

Hybrid repair for acute aortic occlusion using aortobifemoral bypass and AngioVac thrombectomy

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ABSTRACT

Aortic thrombus with multilevel acute ischemia is rare. We report the use of vacuum-assisted thrombectomy of an aortic mural thrombus with superior mesenteric artery involvement causing bilateral lower extremity ischemia and acute mesenteric ischemia, in conjunction with embolectomy and fasciotomy. We describe the novel use of the AngioVac device (AngioDynamics, Latham, NY) for reperfusion in the systemic arterial circulation. This case report demonstrates a feasible and less invasive alternative to the management of aortic thrombi with acute ischemia in patients unfit for open aortic thrombectomy of the visceral segment aorta. (*J Vasc Surg Cases Innov Tech* 2021;7:429-32.)

Keywords: Thrombectomy; Embolectomy; Aortic thrombus; Mesenteric ischemia; Limb ischemia

Aortic thrombus with multilevel acute ischemia is a rare clinical phenomenon. The incidence of nonaneurysmal aortic thrombi is estimated at 0.45%.¹ Aortic thrombi have been managed with different combinations of anticoagulation and thrombectomy with selective stenting, as well as with varying endovascular approaches. We present the case of a patient who developed acute nonaneurysmal aortic occlusion with superior mesenteric artery (SMA) involvement causing acute mesenteric ischemia and bilateral lower extremity ischemia. We describe the novel use of the AngioVac device (AngioDynamics, Latham, NY) in the systemic arterial circulation for reperfusion in a patient unfit for perivisceral direct aortic thrombectomy.

CASE REPORT

A 78-year-old woman with a history of atrial fibrillation (not anticoagulated secondary to intracranial hemorrhage), hepatitis

C, ischemic cardiomyopathy, and chronic kidney disease presented with acute-onset abdominal pain and bilateral lower extremity pain. On physical examination the lower abdomen was tender without peritonitis. Bilateral lower extremities were cool, mottled, and tender. There was sensory and motor loss extending from the toes to the knees bilaterally. Doppler signals were not present in either foot, consistent with Rutherford IIb acute limb ischemia. Computed tomography angiography revealed patent celiac and renal arteries and a large thrombus in the visceral segment of the aorta extending into the proximal SMA; the infrarenal aorta was occluded and the thrombus extended into the right common iliac, right external iliac, and left common iliac arteries (Fig 1). Multiple emboli were present in the bilateral superficial femoral and tibial arteries. Direct aortic thrombectomy with SMA embolectomy was considered, but this procedure would have required a supraceliac clamp given the extent of the near-occlusive thrombus in the perivisceral aorta. Given the patient's age, comorbidities, and high risk of mortality, an aortic thrombectomy with supraceliac clamp was not offered. The AngioVac device was chosen, given the need for emergent revascularization and its availability at the time of the operation. The patient underwent emergent revascularization with aortobifemoral bypass, AngioVac suction thrombectomy, bilateral lower extremity embolectomy, and fasciotomies for acute mesenteric ischemia with concomitant acute Rutherford IIb bilateral lower extremity ischemia.

The procedure was performed under general anesthesia with exposure of the right and left common femoral artery, superficial femoral artery, profunda femoris artery, and common femoral vein. The abdominal viscera were examined by laparotomy revealing a severely ischemic small intestine. The SMA was exposed through dissection of the root of the mesentery. The infrarenal aorta was exposed and transected; thromboembolectomy of the

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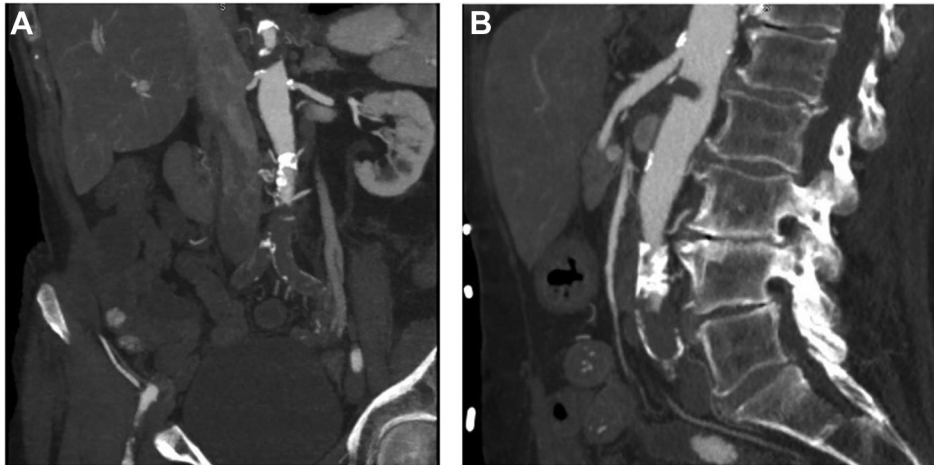


Fig 1. Preoperative (A) coronal and (B) sagittal images, demonstrating thromboembolic occlusion of the superior mesenteric artery (SMA) extending into the perivisceral aorta and thromboembolic occlusion of the infrarenal aorta extending into the right common iliac artery, right external iliac artery and left common iliac artery.

juxtarenal aorta established pulsatile inflow and an infrarenal clamp was placed. A 16 × 8-mm bifurcated Dacron graft (Terumo, Tokyo, Japan) was used for a proximal end-to-end anastomosis.

The AngioVac device was advanced through the left graft limb under fluoroscopic guidance and kept in position with the right graft limb clamped. The right common femoral vein was accessed and a 19F Bio-Medicus cannula (Medtronic, Inc, Minneapolis, Minn) was advanced for venous drainage. Arterio-venous circuit was started with a filter in place used for the AngioVac device. Flow was initially set at 1 L/min and increased to 2 L/min. The device was advanced via the left femoral limb of the bifurcated aortic graft into the supraceliac aorta. Several passes of AngioVac thrombectomy were made, resulting in a palpable SMA pulse and a palpable pulse in the right graft limb. Completion aortography revealed wide patency of the SMA, bilateral renal arteries, and celiac artery without evidence for residual aortic thrombus (Fig 2). The AngioVac device was removed from the left limb and the right femoral vein was decannulated. Bilateral lower extremity embolectomy was performed. Completion of the aortobifemoral bypass resulted in palpable distal pulses bilaterally. Lower extremity fasciotomies revealed viable muscle in all four compartments bilaterally. The small intestine seemed to be pink, healthy, and with normal peristalsis. Abdominal and groin incisions were closed, and fasciotomy wounds were left open and packed. Time from onset of symptoms to onset of mesenteric and lower extremity reperfusion was approximately 12 hours.

The patient was admitted to the surgical intensive care unit postoperatively. Her postoperative course was complicated by midline wound dehiscence, dysphagia requiring tube feeding, and respiratory failure. She was ultimately discharged to a nursing facility. Anticoagulation was discontinued 1 month postoperatively. A CT scan at 6 weeks postoperatively demonstrated a patent SMA and a patent aortobifemoral bypass graft with recanalization at the iliac bifurcations bilaterally, consistent

with successful surgical treatment. The right external iliac artery recanalized and there was bilateral retrograde flow in the internal iliac arteries. She made full recovery after rehabilitation at a nursing care facility and at the 1-year follow-up is living independently in the community. Given a remote history of right parietal hemorrhage while on warfarin, anticoagulation was briefly discontinued in the postoperative period and later resumed by the patient's primary care provider. She has since remained without recurrence of cardioembolic events. The patient has agreed and given consent for publication of their case details and images.

DISCUSSION

Aortic thrombus with acute mesenteric ischemia and acute Rutherford class IIb bilateral lower extremity ischemia is a rare clinical presentation requiring immediate surgical intervention. The incidence of nonaneurysmal acute aortic occlusion is estimated at 0.45%,¹ but does not account for co-occurring complications. Acute aortic occlusion occurs secondary to in situ thrombosis (64.1%), saddle embolus (21.3%), and stent graft occlusion (14.7%), commonly complicated by bilateral acute limb ischemia (81.2%).² In situ thrombosis is now the most common cause of acute aortic occlusion likely secondary to increased prevalence of atherosclerotic disease and improved secondary prevention of cardioembolic events.^{2,3} The mortality of acute aortic thrombus ranges between 30% and 50% despite significant advancement in surgical techniques.^{2,4-6} Management strategies include thromboembolectomy, thrombolysis, and extra-anatomic bypass. The majority of reported cases have been managed by aortobifemoral bypass or direct thromboembolectomy.^{5,7-12} Few case reports describe total percutaneous endovascular management of acute aortic occlusion, but these have occurred secondary to

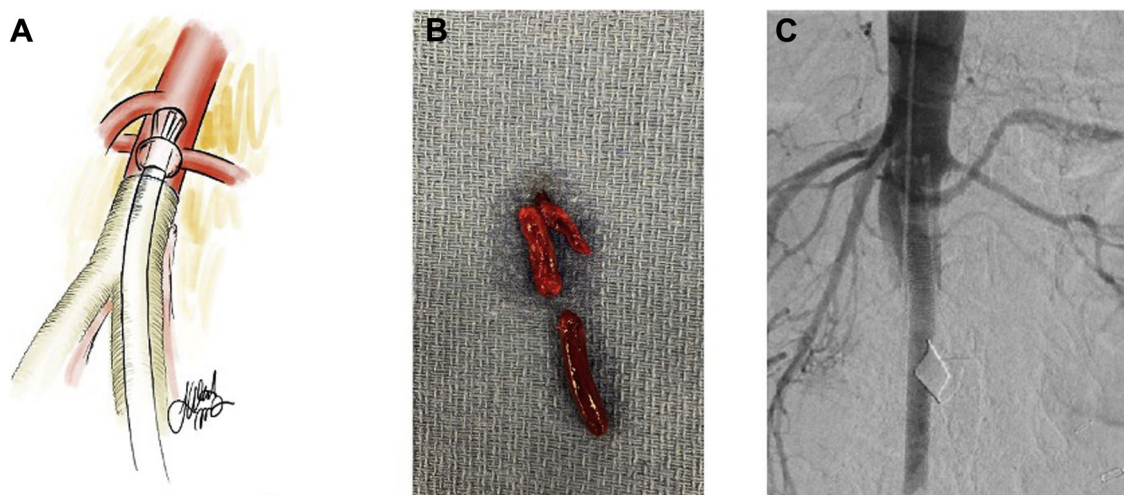


Fig 2. **A**, schematic of AngioVac used in the visceral segment aorta through an aortobifemoral bypass limb. **(B)** Intraoperative photograph of superior mesenteric artery (SMA) and aortic embolus. **(C)** Completion angiogram after visceral segment AngioVac thrombectomy.

abdominal aortic aneurysms and in the setting of atherosclerotic disease.¹³⁻¹⁵ To our knowledge, the current literature has not yet compared direct surgical with endovascular approaches in acute aortic occlusion. The choice of surgical technique should depend on clinical presentation, morphology, and medical comorbidities. Surgical intervention for acute aortic occlusion has a 24% mortality rate at 30 days and an overall postprocedural mortality rate of 15%.¹⁶ Given this patient's comorbidities, her risk of mortality with surgical intervention was at least 75% by the American College of Surgeons National Surgical Quality Improvement Program score,¹⁷ highlighting the importance of a personalized approach in patients with a complex medical history.

The AngioVac device is approved for the purpose of venous thrombectomy. A review of the literature of AngioVac venous thrombectomy showed procedural success in 15 of 18 patients.¹⁸ Success rates were higher in ilio caval thrombosis owing to ease of access from the femoral vein and lack of tortuosity. The AngioVac system is also indicated for pulmonary embolectomy and right heart thrombus, but with less success.^{19,20} D'Ayala et al¹⁹ looked at 12 patients with pulmonary embolus, right heart thrombus, and ilio caval thrombus. AngioVac pulmonary venous embolectomy was unsuccessful in all reported cases owing to difficulty in arterial access, small pulmonary artery vessel caliber, and relative device stiffness. Right heart thrombectomy showed a 60% success rate and ilio caval thrombectomy showed a 100% success rate. Al-Hakim et al²⁰ showed unsuccessful AngioVac pulmonary embolectomy in 60% of their reported cases. The use of the AngioVac device thus far has been limited to the venous circulation with a low success rate in the pulmonary arterial system. Its application in the systemic arterial system has not been well-described.

Given the emergent nature of acute mesenteric and acute bilateral lower extremity ischemia in this patient, the inability to tolerate a supraceliac clamp as well as the need for exploratory laparotomy to evaluate the bowel, endovascular reconstruction was not suitable. Instead, aortobifemoral bypass with AngioVac suction thrombectomy was used. We describe the novel use of the AngioVac device outside manufacturer instructions for use for management of an acute aortic occlusion with mesenteric and lower extremity ischemia. Only two other reported cases describe its use in the systemic arterial system.^{21,22} Habib et al²² describe a thoracic aortic thrombus with embolization to the celiac artery, for which the AngioVac was used only to remove thrombus extending past the stent graft. Monastiriotes et al²¹ describes a supraceliac thrombus with occlusion of the celiac artery and embolization of the distal jejunal branches of the SMA, for which a combination of the AngioVac with over-the-wire thrombectomy resulted in successful reperfusion. Similarly, our case demonstrates the successful use of the AngioVac device for aortic and SMA occlusion in a patient with atrial fibrillation and contraindications to long-term anticoagulation in conjunction with embolectomy and lower extremity fasciotomy.

As a single case, this report is limited and cannot be generalized to all acute aortic occlusions. There are two significant limitations to the use of the AngioVac device. This technique may be cost prohibitive, and the large size of the device cannula of 26F limits its anatomic reach. Challenges and complications included the risk of small vessel caliber dissection, the risk of distal embolization, and the need for arterial venous bypass. Bail-out considerations included traditional SMA thrombectomy and retrograde SMA bypass.

CONCLUSIONS

We have shown the novel use of the AngioVac system in the systemic arterial circulation, a feasible and less invasive alternative to management of aortic thrombi with acute ischemia in patients unfit for open aortic thrombectomy of the visceral segment aorta.

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