Use of Wallstent device as an embolic protection device during stenting of aortic thrombus

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ABSTRACT

Blue toe syndrome can occur due to distal embolization from proximal lesions such as an aortic thrombus. We describe the case of a patient who presented with chronic limb threatening ischemia due to a flow-limiting infrarenal aortic thrombus, with gangrene from distal embolization to the left fifth toe, and was successfully treated with endovascular aortic stent graft insertion. Distal embolization during instrumentation was successfully prevented by using a partially deployed Wallstent (Boston Scientific) as an embolic protection device. The reconstrainable Wallstent device can be considered for distal thromboembolic protection during aortic stenting, in particular, when distal embolization is a concern and commercial devices are not readily available. (J Vasc Surg Cases Innov Tech 2023;9:101340.)

Keywords: Aortic thrombus; Endovascular stenting; Distal embolization; Embolic protection device; Wallstent

Blue toe syndrome or "thrash foot" occurs due to distal embolization from a proximal lesion, such as a proximal thrombus along the aortoiliac vasculature, cardiac embolus, or aneurysm.[1] It can also occur after endovascular instrumentation.[2] Once diagnosed, the treatment approaches available include medical therapy, endovascular intervention, and surgery.[3,4] The use of stent grafts to exclude aortic mural thrombus has been described as a safe and effective approach.[5] Distal embolization remains a concern during instrumentation.[6] We describe the use of a reconstrainable Wallstent endoprosthesis (Boston Scientific) as an embolic protection device during stenting of an aortic mural thrombus in a patient who presented with blue toe syndrome. The institutional ethics board waived the requirement for institutional review board approval. The patient provided written informed consent for the report of her case details and imaging studies.

CASE REPORT

A 57-year-old Chinese woman with a significant medical history of type 2 diabetes mellitus and active smoking history of 15 pack-years presented with left fifth toe pain and erythema of 1 month's duration. Examination was significant for fifth toe dry gangrene limited to the distal phalanx. Bilateral peripheral pulses were absent. Laboratory test results for white blood cell count, hemoglobin, and serum creatinine were within normal limits. Vascular diagnostic laboratory studies performed showed a left toe brachial pressure index of 0.26 (normal, >0.7) and toe pressure of 42 mm Hg. Arterial duplex ultrasound of the aortoiliac vessels showed focal 80% stenosis in the infrarenal aorta with patent infrainguinal vessels, confirmed by computed tomography aortography (Fig 1, *a* and *b*). No cardiac thrombus was seen.

The diagnosis was chronic limb threatening ischemia of the left lower limb due to aortic thrombus, with gangrene from distal embolization to the fifth toe. The revascularization plan was to attempt endovascular covered stenting in view of the short segment thrombus to jail the thrombus. At the initial presentation, the main concern was further distal embolization during endovascular instrumentation. The patient underwent endovascular stenting with an aortic tube stent graft during the same admission.

The procedure was performed under general anesthesia. Left transradial and bilateral groin access with 5F sheaths was obtained. Perclose ProGlide devices (Abbott Laboratories) were deployed, and the groin sheaths were upsized to 8F in the right and 10F in the left. The patient was systematically heparinized. To minimize the risk of dislodging the thrombus, diagnostic angiography from the left radial access above the thrombus was performed (Fig 1, *c*). From the left 10F sheath, a 16 × 60 mm Wallstent was partially deployed above the aortic bifurcation as a filter (Fig 2, *a*). Subsequently, via the right 8F sheath, the aortic stenosis was crossed with a 4F Berenstein catheter and straight Terumo Glidewire (Terumo Interventional Systems) and exchanged for a stiff Lunderquist wire. The sheath was upsized to a 14F long sheath and advanced into the infrarenal aorta past the area of aortic stenosis (Fig 2, *a*) for delivery of an 18 × 47-mm BeGraft aortic balloon-mounted covered stent (Bentley InnoMed). This was deployed with full effacement of the lesion (Fig 2, *b*). The Wallstent was then reconstrained and retrieved safely, with small clot debris visualized in the stent. Completion angiography showed full effacement of the stenotic lesion with brisk distal runoff (Fig 2, *c*). Both femoral access sites were closed with ProGlide devices. Her recovery after the procedure was uneventful with a return of bilateral pedal pulses. The patient was discharged after 2 days with long-term clopidogrel.

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The editors and reviewers of this article have no relevant financial relationships to disclose per the Journal policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

2468-4287

https://doi.org/10.1016/j.jvscit.2023.101340

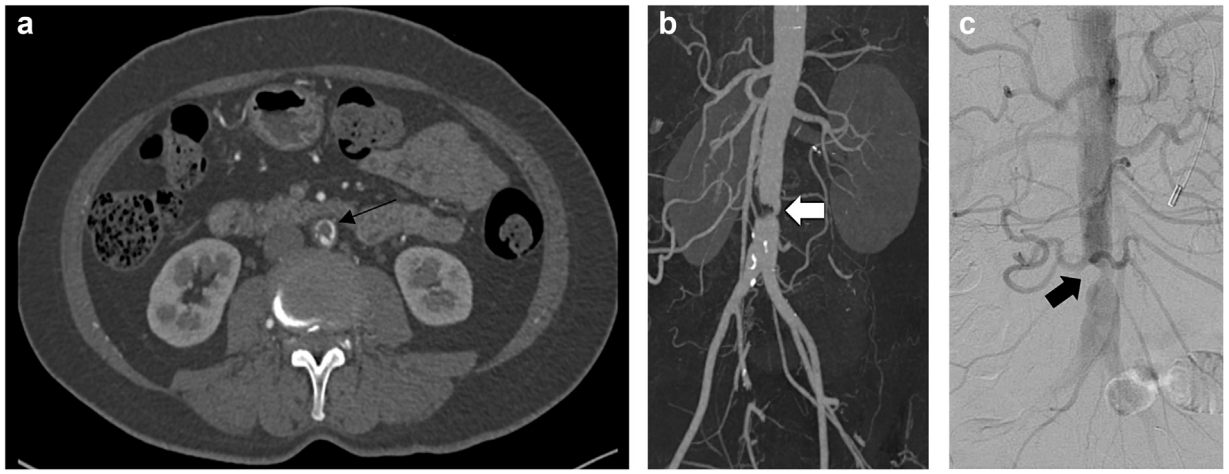

Fig 1. a, Contrast-enhanced computed tomography scan demonstrating the level of maximal narrowing of the aortic thrombus in the infrarenal abdominal aorta. An almost circumferential sliver of contrast (*black arrow*) enveloping the thrombus hints at the tenuous adherence of the thrombus to the aorta just immediately superior. **b,** Three-dimensional rendering of the aortic thrombus in its entirety (*white thick arrow*). **c,** Angiogram confirming the position of the aortic thrombus (*black thick arrow*).

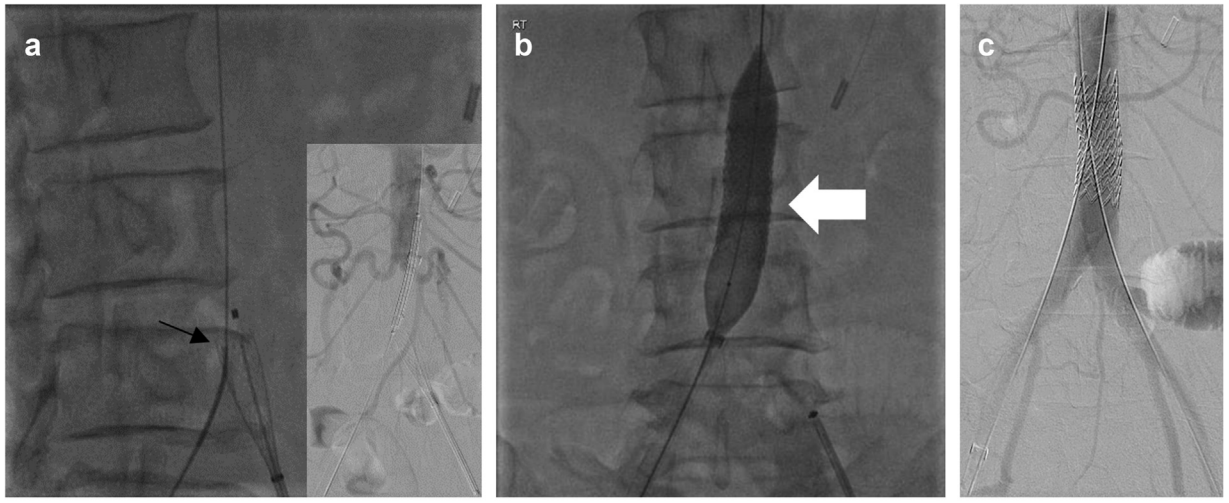

Fig 2. a, A 16-mm Wallstent, sized to the aortic bifurcation, was partially unsheathed (*arrow*) before attempting to cross the narrowed segment. **Inset,** Placement of sheath containing the large-diameter BeGraft stent. **b,** Begraft stent deployed (*white thick arrow*) with simultaneous resheathing of the Wallstent to avoid entrapment by the large balloon as it reaches nominal pressure. **c,** Final angiogram demonstrating restoration of the aortic luminal diameter.

Duplex ultrasound follow-up at 3 months showed a patent stent with preserved distal arterial flow, and her toe wound had healed.

DISCUSSION

Aortic mural thrombus can present as "thrash" phenomenon or blue toe syndrome. The optimal management has yet to be established. A systematic review by Fayad et al[7] on treatment of aortic mural thrombus in the nonaneurysmal, nonatherosclerotic aorta favored surgery over medical treatment, although endovascular methods were not evaluated. Endovascular options described in the treatment of aortic mural thrombus include stent grafts,[5,8] bare metal stents,[8-10] and thrombus aspiration.[11] The use of stent grafts allows for the exclusion of the thrombus, covering any underlying lesion such as an atherosclerotic plaque. Bare metal stents have the advantage of preserving the aortic branches and are described to be safe and effective,[10] although the potential risk exists of allowing a part of the thrombus to squeeze through the mesh of the bare metal stent.

Distal embolization is a concern during instrumentation and aortic stenting,[6] especially in our patient with an initial presentation of blue toe syndrome, suggesting the presence of an unstable thrombus or plaque. Given that the aortic thrombus was flow occluding, wire passage would have a high risk of dislodging part of the thrombus. Another concern is "toothpasting" during stent deployment, causing thrombus extrusion around the stent edges.[12] Commercial embolic protection devices are available for carotid and peripheral arterial stenting, such as the SpiderFX (Medtronic), FilterWire EZ (Boston Scientific), and EmboShield (Abbott Laboratories), but are not manufactured to a size compatible for use as an embolic protection device in the aorta. The use of the Capturex device (previously manufactured by Straub Medical) as a filter during thoracic endovascular aortic repair was previously described,[13] although the device is no longer commercially available. To the best of our knowledge, no current commercial thromboembolic protection devices are available in a size suitable for the native aortic diameter.

The use of a Wallstent has been described as an embolic protection filter device during thromboembolectomy of a free floating thrombus in the proximal descending aorta[14] and also during thoracic aorta stenting.[15] It has also been used as a temporary inferior vena cava filter device during coil embolization of a high-flow arteriovenous fistula.[16] With its reconstrainable design, the Wallstent can be partially deployed up to the limit marker band, allowing it to capture emboli and then be resheathed after. The partial unsheathing can be tested and performed initially outside the patient to gauge the extent of the stent before it is used in vivo. The distal extent of the stent can also be identified fluoroscopically. Care must be taken not to fully unsheathe the stent because it cannot be resheathed once fully deployed. It is manufactured in diameters ranging from 5 mm to 24 mm. For our patient, a 16-mm Wallstent was chosen because that was the native diameter of the patient's aorta. Due to the location of the lesion in the infrarenal aorta, the Wallstent could not be expanded fully because the proximal end of the stent is limited by the left common iliac artery, making it more difficult to use when stenting is performed in the distal aorta. Despite this technical limitation, the deployment of the balloon-expandable BeGraft stent was from the right side; thus, emboli would be less likely to travel into the right side during stent graft deployment with the balloon inflated. The delivery sheath for the Wallstent should also be advanced as close as possible to the distal stent marker during reconstrainment and retrieval of the stent, so that any loose captured thrombi will be caught in the sheath and not allowed to embolize distally. With the COVID-19 (coronavirus disease 2019) endemic in the current era, which results in a higher risk of thrombogenic events for patients infected with COVID-19,[17] it is a timely reminder that the Wallstent is a useful alternative as a makeshift filter in cases of aortic stenting.

CONCLUSIONS

The use of a resheathable Wallstent device can be considered a safe and effective option for distal thromboembolic protection in aortic stenting, particularly when distal embolization is a concern and commercial devices are not readily available.

DISCLOSURES

None.

REFERENCES

1. O'Keeffe ST, Woods BO, Breslin DJ, Tsapatsaris NP. Blue toe syndrome. Causes and management. Arch Intern Med 1992;152:2197-202.
2. Pandit AK, Ohshima T, Kawaguchi R, Srivastava MP, Miyachi S. Cholesterol embolization syndrome after carotid artery stenting associated with delayed cerebral hyperperfusion intracerebral hemorrhage. World Neurosurg 2020;142:274-82.
3. Verma H, Meda N, Vora S, George RK, Tripathi RK. Contemporary management of symptomatic primary aortic mural thrombus. J Vasc Surg 2014;60:1524-34.
4. Matchett WJ, McFarland DR, Eidt JF, Moursi MM. Blue toe syndrome: treatment with intra-arterial stents and review of therapies. J Vasc Interv Radiol 2000;11:585-92.
5. Boufi M, Mameli A, Compes P, Hartung O, Alimi YS. Elective stent-graft treatment for the management of thoracic aorta mural thrombus. Eur J Vasc Endovasc Surg 2014;47:335-41.
6. Radvany MG. Use of embolic protection devices in peripheral interventions. Interv Cardiol Rev 2017;12:31-5.
7. Fayad ZY, Semaan E, Fahoum B, Briggs M, Tortolani A, D'Ayala M. Aortic mural thrombus in the normal or minimally atherosclerotic aorta. Ann Vasc Surg 2013;27:282-90.
8. Jeyabalan G, Wallace JR, Chaer RA, Leers SA, Marone LK, Makaroun MS. Endovascular strategies for treatment of embolizing thoracoabdominal aortic lesions. J Vasc Surg 2014;59:1256-64.
9. Renshaw A, McCowen T, Waltke EA, Wattenhofer SP, Tahara RW, Baxter BT. Angioplasty with stenting is effective in treating blue toe syndrome. Vasc Endovascular Surg 2002;36:155-9.
10. Mahnken AH, Hoffman A, Autschbach R, Damberg ALM. Bare metal stenting for endovascular exclusion of aortic arch thrombi. Cardiovasc Intervent Radiol 2013;36:1127-31.
11. Bertolucci LH, Donadello Martins AP, Rockenbach Pereira O, Schulte AA, Perini SC. Thromboaspiration of abdominal aortic mural thrombus: a new endovascular approach. Vasc Endovascular Surg 2023;57:513-9.
12. Clair DG, Beach JM. Strategies for managing aortoiliac occlusions: access, treatment and outcomes. Expert Rev Cardiovasc Ther 2015;13:551-63.
13. Portugaller RH, Steiner J, Schmid F, Knez I, Asslaber M, Deutschmann HA. The use of a commercially available endovascular filter catheter (Capturex®) for thoracic endovascular aortic repair (TEVAR) in a patient with a coral reef aorta. Cardiovasc Intervent Radiol 2022;45:879-83.
14. Fanelli F, Gazzetti M, Boatta E, Ruggiero M, Lucatelli P, Speziale F. Acute left arm ischemia associated with floating thrombus in the proximal descending aorta: combined endovascular and surgical therapy. Cardiovasc Intervent Radiol 2011;34:193-7.

15. George RK, Singh Y, Ram BL. An endovascular filter to prevent embolization during aortic stenting. J Vasc Surg 2016;63:548-51.
16. Resnick S, Rome V, Vogelzang R. Use of a partially deployed wall-stent to act as an inferior vena cava filtration device during coil embolization of a high-flow arteriovenous fistula. J Vasc Interv Radiol JVIR 2006;17:369-72.
17. Goh SSN, Yong EM, Hong QT, et al. Acute aortic thrombosis presenting as acute limb ischemia in two young, non-atherosclerotic patients. Br J Surg 2020;107:e565-6.

Submitted Jul 14, 2023; accepted Sep 20, 2023.