Current Challenges of Renal Artery Stenosis

An illustrative case report detailing technically difficult renal artery cannulation and angioplasty.

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As the prevalence and treatment of renal artery stenosis become more common, newer challenges arise. This case illustrates three such challenges: (1) the variable anatomy of the perirenal aorta, (2) the etiology and hemodynamic effect of renal artery lesions, and (3) the presence of restenosis.

Renal artery angioplasty and stenting via the retrograde femoral approach can sometimes be difficult due to the inferior and posterior course of the proximal renal artery segment. In some instances, the acute angulation of the renal artery precludes balloon and stent delivery. Some operators, therefore, prefer the brachial approach to allow for a more coaxial alignment. The brachial approach, however, leads to a greater incidence of vascular access site complications.[1] Furthermore, the manipulation of guiding catheters in an atherosclerotic aorta can cause serious complications from cholesterol emboli.[2-4] These technical difficulties with catheter manipulation can be further exaggerated by lesion location or the presence of restenosis.

Atherosclerosis accounts for approximately 90% of cases of stenosis within the renal arterial bed. Atherosclerotic lesions usually involve the origin and proximal third of the main renal artery and also the perirenal aorta.[5] Fibromuscular dysplasia (FMD) accounts for <10% of cases of renal artery stenosis, and usually involves the distal two-thirds of the main renal artery or its branches.[5,6] Additionally, with widespread use of endovascular stenting, the issue of in-stent restenosis is more commonly encountered.

This article describes a technically difficult case of renal artery angioplasty, or percutaneous transluminal angioplasty (PTA). The renal artery assumed an inferior course, arising with an acutely angulated origin from the aorta. Due to concern about the brachial approach in a small-sized patient, cannulation of the artery was performed via a retrograde femoral approach. The proximal portion of the vessel had severe restenosis of a previously stented atherosclerotic lesion. In addition, the distal portion of the main renal artery demonstrated classic FMD with associated high-grade stenosis. All of these factors combined make manipulation of the guiding catheter, wire, and balloon catheter very challenging.

CASE REPORT

An 81-year-old woman with a history of hypertension and renovascular disease underwent PTA and stenting of her ostial left renal artery stenosis in August 2002. A 5-mm X 15-mm balloon-expandable stainless steel stent was deployed and then postdilated with a 6-mm balloon. At that time, she was also diagnosed with distal left renal artery FMD (medial fibroplasia variety). This segment was treated with PTA alone, using a 5-mm balloon.

Renal angiography was performed 3 years later due to worsening renal function, increasing hypertension, and abnormal results of a renal duplex scan. These findings revealed proximal left renal artery in-stent stenosis, as well as recurrent narrowing at the site of

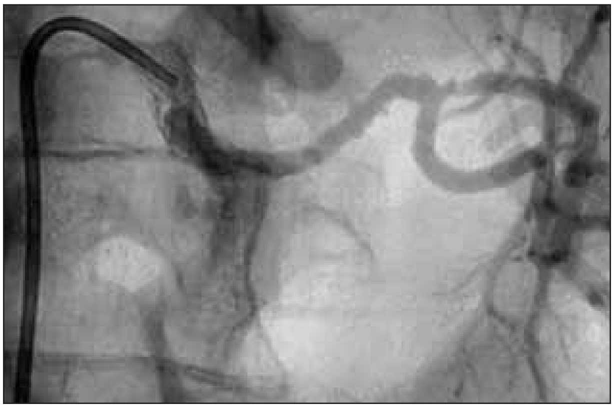

Figure 1. Cannulation and diagnostic angiography of the left renal artery with a Soft-Vu braided renal double curve catheter (AngioDynamics, Inc., Queensbury, NY). Note the acute inferior angulation at origin.

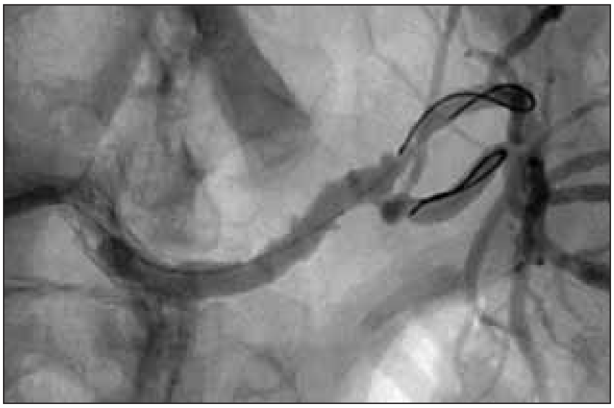

Figure 2. "Buddy wires" inserted into the renal artery render the aortorenal angle less acute. Note the proximal vessel in-stent restenosis and "ridges" of FMD in the distal vessel and branches.

FMD. At that time, the FMD was treated with repeat PTA using a 5-mm balloon. The proximal in-stent restenosis was treated with PTA and deployment of a 3.5-mm X 18-mm drug-eluting stent that was dilated after placement with a 5-mm balloon. More recently (November 2006), a follow-up renal duplex study again demonstrated an elevated peak systolic velocity of 407 cm/s in the proximal left renal artery and an increased renal/aortic velocity ratio of 3.7, suggesting recurrent stenosis. Therefore, the patient was referred for further endovascular assessment.

Nonselective renal artery angiography was performed and revealed an inferiorly directed left renal artery with an acute angulation from the abdominal aorta. Angiographic images revealed approximately 70% distal left renal artery stenosis (FMD) and 80% proximal in-stent restenosis. Selective renal artery cannulation was performed using a 5-F Soft-Vu braided renal catheter (AngioDynamics) over which a 6-F hockey stick guiding catheter was transitioned using a "telescoping technique." This technique of inserting the smaller-lumen 5-F braided renal catheter through the larger-lumen hockey stick guide catheter allows for less traumatic guide manipulation within the aorta. The two-catheter system was then placed in the abdominal aorta and the smaller-lumen braided renal catheter was carefully advanced to the renal artery ostium over a .035-inch wire. Initially, a .035-inch Wholey wire (Mallinckrodt, a Tyco Healthcare Company, St. Louis, MO) was used to hold the catheter tip away from the aortic wall. The tip of the braided renal catheter was then brought approximately 1 cm above and directed toward the origin of the renal artery. With gradual withdrawal of the wire, the catheter tip gently engaged the renal artery ostium. With use of this minimal touch technique, we successfully engaged the left renal artery without excessive catheter manipulation within the diseased aorta (Figure 1). Initially, an attempt was made to advance the .035-inch Wholey wire through the narrowed stent into the distal left renal artery. In theory, the bulbous tip of the Wholey wire would have had less chance of advancing behind the stent struts compared to .014-inch or .018-inch wires. In trying to advance the Wholey wire, the braided renal catheter disengaged from the renal artery ostium. However, after replacing the .035-inch wire with a .014-inch Abbott Asahi Prowater (Abbott Vascular, Abbott Park, IL), the wire was advanced successfully into the inferior pole of the distal left renal artery.

Due to the angulation of the renal artery and the location of the restenotic lesions, it was believed that catheter support, wire manipulation, and the ability to transition balloon catheters might be difficult. Therefore, another .014-inch Prowater wire (a "buddy wire") was passed into the superior pole of the left renal artery to provide extra support (Figure 2). The 5-F renal catheter was then removed after a 6-F hockey stick guiding catheter had been transitioned slowly to the ostium of the renal artery. The proximal and distal vessel lesions were dilated initially with a 3.5-mm X 20-mm AngioSculpt scoring balloon (AngioScore, Inc., Fremont, CA). While trying to withdraw the AngioScore balloon, one of the .014-inch Prowater wires inadvertently came out of the renal artery. Nonetheless, sufficient dilation of the stent and distal lesion had been performed by that time to allow passage of additional catheters. Subsequently, PTA of the proximal lesion was carried out with a 4.5-mm X 30-mm Sterling balloon (Boston

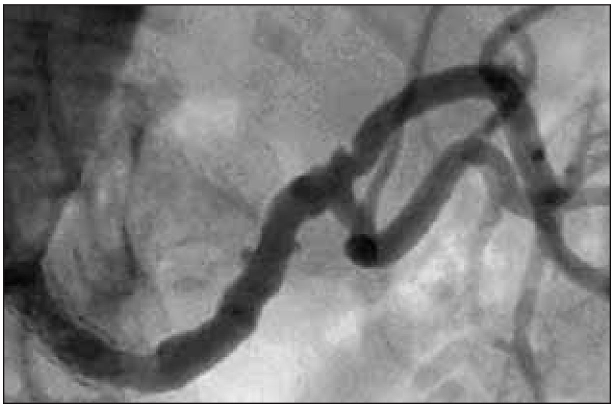

Figure 3. Final angiogram after PTA of the distal main renal artery and superior branch, plus PTA of the ostial in-stent restenosis.

Scientific Corporation, Natick, MA). Final angiographic images revealed a very good result (Figure 3).

DISCUSSION

Endovascular therapy for renal artery stenosis is made more challenging by acute angulation of the renal artery at the aorto-ostial location and by the presence of restenosis in previously treated segments. The technique used for cannulating the renal artery is important, not only for successful completion of the endovascular procedure, but also for limiting the serious complication of atheroembolism.

When trying to cannulate such vessels, the diagnostic catheter can be introduced through the guiding catheter using a less-traumatic telescoping technique. Alternatively, a minimal-touch or no-touch catheter placement technique can be utilized. This limits extensive probing of the aortic wall. The classic no-touch approach uses a .035-inch wire extending beyond the guiding catheter and is used to prevent the tip of the guide from scraping the aortic wall. A second wire is then advanced alongside the .035-inch wire and directed into the ostium of the renal artery. Of note, the guide catheter should not be advanced too far into the renal artery because the nontapered tip may disrupt the plaque at the ostium. These techniques should provide a safe and secure platform for vessel cannulation and subsequent endovascular intervention, so long as the guiding catheter is maintained in a coaxial position with respect to the renal artery.

A stable platform with good guide support becomes more important when delivering stents or balloon catheters into an inferiorly directed and acutely angled renal artery. Advancing two .014-inch wires into the distal renal arterial bed further reinforces guiding catheter support. Alternatively, when advancing wires through previously stented portions, the use of a bulbous-tipped .035-inch Wholey wire may prevent wire insertion behind or between stent struts. The formation of a safety J-curve to a .014-inch wire will also provide easy transition through a previously stented area. With wires in place, the access platform will usually remain stable and secure for lesion intervention.

CONCLUSION

The increase in the prevalence of renal artery angioplasty and stenting has led to a greater recognition of the problems associated with endovascular renal artery therapy. The variability in the aortorenal anatomy, the pathophysiology of the lesions, and the presence of restenosis make these cases more challenging. When performing challenging cases, it is essential to use techniques that will provide both good support for delivery of wires, balloon catheters, and stents, and minimize guide catheter manipulation in the perirenal aorta. The techniques that we have described can be utilized to obtain a good endovascular result, reduce the likelihood of atheroembolic debris, and thereby limit significant renal parenchymal damage. ■

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1. McNeill B, Rosenfield K. Peripheral intervention. In: Baim D, ed. Grossman's Cardiac Catheterization, Angiography, and Intervention. 7th ed. Philadelphia, PA: Lippincott Williams & Wilkins; 2006:562-604.
2. Watson PS, Hadjipetrou P, Cox SV, et al. Effect of renal artery stenting on renal function and size in patients with atherosclerotic renovascular disease. Circulation. 2000;102; 1671-1677.
3. Hiamoto J, Hansen KJ, Pan XM, et al. Atheroemboli during renal artery angioplasty: an ex vivo study. J Vasc Surg. 2005;41:1026-1030.
4. Cremonesi A, Castriota F, Manetti R, et al. Direct renal stenting. Endovasc Today. 2004;3:28-35.
5. Safian R, Textor S. Renal artery stenosis. N Engl J Med. 2001;344:431-442.
6. Slovut D, Olin J. Fibromuscular dysplasia. N Engl J Med. 2004;350:1862-1871.