) ↓ 1 A. interlobares – 1 (III) ↓ **the ventral half of the superior polar segment** **dorsal half of the superior polar segment** ↑ 1 A. interlobares – 1 (III) ↑ A. dorsalis (II)	A. ventralis (II) ↓ 1 A. interlobares – 1 (III) ↓ **superior polar segment**	A. dorsalis (II) ↓ 1 A. interlobares – 1 (III) ↓ **superior polar segment**

Table 6. Blood supply types to the inferior polar segment in the 2nd variant of branching of the ventral and dorsal renal arteries.

Type 1	Type 2	Type 3
54.2 % of cases	37.3 % of cases	8.5 % of cases
A. ventralis (II) ↓ 1 A. interlobares – 1 (III) ↓ **ventral and dorsal halves of the inferior polar segment** **posterior sections of the inferior polar segment** ↑ 1 A. interlobares – 1 (III) ↑ A. dorsalis (II)	A. ventralis (II) ↓ 2 A. interlobares – 1 (III) ↓ **inferior polar segment**	A. renalis (I) ↓ 1 artery ↓ **inferior polar segment**

Table 7. Blood supply types to the superior and inferior anterior segments in the 2nd variant of branching of the ventral and dorsal renal arteries.

Type 1		Type 2	
66.5 % of cases		33.5 % of cases	
A. ventralis (II)		A. ventralis (II)	
↙↙	↘	↙	↘↘
2 A. interlobares – 1 (III) ↓↓ superior anterior segment	1 A. interlobares – 1 (III) ↓ inferior anterior segment	1 A. interlobares – 1 (III) ↓ superior anterior segment	2 A. interlobares – 1 (III) ↓↓ inferior anterior segment

In the 2nd variant of branching of the ventral and dorsal renal arteries, 4 blood supply types to the superior polar segment were observed. In type 1 (36.2% of cases), the superior polar segment's blood supply was carried out through 2 interlobular arteries of the 1st order (III), originating from the ventral artery system (II) and branching separately in the ventral and dorsal parts of the superior polar segment. In type 2 (31.4% of cases), 2 interlobular arteries of the 1st order (III) participated in the superior polar segment's blood supply. One of them originated from the ventral artery (II), and the other one from the dorsal artery (II). In the presented type A. interlobares – 1 (III) formed 2 blood supply zones of the segment, the ventral and the dorsal ones, respectively. In type 3 (24.3% of cases), the superior polar segment's blood supply was carried out through 1 interlobular artery of the 1st order (III), originating from the ventral artery (II). In type 4 (8.1% of cases), the blood supply to the superior polar segment was performed through 1 interlobular artery of the 1st order (III), originating from the dorsal artery (II).

2.2. Blood supply types to the inferior polar segment in the 2nd variant of branching of the ventral and dorsal renal arteries

In the 2nd variant of branching of the ventral and dorsal renal arteries, 3 blood supply types to the inferior polar segment were observed. In type 1 (54.2% of cases), 2 interlobular arteries of the 1st order (III) participated in the inferior polar segment's blood supply. One of them originated from the ventral artery (II), and the other one from the dorsal artery (II). In the presented type, A. interlobares – 1 (III) branching from

the ventral artery (II) supplied blood to the ventral and dorsal halves of the inferior polar segment, and A. interlobares – 1 (III) branching from the dorsal artery (II) supplied blood to the posterior parts of the inferior polar segment. In type 2 (37.3% of cases), the inferior polar segment's blood supply was carried out through 2 interlobular arteries of the 1st order (III), originating from the ventral artery (II). In type 3 (8.5% of cases), the inferior polar segment's blood supply was carried out through the artery originating from the main renal artery – A. renalis (I).

2.3. Blood supply types to the superior and inferior anterior segments in the 2nd variant of branching of the ventral and dorsal renal arteries

In the 2nd variant of branching of the ventral and dorsal renal arteries, 2 blood supply types to the superior and inferior anterior segments were observed. In both types, the superior and inferior anterior segments were supplied with blood through A. interlobares – 1 (III), originating from the ventral artery (II). The difference was that in type 1, the superior-anterior segment was supplied through two A. interlobares – 1 (III), and the inferior-anterior one through 1 A. interlobares – 1 (III); and vice versa, in type 2, the superior-anterior segment was supplied with blood through 1 A. interlobares – 1 (III), and the inferior-anterior one through 2 A. interlobares – 1 (III).

3. Blood supply sources to 5 segments of the kidney in the 3rd variant of branching of the ventral and dorsal renal arteries

In the 3rd variant (19.4% of cases), when the ventral and dorsal renal arteries (II) branched according to the magistral type, 3 blood supply types to the superior polar segment (Table 8) and 3 blood supply types to the inferior polar segment (Table 9) were observed. The superior and inferior anterior segments' blood supply involved 1 segmental artery A. interlobares – 1 (III), which branched off from the ventral artery (II). Blood supply to the posterior segment was carried out by 1 A. interlobares – 1 (III), which branched off from the dorsal artery (II).

3.1. Blood supply types to the superior polar segment in the 3rd variant of branching of the ventral and dorsal Renal arteries

In the 3rd variant of branching of the ventral and dorsal renal arteries, 3 blood supply types to the superior polar segment were observed. In type 1 (64.4% of cases), the superior polar segment's blood supply was carried out through 1 interlobular artery of the 1st order (III), originating from the ventral artery (II). In type 2 (31.3% of cases), the superior polar segment's blood supply was carried out through 2 interlobular arteries of the 1st order (III) originating from the ventral artery (II) and branching separately in the ventral and dorsal parts of the superior polar segment. In type 3 (4.3% of cases), the superior polar segment's blood supply was carried out through 1 artery originating from the main renal artery – A. renalis (I).

3.2. Blood supply types to the inferior polar segment in the 3rd variant of branching of the ventral and dorsal renal arteries

In the 3rd variant of branching of the ventral and dorsal renal arteries, 3 blood supply types to the inferior polar segment were observed. In type 1 (59.3% of cases), the inferior polar segment's blood supply was carried out through 1 interlobular artery of the 1st order (III), originating from the ventral artery (II). In type 2 (32.4% of cases), the inferior polar segment's blood supply was carried out through 2 interlobular arteries of the 1st order (III), originating from the ventral artery (II). In type 3 (8.3% of cases), the inferior polar segment's blood supply was carried out through 1 artery originating from the main renal artery – A. renalis (I).

4. Blood supply sources to 5 segments of the kidney in the 4th variant of branching of the ventral and dorsal renal arteries

Table 8. Blood supply types to the superior polar segment in the 1st variant of branching of the ventral and dorsal renal arteries.

Type 1	Type 2	Type 3
64.4 % of cases	31.3 % of cases	4.3 % of cases
A. ventralis (II) ↓ 1 A. interlobares – 1 (III) ↓ **superior polar segment**	A. ventralis (II) ↓↓ 2 A. interlobares – 1 (III) ↓ **superior polar segment** (ventral and dorsal halves)	A. renalis (I) ↓ 1 artery ↓ **superior polar segment**

Table 9. Blood supply types to the inferior polar segment in the 1st variant of branching of the ventral and dorsal renal arteries.

Type 1	Type 2	Type 3
59.3 % of cases	32.4 % of cases	8.3 % of cases
A. ventralis (II) ↓ 1 A. interlobares – 1 (III) ↓ **inferior polar segment**	A. ventralis (II) ↓↓ 2 A. interlobares – 1 (III) ↓ **inferior polar segment**	A. renalis (I) ↓ 1 artery ↓ **inferior polar segment**

In the 4th variant (11.1% of cases), where the ventral renal artery (II) branched according to the magistral type, and the dorsal one (II) according to the dispersal type, 4 blood supply types to the superior polar segment (Table 10), 3 blood supply types to the inferior polar segment (Table 11) and 2 blood supply types to the posterior segment were observed. The superior and inferior anterior segments' blood supply involved 1 segmental artery A. interlobares – 1 (III) to each segment branching from the ventral artery (II). The posterior segment's blood supply was carried out through 1 or 2 A. interlobares – 1 (III) (88.5 and 11.5% of cases, respectively) originating from the dorsal artery system (II).

4.1. Blood supply types to the superior polar segment in the 4th variant of branching of the ventral and dorsal renal arteries

In the 4th variant of branching of the ventral and dorsal renal arteries, 4 blood supply types to the superior polar segment were observed. In type 1 (55.2% of cases), the superior polar segment's blood supply was carried out through 1 interlobular artery of the 1st order (III), originating from the ventral artery (II). In type 2 (24.3% of cases), 2 interlobular arteries of the 1st order (III) participated in the superior polar segment's blood supply, one of which originated from the ventral artery (II), and the other one from the dorsal artery (II). In type 3 (14.4% of cases), the superior polar segment's blood supply was performed through 1 interlobular artery of the 1st order (III), originating from the dorsal artery (II). In type 4 (6.1% of cases), the superior polar segments' blood supply was carried out through 1 artery originating from the main renal artery – A. renalis (I).

4.2. Blood supply types to the inferior polar segment in the 4th variant of branching of the ventral and dorsal renal arteries

In the 4th variant of branching of the ventral and dorsal renal arteries, 3 blood supply types to the inferior polar segment were observed. In type 1 (67.3% of cases), the inferior polar segments' blood supply was carried out through 1 interlobular artery of the 1st order (III), originating from the ventral artery (II). In type 2 (28.4% of cases), 2 interlobular arteries of the 1st order (III) participated in the inferior polar segment's blood supply. One of them originated from the ventral artery (II), and the other one from the dorsal artery (II). In type 3 (4.3% of cases), the inferior polar segment's blood supply was carried out through 1 artery originating from the main renal artery – A. renalis (I).

Three-dimensional anatomical analysis of 116 patterns of the renal arterial system showed that in 54.3% of cases (in 63 out of 116 preparations) A. renalis (I) was dichotomically divided against the frontal plane into the ventral and dorsal child branches (II). In 63 isolated preparations, 4 variants of intra-organ branching of the arteries of the second order (ventral and dorsal arteries) were identified. In the 1st variant, the ventral branch was divided according to the dispersal type, and the dorsal branch was divided according to

Table 10. Blood supply types to the superior polar segment in the 1st variant of branching of the ventral and dorsal renal arteries.

Type 1	Type 2	Type 3	Type 4
55.2 % of cases	24.3 % of cases	14.4 % of cases	6.1 % of cases
A. ventralis (II) ↓ 1 A. interlobares – 1 (III) ↓ **superior polar segment**	A. ventralis (II) ↓ 1 A. interlobares – 1 (III) ↓ **superior polar segment** ↑ 1 A. interlobares – 1 (III) ↑ A. dorsalis (II)	A. dorsalis (II) ↓ 1 A. interlobares – 1 (III) ↓ **superior polar segment**	A. renalis (I) ↓ 1 artery ↓ superior polar segment

Table 11. Blood supply types to the inferior polar segment in the 4th variant of branching of the ventral and dorsal renal arteries.

Type 1	Type 2	Type 3
67.3 % of cases	28.4 % of cases	4.3 % of cases
A. ventralis (II) ↓ 1 A. interlobares – 1 (III) ↓ **inferior polar segment**	A. ventralis (II) ↓ 1 A. interlobares – 1 (III) ↓ **inferior polar segment** ↑ 1 A. interlobares – 1 (III) ↑ A. dorsalis (II)	A. renalis (I) ↓ 1 artery ↓ **inferior polar segment**

the magistral type (46.2% of cases); in the 2nd variant, both branches were divided according to the dispersal type (23.8% of cases); in the 3rd variant, both arteries had the magistral type of branching (19.4% of cases); and in the 4th variant, the ventral branch was divided according to the magistral type, and the dorsal branch was divided according to the dispersal type (11.1% of cases). Then, in the above 4 variants of intra-organ branching of the ventral and dorsal arteries (II), the analysis of the level organization of the subsequent links of the renal artery system was performed with the calculation of the number of arteries of the III order (segmental arteries). Thus, in the 1st variant, the number of A. interlobares – 1 (III) averaged (X ± m) 7 ± 1; in the 2nd variant 9 ± 1; in the 3rd variant 6 ± 1, and in the 4th variant 7 ± 1.

In 63 scanned preparations of the arterial system of the human kidney, where A. renalis (I) branched into ventral and dorsal child branches (II), blood supply sources were analyzed under the concept of the five-segment structure of the human kidney. It was identified that the polar segments (superior polar and inferior polar ones) could have different blood supply sources for both dispersal and magistral type of branching of the arteries of the second order. The segmental artery going to the polar segments can originate from the ventral artery system (II), the dorsal artery system (II), and also from the main renal artery (I). In addition, cases were identified when the pole segments had 2 blood supply sources: one segmental artery originated from the system from the ventral artery, and the other one from the dorsal artery system. Cases were found when 2 segmental arteries, originating either from the ventral or dorsal artery (II), took part in the polar segment's blood supply.

The superior and inferior anterior segments' blood supply was carried out by 1 or 2 segmental arteries branching to each segment separately from the ventral artery system (II). The posterior segment's blood supply was carried out by 1 or 2 A. interlobares – 1 (III) originating from the dorsal artery system (II).

Conclusion

Based on the results of the study, it can be concluded that the arterial system of the human kidney has a rather complex and variant structure since each link in the hierarchy of renal vessels has several branching options. When analyzing the blood supply sources to the renal segments, it was found that the superior and inferior anterior segments of the kidney were supplied with blood from the ventral artery system, and the posterior segment was supplied from the dorsal artery system. The polar segments of the kidneys could have a different blood supply source, and in some cases, variants were found where one segment's blood supply was carried out from 2 systems: the ventral and the dorsal one. Quantitative analysis of segmental arteries showed that even according to the concept of the five-segmental structure of the kidney, the number of segmental vessels going to each segment was variable and largely depended on the type of branching of the arteries of the 2nd order. Thus, in the dispersal type of branching, the number of segmental arteries was somewhat greater than in the magistral type.

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