International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-8 Issue-4, April 2019

Sources and Options for the Formation of Renal Human Veins

Edgar Sabirovich Kafarov, Larisa Albertovna Udochkina, Khizir Mukhidinovich Bataev, Sergei Vladimirovich Fedorov

Abstract*: The purpose of the study was to identify the sources and options for the formation of human renal veins according to corrosion preparations. One hundred forty-two corrosion preparations of human venous vessels of the kidneys have been manufactured. Sources and variants of the formation of renal veins relative to the sagittal, frontal and horizontal planes have been studied in stereoprojection. It has been found that most often the main renal vein is formed from two venous vessels (57.8 % of the cases) or from three venous blood vessels (31.0 % of the cases) at $p \leq 0.05$. When the main renal vein is formed from two venous vessels, in 32.4 % of the cases it occurs when the upper pole and lower pole venous vessels merge. The second most common case (25.4 % of the cases) is the formation of the main renal vein from the ventral and dorsal venous vessels. When the main renal vein is formed from three vessels, in 15.5 % of the cases it is formed from the upper, central and lower pole venous vessels, in 8.4 % of the cases – from the upper pole, lower pole and dorsal central venous vessels; and in 4.2 % of the cases – from the ventral, dorsal and lower pole venous vessels. The remaining options for the formation of the main renal vein represent less than 5.0 % of the cases.

***Index Terms*: kidney, stereometry, veins.**

I. INTRODUCTION

In the literature there are a lot of data on the formation of renal veins [1-4]. Until now, a large variety of options and forms of the renal vein formation has not allowed researchers to develop a unified point of view regarding the sources of its formation. As for the number of veins that are directly involved in the formation of the renal veins, according to the ultrasonographic studies of T.A. Kvyatkovskaya et al. [1], it is from 3 to 4, and sometimes even more veins. M.P. Burykh [5] suggests that the main renal veins are formed by merging directly segmental (interlobar) veins. According to the author, together with the arteries of the same name, these veins form the vascular legs of the renal segments, which are accessible and convenient for dressing in the hilus area.

K.K. Gubarev [3] calls the vessels that form the renal vein the primary venous inflows. According to the researcher, they are involved in the implementation of the venous outflow from the kidney and form the first, second, third, and fourth type of the venous system of the human kidney. Based on the selective-decomposition analysis of corrosion preparations of the renal venous system, Azmi Mahmoud Ali Hussein [7] isolated the main renal vein; anterior and posterior renal veins; upper and lower pole veins (these were the inflows of the anterior renal vein); interlobar veins (segmental veins being the inflows of the upper pole and lower pole veins, as well as the posterior renal vein), and parapyramidal veins (being the inflows of the interlobar veins), i.e. the researcher identified the names of the levels of the renal venous system.

Yu.P. Kostilenko et al., [8] used the injection-corrosion methods to study the arterial and venous systems of the kidneys. According to the researchers, the veins of the adjacent kidney lobes merge with each other and form interlobar veins, which are directed through the renal columns in parallel with the same-name arteries. Interlobar veins in the area of the renal papillae exit the parenchyma and are directed to the renal sinus, where, merging together, they form the renal vein. Thus, analysis of literary sources shows that, until now, the authors have not had consensus about the sources of the formation of the renal veins, their number, there are no names of the venous vessels of the kidneys, which are directly involved in the formation of the renal vein, called inflows or 2nd order veins by various researchers [1], [3], [7], [9].

II. SCOPE OF THE RESEARCH

The study was aimed at identifying the sources and options for the formation of human renal veins according to corrosion preparations.

III. MATERIALS AND METHODS

The material for the study was 142 kidney preparations of people aged 22 to 90 years who died from diseases not related to kidney disease. The corpse material was collected at the forensic bureau and in the prosectoria of the regional clinical hospital in Astrakhan. The methods of anatomical preparation, manufacture of corrosion preparations of the renal venous system using fast-hardening polymers such as Redont-3, Styracryl, and Protacril were used. Sources and variants of the formation of renal veins relative to the sagittal, frontal and horizontal planes were studied in stereoprojection. The obtained digital material and data from instrumental research methods were processed using variation statistics methods using a workstation with an Intel Core2Duo T5250 1.5 GHz processor, RAM up to 2 GB on a Windows 7 platform. In the course of work, an Excel application package from Microsoft Office 2007 was used.

Manuscript published on 30 April 2019.
* Correspondence Author (s)
Edgar Sabirovich Kafarov*, Chechen State University, Grozny, Chechen Republic, Russia.
Larisa Albertovna Udochkina, Astrakhan State Medical University of the Ministry of Health of Russia, Astrakhan, Russia.
Khizir Mukhidinovich Bataev, Chechen State University, Grozny, Chechen Republic, Russia.
Sergei Vladimirovich Fedorov, Bashkir State Medical University of the Ministry of Health of Russia, Republic of Bashkortostan, Ufa, Russia.

IV. RESULTS

It has been revealed that most often in 57.8 % of the cases (82 corrosion preparations) the main renal vein is formed from two veins, and in 25.4 % of the cases (36 corrosion preparations), it is formed from the ventral and dorsal veins (Fig. 1).

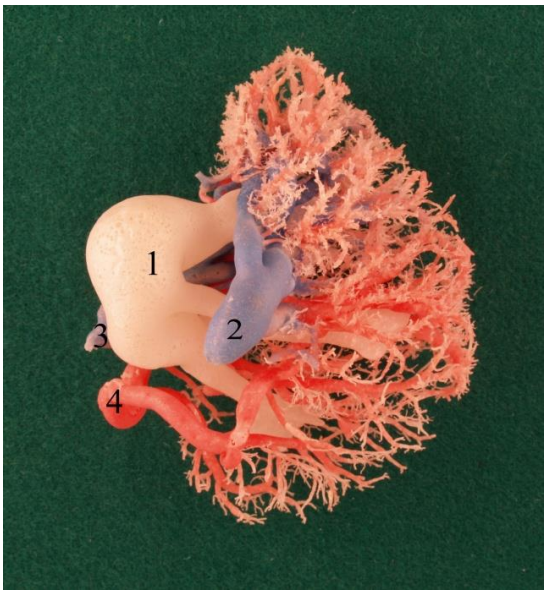

Fig. 1. Corrosion preparation of blood vessels of the kidney. (Men, 76). 1 – pelvis; 2 – ventral vessel; 3 – dorsal vessel of the renal vein; 4 – renal arteries.

In 32.4 % of the cases (46 corrosion preparations), the renal vein is formed from the lower and upper pole veins (Fig. 2).

Fig. 2. Corrosion preparation of blood vessels of the kidney. (Women, 39). 1 – upper pole vessel; 2 – lower pole vessel of the kidney vein

In 44 corrosion preparations (31.0 % of the cases) the renal vein is formed from three vessels. Of these, in 15.5 % of the cases (22 corrosion preparations), the renal vein is formed from the upper pole, central and lower pole vessels. In 8.5 % of the cases (12 corrosion preparations), the renal vein is formed from the upper pole, lower pole and dorsal central venous vessels. In 4.2 % of the cases (6 corrosion preparations), the renal vein is formed from the ventral, dorsal and lower pole venous vessels.

In 4.2 % of the cases, piercing venous vessels take part in the renal vein formation. At the same time, the renal vein is formed with the same frequency (1.2 % of the cases) in three options: the first option – from the ventral, dorsal, upper pole vein, and lower pole perforated vein; the second option – from the upper pole, central, lower pole veins, and dorsal perforated vein; the third option – it had a single trunk with perforated veins. Quite rarely, in 1.4 % of the cases (2 corrosion preparations), the renal vein is formed from the ventral, dorsal and lower pole venous vessels. In 2.8 % of the cases (4 corrosion preparations), the renal vein is formed from the ventral upper pole, ventral lower pole and dorsal central perforated vein.

The authors paid attention to the drugs, where in 25.4 % of the cases, the left renal vein was formed from two veins (ventral and dorsal) (Fig. 1). In addition, each of the veins was formed from interlobar veins, fan-like merged into one vein. The extrarenalized pelvis was located between the ventral and dorsal veins (Fig. 1).

It has been noted above that the position and shape of the pelvis determine the topography of the hilum of the kidneys. Thus, with the extrarenal position of the pelvis, the renal veins covered it ventrally and dorsally. At the same time, the extraorgan position of the veins in the kidney hilum was more often observed. In 46 corrosion preparations (32.4 % of the cases), the upper pole and lower pole veins, coming out of the renal hilum, merged and formed the main trunk of the renal vein. At the same time, the upper pole vein was formed by merging of interlobar veins draining the upper pole and the central sections of the kidney (Fig. 2). The lower pole veins were formed from several interlobar veins draining the lower pole and the central sections of the kidney.

It should be noted that the formation of the main renal vein from the upper pole and lower pole veins was different. In 56.4 % of the cases, the upper pole and lower pole veins were formed at the merging of the ventral and dorsal interlobar veins (Fig. 2). In 28.7 % of the cases, the upper pole vein was formed from veins draining the upper pole and the posterior surface of the lower pole of the kidney, as well as from the lower pole vein draining the lower pole of the kidney. With this option, we can talk about a double system of venous drainage from the lower pole of the kidney. In 14.9 % of the cases, the upper pole vein drained the entire ventral surface of the kidney and the dorsal surface of the upper pole; the lower pole vein drained the remaining part of the dorsal surface of the kidney. In 31.0 % of the cases (44 corrosion preparations) the main renal vein was formed from three veins. At the same time, the renal vein was formed from three veins in several options. In the first option, the renal vein is formed from the upper pole, central and lower pole veins, which represented 15.5 % of the cases. The upper pole vein was formed from veins draining the upper pole and partially the central part of the kidney, the central vein – from the veins draining the central part of the kidney, and the lower pole vein was coming from the lower pole of the kidney.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication (BEIESP)

In 8.5 % of the cases (12 corrosion preparations), the renal vein was formed from the upper pole, lower pole and dorsal central veins. Moreover, the upper pole veins were directed ventrally from the pelvis, draining the upper pole and the central sections of the kidney. The lower pole veins were also located ventrally from the pelvis and were directed from the lower poles and central sections of the kidney. Dorsal central veins came behind the pelvis from the dorsal surface of the kidneys.

In 7.0 % of the cases (10 corrosion preparations), the renal vein was formed from four veins (ventral superior vein, central vein, lower pole vein, and dorsal central vein). The ventral superior pole vein participated in the drainage of the upper pole and the central part of the kidney. The central vein drained the central part of the kidneys. The lower pole vein participated in the drainage of the lower pole of the kidney, and the dorsal central vein came behind the pelvis, draining the dorsal central section of the kidney. In 4.2 % of the cases (6 corrosion preparations), the renal vein was formed from the ventral, dorsal and lower pole veins. At the same time, the ventral vein drained the anterior-upper section of the kidney, the dorsal vein participated in the drainage of the posterior-upper section of the kidney, and the lower pole vein drained the lower pole of the kidney. In 2.8 % of the cases (4 corrosion preparations), the renal vein was formed from the ventrally located upper polar, lower polar and dorsal central perforated veins. Upper pole vein came ventrally to the pelvis, draining the central section and the upper pole of the kidney. The lower pole vein was also located in front of the pelvis and participated in the drainage of the central part and lower pole of the kidney. Dorsal, central perforated veins came behind the pelvis from the dorsal surface of the kidneys. In 1.4 % of the cases (6 corrosion preparations), the renal vein was formed from the ventral, dorsal and upper polar veins. At the same time, the ventral and dorsal veins participated in the drainage of the anterior and posterior surface of the lower pole of the kidney, and the upper pole vein drained the upper pole.

In 4.2 % of the cases (6 corrosion preparations), the renal vein had perforated vessels. At the same time, in 1.4 % of the cases (2 corrosion preparations), the renal vein was formed from the ventral, dorsal, upper pole and lower pole perforated veins. In 1.4 % of the cases (2 corrosion preparations), the renal vein was formed from the upper pole, central, lower pole and dorsal perforated veins. Moreover, the upper pole vein drained the upper pole and partly the central part of the kidney. The central vein drained the central part of the kidney and the lower pole vein drained its lower pole. The dorsal perforated vein came behind the pelvis, draining the posterior-central part of the kidney and fell into the renal vein. In 1.4 % of the cases (2 corrosion preparations), the renal vein had a long single trunk with many small perforated veins.

V. DISCUSSION

Stereoanatomical studies of the venous vessels of the kidneys on corrosion kidney preparations showed that in 91.6 % of the cases the formation of the main renal vein occurred in accordance with the 9 main options identified.

For the convenience of the study, depending on their location and topography in the organ hilum, the names of these vessels relative to the main arteries in accordance with the International Anatomical Nomenclature were defined: upper pole venous vessel, lower pole venous vessel, ventral venous vessel, dorsal venous vessel, central venous vessel, etc. It was also found that most often the main renal vein was formed from two veins (57.8 % of the cases) or from three veins (31.0 % of the cases) with $p \leq 0.05$, which differed from the data of some authors. Thus, it has been found that when a renal vein is formed from two veins in 32.4 % of the cases, it occurs at the confluence of the upper pole and lower pole veins. The second most common case (25.4 % of the cases) is the formation of the renal vein from the ventral and dorsal veins, which differs from the data provided by T.A. Kvyatkovskaya et al., [1], which indicated a greater number of venous vessels that formed the main renal vein.

According to the study, in the formation of the renal vein from three veins in 15.5 % of the cases it is formed from the upper pole, central and lower pole veins, in 8.4 % of the cases it is formed from the upper pole, lower pole and dorsal central veins; in 4.2 % of the cases, it is formed from the ventral, dorsal and lower pole veins.

It should be noted that the remaining options of the formation of the renal vein were observed in less than 5 % of the cases: from the ventral (upper pole, lower pole) and dorsal central veins, which had occurred in 2.8 % of the cases; from the ventral, dorsal and superior pole veins, which had occurred in 1.4 % of the cases.

Some researchers believe that the main renal vein results from the confluence of interlobar veins [5]. However, the authors found that the interlobar veins were the intraorgan (III) link of the venous bed of the kidney. It was also found that only a small part of these venous vessels were located in the renal sinus, and most – in the parenchyma of the organ.

The data of the study partly correspond to the information provided by Giannoulia-Karadana et al., [10], which was obtained by digital angiography methods and indicated similar options of the formation of the renal vein but differed only in percentage.

It should be noted that the authors of the article do not agree with the opinion of some other authors [3], [7] who call the vessels that form the main renal vein as the venous inflows and describe the presence of segmental renal veins. The authors' studies on the corrosion preparations of the venous bed of the kidney did not allow to determine the segmental veins since the kidney does not have an isolated venous outflow in segments.

VI. CONCLUSION

Thus, it has been found that most often the main renal vein is formed from two venous vessels (57.8 % of the cases) or from three venous blood vessels (31.0 % of the cases) at $p \leq 0.05$. When the main renal vein is formed from two venous vessels in 32.4 % of the cases, it occurs when the upper pole and lower pole venous vessels merge. The second most common case (25.4 % of the cases) is the formation of the main renal vein from the ventral and dorsal venous vessels.

Published By:
Blue Eyes Intelligence Engineering
& Sciences Publication (BEIESP)

When the main renal vein is formed from three vessels, in 15.5 % of the cases it is formed from the upper, central and lower pole venous vessels, in 8.4 % of the cases – from the upper pole, lower pole and dorsal central venous vessels; in 4.2 % of the cases – from the ventral, dorsal and lower pole venous vessels. The remaining options for the formation of the main renal vein represent less than 5.0 % of the cases.

ACKNOWLEDGMENT

The article was published as part of the implementation of the RFBR grant in accordance with agreement no. 18-29-09118.

REFERENCES

1. A. Kvyatkovskaya, E.H. Chernyavskiy and T.L. Kutsyak, “Anatomo-sonograficheskoe sopostavlenie morfometricheskikh dannykh pochechnykh sosudov i ikh vnutriorgannykh vetvey” [“Anatomical and sonographic comparison of morphometric data of renal vessels and their intraorgan branches”]. *Rossiyskie morfologicheskie vedomosti*, vol. 1(2), 2000, pp. 201 – 202.
2. L.A. Udochkina, E.S. Kafarov, and E.A. Sandzhiev, “Stereoanatomy of the human kidney vascular system”. *Innovatsionnye tekhnologii v prepodavanii morfologicheskikh distsiplin*. [Innovative technologies in teaching morphological disciplines], vol. 1, 2012, pp:141 – 145.
3. K.K. Gubarev, V.V. Musokhranov, and M.V. Borisenko, “Osobennosti podgotovki mochetochnika pri transplantatsii pochki v zavisimosti ot variantov raspolozheniya mochetochnikovoy veny pri raznykh tipakh formirovaniya pochechnykh ven” [“Features of the preparation of the ureter in kidney transplantation, depending on the location of the ureteral vein in different types of formation of renal veins”]. *Omskiy nauchnyy vestnik*, vol. 3 (37), part III, 2006, pp. 331 – 334.
4. E.S. Kafarov, S.V. Fedorov, and I.U. Lechiev, “Sravnitelnaya kharakteristika venoznykh sosudov pochek cheloveka po dannym rentgenoangiografii i kompyuterno-tomograficheskogo issledovaniya” [“Comparative characteristics of venous vessels of the human kidneys according to x-ray angiography and computed tomographic studies”]. *Morphology*, vol 152(4), 2017, pp. 32 – 37.
5. M.P. Burykh, “*Nervy i sosudy pochek cheloveka i nekotorykh zhivotnykh*” [“Nerves and vessels of the kidneys of humans and certain animals”]. Kharkov: Znanie, LLC, 2000.
6. E.S. Valishin, “*Abstracts of the VI Congress of the International Association of Morphologists*”, vol.121(2), 2002.
7. A. Mahmoud, and A. Hussein, “Venoznoe ruslo i ego sintopicheskie vzaimootnoshe-niya s arteriyami pochek cheloveka” [“Venous bed and its syntopic relationship with human kidney arteries”]. *Medytsyna siogodni i zavtra*, vol. 2, 2008, pp. 101 – 104.
8. Yu.P. Kostilenko, A. Makhmud, and A. Khusein, “Angioarkhitektonika mozgovogo i korkovogo veshchestva pochek” [“Angioarchitecture of the brain and cortical substance of the kidneys”]. *Klinichna anatomiya ta operatyvna khirurhiya*, vol. 7(4), 2008, pp. 44 – 48.
9. O. Mochalov, “*Individualnaya izmenchivost arkhitektoniki krovenosnykh sosudov pochki*” [“Individual variability of the renal blood vessels architectonics”]. The author's abstract of the Doctor of Medical Sciences. Ministry of Health and Social Protection of the Republic of Moldova; State University of Medicine and Pharmacy. N. A. Testemitanu. Chisinau, 2006.
10. A. Giannoulia-Karadana, M. Moschovi, P. Koutsovitis, G. Tolis, F. Tzortzatou-Stathopoulou, “Inferior vena cava and right atrial thrombosis in children with nephroblastoma: diagnostic and therapeutic problems”, *J Pediatr Surg.*, 35(10), 2000, pp. 1459-61.