Clinical outcomes and rates of aortic growth and reoperation after 1-stage repair of extensive chronic thoracic aortic dissection

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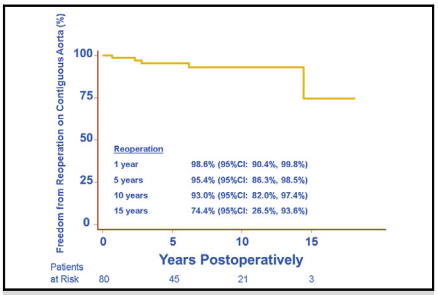
ABSTRACT

Objective: The study objective was to analyze clinical outcomes, distal segmental aortic growth, and aortic reoperation rates after 1-stage open repair of extensive chronic thoracic aortic dissection via bilateral anterior thoracotomy.

Methods: Eighty patients underwent extensive 1-stage repair of chronic aortic dissection that included the ascending aorta, the entire aortic arch, and the varying lengths of the descending thoracic aorta. One half or more of the descending thoracic aorta was replaced in 62 (78%) of the 80 patients. Hospital mortality was 2.5% (2 patients). Stroke occurred in 1 patient (1.2%), spinal cord ischemic injury occurred in 1 patient (1.2%), and renal failure requiring long-term dialysis occurred in 2 patients (2.5%). Sixty-five of the 78 hospital survivors (83%) had serial imaging studies suitable for calculation of growth rates of the remaining dissected thoracic and abdominal aorta. Forty-seven patients were followed for more than 5 years, and 21 patients were followed for more than 10 years.

Results: The mean annual growth rate for the distal contiguous aorta was 1.7 mm/y. Forty aortas increased in diameter, 16 aortas remained unchanged, and 9 aortas decreased in diameter. Five patients required reoperation on the contiguous thoracic or abdominal aorta 8, 27, 34, 51, and 174 months postoperatively for progressive enlargement. Actuarial freedom from reoperation on the contiguous aorta at 5 and 10 years was 95.4% and 93%, respectively. Actuarial freedom from any aortic reoperation at 5 and 10 years was 89.2% and 84.4%, respectively. Actuarial survival for the entire cohort at 5 and 10 years was 76.4% and 52.6%, respectively, and survival free of any aortic operation was 68.6% and 43.9%, respectively. No patient whose cause of death was known died of aortic rupture.

Conclusions: Our extended experience with the 1-stage open procedure confirms its safety and durability for treatment of chronic aortic dissection with enlargement confined to the thoracic aorta. The procedure is associated with low operative risk and a low incidence of reoperation on the contiguous aorta. It represents a suitable alternative to the 2-stage, frozen elephant trunk, and hybrid procedures that are also used to treat this condition. (J Thorac Cardiovasc Surg 2018;■:1-10)



Freedom from reoperation on the contiguous distal aorta.

Central Message

The 1-stage open surgical procedure for repair of chronic extensive thoracic aortic dissection is a safe and durable procedure and a suitable alternative to the other open surgical options.

Perspective

Our extended experience with the 1-stage open procedure for repair of chronic extensive thoracic aortic dissection demonstrates a low operation risk and low incidence of reoperation on the contiguous distal aorta with follow-up extending to 18 years. It represents a safe and suitable alternative to 2-stage, frozen elephant trunk, and hybrid procedures that are also used to treat this condition.

ACQ

Progressive dilation of the thoracic aorta after successful repair of acute type A aortic dissection is not uncommon, and up to 25% to 30% of patients will undergo an operation

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Abbreviation and Acronym
DTA = descending thoracic aorta

on the remaining dissected aorta in the 5 to 10 years after initial repair.[1-4] Unrecognized type A aortic dissection can occur spontaneously or after operations on the coronary arteries and aortic valves, resulting in aneurysmal dilatation of the dissected thoracic aorta that requires surgical treatment.[5,6] Retrograde dissection and enlargement of the aortic arch and ascending aorta can also occur in patients who sustain a type B aortic dissection and in patients after endovascular stent-graft repair of the thoracic aorta.[7-9]

The optimal method of surgical repair for patients who develop substantial enlargement of the remaining ascending aorta, aortic arch, and descending thoracic aorta (DTA) after acute dissection has not been clearly established. Options for management include staged procedures, commonly using the elephant trunk technique (conventional or frozen), hybrid procedures using endovascular grafts to exclude the aneurysmal thoracic aortic segments, and 1-stage procedures.

Concerns with all of these techniques include the fate of the dissected aorta distal to the DTA graft and the need for further interventions on this aortic segment. Since January of 1995, we have used the 1-stage technique exclusively for patients with chronic extensive thoracic aortic dissection, and we present our experience, focusing on the clinical outcomes and on the rates of distal aortic enlargement and reoperation.

PATIENTS AND METHODS

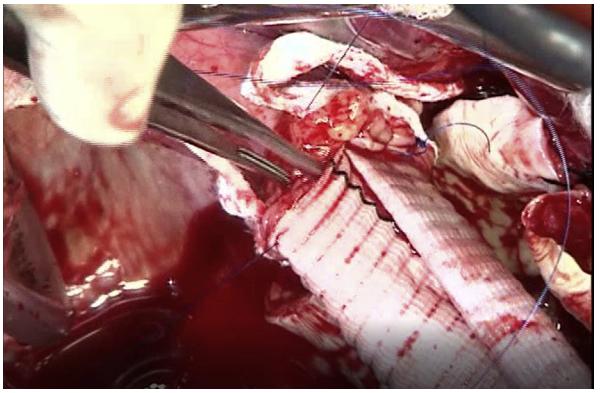
During a 21-year interval ending in December, 2015, 80 patients with chronic, extensive aortic dissection and aneurysmal enlargement confined to the thoracic aorta underwent 1-stage resection and graft replacement of the ascending aorta, the aortic arch, and varying lengths of the DTA. Seventy-three patients had type A dissection, and 7 patients had type B dissection with proximal extension. This study was reviewed by the Institutional Review Board of the Missouri Baptist Medical Center and was exempt from Board Approval. The indications for 1-stage repair and the preoperative studies performed have been reported.[10] All patients undergoing elective operation underwent preoperative cardiac catheterization and assessment of pulmonary function by a pulmonologist. No patient was denied operation because of severe pulmonary dysfunction. This decision was based on the premise that a 1-stage procedure would be less detrimental to pulmonary function than separate median sternotomy and left thoracotomy incisions that would be required for a 2-stage approach. Assessment of renal function and carotid artery disease, as well as other diagnostic studies, was performed when indicated. During the study interval, no other technique was used for repair of aneurysmal dilatation of a chronically dissected aorta that was confined to the thorax. Patients in whom the aneurysmal enlargement extended into the abdominal aorta were treated with staged procedures.

Operative Technique

Our current operative technique has been reported (see Video 1).[10,11] In brief, it involves use of a bilateral anterior thoracotomy through the fourth intercostal space, transverse sternotomy, peripheral venous cannulation through the right common femoral vein using a 2-stage cannula with the tip positioned in the superior vena cava, and cannulation of the right common femoral artery and the right axillary artery. A branched aortic graft is used, sequentially attaching the 3 adjacent branches end-to-end to the 3 brachiocephalic arteries.[11] This was accomplished in the most recent 54 patients during a brief (mean, 12.1 ± 6.7 minutes) interval of hypothermic circulatory arrest, followed by an interval of hypothermic (20°C-22°C) brain perfusion through the right axillary artery (mean 41.1 ± 12.3 minutes) after clamp occlusion of the brachiocephalic arteries.[12] After the interval of circulatory arrest, flow to the lower body is established from the femoral artery after placement of a clamp on the DTA. Cerebral oxygen saturation is continuously monitored using the Invos Cerebral Oximeter (Somanetics Corp, Troy, Mich).

After completion of the arch anastomoses and evacuation of air, the aortic graft proximal and distal to the branch grafts is occluded, and flow to the upper body is established from the right axillary artery. The site for attachment of the distal end of the graft to the DTA is determined. This is generally where the diameter of the remaining dissected aorta does not exceed 3.5 to 4.5 cm (mean measured diameter, 3.9 ± 1.2 cm). In larger patients, a diameter of up to 5 cm was considered suitable for attachment of the graft. Flow from the femoral artery is discontinued, and the clamp on the DTA is removed. A segment of the septum between the true and false lumens of the distal aorta is excised to permit perfusion of both channels, and the graft is sutured to the aorta, reinforcing the suture line with a strip of polytetrafluoroethylene felt. Patent intercostal arteries above the seventh intercostal space are ligated. If the aorta is divided below this level, the distal aorta is beveled when feasible to preserve the intercostal arteries. After this anastomosis is completed and air is evacuated from the graft, flow to the lower body is established in the antegrade direction from the axillary artery, and rewarming is initiated.

During rewarming, aortic valve or aortic root replacement and coronary artery bypass grafting are performed if indicated. The proximal end of the aortic graft is sutured to the ascending aorta at the level of the aortic commissures to an existing aortic graft or to a newly inserted composite graft. Coronary artery bypass grafts, if present, are anastomosed to the aortic



VIDEO 1. One-stage repair of a large aneurysm of the ascending aorta arch and DTA using a bilateral anterior thoracotomy (clamshell) incision through the fourth intercostal space, with left axillary, left femoral artery, and left femoral vein cannulation. Unilateral left axillary artery perfusion was used for brain protection after a brief (12 minutes) interval of hypothermic circulatory arrest. Video available at: http://www.jtcvsonline.org.