Retrograde Ascending Aortic Dissection After Thoracic Endovascular Aortic Repair for Distal Aortic Dissection or With Zone 0 Landing: Association, Risk Factors, and True Incidence

Ourania Preventza, MD, Andrea Garcia, MD, Kristy Moeller, MD, Denton A. Cooley, MD, Lorena Gonzalez, MD, Benjamin Y. Cheong, MD, Kalyan Vunnamadalla, MD, and Joseph S. Coselli, MD

Departments of Cardiovascular Surgery and Cardiovascular Radiology, Texas Heart Institute, Department of Radiology, Baylor St. Luke's Medical Center, and Division of Cardiothoracic Surgery, Michael E. DeBakey Department of Surgery, Baylor College of Medicine, Houston, Texas

Background. **We attempted to determine the true incidence of retrograde ascending aortic dissection (rAAD) and to challenge its reported association with distal aortic dissection or zone 0 deployment.**

Methods. **From January 2005 to August 2014, 305 patients who were at risk for rAAD underwent thoracic endovascular aortic repair. We excluded patients with prior ascending, hemiarch, or traditional or frozen elephant trunk grafts, or who required concomitant ascending graft placement. Patients in group A (n = 111, 36.4%) had distal aortic dissection or hematoma (n = 75, 67.6%) or required landing of the endograft in zone 0 of the native ascending aorta (n = 36, 32.4%). Patients in group B (n = 194, 63.6%) had nondissected descending or distal arch aneurysm (n = 172), penetrating ulcer (n = 9), coarctation (n = 6), endoleak not caused by dissection (n = 3), aortobronchial fistula (n = 3), or transection (n = 1).**

Results. **The incidence of rAAD was 1.3% overall (n = 4), 0.9% in group A (n = 1, Cook Zenith TX2), and 1.5% in group B (n = 3; 1 Talent Captivia, 2 Cook Zenith TX2; $p = 0.64$). No zone 0–treated patient had rAAD. Two patients from group B died, and 1 was treated nonoperatively. The median interval between thoracic endovascular aortic repair and rAAD was 11 days (range, 0 to 90 days).**

Conclusions. **Post–thoracic endovascular aortic repair rAAD is a rare but lethal complication. Operator experience is crucial for prompt recognition and prevention. It does not appear that rAAD is specifically associated with distal aortic dissection or landing in zone 0. To our knowledge, this is one of the few studies to report the true incidence of rAAD in at-risk patients.**

(Ann Thorac Surg 2015;100:509–15)

Developed during the past decade, thoracic endovascular aortic repair (TEVAR) for descending thoracic aneurysms and other thoracic pathologic conditions constitutes a major advancement in aortic surgery. Retrograde dissection of the ascending aorta (rAAD) is an uncommon but serious complication of TEVAR. Although its causes are multifactorial, rAAD has been associated with descending thoracic dissection, intramural hematoma, and endograft landing in zone 0 [1–8]. The reported incidence of 1% to 6.8% [1, 4, 5] may be an underestimate because the denominator used to calculate the incidence is usually the total number of TEVARs performed. To our knowledge, very few reports [2] clearly exclude from the denominator patients with previous aortic repairs that make the development of rAAD impossible, such as ascending or arch thoracic aortic replacement and stage I elephant trunk repair. We therefore attempted to determine the true incidence of post-TEVAR rAAD, to contribute to the sparse literature, and to test the reported association of rAAD with descending thoracic aortic dissection and zone 0 landing.

Patients and Methods

From January 2005 to August 2014, 305 patients who underwent TEVAR were at risk for rAAD (Table 1). Data were obtained from a prospectively maintained database, and the Institutional Review Board of the Baylor College of Medicine approved the study.

Dr Preventza discloses a financial relationship with Medtronic, Inc; and Dr Coselli with Gore, Medtronic, Cook Medical, and Vascutek Ltd, a subsidiary of Terumo Corporation.

Accepted for publication Feb 12, 2015.

Presented at the Sixty-first Annual Meeting of the Southern Thoracic Surgical Association, Tucson, AZ, Nov 5–8, 2014.

Address correspondence to Dr Preventza, BCM 390 One Baylor Plaza, Houston, TX 77030; e-mail: opsmile01@aol.com.

0003-4975/$36.00
http://dx.doi.org/10.1016/j.athoracsur.2015.02.095

Table 1. Preoperative Characteristics (n = 305)[a]

Characteristic	Group A (n = 111)	Group B (n = 194)	*p* Value
Mean age, y	63.99 ± 10.33	68.29 ± 13.77	0.0045
Male	84 (75.7)	177 (91.2)	0.000198
Emergent/urgent procedure	60 (54.0)	49 (25.2)	<0.00001
Smoking	62 (55.8)	78 (40.2)	0.008
Hypertension	105 (94.6)	166 (85.6)	0.015
Prior AAA repair	9 (8.1)	32 (16.5)	0.03
Prior TAAA replacement	7 (6.3)	20 (10.3)	0.23
Cardiac disease unrelated to aorta			
CAD, prior MI, prior PTCA	36 (32.4)	72 (37.1)	0.41
Congestive heart failure	11 (55.0)	20 (10.3)	0.91
History of arrhythmia	8 (7.2)	21 (10.8)	0.30
Renal dysfunction	24 (21.6)	54 (27.8)	0.23
Pulmonary dysfunction	34 (30.6)	99 (51.0)	0.0005
Diabetes mellitus	16 (14.4)	32 (16.5)	0.63
Prior cerebrovascular event	11 (9.9)	39 (20.1)	0.02

[a] Data are reported as mean ± standard deviation for continuous variables and number (%) for categorical variables.

AAA = abdominal aortic aneurysm; CAD = coronary artery disease; MI = myocardial infarction; PTCA = percutaneous transluminal coronary angioplasty; TAAA = thoracoabdominal aortic aneurysm.

We excluded patients with previous ascending aortic replacement, arch replacement, or stage I elephant trunk repair because such patients cannot exhibit rAAD. The indications for TEVAR are shown in Table 2. All patients underwent predischarge computed tomography (CT) unless renal function was marginal (serum creatinine level ≥1.5 mg/dL). Follow-up CT was performed at 6 and 12 months and then annually thereafter if renal function permitted; for patients referred to our institution from outside the immediate area, referring physicians were asked to obtain the follow-up CT scans. All procedures were performed under general anesthesia.

Intraoperative Procedure for Patients With Distal Thoracic Disease Except Patients Requiring Endografting in Zone 0

The femoral artery was accessed either percutaneously or by an open approach. If the diameter of the artery was inadequate, an 8- or 10-mm polyethylene terephthalate fiber (Dacron) graft was sutured to the external iliac or common iliac artery.

Approximately 5,000 units of intravenous heparin was given by the anesthesia team. A soft glide wire (Terumo Medical Corporation, Somerset, NJ) was used initially to navigate the descending thoracic aorta, the arch, and the ascending aorta. The soft wire was exchanged over a Bern catheter (Imager II; Boston Scientific Corporation, Natick, MA) into an extra-stiff Lunderquist wire (Cook Medical, Bloomington, IN). Preoperative angiography was performed with a pigtail catheter. Starting in 2008, intravascular ultrasonography was performed routinely in all cases of thoracic aortic dissection and in most of the remaining cases. The TAG thoracic endograft (W.L. Gore and Associates, Flagstaff, AZ) was used until September 2009, when the comformable TAG (c-TAG; W.L. Gore and Associates) became available (n = 217). The Medtronic TALENT thoracic stent graft was used until 2010, and the Valiant thoracic endograft (Medtronic Inc, Santa Rosa,

Table 2. Indications for Thoracic Endovascular Surgery (n = 305)[a]

Variable	Group A (n = 111)	Group B (n = 194)
Aneurysm of distal arch (except zone 0) or descending thoracic aorta[b]	…	172 (88.6)
Penetrating ulcer	…	9 (4.6)
Primary coarctation	…	6 (3.0)
Endoleak (not caused by dissection)	…	3 (1.5)
Aortobronchial or aortoesophageal fistula	…	3 (1.5)
Transection	…	1 (0.5)
Pathologic condition of the transverse arch necessitating landing in zone 0	36 (32.4)	…
Acute or subacute type III aortic dissection	37 (33.3)	…
Intramural hematoma	9 (8.1)	…
Chronic type III aortic dissection with or without aneurysm formation	29 (26.1)	…

[a] Data are reported as number (%). [b] Includes atherosclerotic aneurysm, intercostal patch aneurysm, anastomotic aneurysm related to prior open procedure, and coarctation-associated aneurysm.