

# Bilateral Renal Artery Aneurysm: Percutaneous Treatment with Stent-Graft Placement

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## Abstract

A 51-year-old man with an 8-year history of hypertension (170/115 mmHg with two drugs) and altered renal function (5.6 mg/dl serum creatinine, 101 mg/dl BUN) was referred to our Department to evaluate the renal arteries and rule out renovascular hypertension. Doppler ultrasound and magnetic resonance angiography revealed significant bilateral renal artery stenosis and the presence of bilateral renal artery aneurysms. A self-expandable polytetrafluoroethylene (PTFE)-covered nitinol stent-graft was deployed in each renal artery to treat the stenoses and to exclude the aneurysm. Postprocedural digital subtraction angiography confirmed the resolution of the renal artery stenoses and the complete exclusion of the aneurysms. At the 6 month follow-up, color Doppler confirmed normal patency of the renal arteries with complete exclusion of the aneurysms and significant reduction of the blood pressure (130/85 mmHg with one drug) and serum creatinine levels (2.1 mg/dl).

**Key words:** Aneurysm—renal/Hypertension—renovascular/Renal arteries—fibrodysplasia/Stents and prostheses

Renal artery stenosis is quite common but renovascular hypertension occurs in only 1–5% of all patients with high blood pressure [1, 2, 2]. Renovascular hypertension can be caused by fibromuscular hyperplasia or by atherosclerosis. Fibromuscular hyperplasia predominates in young women whereas atherosclerosis is encountered more often in individuals over the age of 55 years. Atherosclerosis has a reported incidence of approximately 90% of all renovascular lesions [3]; the stenosis causing hypertension and kidney hypoperfusion can evolve in the long term to renal failure in 5–15% of adult patients who begin dialysis yearly [4, 5]. Renal artery aneurysm (RAA) accounts for 22% of all visceral aneurysms, with a reported incidence of 0.015–1.32% [6–8]; it is usually related to fibromuscular dysplasia or atherosclerosis. The most common symptom is hypertension [8]. Indications for treatment of RAA are a size greater than 2.0–2.5 cm, with progressive enlargement or with a dissection. Indications also include pain, hematuria, intrarenal distal embolization or evolution of renal failure [9–12]. Traditionally RAAs are treated by surgical repair or nephrectomy, although there are few reported cases of their percutaneous treatment [9–13]. To our knowledge there are no reports of bilateral percutaneous endovascular treatment of RAAs associ-

ated with bilateral fibromuscular stenosis. We describe the use of an expanded polytetrafluoroethylene (ePTFE)-covered stent (Symbiot, Boston Scientific) in the treatment of bilateral RAAs associated with bilateral fibromuscular dysplastic stenosis and renovascular hypertension in a patient with a critical renal condition.

## Case Report

A 51-year-old man complaining of backache and an 8-year history of hypertension that was relatively well controlled with metoprolol and verapamil hydrochloride, was referred to our Department to evaluate a suspected renal artery stenosis causing renal hypertension. Chronic renal failure had been previously demonstrated by renal biopsy. He denied hematuria, history of trauma or surgery. The patient had no risk factors for atherosclerosis. The physical examination was unremarkable and no abdominal bruits were auscultated.

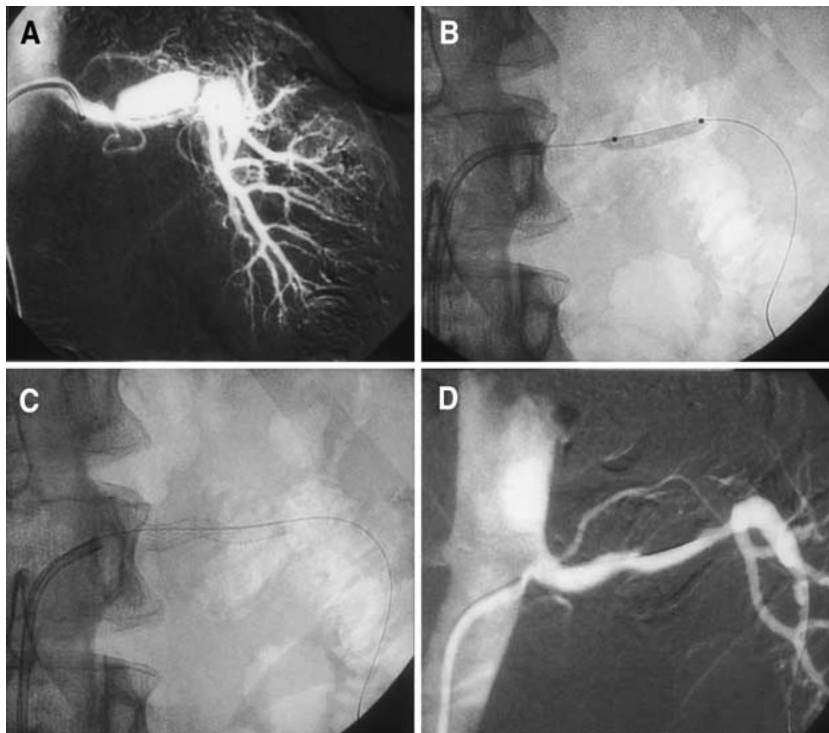
On admission his blood pressure was 170/115 mmHg. Laboratory results showed a serum creatinine level of 5.6 mg/dl and BUN of 101 mg/dl; his renin serum level was high (26.40 ng/ml per hour). The other laboratory parameters were normal. Renal scintigraphy, performed with the use of the captopril test, showed a severe reduction of bilateral filtration with a biphasic curve with a glomerular filtration rate (GFR) of 27.8 ml/ml suggestive of bilateral stenosis. Laboratory tests and scintigraphy showed a critical renal condition that in the long term could have evolved into renal failure and ultimately the need for dialysis.

Color Doppler ultrasound confirmed bilateral parenchymal rate cortex-medulla reduction with a thin cortical area, especially in the right kidney which was slightly smaller than the left (maximum longitudinal length 6.5 cm and 9 cm respectively for the right and left kidneys). The color Doppler evaluation showed a bilateral increase in peak velocity and a slow rise of the wave form (plated pulse) suggesting significant stenosis, with bilateral dilatation at the median and distal portions respectively of the right and left renal artery, with evidence of flow turbulence and no significant wall thrombosis. Subsequent magnetic resonance angiography (MRA) with Gd-DTPA confirmed bilateral significant stenosis with evidence of “signal void” at the proximal portion of the renal arteries and bilateral sacular dilatation of 1.7 cm at the median portion of the right renal artery and 2.8 cm at the distal portion of the left renal artery, related to the presence of RAAs.

Preliminary angiography, performed by a right transfemoral approach with use of a 5 Fr pigtail catheter and 10 ml contrast injection, confirmed the presence of bilateral RAAs arising respectively from the median portion of the right renal artery and the distal portion of the left renal artery (Fig. 1). Subsequent bilateral selective catheterization, using a 4 Fr Cobra catheter, and injection of 8 ml contrast were performed, showing the communication between the aneurysm and the main renal artery at the median portion of the right renal artery. A fibrodysplastic shape of the distal portion of the renal artery and of the main distal branches with evidence of multiple stenoses and normal intraparenchymal vascularization were observed (Fig. 2A). The



**Fig. 1.** Preliminary angiography confirming the presence of bilateral renal artery aneurysms (RAAs) arising respectively from the median portion of the right renal artery and distal portion of the left renal artery.



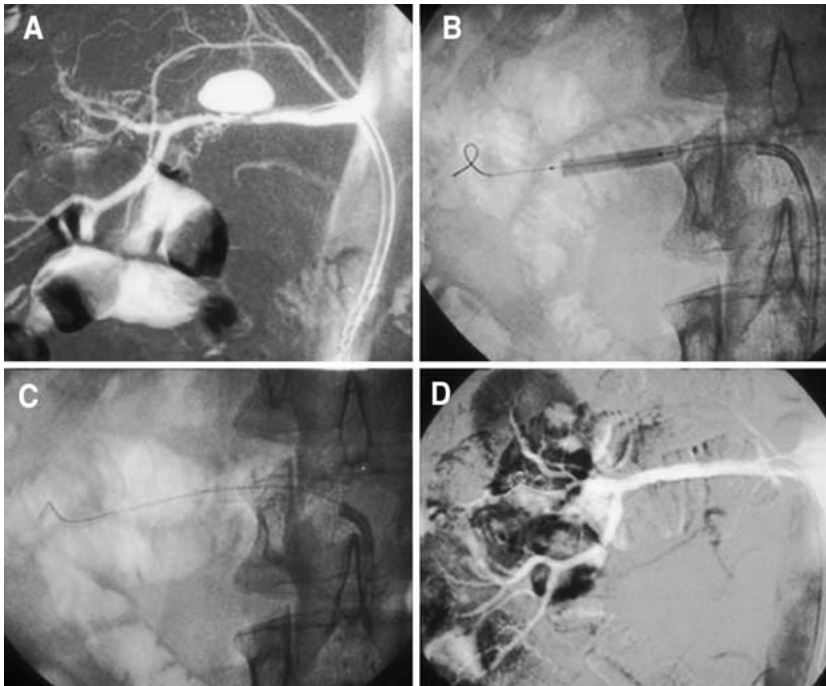
**Fig. 2.** **A** Selective DSA of the right renal artery. **B** Predilation with monorail Gazelle balloon catheter 4 mm in diameter and 20 mm long (Boston Scientific). **C** Deployed Symbiot covered stent-graft 5 mm in diameter and 31 mm long (Boston Scientific). **D** Postprocedural DSA confirming the resolution of the stenosis and the complete exclusion of the aneurysm.

selective injection in the left renal artery confirmed the aneurysm dilatation at the distal portion of the artery with the same fibrodysplastic shape at this level associated with stenosis (Fig. 3A). Significant intraparenchymal reduction of vascularization was also noted in the right kidney.

During the 2 days after angiography the patient underwent dialysis and irradiation therapy; the serum creatinine level was 3.2 mg/dl. Given the critical kidney function that could rapidly have evolved to renal failure with

the need for permanent dialysis, and the favorable anatomy, the decision was taken in consultation with the nephrologists and vascular surgeons to treat the stenosis and the RAA with percutaneous renal angioplasty (PTR) and stent-graft deployment.

After approval from the investigational review board of our institution, informed consent was obtained from the patient. Through a 6 Fr renal-curve sheath (St. Jude), advanced to the right renal artery ostium, 5000 IU heparin



**Fig. 3.** **A** Selective DSA of the left renal artery. **B** Predilatation using a monorail Gazelle balloon catheter 5 mm in diameter and 20 mm long (Boston Scientific). **C** Deployed Symbiot covered stent-graft 5 mm in diameter and 31 mm long (Boston Scientific). **D** Postprocedural DSA confirming the complete exclusion of the aneurysm and normal patency of the left renal artery.

were intra-arterially administered. By means of the road-mapping technique, through the renal-curve sheath a 0.014-inch guidewire (Choice, Boston Scientific) was advanced and secured with its tip in a segmental renal branch. Predilatation was performed with a monorail Gazelle balloon catheter 4 mm in diameter and 20 mm in length (Boston Scientific), after which a Symbiot covered stent 5 mm in diameter and 31 mm in length (Boston Scientific) was deployed to exclude the aneurysm. Final digital subtraction angiography (DSA) control demonstrated the patency and good diameter of the main renal artery, with preservation of the intrarenal branches and complete exclusion of the aneurysm (Fig. 2B–D).

With the same approach and technique the 6 Fr renal-curve sheath (St. Jude) was placed in the left renal artery ostium and a 0.014-inch Choice guidewire (Boston Scientific) advanced distal to the aneurysm—with greater difficulty than on the right side due to significant fibromuscular vessel alterations—and then secured. Predilatation of the right artery was performed by a monorail Gazelle balloon catheter 5 mm in diameter and 20 mm in length (Boston Scientific), after which the same covered stent as on the right side (Symbiot 5 mm in diameter and 31 mm in length, Boston Scientific) was deployed across the RAA neck. Final DSA control demonstrated patency of the stent with a good diameter of the main renal artery, with visualization of the intrarenal branches and complete exclusion of the aneurysm (Fig. 3B–D). In total 25 ml of contrast was used.

Laboratory results 1 day after treatment demonstrated a serum creatinine level of 2.8 mg/dl and color Doppler evaluation showed normal flow to the renal arteries with no aneurysm filling. The patient was discharged 4 days after the procedure with a significant reduction in his blood pressure (135/85 mmHg); he was prescribed oral acetylsalicylic acid 100 mg four times daily. His back pain resolved in approximately 2 weeks. At the 6 month follow-up, blood pressure was 130/85 mmHg with verapamil hydrochloride hypertensive therapy, the creatinine serum level was 2.1 mg/dl and color Doppler control showed wide patency of the stents with complete exclusion of the RAA.

## Discussion

Fibromuscular dysplasia is uncommon but represents the second most frequent cause of renal artery stenosis [14]. The stenosis

causing hypoperfusion of the kidney can evolve in the long term to renal failure with the need for permanent dialysis. Few cases of percutaneous RAA treatment with the use of a covered stent have been reported and there is no reported case of bilateral fibromuscular dysplastic stenosis associated with aneurysms treated with this technique [13, 15–20]. In this patient the first problem to be considered was the critical renal function, as the fibrodysplastic stenosis associated with renovascular hypertension and kidney hypoperfusion had established a critical condition of chronic renal failure with possible evolution to the need for dialysis. The situation was worsened by the association of the RAAs, in this case small-necked aneurysms arising from the trunks of the main arteries. The gold standard treatment for fibromuscular dysplasia stenosis is PTRAs without a stent. In our case we performed percutaneous treatment of the stenoses with PTRAs and the exclusion of the aneurysms with stent-graft deployment.

The combination of PTRAs and stent-grafts allowed us to treat the stenoses, with improvement of vascularization of the compromised kidneys, significant reduction of the hypertension and exclusion of the RAAs.

In accordance with the classification of RAAs reported by Rundback et al. [15], we think that saccular aneurysms arising from the main branch with a small aneurysm neck (type 1) have to be treated percutaneously with the use of a covered stent. If the anatomy allows endovascular treatment, it is possible to preserve renal perfusion (while potentially avoiding surgical and anesthetic risk) and at the same time to treat the stenosis and RAA. Moreover the deployment of a stent-graft in the main branch of the renal artery, with preservation of both the proximal and distal portions, allows surgical treatment in case of failure. In this case the most important problem was the critical condition of the patient's renal function so, independently of the presence of RAAs, it was necessary to treat the stenoses to prevent dialysis.

The Symbiot is a self-expanding monorail nitinol stent covered with ePTFE that is usually used in the coronary district. For this

reason the stent has a highly flexible structure, smooth surface and low profile that allow easy advancement in tortuous vessels with fibromuscular alterations across the lesion. The ePTFE cover allows the total exclusion of the sac and endothelialization. The use of a self-expanding stent gives high adaptability to the vessel anatomy and the predilation of the stenosis, together with the radial force of the stent, supports the long-term primary patency of the renal artery. We have also used this stent-graft to treat internal carotid pseudoaneurysms and to exclude a giant pseudoaneurysm of the superior mesenteric artery that developed in a patient with acute pancreatitis.

The type of aneurysm in our patient (type 1) can also be treated with the use of multiple coils with or without an uncovered stent. Klein et al. [21] describe "packing" of the aneurysm with multiple small coils, but this technique has a risk of distal embolization and the continuous transmission of the pressure at the sac exposes the aneurysm to the risk of rupture [22].

Fusiform RAAs (type 2), with a large neck or located near a bifurcation of the main trunk, are better treated with surgical repair or nephrectomy, while distal or intralobar RAAs (type 3) are candidates for percutaneous treatment with the use of microcoils even if this treatment may cause small infarcts of the kidney.

In accordance with Rundback et al. we think that, for treatment of RAAs that require extension of the stent near a bifurcation, it is better to place a safety wire in each branch so that in case of dissection or thrombosis the safety wire allows access for thrombolytic therapy or stent placement [15].

In conclusion, we think that fibromuscular stenosis associated with bilateral RAAs arising from the main renal branch is best treated with PTRAs and covered stents. This technique is safe, effective and less invasive than surgical treatment, preserving renal perfusion while avoiding the potential risks of surgery and anesthesia, especially in patients with critical renal function that can rapidly evolve to the need for dialysis. Moreover the deployment of the stent in the main branch of the renal artery with preservation of both proximal and distal portions allows surgical treatment in case of failure.

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