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Case Report and Review

VASCULAR VARIATIONS OF THE KIDNEYS: CASE REPORT AND MINI REVIEW

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ABSTRACT

Background: The diversity of the human body structure which results to a great variety of vascular branching, seems to be endless. The vascular variations of the renal arteries are among the most frequent discovered ones. We present such a case, found during an educational cadaveric dissection.

Results: Vascular branching alternations from the norm were observed in both kidneys of the case report. A bilateral presence of additional arteries, a polar one in the right side and a hilar one in the left side, with a double renal vein in the left side were observed.

Conclusions: Anatomy of the renal vessels usually is depicted with a plethora of variants. Clinicians should be aware that the renal topographical anatomy presents such difficulties, in order for complications to be avoided during various procedures.

KEY WORDS: Anatomy, Polar Artery, Hilar Artery, Double Renal Veins.

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INTRODUCTION

The diversity of the human vascular variations (VV) is of great importance for the daily clinical practice among surgeons, cardiologists and radiologists. The awareness towards any branching alternation or any supplementary vessel may improve the interventional procedures and on the other hand reduce potential complications. Blood supply for various organs remains "normal" despite the altered vascular tree [1]. Vascular structure and pattern is the result of a complex biological process, genetically programmed and controlled. A series of triggers during embryological evolution may result in branching anomalies. This process considering the large vessels is due to the persistence of embryonic dispositions [2].

Among the most encountered VV are those concerning kidneys [3]. The renal arteries (RA), right and left, arise from the anterolateral aspect of abdominal aorta, at approximately the level of the superior margin of L1-L2, immediately caudal to the origin of the superior mesenteric artery. Two types of anatomical variations are reported. The first is noted as an early division and characterized by branching of

the main renal arteries into segmental branches proximal to the hilum. The second is known as the extra renal arterial branching, which may further be divided into accessory (hilar) and aberrant (polar) arteries [4-5]. The renal veins (RV) usually travel anterior to the renal arteries. Venous variants include multiple RV, late confluence, and on the left, retroaortic and circumaortic RV [6].

We present a case report of VV of the kidneys discovered during educational dissections in a male cadaver.

CASE REPORT

The reported anatomical variations were discovered in a male cadaver of Caucasian (Hellenic) origin during routine educational dissection at the Anatomy Department of the Medical School of the National and Kapodistrian University of Athens. The cadaver derived from body donation with informed consent written and signed (with signature authentication) by the donator himself. The protocol for the present research had been approved by the ethics committee of our institution.

In order to obtain a better access of the kidneys and their vessels, the abdominal cavity was opened and the intestines were removed. Variations of the vascular pattern were observed in both sides [Figure 1].

The right kidney was supplied by two arteries, a main and an additional one. The first one originated from the lateral aspect of the abdominal aorta at the level of the first lumbar vertebra, 1.3 cm after the origin of the superior mesenteric artery. This artery entered the renal hilum accompanied by the right RV which passed in front of it and was considered as the main RA. The second artery emerged from the lateral side of the abdominal aorta at the level of the second lumbar vertebra, 1.1 cm below the other one and coursed alone to the lower pole of the right kidney [Figure 1]. Both arteries passed behind the inferior vena cava.

The left kidney was also supplied by two arteries which both of them ended at the renal hilum. The main one arise at the level of the first lumbar vertebra, 1.8 cm after the origin of the superior mesenteric artery and the additional one at the level of the second lumbar vertebra, 1.4 cm below the first one [Figures 1 & 2]. In this side double RVs were also observed, both of them draining in the inferior vena cava. The first one was rather large and coursed underneath the additional RA and in front of the abdominal aorta. The second and smaller one came out from the posterior surface of the kidney, coursed behind the abdominal aorta and ended in the inferior vena cava 1.5cm below the first one [Figure 2]. The ureter followed the expected course and pattern in both sides.

Fig. 1: The vascular supply of the right kidney is performed by the main right renal artery [(R) RA] and an additional polar artery [(R)ARA] and one renal vein (RV). In the left side two renal arteries existed, the main one [(L)RA] and an additional one [(L)ARA] and double renal veins [only one is depicted – RV2- the second one is dissected]. U: ureter (R): right (L): left, IVC: inferior vena cana, AA: abdominal aorta.

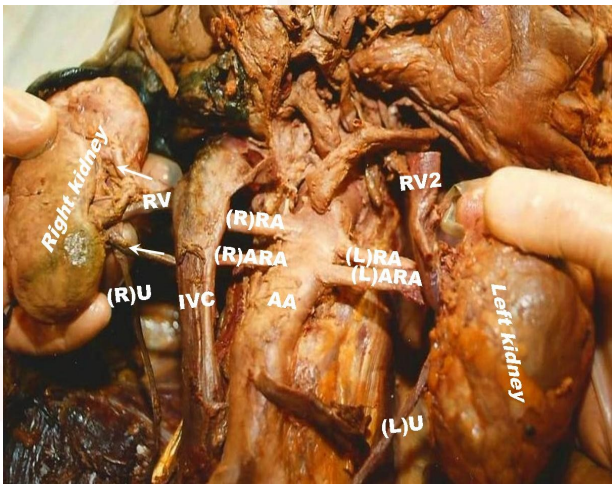
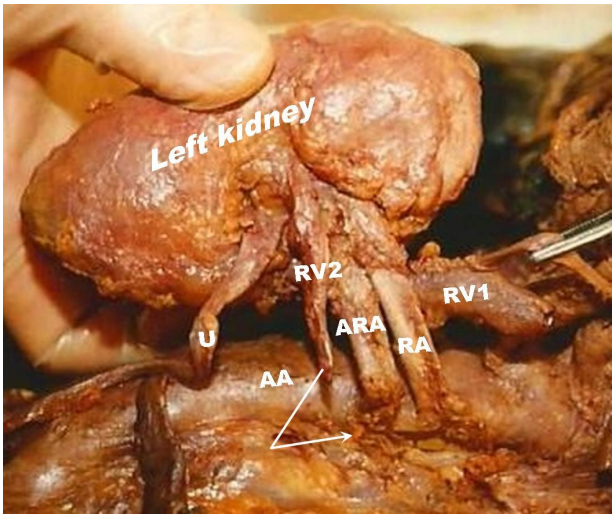


Fig. 2: Left kidney – posterior view: The vascular supply is performed by the main renal artery (RA) and an additiona one (ARA) both entering the hilum and two renal veins (RV1, RV2). The second one (RV2) is dissected; it passed underneath the abdominal aorta (AA) and drained in the inferior vena cava. U: ureter.



DISCUSSION

VV of the renal anatomy occur during embryological development when the kidney originally formed in the pelvis, ascends into the abdominal cavity. A failure of regression of the embryonic vessel network leads to the formation of an accessory RA. In terms of embryology, the anatomy of the RV is defined by the embryology of the inferior vena cava, and is independent of the embryology of the RA. Anomalies in anastomoses of the three sets of paired embryonic veins, namely, postcardinal, supracardinal and the subcardinal result to RV variants [6].

The most common and clinically important anatomical variation is the additional RA, encountered in around 30% of the human individuals (24% unilateral, 5-10% bilateral) [5, 7]. Some studies report a higher incidence up to 75.7%. Several terms have been used for multiple renal arteries such as “accessory”, “supernumerary”, “supplementary”, “extra”, “aberrant”, “ectopic”, “plural” and “additional” [8]. An unreported accessory RA may be not ligated during a nephrectomy operation or occluded during a stent placement procedure, resulting in bleeding and thus to renal infarction [6]. Some studies suggest that VV in RA are more common than VV in RV [9]. RA variants significantly differ according to racial and geographic locations [6]. The gradual increase in renal surgical interventions, renal transplantation and therapeutic empolization, intravascular stent placement and imaging procedures, makes the recognition of the RA variations crucial for the successful accomplishment of various procedures [5].

An additional RV, a retroaortic course of the left RV, late venous confluence and circumaortic venous ring, are the most common branching variants concerning the RV. In general, the right sided multiple RV appear having parallel courses, while the left sided usually present cross connections patterns [10]. The presence of renal venous variations may cause a series of difficulties during abdominal aortic aneurysm surgery, kidney transplantation, laparoscopic kidney tumor excision, and renal venous blood sampling [10].

Developmental variations in RV should be easily detected on computed tomography scans, so that fatal threats during major surgeries such as donor nephrectomies in otherwise healthy donors to be avoided [11].

Anson et Daseler were the first to suggest that the arrangement “vein-artery-renal pelvis” is the most frequent in human individuals [13-12]. In some studies was noted that the presence of an accessory renal vessel may lead to several clinical complications, one of which may be hydronephrosis [9]. In the present case VV were observed in both kidneys, with bilateral presence of additional arteries, a polar one in the right side and a hilar one in the left side and double renal veins in the left side. Surgeons and interventional radiologists should be aware of such variations [14].

CONCLUSION

With more interventional diagnostic and thera-peutic interventional procedures being performed during the last years, surgeons and radiologists require a deeper appre-ciation of the anatomical VV of the kidneys.

Conflicts of Interests: **None**

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