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CASE REPORT

Intravascular lithotripsy-assisted Impella insertion: A case report

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Abstract

Coronary and peripheral arterial calcification increases the complexity of percutaneous treatment strategies in both coronary and peripheral interventions. The first use of intravascular lithotripsy (IVL) using the Shockwave IVL device (Shockwave Medical Inc) in femoropopliteal arteries for modification of calcified plaque was recently described. We present a case illustrating use of the device to deliver a 14 French sheath for delivery of an Impella mechanical circulatory device prior to high-risk percutaneous coronary intervention (PCI). This case illustrates that IVL may be used to facilitate a broadening array of procedures in the catheterization laboratory, including the delivery of large bore sheathes.

KEYWORDS

complex PCI, mechanical circulatory support, new devices, peripheral arterial disease

1 | INTRODUCTION

Coronary and peripheral arterial calcification increases the complexity of percutaneous treatment strategies and peri-procedural complication rates for both coronary and peripheral interventions.[1–3] Both intimal and medial calcifications contribute to arterial wall stiffness and to vessel recoil and restenosis after endovascular interventions.[2] The first use of intravascular lithotripsy (IVL) to treat vascular disease involving significant calcification using the Shockwave IVL device (Shockwave Medical Inc) in femoropopliteal arteries for modification of calcified plaque was recently described.[4,5] Lithotripsy is a well-characterized treatment for calcified renal calculi, in which calcifications are fragmented by high-power acoustic sonic pressure waves that pass through soft tissue and selectively interact with calcium—the absence of hard density interface in normal, soft vascular tissue prevents dissipation of IVL energy and therefore causes injury to the vessel wall. Lithoplasty is a technology based on lithotripsy, in which multiple emitters are mounted on a balloon catheter to provide circumferential pulsatile energy to disrupt calcified plaque by fracturing the calcium and improving acute gain from treatment, while minimizing vessel injury. Use of the IVL device is rapidly expanding to include facilitation of transfemoral access for a broadening array of procedures in the catheterization laboratory. We present a case of Shockwave IVL to enable transfemoral delivery of an Impella CP mechanical circulatory device in a patient with significant peripheral vascular disease (PAD) prior to high-risk percutaneous coronary intervention (PCI).

2 | CASE REPORT

A 78-year-old female with a history of PAD (prior stenting of the left subclavian artery with known stenosis of the right subclavian artery) had a 6-month history of increasing angina to CCS class III on one anti-anginal medication. A nuclear stress test showed reduced ventricular function with high-risk areas of inducible ischemia in the inferior and lateral distributions. This prompted an echocardiogram, which showed a left ventricular ejection fraction of 30–35%, moderate diffuse hypokinesis throughout the left ventricle, and moderate mitral regurgitation. She was then referred for coronary angiography, which showed obstructive three vessel coronary artery disease (CAD) involving the distal right coronary artery (RCA), the proximal and distal circumflex (LCX), the distal left main coronary artery (LMCA) including the bifurcation, and the ostial left anterior descending (LAD) coronary artery, all of which were heavily calcified. In addition, significant bilateral iliofemoral vascular disease, as seen in Figure 1, was present on peripheral angiography at that time. Notably, an eccentric stenosis was present at the junction of the left common and external iliac arteries with a post-stenotic aneurysm in the external iliac artery. The

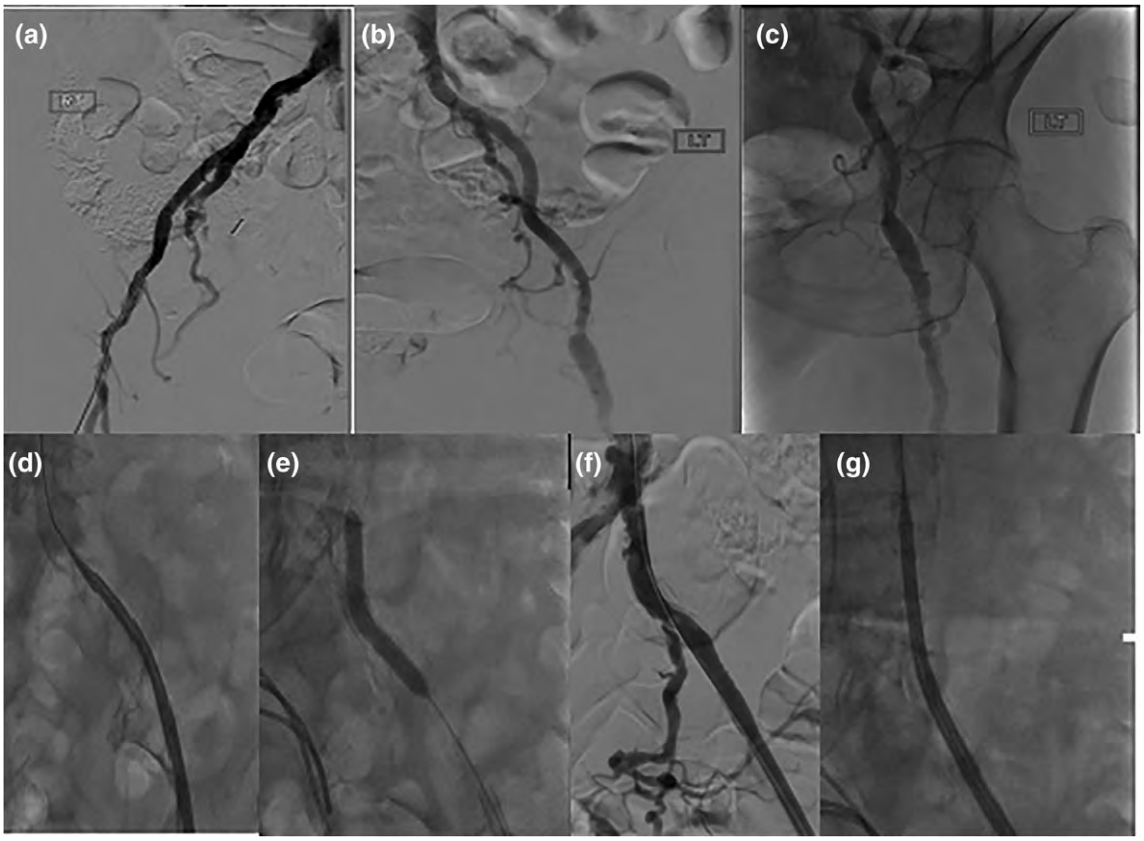

FIGURE 1 Panels A–C show pre-procedural angiography of the left and right iliofemoral systems, which are notable for significant disease diffusely in the right leg and at the junction of the left common and external iliac arteries. Panel D illustrates how a 12 French dilator would not pass through the stenosis at the junction of the left common and external iliac arteries. Panel E shows treatment of the left iliac system with shockwave intravascular lithotripsy system, followed by post-treatment angiography in panel F, and successful delivery of a long 14 French sheath in panel G

right common iliac artery also had a significant, calcified stenosis with diffuse disease of the distal external iliac and common femoral system. A HEART team approach was undertaken to discuss revascularization options and the patient was turned down for surgical revascularization due to elevated surgical risk. Given her moderately reduced left ventricular function, significant mitral regurgitation, three vessel CAD, and the likely need for atherectomy, mechanical circulatory support with an Impella CP device was planned for the intervention of the left coronary system, with staged intervention of the RCA at a later date. As peripheral atherosclerosis appeared worse in the right iliofemoral system, insertion of the 14 French Impella CP sheath from the left femoral access was elected. However, after obtaining access of the left common femoral system, we could not pass a 12 French dilator past the calcified stenosis in the left common iliac artery (Figure 1 and Video 1). Serial dilation of the stenosis was then attempted with a 7 × 40 mm Powerflex balloon at 4 atm, which allowed for delivery of the 14F Impella short sheath, but neither the Impella device, a 14F long sheath, nor a 16 French long dilator would pass across the lesion (Video 2). A 7 × 60 mm Shockwave IVL balloon was then placed and six 30 s IVL treatments of the stenosis were delivered in the left external iliac artery into the common iliac artery as shown in Figure 1. Following Shockwave IVL, the 14 French long Impella sheath was successfully introduced, followed by delivery of the Impella CP device into the left ventricle (Video 3). This was followed by rotational atherectomy of the LCX (1.25 mm burr) and the left main bifurcation (1.5 mm and 2 mm burrs), with intravascular ultrasound-guided PCI of the distal circumflex and left main bifurcation (double kiss mini-crush technique), as shown in Figure 2. The Impella CP was then weaned and removed using percutaneous vascular access closure (Perclose) in the cath lab and the patient was discharged without incident next day with planned staged intervention of the RCA.

3 | DISCUSSION

We present a case report describing use of IVL via the Shockwave device to facilitate delivery of a 14 French sheath used to deliver an Impella CP mechanical support device in a patient with severe peripheral arterial disease to facilitate high-risk PCI. Device-assisted PCI is a growing field for patients deemed at increased peri-operative risk for hemodynamic instability. Arterial access for these larger devices remains a key issue for utilization of these devices as many patients with coronary disease also have concurrent peripheral disease, creating challenges for device delivery.[6] This case illustrates the use of IVL as a novel treatment for calcified peripheral arterial lesions that can facilitate both revascularization procedures as well as vascular access for large bore catheter interventions (transcatheter aortic valve replacement, endografts, etc.). The choice of alternative access in this case might have included surgical axillary-subclavian conduit (not possible in this patient due to significant bilateral subclavian disease),

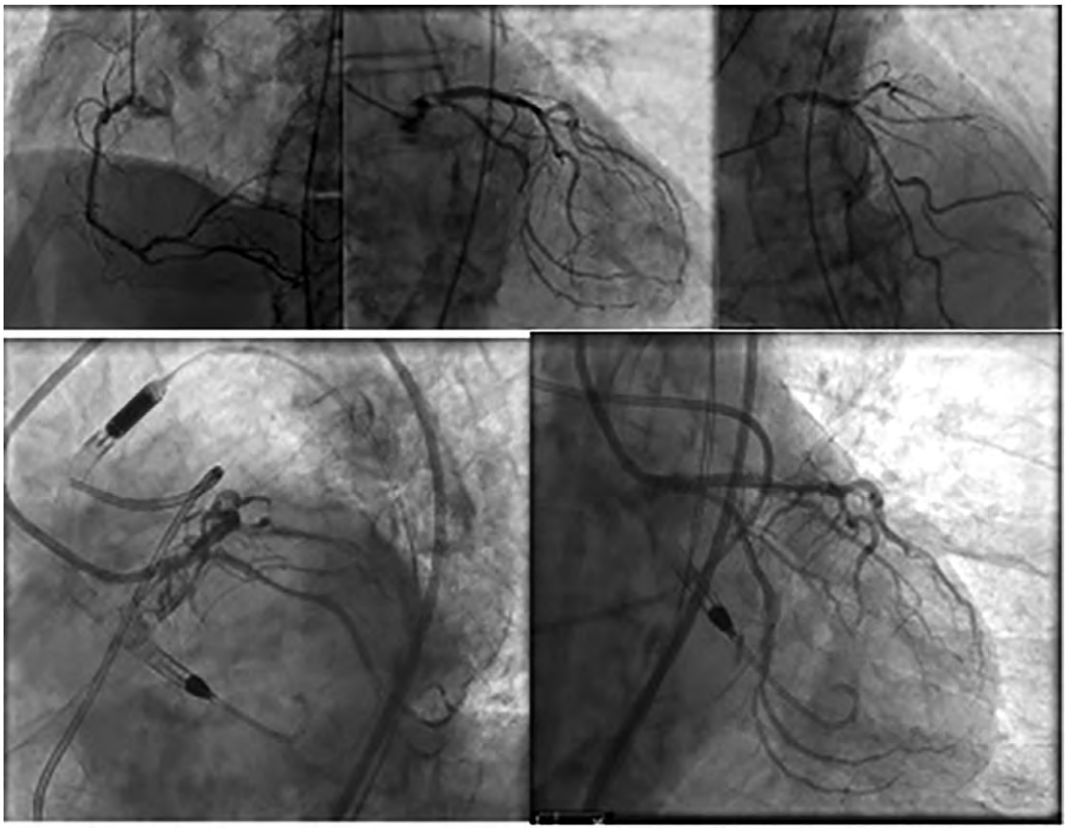

FIGURE 2 The top row shows pre-procedure coronary angiography, revealing obstructive, calcific disease of the left main, circumflex, and left anterior descending coronary arteries. The bottom row illustrates treatment of these arteries with atherectomy and subsequent percutaneous coronary intervention with drug-eluting stents

surgical endarterectomy of the left ilio-femoral system, or transcaval conduit for Impella placement; however, all of these methods would have required general anesthesia and would have prolonged and likely complicated the hospitalization.

Utilization of Shockwave IVL in the coronary space will be evaluated in the upcoming DISRUPT CAD III study and may facilitate the safety and efficacy of coronary stent placement in heavily calcified coronary arteries.

4 | CONCLUSION

We describe the first reported use of Shockwave IVL to facilitate percutaneous transfemoral delivery of an Impella CP mechanical circulatory device.

CONFLICT OF INTEREST

Nothing to report.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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