Transesophageal Echocardiography–Guided Percutaneous Aspiration of a Large Tricuspid Valve Vegetation in a Patient with Infective Endocarditis

Alexander Stoker, MD, Andre Gosling, MD, Adam Williams, MD, Douglas Overbey, MD, MPH, Alina Nicoara, MD, FASE, and Angela Pollak, MD, FASE, *Durham, North Carolina*

INTRODUCTION

Right-sided infective endocarditis (IE) is less common than left-sided IE; however, it is more often associated with intravenous drug use (IVDU) and represents a significant number of IE cases in areas with higher IVDU incidence.[1]

For right-sided IE, surgical intervention is considered when large vegetations are present (>20 mm) and the patient has persistent fevers or bacteremia after 5 to 7 days of appropriate antimicrobial therapy or in cases where there is recurrent septic pulmonary embolism.[2,3] In patients with IVDU, the risk of reoperation after surgical intervention for IE is higher and the decision to intervene is complicated by concerns for recurrence and prosthetic valve endocarditis.[3-5] The use of a percutaneous, vacuum-assisted device for the removal of right-sided intracardiac masses has been described as a bridge to surgery and has been recommended when there is a contraindication to surgery.[6-8] The AngioVac (AngioDynamics, Latham, NY) transcatheter aspiration system consists of an extracorporeal circuit in a veno-venous configuration with an in-line filter capable of debulking tricuspid valve (TV) vegetations and reducing bacterial load so that antimicrobial therapy may be more effective. Here we present a case highlighting the perioperative considerations of a percutaneous approach to debulking a large TV vegetation while using transesophageal echocardiographic (TEE) guidance.

CASE PRESENTATION

A 43-year-old man with schizophrenia, asthma, and polysubstance use disorder with ongoing IVDU presented to our institution with fever, chills, and left-sided pleuritic chest pain. Three years prior to this presentation the patient had been admitted for methicillin-sensitive *Staphylococcus aureus* TV endocarditis and paraspinal abscess requiring percutaneous drainage and 6 weeks of intravenous antibiotic therapy. Upon arrival, he was febrile and tachycardic, although normotensive and with adequate oxygen saturation on room air. He was promptly started on intravenous antimicrobial therapy, and transthoracic

VIDEO HIGHLIGHTS

Video 1: Midesophageal 4-chamber view focused on the right ventricle (RV) demonstrating a vegetation measuring 32 × 26 mm attached to the TV, predominately at the septal and anterior leaflets.

Video 2: Three-dimensional data set of the TV seen en face from the right atrium showing a large vegetation on the TV.

Video 3: Midesophageal 4-chamber view focused on the right ventricle (RV) with color flow Doppler demonstrating mild TR around a TV vegetation.

Video 4: Midesophageal modified bicaval view demonstrating the AngioVac inflow cannula directed toward the TV vegetation.

Video 5: Midesophageal modified bicaval view demonstrating the tip of the AngioVac inflow cannula in contact with the mass attached to the TV during active cannula aspiration. Spontaneous contrast is seen entering the right heart from the inferior vena cava and was likely due to agitated blood from the return cannula of the extracorporeal circuit.

Video 6: Midesophageal modified bicaval view demonstrating significant debulking of the TV vegetation and the tip of the AngioVac cannula positioned near the TV.

Video 7: Midesophageal 4-chamber view focused on the right ventricle (RV) demonstrating significant reduction in size of the TV vegetation with residual vegetation component in the subvalvular apparatus of the TV.

Video 8: Three-dimensional data set of the TV as viewed from the right atrium showing successful debulking of the TV vegetation. Spontaneous contrast is seen in the right atrium and was likely due to agitated blood from the return cannula of the extracorporeal circuit.

Video 9: Midesophageal 4-chamber view focused on the right ventricle (RV) with color flow Doppler demonstrating moderate central TR after debulking of the TV vegetation.

View the video content online at www.cvcasejournal.com.

From the Department of Anesthesiology, Division of Cardiothoracic Anesthesiology (A.S., A.G., A.N., A.P.); and Department of Cardiothoracic Surgery (A.W., D.O.), Duke University, Durham, North Carolina.

Keywords: Transesophageal echocardiography, Right-sided infective endocarditis, Tricuspid valve vegetation, AngioVac

Conflicts of Interest: None.

Correspondence: Alexander Stoker, MD, Cardiothoracic Anesthesiology Duke University Medical Center, 2301 Erwin Road, Durham, North Carolina, 27710 (E-mail: *Stoker.alexander@mayo.edu*).

2468-6441

https://doi.org/10.1016/j.case.2022.04.006

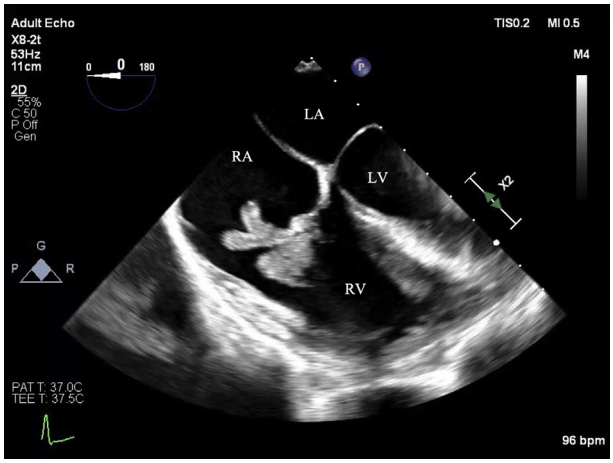

Figure 1 Midesophageal 4-chamber view focused on the right ventricle (RV) in systole demonstrating a mass measuring 32 × 26 mm attached to the TV, predominately at the septal and anterior leaflets. See Video 1. *LA*, Left atrium; *LV*, left ventricle; *RA*, right atrium.

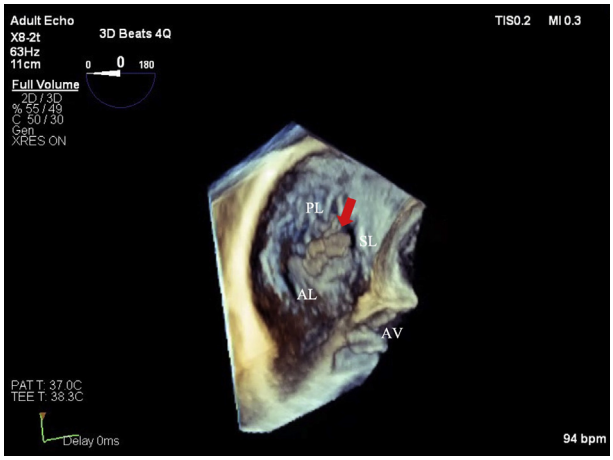

Figure 2 Three-dimensional data set of the TV seen en face from the right atrium in systole showing a large mass on the TV *(red arrow)*. See Video 2. *AL*, Anterior leaflet; *AV*, aortic valve; *PL*, posterior leaflet; *SL*, septal leaflet.

echocardiography was performed, which revealed a 30-mm mobile mass on the TV consistent with a vegetation. The patient was evaluated by a multidisciplinary heart valve team according to recommendations by the American College of Cardiology and American Heart Association for the management of patients with valvular heart disease.[9] The patient's care was provided by a multispecialty team including psychiatry and specialized social work to manage his schizophrenia and substance use disorder. Despite 7 days of appropriate antimicrobial therapy, the patient continued to be febrile and have positive blood cultures. Repeat computed tomography scans of his chest demonstrated ongoing septic pulmonary emboli. Tricuspid valve replacement was offered; however, the patient refused an open surgical procedure. The decision was made to debulk the TV vegetation using a percutaneous vacuum-assisted device, for which consent was obtained from the patient.

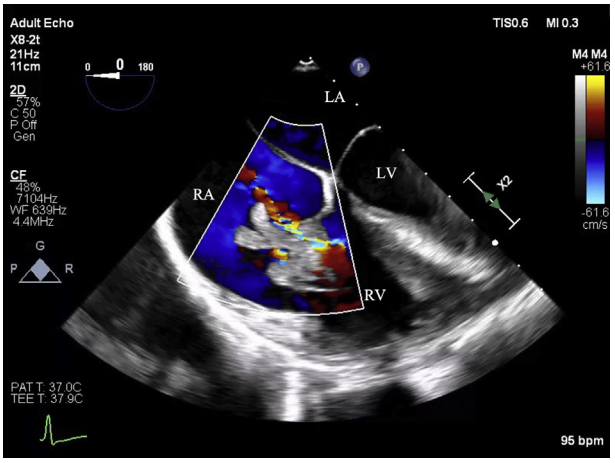

Figure 3 Midesophageal 4-chamber view focused on the right ventricle (RV) in systole with color flow Doppler demonstrating mild TR around a mass attached to the TV. See Video 3. *LA*, Left atrium; *LV*, left ventricle; *RA*, right atrium.

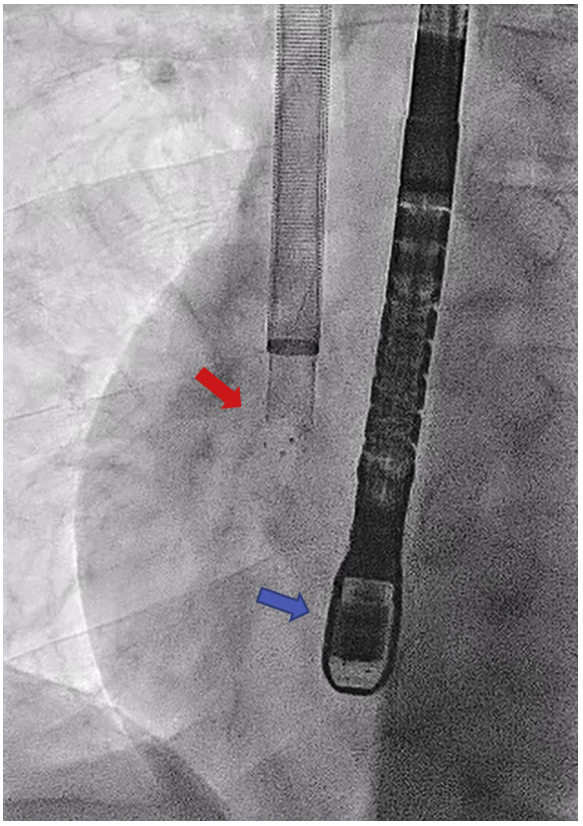

Figure 4 Fluoroscopic image demonstrating the relative position of the AngioVac inflow cannula *(red arrow)* approaching from the right internal jugular vein and TEE probe *(blue arrow)* in the ME position.

The patient was taken to a hybrid operating room and underwent general anesthesia with an endotracheal tube. A left-sided central venous catheter was placed for possible volume and hemodynamic resuscitation. The procedure was performed under TEE guidance.

Intraoperative preprocedural TEE imaging confirmed a vegetation measuring 32 × 26 mm attached to the septal and anterior leaflets of

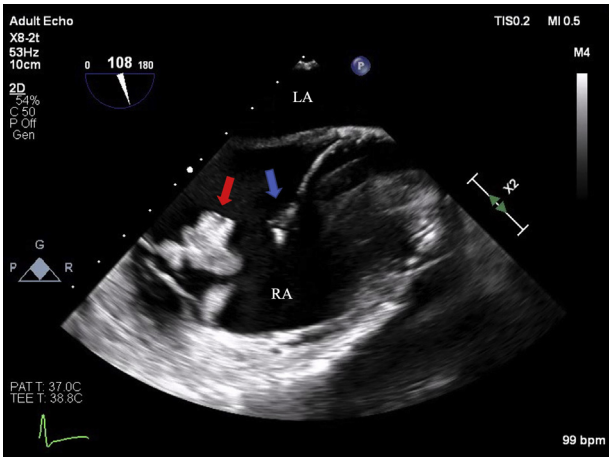

Figure 5 Midesophageal modified bicaval view in systole demonstrating the AngioVac inflow cannula *(blue arrow)* directed toward the TV mass *(red arrow)*. See Video 4. *LA*, Left atrium; *RA*, right atrium.

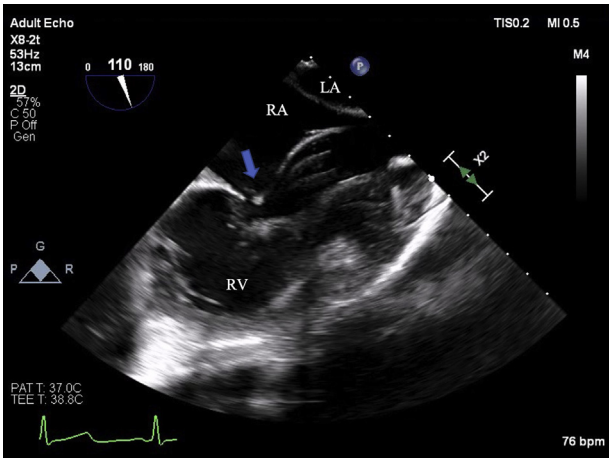

Figure 7 Midesophageal modified bicaval view in systole demonstrating significant debulking of the TV mass and the tip of the AngioVac cannula *(blue arrow)* positioned near the TV. See Video 6. *LA*, Left atrium; *RA*, right atrium; *RV*, right ventricle.

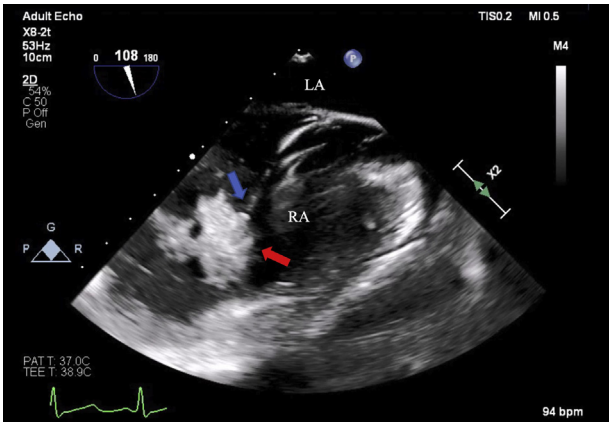

Figure 6 Midesophageal modified bicaval view in systole demonstrating the tip of the AngioVac inflow cannula *(blue arrow)* in contact with the mass *(red arrow)* attached to the TV during active cannula aspiration. See Video 5. *LA*, Left atrium; *RA*, right atrium.

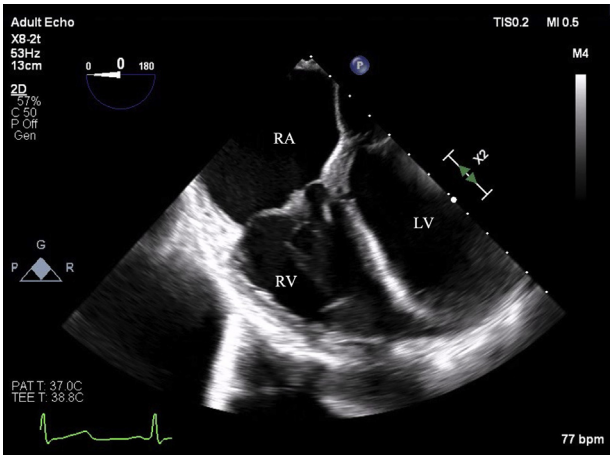

Figure 8 Midesophageal 4-chamber view focused on the right ventricle (RV) in systole demonstrating significant reduction in size of the TV mass with residual components in the subvalvular apparatus of the TV. See Video 7. *LV*, Left ventricle; *RA*, right atrium.

the TV (Figures 1 and 2, Videos 1 and 2). There was mild tricuspid regurgitation (TR), and the right ventricle did not appear dilated and had normal systolic function (Figure 3, Video 3). The TV annulus was measured at 37 mm at end diastole. No vegetations were seen on any other cardiac valves.

The AngioVac vacuum-assisted thrombectomy system was used via right internal jugular and femoral venous access. Fluoroscopy was used during placement of the inflow and outflow cannulas of the AngioVac system (Figure 4). Using TEE guidance, the inflow cannula of the AngioVac was advanced from the right internal jugular vein to the TV vegetation (Figure 5, Video 4). Extracorporeal circulation was initiated with flows of 2-3 L/min. Real-time debulking of the TV vegetation was observed using TEE (Figure 6, Video 5), and additional manipulations of the AngioVac inflow cannula were made toward any remaining supravalvular vegetation components (Figure 7, Video 6).

When TEE revealed satisfactory debulking of the vegetation, the flow was stopped in the extracorporeal pump. The largest components of the vegetation were successfully removed, and only small residual components were noted in the subvalvular apparatus of the TV (Figures 8 and 9, Videos 7 and 8). Moderate TR was seen following the procedure (Figure 10, Video 9). The TV was thoroughly interrogated, and no structural damage was noted. We suspected that the large vegetation was providing some obstruction to regurgitant blood flow through the TV, and after debulking, moderate TR was revealed. Components of vegetation were retrieved from the extracorporeal circuit for visual inspection and culture (Figure 11).

The patient remained hemodynamically stable during the procedure and during the remainder of his hospitalization. Vegetation cultures were positive for methicillin-sensitive *Staphylococcus aureus,* and the patient received 6 weeks of antibiotic therapy. The patient

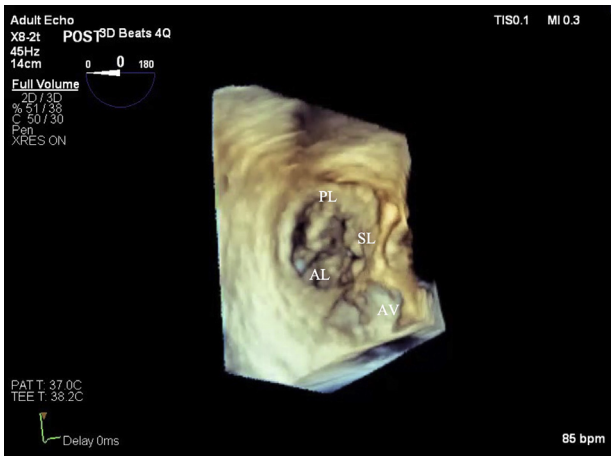

Figure 9 Three-dimensional data set of the TV as viewed from the right atrium in systole showing successful debulking of the TV mass. See Video 8. *AL*, Anterior leaflet; *AV*, aortic valve; *PL*, posterior leaflet; *SL*, septal leaflet.

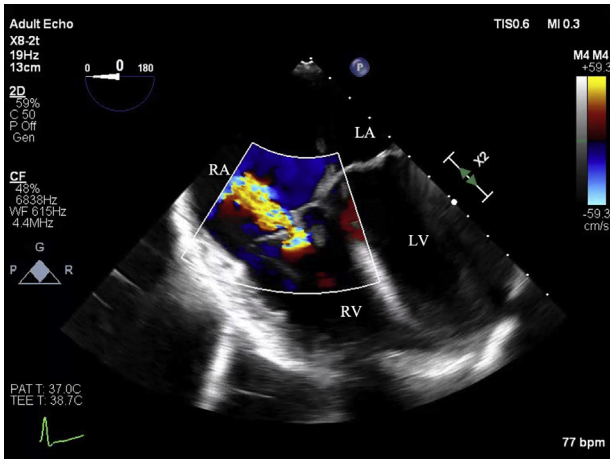

Figure 10 Midesophageal 4-chamber view focused on the right ventricle (RV) in systole with color flow Doppler demonstrating moderate central TR after debulking of the TV mass. See Video 9. *LA*, Left atrium; *LV*, left ventricle; *RA*, right atrium.

was started on suboxone to manage his opioid use disorder and ultimately discharged to a family member's home to complete his antibiotic course.

Five months later, the patient represented with methicillin-resistant *Staphylococcus aureus* bacteremia. Transesophageal echocardiography did not show any abscess or worsening vegetation. The patient received 6 weeks of antimicrobial therapy and was discharged home in stable condition without requiring any further interventions.

DISCUSSION

This case demonstrated the successful use of a percutaneous transcatheter approach to debulk a large TV IE vegetation in a patient who refused surgical TV replacement. This strategy proved to be effective in stabilizing the patient, allowing for continued antimicrobial

Figure 11 Components of the TV vegetation retrieved from the AngioVac extracorporeal circuit filter after successful debulking.

therapy and management of his underlying opioid use disorder through initiation of suboxone.

The AngioVac transcatheter aspiration technique for reducing TV IE vegetation burden has been shown to be successful in a number of case reports and series. However, it is important to be aware of potential complications including myocardial injury, pericardial tamponade, TV leaflet injury, or pulmonary embolism.[8,10,11] Transesophageal echocardiography can be an effective tool to ensure successful debulking but also to prevent complications and alert the proceduralist of suction events on the leaflets or cannula malposition. The most helpful TEE views used to guide cannula manipulation are the midesophageal (ME) 4-chamber view focused on the right ventricle and the ME modified bicaval view. Continued communication with the proceduralist can help optimize cannula position. It should be noted that in the ME modified bicaval view imaged past 90°, a clockwise torque of the AngioVac cannula produces a counterclockwise turn of the catheter on the image.[12] It is important to recognize that other imaging techniques can be used to guide the AngioVac catheter position including intracardiac echocardiography, which can provide real-time visualization of cardiac structures, catheter, or cannula position and can monitor for complications such as pericardial effusion or thrombus formation.[13]

Postprocedure considerations include the potential systemic inflammatory response that may occur due to recirculation of bacteria-containing blood from the IE vegetation. These patients may require vasopressor support and intensive care unit admission postoperatively. It is also important to highlight that TR may increase in severity postprocedure due to leaflet damage, altered valve mechanics after debulking, or volume-related changes in tricuspid annulus size. Patients should be closely monitored in the postoperative period for right ventricular failure due to TR and may require diuresis or inotropic support.

This case highlights how TEE can be used during transcatheter aspiration of TV IE vegetations, including optimization of the AngioVac inflow cannula position, monitoring for complications, and monitoring for worsening TR and other causes of hemodynamic instability, such as a vasodilatory response.

CONCLUSION

Transcatheter debulking of TV IE vegetations is a technique that has been used for patients with significant risk for complications from an open surgical intervention or as a bridge to surgery. Real-time TEE guidance can help facilitate successful removal of vegetations, optimize cannula positioning, and monitor for potentially serious complications.

SUPPLEMENTARY DATA

Supplementary data to this article can be found online at https://doi.org/10.1016/j.case.2022.04.006.

REFERENCES

1. Akinosoglou K, Apostolakis E, Marangos M, Pasvol G. Native valve right sided infective endocarditis. Eur J Intern Med 2013;24:510-9.
2. Pettersson GB, Hussain ST. Current AATS guidelines on surgical treatment of infective endocarditis. Ann Cardiothorac Surg 2019;8:630-44.
3. Habib G, Lancellotti P, Antunes MJ, Bongiorni MG, Casalta JP, Del Zotti F, et al., ESC Scientific Document Group. 2015 ESC guidelines for the management of infective endocarditis: the Task Force for the Management of Infective Endocarditis of the European Society of Cardiology (ESC). Endorsed by: European Association for Cardio-Thoracic Surgery (EACTS), the European Association of Nuclear Medicine (EANM). Eur Heart J 2015;36:3075-128.
4. Shmueli H, Thomas F, Flint N, Setia G, Janjic A, Siegel RJ. Right-sided infective endocarditis 2020: challenges and updates in diagnosis and treatment. J Am Heart Assoc 2020;9:e017293.
5. Shrestha NK, Jue J, Hussain ST, Jerry JM, Pettersson GB, Menon V, et al. Injection drug use and outcomes after surgical intervention for infective endocarditis. Ann Thorac Surg 2015;100:875-82.
6. 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;81:1008-12.
7. Makdisi G, Casciani T, Wozniak TC, Roe DW, Hashmi ZA. A successful percutaneous mechanical vegetation debulking used as a bridge to surgery in acute tricuspid valve endocarditis. J Thorac Dis 2016;8:E137-9.
8. 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. Catheter Cardiovasc Interv 2017;90:1009-15.
9. Otto CM, Nishimura RA, Bonow RO, Carabello BA, Erwin JP 3rd, Gentile F, et al. 2020 ACC/AHA guideline for the management of patients with valvular heart disease: executive summary: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. Circulation 2021;143:e35-71.
10. Starck CT, Dreizler T, Falk V. The AngioVac system as a bail-out option in infective valve endocarditis. Ann Cardiothorac Surg 2019;8:675-7.
11. 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.
12. Cronin B, Robbins R, Maus T. Pulmonary artery catheter placement using transesophageal echocardiography. J Cardiothorac Vasc Anesth 2017;31:178-83.
13. Enriquez A, Saenz LC, Rosso R, Silvestry FE, Callans D, Marchlinski FE, et al. Use of intracardiac echocardiography in interventional cardiology: working with the anatomy rather than fighting it. Circulation 2018;137:2278-94.