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Case Report

Renal Denervation in a Patient with Hypertension and Severe Heart Failure

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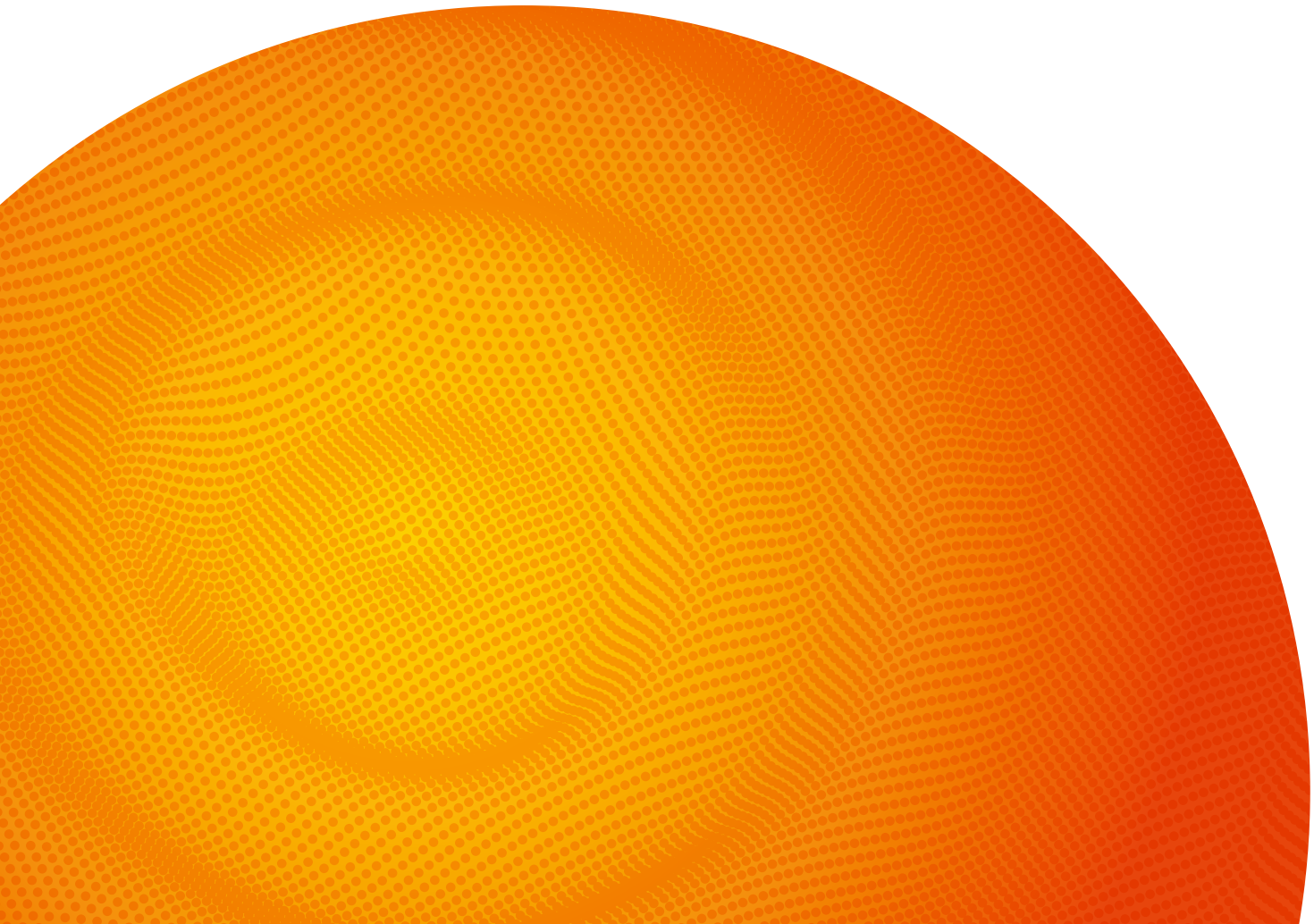

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Abstract

Renal denervation ablates sympathetic nerves to lower blood pressure in patients with therapy-resistant hypertension. We report on a patient with hypertension and ischemic cardiomyopathy who did not tolerate his medication. He was treated with combined ultrasound-based renal denervation and CRT implantation. His blood pressure dropped by 60 mmHg and left-ventricular ejection fraction normalized.

Introduction

Hypertension, defined as an office systolic blood pressure ≥ 140/90 mmHg, affects a 1/3 of the worldwide population[1]. If left untreated, hypertension causes end organ damage, such as hyperten-sive heart disease, athero-sclerosis, hypertensive nephropathy, hypertensive retinopathy, and stroke. A study by the GBD 2019 Risk Factors Collaborators concluded that high systolic blood pressure accounted for 10.8 million deaths or 19.2% of all deaths globally in 2019, ranking it the number one risk factor before tobacco use, dietary risks, air pollution and others[2]. The effect of lowering blood pressure has been well documented. A reduction of 10 mmHg results in a reduction of major cerebrovascular events by 20%, stroke by 27%, heart failure by 28%, ischemic heart disease by 17%, and cardiovascular death by 13%[3]. ACE inhibitors, ARBs, Calcium Channel Blockers, and thiazide/chlortalidone/ indapamide are recommended as first-line treatment[3].

However, hypertension is largely underdiagnosed and undertreated. Indeed, only one in five patients with hypertension has well-controlled blood pressure[1]. Hypertension may persist despite treatment. The most frequent cause of therapyresistant hypertension is nonadherence to prescribed drugs. Frequently, drugs are not tolerated due to side ef-fects. In patients with therapy-resistant hypertension, renal denervation offers an adjunctive treatment option, with 100% adherence — the so-called "always on" effect. In renal denervation, the afferent and efferent sympathetic nerves around the arteries are ablated, resulting in a blood pressure reduction of 8-10 mmHg. However a much larger effect has been observed in some patients[4-6]. Here, we describe a patient with severe heart failure and intolerance to antihypertensive drugs undergoing successful ultrasound renal denervation (uRDN) with a very beneficial treatment effect.

Case report

A 72-year-old man presented with longstanding hypertension and ischemic cardiomyopathy with severely reduced ejection fraction. The patient had a history of an acute anterior myocardial infarction 10 years ago. The patient's ECG showed a complete left bundle branch block with a QRS width of 180 ms. Ejection fraction was 20% with evident dyssynchrony and diffuse hypokinesis, affecting the whole left ventricle, not only the anteroapical portion. There was only mild secondary mitral regurgitation. At the time of first hospital contact, the patient's hypertension was treated with amlodipine 10 mg. He experienced shortness of breath when climbing 1-2 stairs (NYHA 2-3). He also suffered from frequent migraine attacks.

Treatment plan was to establish heart failure therapy and implant a CRT if ejection fraction remained severely reduced despite optimal medical therapy with sacubitril-valsartan, spironolactone, and a SGLT-2 inhibitor. On follow-up 6 weeks later, the patient reported that he took his medication only irregularly, as he suffered from more frequent migraine attacks. On outpatient visit, his blood pressure was 165/100 mmHg, and the ejection fraction remained severely reduced at 20%, with dilatation of his left ventricle. The patient was instructed again about the importance of complying with his medical prescriptions. Another 6 weeks later, he reported worsening shortness of breath, already with mild activities (NY-HA 3). Furthermore, at night he experienced orthopnea and was forced to sit upright in bed to breathe comfortably. Again, he felt that medication intake was associated with migraine attacks. His blood pressure was 149/81 mmHg. The patient agreed to undergo renal denervation and implantation of a three-chamber pacemaker-defibrillator (CRT-D).

Renal denervation was performed with the ultrasound-based Paradise™ Ultrasound Renal Denervation (uRDN) System (Recor Medical, Palo Alto, CA). With this device, ultrasound energy is emitted circumferentially by a cylindrical transducer in the Paradise™ balloon catheter (Figure 1A and 1C). The artery wall is protected with a cooling effect of sterile water circulating through the balloon during the procedure. Typically, 2-3 ablations are performed in each main renal artery, from distal to proximal. The ultrasound energy is delivered for 7 seconds at a target depth of 1-6 mm. As the last seconds of the ablation are painful, the procedure was performed in conscious sedation with midazolam 3 mg and fentanyl 150 µg. A 7F RDC guide catheter was used to engage both renal arteries. Digital subtraction angiography was performed to visualize the anatomy and measure the diameter of both main renal arteries and their side branches (Figure 1B).

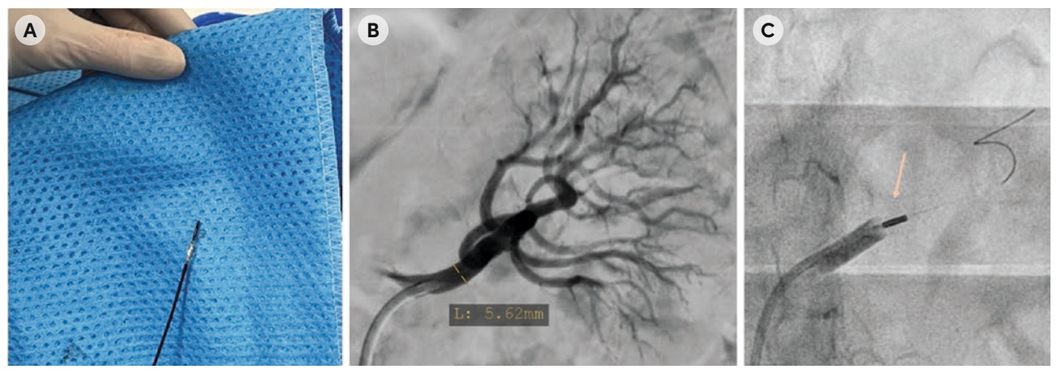

Figure 1: Renal denervation. Paradise™ catheter (1A) is inserted over a guidwire after the anatomy has been visualized (1B). The Paradise™ catheter is inflated and cooled during ablation to avoid artery wall damage (1C).

Renal denervation was performed over a 0.014" support wire (Grand Slam, Asahi Intecc, Tokyo, Japan) utilizing a 6.0 mm Paradise™ catheter on the left main artery, and 4.2 mm and 6.0 mm Paradise™ catheters on the right side, for a large side branch and the main artery, respectively. Before delivering the denervation energy, balloon apposition with complete sealing was confirmed with contrast injection (Figure 1C, arrow pointing at the inflated and cooled Paradise™ catheter). Control angiography confirmed a good result without arterial injury.

Access was closed using one ProStyle (Abbott, Chicago, IL). Procedure time from puncture to closure was 53 min. The patient was monitored for 1 hour outside the cathlab, transferred to the short stay unit, and discharged 4 hours later. On follow-up visit 5 months later, the patient reported an improved quality of life with improved shortness of breath, no orthopnea, and infrequent migraine attacks. He still felt tired after performing strenuous activities. His blood pressure measurements at home had dramatically improved (Figure 2B and 2D). During his office visit, his blood pressure was 120/81 mmHg, and his echocardiography demonstrated normalized left-ventricular ejection fraction of 50-55%. Furthermore, his left-ventricular dimensions were normalized (Figure 2A and 2C). On ECG, his QRS width had decreased to 136 ms.

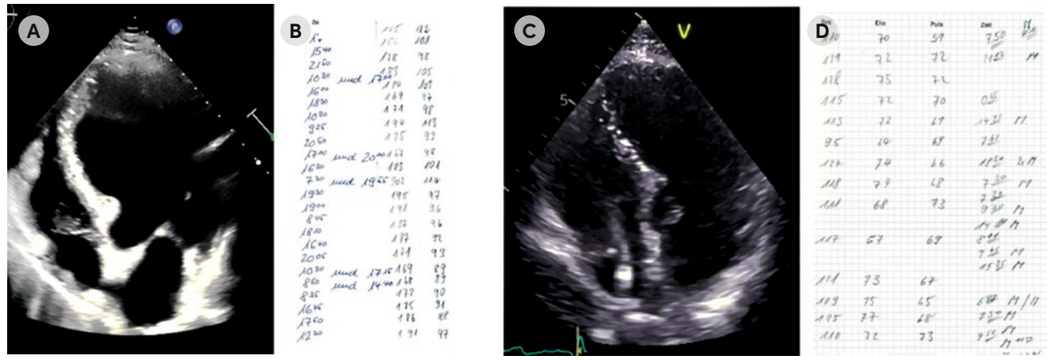

Figure 2: Effect of combined renal denervation and CRT implantation. A and B illustrate the patient's left-ventricular dimension and his blood pressure before treatment. C and D are the corresponding images after treatment.

Discussion

This case report demonstrates a remarkable improvement in blood pressure. It also shows enhanced left-ventricular ejection fraction, and quality of life following the combined use of ultrasound renal denervation and CRT-D implantation. The patient with ischemic cardiomyopathy and heart failure was unable to tolerate his heart failure medication due to migraine attacks. His blood pressure was 150-180 mmHg before treatment and dropped to 120 mmHg after successful renal denervation.

It is well-known that sympathetic nervous system overactivity contributes to the development and progress of hypertension. Renal denervation interrupts afferent and efferent sympathetic nerves in the adventitia and perivascular tissue of the renal arteries. The sham-controlled RADIANCE study program has demonstrated average reduction in blood pressure of 8-10 mmHg after ultrasound-based renal denervation in a broad range of patients with and without blood pressure lowering medication[4-6]. However, blood-pressure reduction > 10 mmHg is frequently observed, while, on the other hand, some patients may be non-responders[7]. Current guidelines recommend renal denervation for resistant hypertension patients who have an uncontrolled blood pressure despite 3 blood pres-sure lowering drugs including a thiazide or thiazidelike drug or in patients on fewer than 3 drugs if they express preference to undergo renal denervation1. Importantly, renal denervation is a safe procedure with low to negligeable risk for devicerelated and long-term complications (<1%)[7,8].

Our patient did not tolerate antihypertensive and heart failure medication and preferred to undergo renal denervation, resulting in an impressive 60 mmHg reduction in blood pressure. This report illustrates that, while some patients may be non-responders to the therapy, others may benefit to a much greater extent. Currently, it is not possible to predict which patients will respond, and to what extent.

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