

Patching an Aortic Tear Using the Side-Arm and Surrounding Skirt of a Physician-Modified Ascending Aortic Graft

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Abstract

Background: Aortic complications, such as aortic tears and dissections, during cannulation must be managed urgently and often require hypothermic circulatory arrest. We report a unique management strategy to repair an aortic tear without dissection by modifying a Dacron ascending aortic graft with side-arm to serve both as a patch for the aortic tear and inflow for the bypass circuit. **Case Presentation:** A 32-year-old female patient undergoing reoperative cardiac surgery suffered an unexpected aortic tear during cannulation for cardiopulmonary bypass. After promptly transitioning to femoral cannulation and hypothermic circulatory arrest, the tear was repaired by utilizing a physician-modified ascending aortic graft with side-arm, in which the surrounding skirt of the side-arm was cut from the circumferential graft to patch the defect. The patient was rewarmed with the side-arm serving as arterial inflow for the bypass circuit, and the remainder of the operation proceeded without complication. **Conclusion:** This type of aortic repair for aortic tears without dissection can offer the patient the benefit of avoiding multiple aortotomies in a weakened aorta, reducing circulatory arrest time, and re-establishing a central cannulation strategy for cardiopulmonary bypass, consequently reducing the likelihood of distal limb ischemia.

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This patient provided verbal and written consent for surgery and anonymous inclusion in the University of Virginia's Department of Surgery research efforts.

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Keywords: Reoperative Cardiac Surgery; Cardiopulmonary Bypass Complications; Aortic Repair

Background

Aortic complications during cannulation for cardiopulmonary bypass are rare, potentially catastrophic, and often difficult to manage expeditiously.^{1,2} We report the management of a large aortic tear without dissection during cannulation that was repaired under brief circulatory arrest with the novel and simple strategy of physician-modifying (P-MOD) a commercially available Dacron aortic graft by trimming out its side-arm and surrounding skirt to serve as the aortic patch repair.

Case Presentation

A 32-year-old female with no significant prior medical history was diagnosed with angina due to a slit-like anomalous right coronary artery traversing between the aorta and pulmonary artery. She subsequently underwent right internal thoracic artery (RIMA) to right coronary artery bypass grafting at an outside facility. Her angina recurred 6 months later; repeat coronary angiography demonstrated RIMA graft occlusion and interval development of severe stenosis in the mid right coronary artery. Our multidisciplinary heart team thus recommended revascularization via redo sternotomy with saphenous vein grafting given unsuitable radial anatomy.

During the redo sternotomy and dissection of the anterior mediastinum, the RIMA graft was well-adhered to the right side of the aorta (near the superior vena cava (SVC)). Likely during this dissection and exposure of the aorta for cannulation, a subadventitial aortic plane was inadvertently entered. Consequently, during aortic cannulation, a significant aortic tear without dissection developed in the distal ascending aorta, extending laterally toward the SVC beyond the site of the aortic pursestring sutures. Given how denuded the aorta was near the tear, the decision was made to maintain digital control of the large aortic tear (as best as possible) while the left femoral artery was cannulated and the patient was cooled for circulatory arrest in order to repair the tear in a bloodless field. After 45 minutes of cooling to a temperature of 22 degrees Celsius, digital control was relinquished and circulatory arrest commenced. The denuded aorta was excised back to healthy tissue, resulting in a large circular defect in the distal ascending aorta/proximal arch. A Dacron Gelweave ascending aortic tube graft with a side-arm (Terumo Aortic, Sunrise, FL) was opened. The side-arm of the graft was then cut out with a generous skirt of surrounding Dacron material to create a large patch that also served as the arterial inflow for the remainder of the operation (**Figure 1**).

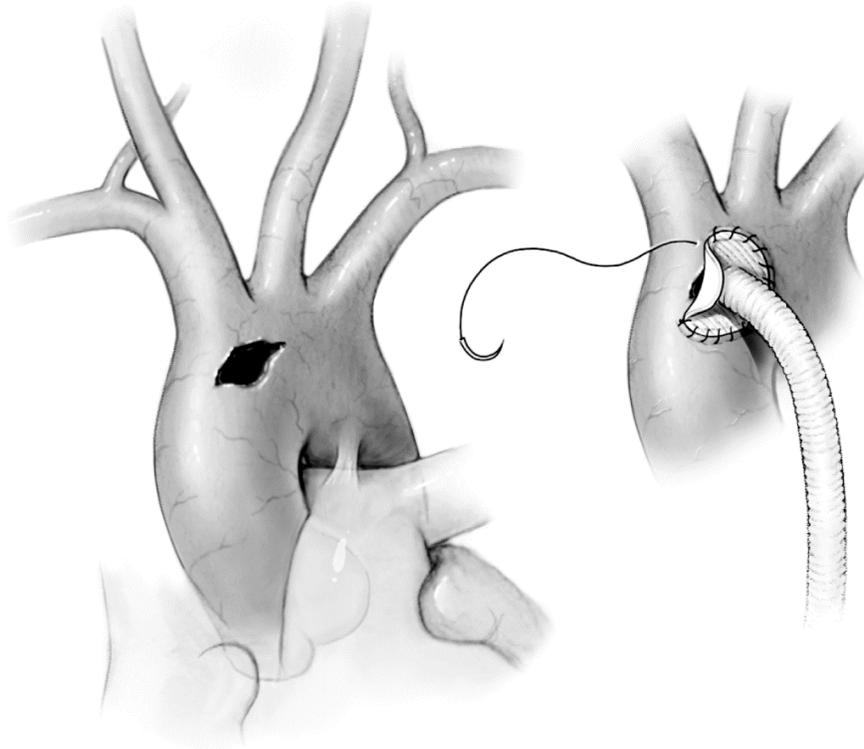


Figure 1 – Side-Arm Patch Repair of Aortic Tear.

This patch was then directly anastomosed to the aorta with a #4-0 Prolene, and the side-arm was cannulated with a #24 French arterial cannula. After this very brief period of circulatory arrest for the extended patch anastomosis, cardiopulmonary bypass was resumed via the side-arm patch, and the patient was rewarmed. The remainder of the vein grafting to the right coronary artery proceeded without complication.

The patient had an unremarkable post-operative course and was discharged home by post-operative day six. At one-month follow-up her angina had completely resolved, and she was consented for anonymous inclusion in publishing our surgical technique for educational value.

Discussion

Complications associated with aortic cannulation can be potentially catastrophic.^{2,3} In the event of aortic injury, prompt recognition and management are critical. Multiple aortic cannulations must also be avoided if the aorta has been partially denuded or weakened.^{4,5}

Repair can range from a small bovine or pericardial patch to total ascending or arch replacement with prosthetic graft as dictated by the degree of injury. For large tears or dissections, hypothermic circulatory arrest is often needed as an adjunct.

Our technique blends both the patch and graft approaches, and it is novel in that—rather than utilizing a circumferential Dacron tube graft with a sidearm—we instead merely cut out the side-arm (with a generous skirt) to serve as the patch. Our technique (1) allows for an extended patch repair of the aorta rather than full aortic replacement (2) consequently shortens the time needed for repair and/or circulatory arrest and (3) simultaneously eliminates the need for a second arterial cannulation site on already potentially comprised aorta. After the repair was complete, the side-arm patch served as arterial inflow for the bypass circuit. Given the small stature of this patient, the femoral artery cannula was most likely providing little perfusion to her distal limb. By converting to a central arterial inflow site, the patients leg experienced greatly reduced

ischemic time.

Potential disadvantages of this technique include the cost and wasted material associated with off-label use of the commercially available aortic graft. Additionally, our technique should only be employed for aortic injuries without an extensive proximal or distal dissection, such that the injured aorta can clearly be distinguished and excised to provide a clean border of healthy aorta for anastomosis. Liberal excision of the damaged aorta is critical for both confirming the absence of dissection and ensuring an anastomosis that will tolerate arterial inflow; longer-term efficacy or safety could otherwise be compromised. The skirt size can be modified to accommodate larger excisions while still avoiding a circumferential repair.

In conclusion, this strategy for managing aortic injuries is an easily reproducible technique or “trick” to simplify the management of a potential aortic cannulation disaster.

List of Abbreviations

P-MOD physician-modified

RIMA right internal mammary artery

SVC superior vena cava

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