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INTERVENTION AND SURGERY

CASE REPORT: CLINICAL CASE SERIES

Aspiration of Left Atrial Masses Using the Large-Bore Manual Aspiration System

The ASPIRATE LA Procedure

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ABSTRACT

Transcatheter mass extraction of left-sided cardiac masses has gained popularity in recent years, with scarce data on effectiveness, safety, and types of devices used. Mostly, left-sided aspirations use mechanical and continuous-flow–mediated devices (the AngioVac [AngioDynamics] and Penumbra systems [Penumbra]). To our knowledge, the use of manual aspiration devices has not been reported yet. Here, we report the first case series on the use of the AlphaVac (AngioDynamics) (a large-bore manual aspiration device) system for left-sided intracardiac masses. (JACC Case Rep. 2024;29:102865) © 2024 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/).

CASE 1

HISTORY OF PRESENTATION. A 75-year-old woman was admitted for evaluation of severe dyspnea. She was afebrile, had a heart rate of 106 beats/min, had an irregular rhythm, and was on oxygen via nasal cannula. On physical examination, Splinter hemorrhages and Janeway lesions were noticed, in addition to 3 toes with black round spots compatible with distal peripheral embolization.

TAKE-HOME MESSAGE

- The large-bore manual aspiration device system proved to be of successful utility in left-sided cardiac mass extraction for select patients who may not tolerate initial or repeat sternotomy.

PAST MEDICAL HISTORY. The patient's medical history included nonischemic cardiomyopathy, heart failure with reduced ejection fraction, persistent atrial fibrillation, chronic obstructive pulmonary disease on home oxygen, essential hypertension, type 2 diabetes mellitus, and peripheral vascular disease.

DIFFERENTIAL DIAGNOSIS. The differential diagnosis included intracardiac thrombus and intracardiac tumor vs infection.

INVESTIGATIONS. Initial blood work revealed high-sensitivity troponin of 5,243 ng/L and B-natriuretic peptide of 1,886 pg/mL. A transthoracic echocardiogram (TTE) showed a large left atrial mass. This was followed by a transesophageal echocardiogram (TEE), which showed 2 large round mobile echodensities in the left atrial appendage, the largest measuring 2.8 × 1.8 cm (Video 1). A multidisciplinary approach was undertaken, and because the patient was on home O_2

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ABBREVIATIONS AND ACRONYMS

TEE = transesophageal echocardiogram

TTE = transthoracic echocardiogram

with severe chronic obstructive pulmonary disease and cardiomyopathy, she was deemed high risk for surgery. Thus, a medical treatment or transcatheter debulking approach was recommended. After discussing the options, the patient elected for an off-label transcatheter mass extraction approach for the left atrial appendage for its diagnostic and therapeutic potential.

MANAGEMENT. The procedure was performed under general anesthesia with fluoroscopy and TEE guidance. Standard access, cerebral protection (with one Sentinel [SENTINEL Cerebral Protection System, Boston Scientific.] [2 filters in the right brachiocephalic and right carotid] in addition to a balloon inflated in the left subclavian arteries), and a transseptal puncture were performed.[2] The F26 C180 large-bore manual aspiration device catheter was advanced to the left atrium using balloon-assisted tracking (Video 2). With TEE guidance, the large-bore manual aspiration device catheter was steered to the left atrial/left atrial appendage mass with successful total aspiration (Video 1). The pathology specimen (**Figure 1**) was consistent with an organized thrombus, with no white blood cells or bacterial growth on culture samples.

OUTCOME AND FOLLOW-UP. The patient tolerated the procedure well and was extubated the following day. Two days later, she was discharged without any complications and was discharged on full-dose anticoagulation. She was seen for a follow-up and was doing well. Postintervention TTE 8 weeks after showed persistent resolution of the mass.

FIGURE 1 Aspirated Left Atrial Vegetation Gross Sample Consistent With an Organized Thrombus

CASE 2

HISTORY OF PRESENTATION. A 42-year-old woman was admitted for evaluation of generalized weakness and fevers. On physical examination, she was noted to be neglecting the left side and found to have a heart murmur.

PAST MEDICAL HISTORY. There was no significant past medical history.

DIFFERENTIAL DIAGNOSIS. The differential diagnosis included infective endocarditis, noninfectious endocarditis, and intracardiac thrombus.

INVESTIGATIONS. Blood work showed a white blood cell count of 15.7 × 103/μL, and blood cultures tested positive for methicillin-sensitive *Staphylococcus aureus*. Computed tomography showed multiorgan infarcts, and magnetic resonance imaging of the brain showed acute right-sided ischemic stroke. A TTE showed a large mitral valve mass, with subsequent TEE showing a large oblong-shaped echocardiogram density attached to the base of the atrial side of the posterior leaflet measuring 1.7 × 4.4 cm with associated moderate mitral regurgitation (Video 3). A team approach with the neurologic and cardiothoracic surgical teams was undertaken. Given the patient's very high risk of hemorrhagic conversion with the recent stroke, open heart surgery was deemed high risk, and thus, medical treatment or a transcatheter debulking approach was recommended. After discussing the options with the patient, the decision was made to proceed with transcatheter extraction given the vegetation size.

MANAGEMENT. The procedure was performed under general anesthesia with fluoroscopy and TEE guidance. Standard access, cerebral protection (with one Sentinel [2 filters in the right brachiocephalic and right carotid] in addition to a balloon inflated in the left subclavian arteries), and a transseptal puncture were performed.[2] The F26 C180 large-bore manual aspiration device catheter was advanced to the left atrium using balloon-assisted tracking (Video 2). Serial aspirations were performed under TEE guidance with 95% removal of the mitral valve mass (Video 3). The mitral valve regurgitation remained unchanged. The pathology specimen was consistent with a vegetation (**Figure 2**).

OUTCOME AND FOLLOW-UP. The patient tolerated the procedure well. One month later, a TTE showed no evidence of the mass. The patient made appropriate functional gains and had no heart failure symptoms to necessitate interventions for the moderate mitral valve regurgitation.

CASE 3

HISTORY OF PRESENTATION. A 65-year-old woman was admitted to the hospital for acute-onset left-sided weakness and neglect. She was vitally stable. Physical examination revealed left-sided neurologic deficits.

PAST MEDICAL HISTORY. The patient's medical history included hypertension, depression, obesity, and mild aortic stenosis.

DIFFERENTIAL DIAGNOSIS. The differential diagnosis included acute stroke of embolic or nonembolic etiology, endocarditis, or venous thromboembolic disease.

INVESTIGATION. Blood work revealed a white blood cell count of 21.7 × 103/μL. Blood culture results remained negative. Brain imaging showed right-sided acute ischemic stroke. A TTE followed by TEE showed large mobile echocardiogram densities on both the anterior and posterior mitral valve leaflets with associated severe mitral regurgitation (Video 4). A team approach with the neurologic and cardiothoracic surgical teams was undertaken. Given her very high risk of hemorrhagic conversion with the recent stroke, open heart surgery was deemed high risk, and thus, medical treatment or a transcatheter debulking approach was recommended. After discussing the options with the patient, the decision was made to proceed with transcatheter extraction given the vegetation size.

MANAGEMENT. The procedure was performed under general anesthesia with fluoroscopy and TEE guidance. Standard access, cerebral protection, and a transseptal technique were performed.[2] The F26 C180 large-bore manual aspiration device catheter was advanced to the left atrium using balloon-assisted tracking. With the help of TEE, the mass was engaged and aspirated >90% of the mobile part (Video 4). Final TEE demonstrated baseline severe mitral regurgitation and successful debulking of the mass (Video 4). Residual anterior leaflet thickening was resistant to aspiration because of its ability to adhere to the leaflet. The pathology specimen (**Figure 3**) was consistent with a thrombus.

OUTCOME AND FOLLOW-UP. Postoperative TTE revealed no evidence of residual mass. An infectious workup found cell-free DNA positive for *Streptococcus anginosus*, for which the patient completed 6 weeks of intravenous antibiotics. The patient was discharged in stable condition.

FIGURE 2 Aspirated Mitral Valve Mass Vegetation Gross Sample

CASES 4 AND 5

HISTORY OF PRESENTATION. A 51-year-old woman was admitted to the hospital for evaluation of altered mental status. Physical examination revealed signs of right-sided neurologic deficits. She was tachycardic, with a heart rate of 107 beats/min, but otherwise vitally stable. The patient would continue to have recurrent embolic events despite optimal medical management, indicating aggressive disease.

PAST MEDICAL HISTORY. The patient's medical history included hyperlipidemia, former smoking with a 30-pack-year history, and prediabetes.

FIGURE 3 Aspirated Anterior and Posterior Mitral Valve Leaflet Vegetation Gross Sample Consistent With a Thrombus

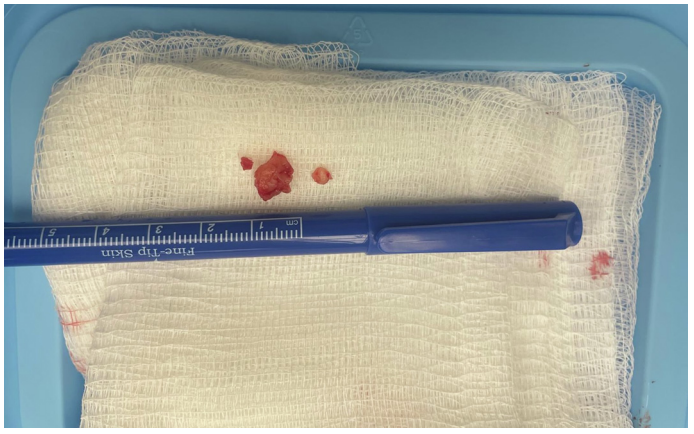
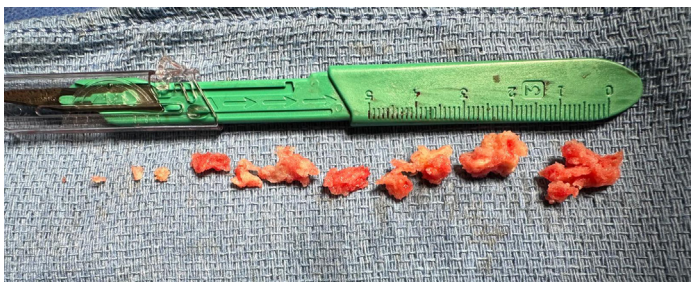


FIGURE 4 Aspirated Anterior and Posterior Mitral Valve Leaflet Vegetation Gross Sample Consistent With a Thrombus

DIFFERENTIAL DIAGNOSIS. The differential diagnosis included intracardiac mass, thrombus, or endocarditis and a large venous-embolic disease with an intracardiac shunt.

INVESTIGATIONS. Blood work results were significant for elevated inflammatory markers but normal white blood cell count. High-sensitivity troponin was elevated at 1,134 ng/L. Blood culture results remained negative. Imaging studies showed multiple organ infarcts consistent with an embolic phenomenon. TTE, followed by TEE, showed a mobile echocardiogram density measuring 1.03 cm on the anterior mitral valve leaflet and another small subcentimeter echocardiogram density on the tips of the posterior mitral valve leaflet with associated moderate-severe mitral regurgitation (Video 5). A team approach with the neurologic and cardiothoracic surgical teams was undertaken. Given her very high risk of hemorrhagic conversion with the recent and recurrent strokes, open heart surgery was deemed high risk, and thus, medical treatment or a transcatheter debulking approach was recommended. After discussing the options with the patient, the decision was made to proceed with transcatheter extraction, given the aggressive embolic nature of her vegetation and the active cancer status.

FIGURE 5 Aspirated Anterior and Posterior Mitral Valve Leaflet Vegetation Gross Sample Consistent With Marantic Noninfective Thrombus



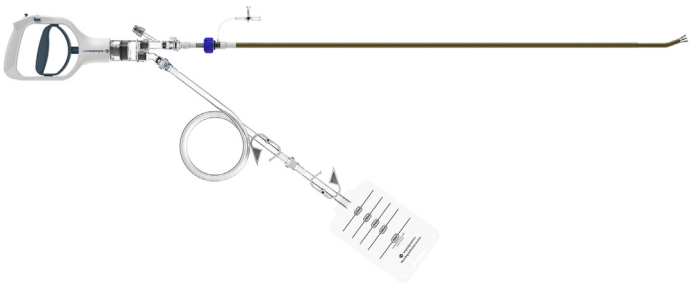
MANAGEMENT. The procedure was performed under general anesthesia with fluoroscopy and TEE guidance. Standard access, cerebral protection (with one Sentinel [2 filters in the right brachiocephalic and right carotid] in addition to a balloon inflated in the left subclavian arteries), and a transseptal puncture were performed.[1] The F26 C180 large-bore manual aspiration device catheter was advanced to the left atrium using balloon-assisted tracking. With the help of TEE, the mitral valve mass was engaged, and >95% of the mass was aspirated (Video 5). The final TEE demonstrated successful debulking of the mass and improved mitral regurgitation to trace from severe at baseline (Video 5). The pathology specimen (**Figure 4**) was consistent with a thrombus, with the final diagnosis being marantic noninfective thrombotic endocarditis. With continued workup, the patient was found to have metastatic lung adenocarcinoma following a lymph node biopsy and was discharged on therapeutic low-molecular-weight heparin (enoxaparin).

OUTCOME AND FOLLOW-UP. The patient had an uneventful hospital course and tolerated inpatient rehabilitation. Plans were made to follow up with the oncology team to start chemotherapy, but she had not started yet. Upon discharge from inpatient rehabilitation, the team decided (against our recommendation) to switch the patient to apixaban for long-term anticoagulation management. On follow-up in the clinic 1 month after the procedure, the patient was noted to have signs of worsening digital and toe ischemic changes suggestive of an embolic process and was instructed to present to the emergency department for further evaluation. She was afebrile but tachycardic. Blood work revealed an elevated white blood cell count. Repeat TTE showed recurrent but multiple large mitral valve echocardiogram densities involving the anterior and posterior leaflets with associated severe mitral valve regurgitation (Video 6).

She underwent repeat transcatheter vegetation aspiration and debulking with improved mitral valve regurgitation to moderate from severe (Video 6). The pathology specimen was consistent with a thrombus, with the final diagnosis of marantic noninfective thrombotic endocarditis (Figure 5).

She tolerated the procedure and was discharged on enoxaparin with plans to follow up with the oncology team for treatment of underlying lung cancer. She underwent repeat TTE a few months later and showed persistent moderate mitral valve regurgitation (without signs of heart failure) with no apparent vegetation and resolving physical signs of embolic disease.

FIGURE 6 The AlphaVac System



Adapted from https://www.alpha-vac.com.

DISCUSSION

Left-sided intracardiac mass debulking is an off-label procedure that has gained popularity over the last few years, with the first case series published using the AngioVac system.[1,2] Circuit-connected continuous-flow devices are commonly used for such left atrial masses. The AlphaVac system (AngioDynamics) uses cannulas comparable to those used in the AngioVac system (AngioDynamics) but omits the need for a continuous circuit component, which improves the efficiency of the procedure and obviates the need for another large-bore access (Figure 6). A comparison of available off-label devices for left-sided mechanical aspiration is shown in Table 1. Notably, the large-bore manual aspiration device system reduces the risk of accidental air introduction and offers a safer aspiration mechanism with instantaneous suction, minimizing the vacuum effect on delicate cardiac structures while maintaining strong suction. Unlike the AlphaVac, the AngioVac's continuous aspiration is beneficial for high mass burden, potentially decreasing embolism risk during catheter manipulation in the left heart. Because each device has pros and cons, further comparative studies are needed.

Over the past several years, transcatheter procedures targeting left-sided cardiac structures via the transseptal approach have advanced significantly, broadening the spectrum of transcatheter structural heart interventions.[3] The literature documents the utility of the AngioVac device system for the mechanical aspiration of thrombi in the left-sided cardiac chambers.[4-6] This report demonstrates the utility of the large-bore manual aspiration device system for

TABLE 1 Comparison of Commercially Available (Off-Label) Devices for Left-Sided Mass Extraction Procedures

Device	Number of Access Sites Needed	Location of Access Site(s)	Aspiration Mechanism	Advantages	Disadvantages	Steerability
AngioVac F18 or F22 (AngioDynamics)	2	For LA aspirations: V-V setup For aortic aspirations: A-V setup For LV: either	Continuous suction via pump (ECMO)	Strong continuous aspiration Lower embolic risk Less blood loss	Need for perfusionist in room More than 1 access site	++
AlphaVac F18 or F22 (AngioDynamics)	1	For LA aspirations: 1 venous access For aortic/LV aspirations: 1 arterial access	Handle manual aspiration	Single access More efficient procedure Easy to operate No need for perfusion in room	Only aspiration when manually operated No automatic blood return (need for filtering blood and returning manually)	++
Penumbra Lightning 12 or 16	1	For LA aspirations: 1 venous access For aortic/LV aspirations: 1 arterial access	Engine-mediated aspirations	Single access, More efficient procedure Easy to operate No need for perfusion in room	No automatic blood return and likely inability to return blood even manually Smaller size Need for a steerable sheath	+++ (with steerable sheath)

ECMO = extracorporeal membrane oxygenation; LA = left atrium; LV = left ventricle; V-A = venoarterial; V-V = venovenous.

TABLE 2 Patient Demographic Characteristics, Case Presentations, and Outcomes

	Case 1	Case 2	Case 3	Cases 4 and 5
Age, y	75	42	65	51
Sex	Female	Female	Female	Female
History of intravenous drug abuse	No	No	No	No
Location of vegetation	Left atrial appendage	Posterior mitral valve leaflet	Anterior and posterior mitral valve leaflets	Anterior and posterior mitral valve leaflets
Size of vegetation, cm	2.8 × 1.8	1.7 × 4.4	1.9 × 1.4	1.03
Blood culture results	Negative	MSSA	Negative	Negative
Distant embolization	Distal extremities	Cerebral/pulmonary	Cerebral	Cerebral/pulmonary/liver/spleen
Indication for procedure	High surgical risk	High risk of stroke hemorrhagic conversion	High risk of stroke hemorrhagic conversion	Hemorrhagic conversion of recent and recurrent strokes
Procedural complications	None	None	None	None
Microscopic evaluation	Organized thrombus with no white blood cells	Bacterial colonies embedded within fibrinous exudate, consistent with infectious vegetation	Organized thrombus	Marantic noninfective thrombotic endocarditis
Aspirated sample culture findings	Negative	Not sent	*Streptococcus anginous*	Not sent
Blood loss, mL	~200	~200	~200	~200
Outcome	Discharged on full-dose anticoagulation	Discharged to inpatient rehabilitation	Discharged to subacute rehabilitation	Discharged to inpatient rehabilitation Found to have recurrent vegetations on follow-up echocardiogram status post-repeat transcatheter vegetation aspiration and debulking with no complications

MSSA = methicillin-sensitive *Staphylococcus aureus*.

select patients. For our institution, the criteria for left-sided mass extraction are as follows: 1) a high risk associated with surgical intervention; 2) the presence of a mass causing embolic events, valvular damage, or persistent sepsis unresponsive to medical treatment or that is of considerable size (>1-2 cm); and 3) the necessity for diagnostic information if the preceding criteria are not satisfied. From a single-center safety perspective, each patient underwent a thorough discussion with the neurology/neurosurgery team, explicitly addressing the risk of hemorrhagic conversion. We posit that the lower doses of heparin boluses administered in our procedures (compared to those used in open heart surgery) significantly reduce the risk of hemorrhagic conversion. Notably, in our experience with more than 30 cases (not all involving the large-bore manual aspiration device system), we had no instances of conversion. Our protocol mandates a minimum 1-week interval following the most recent stroke, with repeat imaging performed before the procedure. From this report's perspective, our experience was successful with all 4 patients, with no immediate postoperative complications (Table 2). In addition, this option was feasible for recurrent vegetations, as demonstrated in case 4. To our knowledge, this is the first case series on using the large-bore manual aspiration device for debulking intracardiac left-sided masses and valvular vegetations with excellent efficacy and safety, although with a small sample size, illustrating its utility for the aspiration of large left-sided masses and valvular vegetations.

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

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KEY WORDS **AlphaVac, large-bore manual aspiration device, left atrial thrombus, thrombectomy, transseptal, valvular vegetation**

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