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Embolization of a large high-flow renal arteriovenous fistula using 035″ and 018″ detachable coils

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Abstract

Transcatheter embolization of renal arteriovenous fistula (AVF) is a minimally invasive procedure that, in some occasions, can replace surgery and potentially save the kidney. The embolization techniques for the renal AVFs have evolved considerably with the availability of newer hardwares. Still, the risk of inadvertent migration of the embolization materials to the pulmonary circulation is a concern. This article describes a novel technique of coiling the feeding segmental artery to a large high-flow renal AVF using 035″ and 018″ detachable coils only, and briefly reviews the previously described strategies to safely embolize renal AVFs.

Key words: Arteriovenous fistula; embolization; renal; therapeutic

Introduction

Arteriovenous fistulas (AVFs) are anomalous connections between the arterial and the venous systems without an intervening capillary network. Renal AVFs are often asymptomatic, but can also present with hematuria, pain, hydronephrosis, and heart failure. Percutaneous interventions and penetrating trauma cause most renal AVFs, although they can rarely be congenital or idiopathic. Transcatheter embolization therapy represents a minimally invasive method that can treat these lesions and potentially save the kidney. However, this technique has unique challenges, most notably the risk of embolic material migration to the pulmonary circulation, especially with high-flow fistulas, which necessitates the usage of complex preventative measures and hardware. This article describes a novel endovascular technique for treating high-flow AVFs solely using 035″ and 018″ interlock detachable coils (IDCs) (Boston Scientific Corporation, Natick, MA, USA) without the use of flow modulation. IDCs are platinum coils with thrombogenic fibers preloaded in a sheath with a coil pusher. A mechanical lock between the junction of the coil and the pusher allows the coil to be retracted as long as the interlock connection is within the delivery sheath. The 035″ IDC has the same mechanism of deployment but with a larger diameter than the 018″ coils, and this results in more stability during the deployment. The denser polyester fabric in the 035″ coils promotes rapid thrombosis of the lumen and improved anchorage.[1]

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Case Report

A 45-year-old man with a past medical history of refractory hypertension presented with a progressively enlarging right renal AVF, which was incidentally discovered a year prior on a computed tomography (CT) scan of the abdomen, and demonstrated interval growth on the follow-up CT scan from a maximum diameter of 21 mm to 33 mm. Considering the increase in size, the patient's team decided to treat this AVF. However, the poor general medical condition secondary to non-ischemic cardiomyopathy precluded the option of total nephrectomy. CT angiogram (CTA) showed an enlarged main renal and posterior segment artery which fed a tortuous fistulous tract having many fusiform dilatations; the maximum diameter of the tract measured 33 mm [Figure 1]. Following an angiogram performed for selective embolization of the renal AVF, access to the right common femoral artery was obtained and a 5-French (F), 45-cm arterial sheath (Ansel sheath, Cook, Bloomington, IN, USA) was placed with its tip in the infrarenal aorta. The right renal angiogram revealed a large posterior segment branch, measuring up to 8 mm in diameter, supplying a tortuous fistulous tract and arising distal to the origin of the segmental branches [Figure 2A]. This tortuous fistulous tract had multiple saccular aneurysms [Figure 2B]. The maximum diameter of the aneurysmal portion of the fistulous tract measured 33 mm and was situated immediately distal to the arteriovenous communication. The posterior segment artery was selected using a Cobra catheter over a 035″ glide wire. The arterial sheath was further advanced over a super stiff wire into the main right renal artery for better support. A 3-F microcatheter having an inner diameter of 0.021 inches (Renegade, Boston Scientific Corporation) was advanced coaxially through the Cobra catheter over a 018″ wire (Transcend wire, Boston Scientific Corporation) into the fistula. Initially, a 018″ 14 mm × 30 cm IDC, which was the largest coil available at the time, was advanced through the microcatheter and partially deployed in the feeding artery. However, the coil was unstable in its position and prolapsed into the aneurysmal fistulous tract; the coil was subsequently withdrawn. The microcatheter was removed and a 035″ 50 mm × 40 cm IDC was advanced through the Cobra catheter into the feeding artery while maintaining a saline flush. The coil was deployed cautiously over 5 min. Once the loops were stable, the IDC was detached [Figure 2C]. This initial coil served as a scaffold for the other coils. The 3-F microcatheter was reinserted coaxially through the Cobra catheter over a 018″ Transcend wire into the feeding artery. Then, a 018″ 10 mm × 30 cm fibered IDC was advanced through the microcatheter, and loops of the coil were deployed proximally in the feeding artery using the previously deployed coil as an anchor. Further coiling of the feeding artery was performed by a 018″ 10 mm × 30 cm and followed by seven 018″ 10 mm × 20 cm. Final angiogram demonstrated non-filling of the AVF with preservation of the remaining segmental branches. A nephrogram was noted in the final angiogram, which was not present in the initial angiogram, indicating redirected arterial flow from the AVF toward the renal parenchyma [Figure 3]. There were no complications during the procedure. Follow-up CTA obtained 6 months after the embolization demonstrated occlusion of the fistulous tract. Focal parenchymal atrophy in the posterior cortex corresponded to the vascular territory of the occluded segment.

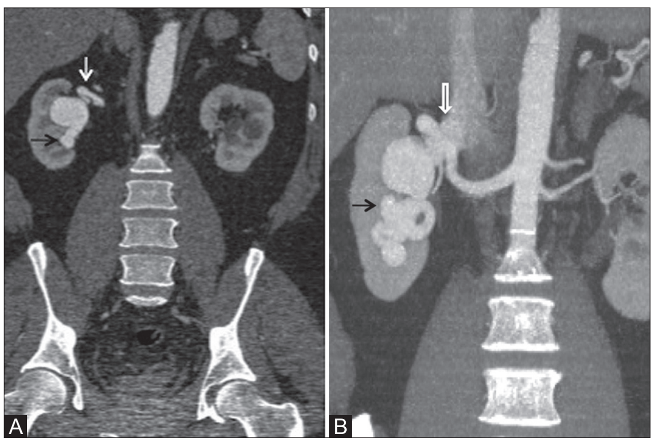

Figure 1 (A, B): (A) Coronal multiplanar reformatted image shows dilated posterior segment artery (white arrow) and tortuous fistula tract (black arrow). (B) Coronal maximal intensity projection image shows enlarged main renal artery, tortuous fistula tract with aneurysmal dilatations (black arrow), and dilated right renal vein (open white arrow)

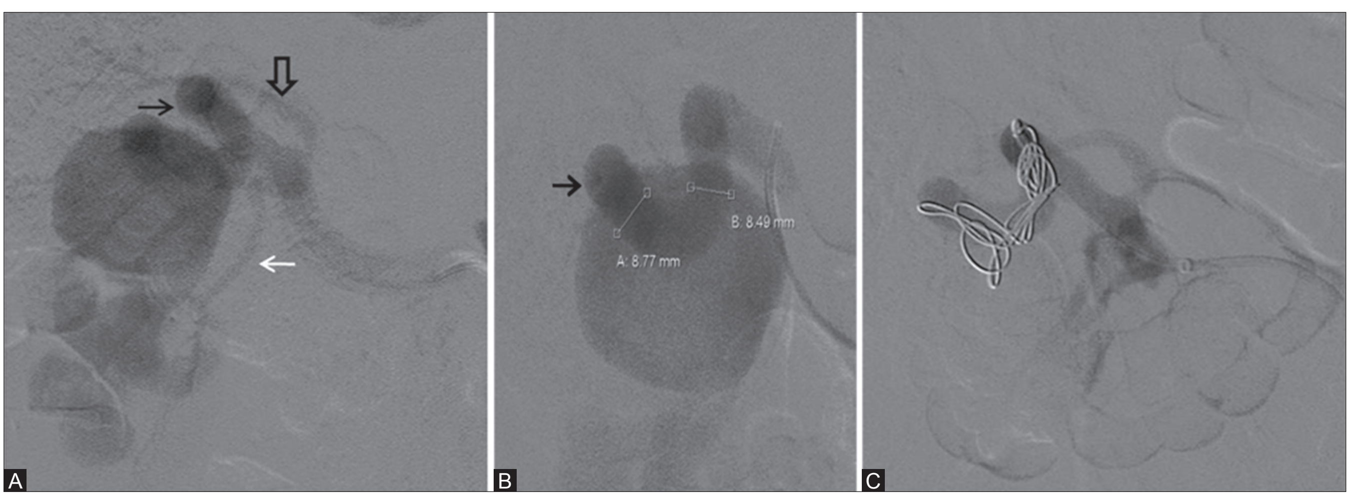

Figure 2 (A-C): (A) Angiographic image from injection into main renal artery shows the dilated fistulous tract arising from the enlarged posterior segmental artery (black arrow) and upper (open black arrow) as well as lower (white arrow) segmental branches arising proximally. (B) Selective angiogram of the posterior segmental artery shows an aneurysmal dilatation of the proximal venous outflow tract (black arrow), measuring up to 8.8 mm. (C) Angiogram from the main renal artery injection after the successful deployment of the first 035” IDC in the feeding posterior segmental artery, just proximal to the fistulous track

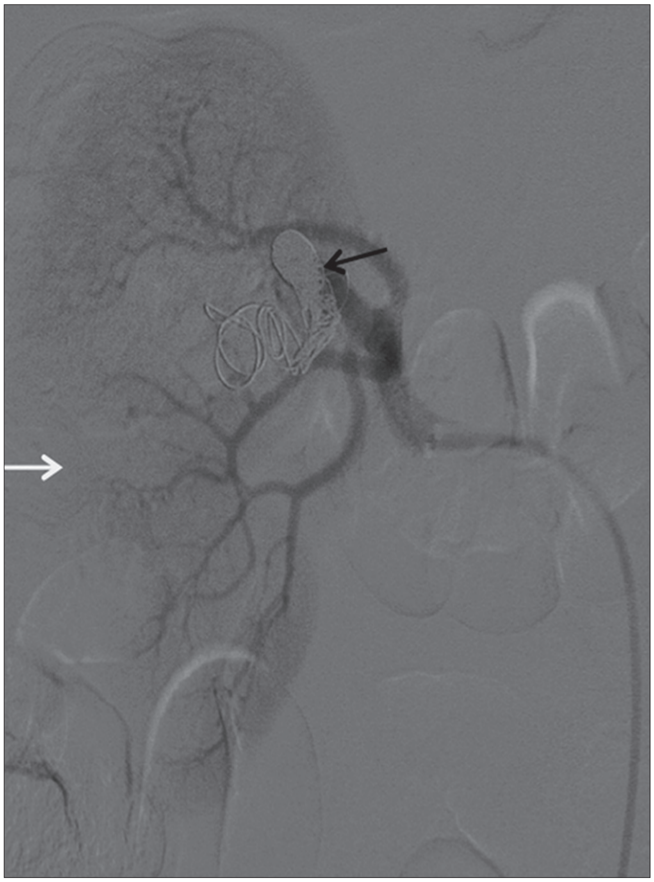

Figure 3: Angiographic image after packing several 018” coils proximal to the 035” coil (black arrow) in the posterior segmental renal artery shows cessation of distal flow and redirection of flow in the other segmental branches which were not present previously. A nephrogram is apparent with a minimal defect (white arrow) at the mid pole corresponding to the territory of the embolized branch

Discussion

The risk of distal embolization into the pulmonary circulation looms large in high-flow AVFs and is compounded by the high flow velocity and flow-related ectasia of the fistulous tract along the venous end that prevents proper anchoring of the embolic agents. Therefore, while treating these large AVFs, various complex techniques involving distal embolization protection, multiple sessions, and combined arterial and venous caliber of the vascular access have been adopted in the past that merit comparison with this new technique. Often the fistulous tracts are larger than the available embolic agent. In one such instance, Idowu *et al*.[2] reported treating a large idiopathic renal AVF with a tract diameter of 2.2 cm using a 16-mm Amplatzer vascular plug (AVP) (AGA Medical, Golden Valley, MN, USA) by a combined femoral artery and vein approach. Combined deployment occlusion balloons proximal and distal to a fistula have been used in the past in order to achieve flow control in renal AVFs.[3,4] The combination of packing of the tract with Guglielmi coils followed by the injection of *N*-methyl cyanoacrylate glue to occlude any residual flow while deploying the occlusion balloons has been a successful approach.[3] Alternatively, using combined venous and arterial access, one such technique makes use of the injection of Acrylic Glue from the arterial side to block a large AVF after the tract was occluded by a balloon from the venous side, without the usage of any coils.[4] Notably, this method carries the risk of entrapment of the balloon catheter by the injected glue. Yet another combined approach involves stents deployed in the AVF in order to downsize the diameter of the fistula; then the tracks were embolized using coils deployed against the constrained segment of the stent.[5,6] Although IVC filters can be used to capture the embolization materials from an AVF embolization procedure, ectasia of the suprarenal IVC and the wide leg strut pattern of the commercially available filters make these filters suboptimal for this purpose.[7] Interestingly, Opt Ease IVC filter (Cordis Endovascular, Bridgewater, NJ, USA) had been deployed in the fistulous tract through the venous access, which was then used as a scaffold for embolizing a 15-mm arterial feeder using a 22-mm AVP-II and several coils.[8]

Mechanically detachable coils have been used in the past to embolize renal AVF.[1] IDC is one such example of a mechanical coil that has been successfully used in treating renal AVF, by using a “pre-framing technique”[9] in which the microcatheter is coiled in the fistulous tract with proximal balloon occlusion. The 018″ microcoil is then loaded in the microcatheter and, by the gradual withdrawal of the catheter, the coil is deployed. This technique requires a small side branch in the fistula that can be used to support the tip of the microwire over which the microcatheter can be coiled. Very large renal AVFs with multilobulated arterial aneurysms have treated using Microplex-18 framing microcoils (Terumo, Somerset, NJ, USA) followed by Azur Hydrocoils (Terumo) in two sessions.[10]

Mechanically detachable coils have found increasing application in transcatheter vascular embolizations. These mechanical coils retain the advantages of the electrically detachable coils in terms of safety and control over delivery. Compared to electrically detachable coils, IDCs are cheaper and do not require galvanic current generating device for detachment. Disadvantages of these coils over the electrically detachable coils are decreased pushability, especially when deployed through catheters having sharp angulation, and rigidity of the delivery system.[11] In the procedure described, 035″ coils require a maintained saline flush through the catheter in order to improve pushability. Rarely, the previously deployed coils could be trapped by the lock of the subsequently deployed coil pusher, which may result in dislodgement of the already deployed coil.

In the case presented here, the maximal aneurysmal tract dimension was too large for the available 018″ IDC. The high-velocity flow in the fistulous tract resulted in instability of a 14-mm, 018″ IDC, which was oversized with respect to the feeder diameter by 75%, although it had a good circumferential contact with the arterial wall. The 035″ coil was then used as a reliable scaffolding against which further embolization was performed without the need of distal embolization protection techniques. AVP-II with 12-mm diameter would have been an alternative for occluding the feeder, which would have necessitated the use of a 5.3-F guiding catheter, requiring upsizing the arterial access to at least 6 F diameter.

Conclusion

Treatment of high-flow renal AVF is challenging and continues to evolve in the wake of new embolization techniques. We present a simple technique to embolize large high-flow renal AVF using 035″ and 018″ interlock coils without the need of flow modulating balloon catheter or additional vascular access for distal protection. This technique provides a potential alternative for the usage of AVP in high-flow AVF.

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