Masters of Cardiothoracic Surgery

One stage ascending and descending aorta replacement through the posterior pericardium to treat aortic rupture due to stent graft-induced new entry (SINE) tear

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Clinical vignette

A 78-year-old hypertensive man, with a history of zone 2 thoracic endovascular aortic repair (TEVAR) to treat a proximal descending aortic aneurysm in 2014, presented with a recent onset of hemoptysis. He had been well post-surgery until four months prior to admission, when he presented with chest discomfort and hemoptysis followed by recurrence and symptom aggravation. Computed tomography (CT) showed a previously absent aortic disruption at the proximal tip of the bare metal portion of the stent graft (SG) that was compatible with a diagnosis of SG-induced new entry (SINE). The presence of aortic rupture was implicated by a large periaortic hematoma of the aortic arch, proximal descending aorta and the upper chest cavity.

Surgical techniques

Preparation and exposure

Surgery was performed through a median sternotomy. Both the innominate artery and distal ascending aorta were cannulated. Separate bicaval cannulation was performed for venous drainage. The left common carotid artery (LCCA) was then divided and perfused separately through a 13 Fr manually inflatable balloon catheter just prior to the institution of cardiopulmonary bypass. The purpose of this maneuver was to minimize the risk of embolization as the presence of fragile atherosclerosis was suggested on the preoperative CT study.

Operation

While systemic cooling to 26 ℃ was commenced, the innominate artery (IA), LCCA and left subclavian artery (LSA) were debranched in that order using a trifurcated debranching graft (Gelweave, Vascutek Ltd., Inchinnan, United Kingdom). As the innominate artery and the distal ascending aorta were cannulated, a dual parallel perfusion system to the upper and lower body was established upon completion of the head vessel bypasses. This measure was helpful in reducing the cardiac ischemic time as the distal aortic anastomosis was immediately followed by the proximal anastomosis. Upon reaching the target temperature, the aorta was cross-clamped and root cardioplegia was administered. The ascending aorta was opened, and the incision extended into the arch. The SINE was located opposite the LSA orifice at the tip of the SG bare metal portion, where the aorta was transmurally disrupted. Next, the heart was retracted cephalad out of the pericardial well. The posterior pericardium was transversely incised, slightly below the left hilum to expose the descending aorta, which was located a few centimeters distal to the previously deployed SG. A 30 mm, 1-branch Dacron graft was attached to a silk tie, which was then secured to a corrugated stylet and passed down the proximal aorta, through the SG and out the descending aorta opening.

The Dacron graft was then gently pulled and guided down the descending aorta through the previous SG. The graft end inside the descending aorta was perfused through the side graft, and the pressure was checked to ensure

kinking did not occur. Subsequently, the graft was cut to an appropriate length and sutured within the native aorta with a continuous 3-0 polypropylene suture. Any bleeding through the graft and proximal opening of the resected native aorta was reinforced with pledgetted prolene sutures. The proximal end of the graft was then anastomosed to the distal end of the ascending aorta to complete the aortic replacement. The proximal end of the common trifurcating graft was anastomosed to the main graft in end-to-side fashion during rewarming. Pressure equalization of both the arms and legs was checked a final time. The remainder of the surgery was completed uneventfully. Although hospitalization was prolonged due to pneumonia and persisting lab signs of inflammation, these issues were self-limiting and the patient was discharged on postoperative day twenty-eight.

Comments

TEVAR has been widely accepted as an effective, less invasive method of treating various aortic diseases. Complications that were unforeseen at its first inception, however, have appeared over time. One of these is SINE, first reported by Dong *et al.* (1), defined as a new SG-induced (aortic) tear excluding any cause arising from natural disease progression or iatrogenic injury from endovascular manipulation. The constant pulsatile interaction between the relatively rigid SG and the fragile native aortic tissue has been implicated as the major contributing factor, and without treatment, it may lead to catastrophic aortic outcomes such as retrograde type A aortic dissection or aortic rupture (2).

The presence of a previously implanted SG may often complicate the surgical procedure and carry considerable risks of perioperative morbidity and mortality. Therefore, various innovative endovascular and hybrid surgical solutions have been devised and implemented to minimize the risk and to avoid extensive complex surgery. Although SG removal and open aortic replacement through a thoracotomy is the most direct treatment method, given the patient's advanced age and poor lung function, the risk of respiratory complications and stroke did not present as being negligible. A frozen elephant trunk (FET) procedure appeared to be an attractive and theoretically simple solution. However, in this patient, a FET procedure was not considered optimal due to uncertainties regarding the deployment of another new SG within the existing grafts; the angulation at the transverse juncture transitioning into the descending aorta may cause unexpected deformity of the newly deployed SG. Furthermore, as reported by Kreibich *et al.*, placing another SG to treat a SG-induced problem seems to have the potential to incur other unforeseen complications (3). Therefore, we decided to adopt the technique originally described by Beaver *et al.* consisting of conducting a single staged ascending, arch and descending thoracic aorta replacement through a median sternotomy and the posterior pericardium (4).

Through this method, we were able to avoid a thoracotomy incision and thereby avoid the significant risk of major postoperative pulmonary complications. This approach may have the added advantage of being able to conduct other cardiovascular surgery concomitantly. A high risk of paraplegia originally reported as 14% by Beaver *et al.* was a major concern, but we believed that this risk would be negligible in this situation as the proximal intercostal arteries had already been chronically occluded by the previous TEVAR. In conclusion, this method may offer a safer and simplified way of treating proximal SINE in the aortic arch after TEVAR where neither an endovascular nor an extensive surgical procedure seems optimal.

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Footnote

Conflicts of Interest: The authors have no conflicts of interest to declare.

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