

MORPHOLOGY OF DOUBLE RENAL VEINS

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ABSTRACT

The study was performed on 116 kidneys, using dissection and injection of plastic mass (followed by dissection or corrosion) as study methods. We found 6 cases of double renal veins (5.17% of cases), 5 cases being straight veins (9.62% of right veins) and 1 single case on the left being left veins (1.56% of left veins). In the formation of the venous trunk, both at the level of the superior veins and at the level of the inferior veins, two branches of origin participated in all cases, which most frequently were of different caliber. The trajectory of the superior renal vein in 4 cases was obliquely supero-medially, and in one case it was obliquely infero-medially, respectively horizontal. The trajectory of the inferior renal vein in 4 cases was obliquely supero-medially, and in 2 cases it was horizontal. The termination of the superior renal vein in the inferior vena cava is was done in 3 cases on the lateral side, respectively on the postero-lateral side. The termination of the inferior renal vein in the inferior vena cava was done in 3 cases on the postero-lateral side, in 2 cases on the antero-lateral side, and in only one case) on the lateral side. The caliber of the superior renal vein at the level of its termination in the vena cava, we found to be between 2.72-8.50 mm, the caliber of the inferior renal vein being between 2.10-3.60 mm. Significant morphological variations, particularly in venous morphometry, were observed compared to existing literature. These differences may be explained by methodological diversity, sample characteristics, and anatomical variability related to geographical area, sex, and age.

Keywords: multiple renal veins – morphology, vena cava, kidney

Introduction

The large renal veins are usually located anterior to the arteries, often ending at a right angle in the inferior vena cava. The right renal vein is located behind the descending part of the duodenum, is often less than 1 cm long, and, because it is very short, makes nephrectomy difficult. The left renal vein is three times longer and is the preferred donor site for nephrectomy (1, 2). Found that multiple renal veins occur in 0.4% of cases, stating that the literature cites a percentage of 0.8–6% (3). Found that anatomical variations of the renal vessels, especially variations of the arteries, are common (4).

Multiple renal vein variations are more common on the right side (20–30% of cases) than on the left (1–8% of cases). Analysing 342 cases of renal vein variation, only 6.4% of cases occurred on the right side (5).

Reported that a single vein was much more common (61.29% of cases), while two, three, or even more renal veins were much less common (9.7% of cases) (6). In 1,859 volunteer donors over an 11-year follow-up period, found multiple right renal veins in 28.2% of cases (2).

Compared with the renal artery, variations in the renal veins were in a smaller percentage. Examining 430 renal pedicles, they found that supernumerary renal arteries were present in

32.25% of cases, while supernumerary renal veins were present in only 14.4% of cases (7).

Determining the frequency of multiple renal veins, right and left, and analyzing them from the point of view of origin (level, number of branches, their externalization from the kidney), trajectory, level of termination in the inferior vena cava and the angle it forms with it, caliber, distance between the double veins at the origin and termination and relationships with the renal artery or arteries on the same side and with the renal vein on the opposite side.

Material and methods

Our study was performed on 116 kidneys, 52 kidneys being on the right side (44.83% of cases) and 64 on the left side (55.17% of cases), using as study methods dissection and injection of plastic mass (followed by dissection or corrosion with NaOH) on human cadavers and on organic aorta-inferior vena cava-kidney blocks.

Results

In the 116 kidney cases, we found 6 cases of double renal veins (5.17% of cases), 5 cases being right veins (9.62% of right veins) and 1 single case on the left (1.56% of left veins) being left veins.

We found only one case, on the right side, in which there were double renal veins along with two double arteries.

Regarding the place of formation of the superior renal vein (Figure 1), we found that it was formed extrahilarly, closer to the kidney, in 2 cases (33.33% of cases), in 4 cases it was formed intrarenal (66.67% of cases). The inferior renal vein was formed intrarenal in 4 cases (66.67% of cases), in only one case (16.67% of cases) it was formed juxtarenally and extrarenal, closer to the inferior vena cava.



Figure 1. Two straight renal veins. The superior renal vein is formed extrahilarly, closer to the kidneys, from two venous trunks, which exit the kidney through the anteromedial face; it has a supero-medial oblique course, ending on the lateral face of the IVC, with which it makes an angle of 78° (open inferiorly); it has a diameter of 8.5 mm. The inferior renal vein has a slightly supero-medial oblique course (almost horizontally), passing anterior to the ureter; it is formed intrarenal, exiting through the postero-inferior part of the hilum and ending on the postero-lateral face of the IVC, with which it makes an angle of 88° (open inferiorly); it has a diameter of 3.2 mm; the distance between the two veins at the origin is 15 mm, and at the end 19 mm.

In all cases, two branches of origin, which were of different caliber, participated in the formation of the venous trunk, both at the level of the superior and inferior veins.

The externalization from the kidney, at the level of the superior vein, was done in 5 cases (83.33) at the level of the renal hilum, in 2 cases at the level of the middle, in the antero-superior part and in the postero-superior part thereof. The inferior renal vein was externalized from the kidney in all 6 cases through the lower part of the hilum, in 3 cases in the antero-inferior part and in the postero-inferior part, respectively.

The course of the superior renal vein in 4 cases (66.67% of cases) was obliquely supero-medial, and in one case (16.67% of cases) it was obliquely infero-medial, respectively horizontal. The course of the inferior renal vein in 4 cases (66.67% of cases) was obliquely supero-medial,

and in 2 cases (33.33% of cases) it was horizontal. In 3 cases (50.0% of cases) the inferior renal vein was located at its origin inferior and on a plane posterior to the superior renal vein, in the other 3 cases the superior renal vein was located at its origin on a plane posterior to the inferior renal vein.

The termination of the superior renal vein into the inferior vena cava was done in 3 cases (50% of cases each) on the lateral side, respectively on the postero-lateral side. The termination of the inferior renal vein into the inferior vena cava was done in 3 cases (50% of cases) on the postero-lateral side, in 2 cases on the antero-lateral side, and in only one case (16.67% of cases) on the lateral side.

The superior renal vein forms an open inferior angle at its termination in the inferior vena cava, with a value between 74-98°, at the level of the inferior renal vein this angle being between 18-90°.

The caliber of the superior renal vein at its termination in the vena cava was found to be between 2.72-8.50 mm (the latter in only one case), the caliber of the inferior renal vein being between 2.10-3.60 mm.

The distance between the two veins at their origin ranged between 1.30-32.0 mm, and at their termination in the inferior cava ranged between 9.0-34.0 mm.

The termination of the left single renal vein in the inferior vena cava in relation to the right veins was made in 4 cases (66.67% of cases) between the termination of the two veins, with three variants: closer to the superior vein (2 cases) (Figure 2) and in one case in the middle of the distance between the two veins, respectively closer to the inferior renal vein. In one case (16.67% of cases) the left renal vein ended at the same level as the superior vein and caudal to the inferior renal vein. The termination of the right single renal vein in the inferior vena cava in relation to the left veins was made between the two veins, closer to the inferior vein.

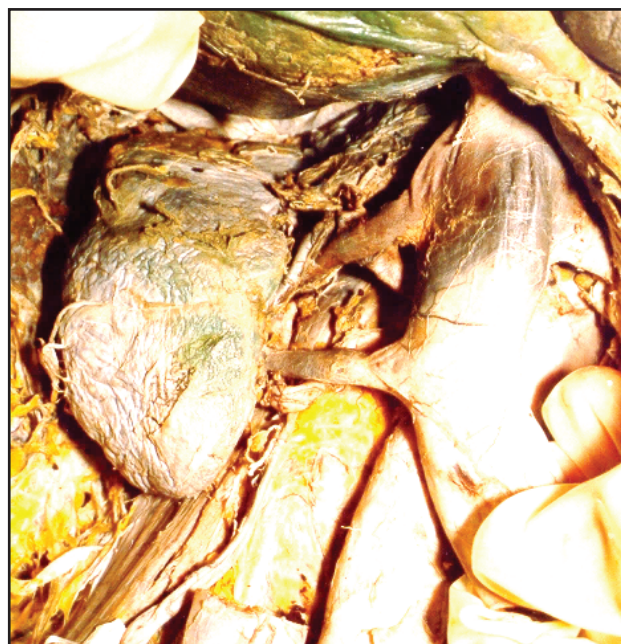


Figure 2. Two left renal veins, both forming intrarenal. The superior renal vein, with a supero-medial oblique course, is externalized from the kidney through the superior-posterior part of the hilum, ending on the lateral face of the IVC, with which it makes an angle of 74° (open inferiorly); it has a diameter of 3.6 mm; The inferior renal vein is formed intrarenal, has a horizontal course, passing anterior to the ureter; it is externalized through the postero-inferior part of the hilum and ends on the lateral face of the IVC, with which it makes an angle of 90°; it has a diameter of 3.1 mm; the distance between the two veins at the origin is 21 mm, and at the end 34 mm. The renal artery is located between the two veins, closer to the superior renal vein. The renal artery is located between the two veins, closer to the superior renal vein.

In relation to the renal pelvis-ureter urinary system, the superior renal vein always passed cranially to it, the inferior renal vein passing in 4 cases anteriorly and in 2 cases (both on the right side) posteriorly to this system.

Discussions

Table 1 Frequency of multiple renal veins: personal results compared with data from the consulted literature

AUTHOR	NUMBER OF CASES STUDYED	MULTIPLE RENAL VEINS (%)
Rupert (1915)	115	1.0
Anson (1936)	200	3.0
Pick&Anson (1940)	194	1.0
Weinstein (1940)	203	6.0
Merklin&Michels (1958)	185	3.1
Reis&Esenther (1959)	500	0.8
Ross (1961)	34	3.0
Beckmann&Abrams (1980)	56	1.0
Pollak (1986)	400	2.0
Satyapal (1994)	153	0.4
Satyapal (1997)	1008	2.6
Silva	342	6.4
Cicek (2021)	1859	28.2
Burihan (2024)	-	9.7
Personal cases	116	5.17; right: 7.69, left: 3.12

In the literature consulted, the lowest frequency of double renal veins is given by (3), and the highest frequency by (2), with a difference of 27.8% between the two authors. The frequency of duplicity on both sides of the body is not specified, only the total frequency of this vascular variant is given. The results obtained by us are close to the results given by (5, 8), lower than the results of (9) by 4.53% and much lower than the results of (2), by 23.03%. Our results are higher than the results of the other cited authors, with differences ranging between 3.07-5.13%.

Comparing the morphological characteristics of the two renal veins, we frequently found multiple differences between them, and when there were similarities, these were in a reduced percentage. Regarding the place of formation of the venous trunk, we found that in only one case it was the same (intrarenal). At the level of the superior vein we did not encounter its formation at the juxtarenal level. Also in only one case the two veins emerged from the kidney at the same level: at the middle of the renal hilum. The double veins presented a similar trajectory (supero-medial oblique) only in 3 cases (Figure 3). Regarding the angle that the renal vein made with the inferior vena cava, it was greater at the

level of the superior vein in 4 cases, at the level of the inferior vein being greater in 2 cases. The termination of the renal vein at the level of the anterolateral face of the inferior vena cava and the caudal trajectory of the pelvis-ureter system were encountered only at the level of the inferior renal vein.

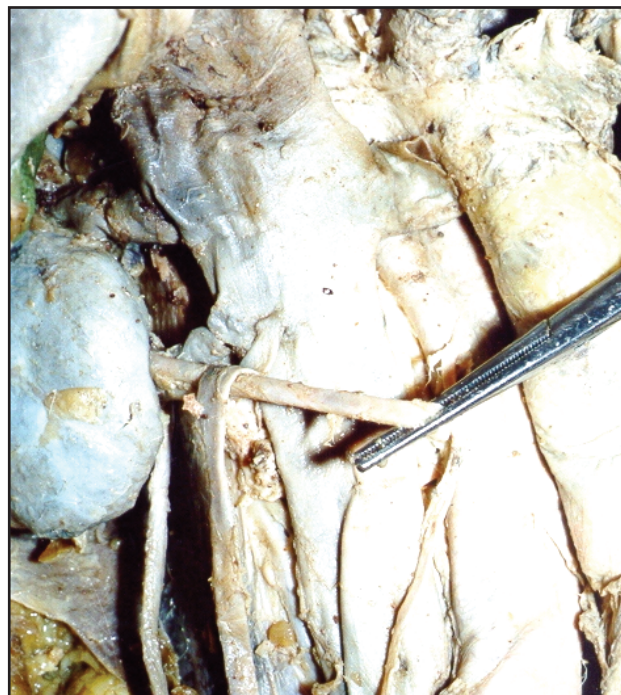


Figure 3. Two straight renal veins. The superior renal vein is formed extrahilarly, closer to the kidneys, from two venous trunks, which exit the kidney through the postero-superior part, ending on the postero-lateral face of the IVC, with which it forms an angle of 98° (open inferiorly); it has an oblique infero-medial course and a caliber of 3.2 mm. The inferior renal vein has an oblique supero-medial course; it is formed intrarenal, exiting through the lower part of the hilum and ending on the antero-lateral face of the IVC, with which it forms an angle of 78° (open inferiorly); it has a diameter of 3.2 mm; the distance between the two veins at the origin is 32 mm, and at the termination 18 mm.

We only found the caliber of the double renal veins to be the same in one case, in 4 cases the caliber of the superior renal vein was larger, with differences ranging between 0.3-5.3 mm, and in one case the caliber of the inferior renal vein was larger by 0.38 mm (Figure 4).

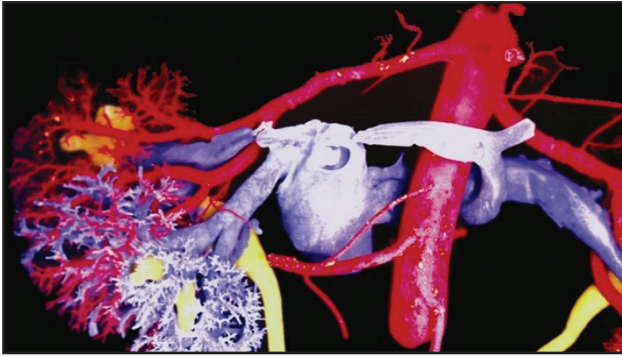


Figure 4. Case with double straight renal arteries and veins. The two veins are located between the arteries, closer to the superior renal artery. The superior renal vein is formed juxtahilarly from two venous trunks, which exit the kidney through the postero-superior part of the hilum, ending on the lateral face of the IVC, with which it forms an angle of 88° (open inferiorly), has a supero-medial oblique course and a caliber of 2.72 mm. The inferior renal vein has a supero-medial oblique course; it is formed juxtarenal, exiting through the lower part of the hilum and ending on the antero-lateral face of the IVC, with which it forms an angle of 18° (open inferiorly); has a diameter of 3.1 mm; the distance between the two veins at the origin is 26 mm, and at the termination 28 mm. The superior vein is located anteroinferior to the superior renal artery, which it partially covers, and at its termination is located between the two terminal branches of the superior renal artery.

Our study is not only of importance to the morphologist (anatomist), but knowledge of the incidence and imaging characteristics of the venous tributary is very important to avoid malpractice or dangerous outcomes (10).

States that “clinicians interpreting radiological imaging or performing laparoscopic and/or open surgical procedures of the posterior abdomen must have a thorough knowledge of the anatomy of common vascular variations in this region to avoid clinical complications” (11).

Conclusions

We most frequently found differences between the morphological characteristics of the monitored landmarks, especially at the level of vein morphometry. The differences with the existing data in the consulted literature, sometimes the differences being significant, would have several explanations: first of all, the different number of cases worked on; the use of different materials and working methods (fresh or formalinized organs, dissection, injection

of plastic materials, imaging methods), with probably also a difference in relation to the geographical area, sex and even the age of the subject

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