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INTERMEDIATE

CASE REPORT: CLINICAL CASE

Vacuuming in Crowded Dangerous Spaces

Aspiration of Large Ascending Aortic Thrombus

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ABSTRACT

A patient had a stroke caused by a large, pedunculated aortic ascending mass and was deemed at high risk for near-term recurrent stroke. This case illustrates percutaneous aspiration thrombectomy of ascending aortic thrombus with the AngioVac system (Angiodynamics, Latham, New York), with conscious sedation for early stroke detection and with endovascular cerebral embolic protection. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2020;2:1979–83) © 2020 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

A 48-year old man presented to the emergency department roughly 23 h after acute-onset dysarthria and persistent right upper and lower extremity weakness, which led to a fall. He thought his symptoms would resolve spontaneously, but they did not. Presenting vital signs were blood pressure 142/76 mm Hg, heart rate 84 beats/min, and O_2 saturation 98%.

LEARNING OBJECTIVES

- To understand that aortic thrombus is one of the causes of embolic acute stroke.
- To understand potential treatment options for ascending aortic thrombus.
- To better understand the technical and practical or clinical implications of percutaneous aspiration thrombectomy in the ascending aorta.

PAST MEDICAL HISTORY

The patient had a history of popliteal arterial thrombosis of unclear origin and had been noncompliant with recommended anticoagulation.

DIFFERENTIAL DIAGNOSIS

The patient's symptoms were highly consistent with an acute cerebrovascular event, the differential diagnosis for which included hemorrhagic event, embolic ischemic event originating from a cardiac structure (e.g., thrombus in the left atrial appendage or left ventricle, myxoma, fibroelastoma), embolic event originating from the aorta (i.e., aortic arch atheroma), and intrinsic atherosclerotic cerebrovascular disease.

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ABBREVIATIONS AND ACRONYMS

CT = computed tomography scan

CTA = computed tomography angiography

INVESTIGATIONS

Computed tomography (CT) and computed tomography angiography (CTA) of the brain showed an infarct in the middle cerebral artery territory without major branch vessel occlusion or hemodynamically significant stenosis. Magnetic resonance imaging of the brain confirmed a left middle cerebral artery–territory acute ischemic stroke with a tiny focus of hemorrhagic transformation. Transesophageal echocardiography and CTA of head and neck revealed a large, pedunculated ascending aortic mass (**Figures 1A to 1C**, Video 1), consistent with thrombus. CTA extended far enough into the abdomen also to detect incidentally an adherent, infrarenal abdominal aortic thrombus.

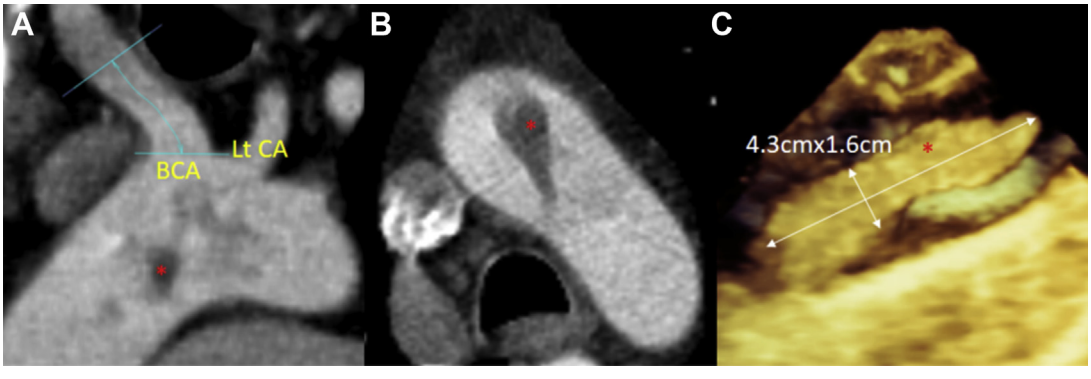
MANAGEMENT

The patient was started on dual platelet inhibition therapy with aspirin and clopidogrel. Blood pressure goals of <220/110 mm Hg were defined, and medical therapy was initiated to that effect. Vascular and cardiothoracic surgical services were involved in his care but deferred surgical intervention in favor of conservative medical therapies. However, after multidisciplinary discussion involving the primary neurological service and surgical and structural heart disease services, it was decided that the location, size, and morphology of the ascending aortic thrombus put the patient at high risk for short-term recurrent stroke or other embolism and that catheter-based aspiration, although off-label, was reasonable. The patient and his family were counseled in detail about the potential risks and benefits of medical therapy versus off-label aspiration thrombectomy. The decision was made to attempt endovascular thrombectomy with the AngioVac system (Angiodynamics, Latham, New York).

Transesophageal echocardiography was used to guide positioning of the AngioVac system, to visualize thrombus extraction, and for detection of thrombus embolization, which would prompt an early cerebral angiogram and, if needed, catheter-based cerebrovascular rescue. The patient was not intubated, and he was sedated only moderately, to allow for early detection of neurological changes. Sentinel cerebral embolic protection (Boston Scientific, Marlborough, Massachusetts) was planned by CT and was used: a 0.014-inch wire was delivered through the right radial approach into the right brachiocephalic artery and directly into the left common carotid artery with the aid of a diagnostic Judkins right-4 catheter (**Figures 2A to 2C**, Video 2), to minimize the risk of wire or device interaction with the thrombus and possible dislodgement and embolization, because the thrombus was located only 1 cm inferior to the great vessels (Video 3). The left vertebral artery was protected with inflation of a balloon in the ostial left subclavian artery (**Figure 2B**).

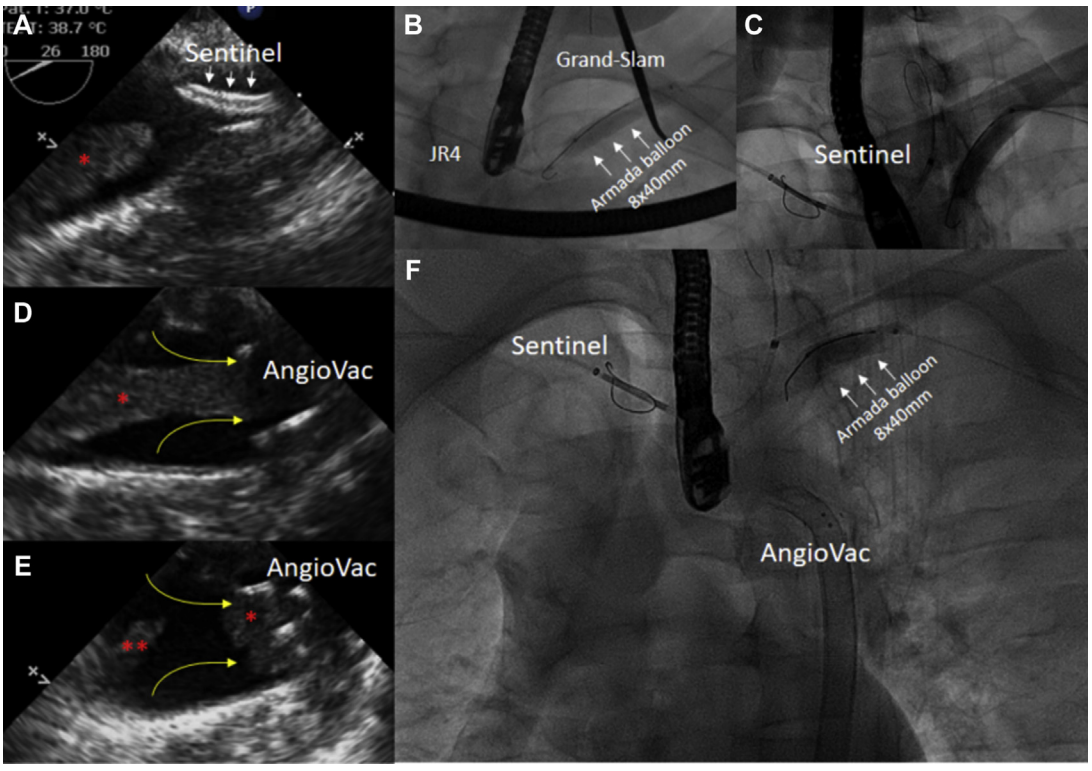
The AngioVac system inflow cannula was inserted through the right femoral artery and outflow cannula in the left femoral vein. The inflow cannula was advanced to the descending abdominal aorta, and the circuit flows slowly increased to 3.5 l/min to ensure stable hemodynamics. The inflow cannula was advanced to the proximal descending aorta, and then the tip was flexed while slowly advancing around the

FIGURE 1 Computed Tomography Angiography and Transesophageal Echocardiography of Ascending Aortic Thrombus



(A and B) Computed tomography angiography and **(C)** transesophageal echocardiography showing the large pedunculated ascending aortic thrombus **(red asterisks)**. BCA = brachiocephalic artery; Lt CA = left carotid artery.

FIGURE 2 Transesophageal Echocardiography and Fluoroscopy During Ascending Aortic Aspiration Thrombectomy



Transesophageal echocardiography (TEE) and fluoroscopic images showing **(A to C)** the deployment of the Sentinel device (Boston Scientific, Marlborough, Massachusetts) and its proximity to the thrombus **(red asterisks)** and the use of a peripheral balloon (Armada balloon, Abbott Vascular, Santa Clara, California) at the ostial left subclavian artery for protection of the left vertebral artery; **(D to F)** successful ascending aortic thrombectomy using the AngioVac system (Angiodynamics, Latham, New York). **Small post-thrombectomy residual adherent clot. JR4 = Judkins right-4.

aortic arch toward the thrombus (Video 4). After the inflow cannula was positioned in close proximity to the thrombus (Video 5), circuit flows were increased to 4 l/min. After approximately 3 min of aspiration, the thrombus finally separated from the aortic wall (Video 6). The large aspirated thrombus became trapped inside the tip of the inflow cannula, thus leaving a small piece still adherent to the aorta (**Figures 2D to 2F**, Video 7). The thrombus and inflow cannula were removed from the body (**Figure 3**); histopathologic examination confirmed organized thrombus. Cerebral angiography before terminating the intervention showed normal head and neck cerebral circulation without stenosis or occlusion.

DISCUSSION

This case illustrates clinical and technical considerations related to safe and effective aspiration thrombectomy of thrombus from the ascending aorta.

The AngioVac Generation 3 cannula has a self-expanding nitinol funnel-shaped tip (20-degree and 180-degree angled tips) that enabled safe navigation across the aortic arch. It is important to emphasize the following: 1) this is off-label use of the device; and 2) this use is not without risk, especially with thrombus located so precariously close to the great cerebral vessels. Careful consideration therefore should be given to risk and benefit of such aspiration attempts on a case-by-case basis.

Potential complications of using the AngioVac system in arterial circulation include systemic distal embolization and vascular complications related to the large-bore access. There are few reports of off-label use of this system in arterial circulation (1,2) and 1 in the ascending aorta (3). Our case importantly included embolic protection using the Sentinel device (filters in brachiocephalic and left common carotid arteries) and an occlusive balloon positioned at the ostium of the left subclavian artery (to protect the left vertebral artery).

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FIGURE 3 Thrombus Aspirated and Removed From the Body

Six-centimeter thrombus was extracted from the body.

Treatment options for thoracic aortic mural thrombus include medical therapy with anticoagulation with or without fibrinolysis, open surgical thrombectomy, endovascular thrombectomy, or endovascular stent placement (location of thrombus in this case makes the last option unfavorable) (4). A systematic review comparing surgical treatment with conservative medical treatment demonstrated that open repair was superior to medical treatment in terms of rate of systemic embolism or persistent thrombus (5). Another review showed that medically treated patients were more likely to have persistent thrombus compared with patients treated with open or endovascular aortic intervention (6). For our patient, cardiothoracic and vascular surgical services deferred open surgical interventions in favor of medical therapy. Medical therapy was considered, but the patient had demonstrated poor adherence in the past, and the thrombus size, location, and morphology were believed to represent a high short-term stroke risk. Thrombolytic therapy was contraindicated given the size of the embolic stroke with small hemorrhagic transformation. AngioVac thrombectomy was chosen only after extensive and multidisciplinary discussion with neurology, neurointerventional, and structural heart disease services, and with the patient, and after multidisciplinary procedure planning among the radiology, neurointerventional, and structural heart disease services.

FOLLOW-UP

The patient awoke. He was discharged without new neurological deficits and had anticoagulant therapy using rivaroxaban. The presumed mechanism for this large thrombus, along with the infrarenal aortic thrombus and a history of popliteal arterial thrombus, is a hypercoagulable state. However, on work-up that included testing for the MTHFR (methylenetetrahydrofolate reductase) variants, the factor V (Leiden) variant, and the 20210G>A variant of the prothrombin gene, no diagnosis was found.

CONCLUSIONS

In the carefully selected patient, percutaneous aspiration thrombectomy of ascending aortic thrombus can be effectively and safely performed with the AngioVac system, in this case with conscious sedation for early stroke prevention and with endovascular cerebral embolic protection.

AUTHOR RELATIONSHIP WITH INDUSTRY

The authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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KEY WORDS AngioVac, ascending aortic thrombus, aspiration thrombectomy, cerebral embolic protection

APPENDIX For supplemental videos, please see the online version of this paper.