How Does Sympathetic Denervation By Endovascular Renal Artery Radiofrequency Ablation Work
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Recently developed endovascular catheter technology has allowed selective denervation of the human kidney using radiofrequency energy delivered via the renal artery lumen. Evidence to date indicates that renal nerve ablation is safe and effective in treating diseases associated with increased sympathetic tone. Catheter-based renal nerve ablation (CBRNA) interrupts both efferent (motor nerves projecting to kidney) and afferent nerve fibers (sensory nerves projecting from the kidney). It is well established that activation of renal efferent nerves can decrease renal blood flow, increase tubular reabsorption of sodium and water, and increase renin release from the kidney. As such, ablation of efferent nerves should have a significant impact on the regulation of blood pressure (BP) secondary to renal vasodilation, increased sodium excretion and decreased activity of the renin angiotensin system. However, there is emerging evidence that renal afferent signaling may be just as important as renal efferent activity in elevating BP in hypertensive patients. Activation of renal afferents can cause a reflex increase in sympathetic tone to the kidneys as well as other organs, but the precise population of afferent nerves that mediate this response is unknown. The extent to which the BP response to CBRNA is mediated by loss of renal efferent or afferent nerves remains to be established.

Initial clinical trials in patients with drug resistant hypertension, defined as systolic arterial pressure > 160 mmHg while on 3 or more antihypertensive drugs, have shown that CBRNA is safe and effective in lowering BP. In addition, the decrease in BP following a single procedure is sustained for up to 3 years. CBRNA decreases both office and ambulatory in patients with resistant hypertension, with the change in office BP being more pronounced than that seen with ambulatory BP monitoring. The clinical data suggest that CBRNA may result in partial rather than complete sympathetic denervation of the kidney, and additional work is needed on methods to verify the extent of efferent and afferent denervation at the time of the procedure. Although re-innervation may occur following CBRNA, it does not appear to attenuate or reverse the BP response over 24-36 months.

In addition to resistant hypertension, there is emerging evidence that CBRNA may have efficacy in the treatment of other conditions associated with increased sympathetic activity such as heart failure, obstructive sleep apnea, insulin resistance, atrial fibrillation, ventricular arrhythmias and chronic end-stage renal disease. Given the prevalence of resistant hypertension and other disease states commonly associated with increased sympathetic tone, it is likely that CBRNA will see more widespread use in the future.