

Endovascular removal of a large free-floating thrombus of the descending thoracic aorta using the AngioVac system

William R. Wilson, MD,^a Kevin H. McCusker, PhD,^a Syed M. Peeran, MD,^a and Peter J. Dourdoufis, DO,^b *Portsmouth, NH*

ABSTRACT

Free-floating aortic mural thrombus in the minimally diseased or nonaneurysmal aorta is a rare, clinically significant source of peripheral embolism. We describe a 41-year-old woman with a history of left brachial thromboembolism who presented with atypical chest pain. Computed tomography angiography and transesophageal echocardiography revealed a 14.0 cm × 1.4 cm mobile mass in the proximal descending thoracic aorta. The thrombus was removed through a minimally invasive catheter-based approach using the AngioVac system. (*J Vasc Surg Cases Innov Tech* 2024;10:101460.)

Keywords: Free-floating aortic thrombus; AngioVac system; NESVS 2023 Annual Meeting

CASE REPORT

The patient is a 41-year-old woman who presented with a 4-week history of pleuritic chest pain. Ten days before her hospital admission, she was seen at an outside emergency room and sent home with a diagnosis of viral pneumonia. Four days later, she was seen at a free-standing emergency room where a computed tomography (CT) angiogram of the chest revealed a large mobile thrombus in the descending thoracic aorta. At the time, she was prescribed apixaban and sent home. One week later, she came to Portsmouth Regional Hospital with persistent chest pain and new palpitations.

The patient is an active cigarette smoker with a 20 pack-year history. Twenty-one months prior, she had undergone a left brachial thromboembolism. Imaging at the time was limited to a vascular ultrasound examination and CT angiogram of the left upper extremity. After a successful embolectomy, she was started on warfarin and discharged. As an outpatient, she had an echocardiogram negative for bubble study and no evidence of an intracardiac mass or clot. Extensive hematologic workup for clotting disorders was negative, including protein C, S, deficiencies, factor V, lupus anticoagulants, and cardio lipid antibodies. After 9 months, warfarin was stopped, and she was prescribed aspirin daily.

At the time of the index admission, she was started on intravenous heparin. A stress test was negative. A chest, abdomen, and pelvis CT angiogram confirmed the aortic thrombus in a nonaneurysmal, minimally diseased thoracic aorta (Fig 1). There was no radiographic evidence of end-organ infarct. A transesophageal echocardiogram demonstrated a mobile thrombus 14.0 cm × 1.4 cm attached to the proximal descending aorta opposite the left subclavian artery. Persistent thrombus despite 15 days of anticoagulation with a large mobile thrombus with high embolic potential was our indication for removal in this low-risk patient.

Under general anesthesia, in a hybrid operating room, the patient underwent transcatheter endovascular removal of the thrombus from the descending aorta using the AngioVac system. Transesophageal echocardiography and fluoroscopic guidance were utilized. The AngioVac system consisted of a 22F Gen 3 180° inflow cannula connected to an extracorporeal circuit with a filter, centrifugal pump, reinfusion line, and a 16F reinfusion venous cannula. The AngioVac aspiration cannula requires a 26F sheath for introduction that was placed through a 10-mm Dacron iliac conduit sewn to the right common iliac artery through a right lower quadrant retroperitoneal exposure (Fig 2). The bypass time was 29 minutes, and the procedure was 273 minutes. Postprocedure transesophageal echocardiography showed successful aspiration of 93% of the material (Fig 3). Completion angiography revealed no splanchnic or distal emboli. Pathology of the recovered material showed thrombus with early organization and no malignancy seen. She was discharged on lifelong apixaban 5 mg twice daily and aspirin 81 mg daily.

Postoperatively, at 9 months, she presented pain and bulging in the right lower quadrant of her abdomen. An incisional hernia was detected and required laparoscopic-assisted hernia repair. Serial follow-up CT angiogram studies have shown no recurrence of the aortic thrombus. The most recent study has shown a persistent 8-mm thickening of the aortic wall and irregularity of the aortic wall at the site of the previous thrombus (Fig 1, D). She has had no further thromboembolic

From the Department of Cardiothoracic and Vascular Surgery,^a and Department of Cardiology,^b Portsmouth Regional Hospital.

Presented at the 50th Annual Meeting of the New England Society for Vascular Surgery Boston, Massachusetts, October 8, 2023.

Correspondence: William R. Wilson, MD, Department of Cardiothoracic and Vascular Surgery, Portsmouth Regional Hospital, 333 Borthwick Ave, Portsmouth, NH 03801 (e-mail: wwilsonmd82@yahoo.com).

The editors and reviewers of this article have no relevant financial relationships to disclose per the Journal policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

2468-4287

© 2024 The Author(s). Published by Elsevier Inc. on behalf of Society for Vascular Surgery. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

<https://doi.org/10.1016/j.jvscit.2024.101460>

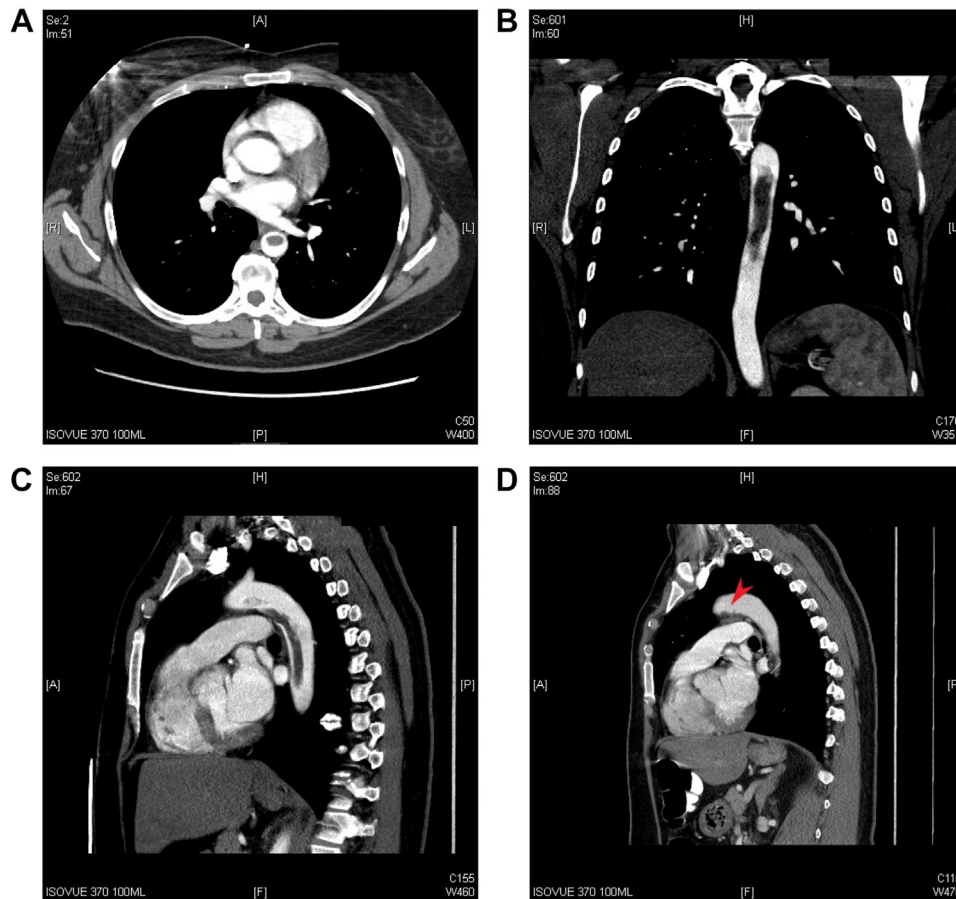


Fig 1. Computed tomography (CT) angiogram showing thrombus in the descending aorta with attachment site opposite left subclavian artery. **(A)** Axial. **(B)** Coronal. **(C)** Sagittal. **(D)** Sagittal 13-month postoperative with residual thickening proximal descending aorta (red arrow).

events. The patient provided written consent for publication including images.

DISCUSSION

Free-floating mural thrombi are extremely rare in the minimally diseased nonaneurysmal aorta. In a large autopsy series of 10,671 cases, Machleder et al¹ found 48 cases, an incidence of 0.45%. Although it has been detected in asymptomatic patients,² mobile thrombus is usually discovered during evaluation for peripheral arterial emboli. In contrast with the majority of patients with emboli, which are due to cardiac cause or a heavily diseased aorta, in the minimally diseased aorta, an isolated small ulcer, arterial wall defect, or lipid-laden plaque may be the nidus for thrombus formation.

Hypercoagulable states, smoking, lupus, estrogen use or thrombophilia owing to factor V Leiden, protein S, or protein C deficiencies, antiphospholipid antibodies, or homocysteine have been associated with aortic mural thrombus in the minimally diseased aorta. The patient presented was a smoker. She had an extensive hematologic workup negative for thrombophilia.

Free-floating mural thrombus in the minimally diseased aorta have been described throughout the thoracoabdominal aorta. Pagni et al³ reported 17 thrombi in 14 patients: 7 in the ascending aorta, 8 in the descending aorta, and 2 in the thoracoabdominal aorta. All of their patients presented with embolic events, several in multiple locations. Nine upper lower extremities, six abdominal, including the superior mesenteric artery, renal, splenic, and six cerebral emboli with stroke.

Imaging with CT angiography of the entire aorta and transesophageal echocardiography should be done in all patients presenting with peripheral emboli to assess the proximal source and rule out free-floating thrombus as a cause.

Treatment of free-floating aortic thrombus remains controversial. Conservative treatment with full anticoagulation has been suggested in selected asymptomatic high-risk patients with contraindications to surgery. A meta-analysis of the literature using Medline search of mural thrombus in normal or minimally atherosclerotic aorta reported 200 cases.⁴ There were 112 patients who were treated with anticoagulation and 88 patients

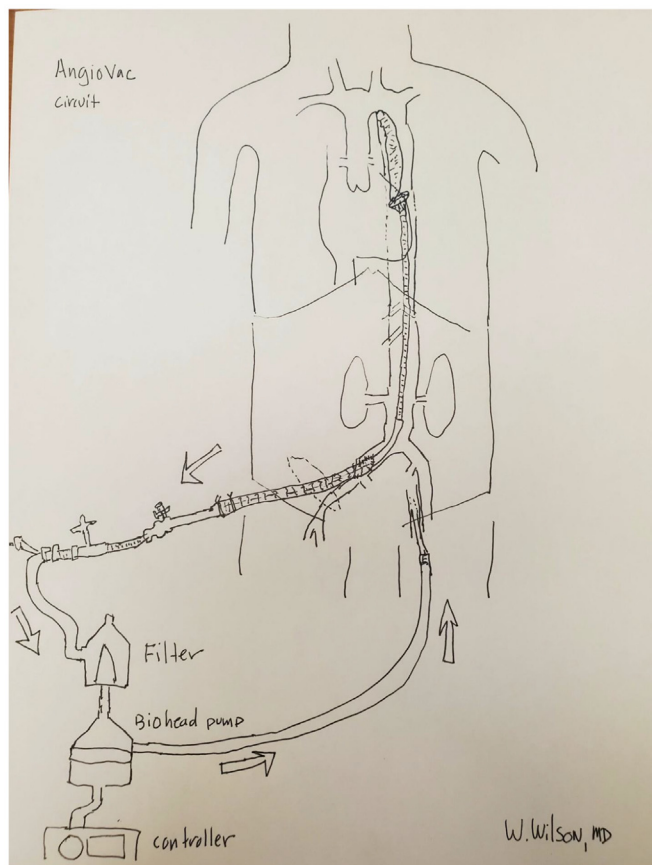


Fig 2. Diagram of the AngioVac circuit showing iliac conduit with a 26F sheath, Gen 3 AngioVac aspiration cannula (Angiodynamics, Lytham, NY) connected to tubing with filter and centrifugal pump to return venous cannula in left iliac vein. Arrows indicate direction of flow.

underwent aortic surgery as primary treatment. Persistence 26.4% vs 5.7%, recurrence of peripheral embolization, 25.7% vs 9.1%, complications 27.0% vs 17.0%, and major amputation rate 9.0% vs 2.0% were all higher in the anticoagulation group. Mortality rates were similar (6.2% vs 5.7%; $P = .879$). The meta-analysis favored surgical management with aortic surgery as initial therapy in good-risk patients. Other authors have suggested high failure rates of anticoagulation as the primary treatment, with 25% requiring secondary aortic surgery. Aortic surgery has been recommended as the primary treatment for low surgical risk patients.

Open aortic surgical thrombectomy has been reported in several series.³⁻⁹ Thrombus in the ascending aorta and transverse arch may necessitate hypothermic cardiopulmonary bypass with a short interval of circulatory arrest, with or without a short resection of the aortic wall. Open surgery for thrombus in the descending aorta usually requires left atrial or femoral bypass. Resected pathology specimens from the attachment site have shown superficial ulcerations.⁴ One series found several cases of an attachment to the ductus arteriosus.

Endovascular approaches using stent grafts have also been described. Vaidya reported deployment of stent graft to successfully treat a free-floating thrombus in the proximal descending aorta.¹⁰

The AngioVac system (AngioDynamics Inc., Lytham, NY) includes a novel designed cannula, intended to be used as venous drainage cannula, and an extracorporeal circuit with a filter, pump, and reinfusion cannula. Our institutional experience of five cases included successfully removing tricuspid vegetations for endocarditis, venous thromboembolism in transit and persistent right atrial infected thrombus.

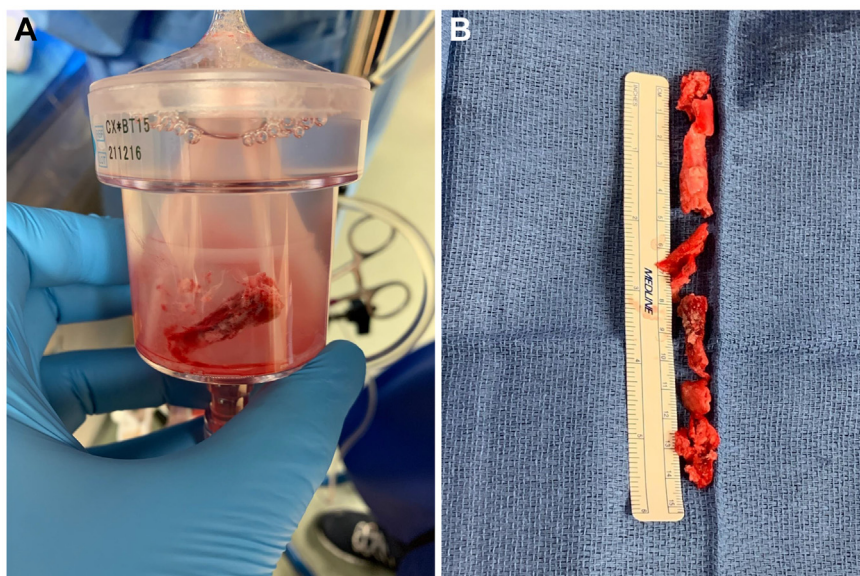


Fig 3. Aspirated thrombus. (A) Washed filter with clot. (B) Thrombus with ruler.

The 22F AngioVac drainage cannula has a funnel-tip design with a self-expanding nitinol tip, which protrudes and expands when advanced through its sheath. The design allows it to be manipulated owing to its 180° curve. It is inserted over a stiff guidewire with a tapered dilator introducer through a 26F dry seal sheath (W. L. Gore & Associates, Flagstaff, AZ). In this patient, the sheath was inserted through a 10-mm Dacron conduit placed through a right retroperitoneal exposure owing to small 6-mm external iliac arteries. The system requires full heparinization with an activated clotting time of >300 seconds. The bypass circuit with a filter, pump, and reinfusion cannula allows for simultaneous reinfusion of filtered blood to minimize blood loss and hemodynamic compromise.

U.S. Food and Drug Administration approval and the largest experience with the AngioVac system has been with thrombus, tumor, foreign body located in the cava, right atrium, or pulmonary artery for vegetation, tumor, or pulmonary embolism located in the right-sided circulation using venovenous bypass with filtration.¹¹

Experience with left-sided arterial circulation has been limited. Quintar et al¹² reported 10 cases using AngioVac to remove material from left atrium in 4, left ventricular in 1, left atrial appendage in 2, and aortic arch in 3. We reported the successful removal of a free-floating thrombus for the proximal descending aorta. Refinement of techniques for embolic protection may allow expansion of indications for the AngioVac system and successful removal of unwanted intravascular material from left-sided cardiac chambers, valves, ascending aorta, and the transverse aortic arch.

CONCLUSIONS

A large, mobile, free-floating aortic thrombus of the descending thoracic aorta was removed successfully

with a minimally invasive approach using the AngioVac system.

DISCLOSURES

None.

REFERENCES

1. Machleder HI, Takiff JF, Lois JF, Holburt E. Aortic mural thrombus: an occult source of arterial thromboembolism. *J Vasc Surg.* 1986;4:473–478.
2. Yang S, Yu J, Zeng W, et al. Aortic floating thrombus detected by computed tomography angiography incidentally: Five cases and literature review. *J Thorac Cardiovasc Surg.* 2017;153:791–803.
3. Pagni S, Trivedi J, Ganzel BL, et al. Thoracic aortic mobile thrombus: is there a role for early surgical intervention? *Ann Thorac Surg.* 2011;91:1875–1881.
4. Fayad ZY, Semaan E, Fahoum B, Briggs M, Tortolani A, D'Ayala M. Aortic mural thrombus in the normal or minimally atherosclerotic aorta. *Ann Vasc Surg.* 2013;27:282–290.
5. Weiss S, Buhlmann R, von Allman R, et al. Management of floating thrombus in the aortic arch. *J Thorac Cardiovasc Surg.* 2016;152:810–817.
6. Bojko ET, Clothier JS, Starnes VA, Baker CJ. Surgical resection of asymptomatic ascending aortic mural thrombus. *Ann Thorac Surg.* 2022;114:e279–e282.
7. Yang P, Li Y, Huang Y, Lu C, Liang W, Hu J. A giant floating thrombus in the ascending aorta: a case report. *BMC Surg.* 2020;20:321.
8. Oki N, Inoue Y, Kotani S. Free-floating thrombus of the aorta: 3 case reports. *Surg Case Rep.* 2021;7:41.
9. Avelino MC, Mendes de Miranta CL, Moreirade de Sousa CS, Bastos BB, Moreira de Souza RF. Free-floating thrombus in the aortic arch. *Radiologia Brasileira.* 2017;50:406–407.
10. Vaidya YP, Schaffert TF, Shaw PM, Costanza M. Management of mobile thrombus of the thoracic aorta. *J Vasc Surg Cases Innov Tech.* 2021;7:627–629.
11. Behrens G, Bjamason H. Venous thromboembolic disease: the use of the aspiration thrombectomy device AngioVac. *Semin Intervent Radiol.* 2015;32:374–378.
12. Quintar M, Wang OD, Lee J, et al. Transcatheter vacuum-assisted left-sided mass extraction with the AngioVac system. *Catheter Cardiovasc Interv.* 2022;7:627–629.

Submitted Dec 8, 2023; accepted Feb 13, 2024.