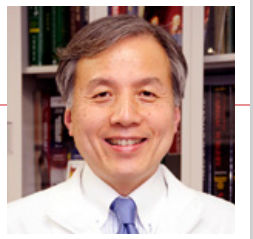
Pitfalls in the use of FROZENIX in conjunction with total arch replacement



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The recent advancement of total arch replacement (TAR) with a frozen elephant trunk (FET) procedure has been widely adopted as a single-stage open aortic repair technique for a non-dissecting arch aneurysm with a downstream extension or a first-stage procedure, followed by a second descending aortic replacement or thoracic endovascular aortic repair (TEVAR). Compared with the conventional elephant trunk (ET) procedure, the FET procedure is also a useful additional TAR procedure in cases of acute and chronic type A or B aortic dissection; in such cases, FET is used to reinforce the distal anastomosis of the TAR and close the false channel of the descending aorta. However, some pitfalls in the performance of this technique with FROZENIX have been identified.

PITFALLS IN THE USE OF FROZENIX

1) Kinking of the non-stented segment. FROZENIX comprises two distinct structural segments: a distal stented segment, and a proximal non-stented segment. We experienced some kinking of the proximal non-stented segment of FROZENIX during TAR for acute type A aortic dissection in a 46-year-old male patient who presented with a small intimal tear at the branching site of the left subclavian artery. TAR with FET was performed using a 26-mm woven Dacron multi-branch arch graft and 27-mm × 6-cm FROZENIX. Malperfusion of the bilateral lower extremities was recognized during surgery, and an extra-anatomical bypass comprising an 11-mm woven Dacron graft between the ascending aorta and the right femoral artery was added. Although the postoperative course was uneventful, the postoperative computed tomography (CT) scans showed some stenosis of the proximal non-stented segment of FROZENIX (Fig. 1).

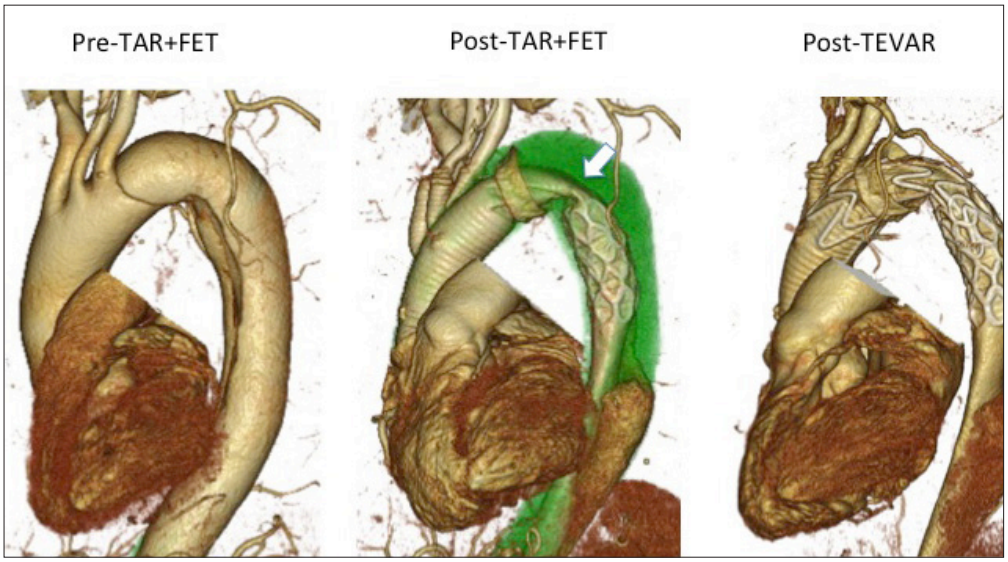
Subsequently, TEVAR was scheduled for dilatation of the false channel of the descending aorta (Fig. 2), after which the stenosis of the non-stented segment disappeared, presumably because of the potential distension of the Dacron graft, as observed on the CT scans before TEVAR (Fig. 2). Another institute reported a similar event (Fig. 3), in which case TEVAR was performed to relieve the stenosis. To prevent this pitfall, the proximal non-stented segment of FROZENIX should be shortened as much as possible (1–2 cm), with the distal anastomosis of TAR suture line placed immediately proximal to the stented segment.

Fig. 1

Fig. 2


Post-TAR+FET
Pre-TEVAR
Post-TEVAR

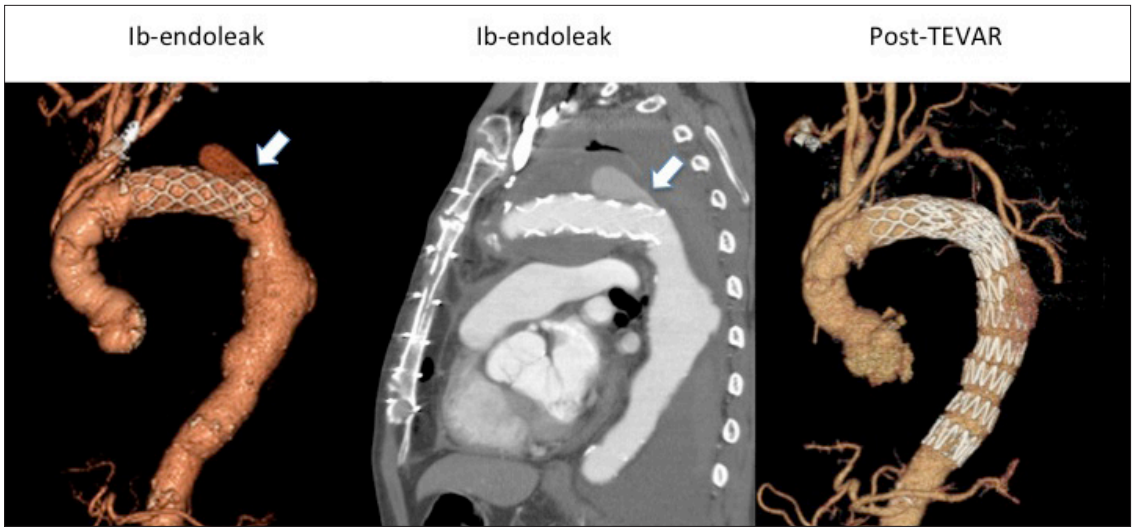
Fig. 3


Pre-TAR+FET
Post-TAR+FET
Post-TEVAR

2) Proximal dislodgement of the distal edge. A moderate radial force placed on the inside stent of FROZENIX could potentially dislodge the distal edge of the stented segment. In addition, during TAR with FET, the proximal site of the FET is fixed tightly with anastomotic sutures. Consequently, proximal dislodgement of the distal stented part of the FROZENIX tends to occur in cases with a larger, fusiform-type aneurysm and a relatively short or poor landing zone. Here we describe an 80-year-old male patient with a fusiform distal arch aneurysm diameter of 75 mm (Fig. 4). This patient underwent TAR with FET using a 26-mm woven Dacron multi-branch graft and 27-mm × 9-cm FROZENIX (Fig. 4). Although his postoperative course was uneventful, within three months he developed an impending rupture of the arch aneurysm due to a type-Ib endoleak, which was caused by proximal dislodgement of the distal stented segment of FROZENIX. Emergency TEVAR was performed successfully (Fig. 5). In the initial TAR with FET, the FROZENIX appeared to be too short to allow sufficient fixation to the descending aorta, particularly as this case involved a larger fusiform arch aneurysm. To prevent this pitfall, FROZENIX with a sufficiently long distal stented part should be used with endoscope as long as possible to assess the distal landing zone in the descending aorta. Currently, our practice uses 12-cm FROZENIX devices almost routinely for non-dissecting arch aneurysms, and 9-cm devices for cases of acute aortic dissection.

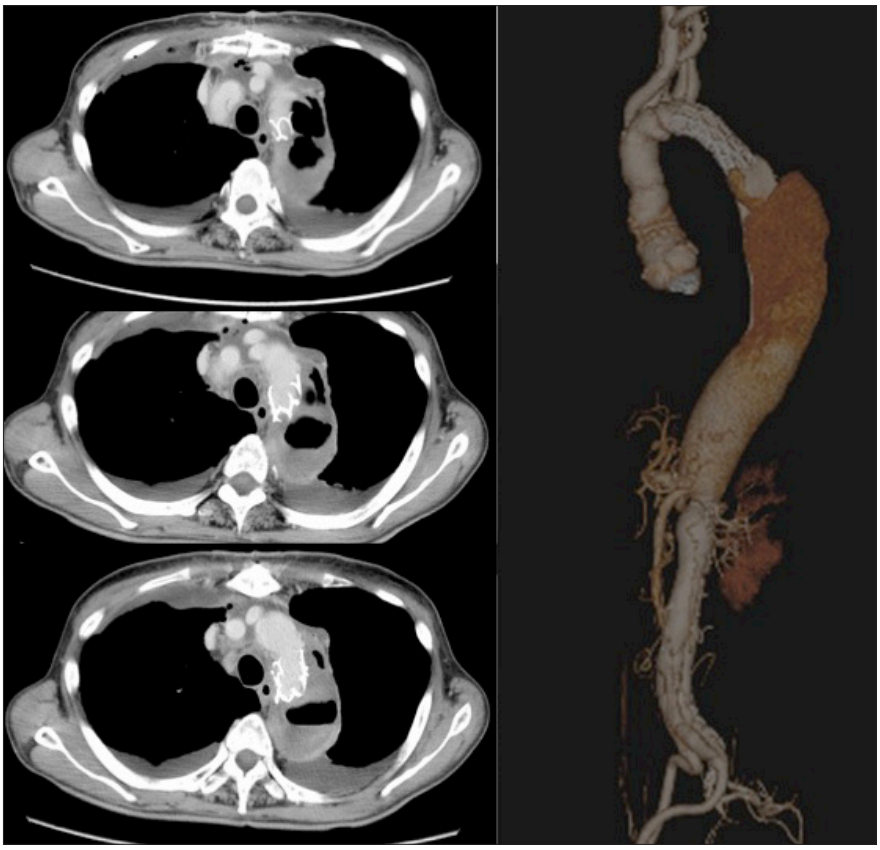
Fig. 4

Fig. 5



3) Spinal cord injury. Spinal cord (SC) injury remains one of the most serious sequelae after TAR with FET, with recent reports describing incidence rates of 5%–10%. The majority of cases are attributable to coverage of the responsible intercostal arteries (ICA), particularly below the T8 level, by the FET, although distal embolization of the ICAs may be responsible in some cases. At our institution, we have experienced only one patient with paraparesis, in which the distal end of FROZENIX was fixed at the T6 level and the condition of the descending aorta was not severe. Fortunately, the patient recovered from paraparesis following routine treatment (e.g., cerebrospinal fluid drainage, norepinephrine for high blood pressure, steroids). Fig. 6 presents interesting postoperative CT findings in another patient who underwent TAR with FET using FROZENIX for chronic type A aortic dissection. In this case, the air remained around the FET in the aneurysmal sac even 10 days postoperatively. Although this patient did not suffer from a SC injury, the case suggests the potential risk of air embolism of the ICA in cases of SC injury consequent to TAR and FET. To prevent this phenomenon, air removal should be ensured carefully before tying the suture of the distal anastomosis. In our practice, this step is performed routinely via puncture with a small needle after distal anastomosis.

Fig. 6



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