Novel approach to treating calcified infrarenal aortic stenosis using intravascular lithotripsy without stenting

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ABSTRACT

This case report presents the use of intravascular lithotripsy (IVL) in a 68-year-old woman with disabling bilateral claudication owing to a heavily calcified subocclusive stenosis of the infrarenal aorta. The patient had a history of tobacco use, dyslipidemia, and chronic obstructive pulmonary disease, with absent femoral pulses and severe arterial calcification. A 12-mm Shockwave L6 lithotripsy catheter was employed to treat the aortic lesion, resulting in a significant decrease in the aortic pressure gradient without the need for stenting. The patient experienced complete symptom resolution postoperatively, and at 1 month, follow-up imaging confirmed vessel patency with no sign of restenosis. IVL, used here as a standalone treatment, demonstrated effectiveness in modifying calcified plaques and restoring vessel compliance, offering a less complex and potentially more cost-effective alternative to stent grafting in calcified aortic lesions. This case highlights the potential of IVL as a safe and effective treatment option in select patients with calcified infrarenal aortic stenosis. (J Vasc Surg Cases Innov Tech 2025;11:101709.)

Keywords: Intravascular lithotripsy; Peripheral arterial disease; Infrarenal aorta; Angioplasty; Stenting

The safety and efficacy of intravascular lithotripsy (IVL), both as a stand-alone treatment and as a vessel preparation strategy, has been demonstrated in both nonrandomized trials and case reports.[1-3] Despite the growing body of literature on IVL as a viable treatment option for various peripheral vascular lesions, the literature on IVL for the infrarenal aorta is limited.[4-7]

Here we present a case of bilateral disabling claudication owing to a large calcified infrarenal aortic stenosis treated with the 12 mm Shockwave (Shockwave Medical, Inc., Santa Clara, CA) L6 lithotripsy catheter without stenting. The patient provided written informed consent for the intervention and the report of her case.

CASE REPORT

A 68-year-old woman with a history of tobacco use, dyslipidemia, and chronic obstructive pulmonary disease was referred to the vascular surgery department for disabling bilateral calf claudication with a pain-free walking distance below 100 m (Leriche-Fontaine 2B). On examination, the patient had no pulses, 0.55 right ankle-brachial index (ABI), 0.70 left ABI, and a monophasic Doppler waveforms at the femoral and tibial sites. After 3 months of best medical therapy, the patient showed no signs of improvement. An abdominal computed tomography scan revealed a calcific subocclusive of approximately 80% stenosis of the infrarenal aorta and severe calcification of the right common femoral artery (CFA), regular patency of the inferior mesenteric artery (2 mm), hypogastric arteries, and nonsignificant stenosis of the iliac axes (Fig 1). The patient was consented for endovascular lithotripsy and right femoral endoarterectomy.

On the day of surgery, ultrasound-guided retrograde puncture of the left CFA was performed, and a 6F introducer was placed. After surgical exposure the right CFA was punctured, a 9F introducer was positioned. After systemic heparinization, a 0.035-inch guidewire was advanced, crossing the aortic lesion. Angiography confirmed severe stenosis at the level of the infrarenal aorta (Fig 2, *A*). Gradient pressure across the stenosis was measured using a 5F diagnostic catheter. Via the left CFA, an 8-mm semicompliant balloon was advanced to protect the left common iliac artery. From the right CFA, the guidewire was exchanged for an 0.018-inch wire, and a 3-mm balloon angioplasty was performed to predilate the vessel and avoid any damage of the catheter. Given the isolated location of the aortic lesion, a 12 × 30 mm Shockwave L6 lithotripsy catheter was used for angioplasty (Fig 2, *B*), achieving good apposition in both the anterior and lateral views. After 10 cycles of lithotripsy, a completion angiogram demonstrated a good result with no sign of rupture or dissection and a nonsignificant residual stenosis (Fig 2, *C*). After IVL, the pressure gradient across the stenotic segment was reduced from 40 mm Hg to 10 mm Hg. Right femoral endarterectomy was then performed, and the arteriotomy was closed with a pericardium patch. The left CFA access was closed using AngioSeal (Abbott Vascular, Santa Clara, CA) system under ultrasound guidance.

The patient had an uneventful recovery and she reported complete resolution of her calf claudication. She was discharged on dual antiplatelet therapy on postoperative day 4 with palpable right posterior tibial and left pedal pulses, a bilateral ABI of 0.95 and biphasic Doppler waveforms at tibial sites. A 1-month follow-up computed tomography scan showed a residual stenosis of approximately 20% without sign of restenosis (Fig 3) and regular patency of the collateral vessels (hypogastric and inferior mesenteric arteries). The patient reported continued resolution of claudication and overall quality of life improvement.

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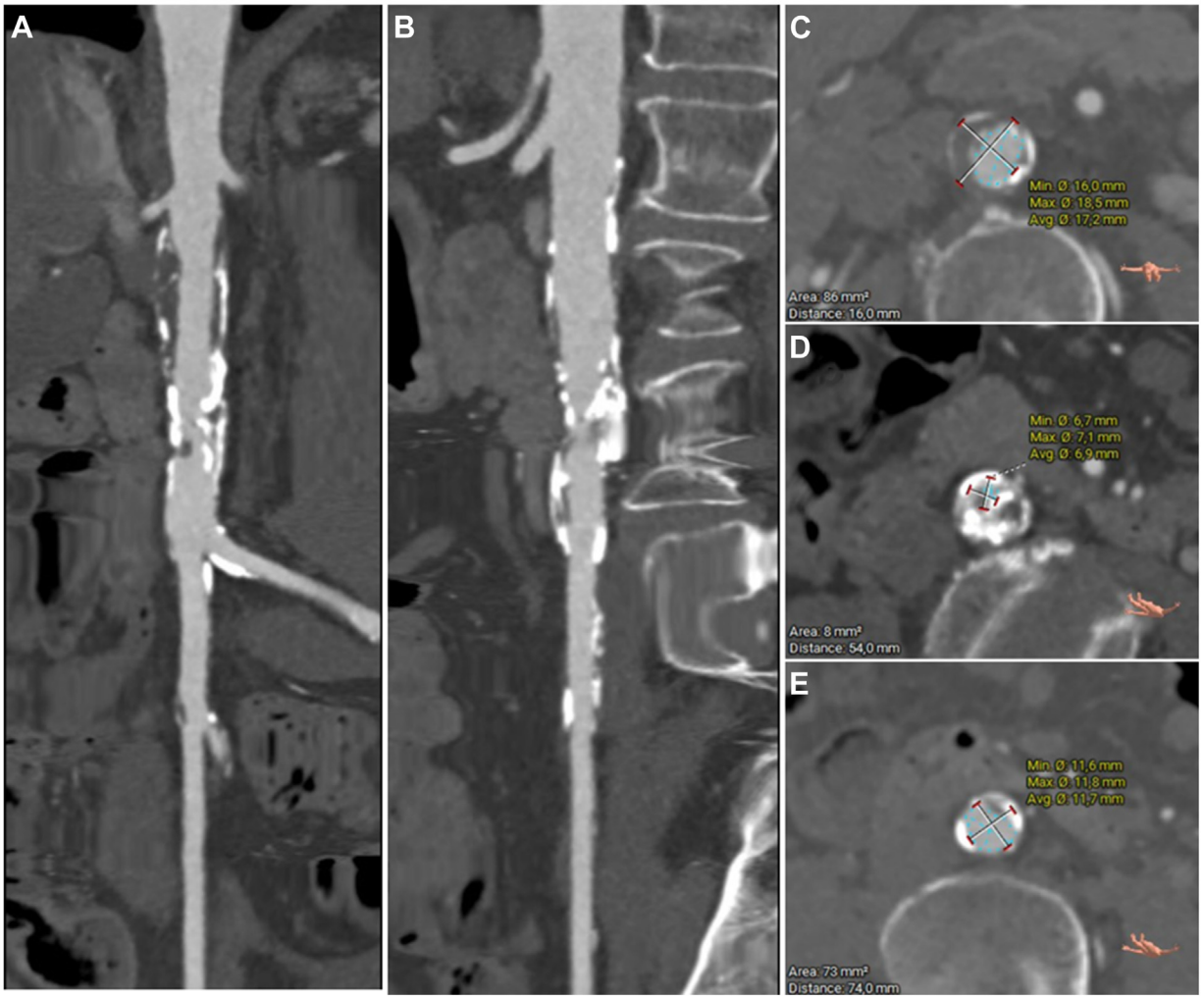

Fig 1. Centerline reconstruction of preoperative computed tomography angiography (CTA) reveals a calcified infrarenal aorta in both the anteroposterior **(A)** and lateral **(B)** views. Transverse sections provide detailed visualization of the aortic lumen before **(C)** and at the site of stenosis **(D)**, followed by the poststenotic segment **(E)**.

DISCUSSION

This case report documents the use of IVL to treat extensive calcification of the infrarenal aorta using a 12-mm Shockwave L6 lithotripsy catheter, without the need for stenting.

Extensive intraluminal calcifications in the aorta have been traditionally managed surgically. However, a surgical approach carries high rates of postoperative mortality and complications.[8-10] Endovascular intervention represents an alternative approach in selected patients with focal aortic disease.[11,12] However, severe calcification alters the arterial wall's morphology and compliance, and percutaneous intervention in heavily calcified aortas, whether with or without stenting, poses significant risks of flow/limiting dissections, acute vessel recoil, stent subexpansion, malposition, and fractures, with consequent increased complexity and costs.[13-16]

In the case of juxtarenal involvement with no safe landing zones for stent grafts, IVL may be a safe and effective alternative to the use of an aortic stent graft with multiple chimney or snorkel stent grafts, decreasing associated costs and procedural complexity.[5] Moreover, when the lesion involves the iliac arteries, performing a kissing stents may be associated with risks and complications. Factors such as the dead lumen space around the stents (radial mismatch), the overlap of the stents in the aorta (protrusion mismatch), and stent conformation can cause flow disturbances, leading to turbulence and blood stasis, thrombus formation, and intimal hyperplasia.[17-19] Even the covered endovascular reconstruction of the aortic bifurcation technique, developed to address these limitations,[20] has some disadvantages, particularly its associated costs, the requirement for larger sheaths,

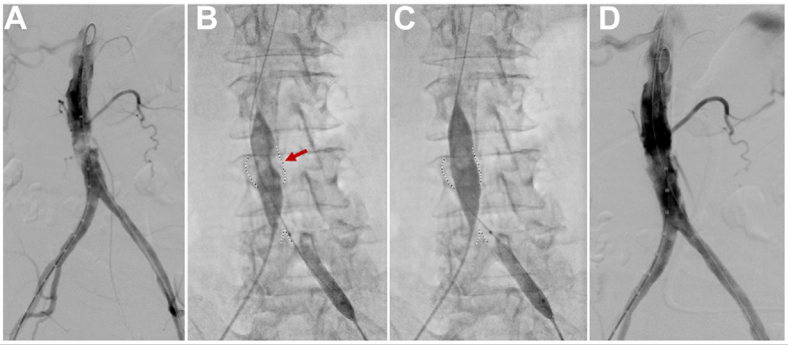

Fig 2. Intraoperative angiogram showing severe stenosis of the infrarenal aorta **(A)**. **(B)** A 12-mm Shockwave L6 balloon positioned in the infrarenal aorta with a protection balloon in the left common iliac artery **(B)** with good apposition **(C)**. Final angiogram showing satisfactory dilatation and patency of the treated aorta **(D)**.

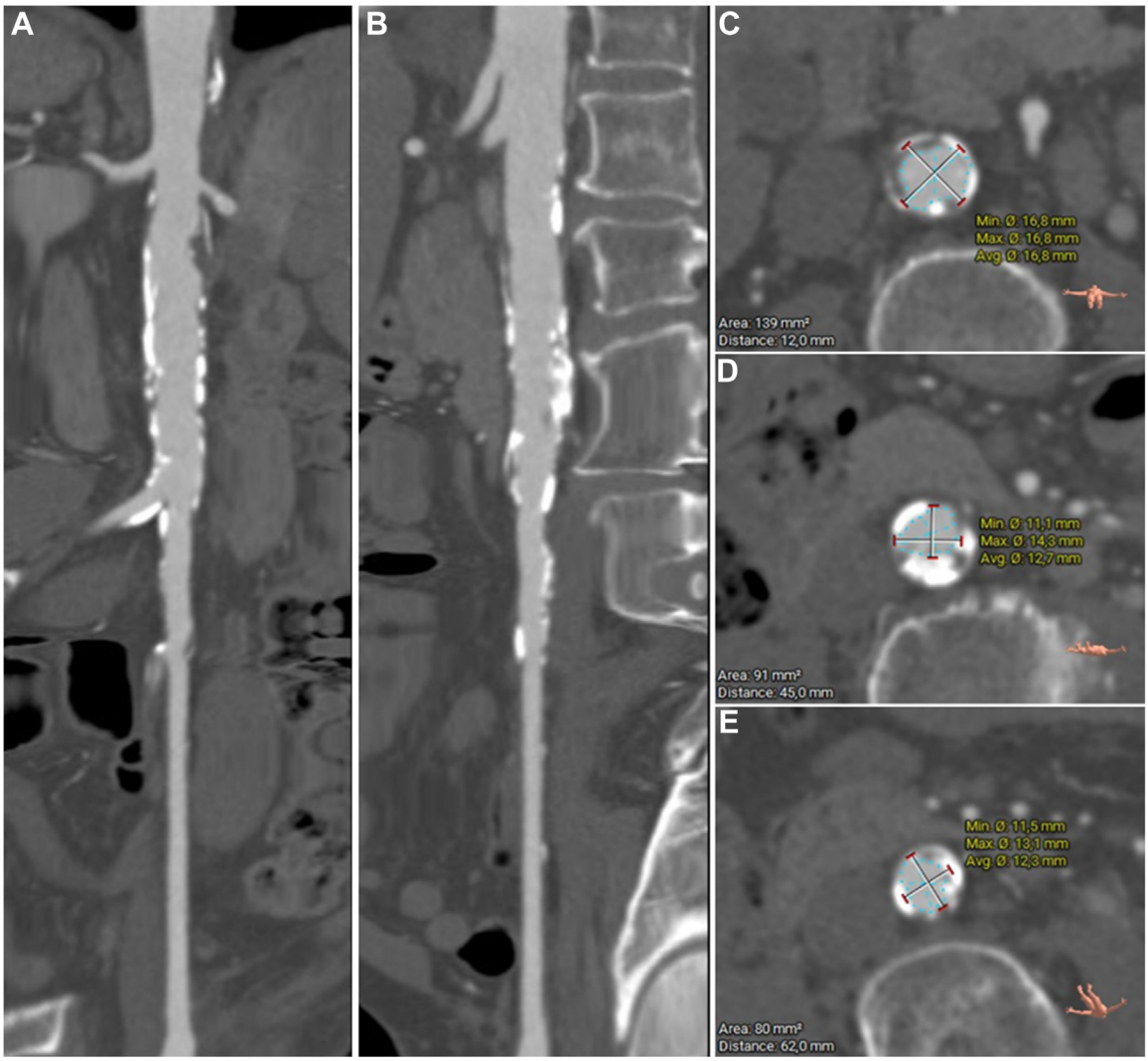

Fig 3. Centerline reconstruction of 1-month postoperative computed tomography angiography (CTA) reveals the regular patency of the infrarenal aorta in both the anteroposterior **(A)** and lateral views **(B)**. Transverse sections provide detailed visualization of the aortic lumen before **(C)** and at the site of stenosis **(D)**, followed by the poststenotic segment **(E)**.

the risk of early stent thrombosis, and the more extensive coverage, which may exclude important lumbar collateral flow.[21-23] Future comparative studies should investigate the long-term patency of the covered endovascular reconstruction of the aortic bifurcation technique vs the shockwave technique and evaluate the risk-benefit ratio.

IVL is a balloon-based technique that uniformly delivers sonic waves around the balloon, creating fractures in the calcified tissue with minimal vessel injury.[2] Although IVL has been used to treat coronary, iliac, and infrainguinal artery disease,[1,24] its use in the aortic and aortoiliac segments has been limited to a few case reports, and only as a vessel preparation strategy before stenting. [4-7] Moreover, the use of two 8-mm Shockwave catheters with two dedicated generators has always been necessary to reach a good apposition in the aorta. With its ideal 30-mm length and expanded diameter range of 8 to 12 mm, the Shockwave L6 catheter is particularly well-suited for treating heavily calcified focal lesions and larger vessels. Unlike the M5/M5þ, which has a higher pressure peak at the middle emitter with its own energy source, it features a more uniform and higher sonic pressure wave peak across its entire balloon surface owing to the positioning of its emitters. This factor ensures effective remodeling of both superficial and deep calcium, enhancing vessel compliance and decreasing fibroelastic recoil, with minimal risk of vessel injury and distal embolization, decreasing the need for stenting. Additionally, the device uses a 7F or 8F sheath with a 110-cm working length and operates on an 0.018-inch system, providing moderate support for eventual post-IVL stent placement.[25]

Our experience suggests that using a single balloon could lower the costs, enhance balloon apposition, and improve the efficacy of sonic waves on the aortic wall. Moreover, IVL alone achieved hemodynamic success and may be considered a standalone treatment in selected cases. This technology is easily implementable in modern hybrid theaters and could reduce the need for multiple stents and stent grafts, thereby lowering overall costs.

CONCLUSIONS

IVL may serve as a safe, less complex, and effective alternative to juxtarenal aortic stent grafting in the treatment of calcified lesions of the infrarenal aorta. The new 12-mm IVL balloon has the potential to lower costs while maintaining comparable efficacy and offering certain advantages over standard treatment. However, further studies with larger sample sizes and longer follow-up periods are necessary to confirm these findings and establish a standardized protocol for IVL in treating aortic lesions.

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