Prophylactic stage 1 elephant trunk for moderately dilated descending aorta in patients with predominantly proximal disease

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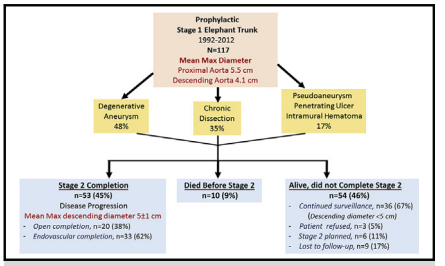
ABSTRACT

Objective: Staged elephant trunk (ET) repair is a commonly performed procedure for extensive aortic disease. A significant proportion of patients with predominantly proximal aortic pathology often have in addition a moderately dilated descending aorta (<5 cm) that can progress over time. Objectives were to characterize patients, determine completion rate after prophylactic stage 1 ET, and assess outcomes.

Methods: From 1992 to 2012, a total of 572 patients underwent stage 1 ET for degenerative aneurysm and dissection at Cleveland Clinic. Prophylactic stage 1 ET was performed in 117 (20.5%) who had predominantly *proximal* disease (5.5 ± 1 cm) with moderate dilation of the *descending* aorta (4 ± 0.6 cm). Aortic pathology included: aneurysm (n = 56 [48%]); chronic dissection (n = 41 [35%]); pseudoaneurysm (n = 9 [7.7%]); penetrating ulcer (n = 9 [7.7%]); and intramural hematoma (n = 2 [1.7%]). Other diagnoses included connective tissue disorder (12 [10%]); aortitis (20 [17%]); bicuspid aortic valve (9 [7.6%]); and previous type A dissection repair (27 [23%]).

Results: Operative mortality was 0.8% (1 of 117). This patient suffered postoperative myocardial infarction and mesenteric ischemia, resulting in sepsis and death. Other complications included: stroke (n = 7 [6%]); tracheostomy (n = 6 [5%]); renal dialysis (n = 4 [3.3%]); and reoperation for bleeding (n = 7 [6%]). The mean follow-up time was 4 ± 3 years. Fifty-three (45%) patients completed the stage 2 ET (open: 20 [38%]; endovascular: 33 [62%]) at a median interval of 6 months (9 days-10 years). The mean descending diameter increased from 4.1 ± 0.6 cm to 5 ± 1 cm at the time of stage 2 completion. In 11 patients, stage 2 was performed for acute aortic events. Estimated survival at 1, 5, and 8 years was 94%, 88%, and 74%, respectively.

Conclusions: Prophylactic ET for moderately dilated descending aorta is an effective strategy for staged repair, especially in patients with chronic dissection, connective tissue disorder, and aortitis. In addition, this approach can be beneficial for emergency treatment of late distal aortic complications. (J Thorac Cardiovasc Surg 2015;150:1150-7)



Outcomes for patients undergoing prophylactic stage 1 elephant trunk.

Central Message

Prophylactic stage 1 elephant trunk is a safe and effective strategy for long-term management of moderately dilated descending aorta in patients with proximal aortic disease requiring aortic replacement.

Perspective

Prophylactic stage 1 ET should be considered in patients with moderately dilated descending aorta, particularly with underlying connective tissue disorder, chronic dissection, or aortitis, who require aortic replacement for proximal disease. This approach is safe and effective and facilitates long-term management of disease progression in the untreated distal aorta and emergency treatment of distal aortic complications with endovascular ET completion.

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Patients with extensive aortic aneurysm and dissection often require multiple aortic repairs for the treatment of progressive disease. A 2-stage treatment approach with a conventional elephant trunk (ET) procedure followed by a stage 2 distal repair is commonly used to manage these patients.[1-4]

Current guidelines recommend aortic replacement when maximum diameter is ≥5 to 5.5 cm for the proximal aorta, and ≥5.5 to 6 cm for the descending aorta, with or without high risk factors, respectively.[5,6] In a substantial proportion of patients, the proximal aorta at the time of presentation is

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Abbreviations and Acronyms
EEC = endovascular elephant trunk completion
ET = elephant trunk

large enough to mandate surgical replacement, but the descending aorta may be only moderately dilated, below the threshold for elective replacement. A very limited body of data is available to guide surgical strategy for these patients. We have increasingly performed replacement of the ascending aorta and arch, including a stage 1 ET, to address the most-diseased aorta and offer a prophylactic benefit if the descending aorta requires a later reintervention. Objectives of this study are to characterize these patients, and to assess the risks and benefits of placing a prophylactic stage 1 ET.

METHODS

Patients

From 1992 to 2012, a total of 572 patients underwent stage 1 ET for degenerative aneurysm and/or dissection at the Cleveland Clinic. For 117 (20.5%) of these, who had a moderately dilated descending aorta (<5 cm) at the time of presentation, the stage 1 ET was performed prophylactically. The stage 1 ET was performed primarily to treat the ascending and arch pathology, but an ET graft was placed prophylactically into the moderately dilated descending aorta based on the presupposition that the patients would require a distal aortic intervention at a later point. The mean age was 63 ± 13 years, and additional descriptive details are included in Table 1. The R programming statistical package (R development Core Team, 2010) was used for analysis.

Indications for Prophylactic Elephant Trunk

The mean maximum aortic diameter at the time of prophylactic stage 1 ET was 5.5 ± 1 cm for the proximal aorta, 4.6 ± 0.8 cm for the arch, and 4 ± 0.6 cm for the thoracic descending aorta. The descending diameter was >4.5 cm, but <5 cm in 36 (31%) patients, between 4.0 and 4.4 cm in 39 (33%), and <4 cm in 42 (36%). Proximal aortic pathology at presentation included: degenerative aneurysm (n = 56 [48%]); chronic dissection with or without aneurysm (n = 41 [35%]); pseudoaneurysm after previous type A dissection repair (n = 9 [7.7%]); penetrating ulcer with or without saccular aneurysm (n = 9 [7.7%]); and intramural hematoma (n = 2 [1.7%]). Additionally, 11 (9.4%) patients had a documented connective tissue disorder; 20 (17%) had aortitis (defined as giant cells seen on histologic examination of the pathology specimen); and 9 (7.7%) had a bicuspid aortic valve. Seven of the bicuspid valve patients had chronic dissection, and 2 patients had coarctation-associated descending aneurysms. The stage 1 ET was performed as a reoperation in 44 (37%) patients, including 27 who had a history of previous acute type A dissection repair.

Stage 1 and Stage 2 Repair Methods

Ascending and total arch replacement was performed in all patients at the time of stage 1 ET, using deep hypothermic circulatory arrest, with or without brain perfusion. The arch anastomosis was performed either as a patch or with separate bypasses to the branch vessels. The distal ET anastomosis was constructed beyond, or proximal to, the left subclavian artery.[3] In 4 patients with chronic dissection, an open fenestration of the dissection flap was performed at the time of prophylactic stage 1 ET to create a suitable distal landing zone for possible stent grafting during stage 2.

Details of this procedure have been described elsewhere.[7] In all patients, the distal portion of the ET graft was marked with large hemoclips to allow for radiographic visualization at the time of stage 2 completion if stent grafting is being contemplated. Patients receiving stent graft devices, or undergoing the frozen ET procedure, were not included in this series.

After the stage 1 ET, patients routinely underwent predischarge imaging to establish a baseline comparison for surveillance monitoring. The descending aorta was <5 cm at the time of discharge in all patients. Three patients underwent the stage 2 ET during the same hospital admission; details are discussed in the Results section.

The stage 2 ET completion was performed in selected patients who developed progressive degeneration or acute complications of the untreated descending aorta during follow-up. This process was managed with either an open (n = 20) or endovascular (n = 33) approach. The open completion was performed through a left posterolateral thoracotomy, with partial left-atrium-to-femoral-artery cardiopulmonary bypass, active cooling, and cerebrospinal fluid drainage. Intercostal arteries were reimplanted when this approach was feasible. Open ET completion included replacement of the thoracoabdominal aorta in 5 patients.

The EEC was performed in a hybrid operating room. In most cases, EEC was performed under general anesthesia, but in a few selected patients with severe pulmonary disease, regional spinal anesthesia was used. The stent graft devices were usually delivered using a wire extending across the right brachial artery and 1 common femoral artery. The stent grafts were delivered via the illiofemoral system into the ET graft and deployed with ≥2 stents of overlap between the stentgraft and the ET graft. Prophylactic cerebrospinal fluid drainage was performed for most patients. Additional details about the techniques used for both open ET completion and EEC are described elsewhere.[4,8]

Concomitant Procedures

Sixty-six concomitant procedures were performed in 58 (50%) patients during the stage 1 ET, including aortic valve repair (n = 7 [6%]) or replacement (n = 30 [26%]); coronary artery bypass grafting (n = 17 [15%]); open distal fenestration (n = 4 [3.4%]); root replacement (n = 3 [2.5%]); atrial septal defect closure (n = 2 [1.7%]); mitral valve repair (n = 2 [1.7%]); and tricuspid valve repair (n = 1 [8.4%]).

Follow-up

All patients underwent computed tomography assessment before discharge and during scheduled follow-up outpatient visits, which typically occur within the first 6 months after an operation, and then annually. If renal function was preserved, patients received contrast, and in those who underwent EEC, a 3-phase protocol was used that included a noncontrast phase through the treated segment, and intravenous contrast scans through the chest, abdomen, and pelvis, timed for both arterial and delayed venous phases. All computed tomography scans were analyzed using 3-dimensional reconstruction software (TeraRecon, Inc, San Mateo, Calif) to assess graft patency, device integrity, endoleaks, and aortic morphology. The mean follow-up time was 4 ± 3 years; 39% of the patients were followed for >5 years, and 16% for >8 years.

Outcome Definitions and Statistics

Operative mortality was defined as death during hospitalization, or within 30 days of the procedure. Renal failure was defined as need for hemodialysis, and respiratory failure as need for reintubation or tracheostomy, postoperatively. Categoric variables are summarized using frequencies and percentages; continuous variables are summarized using