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CASE REPORT

Anomalous Direct Drainage of Left Adrenal Vein into Left-sided Inferior Vena Cava Encountered during Adrenal Venous Sampling: a Case Report

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INTRODUCTION

Primary hyperaldosteronism is a potentially curable cause of hypertension with a prevalence of 5% to 15% in unselected hypertensive patients.[1-3] Aldosterone hypersecretion can be unilateral from a hyperfunctioning adenoma (or glandular hyperplasia) or bilateral from idiopathic cortical hyperplasia. Differentiating between the two is essential for patient management as the treatment of choice is open or laparoscopic adrenalectomy for unilateral disease and medical management using a mineralocorticoid receptor antagonist for bilateral disease.[4]

Adrenal venous sampling (AVS) is widely accepted as the diagnostic gold standard for differentiating between unilateral and bilateral disease. However, it is a technically demanding procedure, particularly with cannulation of the right adrenal vein due to its small size, anatomical variants, and potential angiographic mimickers. In contrast, cannulation of the left adrenal vein is considered easier and more straightforward due to its consistent drainage into the left renal vein and lack of anatomical variations.[5] We report a rare case of anomalous direct drainage of the left adrenal vein into a left-sided inferior vena cava (IVC) identified during AVS.

CASE REPORT

A 59-year-old man presented with a 10-year history of hypertension. Primary hyperaldosteronism was suspected due to suboptimal blood pressure control with amlodipine and hydralazine as well as consistent hypokalaemia (lowest potassium level = 2.5 mmol/L). Spot aldosterone-to-renin ratio was elevated to 2219. Saline infusion test was not performed due to a history of myocardial infarction. Contrast-enhanced computed tomography (CT) scan revealed a 1.8-cm nodule at the right adrenal gland with features in keeping with lipid-rich adenoma and mildly thickened left adrenal gland. The patient was referred to our unit for AVS.

A synacthen bolus injection (250 μg) was given immediately prior to AVS as stimulant, followed by continuous infusion of 250 μg of synacthen in 250 mL normal saline at 300 mL/h during AVS.

A 5-F vascular sheath was placed into the right common femoral vein under sonographic guidance. An unusual course of the catheter was observed along the lower part of the IVC where it deviated to the left, raising the suspicion of transposition of the IVC (Figure 1). The right adrenal vein was catheterised successfully using a 4.1-F SHK catheter, with venogram outlining the adenoma

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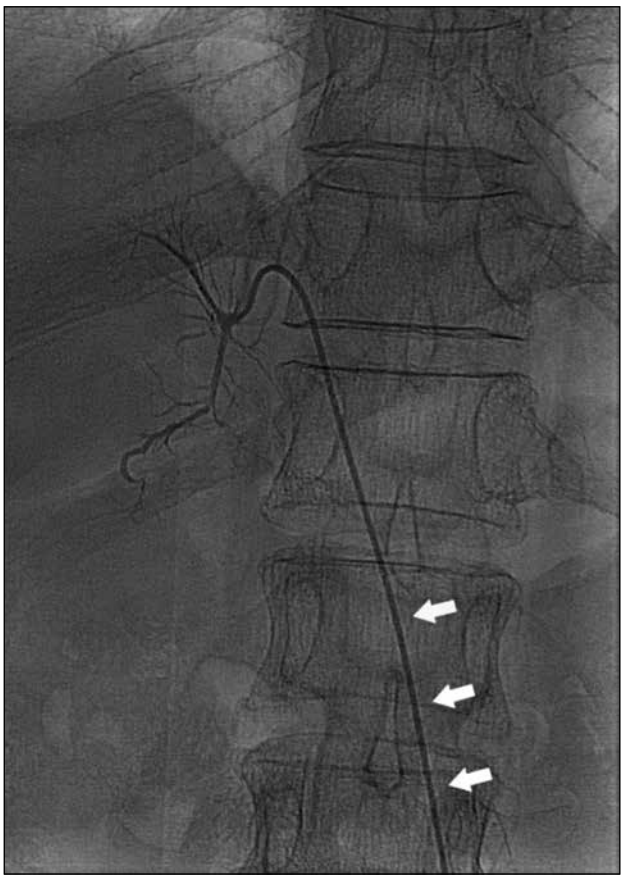

Figure 1. Unsubtracted digital spot image showing an unusual course of the catheter in the inferior vena cava with deviation to the left along its more inferior portion (outlined by thick white arrows), raising the suspicion of transposition of inferior vena cava.

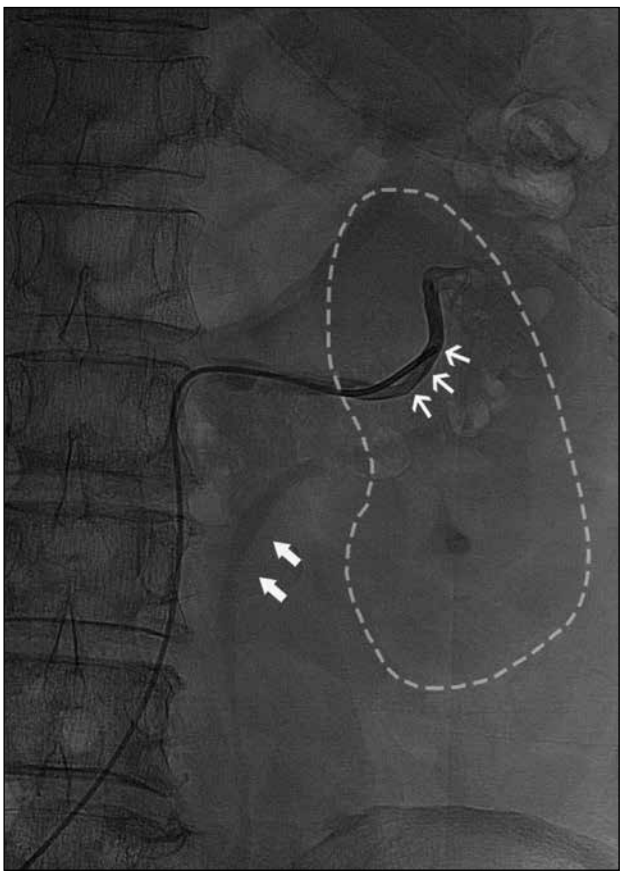

Figure 2. Unsubtracted digital spot image showing cannulation of site A, which is a venous structure (indicated by thin white arrows) located within the renal shadow (outlined by dashed white line). This venous structure is one of the upper renal pole venous tributaries. The left proximal ureter is indicated by thick white arrows.

as a staining defect. Difficulty was encountered during cannulation of the left phrenico-adrenal trunk. By pulling back a 5-F S2 catheter positioned at the peripheral left renal vein, we repeatedly catheterised a cranially pointing venous structure that was more laterally positioned than a normal left phrenico-adrenal trunk, and likely represented an upper pole renal venous tributary (Figure 2). 5 mL of blood was drawn from this location (labelled site A). Due to the difficult cannulation, the preprocedural CT scan was reviewed. Transposition of the IVC was confirmed and a small vessel was seen directly connecting the left adrenal gland and IVC, likely indicating anomalous direct drainage of the left adrenal vein into the IVC (Figure 3). We then switched to a 4.1-F SHK catheter and successfully cannulated this venous trunk that was located superior to the left renal vein and directly draining into the IVC (Figure 4). 5 mL of blood was drawn from this site (labelled site B).

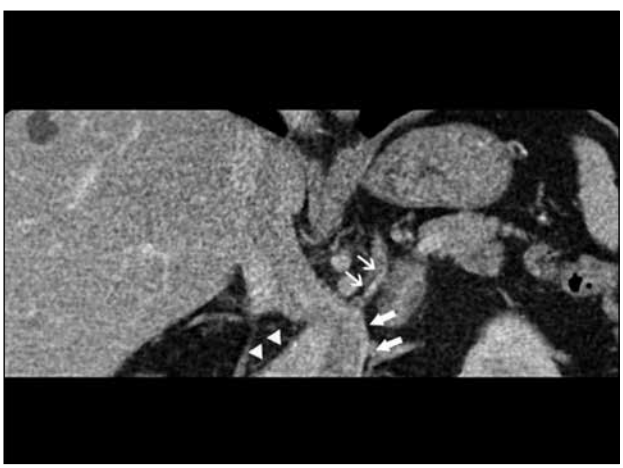

Figure 3. Selected coronal reformatted image of computed tomography showing a venous structure directly draining the left adrenal gland into the inferior vena cava (indicated by thin white arrows), which represents the anomalous left phrenico-adrenal trunk. Transposition of the inferior vena cava was confirmed with its infrarenal course (indicated by thick white arrows) locating left of the abdominal aorta (indicated by white arrowheads).

Biochemical evaluation of samples further proved that site B was the left adrenal vein with a much higher cortisol level obtained (cortisol level of 31,767 nmol/L at site B with an adrenal/peripheral vein cortisol level of 30.0; versus cortisol level of 1120 nmol/L at site A with an adrenal/peripheral vein cortisol level of 1.1). The aldosterone levels from the right and left adrenal vein were 165,000 pmol/L and 23,600 pmol/L, respectively. The aldosterone-to-cortisol ratio was therefore 3.1 on the right side and 0.7 on the left side, with a lateralisation ratio of 4, indicating hypersecretion of aldosterone from a functional nodule in the right adrenal gland. Detailed results are shown in the Table.

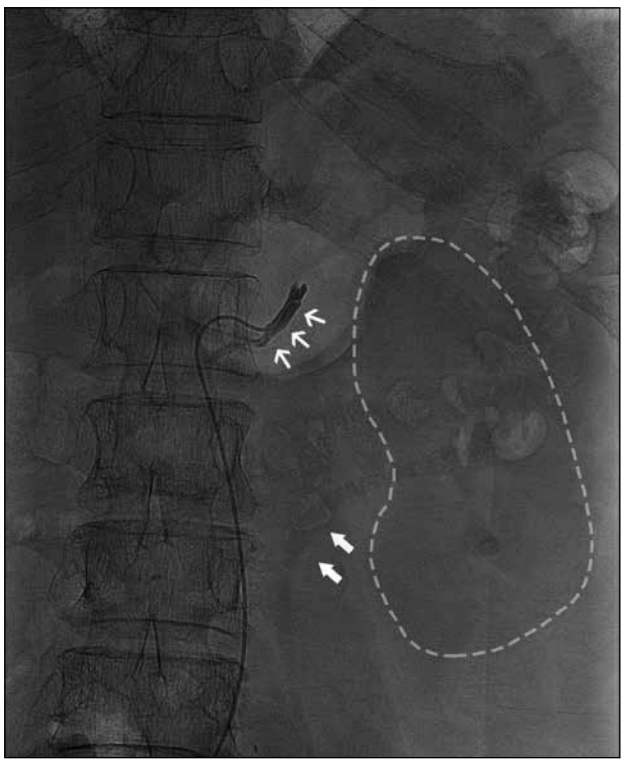

Figure 4. Unsubtracted digital spot image showing cannulation of site B, which is a venous structure directly draining into the inferior vena cava (indicated by thin white arrows), located out of and medial to the renal shadow (outlined by dashed white line). This represents the anomalous left phrenico-adrenal trunk, as confirmed by biochemical results. The left proximal ureter is indicated by thick white arrows.

DISCUSSION

AVS is an important investigation in determining the laterality and subsequent management of patients with primary hyperaldosteronism. A good knowledge of normal anatomy of bilateral adrenal veins and their variations is a prerequisite of successful adrenal venous cannulation and sampling.

The right adrenal vein usually consists of a short trunk and enters the posterolateral wall of the IVC at around the level of T12 vertebra. It has been reported that up to 10% of right adrenal veins enter hepatic venous structures, although this has not been observed in the cohort in our centre (39 examinations) or in another large series in Australia (792 examinations).[5-7] Other variations described include the right adrenal gland being drained by multiple venous branches that may enter the right renal vein, IVC, an inferior hepatic vein or a combination of the above three.[8]

The left adrenal vein normally joins the left inferior phrenic vein to form the phrenico-adrenal trunk that drains into the superior margin of the left renal vein (for the purpose of this article, the phrenico-adrenal trunk will be referred to as the left adrenal vein). Its cannulation is usually easier than the right side due to its longer course and constant anatomy.[5] Only a few rare variants have been described in the literature, often associated with co-existing anomaly of the left renal vein, left kidney or IVC. In patients with a circumaortic left renal vein, the left adrenal vein usually drains to the anterior limb of the circumaortic renal vein. Direct drainage of the left adrenal vein into the IVC has also been reported in patients with retro-aortic left renal vein, left renal ectopia or aplasia, as well as those with transposition of the IVC.[8-11]

Transposition of the IVC, also known as left-sided IVC, refers to a variant course of the IVC where its

Table. Adrenal venous sampling laboratory results.

	Right	Left (site A)	Left (site B)	Peripheral vein
Aldosterone (pmol/L)	165,000	Not performed*	23,600	1990
Cortisol (nmol/L)	53,668	1120	31,767	1058
Cortisol-corrected aldosterone ratio	3.1	Not performed*	0.7	1.9
Adrenal/peripheral vein cortisol ratio	50.7	1.1	30.0	Not applicable

* Aldosterone assay was not performed for the venous sample at site A as the ratio of adrenal-to–inferior vena cava cortisol level did not exceed 1.1, indicating unsuccessful cannulation.

infrarenal course is located to the left of the abdominal aorta. It typically joins the left renal vein and crosses the abdominal aorta anteriorly, uniting with the right renal vein to form a normal right-sided infrahepatic IVC. Embryologically, it results from the regression from the right supracardinal vein with the persistence of left supracardinal vein.[12] Since development of the adrenal-renal vein complex is closely related to embryogenesis of the IVC it is perhaps not surprising that left adrenal vein anomaly is associated with variant IVC anatomy. In our patient, a left-sided IVC was suspected due to the unusual leftward course of the catheter in the lower abdomen that was confirmed upon retrospective review of the preprocedural CT scan.

Our case highlights the value of preprocedural CT scan in AVS. CT imaging has been traditionally described to help identify the right adrenal vein and facilitate planning of the procedure. On a similar note, although left adrenal venous anatomy is constant in most cases, it is important to look for variant anatomy of the left renal vein and IVC in the CT images. The presence of rare variant anatomy may suggest a more challenging catheterisation of the left adrenal vein and may require an alternative approach and catheter. In our patient, we were able to confidently identify the course of the left adrenal vein with direct drainage into the left-sided IVC using the coronal reformatted images from the preprocedural CT scan. This allowed us to switch to an appropriate catheter that ensured successful cannulation of the left adrenal vein.

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