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Case Report

A unique perihilar renal vascular variation with fenestrated left renal vein: a case report

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ABSTRACT

Each kidney is supplied by one renal artery and one renal vein which arises as a lateral branch of abdominal aorta and inferior vena cava respectively between the upper and lower margins of the first and second lumbar vertebrae. Here we report a case of fenestrated left renal vein, retro aortic vein and renal artery variation in a left-sided kidney emphasizing clinical, functional, and embryological perspectives of renal vascular variation. Precise knowledge of renal vascular anatomy and its variations are essential to prevent complications during surgical interventions, especially during kidney transplantation.

Keywords: Fenestrated left renal vein, Retro aortic vein, Renal vascular variation, Renal transplantation

INTRODUCTION

Renal vascular variations have gained clinical significance in surgical management during renal transplantation, repair of abdominal aorta aneurysm, urological procedures and for angiographic interventions. Ligation and division of renal vein are also essential for oncological and surgical outcomes.[1] This case report aims to present a rare fenestrated left renal vein with inferior hilar artery passing through fenestration, retro aortic vein as well as peri hilar renal artery variation with compensatory hypertrophy in left kidney in a cadaver with history of right renal cell carcinoma and right nephrectomy. This case report also highlights clinical, functional, and embryological perspectives of renal vascular variations.

CASE REPORT

During routine retroperitoneal dissection for medical students in our department, we observed compensatory hypertrophy of the left kidney with peri hilar vascular variation in a 74-year-old male cadaver. The body was accepted for research after taking consent of the deceased/next of kin which is in accordance with Anatomy Act of India. As per the records, the donor was a case of renal cell carcinoma with right nephrectomy done and cause of death was disseminated metastasis followed by cardio pulmonary arrest. Varied vasculature was observed in formation of renal vein, renal artery, and hilar arrangements. The left kidney was present in normal abdominal quadrants such as epigastric, hypochondriac, lumbar and umbilical regions. It was found to occupy opposite to T10 to L4 vertebral levels. The inferior pole occupied the level of the L4-L5 intervertebral disc. The morphometric measurements such as length, breadth, antero-posterior thickness, and weight were 15 cm, 7.5 cm, and 4.5 cm and 190 gm respectively. The kidney presented with exaggerated hilum where the indentation was deeper than typically seen. The relations of the structures in hilum from anterior to posterior were renal vein, accessory renal artery, renal pelvis, and renal artery (Figure 1).

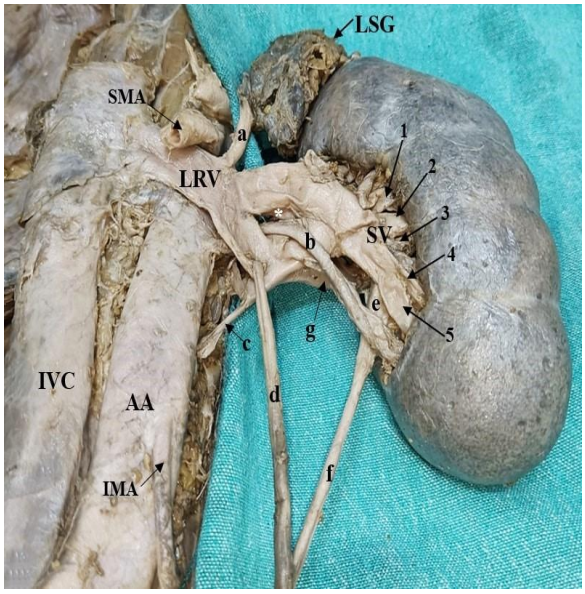

Figure 1: Perihilar renal vascular variation showing fenestrated left renal vein and retro-aortic vein.

IVC: inferior vena cava; AA: abdominal aorta; LRV: left renal vein; LSG: left suprarenal gland; SV: 5 segmental veins; SMA: superior mesenteric artery; IMA: inferior mesenteric artery;*: fenestration of left renal vein; a: left suprarenal vein; b: inferior hilar artery; c: second left lumbar vein;d: left testicular vein; e: renal pelvis; f: ureter g: retroaortic vein.

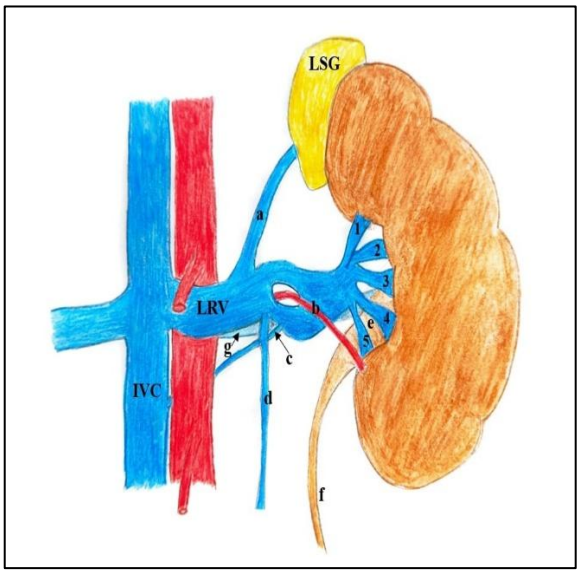

Figure 2: Schematic diagram of left fenestrated renal vein.

IVC: inferior vena cava; LRV: left renal vein;LSG: left suprarenal gland; SV: 5 segmental veins; a:Left suprarenal vein; b: Inferior hilar artery; c: Second left lumbar vein;d: Left testicular vein; e: Renal pelvis; f: Ureter g: Retroaortic vein.

There are two left renal vein variants, one was retro aortic left renal vein passing behind the posterior division of renal artery and aorta to reach IVC, and other was fenestrated left renal vein(FLRV) where five segmental renal veins confluence to form left renal vein where the fenestration was seen with its superior and inferior arms which later united and continued as left main renal vein towards the IVC (Figure 1 and 2). The left testicular vein and second left lumbar vein drained into the inferior arm of fenestration. Left suprarenal vein drained into the main left renal vein. Inferior hilar artery passed through the fenestration (Figure 1 and 2). Medial end of the fenestration was adjacent to the left side of abdominal aorta. The external calibres of superior and inferior arms of left renal vein fenestration were 8.12 mm and 7.78 mm respectively. The length of the left renal vein from its termination to the division of superior and inferior arms was 21 mm. The renal pelvis was sandwiched between the inferior hilar artery, segmental renal veins, anterior division of left renal artery above and posterior division of renal artery below.

The left renal artery originated from the abdominal aorta inferior to the origin of the superior mesenteric artery, and divided 16 mm distance from its origin into two divisions anterior and posterior pre-segmental arteries. The anterior division divided further into two segmental branches which further divided into two branches each in the hilum to reach parenchyma (Figure 3A). The posterior division curved downward and gave 5 segmental branches (Figure3B). Two accessory renal hilar arteries were observed; the superior accessory renal hilar artery originated from aorta above the left main renal artery and reached upper part of hilum. The inferior accessory renal hilar artery passed through the fenestrated left renal vein and above the pelvis to reach the lower part of hilum.

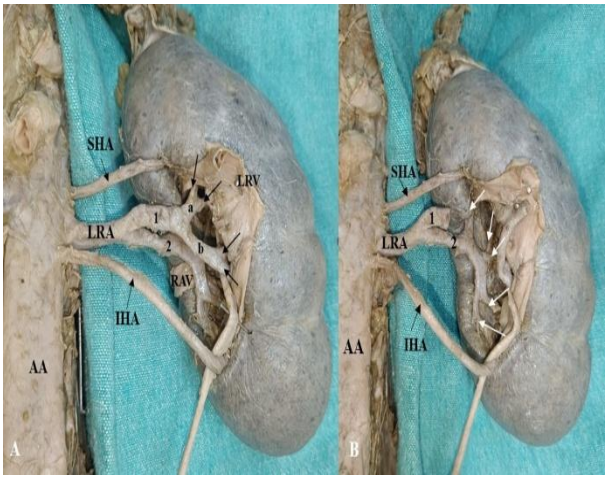

Figure 3A and 3B: renal artery variation showing anterior and posterior pre-segmental arteries.

AA: abdominal aorta; SHA: superior hilar artery; IHA: inferior hilar artery; LRA: left renal artery; LRV: reflected left renal vein; RAV: retroaortic vein (reflected); 1: anterior pre-segmental artery; a and b: anterior segmental arteries (the arrows indicate further division of segmental arteries); 2: posterior pre-segmental artery. Figure 3B: AA: abdominal aorta; SHA: superior hilar artery; IHA: inferior hilar artery; LRA: left renal artery; 1: reflected anterior pre-segmental artery; 2: posterior pre-segmental artery (the arrows indicate 5 segmental branches of posterior pre-segmental artery).

DISCUSSION

The renal dimensions might vary among population of different geographical origin.[2] Normally each kidney is bean shaped with average length of 11 cms, breadth of 6 cms, width of 3 cms with weight of 150 gm and the left kidney 1.5 cm longer than the right.[3] In this case, left renal compensatory hypertrophy and exaggerated hilum is due to the workload following renal cell carcinoma and post right nephrectomy as a physiological response to maintain overall kidney function and glomerular filtration rate. Increased activity by the healthy kidney and release of kidney specific factor initiates compensatory renal hypertrophy.[4]

Fenestration of vessels are rare anatomical variants where the artery or vein splits into two and joins again and continues its course before joining or draining into a vessel. Although sporadic cases have been reported, details of this anatomical variation have not been mentioned in the literature.[5-9] Vascular fenestrations are mostly seen in the arterial system and cerebral vessels, but they can be seen rarely in the venous system.[5]

Renal vascular variations in hilum including origin, course and termination of structures can be attributed to its embryology. The development of renal veins is linked to complex developmental formation of IVC by posterior cardinal veins, the subcardinal veins, and the supracardinal veins are in the order of appearance during early stages of foetal development 7th -10th week of gestation.[10] Renal veins develop from the anastomoses of subcardinal and supracardinal veins.[11] Embryonic kidneys are initially drained by two renal veins, ventral and dorsal vein formed by intersubcardinal anastomosis and postsubcardinal anastomoses ventrally and inter supracardinal anastomosis dorsally. The latter typically degenerates and the ventral vein forms the definitive renal vein.[12] Persistence of dorsal venous limb forms the embryological basis of retroaortic left renal vein, but these developmental processes do not explain the fenestration of left renal vein**.** The persistence and partial fusion of rudimentary venous connections between the posterior cardinal and subcardinal veins are thought to contribute to the development of the segmental veins of the mature kidney, as well as the distal portions of both renal veins.[11,12] In the present case, we hypothesize that the presence of an accessory renal artery may have disrupted the normal fusion of the embryonic circumaortic venous plexus, leading to fenestration of the left renal vein (LRV).

The first reported case of fenestrated left renal vein was by Gundogdu et al where fenestration in the middle part of vein was detected through CT angiography and inferior segmental artery of the left renal artery was passing between the fenestrated segment in male patient who presented with rectal bleeding, and iron deficiency anaemia.[5] Also, a case of left renal vein fenestration with a high origin testicular artery passing through it has also been reported.[6] The prevalence of FLRV reported by Damen et al is 3.34%.[8] In his study, three true FLRV's with a single vein attached at the lateral end and two pseudo-fenestrations, with two veins attached laterally was found. The left suprarenal vein drained into the superior limb of the venous fenestration, while the left gonadal vein drained into the inferior limb. The second left lumbar vein drained into the inferior arms of the fenestrations which was similar to the present case. In one of the cases, the FLRV was traversed by the inferior segmental branch of the renal artery. In previously reported cases, the LRV's fenestration was at a distance on the left side of the aorta.[5,6] Damen et al reported 3/5 cases, the fenestration was immediately on the left side of the aorta which was similar to the present case.[8] The presence of a fenestrated renal vein, particularly when accompanied by an accessory artery or vein, may necessitate modification of the surgical approach and can potentially impact the viability and postoperative outcomes of the donor kidney.

In the present case, retroaortic vein was also seen, where it drains into IVC at orthotopic position. We observed Type 1 in our case report from the most common classification used in literature.[11] Congenital anomalies of the venous system may predispose individuals to renal venous congestion, potentially manifesting as clinical symptoms such as haematuria, flank pain, and pelvic congestion.[11] The left renal vein is often preferred in renal transplantation due to its greater length, making detailed knowledge of its anatomical course particularly whether it follows a pre-aortic path, clinically significant.[13] Awareness of renal vein anomalies is also crucial for the differential diagnosis of retroperitoneal tumors, retroperitoneal lymphadenopathy, and aortic dissection.

The main left renal artery is the artery arising from the abdominal aorta to its initial branching point. The pre-segmental artery is the branch of main renal artery that divides into two or more segmental artery. The segmental arteries are the arteries that enter the renal parenchyma and supply solely a renal segment.[14] Kang et al classified the main renal artery to three types based on the presence and number of pre segmental artery.[15] In each type, the branching patterns were sub grouped according to the number of the segmental artery. He has mentioned a maximum of 5 segmental arteries in classification. In the present study, we found a total of seven segmental arteries. Early branching of the renal artery refers to abdominal aorta approximately 15 mm from the origin of main renal artery ostium.[14] Early division of renal artery was observed in 28.5% in left renal artery as reported by Budhiraja et al.[16] As a result, donors with a perihilar division of the renal artery typically have a shorter vascular pedicle, making anastomosis difficult with the recipient's iliac artery. Therefore, they are usually excluded from renal transplant criteria, since clamping the main renal artery helps reduce bleeding during surgery and provides better control and visibility of the renal hilum for tumour removal.[14-17]

CONCLUSION

Keeping the variations in mind, the surgeons will have to change the standard surgery protocol for renal transplantation and aneurysm resection. A thorough pre-transplant assessment of the donor's kidney is essential to safeguard the well-being of both the donor and the recipient. During the surgical planning stage of a renal transplantation or any other renal interventional procedures, computed tomography (CT) imaging of the renal vascular anatomy plays a crucial role in minimizing the likelihood of intraoperative complications.

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