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*Corresponding author

Ujjwal K. Chowdhury, Department of Cardiothoracic and Vascular Surgery, New Delhi, India, Tel: 91-11-26594835
Email: ujjwalchowdhury@gmail.com

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Aneurysmectomy of the Descending Thoracic Aorta and Graft Interposition using Vascutek Woven Double Velour Vascular Graft under Mild Hypothermic Extracorporeal Circulation: A Video Presentation

Ujjwal K. Chowdhury^{*1}, Niwin George², Sukhjeet Singh², Lakshmi Kumari Sankhyan², Sushama Gayatri B², Parag Gharde², Vishwas Malik² and Sreenita Chowdhury²

¹Department of Cardiothoracic and Vascular Surgery, New Delhi, India

²Cardiothoracic Sciences Centre, All India Institute of Medical Sciences, New Delhi, India

Introduction

Most medial-degenerative aneurysms of the descending thoracic aorta and distal aortic arch are fusiform rather than sacciform in nature. Thus, they involve almost the entire circumference of the aorta and excision requires insertion of a fabric graft to restore circulatory continuity [1].

In patients undergoing surgery for descending thoracic aortic aneurysms, Svensson and associates evaluated the postoperative outcome with particular reference to the risk of spinal cord neurological deficit and divided the descending thoracic aorta into three equal extents: extent A was the proximal third, extent B was the middle third and extent C was the distal extent [2].

Medial-degenerative aneurysms of the descending thoracic aorta are associated with loss of elastic tissues of the aortic wall with variable extent of atherosclerosis within the aortic wall. With progression of disease, there is an increasing amount of deposition of atheromatous material and clot formation within the aneurysm. At times, there is formation of a penetrating ulcer that can lead to dissection or saccular aneurysm formation [3]. If there is extensive atheromatous clot formation, the intercostal vessels get obstructed, thus compromising with the collateral blood supply to the spinal cord [2,3].

For descending thoracic aortic aneurysms, the decision to reattach the intercostal arteries is not clearly defined [2-5]. In a study of 832 descending thoracic aortic aneurysms, Svensson LG demonstrated that most patients who developed paraplegia or paraparesis had the entire descending thoracic aorta (segments A, B, C) repaired or had the segment C replaced [2]. Greenberg and associates in 2001 demonstrated

that the use of stent grafts placed in the distal descending thoracic aorta is associated with a greater risk of postoperative paraplegia or paraparesis [6]. How critical the artery of Adamkiewicz is to the spinal cord blood flow has been debated [2-6]. Svensson and associates advocated reattachment of the intercostal arteries above the arterio radicular is magna because they could potentially supply thoracic radicular arteries [7].

Protection of the spinal cord for patients undergoing descending thoracic or thoracoabdominal aortic aneurysms without circulatory arrest is dependent on the following: establishing atriocaval bypass with cooling to 32°C prior to aortic cross clamping, draining cerebrospinal fluid by gravity during aortic cross-clamping and performing quick and efficient aortic repair with reattachment of all lumbar and intercostal arteries in the segments between T6 and L2 [2,3,7,8].

Over the years, there have been considerable improvement of results of descending thoracic and thoracoabdominal aortic surgery [2,3,7,8]. In the series reported by Svensson and associates on 832 patients undergoing descending thoracic aortic aneurysm surgeries since 1986, the survival was 98% with a 5% risk of paraplegia/ paraparesis [2]. In a series of 1509 thoracoabdominal aneurysm repairs, the mortality rate was 8% and the risk of paraplegia / paraparesis 16% [8].

Although use of intraluminal ringed prosthesis is helpful to shorten the period of aortic occlusion and reduce the risk of paraplegia, we do not have any experience in using this technique [2]. Ablaza and associates in 1978 [9], Dureau and co-workers in 1978 [10] and Lemole and associates in 1982 [11] had independently developed this technique using intraluminal, low porosity Dacron graft with rigid support rings at each end, which can be inserted into the proximal and distal aorta and tied in place with a heavy ligature.

Several ingenious techniques have been used clinically to prevent ischemic injury to the spinal cord. These techniques include: a) controlled extracorporeal circulation as was practised by Denton A Cooley in 1957 [12]; b) atriocaval bypass with an interposed mechanical pump or with an oxygenator in the circuit [13]; c) femoro-femoral bypass with an interposed oxygenator [14]; d) a Gott's aorto-aortic heparin-coated vascular shunt [15]; and e) a Gott's tube between left ventricular apex and lower half of body [16,17].

Although the above techniques were beneficial in preventing paraplegia and reducing strain on the left ventricle in the hands of several investigators across the world, they have all introduced additional complications and slowly have fallen into disfavour [1,18-21].

The Texas Heart Institute Group advocated simple aortic cross clamping with expeditious removal of the aneurysm without any such support measures and restoration of pulsatile flow. This group and other investigators published their clinical observations that indicate that periods of 30 minutes of aortic occlusion was well tolerated with a low incidence of paraplegia [18-21]. We do not have any experience in using this technique.

We report here-in a 62 year-old hypertensive male patient presented with upper back pain, hoarseness of voice and dysphagia to solids of 5 years duration. There was no history of chest trauma

or chest infection. Computerized tomographic angiography revealed a fusiform aneurysm in the descending thoracic aorta, about 15 cm in length and 16 cm in diameter. The proximal aortic arch and distal thoracoabdominal aorta were normal. The arch vessels were arising normally and were normal in calibre.

The patient underwent aortic Aneurysmectomy, and graft interposition using Vascutek Woven Double Velour Vascular Graft (Vascutek Ltd. A TERUMO Company Newmains Avenue, Inchinnan, Scotland, UK) under mild hypothermic extracorporeal circulation.

Surgical Techniques

Position and surgical approach

The chest and abdomen were entered through left sixth left intercostal space using a long oblique left poster lateral thoracotomy incision extending obliquely into the abdomen for exposure of the entire length of the descending thoracic aorta above the diaphragm. A double-lumen endotracheal tube allowed collapse of the left lung, thereby facilitating the operation. The right lung which is larger than the left, provided adequate ventilation during intrathoracic dissection.

Isolation of the Vagus and left phrenic nerve

The Vagus nerve pedicle was dissected away from the aneurysm and looped. The left phrenic nerve pedicle was dissected and isolated using an umbilical tape.

Exposure and cannulation of the femoral artery and femoral vein

An infrainguinal vertical incision was made over the right femoral artery. Both right femoral artery and right femoral vein were dissected and looped to facilitate later cannulation. Following systemic heparinisation, elective femoral arteriovenous cannulation was performed using long femoral arterial and venous cannulae (Edwards Life sciences, LLC, One Edwards Way, Irvine, CA, USA).

Cannulation of the proximal descending thoracic aorta

The descending thoracic aorta above the aneurysm was cannulated and connected to bypass circuit for antegrade aortic perfusion. The femoral arterial perfusion was used for distal aortic perfusion.

Completion of the aortic dissection under controlled extracorporeal circulation

Under norm thermic controlled extracorporeal circulation, the descending thoracic aorta above and below the aneurysm was dissected for proximal and distal aortic control. Meticulous attention was exercised not to injure the intercostal arteries during the process of dissection.

Cross-clamping of the descending thoracic aorta above and below the aneurysm

The descending thoracic aorta was cross-clamped proximally just below the isthmus and distally at the level of the diaphragm.

Aneurysmectomy and graft interposition

The aneurysm was incised in between stay sutures in the midline. All intra-aneurysmal clots were evacuated. The bleeding intercostal

vessels were suture closed. A 10 cm segment of using Vascutek Woven Double Velour Vascular Graft was used for restoration of aortic continuity. The graft was sutured using 4-0 polypropylene sutures ((Johnson and Johnson Ltd., Ethicon, LLC, San Lorenzo, USA), reinforced with Teflon pledgets as and when required. The graft was sutured using inclusion technique. The distal end of the graft was sutured to the descending thoracic aorta above the arterio radicularis magna. Care was taken not to narrow the anastomotic sites. After securing hemostasis and ensuring distal aortic perfusion, the patient was separated from cardiopulmonary bypass and successfully decannulated.

Short- and Long-term Result

The postoperative recovery was uneventful. Follow-up visit at 50th month revealed the patient in New York Heart Association functional class I with good bi-ventricular function and no neurological deficit.

Conclusions

The potential benefits of this dual arterial cannulation are excellent operative exposure, maintenance of perfusion of all the vital organs including brain, avoidance of circulatory arrest, and performance of the operative procedure under controlled conditions. Aneurysmectomy and graft interposition for restoration of aortic continuity can be performed under optimal visualization, achieving perfect hemostasis.

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