Comparison of the Central Adrenal Vein and the Common Trunk of the Left Adrenal Vein for Adrenal Venous Sampling

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ABSTRACT

Purpose: To compare left adrenal venous sampling (AVS) in two locations: the central adrenal vein and the common trunk.

Materials and Methods: A total of 22 patients (12 men and 10 women; mean age, 50 y; range, 26–65 y) who were suspected of having primary aldosteronism (PA) and underwent successful AVS with cortisol concentration measurement and/or venography between November 2010 and August 2011 were retrospectively analyzed. In regard to the left adrenal vein, collections were done at two locations: at the common trunk below the confluence of the inferior phrenic vein and at the central adrenal vein, which was above the confluence. The effects of the inflow from the inferior phrenic vein on plasma aldosterone and cortisol levels were analyzed.

Results: Eight patients had bilateral hypersecreting lesions and 13 had a unilateral lesion. One was diagnosed as having secondary hypertension other than PA. The median cortisol levels below and above the confluence were 129 μg/dL (range, 21–400 μg/dL) and 215 μg/dL (range, 21–690 μg/dL), respectively. The median aldosterone levels were 2,120 pg/mL (range, 164–42,700 pg/mL) and 4,275 pg/mL (range, 119–59,000 pg/mL), respectively. The median aldosterone/cortisol (A/C) ratios were 244 (range, 34–2,401) and 278 (range, 25–2,251), respectively. Cortisol and aldosterone levels were significantly higher above the confluence ($P = .0050$ and $P = .0003$, respectively), whereas the A/C ratio showed no significant difference ($P = .12$).

Conclusions: Although higher levels of cortisol and aldosterone were obtained upstream, A/C ratio was not significantly different between the central adrenal vein and the common trunk.

ABBREVIATIONS

A/C = aldosterone/cortisol, ACTH = adrenocorticotropic hormone, APA = aldosterone-producing adenoma, AVS = adrenal venous sampling, IHA = idiopathic hyperaldosteronism, IVC = inferior vena cava, PA = primary aldosteronism

It has been reported that approximately 3%–10% of hypertension is a result of primary aldosteronism (PA) (1–4). The most common two subtypes of PA are aldosterone-producing adenoma (APA) and bilateral idiopathic hyperaldosteronism (IHA) (5).

When PA has been confirmed, determining whether one or both adrenal glands produce excess aldosterone is the next important procedure to help guide management of hypertension. Unilateral laparoscopic adrenalectomy is an excellent treatment option for patients with APA or unilateral hyperplasia: blood pressure control improves in nearly 100% of patients postoperatively, and average long-term cure rates of hypertension after unilateral adrenalectomy for APA range from 30% to 60% (1).

Although computed tomography (CT), magnetic resonance (MR) imaging, and scintigraphy can provide information about the presence of a nodule or enlargement of the adrenal gland, in many cases, they may show normal-appearing adrenal glands, minimal unilateral adrenal limb thickening, unilateral microadenomas (≤ 1 cm), or bilateral macroadenomas. Several studies have found that CT contributes little to confirm lateralization in patients with PA, and that adrenal venous sampling (AVS) is essential to choose appropriate therapy in patients who have a high

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probability of APA and CT findings of unilateral adrenal limb thickening (1,5–7).

With respect to the sampling method of the right adrenal vein, many arguments have been made to explain its difficulty (8–10). On the contrary, there have been few reports about the method of sampling from the left adrenal vein (6,11). Because the left inferior phrenic vein joins the left adrenal vein in the majority of cases (8,12,13), this effluence may cause dilution and fluctuation of hormone levels. There are reports of blood collected upstream of the confluence (4) and in the lower stream (11), and the appropriate location for blood collection has not yet been established.

The present study was designed to examine the effect on AVS of the dilution caused by the inflow of the left inferior phrenic vein.

MATERIALS AND METHODS

Patient Selection

A total of 25 consecutive patients who were referred for suspected PA and underwent AVS at our institution or an associated facility from November 2010 to August 2011 was selected. Each patient underwent one or two confirmatory tests for aldosterone excess according to the guidelines of the Japanese Endocrine Society and Japanese Society of Hypertension: an oral sodium test, saline solution infusion test, captopril challenge test, and furosemide plus upright test. When PA had been confirmed, patients were referred to the radiology department for AVS. In the meanwhile, an enhanced CT scan was performed to detect the adrenal veins as well as to screen the adrenal glands (4,14). Three patients were excluded from the study because of unsuccessful blood sampling from the adrenal vein, leaving 22 patients (12 men and 10 women; mean age, 50 y ± 12) eligible for the present study.

Our institutional review board approved retrospective data collection and analysis for this research, and informed patient consent was waived.

AVS Procedures

The patients were prepared from a pharmacologic standpoint by stopping diuretic agents, β-blockers, angiotensin-converting enzyme inhibitors, and angiotensin II receptor blockers for at least 2 weeks before AVS and stopping mineralocorticoid receptor antagonists for at least 6 weeks before AVS, as previously reported (4,15,16). Patients who could not be left untreated for clinical reasons were allowed to take α-blockers and/or a calcium channel blocker. Patients first signed an informed consent form that described the AVS procedure and its predictable complications such as groin hematoma, adrenal hemorrhage, thrombosis, and risk of nondiagnostic test results.

AVS was performed by three interventional radiologists (A.T., K.S., and Y.M.) with 11, 13, and 14 years of experience, respectively, and experience with at least 30 AVS cases each. Each operator performed AVS according to the technique and protocols described here.

Procedures were performed under local anesthesia. A 5-F sheath was inserted through the percutaneous femoral vein approach. Blood was obtained from the inferior vena cava (IVC) below the confluence of the renal veins by using the sheath or a 5-F catheter.

A 5-F reverse-curve catheter (LRA; Terumo–Clinical Supply, Gifu, Japan) was inserted into the left adrenal vein, and then venography was performed to confirm the confluence of the central adrenal vein and the left inferior phrenic vein, followed by sampling of blood at the common trunk, which is between the confluence of these veins and the orifice of the adrenal vein at the left renal vein. When the confluence of the left phrenic vein was not well identified or, in rare cases, the left adrenal and inferior phrenic veins entered the left renal vein separately, sampling was performed at the common trunk just above the orifice at the left renal vein. Subsequently, a high-flow–type microcatheter (Renegade Hi-Flo; Boston Scientific, Natick, Massachusetts) was inserted beyond the confluence of the inferior phrenic vein to reach the central adrenal vein, followed by venographic confirmation that the tip of the catheter had been placed proximal to the division of the lateral branch of the left adrenal vein (4). Blood was then collected there (**Fig 1**).

Finally a 4- or 5-F reverse-curve catheter or one with a steep curve on its tip (CJ1, RH, and RRA catheters; Terumo–Clinical Supply) was inserted into the right adrenal vein, followed by venographic confirmation, and blood was collected. When drawing blood was difficult through the 4- or 5-F catheter, a microcatheter was also inserted into the right adrenal vein. One sample was obtained from each vein in one AVS procedure, and blood was aspirated by gentle slow suction to avoid adrenal venous dilution.

The plasma aldosterone and cortisol levels of each vein were measured. In the early cases during the study period, adrenocorticotropic hormone (ACTH) stimulation was not performed, and ACTH stimulation was omitted in some cases with excessively autonomous aldosterone secretion based on review with endocrinologists.

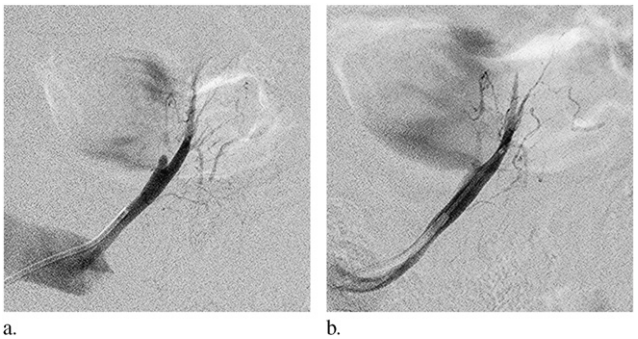

Figure 1. **(a)** Venogram of common trunk of left adrenal vein with a 5-F catheter. **(b)** A microcatheter is inserted into the central adrenal vein beyond the confluence of the left inferior phrenic vein.