CASE REPORTS

CATHETER-BASED ASPIRATION OF A LARGE SUPERIOR VENA CAVA MASS IN A PATIENT WITH ENDOCARDITIS

Alexandra Kats[1], Matthew Bocchese[2], Sabrina Islam[2], Vladimir Lakhter[2], Suyog Mokashi*[3]

[1] Lewis Katz School of Medicine, Temple University Hospital, Philadelphia, Pennsylvania
[2] Division of Cardiology, Temple University Hospital, Philadelphia, Pennsylvania
[3] Division of Cardiovascular Surgery, Temple University Hospital, Philadelphia, Pennsylvania

* **Corresponding author:** suyog.mokashi@tuhs.temple.edu

Abstract

Infective endocarditis carries a high risk of morbidity and mortality with recurrent infections and non-compliance. In the case of right-sided endocarditis, the indications for intervention are less clear. The Angiovac procedure provides a treatment for right-sided endocarditis that is a less-invasive and ideal for a complicated patient population.

Keywords: *infective endocarditis, angiovac*

INTRODUCTION

Infective endocarditis (IE) carries a high risk of morbidity and mortality despite advances in treatment.[1] While many infectious organisms can cause IE, Staph aureus is the most common organism identified.[1] IE is managed with targeted antimicrobial therapy and, possibly, surgery in the appropriate patients. Data on the role of surgery in IE has been limited with only one randomized controlled trial of 76 patients.[2] Classically, surgical indications for IE include: left-sided vegetation greater than 10 mm in size, heart failure, persistent bacteremia, infection with highly resistant organisms, and the presence of an associated abscess.[1] The 10 mm size intervention indication for endocarditis is specific to left-sided vegetations. For the right-sided vegetations, there are no set guidelines given the lower risk of pulmonary embolism than systemic embolization.

Complicating matters further, surgical indications for right-sided IE are even less clear. Right-sided valvular endocarditis, specifically tricuspid valve endocarditis, affects 5-10% of all infective endocarditis cases. Risk factors include rheumatic heart disease, intravenous dug users (majority of cases), indwelling catheters, pacemakers/defibrillators and congenital heart disease.

Because right-sided IE is typically seen in patients who inject drugs (PWID), this poses a complex clinical situation. There is uncertainty regarding medical treatment and significant social factors. Social factors include concern for medication adherence, continued drugs, repeat bouts of endocarditis, and immediate post-operative issues such as pain control and wound healing.[3] Identifying and eliminating barriers to appropriate medical treatment and creating a comprehensive medical and surgical plan for substance use treatment are the focus of multidisciplinary endocarditis teams.[4] These typically comprise members from infectious disease, cardiology, cardiovascular surgery, addiction medicine, and social work, among others.

We present the case of a patient with a history of tricuspid valve (TV) endocarditis with a prior repair and subsequent TV replacement who presented with prosthetic TV endocarditis. The patient was discussed among the multidisciplinary endocarditis team. The salient issues were ongoing drug abuse, two prior sternotomies, and overall young age. Ultimately, the patient was referred for a minimally invasive debulking of her vegetations with the Angiovac system (Angiodynamics, Latham, NY).[5] This allowed for a percutaneous aspiration of infected material to facilitate antibiotic therapy.

CLINICAL CASE

A 41-year-old female with a past medical history of opiate use disorder (OUD) with injection behavior, prior TV endocarditis status post TV replacement (31 mm Epic valve) complicated by complete heart block status post leadless pacemaker implantation, heart failure with reduced ejection fraction (40-45%), and end-stage renal disease on hemodialysis was admitted to a quaternary academic hospital with new facial swelling and hypervolemia from missed dialysis sessions. The patient had long-standing renal failure on dialysis for several years. History of IV drug abuse prohibited renal transplant. Initial workup was notable for hyperkalemia and pulmonary edema on chest x-ray, consistent with her missed dialysis. Laboratory values revealed slight leukocytosis and thus blood cultures were sent. Culture were noted

to be positive for Methicillin-Resistance Staphylococcus aureus. She was initially started on vancomycin and later transitioned to ceftaroline and daptomycin.

Given the concern for prosthetic valve endocarditis, a transthoracic echocardiogram (TTE) was performed showing normal LV size, LVEF 40%, normal RV size and function, mild-moderate tricuspid regurgitation (TR) and severely elevated prosthetic gradient of 12 mmHg at a heart rate of 90 beats per minute. A subsequent transesophageal echo (TEE) showed severe eccentric TR, an elevated prosthetic gradient, and a 3.6 mm mass on the anterior leaflet of the prosthetic TV. Most concerningly, there was a large mass extending from the SVC into the right atrium and prolapsing through the prosthetic TV, consistent with vegetation or thrombus. Although her prosthetic TV was dysfunctional with an adherent vegetation, the immediate concern was the embolization of the SVC mass leading to a significant pulmonary embolism. The etiology of the prosthetic TV degeneration is unknown. Possible causes included failure to adhere to anti-platelet medication (aspirin only as coumadin would be contra-indicated given the social history), infection or thrombus.

Cardiovascular surgery was deemed too high-risk (renal failure, prior sternotomies, and ongoing drug use). Therefore, the patient underwent an AngioVac embolectomy (Figure 1). The AngioVac cannula aspiration system was approved by the US Food and Drug Administration in 2009. The basic premise is a suction (inflow) cannula and a reperfusion (outflow) cannula that are both connected to an extracorporeal bypass circuit. The suction cannula is funnel-shaped and when the bypass pump is started, negative pressure drives blood from the inflow cannula to a filter. The filter removes debris and the filtered blood is then returned to the patient via the reperfusion cannula to the femoral vein. However, given the friable nature of endocarditis we felt the suction would allow greater vegetation debridement.

In the cardiac catheterization lab, after intubation, bilateral femoral venous access and femoral cannulation were performed. The SVC mass was localized using a combination of TEE and fluoroscopic guidance. Next, the vegetation was aspirated using the veno-venous extracorporeal membrane oxygenation (V-V ECMO) circuit (Figure 3). The SVC debulked with minimal residual mass (Figures 4 and 5). Of note, the prosthetic TV stenosis and regurgitation were unchanged at the conclusion of the case. Despite the risk of leaflet injury with the AngioVac device, this was not seen. The patient recovered well from the procedure and was discharged on 6 total weeks of IV antibiotic therapy with daptomycin and single-agent anti-platelet therapy. While guidelines would recommend dual anti-platelet therapy in setting of failed first anticoagulation therapy failed, but the high risk social behavior made dual anti-platelet therapy not practical.[1] The patient was discharged to rehabilitation facility to complete her antibiotic course. The final pathology demonstrated Staphylococcus aureus and thrombus. The management for the persistent tricuspid regurgitation was medical management and antibiotics, with plan for surgical intervention after drug rehabilitation. While the risk of prosthetic valve infection would still remain high after a second surgery, given the renal failure and high risk social behavior, unfortunately transcatheter tricuspid valve replacement would not be a good option in this patient.

Inevitably, the valve will need replacement, however. The patient became lost to follow-up, which is not always surprising as substance abuse patients are often lost to follow-up.

DISCUSSION

Right-sided IE poses a challenge for clinicians, particularly in PWID where the benefits of surgery are unclear and the perioperative and post-procedural risks are particularly elevated.[3,6] Whereas left-sided IE can lead to systemic embolization, right-sided IE does not. Thus, surgery for right-sided IE has few indications. Along these lines, the Angiovac system presents a reasonable approach to endocarditis. Angiovac is a percutaneous mechanical aspiration system that aspirates vegetations by being paired with an extracorporeal bypass circuit (Figures 1 and 2).[7] The result is significant—albeit not complete—removal of the infectious source, leaving remaining infections that can effectively be managed with antibiotics (Figures 4 and 5). This helps accomplish the objective of obtaining source control by improving the effectiveness of antibiotics, without the negative effects of recurrent surgery.

As for any procedure, choosing the appropriate patients is of the utmost importance as this does carry risks of its own including vascular complications, cardiac injury, and disruption of the valvular apparatus. To select patients who would benefit from this, a multidisciplinary discussion among the members of the endocarditis team is paramount. Members provide expertise in their discipline to take care of the patient in a comprehensive manner. The development of multidisciplinary endocarditis teams has become a widespread trend and has been associated with better outcomes for patients.[9] The AngioVac system has two clear advantages: the funnel is designed for vegetations and the cannula is steerable. While the AngioVac system in this case used extra-corporeal membrane oxygenation, newer devices use a suction funnel. Alternatively, the FlowTriever (Inari Medical, Irvine, California, USA) system used for pulmonary embolism could be used.

In this patient, a large burden of infected thrombus was removed to obtain source control and increase the success of medical therapy. The exact benefit of this intervention is unclear, and there are no randomized controlled trials to date studying this. There are several reports in the literature of successful use AngioVac for debulking large right-sided tricuspid valve vegetations.[10,11] George et al. reviewed 33 patients with TV endocarditis treated with AngioVac.[10,12] The average vegetation size decreased from 2.1 cm (pre-procedure) to 0.82 cm (post-procedure) on echocardiography; a 61% average reduction in vegetation size.[10,12] Impressively, all patients in the study survived the procedure, and stunning 90.9% survived the hospitalization with no further reinfection.[10,12]

Identifying patient factors and vegetation characteristics that make it more likely for a patient to benefit from an AngioVac procedure should be the focus of further research. This would allow a medically and socially complex patient population to receive appropriate care with a minimally invasive approach to avoid the risks and consequences of surgery.

There are several problems with substance abuse patients

and endocarditis, two in particular are relapse and lack of effective long-term secondary prevention strategies. Substance abuse can be thought of as a "chronically relapsing condition," as stated by Ramo and Witkiewitz.[13,14] Up to two thirds and four fifths of both adults and adolescents begin to use again in 6 months after community- or hospital-based treatment.[14] Hospital clinicians are tasked with managing the infection, which is short-term management. Unfortunately, patients with substance abuse have relapse. Critical aspects of endocarditis are harm reduction, substance use disorder treatment, and primary care, but yet our system exclusively focuses on inpatient management.[15]

Long-term, practical, solutions are needed to treat endocarditis which involve collaboration from clinicians, social workers and policymakers.

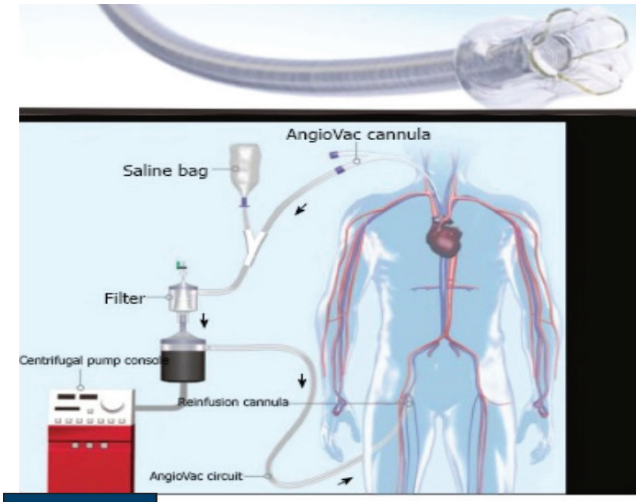

Figure 1 *Angiovac Circuit Illustration: Reproduced from: Nosher JL, Patel A, Jagpal S, Gribbin C, Gendel V. Endovascular treatment of pulmonary embolism: Selective review of available techniques. World J Radiol. 2017 Dec 28;9(12):426-437. doi: 10.4329/wjr.v9.i12.426. PMID: 29354208; PMCID: PMC5746646.*

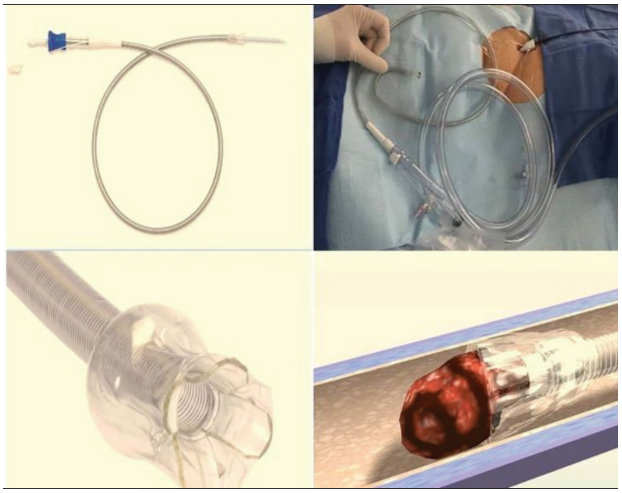

Figure 2 *The Angiovac funnel and thrombus retrieval. Divekar AA, Scholz T, Fernandez JD. Novel percutaneous transcatheter intervention for refractory active endocarditis as a bridge to surgery-angiovac aspiration system. Catheter Cardiovasc Interv. 2013;81(6):1008-1012.*

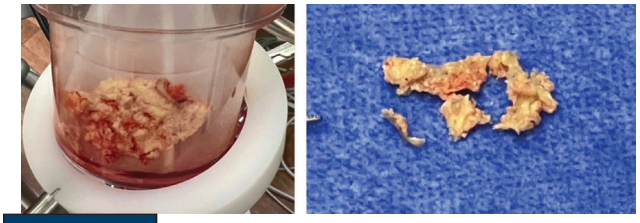

Figure 3 *Debulked SVC thrombus using Angiovac.*

Figure 4 *Initial SVC thrombus on transesophageal echocardiogram.*

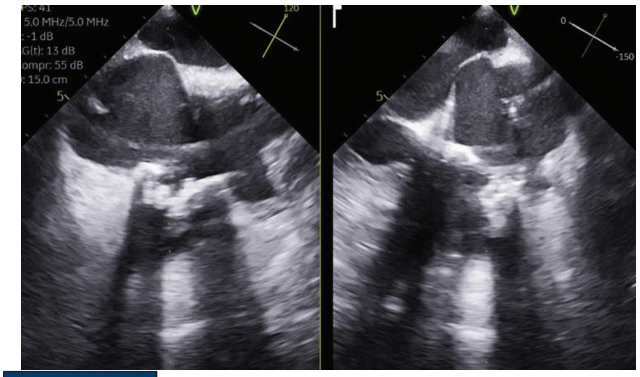

Figure 5 *Transesophageal echocardiogram image after Angiovac debulking.*

REFERENCES

1. Baddour LM, Wilson WR, Bayer AS, Fowler VG Jr, Tleyjeh IM, Rybak MJ, Barsic B, Lockhart PB, Gewitz MH, Levison ME, Bolger AF, Steckelberg JM, Baltimore RS, Fink AM, O'Gara P, Taubert KA; American Heart Association Committee on Rheumatic Fever, Endocarditis, and Kawasaki Disease of the Council on Cardiovascular Disease in the Young, Council on Clinical Cardiology, Council on Cardiovascular Surgery and Anesthesia, and Stroke Council. Infective Endocarditis in Adults: Diagnosis, Antimicrobial Therapy, and Management of Complications: A Scientific Statement for Healthcare Professionals From the American Heart Association. Circulation. 2015 Oct 13;132(15):1435-86. doi: 10.1161/CIR.0000000000000296. PMID: 26373316.
2. Kang DH, Kim YJ, Kim SH, Sun BJ, Kim DH, Yun SC, Song JM, Choo SJ, Chung CH, Song JK, Lee JW, Sohn DW. Early surgery versus conventional treatment for infective endocarditis. N Engl J Med. 2012 Jun 28;366(26):2466-73. doi: 10.1056/NEJMoa1112843. PMID: 22738096.
3. Baddour LM, Weimer MB, Wurcel AG, McElhinney DB, Marks LR, Fanucchi LC, Esquer Garrigos Z, Pettersson GB, DeSimone DC; American Heart Association Rheumatic Fever, Endocarditis and Kawasaki Disease Committee of the Council on Lifelong Congenital Heart Disease and Heart Health in the Young; Council on Cardiovascular Surgery and Anesthesia; Council on Cardiovascular and Stroke Nursing; Council on Clinical Cardiology; and Council on Peripheral Vascular Disease. Management of Infective Endocarditis in People Who Inject Drugs: A Scientific Statement From the American Heart Association. Circulation. 2022 Oct 4;146(14):e187-e201. doi: 10.1161/CIR.0000000000001090. Epub 2022 Aug 31. PMID: 36043414.
4. Delgado V, Ajmone Marsan N, de Waha S, Bonaros N, Brida M, Burri H, Caselli S, Doenst T, Ederhy S, Erba PA, Foldager D, Fosbøl EL, Kovac J, Mestres CA, Miller OI, Miro JM, Pazdernik M, Pizzi MN, Quintana E, Rasmussen TB, Ristić AD, Rodés-Cabau J, Sionis A, Zühlke LJ, Borger MA; ESC Scientific Document Group. 2023 ESC Guidelines for the management of endocarditis. Eur Heart J. 2023 Oct 14;44(39):3948-4042. doi: 10.1093/eurheartj/ehad193. PMID: 37622656.
5. AngioDynamics. (2024, May 6). Global leader in vascular & oncology medical devices | AngioDynamics. https://www.angiodynamics.com/
6. Witten JC, Hussain ST, Shrestha NK, Gordon SM, Houghtaling PL, Bakaeen FG, Griffin B, Blackstone EH, Pettersson GB. Surgical treatment of right-sided infective endocarditis. J Thorac Cardiovasc Surg. 2019 Apr;157(4):1418-1427.e14. doi: 10.1016/j.jtcvs.2018.07.112. Epub 2018 Sep 25. PMID: 30503743.
7. Hameed I, Lau C, Khan FM, Wingo M, Rahouma M, Leonard JR, Di Franco A, Worku BM, Salemi A, Girardi LN, Gaudino M. AngioVac for extraction of venous thromboses and endocardial vegetations: A meta-analysis. J Card Surg. 2019 Apr;34(4):170-180. doi: 10.1111/jocs.14009. Epub 2019 Mar 6. PMID: 30843269.
8. Lane CM, El Sabbagh A, Alkhouli MA. Transseptal Debulking of Mitral Valve Endocarditis Using On-Circuit Aspiration Thrombectomy System and Multimodal Embolic Protection. JACC Cardiovasc Interv. 2023 Sep 25;16(18):2324-2326. doi: 10.1016/j.jcin.2023.07.021. Epub 2023 Aug 23. PMID: 37632477.
9. El-Dalati S, Cronin D, Riddell J 4th, Shea M, Weinberg RL, Washer L, Stoneman E, Perry DA, Bradley S, Burke J, Murali S, Fagan C, Chanderraj R, Christine P, Patel T, Ressler K, Fukuhara S, Romano M, Yang B, Deeb GM. The Clinical Impact of Implementation of a Multidisciplinary Endocarditis Team. Ann Thorac Surg. 2022 Jan;113(1):118-124. doi: 10.1016/j.athoracsur.2021.02.027. Epub 2021 Mar 1. PMID: 33662308.
10. Abubakar H, Rashed A, Subahi A, Yassin AS, Shokr M, Elder M. AngioVac System Used for Vegetation Debulking in a Patient with Tricuspid Valve Endocarditis: A Case Report and Review of the Literature. Case Rep Cardiol. 2017;2017:1923505. doi:10.1155/2017/1923505
11. Divekar AA, Scholz T, Fernandez JD. Novel percutaneous transcatheter intervention for refractory active endocarditis as a bridge to surgery-angiovac aspiration system. Catheter Cardiovasc Interv. 2013;81(6):1008-1012. doi:10.1002/ccd.24593
12. George B., Voelkel A., Kotter J., Leventhal A., Gurley J. A novel approach to percutaneous removal of large tricuspid valve vegetations using suction filtration and veno-venous bypass: a single center experience. Catheterization and Cardiovascular Interventions. 2017 doi: 10.1002/ccd.27097.
13. Witkiewitz, K., & Marlatt, G. A. (2004). Relapse prevention for alcohol and drug problems: That was Zen, this is Tao. American Psychologist, 59, 224 –235.
14. Ramo DE, Brown SA. Classes of substance abuse relapse situations: A comparison of adolescents and adults. Psychology of Addictive Behaviors. 2008;22(3):372-379. doi:10.1037/0893-164X.22.3.372.
15. At the Cusp — Reimagining Infective Endocarditis Care amid the Opioid Epidemic. N Engl J Med. 2021;384(4):297-299. doi:https://doi.org/10.1056/NEJMp2032066.