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Treatment of a heavily calcified celiac artery ostial subtotal occlusion using shockwave lithotripsy: A novel approach

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ABSTRACT

Purpose: We present the novel use of adjunctive intravascular lithotripsy (IVL) before definitive intravascular stenting of a heavily calcified celiac artery ostial occlusion.
Case report: A 79-year-old woman presented with chronic post-prandial abdominal pain and weight loss. Selective angiography revealed a sub-totally occluded celiac artery. Percutaneous endovascular intervention of the celiac artery was attempted but was unsuccessful because of heavy calcification.
The patient returned for a repeat procedure. A guidewire was successfully advanced across the sub-totally occluded ostium. A Shockwave Lithotripsy BDC 7.0-mm/60-mm balloon catheter (Shockwave Medical Inc., Santa Clara, California) was successfully used to modify the calcified plaque. Next, a stent was deployed for definitive therapy. The final angiogram showed an excellent result. The patient tolerated the procedure well and was sent home on dual antiplatelet therapy. Nine months after the procedure, she had gained weight and denied any further post-prandial abdominal pain.
Conclusion: IVL treatment modality to modify calcified lesions in the splanchnic circulation should be considered as a novel approach to patients in whom traditional endovascular treatment modalities are thought to be suboptimal. Further controlled studies are needed to access the safety, feasibility, and efficacy of the use of this novel technology in this vascular territory.

1. Introduction

Celiac artery stenosis (CAS) has become increasingly more recognized, with an incidence rate of 24% among a sample of 50 asymptomatic patients [1]. The most common cause of CAS is atherosclerosis, with an incidence rate of 87% in Western countries [2].

Patients present with generalized symptoms such as post-prandial abdominal pain and weight loss when there is 60% to 75% reduction in blood flow [2]. Diagnostic imaging tests such as computed tomography (CT) scan or lateral projection angiography are needed to visualize narrowing of the proximal celiac axis and development of collateral pathways [1,2]. Treatment options include open surgical revascularization and percutaneous mesenteric artery stenting (PMAS). Both have successful short- and long-term outcomes based on survival and patency rates. Despite revascularization being a less invasive procedure, complications can still occur, including thrombosis, restenosis, and dislocation of the stent [2].

This is a case of a patient with post-prandial abdominal pain and unexplained weight loss from CAS due to heavy calcification. We present the novel use of adjunctive intravascular lithotripsy (IVL) before definitive intravascular stenting. We confirm that written informed consent was obtained from the patient described this manuscript.

2. Case report

The symptoms of a 79-year-old woman included chronic post-prandial abdominal pain and 50% weight loss over the course of 24 months. Her comorbidities include hypertension, hyperlipidemia and current tobacco use. CT angiography revealed extensive atherosclerotic disease involving the aortoiliac, celiac, superior mesenteric (SMA), inferior mesenteric (IMA), and splenic arteries. Severe ostial celiac artery occlusion was noted with severe calcification (Fig. 1). Chronic occlusion of the proximal SMA was noted with reconstitution of the mid-vessel from IMA to SMA collateral flow. Selective angiography revealed a sub-totally occluded celiac artery and total occlusion of the SMA (Fig. 2). Percutaneous endovascular intervention (PEI) of the celiac artery was attempted but was unsuccessful because of inability to cross the occlusion with the guidewire and the patient being uncooperative on the table. The patient was sent home on dual antiplatelet therapy.

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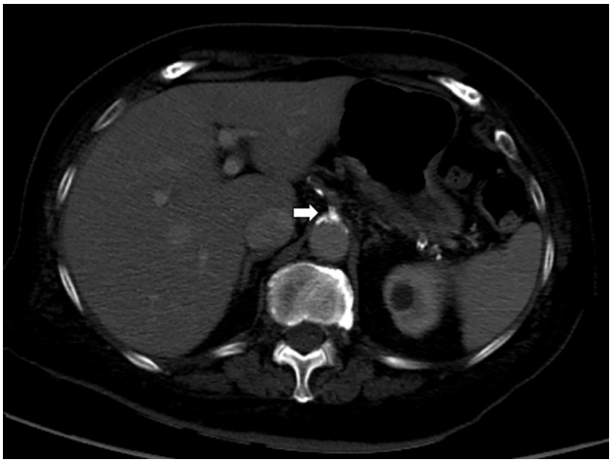

Fig. 1. CT slice demonstrating the heavily calcified celiac artery (arrow).

The patient returned after a few weeks for a second attempt at PEI performed under general anesthesia. Vascular access was established in the right common femoral artery with the insertion of a 9-French sheath. An Aptus 7F TourGuide™ steerable sheath (Medtronic, Minneapolis, Minnesota) was advanced through the sheath into the abdominal aorta and used to engage the ostium of the celiac trunk. An Asahi 0.014″ Confianza Pro-12 guidewire (Asahi Intecc, Japan) was successfully advanced across the sub-totally occluded ostium and positioned distally. Predilatation of the heavily calcified stenosis had to be performed sequentially using 2.0-, 3.0-, and 4.0-mm diameter balloon catheters to allow the successful advancement of the lithotripsy balloon across the lesion. A Shockwave Lithotripsy BDC 7.0-mm/60-mm balloon catheter (Shockwave Medical Inc., Santa Clara, California) was then positioned across the ostium of the celiac trunk, and six treatments of 30 pulses each were delivered, with excellent angiographic result. A Cordis Genesis 7.0/18-mm balloon expandable stent (Cordis, Hialeah, Florida) was deployed for definitive therapy. The final angiogram showed excellent dilatation of the stenotic segment, with no significant residual stenosis and brisk flow to the distal vessels (Fig. 3). The patient tolerated the procedure without any complications and was sent home on dual antiplatelet therapy of aspirin and clopidogrel.

Eight months after the procedure, the patient reported an uneventful post-endovascular intervention course. She relayed much improvement of her well-being. Patient gained 22 pounds with no complaints of post-prandial abdominal pain.

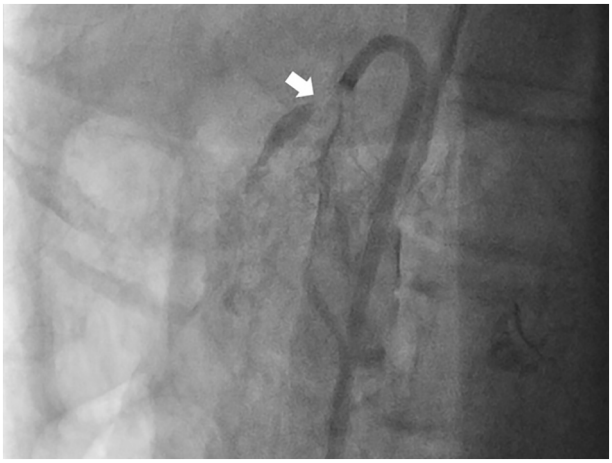

Fig. 2. Selective angiography showing the sub-totally occluded celiac artery (arrow).

Fig. 3. Post-lithotripsy and stenting of celiac artery (arrow) showing good flow to the distal vessels.

3. Discussion

To our knowledge, this is the first reported use of IVL for CAS due to atherosclerosis. IVL delivers sonic pressure waves in a pulsatile manner, providing sheer stress to the calcium deposits within vasculature, breaking it down into smaller fragments [3]. The diseased vessel pretreated with lithotripsy can be stented immediately or dilated using a balloon catheter and subsequently stented [4].

Currently, this technology has been used in several endovascular procedures — coronary [5], peripheral [3,4,6], and vascular. In the United States, IVL is approved by the Food and Drug Administration for use in the peripheral vasculature, including the iliac, femoral, and renal arteries. Several multicenter studies are currently ongoing to assess the safety (DISRUPT CAD II) and efficacy (DISRUPT CAD/PAD III) of IVL in the coronary and peripheral settings.

This technology shows promising results, with the first few studies on its peripheral use showing 100% patency after 30 days, 70% to 80% at six months, and 70% at 12 months [6]. Studies have shown a 95% clinical success rate, indicating less than 50% residual stenosis post-procedure with no evidence of in-hospital major adverse cardiac events, embolizations, thrombus formations, or perforations [5,6].

There is no documentation of IVL use in the treatment of atherosclerotic disease of the splanchnic circulation presenting as mesenteric ischemia. Traditionally used open surgical repair has survival rates of approximately 80% to 90%, primary patency rates around 88%, and secondary patency rates of 93.6% at 5 years [7]. Endovascular repair has become an alternative to open surgery. One study demonstrated that despite poorer primary patency rates of 45%, secondary patency rates were comparable at 94%. A meta-analysis showed that in-hospital outcomes were better in endovascular repair, but long-term clinical outcomes were better with surgical repair [8]. A major limitation of endovascular interventions is the presence of heavily calcified ostial occlusions [8].

The combination of a large calcium arc central angle of >270° of the circumference of the vessel and calcium thickness are characteristics of non-balloon-dilatable lesions [9]. This results in an underexpanded stent, a predictor of target vessel revascularization due to calcified lesions, rendering device delivery more difficult. This report demonstrates that the described difficulty can be addressed with the use of IVL to

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prepare a heavily calcified stenotic vessel and optimize stent implantation for successful revascularization.

4. Conclusion

IVL is an emerging adjunctive treatment modality to dilate calcified lesions in the vasculature. Its use in the treatment of heavily calcified vessels in the splanchnic circulation should be considered as a novel approach to patients in whom traditional endovascular treatment modalities are thought to be suboptimal. Further controlled studies are needed to access the safety, feasibility, and efficacy of the use of this novel technology in this vascular territory.

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Declaration of competing interest

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