Aortic rupture during STABILISE (stent-assisted balloon-induced intimal disruption and relamination in aortic dissection repair) technique

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ABSTRACT

The STABILISE (stent-assisted balloon-induced intimal disruption and relamination in aortic dissection repair) technique has shown promising results for treating type B aortic dissections, but the potential exists for fatal adverse effects. We present a case of infrarenal aortic rupture while using a compliant balloon to balloon mold the true lumen inside previously placed bare metal stents during the STABILISE technique. Caution is advised for providers who wish to perform the STABILISE technique, and we recommend using a semi-compliant balloon sized to the smallest total aortic diameter to mitigate the risk of rupture. (J Vasc Surg Cases Innov Tech 2023;9:101338.)

Keywords: Aortic ballooning; Aortic dissection; Aortic rupture; Endovascular repair; STABILISE technique

The standard of care for complicated type B aortic dissection is endovascular repair with stent graft coverage of the proximal entry tear.[1,2] Sealing the proximal entry tear resolves malperfusion in the majority of patients and results in fewer early delayed failures compared with limb-first interventions such as extra-anatomic bypass.[3,4] The goal is to expand the true lumen and restore perfusion to the aortic branches and, in the long term, to induce false lumen thrombosis and promote aortic remodeling. However, this approach fails to result in complete abdominal aortic remodeling in ≤80% of cases.[5,6] Late complications of incomplete aortic remodeling include aneurysmal degeneration, rupture, and the need for reoperation.

To address the potential problem of sustained pressurized false lumen flow, the PETTICOAT (provisional extension to induce complete attachment) technique was introduced.[7] This technique has also been referred to as the STABLE (staged total aortic and branch vessel endovascular) reconstruction technique.[8-10] It involves stent graft coverage of the proximal entry tear and deployment of self-expandable bare metal stents in the visceral aorta to expand the true lumen, relieve dynamic malperfusion, and promote false lumen thrombosis and aortic remodeling.[7] At 2 years of follow-up using this technique, Melissano et al[11] found a 140% increase in true lumen volume, especially in the thoracic aorta. However, the abdominal aorta failed to progressively remodel, and evidence was found of persistent false lumen perfusion and a tendency to grow distal to the stent graft.[11,12]

The STABILISE (stent-assisted balloon-induced intimal disruption and relamination in aortic dissection repair) technique was subsequently proposed as a method to improve aortic remodeling. This technique is similar to the PETTICOAT technique but includes balloon molding of the true lumen inside the stent graft and bare metal stents. Aortic ballooning ruptures the intimal lamella, allowing full expansion of the stent within a single-channeled aorta and restoring uniluminal flow.[8] Several studies have demonstrated favorable short-term and mid-term outcomes of the STABILISE technique. It successfully relieves malperfusion, achieves complete obliteration of the false lumen at the thoracoabdominal level, and reduces the reintervention rate.[8,13,14] Although the STABILISE technique has demonstrated promising results, the potential exists for aortic rupture, as demonstrated in this case report. The patient provided written informed consent for the report of his case details and imaging studies.

CASE REPORT

The patient was a 57-year-old man with a history of hypertension who presented with an acute complicated type $B_{3,10}$ aortic dissection with lower extremity malperfusion that was successfully treated with zone 2 thoracic endovascular aortic repair (TEVAR) and bare metal PETTICOAT stenting of the aorta distally to the aortic bifurcation. At 8 months postoperatively, he developed a distal stent graft-induced new entry tear with expansion of the aorta at this location that was repaired with a TEVAR distal

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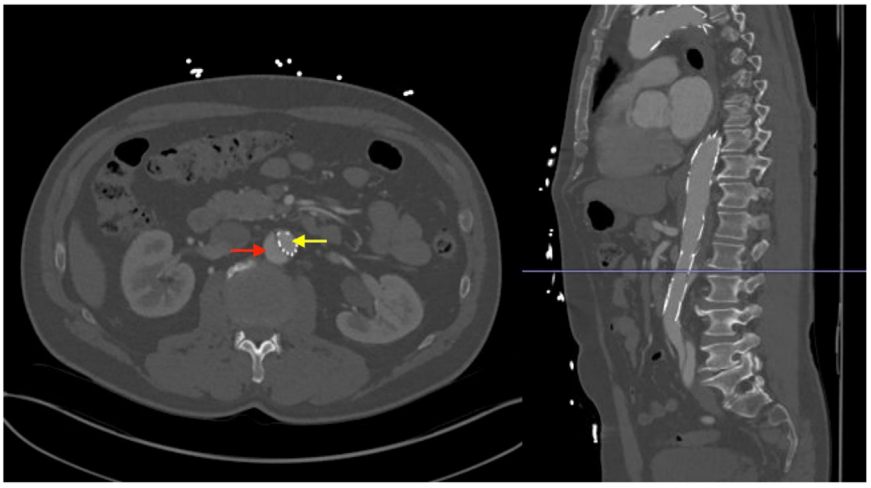

Fig 1. Preoperative computed tomography scan demonstrating narrowing of the true lumen (*yellow arrow*) in the infrarenal aorta within the previously placed bare metal stents. At this level, the true lumen measures 1.2 × 1.9 cm, and the false lumen (*red arrow*) measures 1.3 × 2.4 cm.

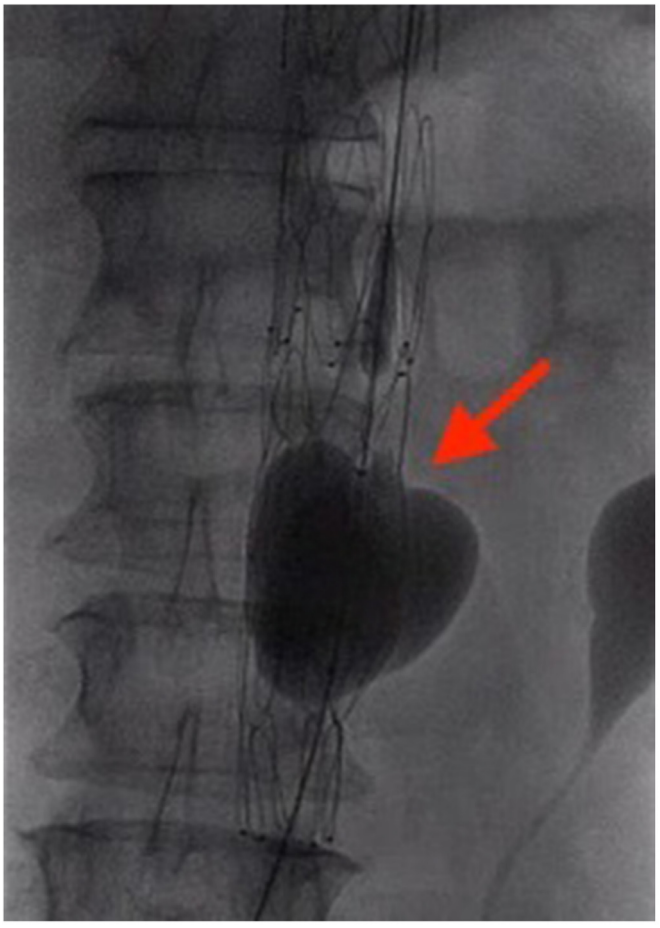

Fig 2. Aortic ballooning inside the bare metal stents within the infrarenal aorta as part of the STABILISE (stent-assisted balloon-induced intimal disruption and relamination in aortic dissection repair) technique. The Tri-Lobe balloon (WL Gore & Associates) appears to expand past the bare metal stents.

extension. He simultaneously underwent left carotid–subclavian transposition because he was complaining of left arm effort fatigue. At 11 months after the reintervention, he developed a new type Ia endoleak with distal stent migration, and the plan was to treat this with a TEVAR proximal extension.

During the TEVAR proximal extension, advancement of the 22F sheath through the infrarenal aorta was challenging because the wire repeatedly traversed through the interstices rather than through the middle of the previously placed bare metal PETTICOAT stents. This likely occurred because the true lumen of the distal aorta was still relatively narrow (Fig 1). After multiple attempts using a pigtail catheter, intravascular ultrasound, and other catheter and wire combinations, the wire appeared to travel solely within the middle of the bare metal stents; however, the sheath still could not be advanced without catching against the PETTICOAT stents, pushing them upward. It was unclear whether the wire was around one of the interstices still or if the edge of the large sheath at the interface between the dilator and the sheath was caught. The decision was made to use the STABILISE technique to expand the true lumen to aid in sheath advancement. Serial ballooning was performed with a Tri-Lobe balloon catheter (WL Gore & Associates), which provided true lumen expansion and enabled sheath advancement. However, there was concern for aortic rupture because the balloon appeared to expand beyond the lumen of the bare metal stents (Fig 2). Subsequently, the patient became hypotensive, and suprarenal balloon occlusion of the aorta was performed using a Coda balloon (Cook Medical Inc). The location of the infrarenal aortic rupture was confirmed with an angiogram (Fig 3), and the rupture was treated with endovascular aortic repair. Due to the urgency of the situation, several aortic cuffs (32 × 45 mm) were initially placed in the infrarenal aorta while the appropriately sized bifurcated aortic graft was being obtained. After placement of the cuffs, the blood pressure stabilized. An angiogram demonstrated a delayed endoleak; thus, a bifurcated graft was deployed, along with a left iliac

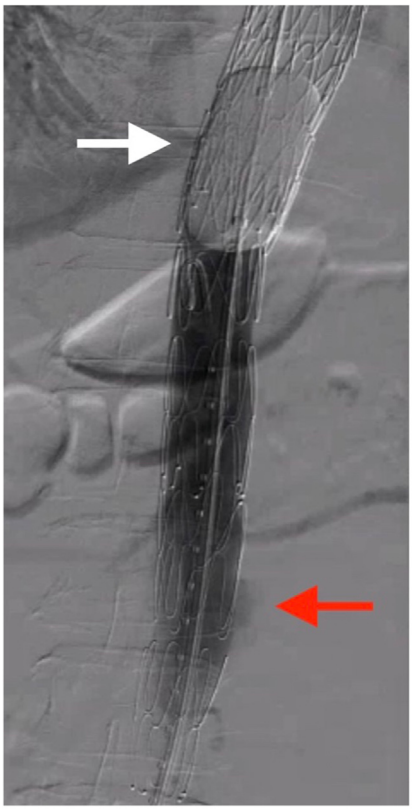

Fig 3. Angiogram demonstrating balloon occlusion of the suprarenal aorta (*white arrow*) and infrarenal aortic rupture (*red arrow*).

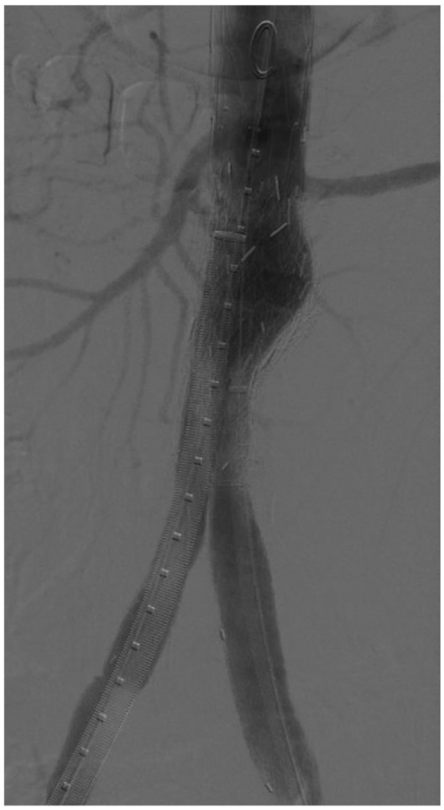

Fig 4. Angiogram demonstrating successful treatment of the infrarenal aortic rupture with endovascular aortic repair.

limb. No endoleak was seen on the final angiogram (Fig 4), and proximal extension of the TEVAR was completed.

The patient made a full recovery but continued to have a persistent type Ia endoleak. Given the patient's history of acute type B aortic dissection, stent graft-induced new entry tear, type Ia endoleak, and aortic rupture, genetic testing for aortopathy was performed. However, no known genetic variants were identified. He ultimately underwent total aortic arch replacement with frozen elephant trunk for the type Ia endoleak and enlarging aortic arch aneurysm, and he recovered well without further issues.

DISCUSSION

The STABILISE technique has not been widely accepted, in part due to safety concerns and the lack of long-term data. The technique was originally proposed as a treatment for acute and subacute dissections before aneurysmal degeneration occurs and when intimal flap to aortic wall relamination is possible.[8] However, a recent study by Faure et al[15] found the technique to be safe and effective for inducing complete thoracoabdominal aortic remodeling and stabilizing the diameter of the dissected aorta in chronic complicated dissections. In the present case, the technique was used in the setting of a chronic type B aortic dissection that occurred 19 months after the initial dissection but resulted in aortic rupture.

We do not recommend routine use of the STABILISE technique to treat complicated aortic dissections, considering the potential risk for rupture. For the present case, the use of the STABILISE technique was unplanned, and the decision was made only after multiple attempts to advance the large sheath through the true lumen within the bare metal stents failed. To expand the true lumen, we used a Tri-Lobe balloon, which was the only compliant balloon in the operating room at the time. After the rupture, a Coda balloon was obtained from a different operating room. The original description of the STABILISE technique used a Coda balloon, but other reports have described successful use of Tri-Lobe balloons and noncompliant or semi-compliant balloons.[8,13-15] In the past, we have used both Coda and Tri-Lobe balloons for this technique. However, based on our experience from the present case, we advise that providers who wish to use the STABILISE technique consider using a semi-compliant balloon, such as a Z-MED balloon (B. Braun Interventional Systems Inc) sized to the smallest total aortic diameter (Fig 5). The Tri-Lobe balloon is oversized and expands with three focal points of contact, rendering it unsuitable for rupturing an unprotected aortic septum. When selecting the appropriate balloon size, the diameter only needs to be large enough to rupture the intimal lamella. The bare metal stent will

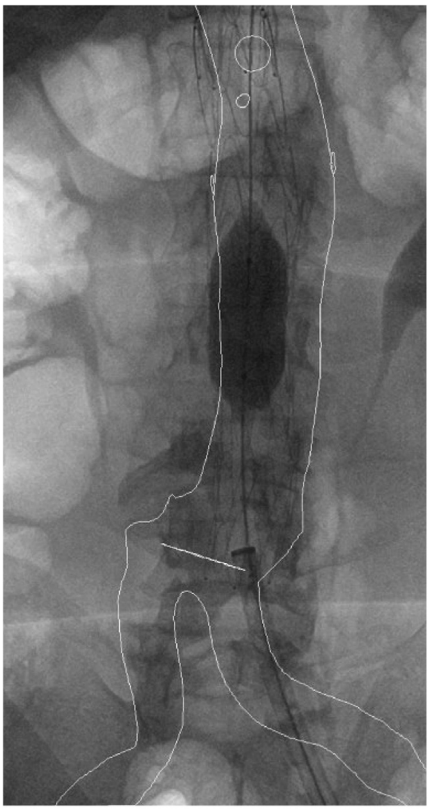

Fig 5. Example of using a semi-compliant Z-MED balloon (B. Braun Interventional Systems Inc) sized to the smallest total aortic diameter for the STABILISE (stent-assisted balloon-induced intimal disruption and relamination in aortic dissection repair) technique.

then fully expand using its intrinsic radial force, and this approach will mitigate the risk of rupture.

One of the essential issues the present case highlights is the challenge of subsequent endovascular aortic operations after the use of bare metal aortic dissection stents. At least two potential technical issues need to be considered. The first is to establish wire access that does not track around any of the bare stents, and the second is to address issues that could arise during large bore sheath advancement. As demonstrated in the present case, it is not always immediately apparent that the guide wire has advanced around the interstices of one of the bare metal stents, because they have little radial force and might not impede tracking of a catheter for exchange to a stiff wire. Use of intravascular ultrasound might be falsely reassuring because the bare metal can cause an artifact. Careful attention should be paid during exchange to a stiff wire because tenting of the stent can occur if the wire tracks outside. When in doubt, our recommendation is to push a pigtail catheter up from below the bare stents and use that to exchange to a stiff wire because this is less likely than a wire to track around the bare metal stent. The second issue that can occur, especially when the true lumen is narrow, is that the edge of the large bore sheath at the interface between the dilator and sheath can catch on one of the bare metal stents and cause it to telescope the stent superiorly. One possible method to avoid this is to use a balloon catheter to advance the sheath over. This can take multiple attempts, but, as the present case demonstrates, it is important to be patient.

CONCLUSIONS

The STABILISE technique has been advocated as a safe treatment method for type B aortic dissection; however, the present case demonstrates the possible danger of aortic rupture as a serious and potentially fatal complication. Caution is advised, and when using this technique, surgeons should consider using a semi-compliant balloon sized to the smallest total aortic diameter.

DISCLOSURES

None.

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