Emergent open conversion for stent-graft deployment failure in a ruptured thoracic aneurysm

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ABSTRACT

Thoracic endovascular aortic repair (TEVAR) is the standard of care for ruptured thoracic aortic aneurysms. A 92-year-old man had presented in stable condition but with acute severe back pain. Computed tomography revealed a ruptured thoracic aortic aneurysm. TEVAR (Valiant; Medtronic Vascular, Santa Rosa, Calif) into zone 2 with intentional coverage of the left subclavian artery was planned. After release of the stent-graft body, proximal release of the bare springs was impossible. Troubleshooting techniques were applied; but tip capture could not be released. Emergent conversion to open repair was performed. Intraoperative device deployment failure in TEVAR is rare. The findings from the present report have demonstrated the advantages of having in-house cardiac surgery backup available. (J Vasc Surg Cases and Innovative Techniques 2021;7:180-2.)

Keywords: Descending aorta; TEVAR; Thoracic aneurysm; Ruptured aneurysm

Thoracic endovascular aortic repair (TEVAR) is the preferred treatment option for ruptured thoracic aortic aneurysms, provided the morphology is suitable.[1] We have reported the case of device failure that required emergent conversion to open aortic arch repair. The patient provided written informed consent to report his case.

CASE REPORT

An active 92-year-old male patient had presented with acute severe back pain in a hemodynamically stable condition. He had a history of a ruptured infrarenal aortic aneurysm that had been treated by open repair 23 years previously. He had also undergone TEVAR of a descending thoracic aortic aneurysm 17 years previously. A distal TEVAR extension had been performed 6 years previously to treat a type Ib endoleak. The patient had developed sinus bradycardia for which he had undergone pacemaker implantation 6 years before the current presentation. Computed tomography angiography revealed a ruptured aneurysm of the descending aorta with a maximum diameter of 88 mm caused by type Ia and III endoleaks (Fig 1). Additionally, a bovine arch was present. Zones 0 to 3 were diseased, with a maximum diameter of 50 mm in zone 3 and 42 mm in zone 2 (oversizing of 10%). Urgent treatment was indicated. A TEVAR extension into zone 2 with intentional coverage of the left subclavian artery was planned. Using percutaneous transfemoral access, a Valiant thoracic stent-graft (proximal bare springs, straight configuration, diameter of 46 mm, length of 150 mm; Medtronic Vascular, Santa Rosa, Calif) was placed in the aortic arch. Stent-graft insertion was performed without difficulty. The release of the stent-graft was performed under rapid right ventricular pacing by retracting the integrated slider handle. Next, the tip capture release handle at the rear of the

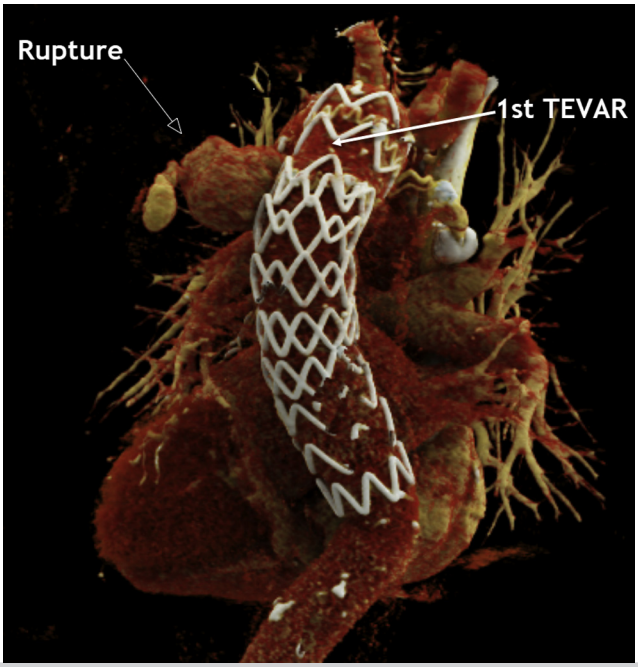

Fig 1. Three-dimensional reconstruction of computed tomography angiography showing rupture of the thoracic aneurysm due to a type Ia endoleak.

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Author conflict of interest: none.

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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.2020.10.017

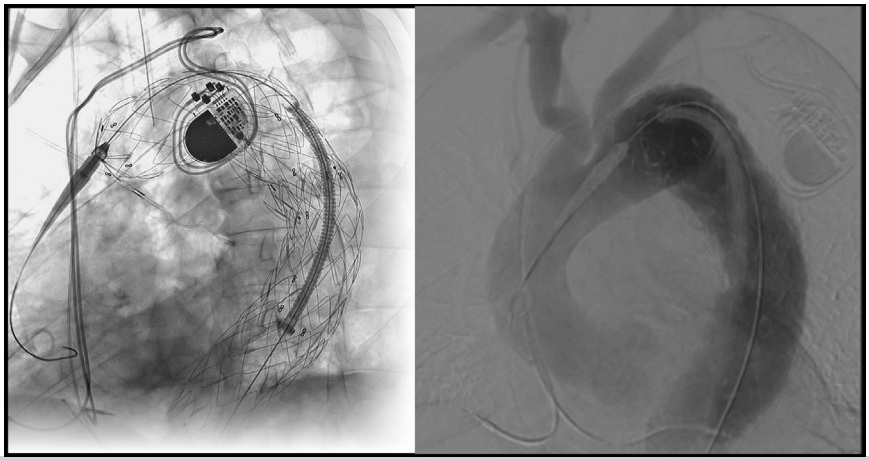

Fig 2. Deployed stent-graft in the aortic arch and failure of the tip capture release mechanism.

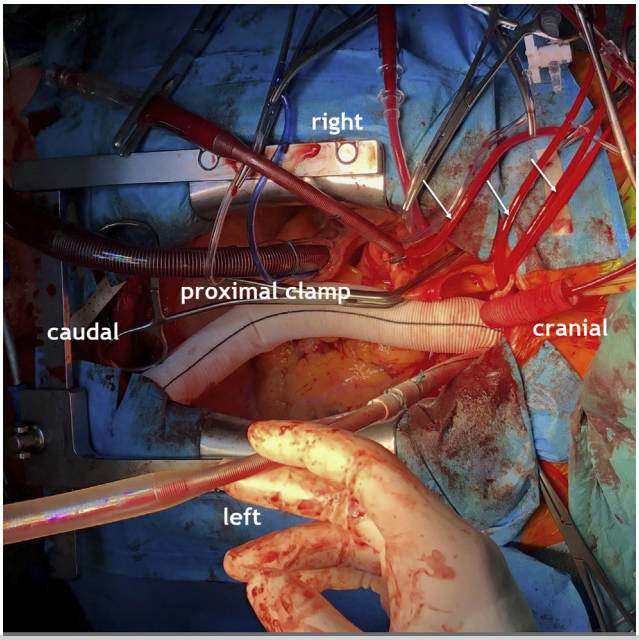

Fig 3. Intraoperative view during total arch repair under continuous selective antegrade cerebral perfusion (catheters indicated by *arrows*).

delivery system was unlocked and retracted. However, the tip capture did not release the proximal bare springs. For the Freeflo stent-graft delivery system (Medtronic Vascular), the proximal bare stent is constrained by the tip capture mechanism. Thus, if the tip capture mechanism fails, the proximal bare springs will remain locked (Fig 2). The delivery system could not be withdrawn because the stent-graft body had been deployed. The manufacturer's instructions for use were consulted for troubleshooting techniques, which revealed "alternative instruction for deploying tip capture mechanism." These included removing the backend lock and pulling off the delivery system. Next, the clamping ring was removed, and we attempted to retract the tip capture tube. However, the bare metal stent could not be released. Additional endovascular methods (eg, balloon disruption, dilatation of the captured tip) were not considered because of the unpredictable stroke risk.[1-7] We decided to perform emergent conversion to open repair. Thus, sternotomy, deep hypothermic circulatory arrest, and total arch repair with bypasses to all supra-aortic vessels under continuous selective antegrade cerebral perfusion were performed (Fig 3). The proximal bare springs of the stent-graft were cut from the delivery system using wire forceps. The ruptured side could be verified. The delivery system was withdrawn. The patient had remained hemodynamically stable and showed a good recovery. On the seventh postoperative day, computed tomography angiography revealed a persisting low-flow type III or IV endoleak in the stent-graft overlap zone in the aneurysm sac at the descending aorta. Therefore, a fourth thoracic stent-graft was implanted during a second operation 9 days postoperatively. Finally, complete aneurysm exclusion was achieved without any endoleak (Fig 4). The postoperative course was uneventful. The patient recovered well without complications. He was discharged to a rehabilitation facility on the 15th postoperative day.

DISCUSSION

Endovascular treatment remains the first-line treatment of pathologies of the descending aorta.[1] Open repair, including left heart bypass, is more invasive but can be useful in the presence of rupture.[7] Considering our patient's age, TEVAR was favored as the most reasonable therapeutic option. Intraoperative device deployment failure during TEVAR is rare. Three prospective, multicenter, nonrandomized clinical studies of the same device reported no graft complications and 100% successful delivery and deployment of the stent graft.[2-5] The 1-year results of the rescue trial demonstrated no conversion to open repair. Another study reported a device-related complication rate of 12.5% in aortic dissection but no device deployment failure.[6] Device deployment failure issues concerning a stent-graft during endovascular aortic repair from another company

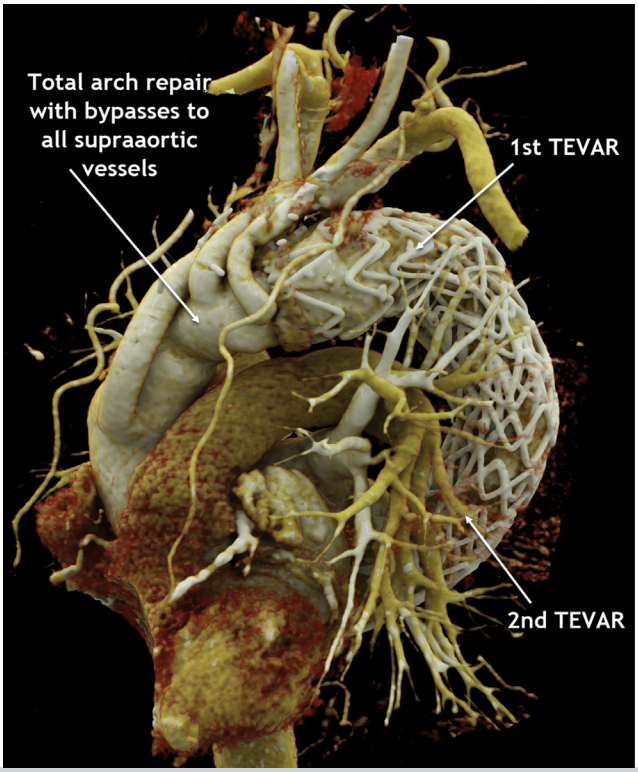

Fig 4. Final three-dimensional reconstruction of computed tomography angiography demonstrating no endoleak.

many years ago, which had led to device retrieval. We filed a report to the Swiss Medical Device Vigilance Agency and the device company for device investigation. From a review of the procedural films and analysis of the delivery system, the cause of the deployment and expansion difficulties could not be conclusively determined. If conversion to open repair is inevitable, the in-house availability of a cardiac surgery service can be lifesaving. The results from the present case report have demonstrated that maximal invasive therapy for an initially minimally invasive intention to treat could be necessary in extremely rare conditions. Nevertheless, the indication for treatment must be determined individually.

CONCLUSIONS

Intraoperative stent-graft deployment failure is extremely rare. Deployment difficulties and failures are recognized as potential adverse events associated with the implantation of a stent-graft. If all strategies for troubleshooting fail, conversion to open surgery might be the last option to rescue the patient. The present case report has demonstrated the advantage of having an in-house cardiac surgery backup available to treat such pathologies.

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Submitted Sep 3, 2020; accepted Oct 30, 2020.