A novel diagnostic approach to a mass on a device lead

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Introduction

Utilization of cardiovascular implantable electronic devices (CIEDs), including pacemakers and cardioverter-defibrillators, as a therapeutic modality for cardiac arrhythmias is vastly expanding in the setting of an aging patient population. More than 200,000 devices were implanted in the United States in 2006 and over 3 million patients worldwide currently have CIEDs.[1] While a great deal of focus is placed on advances in technology and clinical efficacy of the devices, prompt diagnosis and management of device infections and thrombi on transvenous leads are also important. Large clinical registries such as the Denmark registry have shown a 1.83% incidence of device infection leading to a CIED removal.[2] The incidence of thrombi on device leads has been reported to be as a high as 48% of atrial leads and 33% of ventricular leads on autopsies.[3]

Finding an echogenic mass on a device lead is reported to occur in 14% of leads imaged by echocardiography.[4] Despite this relatively high incidence, determining the etiology of the mass in certain clinical settings remains challenging. For example, echocardiography may reveal lead-associated masses or vegetations in patients without other signs or symptoms of a systemic infection or venous thromboembolism. As a result, finding a mass of uncertain etiology on a device lead may result in unnecessary and/or delayed treatments.

Discovering a mass on a device lead is expected to be more common as more devices are implanted. Case reports on various techniques such as using a triple-loop wire snare to biopsy a lead-associated mass have been published; however, the literature on this topic remains scant.[5] We present 2 cases in which a novel diagnostic method was used in patients with masses on their device leads. In both cases, a transesophageal echocardiogram (TEE)-guided biopsy of the mass was performed utilizing a bioptome introduced through a steerable sheath via the femoral vein. An experienced echocardiographer utilized a combination of primarily bicaval view of the right atrium in 2-dimensional TEE and fluoroscopy in both cases. The leads could be differentiated by targeting each lead on fluoroscopy with the bioptome and watching the motion on TEE. Since most electrophysiologists are more comfortable guiding catheters with fluoroscopy, we used a combination of both approaches. Once each lead was identified on TEE, the location of the mass on the lead was confirmed. The bioptome was then positioned to that portion of the lead by fluoroscopy. The bioptome was moved in and out of view on TEE to identify the tip. Moving the lead while grasping the mass, but not the lead, helped confirm location. Although not excessive, traction can be applied to the lead, so care should be taken with newly implanted leads.

The samples were sent to histology, gram stain, and culture, allowing for a prompt diagnosis. Our patients were started on appropriate treatment based on the biopsy results and both had good clinical outcomes.

KEY TEACHING POINTS

- An undifferentiated mass on a device lead can result in delayed or unnecessary treatments.
- We describe a novel technique involving a transesophageal echocardiogram–guided biopsy of a lead-associated mass by means of a bioptome.
- This safe technique did not affect the lead stability or integrity and was crucial for determining the etiology of the mass and facilitating appropriate care in our patients.

Case report

Case 1

An 80-year-old woman with a remote history of breast cancer and a dual-chamber pacemaker implanted 2 years prior for sick sinus syndrome presented to another hospital for progressively worsening vision in her left eye for 3 weeks. A computed tomography angiography was done, revealing a

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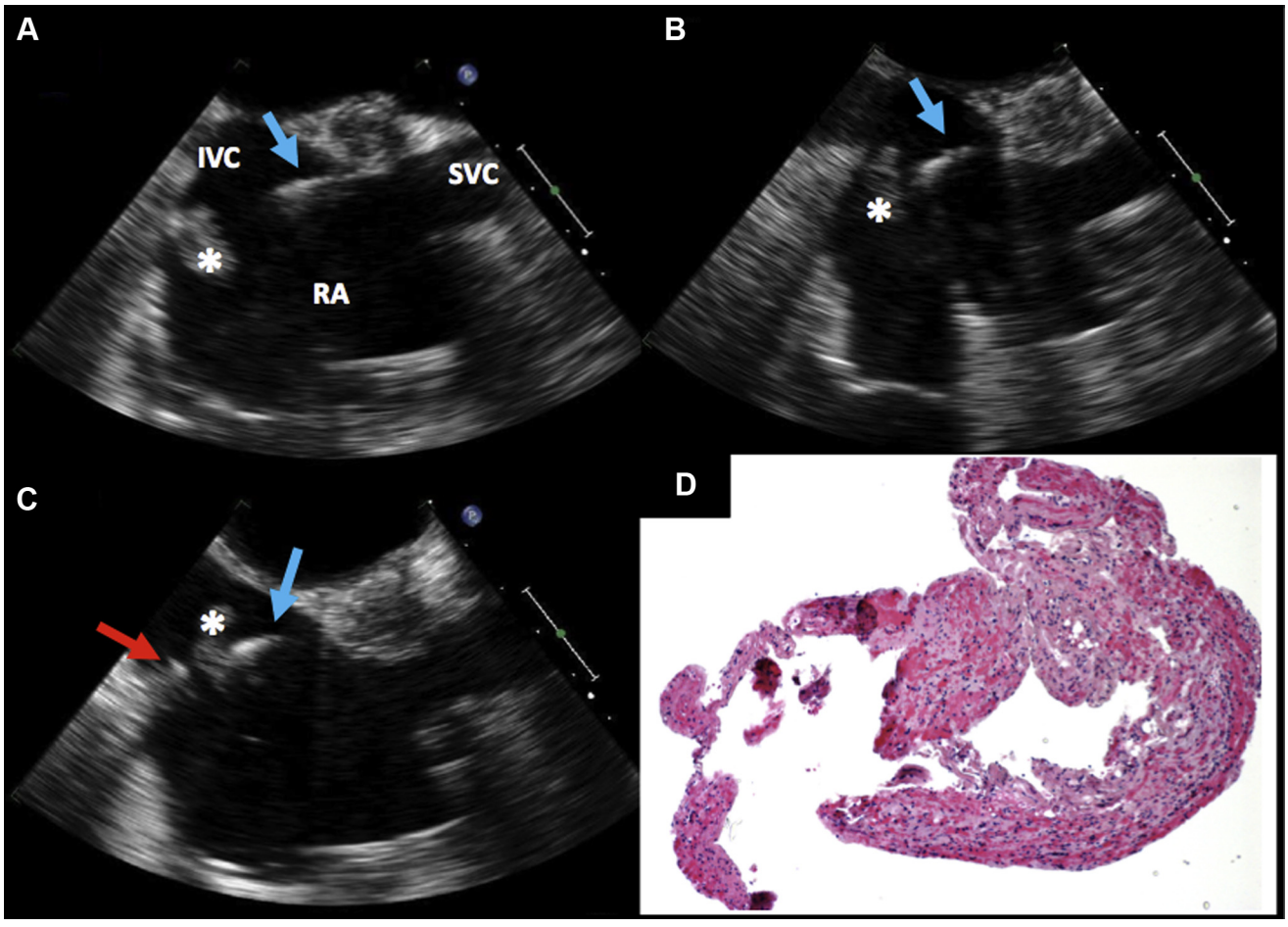

Figure 1 Transesophageal echocardiography–guided biopsy of thrombus on a device lead. **A–C:** Bicaval transesophageal echocardiogram views of the thrombus on the right atrial lead. The *asterisk* denotes the thrombus. *Blue arrows* point to the lead. The *red arrow* in panel C is the bioptome in close proximity to the thrombus. **D:** Intracardiac mass, hematoxylin–eosin stain, ×200. Haphazard admixture of erythrocytes, fibrin, and neutrophils, consistent with thrombus. IVC = inferior vena cava; RA = right atrium; SVC = superior vena cava.

90% stenosis of her left internal carotid artery and an incidental finding of a mass on her right atrial (RA) lead. A TEE confirmed the presence of the 1.6 × 1.0-cm mass. The patient had a mild leukocytosis in the setting of a recent dental procedure but was afebrile, with negative blood cultures. She was started on unfractionated heparin and intravenous antibiotics and transferred to our hospital for a device extraction. She had no clinical findings suggestive of an infection or a recurrence of her malignancy but was continued on antibiotics and anticoagulation. A biopsy was performed in an effort to determine the etiology of the mass on her RA lead. Femoral access was obtained and an Agilis NxT Steerable Introducer (Abbott, St. Paul, MN) was advanced under fluoroscopy into her right atrium. A 2.4 mm × 105 cm, 7.5F Argon bioptome (Argon Medical Devices, Athens, TX) was employed under TEE guidance and 10 biopsy specimens of the RA lead mass were obtained (Figure 1A–C). She tolerated the procedure well, with no significant changes in the sensitivity, impedance, and pacing threshold of the RA lead. The lead was not dislodged on fluoroscopy and follow-up chest radiograph. Pathology results returned within hours of the procedure and confirmed that the mass was a thrombus with irregular fragments of soft tissue (Figure 1D). The gram stain showed no polymorphonuclear cells and the tissue culture confirmed no growth. Antibiotics were discontinued and the patient was transitioned to oral anticoagulation. She did not require a device extraction and was safely discharged on anticoagulation. On follow-up imaging, the mass had significantly decreased in size and the patient was cleared for carotid surgery.

Case 2

A 29-year-old man with a history of a resected chest wall dermatofibrosarcoma and a primary-prevention implantable cardioverter-defibrillator (ICD) implanted 10 years prior for Brugada syndrome presented with 1 week of intermittent fevers and night sweats followed by syncope. A computed tomography angiography of the chest showed multifocal acute pulmonary emboli (PE) within the bilateral upper and lower segmental branches. A transthoracic echocardiogram followed by a TEE revealed a mass in the right atrium and right ventricle of 2.9 cm × 1.2 cm, encasing the device lead, suggestive of a thrombus. A single blood culture from

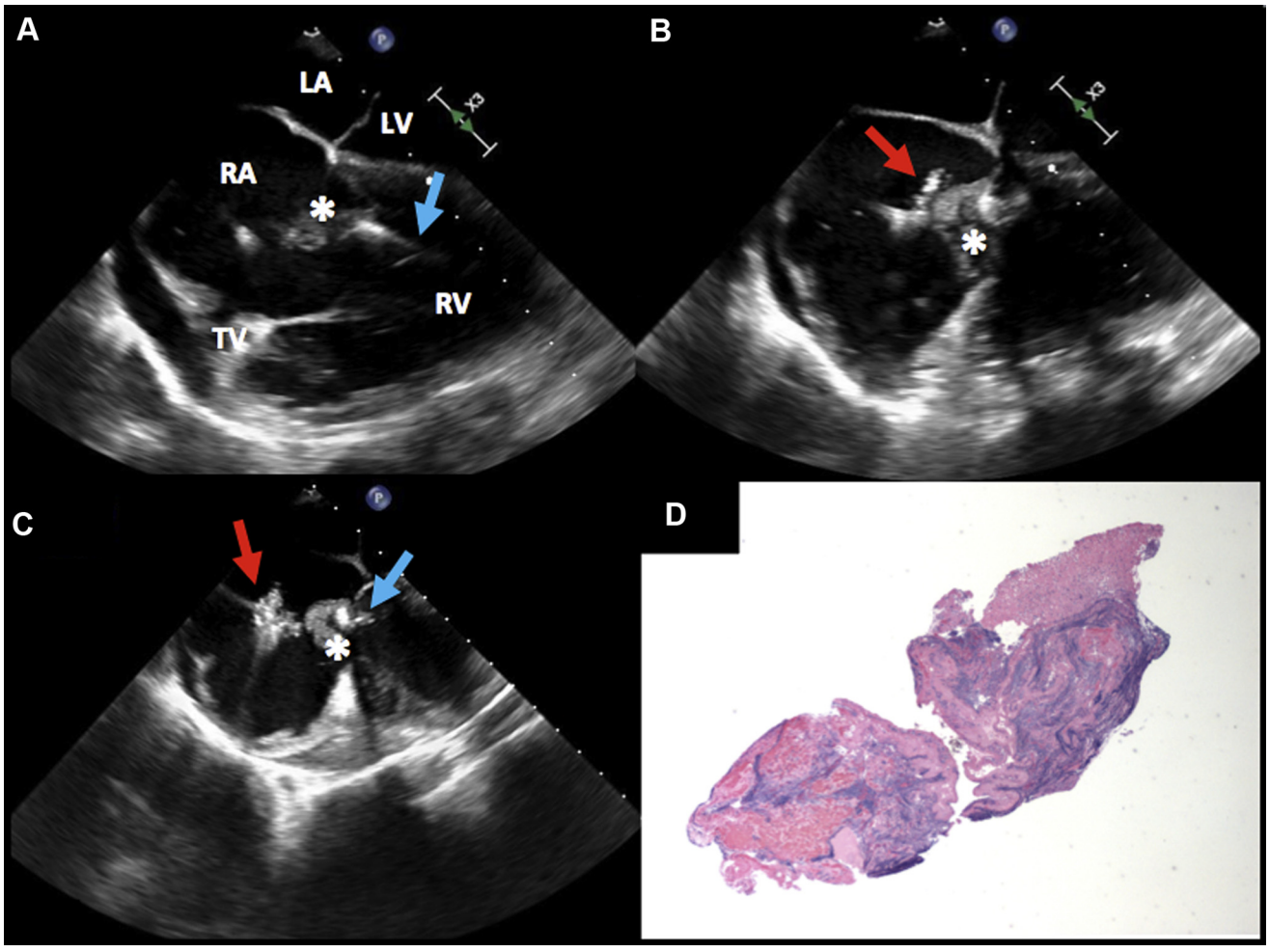

Figure 2 Transesophageal echocardiography–guided biopsy of a vegetation on a device lead. **A–C:** Midesophageal 4-chamber views at 0 degrees of the vegetation on the right ventricular lead. The *asterisk* denotes the vegetation. *Blue arrows* point to the lead. The *red arrow* in panels B and C is the bioptome sampling the vegetation. **D:** Mass on right ventricular lead, hematoxylin–eosin, ×40. Aggregates of fibrin admixed with neutrophils and basophilic debris with few erythrocytes, consistent with vegetation. Special stains (Gram, periodic acid–Schiff, and Gomori methenamine silver) for organisms were negative. LA = left atrium; LV = left ventricle; RA = right atrium; RV = right ventricle; TV = tricuspid valve.

admission grew a *Propionibacterium* species that was thought to be a contaminant. In the setting of persistent low-grade fevers and leukocytosis, he was treated with both unfractionated heparin for PE and intravenous antibiotics for possible culture-negative endocarditis. The patient had multiple subsequent negative blood cultures, which were held for extended growth; and owing to a low clinical suspicion for infection, antibiotics were discontinued. To confirm a presumed diagnosis of thrombus, the right ventricular mass was biopsied using the same technique as the previous case (Figure 2). Fifteen tissue samples were collected with the bioptome. The patient's right ventricular lead sensitivity, impedance, and pacing threshold were unchanged following the biopsy and the lead was not dislodged on fluoroscopy and subsequent chest radiograph. Pathology resulted 24 hours after the procedure and revealed pieces of fibrin mixed with neutrophils harboring calcifications, consistent with an infectious etiology (Figure 2D). Antibiotics were resumed and the patient underwent lead extraction. Culture of the extracted ICD lead tip was positive for the same *Propionibacterium* species as the single isolate from the initial blood cultures that were originally thought to be a contaminant. He was treated with an extensive course of antibiotics and received a subcutaneous ICD prior to discharge.

Discussion

With the advancement in CIEDs, the implantation rate has been increasing, with a recent study reporting over a million device implantations in 2017 worldwide.[6] Device infection rates have also increased out of proportion to the number of devices implanted.[7] Infection can cause device malfunction and clinical complications such as PE and bacteremia. Studies have shown that early diagnosis of device infection and lead extraction within 3 days are associated with decreased mortality. A delay in treating a device infection is associated with a 30-day mortality of 5.5% and a 1-year mortality of 14.6%.[6] Owing to poor clinical outcomes in patients with device-related infections, even in the absence of clinical signs or symptoms of an infection, the practical approach is to start

empiric antibiotic therapy in patients with a mass on their device lead. However, not all masses on device leads are infectious in etiology.

As seen in our 2 cases, determining the etiology of the mass and initiating the appropriate management can be challenging. Difficulty in making a timely diagnosis may lead to delays and potentially unnecessary treatments. To solve this problem, we propose a novel diagnostic approach that allows for pathology results to make the diagnosis within 24 hours. We utilized a bioptome with TEE and fluoroscopic guidance to directly biopsy masses of uncertain etiology on device leads. Three-dimensional (3D) TEE was not deemed necessary in both cases, as 2-dimensional TEE and fluoroscopic images clearly delineated the bioptome and the lead masses. Cardiac anesthesiology experienced in TEE may be consulted for difficult cases such as mobile masses.

In our first case, antibiotics were discontinued as soon as the pathology report of the biopsy confirmed thrombus. This circumvented a possible long-term course of antibiotics as well as a device extraction. In our second case, antibiotics were prematurely discontinued owing to a presumptive diagnosis of thrombus. When the biopsy confirmed an infectious process, the patient was restarted on the antibiotics and the device was extracted prior to potential complications of a systemic infection. Both cases highlight the benefit of utilizing our diagnostic approach with a bioptome to identify the etiology of a mass on a device lead.

It is important to compare our biopsy approach to what has been published in the literature. A case of infective endocarditis has been reported in which a triple-loop wire snare (Atrieve vascular snare, Angiotech, Vancouver, British Columbia, Canada) was used under TEE to completely remove a mass of 2.41 cm in length on the RA lead inserted in 1996.[5] Histology confirmed a noninfected thrombus and the patient was treated for a long-term anticoagulation without lead extraction. The patient had no recurrence of thrombus, nor infectious etiology. A triple-loop wire snare may be a useful diagnostic tool that enables complete removal of a lead mass, but the disadvantage of the snare compared to the bioptome is the lack of control in maneuvering the snare around a lead mass. In addition, the snare is more likely to disrupt the mass than a bioptome, sending emboli to the lungs.

Imaging modalities may also play a role in differentiating a lead mass. Two case reports utilized 18F-fluorodeoxyglucose positron emission tomography scans.[5,8] In both cases, the low level of glucose metabolism around the lead helped make the diagnosis of thrombus rather than vegetation. One of the cases also involved 3D TEE to better visualize the lead mass.[5] However, the diagnosis was not definitive until the pathologic studies were done, which points back to the importance of the biopsy of the lead mass.

While the safety of the approach still needs further investigation, our 2 cases demonstrated that the biopsy samples can be obtained directly from the lead without affecting the lead parameters. The dwell time for the leads in our patients were 2 and 10 years. As is the case with any lead manipulation, performing a biopsy of a lead-associated mass using the technique described above carries a risk of lead dislodgement, especially in leads with shorter dwell times.

Conclusion

In clinical practice, it is not uncommon to encounter a lead-associated mass by echocardiography. Differentiating a vegetation from a thrombus can be challenging in certain clinical scenarios. We report, to our knowledge, the first cases of a bioptome being used to sample tissue from lead-associated masses. We highlight how important the pathologic diagnoses were to the patients' care. The biopsy prevented an unnecessary extraction in 1 case and facilitated an appropriate extraction in the other. This novel technique can be performed safely without affecting the integrity of the lead, as seen in our cases. Accurately and promptly diagnosing a lead mass utilizing innovative tools such as a bioptome and a wire snare, as well as imaging modalities such as a 3D TEE and a positron emission tomography scan, needs more experience and further discussion, as there is limited literature on the topic.

References

1. Hao Y, Li Y, Liao D, Yang L. Seven times replacement of permanent cardiac pacemaker in 33 years to maintain adequate heart rate: a case report. Ann Transl Med 2015;3:341.
2. Johansen JB. Danish Pacemaker and ICD Register Annual Report 2016;32. Available at https://ssl.icddata.dk/download/Danish_Pacemaker_and_ICD_Register_Annual_Report_2016.pdf. Accessed February 15, 2019.
3. Ansari M, Udyavar A. Successful resolution of clots on the pacemaker lead by warfarin therapy. Indian Heart J 2018;2:1–3.
4. Downey BC, Juselius W, Pandian N, Estes M, Link M. Incidence and significance of pacemaker and implantable cardioverter-defibrillator lead masses discovered during transesophageal echocardiography. Pacing Clin Electrophysiol 2011;34:679–683.
5. Salaun E, Deharo JC, Casalta JP, et al. An oscillating mass attached to a pacemaker lead. JACC Clin Electrophysiol 2017;3:915–916.
6. Kusumoto FM, Schoenfeld MH, Wilkoff BL. 2017 HRS expert consensus statement on cardiovascular implantable electronic device lead management and extraction. Heart Rhythm 2017;14:e503–e551.
7. Voigt A, Shalaby A, Saba S. Rising rates of cardiac rhythm management device infections in the United States: 1996 through 2003. J Am Coll Cardiol 2006;48:590–591.
8. Niewinski P, Jankowska E, Cwynar A, et al. The differentiation of the growing thrombus on the electrode cardioverter defibrillator – the role of PET in a difficult diagnostic process. Kardiol Pol 2010;68:797–801.