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Original Article

Description of an Atypical Vascular Arch in the Renal Parenchyma

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Abstract

Introduction: Variability in renal vascularization occurs with a frequency of around 30%. During the routine dissection of one cadaver without renal pathology, we revealed the presence of one. **Material and Methods:** Dissection of a cadaver carried out in the practicing room of School of Medicine. **Results:** During the routine dissection of one cadaver without renal pathology, we revealed the presence of an early bifurcation of the renal artery on the left side, and the presence of two polar arteries – superior and inferior -, the latter presenting an anterior and posterior vascular arch to the renal pelvis in the parenchyma, which anastomoses the pre- and retro-pyelic branches of the renal artery with the pre- and retro-pyelic branches of the inferior accessory polar artery. In addition, the presence of an accessory polar artery was observed in the right kidney. **Discussion and Conclusion:** For vascular surgeons, knowledge of this anatomical variation is of real clinical relevance in cases such as fenestrated endografting in order to preserve the function of the entire kidney.

Keywords: *Inferior polar artery, intrarenal vascular arch, renal artery, variations*

Introduction

In classical anatomical terminology, standard renal vascularization is generally described as a single renal artery originating bilaterally and laterally from the abdominal aortic artery at the level of lumbar vertebrae L1 and L2, approximately 1 cm below the exit from the superior mesenteric artery.[1-3] In general, at a variable distance from the renal hilum, it splits into two terminal branches, the prepyelic artery (PA) and the retro-pyelic artery (RP), which in turn will split into segmental branches. However, this vascular pattern may present anatomical variations with a variable incidence depending on the ethnic origin, ranging from 4% to 61.5% (with an average of 20%), and on the number of accessory arteries, between 3% and 30% unilaterally, and 10% bilaterally, and the study method (computerized tomography/dissection).[1,2,4-8]

These variations have been classified as hilar, when they go to the renal hilum, and polar, when they go to the renal poles, and the latter, in turn, as solitary, pedicular, false supernumerary, and true supernumerary.[9]

The inferior polar artery generally comes from the aorta, in its superior or inferior portion, from the renal artery, and less frequently from the suprarenal artery, common iliac, or superior mesenteric artery. The incidence of this inferior polar artery coming from the abdominal aorta varies between 1 and 9.7%.[10]

In this case, we present a rare anatomical variation that involves the presence of accessory polar arteries in the right kidney, and more prominently, the presence of an anterior (PA) and posterior (RP-pyelic) vascular arch to the renal pelvis in the renal parenchyma, between the branches of the main renal artery and the branches of the inferior polar artery.

Material and Methods

During the routine dissection of one cadaver without renal pathology, carried out for university teaching, given by the department of human anatomy and histology, the presence of two anatomical variants related to the arterial supply of the kidney was observed: On the one hand, an early division of the segmental branches in the left kidney, and on the other hand, the presence of two polar arteries – superior and inferior, in the right kidney. For a better visualization of the structures found, specific silicone was used

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Figure 1: Green silicone injected into arteries

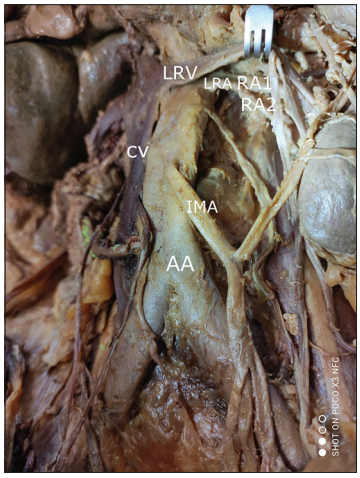

Figure 2: Early bifurcation of the left renal artery. AA: Aorta artery; IMA: Inferior Mesenteric Artery; CV: Cava Vein; LRV: Left Renal Vein; LRA: Left Renal Artery; RA1: Prepyelic segmentary Artery; RA2: Retro-pyelic segmentary Artery

(Green color: 3M ESPE ExpressTM. Vinyl Polysiloxane Impression Material. Regular Set-Light-Body-Hydrophilic. ISO 4823 Type 3.50 ml.Base Paste/Catalyst Paste. 7302. Made in Germany by 3M ESPE AG, D-82229 Seefeld), administered through an arterial line, through the exit point of the inferior polar branch, from the side of the right aorta [Figure 1].

Results

The arteries were designated as AR (renal artery), AR1 (pre-PA), and AR2 (RP-PA) in the left kidney [Figure 2 and Diagram 1], showing the early bifurcation of the renal artery before reaching the hilum area, and in the right one as R1 (renal artery), R2 (superior polar artery), and R3, respectively [Figure 3a and Diagram 2a]. The inferior right polar artery also showed a similar segmentation to that of the main renal artery in the vicinity of the hilum, from which two branches emerged that ran in front of and behind the ureter and renal pelvis in that distal location [Figure 3b and Diagram 2b].

Dissection of the left renal artery showed early branching of the anterior and posterior lobar branches to the renal pelvis [Figure 2].

Instead, dissection of the arteries and renal parenchyma in the right kidney revealed the presence of two anatomical variations: First, the presence of two accessory polar arteries, one superior and one inferior, in the direction of the superior and inferior renal poles, respectively, and on the other, the presence of two communicating vascular arches, not previously described in the literature consulted, one being anterior and the other posterior to the renal pelvis, between the branches coming from the main renal artery, penetrating the renal sinus, and ascending branches

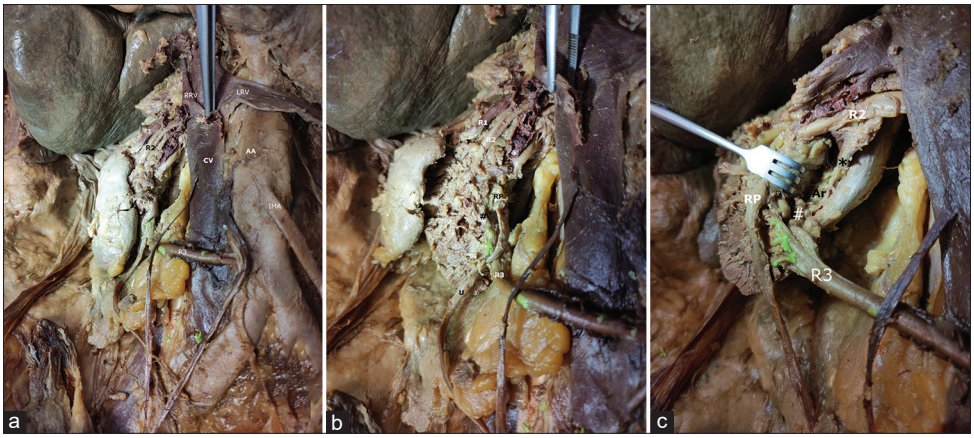

Figure 3: (a) Presence of polar superior, renal, and polar inferior arteries. AA: Aorta artery; IMA: Inferior Mesenteric Artery; CV: Cava Vein; LRV: Left Renal Vein; R1: Right superior polar artery; R2: Renal artery; R3: Inferior polar artery. (b) Presence of pre and retropyelic bifurcation of the inferior polar arteries with description of anastomosis between the prepyelic branches of the main renal artery and the inferior polar artery. R1: Right superior polar artery; R2: Renal artery; R3: Inferior polar artery; U: Ureter; RP: Renal Pelvis; *: Prepyelic branch of the renal artery; # Prepyelic branch of the inferior polar artery. (c) Presence of pre- and retropyelic bifurcation of the inferior polar arteries with description of anastomosis between the prepyelic branches of the main renal artery and the inferior polar artery. R2: Renal artery; R3: Inferior polar artery; U: Ureter; RP: Renal Pelvis *: Retro-pyelic branch of the renal artery; #Retro-pyelic branch of the inferior polar artery; Ar: Vascular Arch between prepyelic branches

of the bifurcation of the lower polar artery [Figure 3b, c and Diagram 2b, c].

Discussion

Anatomical variants related to renal vascularization appear relatively frequently (around 30%), due to the permanence of some of the caudal and cranial mesonephric arteries, which in normal conditions should degenerate, and the complex development of renal formation in the embryonic period.[11,12] Among the anatomical variants, most frequently described by dissection studies is the presence of superior or inferior polar numerary arteries, mainly unilaterally, as described in our case.[13,14]

According to the literature consulted, both in studies of dissection of cadavers and image diagnosis, there is talk of the irrigation of the renal territory being terminal, and even of the presence of two independent vascular territories: One anterior and one posterior, irrigated, respectively, by the PA and RP-pyelic arteries, without the presence of anastomosis between some areas and others. However, in our case, the findings do not correspond to the previous description, due to the presence of a vascular arch that allows anastomosis between the PA and RP-pyelic branches of the renal artery in the right kidney, with similar distribution (anterior and posterior to the pelvis) of the branches derived from the inferior polar artery on the same side.

The knowledge of the renal anatomy and its possible variations is necessary to avoid medical-surgical problems, and its fortuitous presence should raise the need for complete studies, at the vascular level, before any surgical procedure.

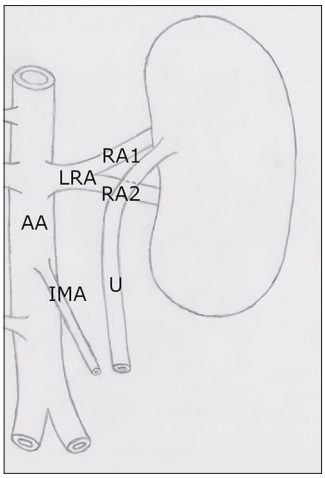

Diagram 1: Early bifurcation of the left renal artery. AA: Aorta artery; IMA: Inferior Mesenteric Artery; CV: Cava Vein; LRV: Left Renal Vein; LRA: Left Renal Artery; RA1: Prepyelic segmentary Artery; RA2: Retro-pyelic segmentary Artery

Conclusion

Vascular surgeons describe that this anatomic variation has a true clinical utility. The connection between both arteries makes it possible to perfuse the whole kidney even if one of them is occluded. This fact makes it possible to embolize one of the arteries without impairing the renal function. In the case of an aortic aneurysm, knowing this fact could be key for the surgical planning. When planning a fenestrated endograft, it is very difficult to deal with double renal arteries, as there is seldom space to stent both of them. In patients with this variation, it is possible to embolize one and revascularize the other, thus preserving the function of the whole kidney.

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Conflicts of interest

There are no conflicts of interest.

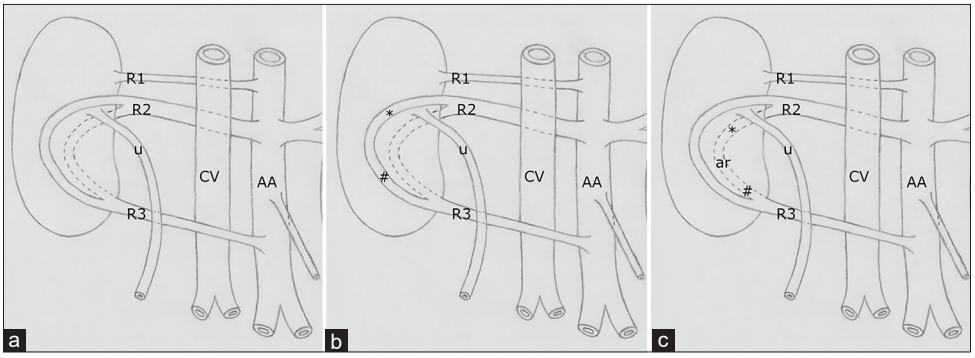

Diagram 2: (a) Presence of polar superior, renal, and polar inferior arteries. AA: Aorta artery; IMA: Inferior Mesenteric Artery; CV: Cava Vein; LRV: Left Renal Vein; R1: Right superior polar artery; R2: Renal artery; R3: Inferior polar artery. (b) Presence of pre and retropyelic bifurcation of the inferior polar arteries with description of anastomosis between the prepyelic branches of the main renal artery and the inferior polar artery. R1: Right superior polar artery; R2: Renal artery; R3: Inferior polar artery; U: Ureter; RP: Renal Pelvis; *: Prepyelic branch of the renal artery; # Prepyelic branch of the inferior polar artery. (c) Presence of pre- and retropyelic bifurcation of the inferior polar arteries with description of anastomosis between the prepyelic branches of the main renal artery and the inferior polar artery. R2: Renal artery; R3: Inferior polar artery; U: Ureter; RP: Renal Pelvis *: Retro-pyelic branch of the renal artery; # Retro-pyelic branch of the inferior polar artery; Ar: Vascular Arch between prepyelic branches

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