TEE-Guided Percutaneous Aspiration of a Large Lead-Associated Vegetation Prior to Transvenous Lead Extraction

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INTRODUCTION

Cardiovascular implantable electronic devices (CIEDs) are increasingly used in current cardiology practice.[1] Concomitantly there has been a significant increase in the prevalence of CIED infections. CIED infections require complete device (lead and pulse generator) removal in addition to antimicrobial therapy.[1] However, there is concern that transvenous lead extraction in the presence of large lead-associated vegetations (defined as >2.5 cm) may expose the patient to risk for septic pulmonary embolization.[2] Vacuum-assisted aspiration of lead-associated vegetations is a new percutaneous intervention meant to reduce in size or completely remove lead-associated vegetations before transvenous lead extraction. We describe a patient in whom percutaneous aspiration of a large lead vegetation was performed before lead extraction and underscore the critical role of transesophageal echocardiographic (TEE) imaging during this procedure.

CASE PRESENTATION

A 50-year-old man with coronary artery disease and poorly-controlled type 2 diabetes presented to an outside hospital complaining of fever and pain over a chronic right ankle ulcer. He was diagnosed with osteomyelitis and was found to have methicillin-sensitive Staphylococcus aureus (MSSA) bacteremia. Seven months prior to this presentation, he underwent a 3-vessel coronary artery bypass graft (CABG) for severe multi-vessel coronary artery disease with subsequent single-chamber implantable cardioverter-defibrillator (ICD) placement for primary prevention in the setting of ischemic cardiomyopathy with a left ventricular ejection fraction of 10% to 15%. Transthoracic echocardiography performed as part of the bacteremia workup revealed a 4-cm mobile mass on the ICD lead. The patient was started on intravenous antibiotics and transferred to our facility for device removal. Upon arrival, his temperature was 37.8°C, heart rate was 80 beats/min, blood pressure was 105/52 mm Hg, and oxygen saturation was 92% on room air. Preprocedural TEE imaging confirmed a 2.8 × 1.0 cm vegetation, attached to the right atrial portion of the ICD lead, prolapsing across the tricuspid valve during diastole (Figures 1 and 2, Videos 1 and 2). There was mild tricuspid regurgitation and dilation of the right heart chambers, but no obvious evidence of vegetations on any of the heart valves.

A multidisciplinary team involving interventional cardiology, electrophysiology, cardiac surgery, and infectious disease concluded that given the large size of the lead vegetation, lack of significant tricuspid regurgitation necessitating surgery, and elevated surgical risk, percutaneous aspiration of the vegetation followed by transvenous lead extraction was the most prudent management option. Additionally, it was determined that ICD reimplantation for primary prevention was no longer indicated. as on transthoracic echocardiography the left ventricular ejection fraction had improved to 35% to 40% from 10% to 15% at the time of ICD placement 7 months prior.

The procedure was performed in a hybrid catheterization laboratory with members from interventional cardiology, electrophysiology, cardiac surgery, and echocardiography present. The AngioVac (Angiodynamics, Latham, NY) vacuum-assisted thrombectomy system was used via bilateral femoral venous access. Under TEE guidance, a 22-Fr inflow cannula was advanced to the lead vegetation in the right atrium, where aspiration was performed (Figure 3, Videos 3 and 4). The initial aspiration resulted in a significant reduction in the vegetation size (Figure 4, Video 5). Repeat aspiration was performed, with near complete removal of the lead-associated vegetation. Careful TEE imaging of the pulmonary artery was repeatedly performed during aspiration and lead extraction. The lead was extracted without complications. No embolization was noted, and the pulmonary artery was free of emboli on TEE interrogation at the end of the procedure.

Following extraction, a mobile tubular mass tethered proximally to the superior vena cava wall was noted (Figure 5, Video 6). Aspiration of this mass was attempted but was unsuccessful (Figure 6, Video 7). This tubular mass was thought to represent a cast, or ghost, of the extracted lead.

Additionally, a small mass was seen on the atrial aspect of the septal leaflet of tricuspid valve, which was not apparent before extraction (Figures 7 and 8, Videos 8 and 9). There was mild tricuspid regurgitation, which was present preprocedurally (Video 10). Interestingly, color Doppler showed a narrow jet of regurgitant flow through the newly discovered mass on the tricuspid valve. It was thought that this represented a perforation related to infective endocarditis or flow through an additional ghost on the septal leaflet rather than valve injury related to the lead (Figure 9).

The patient showed no signs suggestive of hemodynamic compromise throughout the procedure and in the following days. The CIED pocket tissue was cultured and grew methicillin-susceptible *Staphylococcus aureus*, but all blood cultures from his hospitalization

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VIDEO HIGHLIGHTS

Video 1: Preprocedural TEE demonstrating 2.8 × 1.0 cm vegetation attached to single-chamber ICD lead with prolapse into the right ventricle during diastole.
Video 2: Three-dimensional TEE of lead vegetation in the right atrium attached to ICD lead.
Video 3: TEE showing initial aspiration of the vegetation by the AngioVac inflow cannula.
Video 4: Three-dimensional TEE showing initial aspiration of the vegetation by the AngioVac inflow cannula.
Video 5: Transesophageal echocardiographic images following initial debulking of lead vegetation.
Video 6: TEE showing mobile, nonrigid tubular mass, attached to the superior vena cava wall, which appeared immediately following lead extraction, likely representing a ghost.
Video 7: TEE-guided attempted aspiration of ghost attached to superior vena cava wall.
Video 8: TEE following lead extraction showing a small mass on the atrial side of the septal leaflet of the tricuspid valve that was not noted prior to extraction.
Video 9: Three-dimensional transesophageal echocardiographic image of tricuspid valve mass after lead extraction.
Video 10: TEE color flow Doppler showing regurgitant flow through the residual mass on tricuspid valve.

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

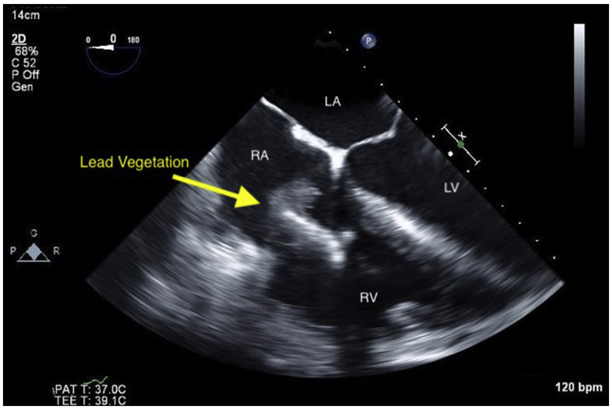

Figure 1 Preprocedural TEE imaging demonstrated a 2.8 × 1.0 cm vegetation attached to a single-chamber ICD lead with prolapse into the right ventricle (RV) during diastole. See Video 1. *LA*, Left atrium; *LV*, left ventricle; *RA*, right atrium.

showed no growth. It was decided to continue antibiotic therapy for 4 weeks from the procedure given the residual tricuspid mass and ongoing right lower extremity osteomyelitis. The patient was transferred back to the referring hospital on the second postprocedural day per his request to be closer to his home.

Figure 2 Three-dimensional TEE imaging of lead vegetation (*arrow*) in the right atrium attached to the ICD lead. See Video 2.

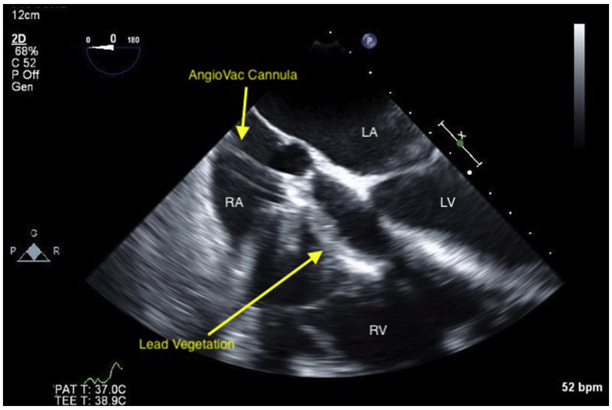

Figure 3 TEE imaging showing initial aspiration of the vegetation by the AngioVac inflow cannula. See Videos 3 and 4 (three-dimensional). *LA*, Left atrium; *LV*, left ventricle; *RA*, right atrium; *RV*, right ventricle.

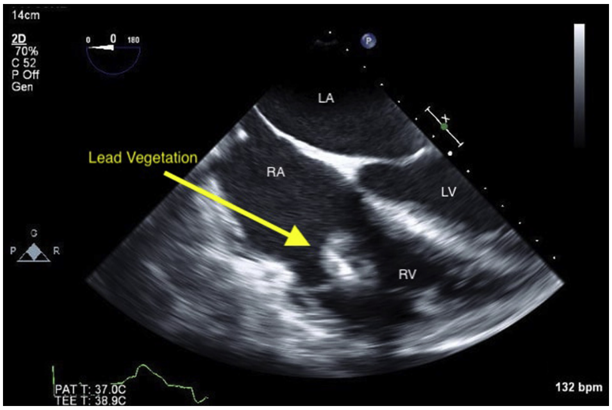

Figure 4 TEE images following initial debulking of lead vegetation. See Video 5. *LA*, Left atrium; *LV*, left ventricle; *RA*, right atrium; *RV*, right ventricle.

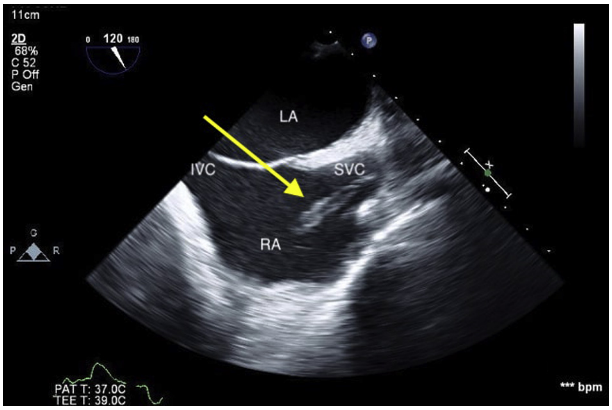

Figure 5 TEE imaging showing mobile, nonrigid tubular mass (*arrow*) attached to the superior vena cava (SVC) wall, which appeared immediately following lead extraction, likely representing a ghost. See Video 6. *IVC*, Inferior vena cava; *LA*, left atrium; *RA*, right atrium.

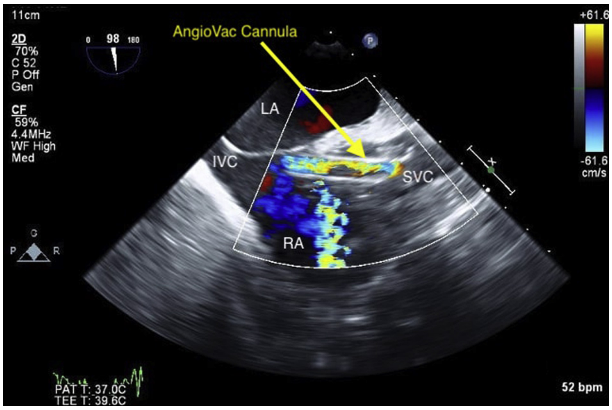

Figure 6 TEE imaging–guided attempted aspiration of ghost in the superior vena cava (SVC). See Video 7. *IVC*, Inferior vena cava; *LA*, left atrium; *RA*, right atrium.

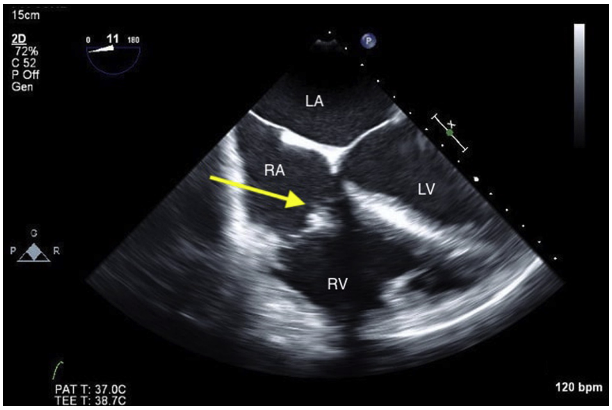

Figure 7 TEE imaging following lead extraction showed a small mass (*arrow*) on the atrial side of the septal leaflet of the tricuspid valve, which was not noted before extraction. See Video 8. *LA*, Left atrium; *LV*, left ventricle; *RA*, right atrium; *RV*, right ventricle.

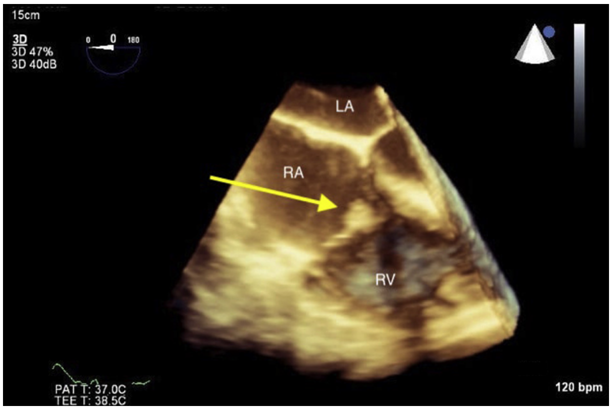

Figure 8 Three-dimensional TEE image of tricuspid valve mass (*arrow*) after lead extraction. See Video 9. *LA*, Left atrium; *RA*, right atrium; *RV*, right ventricle.

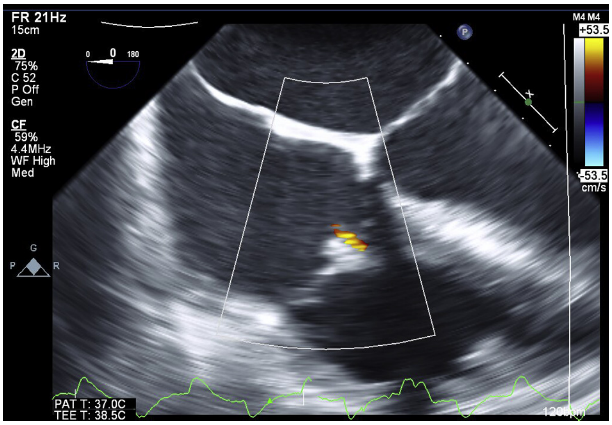

Figure 9 TEE color flow Doppler showing regurgitant flow through the residual mass on the tricuspid valve. See Video 9.

DISCUSSION

The best management of CIED infections associated with large lead vegetations is a current area of uncertainty. Although transvenous lead extraction with vegetations <2 cm has been shown to be safe, there is concern for a high risk for septic pulmonary embolization with larger vegetations.[1,2] The 2017 Heart Rhythm Society consensus statement on lead infection suggests that open extraction should be considered in patients with large (>2.5-cm) lead vegetations.[1] A potential advancement in this area is the novel use of vacuum-assisted aspiration devices to remove or significantly debulk lead-associated vegetations before percutaneous extraction.[3-6] This new management option is especially appealing in light of the increasing need for lead extractions in older patients and those with more comorbidities, who may not tolerate surgical management.[7] Although there is a number of available percutaneous devices that can remove intravascular or intracardiac thrombus, vegetations, or masses, the AngioVac system has a large inflow cannula that was well suited to handle the sizable vegetation encountered in this case. Additionally, this device offers consistent suction that facilitates the removal of organized debris, which can be adherent to other structures.

The limited number of published reports of this procedure suggest that percutaneous aspiration of large lead vegetations before transvenous lead extraction is feasible and has a low complication rate. However, a recent meta-analysis describes the limitations of the available data and the paucity of randomized comparisons of any lead extraction strategies for CIED infections.[5] Moreover, the data reported on percutaneous aspiration before lead extraction are heterogeneous, and poor outcomes are likely underreported. Additionally, patients are often sent to tertiary centers for this procedure and, as with our patient, transferred back postprocedurally, resulting in loss of rigorous follow-up. As such, more research is needed to evaluate the indications and efficacy of percutaneous aspiration of lead vegetations before transvenous CIED extraction.

This case underscores the crucial role of periprocedural TEE guidance in percutaneous aspiration of large lead vegetations before transvenous lead extraction. Before lead extraction, TEE should be used to assess the size and characteristics of the vegetation as well as for any valvular involvement, particularly in the tricuspid valve. This is needed, as significant valvular infection or dysfunction likely requires surgical management, and large vegetation size, as well as globular shape, is associated with worse outcomes.[8] TEE guidance could enable accurate and complete aspiration of vegetations without damage to cardiac structures. TEE guidance is particularly helpful for improving the safety of the procedure, given the limited steerability of the AngioVac cannula.[4] Last, intraprocedural TEE guidance allows real-time detection of procedural complications such as pulmonary emboli and iatrogenic valvular or other tissue injury, which may require additional management. Findings such as residual vegetation or the presence of ghosts have both therapeutic (longer duration of antibiotic therapy) and possibly prognostic (increased mortality) implications.[9]

CONCLUSION

This case highlights the critical role of periprocedural TEE imaging guidance in percutaneous aspiration of large lead vegetations before transvenous lead extraction for CIED infections. A multidisciplinary approach to the management of CIED infections is important. Intraprocedural TEE guidance facilitates the safe and complete removal of lead-associated vegetations. Furthermore, real-time TEE imaging identifies unexpected residual findings following lead extraction, such as residual vegetation or the presence of ghosts, which may have both therapeutic and prognostic implications.

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SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.case.2020.10.001.

REFERENCES

1. Kusumoto FM, Schoenfeld MH, Wilkoff BL, Berul CI, Birgersdotter-Green UM, Carrillo RG, et al. 2017 HRS expert consensus statement on cardiovascular implantable electronic device lead management and extraction. Heart Rhythm 2017;14:e503-51.
2. Greenspon AJ, Le KY, Prutkin JM, Sohail MR, Vikram HR, Baddour LM, et al. Influence of vegetation size on the clinical presentation and outcome of lead-associated endocarditis. JACC Cardiovasc Imaging 2014;7:541-9.
3. Richardson TD, Lugo RM, Crossley GH, Ellis CR. Use of a clot aspiration system during transvenous lead extraction. J Cardiovasc Electrophysiol 2020;31:718-22.
4. Starck CT, Schaerf RHM, Breitenstein A, Najibi S, Conrad J, Berendt J, et al. Transcatheter aspiration of large pacemaker and implantable cardioverter-defibrillator lead vegetations facilitating safe transvenous lead extraction. EP Europace 2020;22:133-8.
5. Rusia A, Shi AJ, Doshi RN. Vacuum-assisted vegetation removal with percutaneous lead extraction: a systematic review of the literature. J Interv Card Electrophysiol 2019;55:129-35.
6. Chakravarthy M, Lasorda D, Bhanot N, Cherukuri K, Ghosh P, Abbadi D, et al. TCT-568 Effectiveness and safety of vacuum-assisted thrombectomy device (angiovac) for extraction of vegetations on intra-cardiac devices and valves prior to device removal: a single center experience. J Am Coll Cardiol 2019;74:B560.
7. Nof E, Epstein LM. Complications of cardiac implants: handling device infections. Eur Heart J 2013;34:229-36.
8. Arora Y, Perez AA, Carrillo RG. Influence of vegetation shape on outcomes in transvenous lead extractions: does shape matter? Heart Rhythm 2020;17:646-53.
9. Narducci ML, Di Monaco A, Pelargonio G, Leoncini E, Boccia S, Mollo R, et al. Presence of "ghosts" and mortality after transvenous lead extraction. Europace 2017;19:432-40.