Bifurcated Renal Artery Stenosis

Bifurcated RAS in a patient with refractory hypertension and pulmonary edema.

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Renal artery stenosis (RAS) can result in difficult-to-control hypertension or unexplained azotemia.[1,2] In addition, patients with bilateral RAS or its equivalent may present with recurrent congestive heart failure (CHF) or flash pulmonary edema.[3,4] Several reports have shown that percutaneous transluminal angioplasty (PTA) with stent implantation results in improvement in blood pressure control as well as prevention or amelioration of symptoms of recurrent CHF.[5-7] Major complications aside from recurrent flash pulmonary edema and hypertensive crisis include renal atrophy and dialysis.

CASE REPORT

A 75-year-old man was transferred to our institution for management of respiratory failure and non–ST-elevation myocardial infarction. His medical history was remarkable for hypertension, diabetes mellitus, chronic renal insufficiency, and chronic obstructive pulmonary disease. Examination on transfer was significant for blood pressure of 200/100 mm Hg; dullness to percussion at both lung bases; a regular heart rhythm with S1, S2, and S4; and mild bilateral pedal edema. Laboratory data were remarkable for troponin I elevation (peaked at 6 mg/dL) and a creatinine level of 2 mg/dL. Electrocardiography showed sinus rhythm with nonspecific repolarization abnormalities. Echocardiography revealed normal left ventricular systolic function without significant valvular disease.

A detailed review of the patient's hospital course in the transferring institution revealed that the initial respiratory failure occurred and resolved quickly. He had persistent uncontrolled hypertension with blood pressure exceeding 200/100 mm Hg despite treatment with four oral agents and a nitroglycerin drip. The patient confirmed that although he had hypertension for many years, it had been controlled with two medications, and more recently, this had morphed into more difficult-to-control hypertension. Additionally, he had experienced similar episodes of acute respiratory failure in the past.

CLINICAL DECISION MAKING AND ANGIOGRAPHIC FINDINGS

In light of the clinical presentation, we suspected that the patient has underlying coronary artery disease complicated by uncontrolled hypertension with a high likelihood of RAS.

Figure 1. Selective left renal artery angiogram showing a severe ostial stenosis.

Figure 2. Selective right renal artery angiogram demonstrating a severe ostial stenosis that involves a very proximal bifurcation.

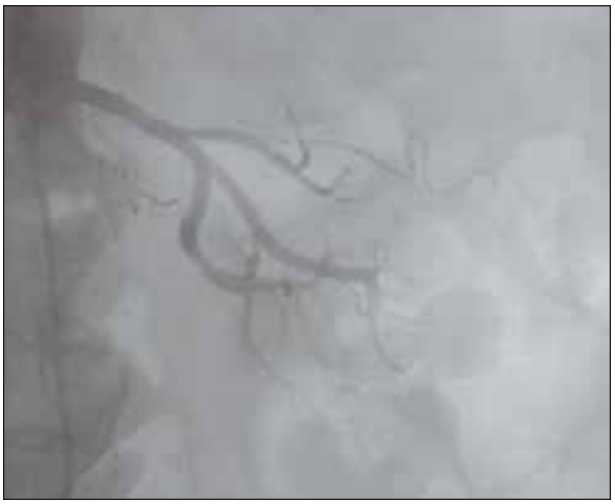

Figure 3. Final angiogram of the left renal artery after successful stent placement.

Therefore, we planned coronary and bilateral selective renal angiography. Coronary angiography revealed a 70% obstruction of the mid left circumflex coronary artery and a totally occluded proximal right coronary artery that was collateralized from the left anterior descending artery. Selective bilateral renal angiography showed a focal severe ostial left RAS (Figure 1) and severe stenosis at the origin of a bifurcated right renal artery involving the ostia of both branches (Figure 2).

PROCEDURE

Percutaneous revascularization of both renal arteries was performed in two stages to minimize the risk of contrast-induced nephropathy. The left RAS was treated first using standard technique, and a 5- X 15-mm Herculink Plus Rx stent (Abbott Vascular, Santa Clara, CA) was implanted successfully with an excellent angiographic result (Figure 3).

The subject of this case report is the technical challenge posed by the location of the right RAS. Intervention on the right renal artery was delayed for 3 days to ensure a stable creatinine level. Arterial access was obtained in the left common femoral artery with an 8-F X 10-cm Pinnacle sheath (Terumo Interventional Systems, Somerset, NJ). The right renal artery was engaged with an 8-F Hockey Stick guide (Medtronic Vascular, Santa Rosa, CA) using the "no-touch" technique. The 8-F guide was used to accommodate placing two stents simultaneously. Bivalirudin was used for anticoagulation. Wire cannulation of both branches of the right renal artery was very challenging due to the severity of the stenosis and the angulation of the branches. After failure of multiple wires, successful wiring of both branches was achieved using the Synchro standard wire (.014-inch X 190-cm) (Boston Scientific Corporation, Natick, MA). The Synchro wires do not provide adequate support for stent delivery; therefore, these wires were exchanged to high support coronary wires. The Twin Pass dual lumen catheter (Vascular Solutions, Minneapolis, MN) was used to enable this exchange.

Intravascular ultrasound (IVUS) (Revolution 45 MHz, Volcano Corporation, Rancho Cordova, CA) was then performed on both branches of the renal artery. IVUS revealed a very short right main renal artery segment with obstructive disease in this segment as well as the ostia of both branches (Figure 4). We decided to proceed with a simultaneous kissing stent technique. Two Quantum Maverick RX

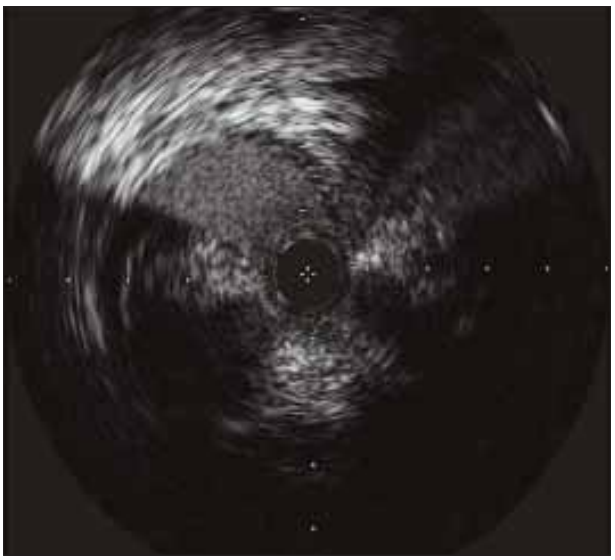

Figure 4. Preintervention IVUS image of the right main renal artery at its first bifurcation demonstrating a severe stenosis.

Figure 5. Simultaneous kissing balloon predilatation of the right renal artery bifurcation lesion.

Figure 6. Final angiogram of the right renal artery showing excellent post-kissing stent result. Final angiogram performed with guidewires in place to preserve guide position.

3- X 15-mm balloons (Boston Scientific Corporation) were advanced to the bifurcation lesion, and simultaneous kissing balloon inflation to 14 atm was performed (Figure 5). This was repeated with the balloons positioned more proximally, at the ostium of the main renal artery. Two 4- X 15-mm Vision ML RX stents (Abbott Vascular) were then positioned simultaneously in both branches with their proximal edges extending approximately 1 mm proximal to the ostium of the main renal artery into the aorta. The simultaneous kissing stent technique was then used to deploy both stents at 10 atm. The stent balloons were then used to postdilate the stents sequentially and then simultaneously. Repeat angiography showed optimal stent positioning without distal dissection (Figure 6). Repeat IVUS imaging revealed well-expanded and apposed stents that extended just beyond the ostium of the left renal artery (Figure 7).

The patient's hospital course was uneventful. On day 1 postprocedure, his blood pressure was in the range of 120 to 140 mm Hg. He was discharged home 2 days after the procedure with a stable creatinine level. The patient was placed on dual antiplatelet therapy (aspirin, clopidogrel) for 6 months. At 4-week follow-up, the patient was on two antihypertensive medications with good blood pressure control.

DISCUSSION

This case of RAS presents a technical challenge due to the ostial involvement of a bifurcated right renal artery with two important large branches. Both branches were large and were compromised at their ostia. The option of provisionally placing a single stent in one branch and performing PTA on the other was discussed, but we felt that this approach was unlikely to succeed in achieving an optimal result in both branches due to the severe disease of both ostia. The simultaneous kissing stent technique is used in coronary bifurcation lesions particularly when the stenosis involves both the ostia of the left anterior descending artery and the left circumflex artery with or without involvement of the distal left main coronary artery. The morphology of the right RAS in our patient is somewhat similar to the coronary morphology described above.

The use of IVUS in this case was very helpful in determining the exact location and the stenosis severity in both branches as well as the respective size of the branches. The use of the hydrophilic guidewires was instrumental in successfully cannulating both branches of the renal artery. It is critical, however, to point out that hydrophilic wires can increase the chances of distal perforations and should be exchanged to nonhydrophilic wires prior to proceeding with PTA and stent placement. In this patient, the use of the Twin Pass catheter enabled the exchange of the two short Synchro wires without the need for wire extension. We chose a coronary and not a biliary stent platform (both are considered off-label use for this indication) due to the low profile of the Vision stent, which enabled positioning two stents in the 8-F guide.

It is uncommon to require two stents for treatment of a RAS because the frequency of a lesion morphology requiring such strategy is very uncommon. Therefore, there are no data as to the rate of restenosis in these patients. If we were to extrapolate from the coronary intervention literature, it would be likely that lesions treated with two stents would have a higher restenosis rate than lesions requiring a single stent due to the more complex nature of lesions

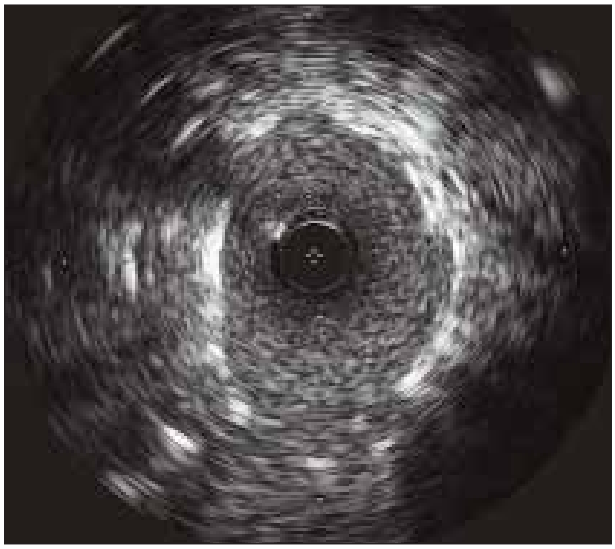

Figure 7. Postintervention IVUS image of the right main renal artery demonstrating excellent expansion and apposition.

requiring two stents. The use of duplex ultrasound imaging to determine stent patency at follow-up in this patient will be challenging due to the overlap in the proximal part of the stents. Therefore, we performed duplex ultrasound the day after intervention to provide a new baseline for future comparison.

CONCLUSIONS

Bilateral RAS is an underrecognized problem in patients with refractory hypertension and CHF. Renal artery PTA and stent implantation is an effective therapeutic modality in these patients. The majority of RAS are located at the ostium of a nonbifurcating artery and can be readily treated with single stent implantation. However, occasionally, RAS can involve an early bifurcation, posing a technical challenge. Bifurcation stenting techniques used in the coronary circulation can be adopted and, if necessary, modified to optimally treat this uncommon but difficult anatomic variant. ■

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