Management of Renal Arterial Disease

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KEYWORDS

• Atherosclerotic renal artery stenosis • Renal artery stenting • Resistant hypertension
• Ischemic nephropathy • Cardiac disturbance syndrome

KEY POINTS

- Noninvasive testing can be used for screening for renal artery stenosis in the patient presenting with symptoms consistent with renovascular disease.
- Invasive testing and intervention can be performed safely by the experienced operator, with a high success rate.
- Patient history and workup are vital to determine the appropriate candidate for revascularization.
- Revascularization is appropriate in patients with cardiac disturbance syndromes (recurrent flash pulmonary edema, heart failure, and unstable angina), refractory or malignant hypertension, and ongoing renal ischemia.
- Contemporary randomized controlled trials affirm that optimal medical therapy should be first implemented before pursuing revascularization in most cases.

INTRODUCTION

The influences of the renal system on cardiovascular health have been described as early as 1836 by Richard Bright.[1] In 1934, Goldblatt, working in the Western Reserve of Cleveland, described a method by which sequential, partial constriction of both renal arteries in a dog reliably produced hypertension.[2] During the next 25 years, investigators sought the pathway that would later become the enzymatic relationship between renin and angiotensin.[1]

It is now well established that renal artery stenosis activates the renin-angiotensin-aldosterone system (RAAS), causing systemic hypertension. The most common cause of renal artery stenosis is atherosclerosis. Other less prominent causes include fibromuscular dysplasia (FMD), vasculitis, embolic phenomenon, and trauma. Owing to the prevalence of atherosclerotic renal artery stenosis (ARAS) and the continued debate on its clinical management, this review addresses the pathophysiology and management of the condition.

ARAS is defined as stenosis 50% or more in the proximal one-third of a renal artery.[3] ARAS has been estimated to affect 1% to 5% of patients with essential hypertension.[4] The prevalence increases to 20% to 40% in certain patient populations, for example, in patients with severe or refractory hypertension, with documented multivessel coronary artery disease, and with newly

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initiated hemodialysis.[5–7] The presence of ARAS is associated with atherosclerotic disease in other vascular beds, which renders it an important surrogate for coronary, carotid, and peripheral arterial disease.[4,8,9]

The common clinical scenarios that prompt a clinician to consider the diagnosis of ARAS include the following:

1. A patient with poorly controlled hypertension despite the use of multiple antihypertensives
2. A patient with chronic kidney disease whose kidney function worsens with initiation of an RAAS blocking agent
3. A patient with recurrent flash pulmonary edema despite a normal left ventricular systolic function (**Box 1**)[10–12]

The diagnosing clinician must exercise vigilance, as it is feasible that the presence of ARAS is simply a bystander of an underlying medical renal disease from another cause, such as diabetic nephropathy. Similarly, the concomitant presence of hypertension and renal artery stenosis in a patient does not always imply the diagnosis of renovascular hypertension, as hypertension is known to result in increased systemic atherosclerotic burden and may in fact lead to ARAS.[13]

Appropriate patient selection for referral for renal artery revascularization is vital for procedural success and adequate clinical response. The favorable patient profile includes hemodynamically significant stenoses in bilateral renal arteries or in a solitary kidney, cardiac disturbance syndromes consisting of flash pulmonary edema or exacerbation of coronary ischemia in setting of peripheral arterial vasoconstriction, and ischemic nephropathy resulting in a rapid decline of renal function.[14–16] These characteristics are highlighted in the most up-to-date American College of Cardiology/American Heart Association (ACC/AHA) Practice Guidelines and reflect class I and II recommendations for renal artery revascularization (**Table 1**).

Box 1
Common clinical scenarios to prompt workup for renal artery stenosis

Indications for noninvasive testing for atherosclerotic renal artery stenosis

- Cardiac disturbance syndromes
  - Recurrent flash pulmonary edema
  - Refractory heart failure
  - Refractory unstable angina
- Hypertension
  - Accelerated, defined as sudden and persistent worsening of previously well-controlled hypertension
  - Resistant, defined as inability to achieve goal blood pressure with greater than or equal to 3 antihypertensive agents
  - Malignant, defined as coexistence with end-organ damage
  - Onset of hypertension at a young age (<30 years old)
- Rapidly progressive renal dysfunction
  - Acute worsening of kidney dysfunction with initiation of an RAAS blocking agent
  - New initiation of renal replacement therapy
- Asymmetric atrophic kidney with greater than 1.5 cm discrepancy in size
- Evaluation of a prior renal artery stent

Data from Hirsch AT, Haskal ZJ, Hertzer NR, et al. ACC/AHA 2005 guidelines for the management of patients with peripheral arterial disease (lower extremity, renal, mesenteric, and abdominal aortic): executive summary a collaborative report from the American Association for Vascular Surgery/Society for Vascular Surgery, Society for Cardiovascular Angiography and Interventions, Society for Vascular Medicine and Biology, Society of Interventional Radiology, and the ACC/AHA Task Force on Practice Guidelines (writing committee to develop guidelines for the management of patients with peripheral arterial disease) endorsed by the American Association of Cardiovascular and Pulmonary Rehabilitation; National Heart, Lung, and Blood Institute; Society for Vascular Nursing; TransAtlantic Inter-Society Consensus; and Vascular Disease Foundation. J Am Coll Cardiol 2006;47(6):1239–312; and Gerhard-Herman M, Gardin JM, Jaff M, et al. Guidelines for noninvasive vascular laboratory testing: a report from the American Society of Echocardiography and the Society of Vascular Medicine and Biology. J Am Soc Echocardiogr 2006;19(8):955–72.

PATHOPHYSIOLOGY

The presence of renal artery stenosis results in decreased perfusion pressure to the juxtaglomerular apparatus (JGA), prompting the release of renin. Activation of the RAAS results in subsequent retention of salt and water to create a hypertensive milieu and increased perfusion back to normal in the poststenotic JGA and its associated nephron (**Fig. 1**). Unilateral ARAS creates a concomitant increase in flow to the nonstenotic kidney. Pressure natriuresis occurs in the contralateral and unaffected kidney, ultimately resulting in a decrease in systemic blood pressure back to normal. In bilateral ARAS, RAAS activation increases the perfusion pressure of the poststenotic JGA back to normal. However, the lack of natriuresis causes