

# Renal Artery Stenosis and the Interventionist

Despite improved treatment options, the need for consensus among specialties remains.

BY JAMES A. M. SMITH, DO

**R**enal artery stenosis (RAS) has been recognized as a condition that predisposes individuals to worsening renal function, acceleration of hypertension, and ultimately to renal failure with all the ramifications thereof, including but not limited to progressive systemic atherosclerosis, coronary artery disease with myocardial infarction, congestive heart failure, dialysis, stroke, and even limb-threatening peripheral artery disease. The condition has been recognized and written about for decades in the surgical literature, nephrology journals, cardiology interventional journals, radiology literature, and numerous research journals.

Surgical intervention with revascularization of renal artery blood flow and now percutaneous intervention with angioplasty and stents has been widely touted in the medical literature for at least the last 30 years.<sup>1-3</sup> Interventional techniques—first with angioplasty alone, next with stents, and now with renal artery protection devices—continue to be advocated by physician leaders, industry, and especially those of us who perform catheter-based interventions. Despite all of the enthusiasm for intervention in patients with RAS, there is still no clear understanding or policy for intervention in this population of patients, and there remains great controversy among the medical specialists who treat them.

In various communities where I have practiced, I have found that there is a belief among some nephrologists that too many individuals are being treated for renal artery disease; however, many interventionists believe

that this group of patients is not being given the opportunity by nephrologists to receive intervention, preserve renal function, and improve control of hypertension. In fact, it seems that some nephrologists, rather than referring these patients for treatment, tend to look the other way and not identify patients who have RAS because they believe that medical treatment is just as effective as interventional therapy with angioplasty and/or stents. This belief has been supported in the medical literature.<sup>4</sup> Furthermore, subjecting these patients to surgical bypass for RAS is not without considerable morbidity and the need for prolonged hospitalizations. This is an ever-increasing problem because fewer surgical reconstructions are being done.

It seems that the ideal solution for patients with renal artery atherosclerosis would be a minimally invasive technique with few complications and excellent potential for sustaining renal artery blood flow. Furthermore, preservation of blood flow should theoretically preserve renal size and prevent atrophy with its associated decline in renal failure. In patients whose RAS activates the renin angiotensin axis, there should be better control of blood pressure with fewer medications, as well. This is supported by registry results in 1,058 patients with normal or only mildly impaired renal function.<sup>5</sup> Because of the complexity of the blood pressure mechanisms involved in the kidney, the predictability of blood pressure influence is weak at best. One must also consider a variety of other factors, including aldosterone production, cardiac output, and even the presence of carotid artery disease and its potential influence

on renin production and activation of angiotensin with its influence on systemic blood pressure as well. Thus, the existence of RAS alone does not imply that it is the only component that influences blood pressure control. It is well known, however, that narrowing in the renal artery ultimately influences the size of the kidney, and progression of RAS will lead to deterioration in renal function. In most of these patients, control of hypertension also becomes more difficult, and the influence on other target body systems can be devastating. Prevention of renal failure and the need for dialysis would strongly influence the clinical course of many patients; however, intervention with no hope of maintaining renal function may actually worsen the clinical course in these patients. In addition, failure of the procedure to prevent dialysis or stroke, heart failure, or myocardial infarction makes it vital that we be able to predict who can benefit from this procedure in the first place.

Why then do specialists argue about who should be treated and which treatment is best in these individuals? One reason may be that there has never been a proven technique for curing hypertension nor has there been proof that angioplasty with or without stents prolongs longevity or controls hypertension any better than aggressive medical management with medication. With the exception of RAS from fibrous dysplasia, which is generally treated with angioplasty alone, there remains great controversy as to who should be offered percutaneous interventions. From the view of the interventionist, issues remain as to which stent, which protection device, and what best therapy should be offered after the intervention to manage and prevent recurrence of the problem.

## INTERVENTIONAL ISSUES OF CONCERN

### Microembolism

Similar to carotid interventions, it is generally accepted that microembolization occurs when a patient receives angioplasty with or without stents. This problem undoubtedly will contribute to the degree of success of the procedure. In the brain, there is extensive documentation by transcranial Doppler that “hits” occur with or without endovascular protection, yet clinical manifestations (eg, overt stroke) are surprisingly uncommon. This suggests that the brain has a tremendous capacity to tolerate microembolic events, or that our ability to discern nonmotor insults to the cerebral hemisphere is lacking. Similarly, the lung can tolerate multiple small pulmonary emboli while the patient presents with subclinical findings that are frequently not life-threatening.

It is fairly safe to assume that microembolism in the kidney has a negative and detrimental effect. As one potential etiology for failure of angioplasty and stents to preserve renal function and at least partially control hypertension, it can be assumed that elimination of this complication will help optimize the result of the procedure. There have been reports on and there are advocates for using renal protection devices during the procedure; however, there is no specific device designed for the renal artery. Furthermore, the existing devices used off-label can potentially damage the kidney because of close proximity of the filtration device beyond the stent, which makes delivery and retrieval very cumbersome. Any additional manipulation in the kidney increases the likelihood of embolization, and despite the 0.014-inch delivery systems to deliver these devices, deployment and movement during the procedure and retrieval are fraught with potential complications even in the most experienced operators. The design of the embolic protection devices for the carotid artery can make off-label use hazardous in the kidney; the major problem is one of design. The landing-zone requirement in a straight segment of the carotid artery is such that deployment in a renal artery can and will be very difficult.

The FiberNet EPS (Lumen Biomedical, Inc., Plymouth, MN), which was approved by the US Food and Drug Administration on November 19, 2008, has a much shorter landing zone than that of carotid protection devices, and efficacy in the pilot study for approval suggests that it has the lowest stroke rates for any filter currently available in the United States market. The FiberNet EPS is a low-profile system capable of capturing debris in vessels ranging from 3.5 to 7 mm in diameter. The landing zone for deployment is 1.5 cm and has the ability to contour to the shape of the artery beyond the stenotic segment. In preliminary trials, this device in conjunction with an accompanying extraction catheter has the ability to apply negative suction before and during retrieval of the filter. As with the carotid protection devices, use in the renal artery would be off-label.

### Contrast Nephropathy and Other Issues Regarding Intervention

Contrast nephropathy remains a major problem during interventional procedures. Although fluid prophylaxis with sodium bicarbonate and acetylcysteine provides some degree of protection for patients with renal insufficiency, it remains incumbent on the operator to use the absolute minimum amount of contrast necessary for the performance of the procedure. Reviewing old films to see the renal anatomy before the interven-

tion can save considerable contrast and effort in cannulating the renal artery to be treated. This is often an overlooked issue due to the volume of the patients we treat, but these films can be extremely beneficial when trying to minimize dye exposure.

Exposure of the patient to contrast should not be an issue in the referral of most patients. These interventions can frequently be completed with < 20 mL of contrast administration, and it should be the goal of all operators to limit the exposure of the patients undergoing these procedures. Nonionic contrast may be diluted in patients with a small body habitus. This will permit the use of lower contrast volumes and lessen the potential for nephrotoxicity.

Achieving euglycemia before the intervention should be the goal in patients with diabetes. In patients with significant proteinuria, the potential for success should be questioned ahead of time because the etiology for renal insufficiency is likely due to a cause other than incidentally found RAS.

The renal resistive index (RRI) has potential to further eliminate those patients who will not benefit from renal revascularization. As part of the renal duplex evaluation the RRI is calculated by the following formula:  $RRI = [(Peak\ systolic\ velocity - end-diastolic\ velocity) / peak\ systolic\ velocity] \times 100$ . These calculations are averaged over four to six measurements in the upper, middle, and lower poles of the kidney.

Initially described by Radermacher,<sup>6</sup> the RRI correlates highly with outcomes for renal intervention. Patients with RRI > 80% have poor outcomes with regard to hypertension control after revascularization because their disease is primarily within the renal parenchyma. In one study, patients who underwent revascularization with RRI < 80% benefited most with regard to control of their hypertension and avoidance of dialysis.

## BENEFITS AND GOALS OF REVASCLARIZATION

It seems logical that we need to predict the degree of potential success before we subject patients to renal interventions. Renal duplex scanning is a valuable tool in the diagnosis of RAS. It provides detailed information with regard to renal artery velocities, kidney size, and assessment of cortical integrity.<sup>7</sup> Functional testing using angiotensin-converting enzyme inhibition also has a role in predicting who might respond to intervention,<sup>8</sup> as does the clinician's assessment of the patient based on longevity of the hypertension, recent change in severity or lack of blood pressure control, and the need for additional medications to control the blood pressure.

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The surgical literature and some of the medical literature support intervention for RAS in select patients. However, previous studies have not described patient selection adequately nor have the issues mentioned in this article been addressed to select the best patients for this procedure. What we currently have is a mixed bag of results from nonrandomized patients with variables that have not been well outlined or controlled. In order for any of our results to be meaningful, it will be necessary to control as many of these variables as possible. By doing so, it is likely that this procedure will be endorsed as a viable alternative to prevent both progression to renal failure and a method to improve blood pressure control in carefully selected individuals. Furthermore, a consensus can be developed among cardiovascular experts including cardiologists, vascular surgeons, vascular radiologists, and nephrologists for improved patient outcomes. Management of lipid pathology and the use of antiplatelet medications for control of as many variables as possible are also extremely important when considering the best treatment for those patients afflicted with this disease. ■

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