Hybrid endovascular exclusion of a bleeding innominate artery pseudoaneurysm in a patient with no open surgical options

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ABSTRACT

Mycotic pseudoaneurysms (MPs) rarely affect the aortic arch vessels and usually require surgical resection for definitive treatment. In this case, a 58-year-old woman developed a bleeding innominate artery MP after primary lung cancer resection complicated by an infected chest wound. Because of her previous surgery, irradiation, and chest wall reconstruction, she was not a candidate for open resection. A hybrid endovascular approach successfully excluded her innominate artery MP through placement of an aortic arch stent graft. Cerebral circulation was maintained through a periscoped left common carotid artery stent graft to the descending thoracic aorta graft, which supplied a left-to-right carotid-carotid bypass. (J Vasc Surg Cases and Innovative Techniques 2019;5:132-5.)

CASE REPORT

A 58-year-old woman had a left superior sulcus mass incidentally discovered during evaluation for squamous cell carcinoma of her eyelid. Imaging studies demonstrated a 6- × 4.5- × 3.4-cm primary lung squamous cell carcinoma. After 6 months of chemotherapy and radiation therapy, imaging studies showed progression of disease with mediastinal and anterior chest wall involvement. A multidisciplinary oncology team recommended staged surgical resection to increase the chance of long-term survival.

The patient had an open left upper lobectomy with en bloc first rib and partial sternal resection through a trapdoor incision. She was discharged on postoperative day 8 and returned 1 week later with chest wound dehiscence (Fig 1, A). Cultures grew coagulase-positive *Staphylococcus aureus.* Treatment involved intravenous antibiotics and multiple surgical débridements followed by reconstruction of the chest wall defect with two rotational muscle flaps and a skin graft.

Three months later, she had intermittent bleeding from an unhealed portion of the wound (Fig 1, B). Computed

tomography angiography (CTA) of the thorax showed a pseudoaneurysm with a small focus of contrast material extravasation from the proximal innominate artery (Fig 2). The aneurysm was assumed to be mycotic, given the patient's history of wound infection. On hospital day 2, she had bleeding from the wound with hypotension and syncope requiring transfusion of blood products. She had an emergency right brachial cutdown and placement of two stent grafts (iCAST 9 × 38 mm; Atrium, Hudson, NH) into the proximal innominate artery, with the second stent graft extending slightly into the aortic arch (Fig 3). A completion aortogram seemed to show that the stents were adequately apposed to the arterial wall, with no evidence of contrast material extravasation. The patient was discharged on postprocedure day 4 and was taking 75 mg of clopidogrel daily.

Four days later, she returned with pulsatile bleeding from the chest wound. CTA of the thorax demonstrated failure of the previously placed stent grafts to exclude the pseudoaneurysm, with contrast extravasation from the origin of the innominate artery at the aortic arch (Fig 4). The cardiothoracic surgery service determined the patient to be at prohibitively high risk for any open surgical intervention, given her previous surgery, irradiation, rotational muscle flaps, and skin graft covering the surgical site.

The patient's only endovascular option was exclusion of the entire aortic arch with preservation of cerebral perfusion through an extra-anatomic bypass. The treatment plan consisted of the following steps:

1. Left to right carotid-carotid bypass;
2. Placement of an occlusion device in the innominate artery;
3. Placement of a thoracic stent graft covering the aortic arch; and
4. Placement of a stent graft from the left common carotid to the descending thoracic aorta to act as a periscope perfusing the carotid-carotid bypass.

Fig 1. A, Image of chest showing wound dehiscence of surgical site 2 weeks after primary resection of the lung cancer. **B,** Image of chest wound during follow-up after the wound was débrided and closed with a myocutaneous rotational flap and skin graft. The top left corner of the wound continues to demonstrate an unhealed portion with ongoing bleeding.
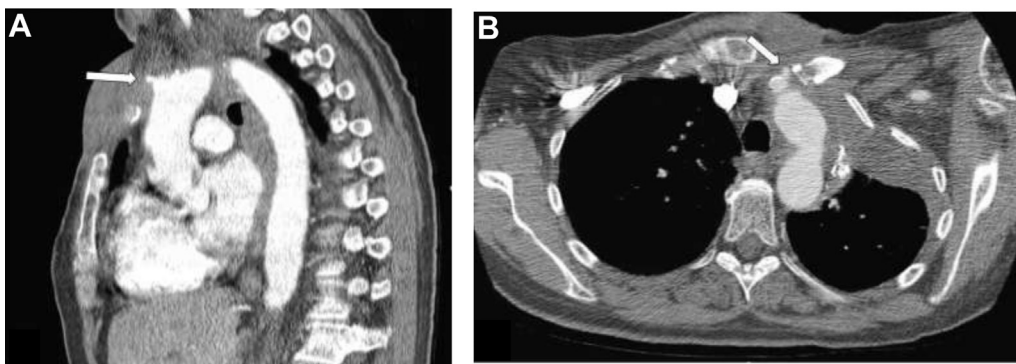

Fig 2. A, Computed tomography angiography (CTA) of the thorax (median sagittal view) demonstrating the mycotic pseudoaneurysm (MP). The *arrow* shows a small focus of contrast extravasation from the proximal innominate artery. **B,** The same CTA image (axial view) demonstrating contrast extravasation from the aortic arch consistent with an MP.

The procedure started with construction of a retropharyngeal left-to-right carotid-carotid 6-mm polytetrafluoroethylene bypass graft. The right common carotid artery was then accessed retrograde with an 8F sheath. A 12-mm Amplatzer occlusive plug (St. Jude Medical, St. Paul, Minn) was then placed in the proximal innominate artery. Retrograde access through the left common carotid artery was used to position a wire and an 8F sheath into the descending thoracic aorta. A Zenith Alpha thoracic stent graft (Cook Medical, Bloomington, Ind) was then positioned in the aortic arch through percutaneous femoral access. As the thoracic stent graft was deployed in the aortic arch, a Gore Viabahn 8-mm × 15-cm stent graft (W. L. Gore & Associates, Flagstaff, Ariz) was periscoped into the descending thoracic aorta to maintain perfusion to the carotid-carotid bypass. A completion aortogram showed exclusion of the innominate artery with no contrast extravasation and adequate bilateral carotid blood flow (Fig 5).

The patient had normal findings on neurologic examination and was discharged home on postoperative day 10. She has continued oral antibiotics, and 16 months after the procedure, she has had no further episodes of bleeding. The patient has consented to having her case report published in a medical journal.

DISCUSSION

Mycotic pseudoaneurysms (MPs) involve vessel dilation usually caused by weakening of the arterial wall due to infection, trauma, or a combination of both.[1-3] MPs represent 2.6% of all aortic aneurysms, with the thoracic aorta being the least common site.[4,5] Only a few case reports have described MPs involving the innominate artery.[3,6,7] We treated an extremely complicated patient with bleeding from an innominate artery MP requiring a unique hybrid endovascular intervention.

Fig 3. Completion aortogram showing placement of two stent grafts (iCAST 9 × 38 mm; Atrium, Hudson, NH) into the proximal innominate artery. The stents are apposed to the arterial wall, with no evidence of contrast material extravasation from the aortic arch or innominate artery.

Fig 4. Computed tomography angiography (CTA) of the thorax. The *arrow* shows a focus of contrast extravasation from the innominate artery despite placement of previous iCAST stent grafts in the innominate artery.

Surgical site infection after a cardiothoracic operation makes patients vulnerable to vascular arteriopathy that can lead to development of an MP.[5] Coagulase-positive *S. aureus* remains the most commonly isolated pathogen and was the presumed causative organism in our case.[8-11] Most case series support surgical excision of the infected aorta and prolonged antibiotic therapy as the preferred treatment of MP.[1,12]

Diagnosis of an MP relies on a high degree of clinical suspicion as patients often present with nonspecific clinical manifestations, such as repeated febrile illness, weight loss, chest or back pain, and malaise.[1,2] Laboratory studies including complete blood cell count, inflammatory markers, and blood cultures may suggest an underlying infection.[12] Imaging studies, such as CTA and magnetic resonance angiography, prove to be highly sensitive in detecting a pseudoaneurysm of the aorta and great vessels. Confirming the diagnosis of MP usually requires a tissue sample and direct cultures. Treatment options and interventional plans depend on the anatomy as defined by the imaging studies.[1]

Definitive surgical management of MP involves removal of all the infected tissue and rerouting of arterial blood flow through uninfected planes if possible.[10] For MP of the thoracic aorta, this approach often consists of a thoracotomy or sternotomy with arterial excision and reconstruction.[1,13] If open surgery is deemed prohibitive, an endovascular approach with graft deployment has been described to prevent rupture of the pseudoaneurysm.[2,3,14]

In this case, the pseudoaneurysm appeared to arise from the aortic arch at the origin of the innominate artery. This location made an endovascular repair challenging because of the larger diameter of the innominate artery's origin compared with the more distal artery. Our initial attempt to exclude the pseudoaneurysm with a stent graft failed because it could not adequately provide wall apposition in the transition zone from aortic arch to innominate artery. A stent graft with a larger diameter at one end may have been more effective, but this type of stent was not available at the time and the patient had active hemorrhage. When bleeding recurred, surgical resection and arterial reconstruction were considered for definitive treatment. Because of the patient's surgical history, prior irradiation, and chest wall reconstruction, she was at prohibitive risk for open surgery. The only option for treating her ongoing bleeding was aortic arch exclusion with cerebral perfusion through a left common carotid periscope stent graft and a carotid-carotid bypass. The periscope carotid stent graft positioned in the descending thoracic aorta minimized seal disruption of the proximal thoracic stent graft. The thoracic stent graft occluded the left subclavian artery. Vertebral artery flow was maintained through the right vertebral artery, which is fed by the right subclavian artery through retrograde flow from the right common carotid. This hybrid endovascular procedure successfully excluded the pseudoaneurysm, and the patient has not had any bleeding episodes for the last 16 months. Her long-term prognosis remains guarded because of the aggressive nature of her lung cancer.
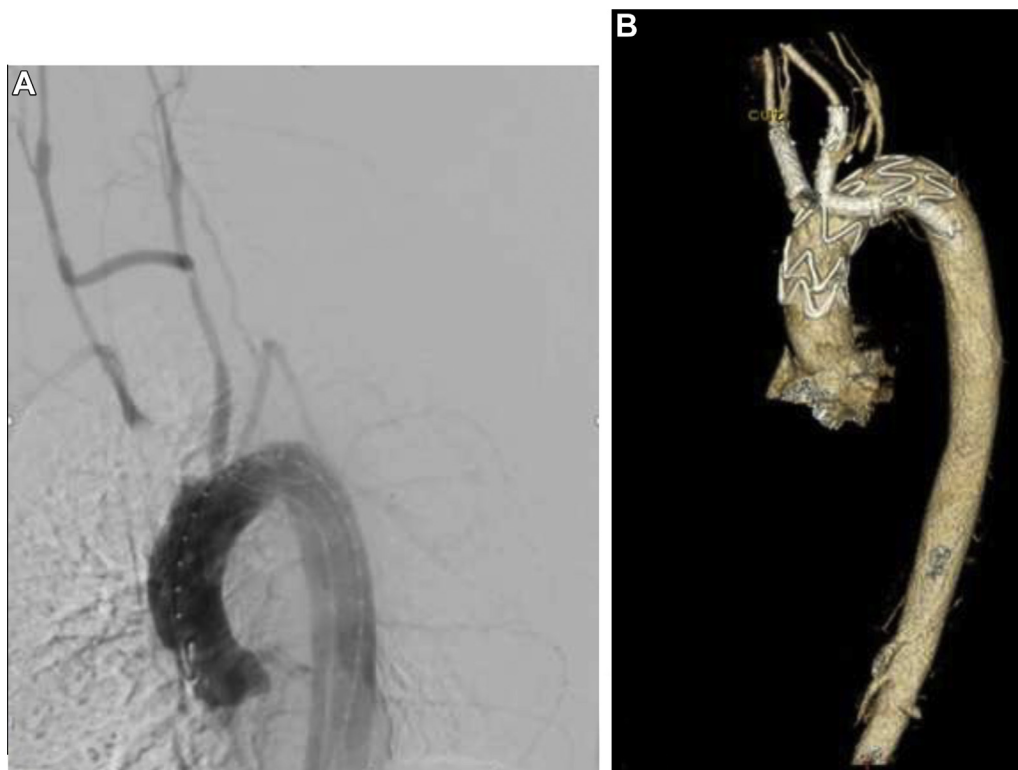
Fig 5. A, Completion aortogram demonstrating placement of an innominate artery occlusive plug and proximal thoracic aortic stent graft for exclusion of the proximal arch with preservation of cerebral blood flow through a snorkeled left common carotid to descending thoracic aorta with a left-to-right carotid-carotid retropharyngeal bypass. No additional bleeding is demonstrated from the previous site of the innominate artery takeoff from the aortic arch. **B,** Computed tomography angiography (CTA) reconstruction showing the excluded aortic arch and snorkeled left common carotid to descending thoracic aorta stent graft.

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