



## Secondary renal revascularization for recurrent renal artery stenosis

ERDAL ERTURK, MD; ANDREW C. NOVICK, MD; DONALD G. VIDT, MD; ROBERT CUNNINGHAM, MD

■ Six patients are presented who underwent secondary renal revascularization for recurrent renal artery stenosis. The initial pathologic diagnosis was fibrous dysplasia in three patients and atherosclerosis in three patients. All patients had initially undergone a successful aortorenal bypass operation. Recurrent renal artery stenosis and hypertension developed 11 to 120 months later (mean, 58 months). Secondary revascularization operations included renal autotransplantation (2 patients), hepatorenal bypass (2), ilioarenal bypass (1), and aortorenal bypass (1). Hypertension was relieved, and renal function was stabilized or improved in all cases. If hypertension recurs after renal revascularization, a recurrent but correctable lesion should be suspected.

□ INDEX TERM: RENAL ARTERY OBSTRUCTION, THERAPY □ CLEVE CLIN J MED 1989; 56:427-431

**S**URGICAL renal revascularization is well established as an effective form of treatment for patients who have severe hypertension, renal insufficiency, or both, resulting from renal artery disease. Recurrent stenosis of the surgically repaired renal artery is an uncommon complication that generally occurs months or years after the initial operation. Few reports have been published on the optimal method of management in such cases.<sup>1-3</sup> We believe that secondary revascularization is the treatment of choice in patients with functionally significant recurrent renal artery stenosis and a viable kidney. We describe six recent patients in whom this approach was employed. These cases illustrate the range of presentations and

available surgical options for relieving renal artery stenosis in this setting.

### CASE REPORTS

#### Case 1

A 64-year-old man initially presented in 1982 with a two-year history of hypertension. An aortogram at that time showed bilateral high-grade atherosclerotic renal artery stenosis. A left aortorenal saphenous vein bypass and a right saphenous vein patch angioplasty were performed. In 1984, recurrent hypertension developed. An aortogram showed complete occlusion of the right renal artery and stenosis of the left aortorenal bypass graft. A second left aortorenal saphenous vein bypass was performed, and the graft was anastomosed end-to-side to the aorta and end-to-side to the distal left renal artery.

Postoperatively, the patient's hypertension improved, but it subsequently recurred in 1987. The serum creatinine level at this time was 4.1 mg/dL. Aortography showed a severe diffuse stenosis of the distal portion of the left aortorenal saphenous vein graft (*Figure 1A*). Per-

From the Departments of Urology (E.E., A.C.N.) and Hypertension and Nephrology (D.G.V., R.C.), The Cleveland Clinic Foundation. Submitted July 1988; accepted Dec 1988.

Address reprint requests to A.C.N., Department of Urology, The Cleveland Clinic Foundation, One Clinic Center, 9500 Euclid Avenue, Cleveland, Ohio 44195.



A, B

FIGURE 1A. Case 1. Aortogram shows diffuse stenosis of the distal portion of aortorenal saphenous vein graft to solitary left kidney. FIGURE 1B. Intravenous digital subtraction angiogram showing unobstructed graft to left kidney (arrow) following left iliorenal bypass.

cutaneous transluminal renal angioplasty (PTRA) was attempted, but it was unsuccessful. The patient was then referred to the Cleveland Clinic for further treatment.

Surgical revascularization of the left kidney was performed with a left iliorenal graft anastomosed end-to-side to the left common iliac artery and end-to-end to the distal left renal artery. Since an autogenous vascular graft was not available, a bypass graft of polytetrafluoroethylene was employed. Histopathologic study of the stenotic left saphenous vein graft revealed subendothelial fibroplastic proliferation. A postoperative intravenous digital subtraction angiogram showed an unobstructed left iliorenal bypass (Figure 1B). Three months later, the patient was normotensive, and his blood pressure was controlled with modest antihypertensive therapy. The serum creatinine level was 2.8 mg/dL.

## Case 2

A 21-year-old woman was initially evaluated in 1978 for recent onset of hypertension. An arteriogram at that time showed severe right renal artery stenosis and mild left renal artery stenosis from fibrous dysplasia. A right aortorenal saphenous vein bypass was performed.

Although the patient was normotensive postoperatively, in 1982, recurrent hypertension developed. A repeat arteriogram showed a patent right aortorenal bypass and progressive left renal artery stenosis involving several branches. Extracorporeal left renal revascularization and autotransplantation were successfully performed, and the patient's blood pressure returned to normal.

In 1983, recurrent hypertension developed. Arteriography showed dilation of the right aortorenal saphenous vein graft with a severe distal stenosis involving two branches (Figure 2A)<sup>4</sup>; the previously repaired left renal arterial circulation was unobstructed. Extracorporeal right renal revascularization with a branched hypogastric arterial graft and autotransplantation were performed. A postoperative intravenous digital subtraction angiogram showed an unobstructed arterial supply to the revascularized right kidney (Figure 2B).<sup>4</sup> Four years postoperatively, the patient was normotensive, and no antihypertensive medication was required. The serum creatinine level was 0.9 mg/dL.

## Case 3

A 60-year-old woman presented initially in 1979 with poorly controlled hypertension. An aortogram at that



A, B

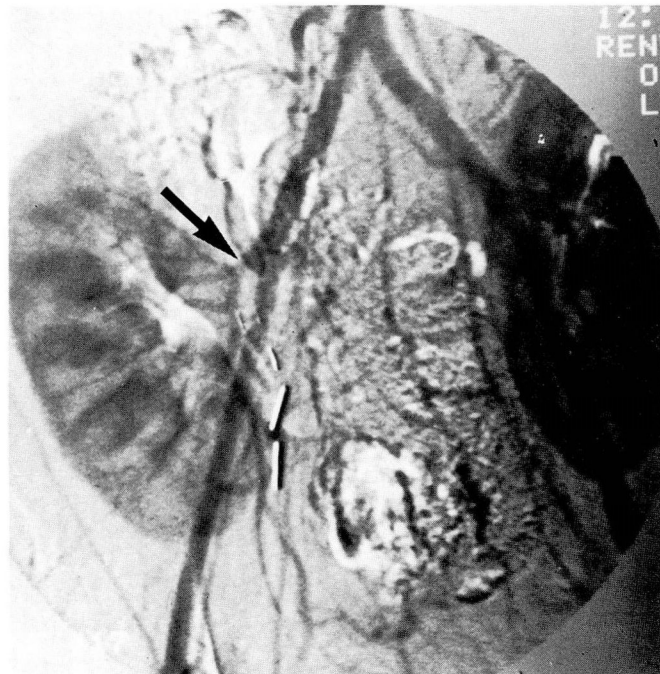
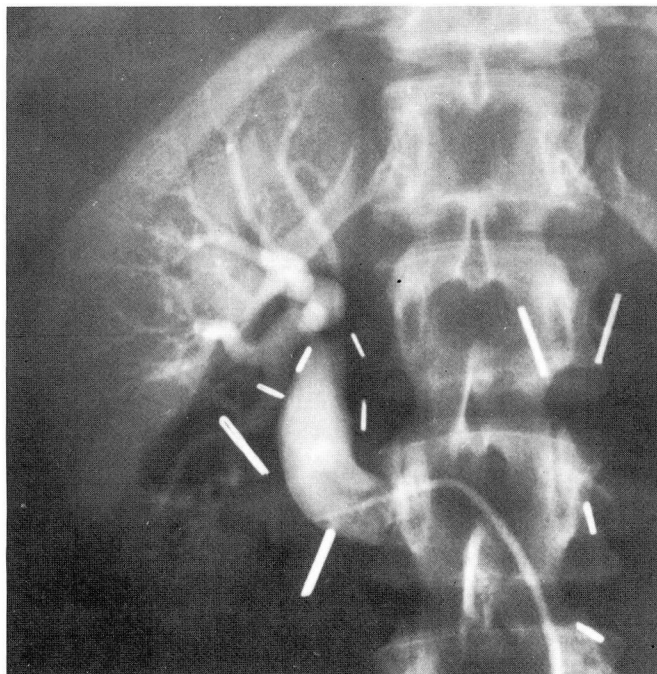


FIGURE 2A. Case 2. Right renal arteriogram demonstrates expansion of saphenous vein graft with distal stenosis involving renal artery branches. FIGURE 2B. Digital subtraction angiogram shows patent right main renal artery and branches (arrow) following extracorporeal right renal revascularization and autotransplantation. Note previously autotransplanted kidney in the left iliac fossa. Reproduced with permission from Jordan ML, Novick AC, Cunningham RL. The role of renal autotransplantation in pediatric and young adult patients with renal artery disease. *J Vasc Surg* 1985; 2:385.

time showed severe atherosclerotic proximal right renal artery stenosis and complete occlusion of the left renal artery. A right aortorenal bypass was performed using a synthetic graft that was anastomosed end-to-side to the infrarenal aorta and end-to-side to the distal right renal artery.

Postoperatively, hypertension improved, but subsequently it recurred in 1982. The serum creatinine level at this time was 6.8 mg/dL. On an aortogram, the previously placed right aortorenal bypass graft could not be visualized, indicating that it was occluded. In addition, there was almost total occlusion of the proximal portion of the native right renal artery from atherosclerosis (Figure 3). PTRAs were attempted, but it was unsuccessful. The patient was referred to the Cleveland Clinic for further treatment.

A repeat aortogram (anteroposterior and lateral views) showed patent celiac and hepatic arteries. Right renal revascularization with a hepatorenal saphenous vein bypass graft was performed. The saphenous vein was anastomosed end-to-side to the common hepatic artery and end-to-end to the distal right renal artery. At the same time, a simple left nephrectomy was performed.

Five years postoperatively, the patient's blood pressure was normal, and minimal antihypertensive therapy was required. The serum creatinine level was stable at 2.6 mg/dL.

#### Case 4

A 67-year-old man presented initially in 1970 with recent onset of severe hypertension. Aortography at that time showed severe atherosclerotic proximal right renal artery stenosis and complete occlusion of the left renal artery. A right aortorenal saphenous vein bypass operation was performed with anastomosis of the graft end-to-side to the aorta and end-to-end to the distal right renal artery.

Postoperatively, the patient was normotensive with medication, but in 1986, recurrent severe hypertension developed. The serum creatinine level was 2.6 mg/dL. Differential renal vein plasma renin assays lateralized to the right kidney with a ratio <2:1. Aortography at this time showed severe stenosis at the aortic origin of the right renal saphenous vein graft; lateral views showed patent celiac and hepatic arteries. Right renal revascularization with a hepatorenal saphenous vein bypass was





FIGURE 3. Case 3. Aortogram shows severe proximal stenosis of native artery to solitary right kidney. Previously inserted aortorenal bypass graft is occluded and not visualized.

performed. The saphenous vein was anastomosed end-to-side to the common hepatic artery and end-to-end to the distal right renal artery. One year postoperatively, the patient was normotensive, only minimal antihypertensive therapy was required, and the serum creatinine level was 2.0 mg/dL.

#### Case 5

A 12-year-old boy presented initially in 1986 with recent onset of hypertension. Arteriography at that time showed a normal left renal artery and stenosis of the right renal artery from fibrous dysplasia. PTRAs were attempted, but it was not successful. A right aortorenal saphenous vein bypass operation was performed, and the patient's blood pressure returned to normal. One year later, when his hypertension recurred, he was referred to the Cleveland Clinic.

A repeat aortogram showed stenosis of the right renal saphenous vein graft at the aortic origin with an unobstructed distal anastomosis; the left renal artery was normal (Figure 4). The serum creatinine level was 0.7 mg/dL. At surgery, only minimal scarring of the lower aorta was seen, and a secondary right aortorenal saphenous vein bypass operation was performed. The new vein graft was anastomosed end-to-side to the lower aorta and end-to-end to the distal right renal artery. A follow-up technetium renal scan showed improved perfusion and function of the right kidney as compared with a preoperative scan. One year postoperatively, the patient's blood pres-



FIGURE 4. Case 5. Aortogram shows stenosis of right renal saphenous vein graft at aortic origin. The left renal artery is normal.

sure was normal without hypertensive medication, and the serum creatinine level was 0.6 mg/dL.

#### Case 6

A 46-year-old woman presented initially in 1960 with recent onset of hypertension. Arteriography showed complete occlusion of the left renal artery and severe right renal artery stenosis from fibrous dysplasia. A right aortorenal bypass with a synthetic graft was performed. In 1962, recurrent hypertension developed, and an aortogram showed a stenotic right aortorenal graft. Synthetic aortic replacement was performed, and a right aortorenal saphenous vein graft was inserted at that time.

Twenty years later, in 1982, the patient's hypertension recurred, and she was referred to the Cleveland Clinic. Aortography showed severe stenosis of the proximal portion of the right renal bypass graft. The serum creatinine level was 36 mg/dL. Extracorporeal revascularization of the right kidney with a hypogastric arterial graft and autotransplantation to the iliac fossa were performed. Four years later, the patient's blood pressure was normal, and she required no medication. The serum creatinine level was 1.0 mg/dL.

#### DISCUSSION

The incidence of stenosis of a surgically repaired renal artery is <10% with current techniques.<sup>5</sup> Typically, it is a

late complication that may occur weeks, months, or even years after revascularization. The causes include faulty suture technique, intimal trauma, incomplete excision of primary vascular disease, tension on the vascular suture line, wide disparity in vessel size, torsion or kinking of the vessels, devascularization injury of a saphenous vein graft, and recurrent or de novo primary vascular disease. Other possible causes of persistent or recurrent post-reconstructive hypertension include renal parenchymal disease, essential hypertension, and untreated renal artery disease.

All patients who have undergone renal revascularization should be followed at six- to 12-month intervals with blood pressure measurements, renal function evaluation, and isotope renography with technetium. Post-operative renal artery stenosis that is more than 75% occlusive is invariably accompanied by elevated blood pressure and, not uncommonly, deteriorating renal function. If either of these conditions exists, or if there is serial isotope renographic evidence of diminished renal perfusion, repeat arteriography is indicated to evaluate the status of the repaired renal artery.

Although recurrent arterial stenosis is most often located at a vascular suture, it may be evident anywhere along the course of the repaired renal artery. All six patients reported here had previously undergone an aortorenal bypass operation, which is the most commonly performed revascularization technique. Focal fibrotic stenosis developed at either the proximal (3 patients) or distal (1) anastomosis of a saphenous vein bypass graft. One patient had diffuse stenosis of a saphenous vein graft due to subendothelial fibroplastic proliferation; this condition is considered a consequence of intimal vein graft damage from ischemia.<sup>6</sup> Complete thrombosis of an aortorenal synthetic graft that had been anastomosed end-to-side to the distal native renal artery developed in one patient. The native renal artery remained patent, and reoperation was then undertaken to relieve the proximal stenosis involving that vessel. All six patients

developed recurrent renal artery stenosis months or years (mean, 4.8 years) after their initial operation.

In patients who present with recurrent renal artery stenosis, the therapeutic options are medical management, PTR, and surgical reoperation. If hypertension is severe and the involved kidney has suffered irreversible ischemic damage, then a simple nephrectomy should be performed. If the involved kidney can be saved, an attempt to restore normal renal arterial flow should be made. Indeed, four of the six patients in this report presented with recurrent stenosis in a solitary kidney. Although there has been scant experience with PTR in this setting, this procedure may be a reasonable initial approach for focal stenotic lesions.

Secondary surgical revascularization is more likely to provide definitive therapy in such cases, but it is also technically complicated. Reoperation entails dissection in a surgical field obliterated by fibrous scar tissue, which may be particularly problematic when the surgeon attempts to mobilize the renal artery distal to the primary revascularization site. These problems can be minimized by employing alternate bypass techniques that avoid the previously operated-on aorta.<sup>7</sup> With extensive renal hilar fibrosis or branch arterial involvement, extracorporeal revascularization may provide the optimal technique to mobilize and repair the distal renal arterial circulation.<sup>8</sup> The cases in this report illustrate various approaches that may be effectively employed to achieve secondary renal vascular reconstruction.

#### SUMMARY

Secondary revascularization is the treatment of choice for patients with recurrent renal artery stenosis involving a functioning kidney. Nephrectomy should be reserved for patients with a non-salvageable kidney or patients in whom repeat reconstructive surgery is not possible for medical or technical reasons.

#### REFERENCES

1. Ekstrom S, Liljeqvist L, Nordhus O, Tidgren B. Persisting hypertension after renal artery reconstruction. A follow-up study. *Scand J Urol Nephrol* 1979; 13:83-88.
2. Stanley JC, Whitehouse WM, Zelenock GB, Graham LM, Cronewett JL, Lindenauer SM. Reoperation for complications of renal artery reconstructive surgery undertaken for treatment of renovascular hypertension. *J Vasc Surg* 1985; 2:133-142.
3. Fowl RJ, Hollier LH, Bernatz PE, Pairolero PC, Vogt PA, Cherry KJ. Repeat revascularization versus nephrectomy in the treatment of recurrent renovascular hypertension. *Surg Gynecol Obstet* 1986; 162:37-42.
4. Jordan ML, Novick AC, Cunningham RL. The role of renal autotransplantation in pediatric and young adult patients with renal artery disease. *J Vasc Surg* 1985; 2:385.
5. Novick AC, Ziegelbaum M, Vidt DG, Gifford RW, Pohl MA, Goormastic M. Trends in surgical revascularization for renal artery disease. Ten years' experience. *JAMA* 1987; 257:498-501.
6. Dean RH. Late results of aortorenal bypass. *Urol Clin N Am* 1984; 11:425-434.
7. Novick AC, Banowsky LH, Stewart BH, Straffon RA. Renal revascularization in patients with severe atherosclerosis of the abdominal aorta or a previous operation on the abdominal aorta. *Surg Gynecol Obstet* 1977; 144:211-218.
8. Novick AC. Management of intrarenal branch arterial lesions with extracorporeal microvascular reconstruction and autotransplantation. *J Urol* 1981; 126:150-154.