Interventional Radiology

Anomalous adrenal vein anatomy complicating the evaluation of primary hyperaldosteronism

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ABSTRACT

Adrenal vein development in utero occurs concurrently with the development of the inferior vena cava, the renal veins, and the gonadal veins. The embryologic formation of these veins involves communication of various venous systems. Although the left adrenal-renal vein complex is most commonly described as a shared emptying of the left adrenal vein and the left inferior phrenic vein into the left renal vein, there have been reports of numerous anatomic variations of this complex. In this report, we present a case of a rare variant of the left adrenal vein, in which the left adrenal vein empties into the left gonadal vein, which takes an atypical course superolateral to the left kidney. Knowledge of the anomalies of the adrenal-renal vein complex can help radiologists and surgeons in the recognition and protection of these veins during procedures of the abdomen and the pelvis.

Case

A 58-year-old Caucasian woman with no significant medical history presented to a tertiary care facility with new-onset hypertension. This condition had been discovered during visits to a podiatrist for an unrelated complaint. After monitoring at home, the patient was found to consistently have blood pressures of
150-160 and 90-100 despite exercise, adhering to a low-sodium diet and limiting caffeine intake. The patient was initiated on therapy with lisinopril 10 mg daily, which was increased incrementally to 40 mg daily with hydrochlorothiazide 12.5 mg over the course of 8 weeks, at which time the therapy was changed to amlodipine 5 mg daily with losartan, given the presence of a cough. The patient was also started on potassium supplementation due to hypokalemia (potassium level of 2.9 mmol/L). The serum aldosterone level was within normal limits at 15 ng/dL, the plasma renin activity was low at 0.23 ng/mL/h, and the aldosterone-to-plasma renin activity ratio was elevated at 65.2. A sodium suppression test was indicative of primary hyperaldosteronism. A computed tomography of the abdomen was then performed, which showed a 1.5-cm left adrenal mass with an absolute washout greater than 60% and a relative washout greater than 40%, consistent with an adrenal adenoma. A cortisol suppression test and subsequent adrenal vein sampling were performed, which lateralized aldosterone hypersecretion to the left adrenal gland (aldosterone levels of 4700 ng/dL on the left compared with 63 ng/dL on the right and 50 ng/dL in the inferior vena cava [IVC]). As one might expect, a sample obtained using a microcatheter directly into the vein communicating with the draining gonadal vein had a reduced aldosterone level at 345 ng/dL. Together, these findings confirmed the presence of a primary hyperaldosteronism in the setting of a functioning left adrenal adenoma, although if the variant had not been identified, this diagnosis might have been missed altogether.

The patient went for a subsequent left retroperitoneoscopic adrenalectomy, which took place without complication. Post procedure, the patient’s blood pressure improved, such that she was discharged on only 1 antihypertensive medication. A final diagnosis of an adrenal cortical adenoma was found on surgical pathology. Three months later, all antihypertensives were discontinued and the patient was found to have a blood pressure within normal limits.

**Discussion**

The adrenal-renal vein complex arises via a complex series of development, anastomosis, regression, and replacement of various venous systems [1]. This process begins in early development at which time the paired subcardinal, supracardinal, and inferior cardinal veins form an anastomotic net. From this net arise the paired renal, adrenal, and gonadal veins [1,3]. The suprarenal veins, in particular, arise from both the subcardinal vein proximal to the IVC and the inferior cardinal vein more distal to the IVC [3]. This complicated embryogenesis of the adrenal veins occurs concurrently with that of the gonadal and renal veins, which contributes to adrenal vein variations and their relationship with the gonadal and renal veins [1].

The left adrenal vein most commonly originates at the hilum of the left adrenal gland and travels inferomedially, connecting with the left inferior phrenic vein, to drain into the superior border of the left renal vein. Adrenal vein variants include the left adrenal vein entering the renal vein without receiving the inferior phrenic nerve, the bifid left adrenal vein, the double adrenal veins, the left adrenal vein joined by one of the duplicated gonadal veins, the adrenal vein draining directly into the IVC, the adrenal vein receiving gonadal and second lumbar before draining into the renal vein, and the 2 inferior phrenic veins merging with left adrenal vein [1,2]. The variant described in our patient may be a remnant of the embryonic inferior cardinal venous system. A failure of regression of its communication with the median sacral vein might have resulted in this anomalous branching pattern.

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Knowledge of adrenal and gonadal vein variants is important for the surgeon and the interventional radiologist. For the surgeon, this knowledge might be significant in assessing bleeding risk during an abdominal procedure. During left adrenalectomy in this patient, the left adrenal vein branches, including this gonadal vein, were clipped with no adverse effect (Figs. 1 and 2). For the interventional radiologist, knowledge of variants can aid in accurate technique during an adrenal vein sampling procedure. In addition, in the male patient with a varicocele, knowing this variant can assist in the timely identification of the gonadal vein for embolization.

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Fig. 1 – Digital imaging during contrast injection into the origin of the left adrenal vein (white arrow) demonstrating an aberrant vein (black arrow) coursing lateral and then superior to the left kidney and draining in the adrenal vein, demonstrated on prolonged injection to represent the gonadal vein. The left adrenal vein shares a common origin with the left L2 lumbar vein (blue arrow).

Fig. 2 – Digital imaging of the pelvis performed during contrast injection into the origin of the left adrenal vein demonstrating an opacification of the left gonadal vein (white arrow).

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