patients with hypertensive nephrosclerosis have mild hypertension. The risk is greater for those who have had poorly controlled hypertension and for those of African descent, who are at particularly high risk for hypertensive nephrosclerosis. Polymorphisms in the genes that encode for apolipoprotein L1 *(APOL1)* and podocyte nonmuscle myosin heavy chain 9 *(MYH9)* are found more commonly in African Americans compared with European Americans and strongly associate with the risk of hypertensive nephrosclerosis. A diagnosis of hypertensive nephrosclerosis as the cause of otherwise unexplained CKD is much less likely to be made in white patients compared with black patients, particularly in the absence of long-standing, severe hypertension or a history of malignant hypertension.

The diagnosis of hypertensive nephrosclerosis is typically based on a history of long-standing hypertension that precedes development of proteinuria and CKD in the absence of other causes. The urinary sediment is typically bland, with only low-grade proteinuria (<1 g/day). Symmetrical loss of renal cortical thickness is commonly found on renal ultrasound.

Pharmacologic treatment of severe hypertension reduces the risk for progression of CKD to ESRD in many patient populations, providing further evidence for the causative role of hypertension. The optimal blood pressure for patients with hypertensive nephrosclerosis has not been determined. For black patients, this was best addressed by the African American Study of Kidney Disease (AASK) trial, which examined more than 1000 African Americans with long-standing hypertension, slowly progressive CKD, and low-grade proteinuria. Subjects were allocated to treatment with ramipril, metoprolol, or amlodipine to a blood pressure goal of 125/75 mm Hg or 140/90 mm Hg. The mean rate of change in GFR and the rate of other secondary outcomes were similar in the two groups, suggesting that lowering blood pressure to less than 140/90 mmHg does not provide further benefit in slowing CKD progression in black patients with hypertensive nephrosclerosis. However, there was a trend favoring the lower blood pressure goal for patients with higher baseline proteinuria.

Lower blood pressure goals may also be appropriate for patients with other comorbid conditions such as diabetes mellitus. Besides affecting CKD progression, blood pressure control reduces the risk of heart failure and stroke. Most patients with hypertensive nephrosclerosis and CKD require multiple antihypertensive medications to control blood pressure, typically including a thiazide or thiazide-like diuretic (when GFR is well preserved) and a loop diuretic (as the GFR declines to less than 25 to 30 mL/min), along with an ACE inhibitor or ARB, calcium-channel blocker, and β-blocker.

Atheroembolic Disease

Atheroembolic disease is the result of cholesterol embolization from atherosclerotic plaques, most commonly from the aorta and typically dislodged during an invasive arterial procedure such as cardiac catheterization, aortic angiography, cardiac surgery, or surgery on the aorta. Cholesterol emboli may occur spontaneously or may be precipitated by systemic anticoagulation, such as with heparin, or during systemic administration of thrombolytic agents. Because patients must have underlying atherosclerosis, the incidence increases with age, and atheroembolic disease rarely occurs before 40 years of age.

As the result of systemic embolization from atheromatous plaques, cholesterol crystals lodge in small arterial vessels, including the arcuate or interlobular arteries of the kidneys. Cholesterol emboli frequently involve other organs, and the pattern of organ involvement depends in part on whether disrupted plaque is in the ascending or descending aorta. The extremities are commonly affected with digital ischemia and gangrene, the skin with livedo reticularis, and the gastrointestinal tract with intestinal ischemia, but any organ can be affected. Embolization from the ascending aorta can cause cardiac ischemia, and emboli arising from the ascending aorta or carotid arteries (e.g., after carotid endarterectomy) can cause stroke.

Cholesterol embolization to the eye may be recognized by finding Hollenhorst plaques on funduscopic examination, which are whitish yellow flecks at retinal arteriole bifurcations. They are often asymptomatic but may cause retinal ischemia with usually transient visual field defects.

Patients with atheroembolic disease may have fever, eosinophilia, eosinophiluria, and hypocomplementemia, particularly acutely. Laboratory findings include an elevated erythrocyte sedimentation rate and elevated levels of amylase or liver enzymes. The widespread systemic clinical and laboratory manifestations of atheroemboli can lead to a clinical picture suggesting systemic vasculitis.

The typical pattern of renal atheroembolic disease is a decline in kidney function that first becomes apparent 3 or more days after an inciting procedure or other event. The degree of acute and chronic kidney injury that follows is determined by the magnitude of the embolic burden, whether atheroembolism is a one-time or ongoing process, and the degree of inflammation induced by the plaque material. Many patients have stabilization of the process after the initial insult, whereas others progress with various patterns and tempos to advanced CKD and ESRD. Cholesterol embolization also may cause severe hypertension due to acute renal ischemia leading to renin release.

Diagnosis of renal atheroembolic disease is usually made clinically in the appropriate setting, but for some patients, a kidney biopsy is needed to confirm the diagnosis and exclude others. Because the fixation process washes out the cholesterol crystals from the renal biopsy sample, the pathologic examination reveals a typical needle-shaped disruption in the arterial lumen surrounded by reactive endovascular cells.

There is no specific treatment for cholesterol emboli. Because an inflammatory reaction typically results from the emboli, some physicians advocate corticosteroids, but their use is unproved for preventing further atheroembolism or progression of kidney failure. Avoidance of anticoagulation has been recommended to prevent dissolution and embolization of thrombus that may overlie an atheromatous plaque. Statin therapy is appropriate for most patients for treatment of their underlying atherosclerotic disease, but it has not been shown to influence the renal manifestation of atheroemboli. Treatment with ACE inhibitors or ARBs may be effective for hypertension control in the acute setting, but worsening kidney function may limit their use. Dialysis may be necessary if AKI and ESRD develop.