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Treatment of a Heavily Calcified Renal Artery Ostial Stenosis Using Shockwave Lithotripsy

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Abstract

Performing endovascular interventions such as stent placement is notoriously difficult in patients who have advanced renal artery stenosis with severe calcification, and these patients are at risk of unfavorable outcomes from stent expansion. Intravascular lithotripsy, a recently developed clinical tool that uses shockwaves to break up calcified plaques, is a promising approach for making endovascular interventions safer and more effective. We present the case of an 85-year-old woman with refractory hypertension who presented with Pickering syndrome (recurrent flash pulmonary edema secondary to renal artery stenosis) and ischemic nephropathy. Imaging, angiography, and intravascular ultrasonography revealed severe bilateral ostial renal artery stenosis within the context of significant calcification of the left renal artery ostium. Shockwave intravascular lithotripsy was used before successful stent placement, and the patient had a complication-free recovery. This case outlines a hallmark treatment approach for utilizing intravascular lithotripsy to improve the arterial physiological space for stent placement.

Introduction

Endovascular interventions such as stent deployment for remediating coronary heart disease are particularly challenging in patients with heavily calcified arteries, a situation that poses multiple procedural risks [5]. Debulking calcified lesions before performing stent placement is a crucial step for obtaining optimal results. Shockwave intravascular lithotripsy (IVL), a technology that has been used for many years to treat kidney stones, is now an attractive option for treating heavily calcified renal artery stenosis (RAS), a significant treatment challenge, especially when stent placement is the only feasible treatment option [6,10,11].

Here, we present the case of an 85-year-old woman with refractory hypertension secondary to severe bilateral ostial RAS who was successfully treated with a renal artery stent that was placed with concomitant IVL. This case outlines a successful approach to using IVL for treating RAS within the context of significant arterial calcification in a patient with hypertension.

Case Presentation

An 85-year-old woman with hypertension presented with Pickering syndrome and progressive ischemic nephropathy. The patient's hypertension was refractory to 3 maximally tolerated antihypertensive medications, including a diuretic. Previous computed tomography imaging had shown severe bilateral ostial RAS (Figure 1A-B). An informed decision was made to perform renal artery stenting. Arterial access was obtained from the right common femoral artery with retrograde insertion of a 7 Fr sheath. A renal double curve 7 Fr guide was advanced to the left renal artery with the "no-touch" technique to minimize atheroembolization (Figure 1C). Selective renal artery angiography and intravascular ultrasonography (IVUS) showed a severely calcified ostium of the left renal artery. In accordance with the IVUS assessment, a shockwave IVL catheter (4.5/60-mm balloon) (Shockwave Medical Inc., Santa Clara, CA) was positioned across the ostium of the left renal artery. The guide catheter was retracted to avoid potential sheath damage by the shockwaves, and a total of 120 pulses were delivered at 4 atm (Figure 1D). A 5.0/18-mm Herculink stent (Abbott Vascular, Santa Clara, CA) was deployed with a 5.5/15 -mm non-compliant balloon for definitive therapy and post-dilation. The post-procedure angiogram and IVUS revealed excellent dilatation of the stenotic segment, appropriate aorto-renal ostium coverage, no edge dissection, and brisk distal blood flow (Figure 1E-F). The patient had an uneventful post-procedure recovery.

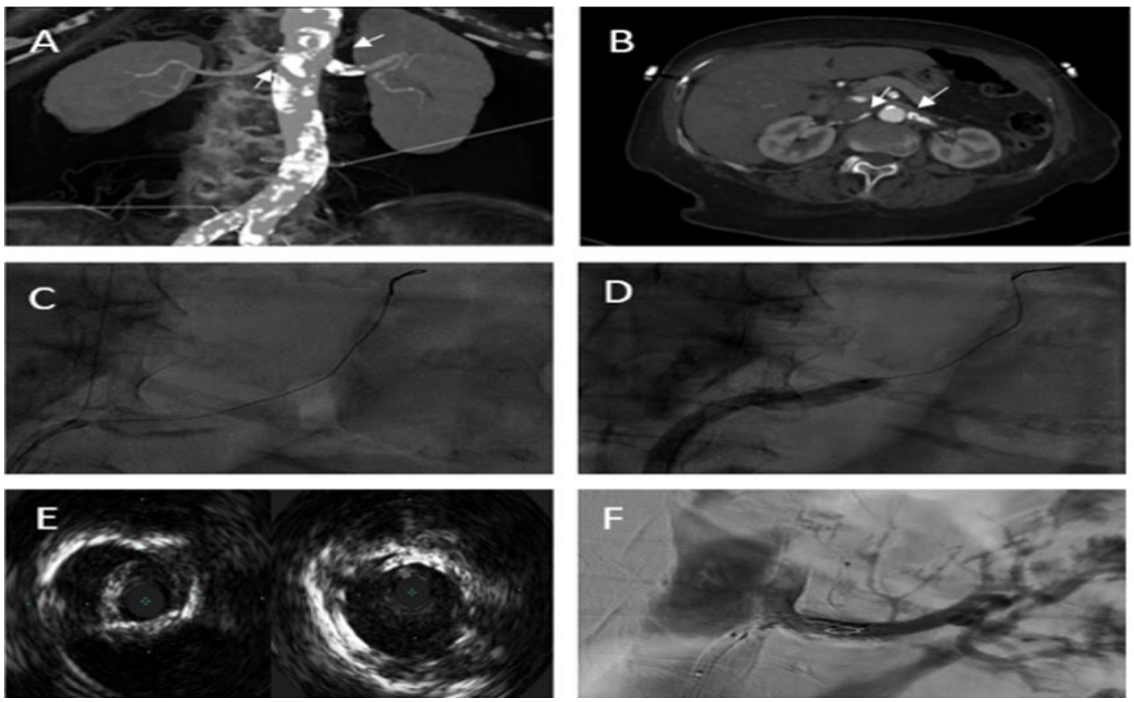

Figure 1(A-B): CT abdomen showing calcification within the ostial and proximal segment of left RA (white arrow), severe ostial stenosis of the right RA (white arrow); **(C):** "No-touch" technique: A 0.014 in steerable guide wire advanced through the guide catheter (alongside the 0.035-in wire) into the distal renal artery minimizing catheter trauma; **(D):** Shockwave balloon, partially in the aorta, inflated across the left RA with a minimal waist at the lesion after guide catheter withdrawal; **(E):** Pre and post stenting IVUS images; **(F):** Final left renal angiogram showing good stent expansion and intact antegrade flow. CT = Computed tomography. RAS = Renal artery stenosis. IVUS = Intravascular ultrasound.

Discussion

Renal artery stenosis is one of the most common causes of secondary hypertension that can eventually lead to refractory hypertension [doi.org/10.1055/s-0033-1337930], which may result in cardiac complications such as Pickering syndrome (flash pulmonary edema and recurrent heart failure exacerbation) and a decline in kidney function. Randomized clinical trials have failed to show a significant benefit of stenting in addition to medical therapy for preventing major cardiovascular and renal events in patients with RAS and hypertension [7]. However, other studies have shown that revascularization of affected arteries may be beneficial in lowering the blood pressure of patients with renovascular hypertension [9] and considering revascularization in symptomatic patients despite optimal medical therapy may be a reasonable clinical approach. IVL has been recently approved for treating heavily calcified coronary arteries and is now an attractive modality for optimizing endovascular interventions in patients with hypertension and arterial calcification [6]. IVL involves delivering sonic pressure waves that disrupt and modify calcified plaques in a uniform pattern which results in enhanced stent expansion.

Placing arterial stents in patients with heavily calcified arteries is a well-known clinical challenge, and risks incurred by endovascular interventions for these patients include compromised drug delivery, limited arterial expansion, and the potential for dangerous vessel dissection or perforation [5]. IVL also minimizes the physical interaction and is less traumatic to the arteries compared to atherectomy and balloon dilatation, resulting in fewer complications [11]. In clinical trials, shockwave IVL has been shown to be a safe and effective approach for addressing arterial calcification compared to other conventional techniques (atherectomy and balloon dilatation) [Brinton 2019; Ali 2019; Saito 2021; Hill 2020]; however, the cost-effectiveness of this technical advance is still unknown, and ascertaining this important metric will help expand the availability of this powerful tool [10]. Our successful placement of a stent with the aid of IVL in an 85-year-old woman with RAS and hypertension further emphasizes the feasibility and utility of IVL, even within the context of severe arterial calcification in older adults.

Conclusion

IVL has been shown to be safe and effective for treating heavily calcified coronary and peripheral lesions, but limited data exist on the optimal management approach for using IVL while treating patients with severely calcified RAS. Our patient's case is an example of a successful IVUS-guided RAS revascularization that was aided by the IVL modality. However, more prospective, controlled clinical trials are needed to determine the safety and efficacy of using IVL when performing endovascular interventions for heavily calcified RAS in the general population.

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