Interventional Radiology
GRAND ROUNDS

Topic: Renovascular Hypertension

Hypertension affects an estimated 10 percent to 25 percent of the U.S. population. Of these, the great majority have primary elevation of blood pressure, which can be ameliorated with pharmacological treatment. A subset of patients — an estimated 3 percent to 8 percent — have secondary hypertension attributable to renovascular disease caused by narrowing of the renal artery.[1-2] Diminished perfusion to the kidney results in increased renin secretion and production of angiotensin II, leading to systemic vasoconstriction and retention of salt and water. Renovascular hypertension may be present when systemic blood pressure is normal.

Renovascular hypertension has emerged as a major cause of end-stage renal disease, especially in the elderly. As the U.S. population ages, the number of individuals with atherosclerotic disease will increase, as will the number with renovascular hypertension and end-stage renal disease. White males and blacks of both sexes are at increased risk.

Suspect renovascular hypertension when:

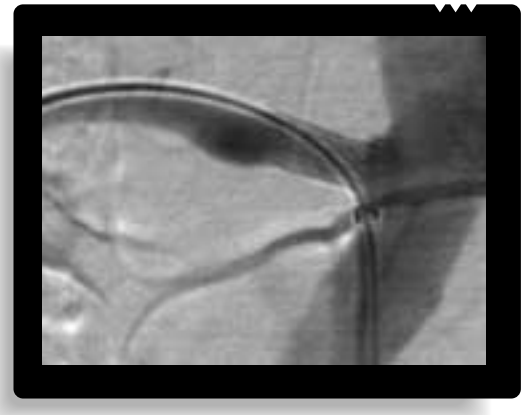
- Onset of hypertension is ≤ 30 or ≥ 50 years of age
- Hypertension is accelerated, resistant to treatment or difficult to control
- Fundus hypertonia is Grade III-IV
- Epigastric bruit is detected
- Kidney is atrophic or there is discrepancy in renal sizes
- Patient becomes azotemic during ACE inhibitor therapy
- Atherosclerosis is generalized
- There is recurrent pulmonary edema

Etiology

Vascular occlusive disease may affect different segments of one or more vessels in one or both kidneys. The most common cause, affecting approximately two-thirds of patients, is atherosclerosis, typically seen in patients over the age of 50. Atherosclerotic stenoses are usually found at the

Figure 1
Typical appearance of renal artery narrowing (arrow).

Figure 2
Renal artery after stent placement.



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ostium of the renal artery or in the proximal third of the vessel. Fibromuscular dysplasia, which tends to occur in younger patients, includes a group of conditions in which fibrous or muscular proliferation results in a variety of morphological renal artery narrowings that usually spare the ostium. Other causes of renal occlusion include trauma, embolism, vasculitis, aortic dissection and neoplasms.

Clinical Diagnosis

Renovascular hypertension is suspected when the onset of hypertension occurs before the age of 30 or after the age of 50, or when previously stable hypertension becomes more difficult to control. Most often, no clinical symptoms are present, although in severe cases patients may experience fatigue, confusion, vision changes, nausea and vomiting, anxiety, excessive perspiration or angina-like chest pain.

Confirming the diagnosis of renovascular hypertension generally includes both biochemical workup and imaging studies. Biochemical workup is focused on the detection of elevated levels of plasma renin activity. The sample is usually collected before and after administration of the ACE-inhibitor captopril. The test is less useful in patients with impaired renal function, and attempts to improve accuracy of plasma renin activity measurements may include direct renal vein renin sampling.

Diagnostic imaging modalities include:

- Renal scintigraphy. The most widely accepted non-invasive imaging test requires intravenous administration of a radioactive isotope to evaluate the degree of renal uptake before and after administration of captopril. Reported sensitivities are variable. Positive ACE inhibitor-enhanced renography best identifies patients who are likely to experience improvements in blood pressure after revascularization. When resolution of hypertension following revascularization is considered a positive endpoint, the sensitivity may reach 93 percent.[3]
- Color duplex ultrasound. Ultrasound is a readily available, noninvasive screening method that detects flow disturbances in the renal vasculature. The procedure is quite operator-dependent and has the usual limitations of abdominal ultrasound attributable to the presence of bowel gas.
- Magnetic resonance (MR) angiography is being increasingly used in the diagnosis of renal artery stenosis, and is considered the standard of care at some institutions.
- Renal arteriography. Angiography remains the gold standard but the test is invasive. It does not necessarily indicate which patients will benefit from revascularization. In patients who are at risk for contrast-induced nephropathy, alternative contrast agents such as CO_2 and gadolinium are available.

Complications of renovascular hypertension

- Early death
- Hypertensive heart disease
- Myocardial infarction
- Congestive heart failure
- Renal insufficiency/failure
- Stroke
- Retinopathy

Treatment Options

Renovascular hypertension is a complex disorder and treatment options depend on the type, location and extent of disease, as well as the presence of other concomitant vascular or nonvascular diseases. According to the report of the National High Blood Pressure Working Group, treatment of

hypertension to the goal of 130/85 mm Hg is recommended with whatever therapy is necessary to prevent the development of hypertensive nephrosclerosis or the progression of established renal disease of diverse causes.[4]

Noninterventional treatment options include close observation and follow-up, medical management of hypertension and other risk factors such as hyperlipidemia, and lifestyle changes such as exercise programs and smoking cessation. More aggressive interventions are indicated in patients with poorly controlled hypertension with concomitant congestive heart failure or renal insufficiency.

Interventional radiology treatments include percutaneous transluminal angioplasty and intravascular stenting. Surgical treatments, including endarterectomy, bypass and nephrectomy, are primarily reserved for patients undergoing aortic bypass, aneurysm repair or other operative procedures. Otherwise, angioplasty and/or intravascular stenting have become the standard of care in most institutions.

Interventional Radiology Treatments

The goals of interventional radiology treatments for renal occlusive disease are normalization of blood pressure or improvement in its control with medications, and improvement or preservation of renal function.

Percutaneous transluminal angioplasty (PTA)

Although cure of hypertension in patients with atherosclerotic renal disease is relatively uncommon (≤ 25 percent), improvement in control has been reported in 34 percent to 90 percent of patients treated with PTA. Results with PTA are significantly better in the treatment of patients with fibromuscular disease, with published studies reporting cure or improvement in hypertension in 76 percent to 100 percent of patients. In patients with renal failure, revascularization has gained acceptance as a means of improving or stabilizing renal function, with improvement seen in approximately 40 percent of patients.[5] Its use will probably increase as awareness of the benefits and relative low risk of PTA become more widely understood.

Renal stenting

Renal stenting is most commonly used to treat ostial atheromas. The most common indication for stent placement is immediate elastic recoil of the vessel after conventional PTA. Dissection after PTA with compromise of the lumen is also an indication for stent placement. Clinical studies to date do not support the routine use of intravascular stents.

Factors affecting clinical success after PTA for atherosclerotic lesions

- Age
- Baseline renal function
- Condition of the contralateral kidney
- Diabetes
- Duration and severity of hypertension
- Kidney size
- Lipid metabolism and diet
- Medication regimen (antiproliferative effects of pharmacologic agents)
- Smoking history
- Presence and type of renal parenchymal disease

In a multi-center trial of renal stenting, Kaplan-Meier life-table analysis showed improvement or cure of hypertension in 91 percent at one month, 84 percent at three months, 70 percent at six months and 61 percent at 12 months. In patients with renal insufficiency, improvement was noted in 34 percent, stability in 39 percent and deterioration in 27 percent at the longest follow-up (mean

7.9 months).[5] Patients in the trial were generally elderly and a high risk, with a high prevalence of widespread atherosclerotic disease and renal insufficiency.

Restenosis rates of approximately 30 percent at one year have been reported for both renovascular PTA and stenting. An accurate comparison between PTA and stents cannot be made, however, because most patients undergoing stent placement underwent unsuccessful PTA and were at higher risk for restenosis.[5] Patients can be followed with noninvasive studies, and revascularization can be repeated when restenosis occurs.

References

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