Abstract: Introduction: In comparison with other organs, variants of blood supply to the kidneys were always at special attention. In many respects, the relevance of the topic can be explained by the presence of a large number of surgical and non-surgical procedures performed on this organ, the number of which continues to grow. Material and methods: The study was performed on 28 organ complexes (56 kidneys) obtained from patients of Moldavian origin, fixed in a 10% formalin solution and then carefully dissected. Results: In our study, we found one renal vein in 51 cases (90.1%). Accessory right renal vein was detected in 5 cases (9.9%). Late venous confluence was in seven cases (12.46%), and more often, this variant of venous outflow was seen on the right - 5 cases. We also had a rare case where the adrenal vein drained directly into the upper pole of the kidney (1.78%). In one case (1.78%) we found a left renal vein, which had a retroaortic location. We also found one case (1.78%) of an additional vein on the right and an additional artery on the left. In 20 cases (35.6%) the artery was located in front of the vein in the kidney sinus. Conclusions: The incidence of renal vein variations is relatively lower in Moldavian population compared to other studies. Data, provided in the article, can be used by specialists in urology, nephrology, vascular surgery, as well as in other surgical and therapeutic specialties.

Key Words: Renal veins, accessory renal veins, retroaortic left renal vein, late venous confluence.

Introduction: In comparison with other organs, variants of blood supply to the kidneys were always at special attention. In many respects, the relevance of the topic can be explained by the presence of a large number of surgical and non-surgical procedures performed on this organ, the number of which continues to grow. Laparoscopic kidney surgery has become a widely used procedure in urology. Nevertheless, bleeding due to vascular trauma still remains one of the most common intraoperative complications.(1) The frequency of surgical complications directly depends on the experience of the medical personnel, as well as on a deep understanding of the region's anatomy, including variants and anomalies in the development of blood supply to the organs. The experience from large centers demonstrated that the number of complications decreases noticeably with the increase in the volume of performed procedures.(1, 2) Unexpected anomalies can increase the risk of bleeding to such an extent that the surgeon may have to abandon laparoscopic procedures and go to an open procedure instead.(3)

variants of blood supply to the kidneys are of great importance not only in the fundamental aspect, but also in clinical practice. Data provided in the article are useful in urology, nephrology, vascular surgery, as well as in other therapeutic and surgical specialties.

Material and Methods

Variant anatomy of the blood supply of the kidneys was studied by the method of macro- and microscopic anatomical dissection. The study was performed on 28 organ complexes (56 kidneys) donated to the Department of human anatomy, obtained from patients of Moldavian origin, who died of causes not related to renal pathology. The organs were fixed in a 10% formalin solution. The material was described and analyzed using morphometric methods. Descriptive statistics was used to analyze the obtained data.

Results

All the abnormalities of renal veins can be classified into three groups: quantitative anomalies, fusion anomalies and anomalies of the position of the renal vein. Quantitative anomalies include the presence of more than one renal vein (accessory vein). Most often (in 51 cases, 90.1%) there was a classical variant of venous drainage by one renal vein located in the hilum of the kidney lower and anterior to the renal artery. A rarer variant is the presence of an accessory right renal vein, which we detected in 5 cases (9.9%) (Fig. 1). In one case (1.78%) we identified an accessory vein on the right and an accessory artery on the left (Fig. 1). Nevertheless, in our lot of research, the left accessory vein was not present.
Fig. 1. An accessory renal vein on the right and an accessory renal artery on the left. [A – aorta, IVC – inferior vena cava, K – kidneys, RA – renal artery, RV – renal vein, aRV – accessory renal vein, aRA – accessory renal artery.]

Fig. 2. Bilateral late venous confluence. [A – aorta, IVC – inferior vena cava, K – kidneys, LVC – late venous confluence, RA – renal artery, aRA – accessory renal artery, Ur - ureter.]

Fusion anomalies as late venous confluence were identified in seven cases (12.46%), and more often, this variant of venous drainage was seen on the right side - 5 cases (Fig. 2). An unusual case was encountered, where the adrenal vein drained directly into the upper pole of the kidney (1.78%) (Fig. 3).

Fig. 3. An adrenal vein, which drained directly into the upper pole of the kidney. [K – kidney, P – pancreas, A – aorta, SA – splenic artery, CHA – common hepatic artery, AD – adrenal gland, SAdA – superior adrenal artery, MAdA – middle adrenal artery, AdV – adrenal vein]

Fig. 4. Retroaortic left renal vein and bifurcation of the left renal artery. [A – aorta, IVC – inferior vena cava, K – kidneys, RA – renal artery, aSb – anterior presegmental branch, pSb – posterior presegmental branch, RV – renal vein, Ur - ureter.]

The anomalies of position are among the rarest. In one case (1.78%), we found a left renal vein that had a retroaortic course (retroaortic left renal vein [RLRV]), which according to the classification can be attributed to the II type (Fig. 4). The normal position of the structures of the renal pedicle (from front to back) is artery, vein and pelvis. In 20 cases (35.6%) the artery was located in front of the vein in the kidney sinus.

Discussion

Based on the data from studies, which involved corrosion cast method, a single renal vein occurs bilateral in 78.25% of cases. One or more accessory veins occur in 21.8% of cases (17.9% one accessory vein and 3.2% two accessory veins). Accessory veins on the left are extremely rare - 0.6% of cases.(4) Although, it should be noted, that the incidence of accessory real vein significantly depends on the method, population and sample size. Thus, their incidence ranges from 8% to 38.79%.(5, 6) Compared to other reports, the incidence of accessory veins in our study is considered to be of low incidence.

There is usually no relationship between the sex and the frequency of renal vein anomalies.(7) Authors consider that renal vein anomalies are more frequent on the right than on the left side (20.1% vs. 7.4%).(8) The presence of accessory vein also increases the likelihood of urological symptoms such as hematuria.(9)

RLRV can be seen in 0.6%-3.6% of cases and is classified in 4 types.(10,11) In type I, the ventral preaortic limb of the left renal vein is obliterated, but the dorsal retroaortic limb persists and joins the IVC in the orthotopic position. This type represents 0.3-1.9% of cases.(10,12,13) Type II results from the obliteration of the ventral preaortic limb of the left renal vein, and the remaining dorsal limb turns into the RLRV. The left renal vein lies at the level of L4 to L5 and joins the gonadal and ascending lumbar veins before joining the IVC. Type II RLRV is seen in 0.4-0.9% of cases.(10, 14, 15) Type III is the circumaortic left renal vein or venous collar. This type is due to the persistence of subsupracardial and intersupracardial anastomoses and the dorsal limb of the left renal vein and is encountered in 1.5-8.7% of cases.(10, 12, 16) In type IV, the ventral preaortic limb of the left renal vein is obliterated, and the remaining dorsal limb becomes the RLRV. Then, the RLRV courses obliquely and caudally behind the aorta to join the left common iliac vein (approximately 0.16% of cases).(10)

Patients with RLRV in 6.6%-65% of cases may have urological symptoms (more often in type II and IV).(10, 11) The most frequent symptoms are microhematuria, macrohematuria and pain in the left flank and inguinal areas.(17)
The presence of renal vein variation can also lead to diseases. Thus, varicose veins of the pelvis are more common in women with variants of development of the left renal vein (33% vs. 16%, p = 0.009). Authors also state that varicose veins of the pelvis are seen even more often in case of left retroaortal vein.(18) It is also important to take in consideration variants of development of renal vein during surgical interventions involving abdominal aorta, since inflammatory changes can lead to devastating complications.(19)

The development of the renal veins is a part of the complex developmental process of the IVC during which three different venous systems develop and later on partially regress. The process starts from the 6th week of conception and ends at about the 8th week. The IVC is formed from a vast network of three pairs of parallel veins in communication: the posterior cardinal veins, the subcardinal veins, and the supracardinal veins. Failure or errors of regression give rise to a variety of anatomical variations(20-22) Thus, several groups of anomalies can appear based on the segment of the final vena cava that is abnormal: anomalies of the posterior cardinal veins, anomalies of the subcardinal veins, anomalies of the supracardinal veins, anomalies of the renal segment. Anomalies of the renal segment include circumaortic venous ring, retroaortic right renal vein and multiple renal veins.(22)

Conclusions

In comparison with other organs, variants of blood supply to the kidneys were always at special attention. In many respects, the relevance of the topic can be explained by the presence of a large number of surgical and non-surgical procedures performed on this organ, the number of which continues to grow. In our study we found one renal vein in 51 cases (90.1%). Anomalous right renal vein was detected in 5 cases (9.9%). Late venous confluence was in seven cases (12.46%), and more often, this variant of venous outflow was seen on the right - 5 cases. We also had a rare case where the adrenal vein drained directly into the upper pole of the kidney (1.78%). To our knowledge, this finding is rare and previously was not reported in the literature. In one case (1.78%) we found a left renal vein, which had a retroaortic location. We also found one case (1.78%) of an accessory vein on the right and an accessory artery on the left. In 20 cases (35.6%) the artery was located in front of the vein in the kidney sinus. The incidence of renal vein variations is relatively lower in Moldavian population compared to other studies. Data provided in the article can be used by specialists in urology, nephrology, vascular surgery, as well as in other therapeutic and surgical specialties.

References