Case - Kidney donor with aberrant left renal artery takeoff above the diaphragm

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Cite as: Pandith N, Harriman D, Nguan C. Case - Kidney donor with aberrant left renal artery takeoff above the diaphragm. *Can Urol Assoc J* 2026;20(7):E298-300. http://dx.doi.org/10.5489/cuaj.9479

Published online March 16, 2026

INTRODUCTION

Renal artery anomalies are relatively common, with multiple renal arteries occurring in approximately 24% of individuals.[1,2] In contrast, a supradiaphragmatic origin of the renal artery, arising from the thoracic aorta, is rare and mainly documented in case reports.[3,4] Understanding such anomalies is crucial, as renal vascular variations can affect genitourinary upper tract surgery planning, surgical complexity, and in the case of donor nephrectomy, transplant outcomes.[5]

While most reported cases involve the right renal artery, left-sided supradiaphragmatic origins are particularly uncommon.[6] To our knowledge, there are no previous reports describing a left-sided variant in the context of a living kidney donor evaluation. We present a case of a healthy female kidney donor candidate found to have an incidental left renal artery arising from the thoracic aorta, with a retrocrural trajectory and physiologic compression by the diaphragm.

CASE REPORT

A 44-year-old female was referred for evaluation as a living unrelated kidney donor. She was otherwise healthy except for treated hypothyroidism. Her body mass index was 19.5 kg/m², and vital signs were within normal limits on multiple readings. Laboratory testing demonstrated normal serum creatinine of 60–64 µmol/L, confirmed via 99mTc DTPA GFR as 119 mL/min/1.73 m². Differential renal function, measured via 99mTc MAG-3 renogram, was 52% on the left and 48% on the right. Abdominal and pelvic ultrasonography was unremarkable.

A computed tomography (CT) scan of the abdomen and pelvis was performed, confirming normal anthropomorphic dimensions and parenchyma of the kidneys bilaterally, with the right kidney served by the main renal artery measuring 5.2 mm in diameter, with a small 1 mm accessory lower pole renal artery arising 8 mm cranial from the main artery takeoff on the aorta.

The right renal vein measured 2.1 cm and emptied directly into the inferior vena cava without duplication. The left kidney harbored a typical main renal

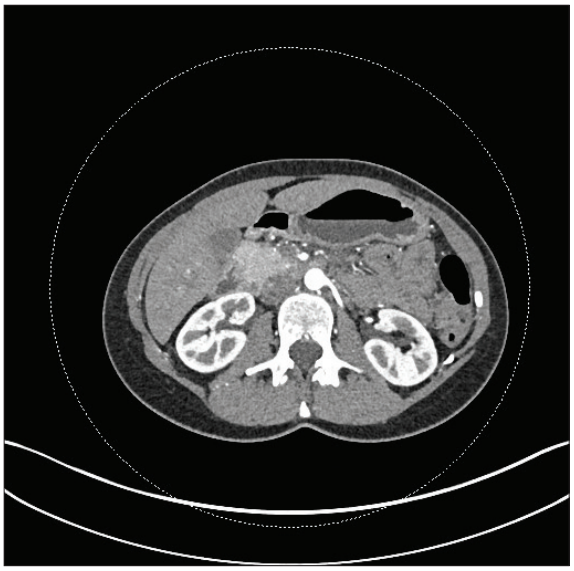

Figure 1A. Normal renal anatomy bilaterally with typical left renal artery origin.

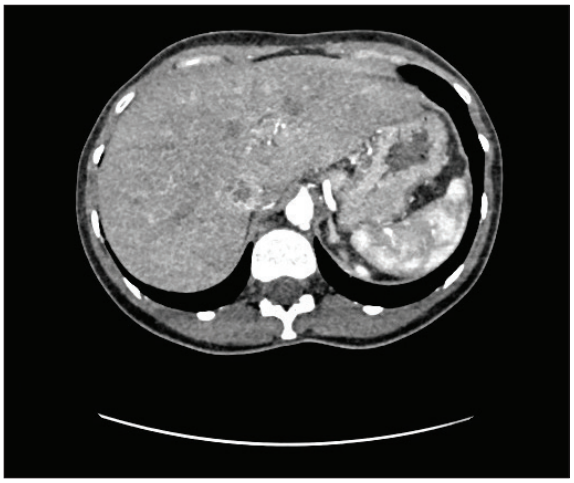

Figure 1B. Supradiaphragmatic origin of codominant left renal artery posterolateral to aorta behind ipsilateral crus of the diaphragm.

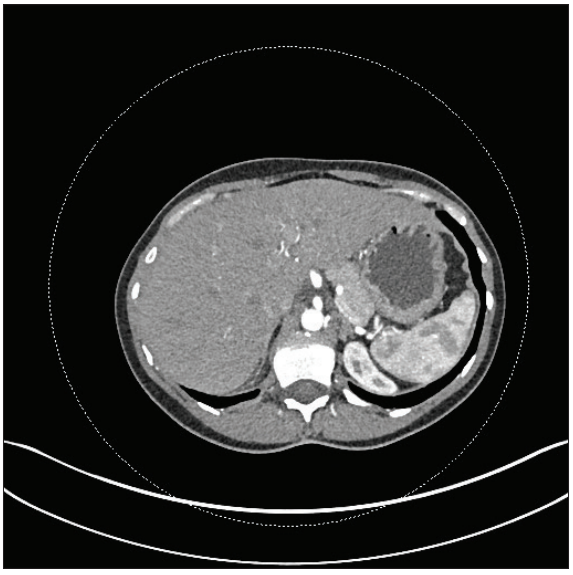

Figure 1C. Compression of supradiaphragmatic left renal artery as it traverses the crus of the diaphragm between the thoracic and abdominal cavities.

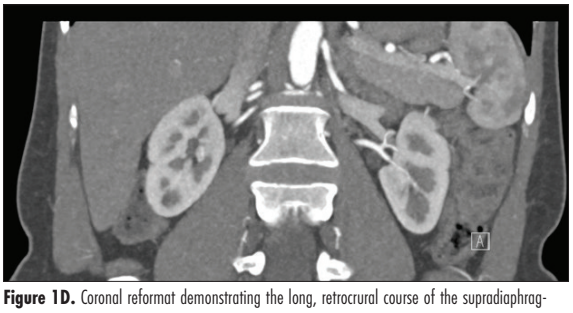

Figure 1D. Coronal reformat demonstrating the long, retrocrural course of the supradiaphragmatic left renal artery to the left kidney. Distal branching of the codominant caudal left renal artery is visible.

artery entering the left kidney just caudal to the main renal vein and measuring 4.2 mm in diameter, with a notable 5.2 mm codominant renal artery entering the left kidney sinus at the level of the superior border of the left renal vein; however, the takeoff and course of the superior vessel was unusual in that its origin on the aorta was 7.8 cm cranial to the caudal renal artery origin, taking off from a posterolateral aspect of Zone 5 of the thoracic aorta, and coursing in a retrocrural fashion to the left kidney, with some compression of the artery between the aorta and the crus of the diaphragm (Figures 1A–E). Due to the complex nature of this patient's vascular anatomy, she was declined as a renal donor but was reassured that this represented a normal variant of anatomy.

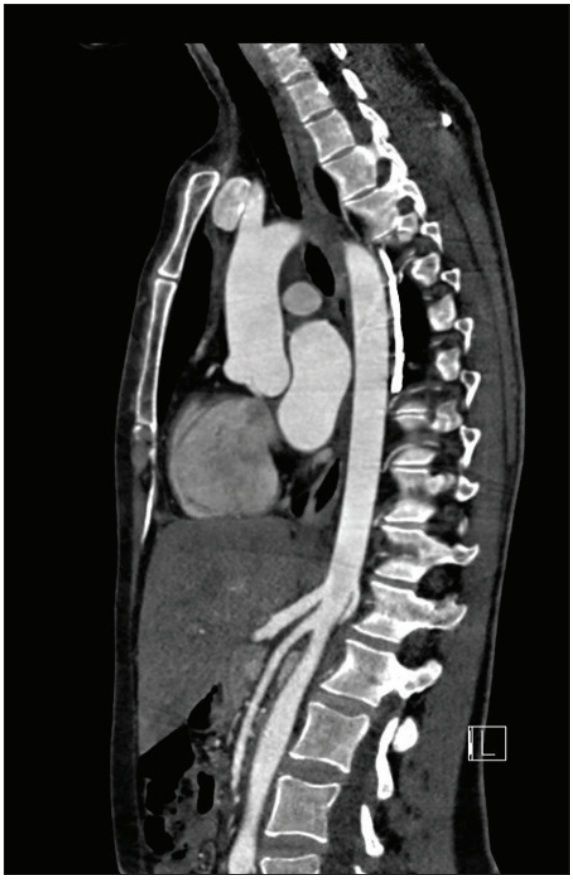

Figure 1E. Sagittal reformat demonstrating the posterolateral origin of the supradiaphragmatic left renal artery.

DISCUSSION

Renal vascular variations are found in up to 51% of individuals undergoing imaging for kidney donor workups.[7,8] Accessory and aberrant renal arteries are the most common variation and are typically considered acceptable if identified preoperatively, except in highly complex vascular configurations.[2,5,8] Early branching and accessory vessels are considered acceptable anatomic variants for donation; however, their presence may increase operative complexity and risk.[9]

Supradiaphragmatic origin of a renal artery, where the vessel arises from the thoracic aorta above the diaphragm, is a rare anomaly. In one of the largest imaging studies available, Taydas et al evaluated 3002 contrast-enhanced magnetic resonance (MR) angiography studies and found only three cases of left-sided supradiaphragmatic renal arteries.[6] Most previously published cases involve the right side.[3,4,10,11] Therefore, the case presented herein adds to the limited literature on left-sided variants and is, to our knowledge, the first identified during living donor workup.

The presence of supradiaphragmatic renal artery takeoff is explained by the embryologic development of renal vasculature. During fetal life, the kidneys ascend from the pelvis to the retroperitoneum after the firth week, during which they are sequentially supplied by transient arterial branches from the dorsal aorta.[12] The developing fetus possesses nine pairs of lateral mesonephric arteries arising from the aorta.[11] The definitive renal arteries typically arise from the middle group of lateral mesonephric arteries around L1–L2.[12] Persistence of the cranial lateral mesonephric arteries or failure of arterial regression during kidney ascent can lead to anomalous renal artery origins, including high thoracic takeoffs.[11]

Although this variant was asymptomatic and incidentally discovered in our patient, its anatomical course has potential clinical implications. Retrocrural arteries may be vulnerable to extrinsic compression by the diaphragmatic crura, which has been associated with renal artery entrapment syndrome, a rare cause of renovascular hypertension and renal involution.[13,14]

From a surgical planning standpoint, the presence of this variant required careful consideration for donor surgery. While the course of the retrocrural artery was long on imaging, the segment safely accessible within the abdomen was not clear, and whether such an artery can be safely mobilized and transected at an acceptable length for vascular anastomosis was uncertain. Currently, there are no published accounts of donor nephrectomy involving a left supradiaphragmatic renal artery, and taking a conservative approach, the patient was declined as a renal donor due to complex anatomy in this case.

If renal donation was to be pursued, alternative renal recovery strategies might be considered in patients with this anatomy. Proceeding with left donor nephrectomy via a minimally invasive surgery approach, with the understanding of potential for increased risk of open conversion, a wholly open surgical approach maximizing the upper abdomen visualization for safety could be proposed.

Another option would be to recover the contralateral right kidney, accepting its shorter renal vein while leaving the more complex left kidney in situ; however, each alternative carries its own set of complexities and donor risk. Given the rarity and poor characterization of a supradiaphragmatic renal artery in living donors, and the uncertainty regarding safe intra-abdominal arterial length, our program prioritized donor safety and elected to decline donation. Retaining the left kidney with this aberrant artery was also judged prudent to avoid possible long-term renovascular complications if it remained as the solitary kidney.

CONCLUSIONS

This case highlights an unusual anatomic variant of renal vascular anatomy that should not be overlooked when surgical planning regarding upper tract manipulation is being considered.

COMPETING INTERESTS: The authors do not report any competing personal or financial interests related to this work.

This paper has been peer-reviewed.

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