

## Case Report

# Renal Artery Aneurysm Due to Fenestration of a Branch of the Renal Artery: A Case Study

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**Abbreviations:** BP, blood pressure; CT, computed tomography; DTPA, diethyl-enetriamine-pentaacetic acid; eGFR, estimated glomerular filtration rate; PAC, plasma aldosterone concentration; PRA, plasma renin activity; RAA, renal artery aneurysm.

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## Abstract

Artery fenestration is a congenital vascular malformation, often of the intracranial arteries, that causes an aneurysm. However, there have been no reports of artery fenestration causing renal aneurysm. We present the case of a 58-year-old man who developed renin-dependent hypertension. He was aware of heaviness of the head, and his blood pressure was 196/134 mm Hg on 5 mg of amlodipine. Laboratory tests showed hypokalemia, hyperreninemia, and hyperaldosteronemia. An enhanced 3-dimensional computed tomography scan showed a 19-mm renal aneurysm in a branch of the left renal artery, and renal arteriography showed a fenestration in the aneurysm-forming branch. Coil embolization was performed on the central side of the artery forming the aneurysm and fenestration, after which blood pressure, serum potassium, and plasma renin levels improved. The patient in the present case had renin-dependent hypertension as a result of decreased renal blood flow caused by the renal aneurysm and fenestration, which is considered an extremely rare etiology of hypertension.

**Key Words:** renal artery aneurysm, renovascular hypertension, renin activity, fenestration

Renal artery aneurysm (RAA) is a rare entity, with an incidence ranging between 0.01% and 0.09% reported on autopsy [1] and 0.7% detected incidentally on computed tomography (CT) scan [2]. The majority of RAAs have been

reported in women as complications of fibromuscular dysplasia [3]. However, there are limited reports on the causes of RAA. Herein, we describe the case of a 58-year-old man with renin-dependent hypertension associated with RAA

due to fenestration of the left renal artery that was resolved with coil embolization of the artery.

## 1. Case Report

A 58-year-old man was referred to our hospital because of severe hypertension. He had been diagnosed with hypertension and dyslipidemia at age 48 years and had been taking 5 mg of amlodipine and 2.5 mg of rosuvastatin daily. He was not obese and did not smoke. There was no past history of trauma or renal disease, or family history of hypertension.

His head had felt heavy, and he had staggered on trying to walk several days ago. Therefore, he had gone to a nearby hospital, where his blood pressure (BP) had been found to be 196/134 mm Hg. No bruits were audible in the abdomen. On physical examination, he was not found to have edema or any other relevant clinical findings. There was no protein or blood in the urine test. Laboratory examination showed that serum potassium levels were 3.0 mEq/L, plasma renin activity (PRA) 19.2 ng/mL/h (reference range, 0.3-2.9 ng/mL/h), and plasma aldosterone concentration (PAC) was 405 pg/mL (reference range, 35.7-240 pg/mL). The captopril challenging test was performed, and the results were as follows: at rest, the PRA was 15.9 ng/mL/h and the BP was 148/98 mm Hg. One hour after oral administration of 50 mg of captopril, the PRA increased to 75.1 ng/mL/h and the BP decreased to 112/63 mm Hg.

Renal echography showed that the right kidney was 118 mm in size and the left kidney was 115 mm in size. The flow velocity of the right renal artery was 73 cm/s, and the velocity of the left renal artery was 492 cm/s. Enhanced 3-dimensional CT revealed a solitary left RAA that was 19 × 16 mm in size. The renal parenchyma in the area supplied by the aneurysm showed time delay after contrast injection. No aneurysms were found in other arteries of the abdominal cavity. The estimated glomerular filtration rate (eGFR) measured by <sup>99m</sup>Tc-diethyl-enetriamine-pentaacetic acid (DTPA) renal scintigraphy was 45.5 mL/min in the left kidney and 53.9 mL/min in the right kidney, and there was no apparent delayed excretion in either kidney. Selective renal vein renin activity sampling was performed. The PRA in the right renal vein was 10.3 ng/mL/h, and the PRA in the left renal vein was 51.8 ng/mL/h.

Renal angiography revealed an aneurysm and fenestration in the left renal artery branch. Coil embolization (packing and isolation) was performed for the left renal aneurysm (Fig. 1). One week after endovascular therapy, the patient's PRA was 23.9 ng/mL/h, and PAC was 309 pg/mL; however, his BP was 127 to 133/80 to 88 mm Hg on 10 mg of amlodipine and 2 mg of doxazosine.

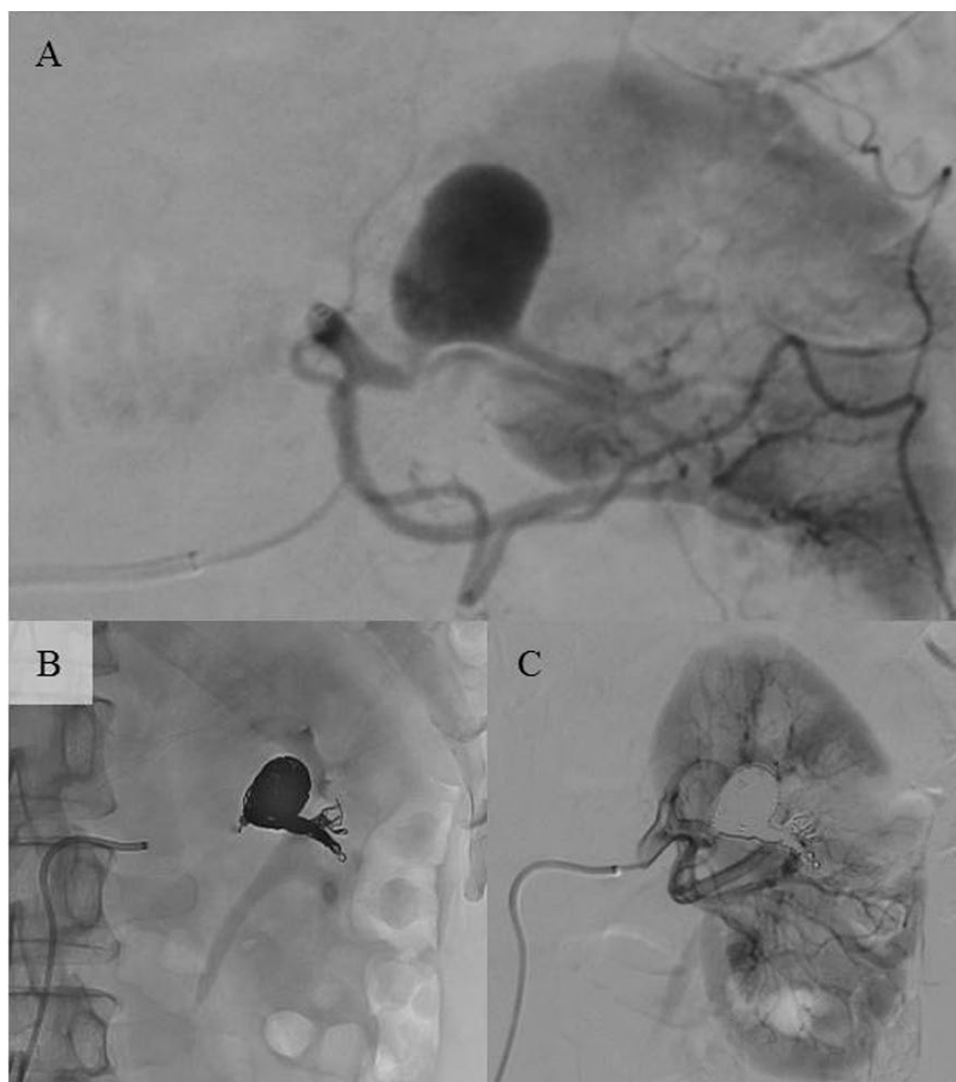
Two years after coil embolization, his BP was well controlled with 5 mg oral amlodipine (office BP, 113/75 mm Hg; home BP 114-125/69-73 mm Hg). In addition, laboratory tests showed the following: serum potassium levels, 4.0 mEq/L; PRA, 2.1 ng/mL/h; and PAC, 183 pg/mL. His eGFR was 41.2 mL/min in the left kidney and 47.6 mL/min in the right kidney on <sup>99m</sup>Tc-DTPA renal scintigraphy.

## 2. Discussion

We encountered a case of renin-dependent hypertension caused by an RAA due to fenestration of the ventral branch of the left renal artery. The central artery forming the aneurysm and fenestration was embolized, following which the patient's BP was well controlled; his PRA was elevated once postoperatively, but then PRA and serum potassium levels improved.

Artery fenestration is a congenital arterial malformation in which a segment of a single vessel divides into at least 2 channels, each comprising endothelial and muscular layers that coalesce to form a single lumen along its more distal course [4]. Arterial fenestration is mainly found in the cerebral arteries, but fenestration of the abdominal artery is very rarely found. Congenital weakness of the wall of the fenestrated arterial segment and hemodynamic stress at the origin of the fenestrated segment are both considered to play important roles in the formation of the aneurysm. Generally, most causes of RAAs are highly correlated with fibromuscular dysplasia [3]. In this case, angiography revealed no characteristic bead-shaped vascular abnormalities, and no vascular abnormalities suggestive of fibromuscular dysplasia were observed. There was no atherosclerosis or complications of infection or autoimmune disease. Therefore, fenestration was suspected to be the contributing cause of the aneurysm.

Surgical options for RAA are either open surgery or endovascular treatment. The indications for RAA intervention include size greater than 2 cm, women of childbearing age, symptoms like pain, hematuria, and refractory hypertension associated with renal artery stenosis, thromboembolism, and rupture [2, 3, 5]. Approximately 70% of patients with RAA have hypertension [3]. The mechanism of hypertension associated with RAA is renin dependent. Measuring PRA is important in patients with hypertension and RAA to assess the presence or absence of complications of renal vascular stenosis with RAA and the improvement of renin-dependent hypertension after treatment. Down et al reported computational fluid studies that modeled renal flow for renal aneurysms [6]. The pressure of the aneurysm wall deforms and creates a force that obstructs the renal artery. This results in a decrease in renal artery pressure and is demonstrated to



**Figure 1.** Renal arteriography and coil embolization. A, Branching centrally from the aneurysm, the cephalic branch with the aneurysm and the caudal branch run together and rejoin at the periphery. (Fenestration) B, Coil embolization was performed in the caudal branch, cephalic branch, and aneurysm. C, The contrast effect in the renal parenchyma area, supplied by the coil-embolized renal arteries, is deficient.

induce renin-dependent hypertension. A saccular aneurysm located in a renal arterial branch leads to a risk of occlusion and stenosis to that branch, so an approach to both the arterial branch and the aneurysm is necessary.

In this case, residual artery fenestration could have led to inadequate treatment of renal vascular hypertension and the formation of a new renal aneurysm from one of the branches at a later date. Therefore, coil embolization was performed on the central side including the fenestration and renin-dependent hypertension improved after the operation.

There are a lot of studies about RAAs, but to the best of our knowledge, there have been no case reports of renal aneurysms due to renal artery fenestration or with concomitant renovascular hypertension. The pathogenesis of

hypertension here is renin dependent, and it is important to measure PRA, PAC, and serum potassium levels before and after treatment.

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### Additional Information

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**Data Availability:** Data sharing is not applicable to this article because no data sets were generated or analyzed during the present study.

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