

The use of the Cardiatis multilayer flow modulator stent to treat sequential saccular aneurysms of the renal artery in a solitary kidney

*Soliter böbrekteki ardışık sakküler renal arter anevrizmalarının tedavisinde
Cardiatis çok katmanlı akım çevirici stentin kullanımı*

Murat Canyığıt,¹ Ali Çam,¹ Hüseyin Çetin,¹ Alpaslan Altunoğlu,² Mete Hidiroğlu³

Departments of ¹Radiology, ²Nephrology and ³Cardiovascular Surgery,
Ankara Atatürk Training and Research Hospital, Ankara, Turkey

ABSTRACT

Prevalence of renal artery aneurysm is very low in the general population and it is thought to develop due to atherosclerosis or fibromuscular dysplasia. Rupture is among the most feared complications due to its high mortality rates. Surgical methods in renal artery aneurysm are complex with high morbidity rates. Endovascular approach with covered stent and coil embolization is a successful alternative treatment in adequate patients. In this article, we report a successful endovascular treatment of sequential saccular aneurysms extending to the hilar area in renal artery of solitary kidney with a flow-diverting multilayer stent where other endovascular methods were insufficient.

Keywords: Flow-diverting multilayer stent; renal artery; saccular aneurysm.

Although not frequent, renal artery aneurysms (RAAs) account for 25% of all intra-abdominal visceral aneurysms and are usually asymptomatic. Current studies have found an incidence rate for RAAs of between 0.1 and 1.3% in the general population and 2.5% in hypertensive (HT) patients.^[1,2] An untreated RAA may be fatal if it ruptures. Major treatment indications are a symptomatic aneurysm, aneurysms measuring >2 cm in diameter, and uncontrolled HT, and RAAs may also be seen in pregnant women.^[3] Surgery and endovascular methods are among the available treatment options.^[1,4] Herein, we present a case in which endovascular treatment with the Cardiatis Multilayer Flow Modulator (MFM®) stent (Cardiatis, Isnes, Belgium) was successful in a patient

ÖZ

Renal arter anevrizmasının genel nüfusta yaygınlığı oldukça düşük olup ateroskleroz ya da fibromusküler displaziye bağlı geliştiği düşünülmektedir. Yüksek mortalite oranları nedeniyle rüptür en korkulan komplikasyonlar arasındadır. Renal arter anevrizmasında cerrahi yöntemler karmaşıktır ve morbidite oranları yüksektir. Uygun hastalarda kaplı stent ve koil embolizasyon ile endovasküler yaklaşım başarılı bir alternatif tedavidir. Bu yazıda, diğer endovasküler yöntemlerin yetersiz kaldığı, soliter böbreğe ait renal arterdeki hiler bölgeye uzanan ardışık sakküler anevrizmaların akım-çevirici multilayer stent ile başarılı bir endovasküler tedavisi sunuldu.

Anahtar sözcükler: Akım-çevirici multilayer stent; renal arter; sakküler anevrizma.

with HT, flank pain, and subsequent saccular RAAs extending to the hilar area of a solitary kidney. Other endovascular treatments were tried on this patient, but there was no improvement.

CASE REPORT

A 57-year-old female patient who had previously undergone a right nephrectomy was referred to our hospital due to saccular aneurysms of the left renal artery and a parapelvic renal cyst that were detected on ultrasonography. The patient's history revealed that the nephrectomy had been performed 30 years earlier on her nonfunctional right kidney due to pyelonephritis. The patient was a non-smoker and had no diabetes. However, she had HT that was being controlled with an



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Correspondence: Murat Canyığıt, M.D. Ankara Atatürk Eğitim ve Araştırma Hastanesi, Radyoloji Kliniği, 06800 Çankaya, Ankara, Turkey.

Tel: +90 312 - 291 25 25 e-mail: mcanyigit@yahoo.com



Figure 1. Preoperative axial (a) and three-dimensional, volume-rendered (b) images show the sequential saccular aneurysms (arrows) on the left main renal artery and the parapelvic cyst (arrowhead in Figure 1a).

antihypertensive drug. All of the laboratory findings were within normal ranges.

Computed tomography angiography (CTA) revealed consecutive saccular aneurysms (11x9 mm, 21x13 mm, and 27x17 mm) extending to the hilar region on the main left renal artery (Figures 1a, b). All of the segmental arteries originated from the aneurysms, and stenotic segments were also present between the aneurysms. In addition, an accessory renal artery and a parapelvic cyst measuring 48x63 mm were also present. No dilation of the renal collecting system or urinary tract stones were detected.

Endovascular treatment was preferable to surgery because of the solitary kidney, the location of the saccular aneurysms, and the originating point of the segmental renal arteries. The options of a covered stent

or coil embolization were not considered due to the wide-necked aneurysms and the origin of segmental arteries. We decided to use the MFM[®] stent because we intended to exclude the aneurysms from the vascular system and preserve the segmental arteries.

The patient was given clopidogrel (75 mg) and acetylsalicylic acid (300 mg) for 10 days prior to the procedure. The right brachial artery was cannulated under ultrasound guidance with a 6 French (F) 90 cm guiding sheath (Cook Medical Inc., Bloomington, IN, USA) and then advanced to the abdominal aorta. Meanwhile, an IV bolus of heparin (5000 IU) was also administered. The proximal part of the renal artery was catheterized with a 5F headhunter catheter (Boston Scientific-Heridia, La Aurora, Heredia, Costa Rica) and a 0.035-inch Radifocus[®] Glidewire Advantage[™]

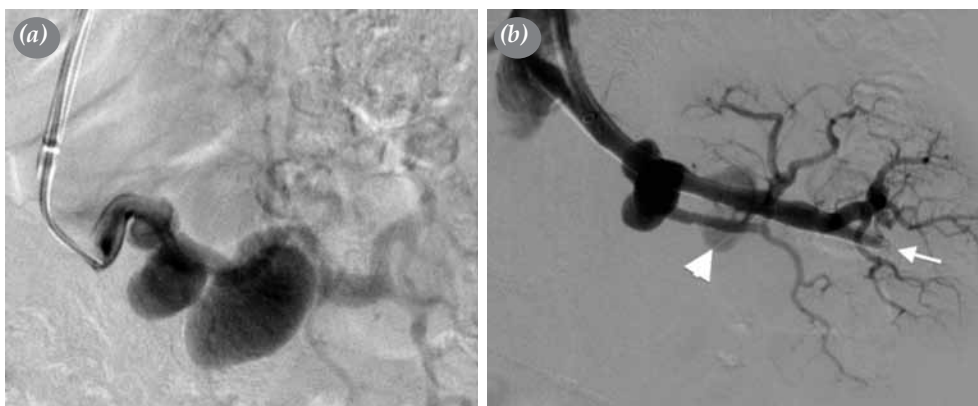


Figure 2. Selective left main renal digital subtraction angiography image (a) confirmed the sequential saccular aneurysms on the artery. A control renal angiogram obtained just after the deployment of the stent (b) shows the complete filling of the proximal and middle aneurysms, but this was delayed in the distal portion (arrowhead). In addition, the artery loss distal to the stent can be seen (arrow).

peripheral guide wire (Terumo Europe N.V., Leuven, Belgium) via the guiding sheath. Next, a Progreat 2.7F coaxial micro catheter system (Terumo Europe N.V., Leuven, Belgium) was used to pass the aneurysmal segments through the headhunter catheter. After inserting a long, stiff Hi-Torque Steelcore 0.018-inch peripheral guide wire (Abbott Vascular Inc., Santa Clara, CA, USA), the 10x80 mm MFM® stent was inserted through the renal artery to cover all of the aneurysms (Figures 2a, b). The patient was then discharged without any complications on the same day with dual antiplatelet therapy (300 mg acetylsalicylic acid and 75 mg clopidogrel).

The first-, six-, and 12-month follow-up CTA showed no changes in the aneurysms. The proximal and distal aneurysms were thrombosed, but the aneurysm in the middle had a 6 mm residual enhancement (Figures 3a, b). The stent patency was intact, and no intimal hyperplasia or loss in the segmental branches originating from the aneurysms was detected. Although focal cortical loss of the renal parenchyma distal to the stent was noted, no renal function loss was seen after the procedure. At the one-year follow-up, the patient's flank pain had completely resolved.

DISCUSSION

Renal artery aneurysms are more common in women than in men and occur more often on the left side than the right. In addition, they are rarely bilateral and are

typically solitary in nature.^[5] These aneurysms most frequently settle in the renal artery, and calcification is seen in 18% of these patients. Although the pathology involved is not clear, atherosclerosis or fibromuscular dysplasia are routinely seen, and malignancy, mycotic infection, trauma, vasculitis, tuberous sclerosis, iatrogenic causes, William's syndrome, and renal biopsies are among the other possible causes.^[4] Renal artery aneurysms can be classified as either a true aneurysm or a pseudoaneurysm, and there are four basic aneurysm types: saccular, fusiform, dissecting, and intrarenal. Saccular aneurysms are the most common and account for 80% of all RAAs.^[4]

Fibromuscular dysplasia is an idiopathic event caused by the hypertrophy of fibrous and muscular elements of the arterial media and adventitia leading to stenosis. It is thought to be related to aneurysms as well as spontaneous arterial dissection. This type of dysplasia often involves the medial part of renal arteries and does not contain calcifications. Furthermore, the aneurysms originating from fibromuscular dysplasia accompanied by stenosis are chaplet-like in appearance and are usually seen in women.^[6] Although radiological images might indicate the etiology, the final diagnosis is made via a histopathological evaluation. Our patient was also female and had chaplet-like aneurysms located in the medial part of the renal artery accompanied by stenotic segments. Moreover, no calcification was noted; therefore, we believe that the underlying cause of the RAA was fibromuscular dysplasia.



Figure 3. Computed tomography angiography images obtained at the 12th month follow-up (a, b) show the thrombosed proximal and distal aneurysms, but the aneurysm in the middle had residual enhancement (Figure a, arrowhead). In addition, the stent patency is intact, and the focal cortical loss of the renal parenchyma (Figure a, arrow) distal to the stent can be seen.



Figure 4. The Cardiatis Multilayer Flow Modulator (MFM)[®] is a self-expandable device made of metallic cobalt alloy wires interconnected in multiple layers.

Renal artery aneurysms are usually asymptomatic, but HT, flank pain, and hematuria can be seen in symptomatic patients, with the most common finding (90%) being HT.^[7] Renal artery thrombosis, secondary infarction to the distal emboli, arteriovenous fistula formation, and rupture are among the complications associated with RAAs. Rupture is feared the most because of its fatal consequences (nearly 80% mortality rate).^[8] Males and postmenopausal women have a low risk of rupture, whereas women in the third trimester of pregnancy have a very high risk. Furthermore, fusiform and calcified aneurysms have a lower risk of rupture, whereas non-calcified and saccular aneurysms have a higher risk. For all aneurysms, a greater RAA diameter increases the risk of rupture, but this is especially true for those larger than 2 cm in diameter.^[6]

Henke et al.^[9] recommended treatment for RAAs measuring ≥ 1 cm accompanied by uncontrolled HT, all RAAs > 2 cm, and most RAAs with a diameter of between 1.5-2 cm. The most important indications are uncontrolled HT and female gender, but flank pain, distal emboli, and pregnancy should also be kept in mind.^[3] Among the treatment indications for our patient were the saccular form of the RAA, its large diameter, and the absence of calcification. Additionally, the patient was female and had flank pain.

Surgical treatment includes resection of the aneurysm, an aortorenal bypass, renorenal graft interposition, and patch angioplasty.^[3] In their surgical

series, Dzsinič et al.^[10] reported that HT was treated in between 50-88% of their cases and that successful preservation of segmental branches occurred in 86%. Surgical complications may include branch occlusion, urethral stenosis, postoperative graft occlusion, the need for a nephrectomy, and death.^[5] The various surgical methods for treating RAAs are technically difficult and require a retroperitoneal dissection, which has a 28% morbidity rate. Therefore, these risks make endovascular treatment a strong alternative to other surgical options.^[5]

There are various endovascular treatment methods, including stent-graft placement, coil embolization with or without a balloon or stent, and glue or onyx embolization to separate the aneurysm from arterial circulation. However, these techniques may be technically difficult to perform since side branches may originate from the wide-necked aneurysm, as was the case with our patient. This complication can then lead to a significant loss of renal parenchyma.^[3,5]

Due to such conditions, new endovascular treatment methods, such as the MFM[®] stent should be considered. This stent (Figure 4) is composed of a three-dimensional, interlocked, porous system which cannot prevent the blood flow from entering the aneurysmal sac. However, the flow velocity within the aneurysmal sac is reduced, thus causing an organized thrombus to form in the sac, due to the hemodynamic flow-modulating effect. When this occurs, there is little or difficult supply with blood collateral circulation and multilayer stenting allows the collateral circulation to be correctly supplied, promoting a more regular flow. Finally, with the MFM[®], the turbulent flow caused by the aneurysm is reversed and becomes laminar in nature, thus excluding the aneurysm from the circulation but preserving the flow into the side branches.^[11-13]

We treated our patient with this specifically designed stent, and after one year of follow-up, no loss in renal function was detected, and the patient's flank pain disappeared. In addition, two of the aneurysms were completely thrombosed, and the third was substantially thrombosed. Furthermore, no changes in the diameter of the aneurysms were seen during the follow-up.

Conclusion

Among the various endovascular methods used to treat RAAs, the MFM[®] stent seems to work well, and it is easy to use when treating wide-necked saccular and/or fusiform aneurysms with segmental branches originating from them. We would especially recommend this technique when other endovascular methods are not feasible. However, studies with a

larger number of patients that include mid- and long-term follow-up results are needed to establish the efficacy of this stent.

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