Thoracic wall ischemia after repair of thoracoabdominal aortic aneurysm requiring large microvascular soft tissue reconstruction

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ABSTRACT

A 67-year-old man presented to the vascular service with a Crawford extent I thoracoabdominal aortic aneurysm. He underwent open thoracoabdominal aortic replacement from just distal to the left subclavian artery to just proximal to the origin of the superior mesenteric artery under deep hypothermic circulatory arrest. His postoperative course was complicated by thoracic wall ischemia, resulting in a life-threatening defect of the chest wall that exposed lung parenchyma and the aortic graft. Successful microvascular soft tissue reconstruction was performed using an anterolateral thigh flap and arteriovenous loop. This is a case report of a large chest wall defect resulting from thoracoabdominal aortic aneurysm repair. This case highlights the feasibility of microvascular reconstruction techniques to repair even the largest defects. (J Vasc Surg Cases and Innovative Techniques 2019;5:255-8.)

Keywords: Thoracoabdominal aneurysm; Thoracic wall reconstruction; Microsurgery

Thoracoabdominal aneurysms account for 10% of all aortic aneurysms.[1] There is a 7% risk of rupture annually when they reach a diameter of 6 cm, and the overall 5-year mortality of these aneurysms is 56%.[1] For these reasons, well-timed elective repair is important. Elective repair is known to have a major complication rate of 12.7%, with the highest rate of complications observed in extent II repair. Complications can include death, stroke, spinal cord ischemia, renal dysfunction, cardiac complications, pulmonary complications, and gastrointestinal complications. Intercostal artery disruption is a known consequence of repair of thoracoabdominal aortic aneurysm, often resulting in spinal cord ischemia.[2,3] It is known to increase the morbidity and mortality of the procedure, and some surgeons have recommended reattachment of the intercostals to decrease this risk.[3] In rare circumstances, ischemia of the posterior trunk and chest wall soft tissue can also complicate the surgical course. The thoracic wall soft tissues and intercostal muscles are largely supplied by the posterior intercostal vessels, which are supplied by the thoracic aorta.[4] Ischemia of these muscles and tissues can result in a large and complex wound.

In this report, we present the case of a patient with a life-threatening thoracic wall defect resulting from repair of a thoracoabdominal aortic aneurysm. There are no reported cases of wound defects of this size and complexity secondary to repair of the thoracoabdominal aortic aneurysm alone. Soft tissue reconstruction was performed with a large anterolateral thigh free flap including vastus lateralis muscle and cephalic vein graft for an arteriovenous loop.

Consent for publication was obtained from surviving family members.

CASE REPORT

A 67-year-old man presented to the vascular surgery service with a thoracoabdominal aortic aneurysm Crawford extent I. His past medical history was significant for hypertension, gastroesophageal reflux disease, and hyperlipidemia. He had a 40-pack-year smoking history. Open repair was recommended because of continued enlargement of the thoracoabdominal aorta to a maximal diameter of 57 mm. Before undergoing surgery, he underwent placement of a lumbar drain. The operation involved replacement of the thoracoabdominal aorta with a Dacron graft under deep hypothermic circulatory arrest through a retroperitoneal thoracoabdominal exposure. Total cardiopulmonary bypass was 281 minutes, with a circulatory arrest time of 37 minutes. The aorta was replaced from just distal to the origin of the left subclavian artery to just proximal to the origin of the superior mesenteric artery in a beveled distal anastomosis. Notably, there were no suitable intercostal arteries for reimplantation as his lower intercostal and lumbar arteries were thrombosed. An attempt was made to reimplant the celiac artery but was unsuccessful because of significant atheromatous disease. Ultimately, the celiac artery was ligated, but it was noted to have pulsatile backbleeding after reperfusion of

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Fig 1. Postoperative necrosis of left thoracotomy incision.

the superior mesenteric artery, indicating significant collateralization. The thoracoabdominal incision extended from the tip of the left scapula to just below the umbilicus.

Immediately postoperatively, the patient was coagulopathic and hypotensive and required vasopressor support. After appropriate resuscitation with blood, vasopressors were discontinued by postoperative day 1. His postoperative course was complicated by acute kidney injury requiring continuous renal replacement therapy, spinal cord injury resulting in T5 paraplegia, and respiratory failure. He developed a nonhealing thoracotomy incision that progressed to full-thickness necrosis, probably secondary to disruption of the intercostal vessels (Fig 1). He underwent operative debridement of the chest wall wound on postoperative day 24 and multiple debridements that ultimately resulted in a large defect with exposure of lung parenchyma and graft material, measuring 50 × 14 cm (Fig 2). Serial debridements occurred for approximately 5 weeks, and the wound was managed with application of a negative pressure wound device between debridements. Debridement included intercostal muscles, ribs, and trapezius and latissimus dorsi muscles.

Microvascular reconstruction of the hemithoracic defect was performed with a 45- ×17-cm left chimeric anterolateral thigh free flap consisting of skin and vastus lateralis muscle (Fig 3). The thigh tissue was harvested on the descending branch of the lateral circumflex femoral vessels. The left subscapular vessels were dissected for recipient microvascular anastomoses. The lateral femoral circumflex vessels were not long enough for proper inset of the flap into the thoracic defect. Therefore, a left cephalic vein graft was harvested. The proximal outflow of the cephalic vein remained attached; the distal end of the graft was anastomosed to the subscapular artery, creating an arteriovenous loop that was matured for 30 minutes to properly dilate the vein. The descending branch of the lateral femoral circumflex artery and vein were then anastomosed to the arteriovenous loop that was divided (Fig 4). The patient was discharged to a nursing facility 2½ weeks after his microvascular reconstruction.

At the time of discharge, the patient had a viable flap and adequate thoracic wound coverage (Fig 5). Renal function had improved, and he no longer required hemodialysis. Paraplegia remained unchanged, and he received most of his nutrition through gastrostomy tube. One month after discharge, he suffered a cardiac arrest and ultimately died of respiratory failure.

DISCUSSION

Thoracoabdominal aortic aneurysms carry the risk of rupture and death, but their repair also carries serious risks.[2] The operative death rate, defined by a large study as death within 30 days of surgery, is as high as 7.5%.[2] Crawford extent II aneurysms were found to have the highest rates of operative death (9.5%) and the highest rates of adverse events (19%).[2] Renal failure is the most common complication, with 12.3% of patients suffering from acute renal dysfunction.[2] Advances in surgical repair, such as reattachment of intercostal arteries, deep hypothermia, and use of spinal drains, have decreased the rates of paraplegia after aneurysm repair, although these adjuncts are controversial.[3]

Wound complications and chest wall necrosis are not often cited as common complications after thoracoabdominal aortic aneurysm repair. There are reported cases of chest wall necrosis in which the left internal mammary artery had been previously harvested in the setting of thoracoabdominal aortic aneurysm but not from aneurysm repair alone.[4] Our patient had no prior history of internal mammary intervention. He developed significant loss of soft tissue, muscle, and bone of the hemithorax because of ischemia after thoracoabdominal aortic aneurysm repair. The extent of the ischemia was unexpected, given that the patient already had thrombosed intercostal arteries and no evidence of left subclavian, axillary, or aortoiliac occlusive disease. The patient's smoking history, nutritional status, and poor cardiac function were likely to be contributing factors to the development of this extensive wound. He also developed culture-positive urinary tract infections and pneumonia and went on to demonstrate growth of the same organisms in his chest wound. His reconstruction was delayed until his chest was cleared of apparent infection.

The chest wall provides several essential functions. It protects the intrathoracic and upper abdominal organs, maintains relative negative pressure of inspiration and positive pressure for expiration, and provides a base for upper limb movement.[5] Indications for chest wall reconstruction include resections after lung cancer, advanced breast cancer, primary tumors of the chest wall, and radiation necrosis. When approaching reconstruction of the chest wall, one must consider management of the pleural cavity, assess skeletal support, and provide soft tissue coverage and, if possible, an aesthetic outcome.[6] Traditional options for reconstruction include local and regional flaps, such as the vertical and transverse rectus abdominis myocutaneous, latissimus dorsi, pectoralis major, and omental flaps.[7] Because of the extensive

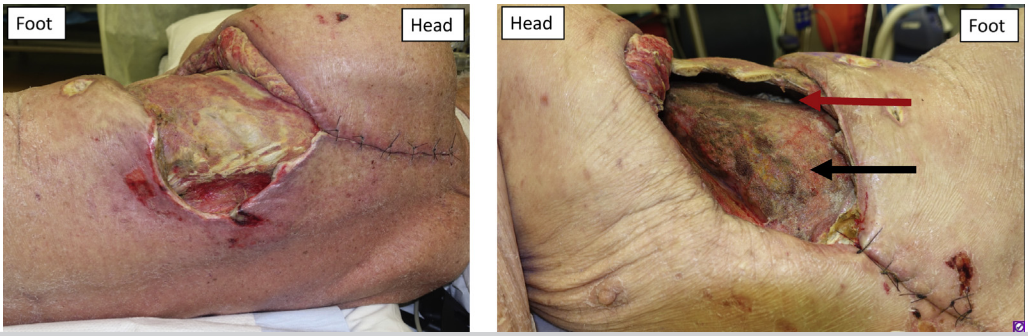

Fig 2. Final wound, exposed aortic graft (*red arrow*) at base of wound and lung (*black arrow*).

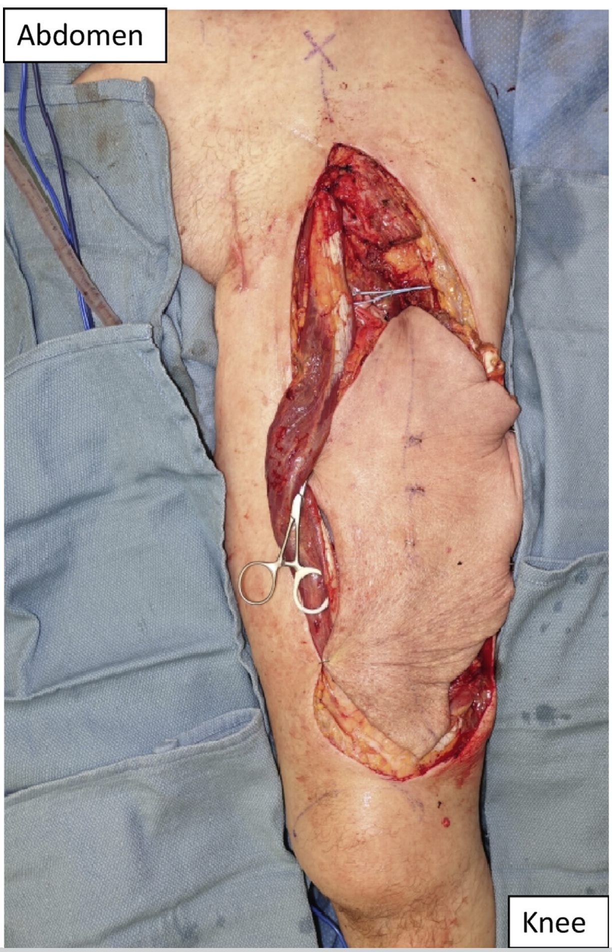

Fig 3. Flap harvest. Large anterolateral thigh flap with vastus lateralis muscle (45 × 17 cm).

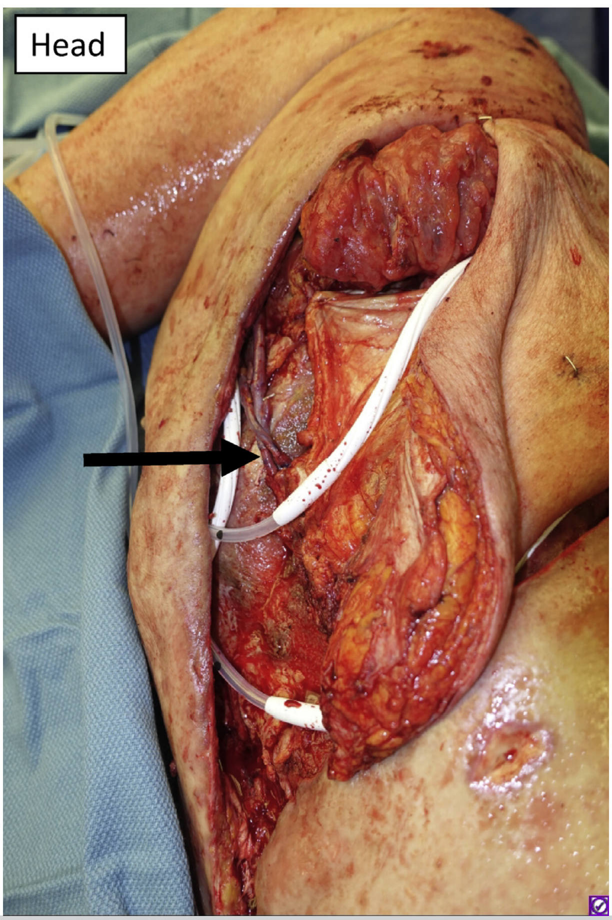

Fig 4. Anastomosis of the thigh flap to the recipient arteriovenous loop.

nature of this patient's defect and exposed lung and graft, no local reconstructive options were available.

Large studies have shown microsurgical techniques to be safe and effective for coverage of the thoracic wall.[6,8,9] In our case, reconstruction was performed with microvascular free tissue transfer from the thigh. The anterolateral thigh flap has long been used as a workhorse flap for microvascular reconstruction of the chest wall. With its ability to include vastus lateralis muscle and a large skin territory of the lateral thigh, it can be used to reconstruct large defects and to obliterate dead space. In addition, there is minimal morbidity with harvest of large skin flaps and minimal to moderate morbidity with harvest of the vastus lateralis if the remaining quadriceps muscles are intact.[7]

Fig 5. Inset of myocutaneous flap.

Disadvantages to the use of anterolateral thigh flaps for chest wall reconstruction include the following: they do not provide skeletal support; microsurgery can increase operative time in patients who cannot tolerate a long procedure; and they cannot be constructed in areas without good arterial inflow or venous outflow.[7,10] In this case, the use of a cephalic vein graft with arteriovenous loop allowed adequate length of recipient vessels for inset of the thigh soft tissue into the thoracic defect. The vastus lateralis muscle provided obliteration of dead space and the thigh cutaneous tissue adequate skin coverage.

CONCLUSIONS

This is a rare case report of a large wound defect resulting from thoracoabdominal aortic aneurysm repair. The case highlights the feasibility of microvascular reconstruction techniques to fix even the largest defects.

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