

# Renal Artery Aneurysm Embolization Using Microcatheters and Detachable Coils

A technical overview of one option for treating renal artery aneurysms that could also be applied to other visceral aneurysms and renal AVFs.

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**A**lthough renal artery aneurysms are the most common visceral artery aneurysm, they are relatively rare overall, accounting for < 1% of all aneurysms.<sup>1</sup> Nonetheless, the incidence of this diagnosis is increasing as the use of cross-sectional imaging becomes more common. The current angiographic incidence ranges from 0.3% to 0.7%, with most discovered incidentally.<sup>2</sup> These aneurysms are often complex and perihilar.

Renal arteriovenous fistulas (AVFs) are less common, with a prevalence of 0.04%. Most AVFs (70%) arise from a predisposing renal artery aneurysm that ruptures into the adjacent renal vein.<sup>3,4</sup> Both renal aneurysms and AVFs may result in renovascular hypertension, thrombosis, flank pain, hematuria, and progressive arterial dilatation with a significant associated risk of rupture. Rupture may be associated with a mortality rate of up to 80%.<sup>5</sup> The occurrence of any of these complications or an aneurysmal artery larger than 1.5 cm indicates the need for intervention. Surgical treatment requires resection with bypass; however, nephrectomy may be the only option in some cases.<sup>1-5</sup>

Endovascular techniques have been employed for the treatment of renal artery aneurysms and are becoming first-line therapies.<sup>6-10</sup> Likewise, these options may be applied to AVFs.<sup>8,11</sup> This article describes a technique for coiling of both renal artery aneurysms and AVFs with frameable detachable coils and reviews the advan-



Figure 1. Computed tomographic angiography (CTA) showing a right renal artery aneurysm with growth over a 2-year period of time. The aneurysm begins at the renal hilum.

tages of this technique over other endovascular options.

## CASE 1

A 57-year-old man presented with hypertension and during the workup of a thoracic aneurysm was found to have a 3-cm right renal artery aneurysm. The patient underwent successful endovascular management of his



**Figure 2.** Aortogram before selective renal artery catheterization with the renal artery aneurysm present near the hilum of the kidney.

thoracic aneurysm, and the right renal artery aneurysm was repaired in a staged fashion. CTA showed a single left renal artery that was widely patent without aneurysmal dilatation or stenosis and a single right renal artery with a widely patent origin. There was an aneurysm of the right renal hilum that measured 22 X 21 X 20 mm, with minimal calcification (Figure 1).

Presented with the options of coil embolization versus open repair of the aneurysm, the patient elected to undergo coil embolization. The left femoral artery was accessed under ultrasound guidance, and an aortogram was obtained (Figure 2). The right renal artery was accessed with a reversed curve catheter, and a 6-F Pinnacle Destination guiding sheath (Terumo Interventional Systems, Somerset, NJ) was advanced into the renal artery. A 2.4-F Progreat catheter (Terumo Interventional Systems) was then advanced into the aneurysm sac to allow for the placement of coils. With the aneurysm at the hilum of the renal artery, the use of detachable coils was used to allow for accurate placement and prevention of embolization. Multiple Azur coils (Terumo Interventional Systems) were placed into the aneurysm sac. A 20-mm X 50-cm framing coil was placed first followed by four 8-mm X 10-cm hydrocoils (Figure 3).

The patient was discharged home the same day without complications, and his follow-up CTA has showed that the renal artery aneurysm was completely excluded, with a well-perfused right kidney (Figure 4).



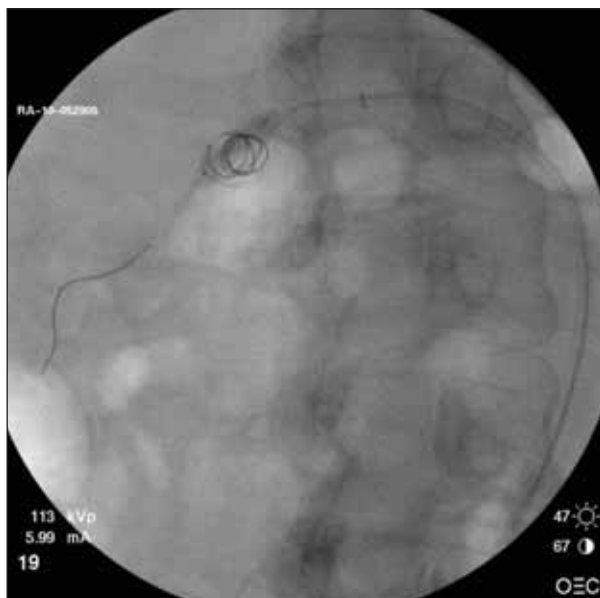
**Figure 3.** The renal artery aneurysm is cannulated with a Progreat catheter, and multiple Azur hydrocoils are placed after a framing coil was placed within the sac. This resulted in complete thrombosis of the aneurysm sac.



**Figure 4.** Densely packed right renal artery aneurysm with complete thrombosis of the aneurysm sac. There is normal perfusion and filling of the right kidney compared with the left kidney. Creatinine remains normal.

## CASE 2

A 43-year-old man presented with a 3-cm right renal artery aneurysm arising near the hilum of the kidney. The aneurysm had been followed for 2 years, with recent growth from 25 to 30 mm and was referred for coil embolization of the aneurysm. The patient was oth-

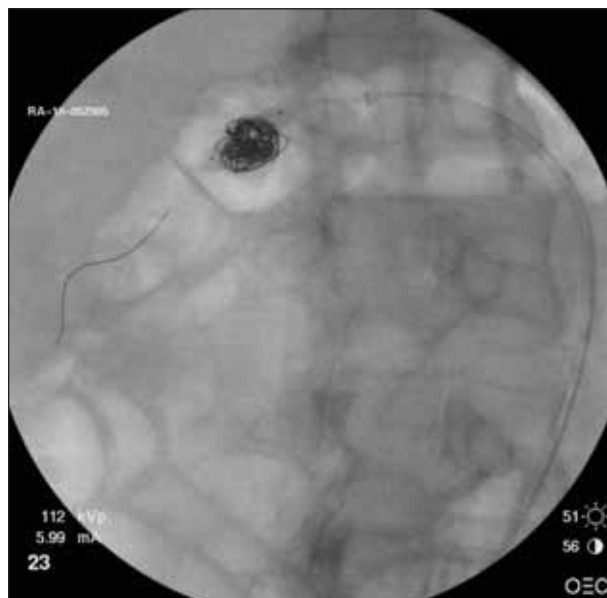


**Figure 5.** Two-wire technique with a balloon across the aneurysm and a Progreate catheter within the aneurysm sac. With the balloon inflated, the Azur coils are placed within the aneurysm sac. Again, a framing coil is placed first followed by smaller Azur coils densely packing the aneurysm, resulting in thrombosis.

erwise asymptomatic. Aortography and selective catheterization of the renal artery aneurysm was performed. After this, a 7-F sheath was advanced into the orifice of the renal artery, and a two-wire technique was used to thrombose the wide-neck aneurysm. The first 0.014-inch wire was used to cross the aneurysm, and a second 0.014-inch wire was placed into the aneurysm sac itself. Then, a 4- X 2-mm balloon was passed across the neck of the aneurysm. A Progreate catheter was then placed into the aneurysm sac itself (Figure 5). A 20-mm X 50-cm framing coil was placed first with the balloon inflated. This was followed by five 8-mm X 20-cm Azur coils, which achieved complete exclusion of the aneurysm sac (Figure 6). Follow-up CTA at 6 months showed exclusion of the aneurysm sac with normal kidney size and no flow into the aneurysm sac. Noncontrast images show that the coils completely exclude the aneurysm sac (Figure 7).

### CASE 3

A 50-year-old woman was found to have a right renal AVF via CTA. On selective renal angiogram, the flow was so high that it was not possible to see the renal angiogram, as all the flow was going through the AVF (Figure 8). A 6-F Pinnacle Destination guiding sheath was then placed within the right renal artery. A Progreate



**Figure 6.** Densely packed aneurysm of the right renal artery.

catheter with coaxial wire was used to traverse the lesion. A series of coils were placed into the AVF to slow the flow. Multiple Azur coils (total of 12) (Figure 9) were placed within the AVF with preservation of flow to the kidney. A 6-month follow-up CTA showed normal function of the kidney and exclusion of the flow (Figure 10). Use of the detachable coils was beneficial in preventing distal embolization and accurate positioning in the high-flow AVF. The patient tolerated the procedure well without any complications.

“Endovascular repair of renal artery aneurysms and AVFs has been associated with a decreased length of hospital stay . . .”

### DISCUSSION

Indications for repair of renal artery aneurysms include rupture, aneurysms larger than 1.5 cm, renovascular hypertension, flank pain, hematuria, or the presence of an AVF.<sup>1,2,5</sup> Open repair with surgical exclusion and bypass is considered the gold standard for treatment. However, open repair is associated with the risks of general anesthesia, as well as a 6% incidence of technical failure with graft thrombosis, a 6% incidence of unplanned nephrectomy, and a 0% to 4% procedure-related mortality rate.<sup>1-5,9,10</sup>



**Figure 7.** Noncontrast computed tomography with normal-sized kidney and coils within the aneurysm with complete filling of the aneurysm sac. CTA showed complete exclusion of the aneurysm with thrombosis.

Endovascular repair of renal artery aneurysms and AVFs has been associated with a decreased length of hospital stay, lower morbidity rates (including a lower incidence of nephrectomy), and lower mortality rates compared to open repair. At the same time, aneurysm-related outcomes are near equivalent to surgical interventions.<sup>9,10</sup>

Several options exist, including stenting, thrombogenic liquid injections, and coiling. Although successful results have been reported with each of these options, disadvantages exist for each approach.<sup>9,10</sup> Covered stents may not be ideal for patients with disease near the renal hilum or major branch points. Thrombogenic liquids and coils have uncontrolled delivery, may be difficult to manipulate, and alternatively share the risks of embolization. When used in the extraparenchymal renal artery, major parenchyma may be at risk from these adverse consequences. In fact, most series reporting on these techniques describe the occurrence of major renal artery branch occlusions.<sup>9,10</sup> Further, the use of traditional coils or thrombogenic liquids in the setting of renal AVF carries the risk of occlusive device embolization to pulmonary vasculature resulting in pulmonary embolism.<sup>8,11</sup>

The technique employed for our patients involved the use of superselective microcatheters as well as detachable peripheral hydrocoils. Because the goal for repair involves aneurysm or AVF exclusion without embolization or loss of renal parenchyma, this technique has several advantages. First, these catheter systems are both softer and more flexible than earlier versions, allowing more con-



**Figure 8.** Renal AVF with high flow through the fistula.

“The use of framing coils—larger coils to which the smaller coils are attached—is key to the safety and success of this technique.”

trolled and safer superselection of the thin-walled aneurysmal vessels. True detachable coils, such as the Azur coils, allow for controlled release, decreasing the risk of embolization, migration, and partial deployment in the main renal artery. These coils remain attached to the system until deliberately released. They can be positioned, confirmed angiographically, and then withdrawn and replaced if positioning is not ideal. The coil itself combines a platinum coil and an expandable hydrogel polymer, and these elements provide a stable and permanent platform for blood stasis, thrombus formation, and neointima formation. Full expansion of the hydrogel occurs within 20 minutes, and this results in greater filling and mechanical stability with fewer coils required.

The use of framing coils—larger coils to which the smaller coils are attached—is key to the safety and success of this technique. These larger coils stabilize the coil conglomerate within the aneurysm sac or AVF, preventing embolization and ensuring rapid coagulation and aneurysm or AVF exclusion. This advantage is of particular interest in high-flow AVFs, which may require tem-



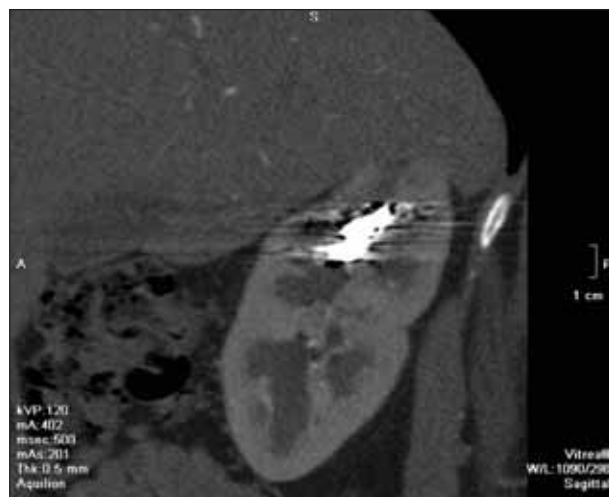


**Figure 9.** Severe tortuosity of the right renal artery. Note the Progreat catheter within the renal artery into the AVF. Large framing coils were placed into the fistula. Once flow was slowed, numerous Azur coils were placed, resulting in the cessation of flow through the fistula. The true detachable coils allowed for precise placement and prevention of embolization of the coils.

porary renal artery balloon occlusion to allow time for thrombosis with other techniques. Although some operators continue to use temporary balloon occlusion, even with framing detachable coils,<sup>7,8</sup> we have not found this to be necessary, and we consider avoidance of this need a distinct advantage. The detachable Azur coils used in this series are released with an electrocurrent. The use of electrocurrent seems to advantageously prevent last-minute movement of the coils that may be associated with the mechanical release mechanisms of other similar coil designs. It has also been suggested that the electrocurrent may confer an additional thrombotic advantage.<sup>11</sup>

## CONCLUSION

The techniques we have described have been successfully reported in several case reports and small series without loss of renal parenchyma.<sup>6,7</sup> Our experience provides further evidence that the use of microcoils and detachable coils is a safe and effective means of treatment for renal artery aneurysms and renal AVFs while limiting the risks associated with other endovascular techniques. The advantages demonstrated with these techniques apply with equal ease to other types of visceral artery aneurysms. As these techniques continue to



**Figure 10.** Follow-up CTA with obliteration of the AVF and preservation of flow to the right kidney.

improve, it is likely that they will become the treatment of choice for visceral artery aneurysm disease. ■

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