Aortic Arch Replacement and Autologous Pericardial Tracheal Patch for an Aorto-Tracheal Fistula

Kelsey A. Musgrove[1], Daniel McCarthy[1], and Andreas de Biasi[1]

[1]Division of Cardiothoracic Surgery University of Wisconsin Department of Surgery Madison WI USA

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Abstract

Aorto-tracheal fistulas are rare and highly lethal, with few reports of successful surgical intervention. We present a 48 year old man with aorto-tracheal fistula induced by radiation therapy for tracheal squamous cell carcinoma. He presented with hemoptysis and chest pain and workup revealed the aorta-tracheal fistula between the posterior aortic arch and anterior distal trachea. He was emergently taken to surgery. To our knowledge, this is the first report of an aorto-tracheal fistula successfully treated with a transverse aortic arch replacement and complex tracheal repair using autologous pericardium with an omental buttress.

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1. Division of Cardiothoracic Surgery, University of Wisconsin Department of Surgery, Madison, WI, USA

Disclosures: None

Abstract:

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Case Report

A 48-year-old man with history of tracheal squamous cell carcinoma and completion of definitive chemoradiotherapy nine months prior presented to an outside hospital with a three-day history of small-volume hemoptysis and chest pain. Subsequent workup with computed tomography revealed an aorto-tracheal fistula between the posterior aortic arch (zone 1) and anterior surface of the distal trachea, with concomitant tracheal stricture (Figure 1). His vital signs were within normal limits and he was directly transferred to an operating room for emergency surgical intervention.

The patient was intubated with a single-lumen endotracheal tube following sedation and direct laryngoscopy. With bronchoscopic guidance the endotracheal tube was positioned proximal to the stenosis to avoid instrumenting the fistula. Flexible fiberoptic bronchoscopy then demonstrated an irregular stricture involving the

mid-distal cartilaginous trachea with preservation of the membranous airway. Immediately distal to the stenosis, a pit in the anterior trachea was identified approximately 2 cm from the carina with associated bloody mucoid secretions. Following placement of additional arterial monitoring lines, central line, Swan-Ganz catheter, Foley catheter, and brain function monitor (Masimo Corp., Irvine, CA, USA), an 8 mm right axillary artery chimney graft was placed (Getinge AB, Göteborg, Sweden) via right axillary cutdown. Placement of a transesophageal echocardiography probe was attempted but resulted in extremely poor ventilation, likely secondary to extrinsic compression from the probe onto the narrowed trachea at the level of the stricture. Therefore, it was removed and later re-introduced after initiating cardiopulmonary bypass. A median sternotomy was then made; the incision was extended inferiorly into a partial upper laparotomy. A two-stage venous cannula was inserted into the inferior vena cava via the right atrial appendage. Following systemic heparinization, the patient was placed on cardiopulmonary bypass and cooled; an aortic root cannula, retrograde cardioplegia cannula, and left ventricular vent were then placed. Simultaneously, a pedicled omental flap was harvested.

The ascending aorta and aortic arch were next mobilized as the patient was cooled to 24 degrees Celsius (bladder temperature). The aorta was cross-clamped and the heart arrested with 1 L of antegrade Del Nido cardioplegia. Selective antegrade cerebral perfusion was initiated at 10 cc/kg/min by clamping the innominate artery. The aortic cross-clamp was removed and the proximal and mid aortic arch were excised, most aggressively along the lesser curve and slightly posteriorly into the arch, so that the fistula defect was incorporated into the resected specimen. The tracheal defect thereby came into view immediately posterior to the resected transverse arch. At this point only a peninsula of greater curve remained, which contained the innominate and left common carotid artery takeoffs. The distal extent of the lesser-curve resection was between the level of the left common carotid and left subclavian arteries. To fully visualize the tracheal defect, the innominate artery was sharply detached from the remaining greater curve.

The trachea was carefully inspected. There was extensive fibrosis related to prior therapy, as well as fibrinous material consistent with a subacute inflammatory process. After limited debridement of scar and devitalized tissue, a 3 mm airway defect was defined. Primary repair was not possible due to tissue loss and fibrosis, thus an overlay patch repair was performed. Horizontal mattress sutures were placed circumferentially around the defect using 4-0 PDS. A portion of autologous pericardium, harvested earlier in the case and placed in saline, was folded and trimmed to form a double-layer pericardial patch. This patch was then parachuted-down using the horizontal mattress sutures to rapidly provide an initial scaffold for repair before replacing the aorta and compromising exposure (Figure 2).

An open distal, zone-1, anastomosis was then performed using a 26 mm x 10 mm x 8 mm x 8 mm x 10 mm multi-branch graft (Getinge AB, Göteborg, Sweden). Antegrade flow was then reestablished via sidearm perfusion; the proximal graft-to-native ascending-aorta anastomosis was then performed, after which the aortic cross-clamp was removed and the innominate artery was anastomosed to one limb of the multi-branch graft (the unused limbs were ligated) (Figure 3).

The tracheal repair was completed during rewarming. The aortic graft was carefully retracted, the field was flooded with saline, and ventilation commenced to assess air leak. The edge of the patch was reinforced with a continuous running 4-0 PDS suture and several targeted horizontal mattress sutures until complete pneumostasis was achieved. Progel sealant (BD, Franklin Lakes, NJ, USA) was applied to reinforce. Once the patient had rewarmed to 36 degrees Celsius, he was successfully weaned from cardiopulmonary bypass and hemostasis achieved. The greater omentum was liberated from the transverse colon, rotated on the gastroepiploic pedicle, and secured to the repair to provide vascularized tissue between the tracheal repair and the aortic graft.

The patient was extubated on post-operative day 1; the remainder of his hospitalization was notable for reintubaton for aspiration pneumonitis on post-operative day 6, as well as gastric outlet obstruction necessitating open revision of his omental flap on post-operative day 22. He was ultimately discharged to a rehabilitation facility on post-operative day 38. He made a satisfactory recovery thereafter and was alive and neurologically intact as of 13 months post-operatively.

Comment

Fistulas between the aorta and tracheobronchial tree are rare and uniformly fatal if not surgically treated (1,2). More than 95% of patients present with hemoptysis and greater than 50% with massive hemoptysis (>400 mL); dyspnea and cough were also common (1). These fistulas most commonly involve the left bronchial tree (3). Macintosh et al noted 92% of cases involved the descending thoracic aorta to left bronchial tree and 87% involved a thoracic aortic aneurysm after graft repair (2).

Aorto-tracheal fistulas are very rarely described, with most cases likely being lethal prior to any intervention (3,4). Allende et al described a fistula between the trachea and aortic arch found on autopsy in a patient with tracheal squamous cell carcinoma two years after completing radiation therapy. He presented in cardiac arrest after massive hemoptysis (3). Two cases of aorto-tracheal fistula following repair of pulmonary artery sling and tracheoplasty in children are reported, both successfully repaired via cardiopulmonary bypass and repair with pericardial patch of the aortic arch. One tracheal defect was also repaired with pericardial patch and the other with tracheal reconstruction with cadaveric tracheal homograft (4,5).

To our knowledge, this is the first report of an aorto-tracheal fistula successfully treated with a transverse aortic arch replacement and complex tracheal repair using autologous pericardium with an omental buttress.

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Figures:

Figure 1 – Pre-operative CT scan showing the aorto-tracheal fistula between the posterior aortic arch (zone 1) and the anterior surface of the distal trachea

Figure 2 – Autologous pericardial patch being parachuted onto the tracheal defect with vessel loop around the innominate vein and drop sucker in the open aortic arch

Figure 3 – Aortic arch replacement with multi-branch graft with anastomosis to the innominate artery