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CASE REPORT

ADVANCED

CLINICAL CASE

Using Aspiration-Based Tricuspid Valve Endocarditis Debridement

Highlighting Imaging-Based Modification in a High-Risk Clinical Scenario

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ABSTRACT

This report describes a high-risk case of tricuspid valve endocarditis secondary to intravenous drug abuse. Information gleaned from intraoperative transesophageal echocardiographic imaging and real-time measurements was used to effectively modify procedural hardware and successfully treat the patient using an aspiration-based strategy. (**Level of Difficulty: Advanced.**) (J Am Coll Cardiol Case Rep 2019;1:742–5) © 2019 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 28-year-old man presented to the hospital in February 2019 with endocarditis and florid sepsis. Evaluation revealed confusion, hypotension, tachycardia, tachypnea, hyponatremia, acute kidney injury, and concurrent thrombotic thrombocytopenic purpura. Echocardiography revealed the presence of a large tricuspid vegetation resulting in severe tricuspid valve regurgitation.

LEARNING OBJECTIVES

- IVDA is a major risk factor for developing IE, and its incidence is rising.
- Aspiration-based therapy may be an adjunctive therapy in certain patient subpopulations.
- Three-dimensional TEE and derived angular measurements allowed the use of aspiration-based therapy, which was used to treat tricuspid valve endocarditis as an alternative to very high-risk open-heart surgery.

PAST MEDICAL HISTORY

The patient had a history of active intravenous drug abuse (IVDA) of heroin and hepatitis C. Prior to presentation, the patient had a several-week history of fever, cough, dyspnea, nausea, vomiting, diarrhea, and arthralgias.

DIFFERENTIAL DIAGNOSIS

In this young septic patient with a history of IVDA, the differential diagnoses included complicated pneumonia, rheumatologic or infectious vasculitis, and bacterial meningitis.

INVESTIGATIONS

The patient's pre-operative transesophageal echocardiography (TEE) revealed severe tricuspid regurgitation and a large mobile vegetation predominantly over the posterior valve leaflet (4.2 × 1.8 cm) near the posterior annulus of the valve (Videos 1, 2, and 3).

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Informed consent was obtained for this case.

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Right ventricular systolic pressure was estimated to be 30 to 35 mm Hg. The right ventricular cavity was mildly enlarged. Blood cultures grew methicillin-sensitive *Staphylococcus aureus* (4 of 4 blood culture samples).

MANAGEMENT

Despite antibiotic treatment with intravenous vancomycin and ongoing supportive therapy, the patient continued to be septic, with no decrease in the bulk of the tricuspid vegetation over time. The patient required intubation because of worsening hypoxemia along with pressor support using norepinephrine. Open heart surgery and mechanical tricuspid valve replacement were considered, but the patient's clinical status translated to a very high risk for perioperative mortality. Hence, the decision to debride the vegetation using aspiration-based therapy was made.

The position of the vegetation on the tricuspid valve posed a challenge in that an approach from either the inferior or superior vena cava did not allow direct access to the vegetation. Using 3-dimensional (3D) TEE, the tricuspid vegetation was noted to have attachment on the posterior valve leaflet in close association with the posterior annulus abutting against the posterior wall of the right atrium, thereby making catheter access to the mass more difficult (Videos 4 and 5). Measurements were made using TEE of the angle (approximately 120°) from the superior vena cava to the point of maximum bulk of the tricuspid vegetation (**Figure 1**). An AngioVac straight catheter (Angiodynamics, Latham, New York) was bent to a 120° angle using heat derived from an industrial hot gun (Online Video 6). The catheter was then introduced using into the right internal jugular vein with a 24-F inlet sheath. Extensive debulking of the vegetation was performed with a suction time of <10 min (Videos 7, 8, and 9). Greater than 85% of the vegetation bulk was removed (Video 10, **Figure 2**). The AngioVac system was removed with no significant bleeding. The patient remained hemodynamically stable throughout the procedure, and no complications were noted.

ABBREVIATIONS AND ACRONYMS

3D = 3-dimensional

IE = infective endocarditis

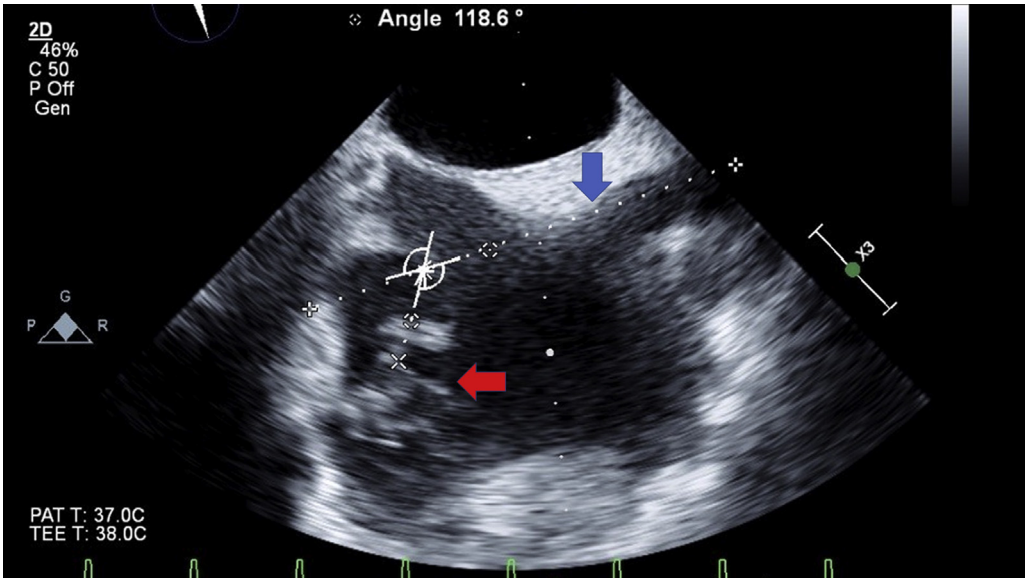
IVDA = intravenous drug abuse

TEE = transesophageal echocardiography

DISCUSSION

Within the United States, there are an estimated 10,000 to 15,000 cases of infective endocarditis (IE) each year (1). IVDA is a major risk factor for developing IE. Because of the current national opiate epidemic, the burden of IE in hospitals in the United States continues to rise. In the United States, IVDA association in IE cases increased from 15% to 29% between 2010 and 2015 (2).

FIGURE 1 Measurement of the Angle From the Ostium of the Superior Vena Cava and the Vegetation on the Posterior Valve Leaflet of the Tricuspid Valve



Measurement of the angle (118.6°) from the ostium of the superior vena cava (noted by a **blue arrow**) and the vegetation on the posterior valve leaflet of the tricuspid valve (noted by a **red arrow**).

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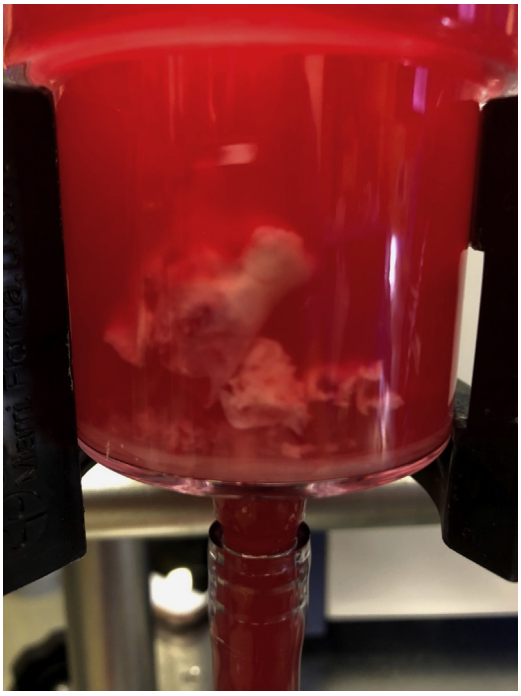
FIGURE 2 Vegetation Material Caught by the Reservoir of the AngioVac System



The current standard of care for IVDA-associated IE is the use of long-term antibiotic treatment, often requiring long-term intravenous access, and surgical intervention with the use of mechanical valve replacement. The surgical procedure is associated with high perioperative mortality in the setting of sepsis. Moreover, mechanical valves come with a higher propensity for reinfection than native valves. A study on repeat IE reported that 25.3% of patients with IVDA-associated IE who survived their first occurrence of IE experienced repeat IE. All of these patients reported intravenous drug use between IE episodes (3).

The use of an aspiration-based technique may be a viable alternative to the standard of care in the treatment of IE, which, in the current era, often leads to open heart surgery. Some plausible therapeutic mechanisms of the procedure are presented here. By debulking the vegetation, the microbial burden may rapidly lessen, as was noted in our patient. Disruption of organized, fibrotic vegetations, which in turn creates more surface area by which antimicrobials can interact with the mass, may also occur; this mechanism is similar to the effect of surgery-based infected wound debridement. Last, vegetation aspiration can improve valvular hemodynamic status by decreasing the bulk of the space occupying mass contributing to stenosis or regurgitation. Reports using this approach continue to accrue. In a recently published meta-analysis, observed outcomes with the use of the AngioVac catheter were studied. In the 81 vegetations treated with the catheter, a pooled event rate of 74.5 (95% confidence interval: 48.2 to 90.2) was noted for successful aspiration, with a lower morality rate than those converted to open surgery (pooled event rate: 14.6 [95% confidence interval: 7.7 to 25.8] vs. 25.0 [95% confidence interval: 9.3 to 51.9] for open surgery) (4). However, for these procedures to be performed well, intraoperative imaging is of utmost importance. Specifically, cases involving the tricuspid valve come with many imaging challenges, given its complexity and position, which render it less amendable for evaluation using standard transesophageal echocardiographic techniques.

In more challenging cases, manual alterations of nonsteerable catheters may be necessary. One such modifying technique is heat sculpting. Heat has been used to shape vascular catheters from the advent of invasive vascular imaging (5). Using the AngioVac catheter, a published case series describes 6 cases in which heat bending of the catheter was performed for either thrombectomy or valvular debridement, with favorable outcomes. No adverse events were noted secondary to heating and bending of the catheter (6). However, the technique described did not use imaging as a guide for specific angle sculpting and catheter modification, as was done in our case.

Traditionally, the use of TEE has been reserved for patients with overt bacteremia or, worse, septicemia. In addition, sensitivity (which should approach 100% with TEE) of detection may be lacking. Hence, training and widespread use of 3D TEE for detection of vegetation and therapeutic planning may be of great benefit. Particularly in cases in which prosthetic valves are in place, the use of 3D TEE has shown greater sensitivity toward detection (7). Moreover, complementary imaging modalities such as cardiac computed tomography and magnetic resonance imaging assist in better mass characterization and preprocedural planning.

FOLLOW-UP

Post-operative TEE revealed moderate to severe tricuspid regurgitation and a >85% reduction in vegetation size. The right ventricular ejection fraction was 55% to 60%, and right ventricular systolic pressure was estimated at 53 mm Hg. After aspiration therapy, the patient became afebrile within 48 h and

on day 10 was extubated. On post-operative day 18, he was discharged to a subacute rehabilitation center with continued intravenous vancomycin. In April 2019, severe tricuspid regurgitation was noted on subsequent echocardiography, and the patient was referred for mechanical tricuspid valve replacement, which was performed without perioperative complications.

CONCLUSIONS

The use of aspiration-based therapies for endocarditis in severely ill patients may have an important impact on overall morbidity and mortality. In this case, we were able to delay high-risk surgery for the sake of greater clinical stability and potentially lower in-hospital mortality. The use of 3D TEE and imaging measurements may be required for greater procedural success rates. Further prospective studies examining the role of aspiration-based therapies in this patient cohort as a means of improving outcomes may be warranted.

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KEY WORDS 3-dimensional imaging, endocarditis, tricuspid valve

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