Multiple Intracardiac Masses Involving 3 Chambers of the Heart

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INTRODUCTION

Cardiac masses are an uncommon finding, often first detected on transthoracic echocardiography (TTE), with differential diagnosis including benign and malignant neoplasm as well as nonneoplastic etiologies.[1,2] The most common cause of cardiac masses identified on echocardiography are nonneoplastic "pseudotumors" such as thrombus or a misidentified normal variant.[1,3] Among the tumors identified, metastatic disease is more prevalent than primary cardiac neoplasm.[4] Melanoma, carcinoma (including lung, breast, and esophageal), and hematologic malignancies are possible sources of spread.[4] Less than a quarter of primary cardiac tumors are malignant, of which many are sarcomas. The most common benign neoplasm of the heart is cardiac myxoma, followed by papillary fibroelastoma.[4]

Characterization and identification of masses on TTE are based on location, attachment site, physical appearance, mobility, and degree of enhancement with contrast perfusion imaging.[5] Additional imaging modalities, namely, transesophageal echocardiography (TEE), cardiac computed tomography (CCT), and/or cardiovascular magnetic resonance imaging (CMR), are often used to further delineate features of the mass. While these findings can then be correlated with clinical history to reach a presumptive diagnosis, biopsies, at times, may be required to confirm the etiology.

The presence of multiple intracardiac masses involving 2 or more chambers of the heart is especially rare, with case reports identifying lymphoma, tuberculosis, and thrombi as possible etiologies.[6,7] We present a case of multiple intracardiac masses visualized on echocardiography and CCT involving the right atrium (RA), right ventricle (RV), and left atrium (LA).

CASE PRESENTATION

A 42-year-old man with a history of HIV, severe biventricular heart failure status post–implantable cardioverter defibrillator (ICD), and atrial fibrillation (AF) presented to the emergency room after receiving 3 ICD shocks. The patient's home medications included rivaroxaban 20 mg daily for AF as well as goal-directed medical therapy for heart failure and highly active antiretroviral therapy for HIV. An electrocardiogram on arrival showed AF with rapid ventricular response, and ICD interrogation revealed multiple episodes of polymorphic ventricular tachycardia and coarse ventricular fibrillation.

The patient had a TTE performed that demonstrated an RV apical mass (3.5 cm × 2.0 cm), a mass protruding out of the left atrial appendage (LAA) into the body of the LA, and a mobile mass in the RA (5.6 cm × 4.6 cm). These masses appeared homogenous and well circumscribed (Figures 1A and 2A, Video 1). The left ventricle was normal in size (end-diastolic diameter 5.7 cm) with severely reduced systolic function (left ventricular ejection fraction 14%), and the RV was moderately dilated (basal diameter 49 mm) with severely reduced systolic function (visually estimated ejection fraction 20%-25%).

A retrospectively gated full-phase contrast-enhanced CCT with delayed imaging acquired at the 40% phase was obtained for further assessment. Multiple masses were again noted in the RV, LAA/LA, and RA (Figure 1B and C). These masses appeared homogenous and did not have any contrast enhancement on arterial phase or delayed imaging. The RA mass was noted attached to the RA free wall by a small stalk and appeared freely mobile on dynamic imaging. The RV mass was fixed to the RV free wall. The LA mass appeared contiguous with a filling defect in the LAA. Tissue characteristics appeared similar across the 3 masses.

Based on clinical history and imaging findings, the masses were presumed to all represent thrombus. Due to the precarious appearance and size of the RA mass with the associated risk of embolization as well as the need for definitive diagnosis, the decision was made to extract the RA mass for both diagnostic and therapeutic purposes. Given the comorbidities, the risk of surgery was felt to be prohibitive, and thus a percutaneous aspiration thrombectomy (PAT) approach was chosen.

The patient was brought to the cardiac catheterization laboratory, and a coronary angiogram was first performed. No epicardial coronary artery disease was noted. A TEE probe was placed, and initial images were acquired, again demonstrating a mobile RA mass attached by a small stalk to the RA free wall by both two-dimensional and three-dimensional (3D) techniques (Figure 2B and C, Video 2) in addition to the LAA thrombus (Video 2). New 3D rendering techniques (TrueVue and Glassvue) were used, introducing a freely moveable light source into the 3D data set (Figures 2A, 2C, and 3A) to enhance visualization of the borders and attachment point of the RA mass. Compared to standard 3D rendering of both the TTE and TEE images, the addition of the transparency mode to transillumination rendering substantially augmented the image quality of the intracardiac masses. This new rendering mode has significant potential for improving the visualization of anatomic structures such as the stalk and facilitating appreciation of mass size by accentuating its borders, potentially obviating the need for additional imaging. A 17-French

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VIDEO HIGHLIGHTS

Video 1: (A) Apical 4-chamber view with the appearance of a floating mass noted in the RA on 3D TrueVue. **(B)** Apical 4-chamber view demonstrating 3 masses. Masses noted in the RA, RV, and LAA.

Video 2: (A) Multiplanar reconstruction (MPR) demonstrating stalk attachment site. **(B)** Preprocedural TEE bicaval view (90°) with biplane demonstrating RA clot. **(C)** Percutaneous aspiration catheter with suction on attempting to extract the RA clot. **(D)** Left atrial appendage (180°) with thrombus.

Video 3: (A) Biplane TEE bicaval view (90°) demonstrating macerated RA clot post–percutaneous aspiration. **(B)** TEE bicaval view (90°) post–percutaneous aspiration with RA clot removed.

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venous cannula was then placed in the left common femoral vein and connected to an extracorporeal bypass circuit. A large-bore percutaneous aspiration cannula was used to extract the RA mass under TEE and fluoroscopic guidance (Figure 3A–C, Video 2). Several passes were required, and ultimately the entire mass with the exception of a small residual stalk was successfully removed (Figure 3D and E, Video 3).

The final pathologic diagnosis demonstrated fragments of organizing blood clot, confirming the presumed diagnosis. The patient was transitioned to warfarin for anticoagulation, and on follow-up was noted to have labile international normalized ratio values. Unfortunately, follow-up TTE just under 3 months after the procedure demonstrated a recurrent mobile, pedunculated right atrial mass at the same location as the prior aspirated thrombus, likely representing recurrence of the thrombus.

DISCUSSION

This is an unusual case of 3 large cardiac thrombi involving multiple cardiac chambers that were discovered after a patient presented for ICD shocks. The pedunculated, mobile RA thrombus posed an embolization risk and was extracted percutaneously using a large-bore PAT system for both diagnostic and therapeutic purposes.

Multimodality imaging was used to reach a presumptive diagnosis prior to intervention and to guide the thrombectomy. While TTE findings were suggestive of thrombus, CCT enabled acquisition of a 3D data set with higher spatial resolution and a large field of view, allowing for a more detailed visualization of anatomic features for preprocedural planning including assessment of the attachment point in multiple planes, evaluation of vascular access options, and reconstruction of fluoroscopic views. While CCT provided some degree of tissue characterization, CMR may enable a more nuanced assessment of mass characteristics in many settings. However, in this particular case, a device artifact from the patient's ICD and the high degree of mobility of the mass would likely limit adequate tissue characterization by CMR. A TEE was subsequently performed intraprocedurally to guide aspiration of the thrombus in real time.

Features that supported the diagnosis of thrombus included the discrete, homogenous appearance of the masses and the lack of contrast uptake. Cardiac imaging also demonstrated evidence of several risk factors for thrombus formation including AF and severe biventricular heart failure leading to a low-flow state. While the location and features of the LA/LAA mass appeared most classic for thrombus, the etiology of the RA mass was less clear given its pedunculated nature and location. Consequently, cardiac myxoma was also on the differential. However, as tissue characteristics appeared similar across the 3 masses, a common etiology was suspected.

The mainstay of treatment for intracardiac thrombi is systemic anticoagulation. While guidelines currently recommend vitamin K antagonists when a left ventricular thrombus is present, there has been some recent evidence suggesting the use of direct oral anticoagulants may be appropriate in that setting.[8] The optimal anticoagulant in the setting of right-sided thrombi is less studied. In this case, the patient had been previously adherent to rivaroxaban. This, combined with the likely chronicity of the thrombus, raised concern that

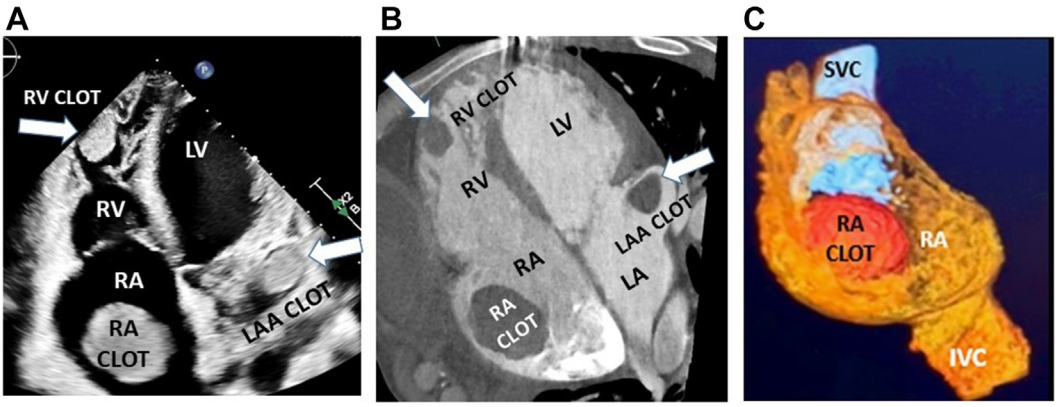

Figure 1 **(A)** Apical 4-chamber view demonstrating multiple clots (*arrows*) noted in the RV apex, RA, and LAA. **(B)** Contrast-enhanced CCT in the apical 4-chamber view demonstrating multiple filling defects (*arrows*) in the RA, RV, and LAA. **(C)** Computed tomography 3D reconstruction demonstrating a large clot in the RA. *IVC*, Inferior vena cava; *LV*, left ventricle; *SVC*, superior vena cava.

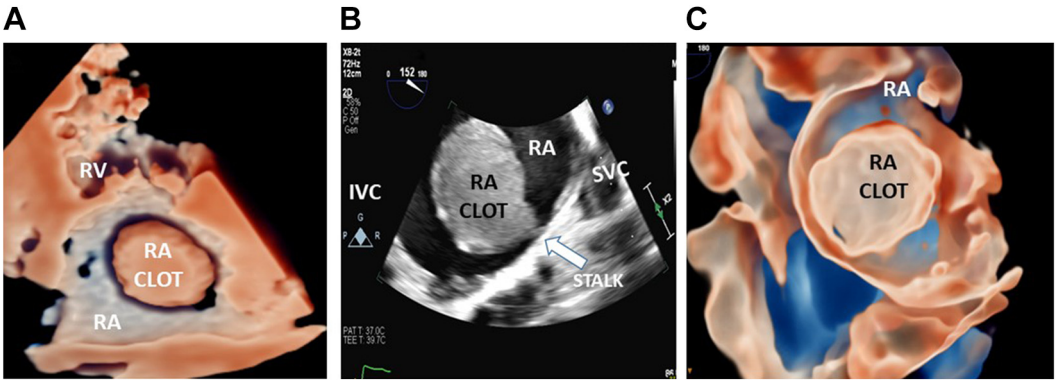

Figure 2 **(A)** Right ventricular inflow view 3D rendering (TrueVue) demonstrating RA clot. **(B)** Bicaval view (152°) on TEE demonstrating RA clot and site of attachment (*arrow*). **(C)** Bicaval view on TEE demonstrating RA clot on 3D rendering (GlassVue). *IVC*, Inferior vena cava; *SVC*, superior vena cava.

anticoagulation alone may not be sufficient for management. This is also supported by data on left ventricular thrombi that suggest complete resolution of intracardiac thrombus is not accomplished in approximately a third of patients despite appropriate anticoagulation therapy.[9] In general, anticoagulation therapy is more effective in acute or subacute thrombus, as the cross-linked fibrin in chronic thrombus renders it more resistant to fibrinolysis.[10]

The substantial mobility and size of the right atrial thrombus were felt to pose the most immediate threat for potential embolization. There is a paucity of data regarding management strategies for right atrial thrombi beyond anticoagulation. There have been case reports of thrombolytic therapy for mobile right atrial thrombi; however, this can be associated with increased bleeding and risk of thrombus fragmentation.[11,12] Surgical embolectomy has also been reported,

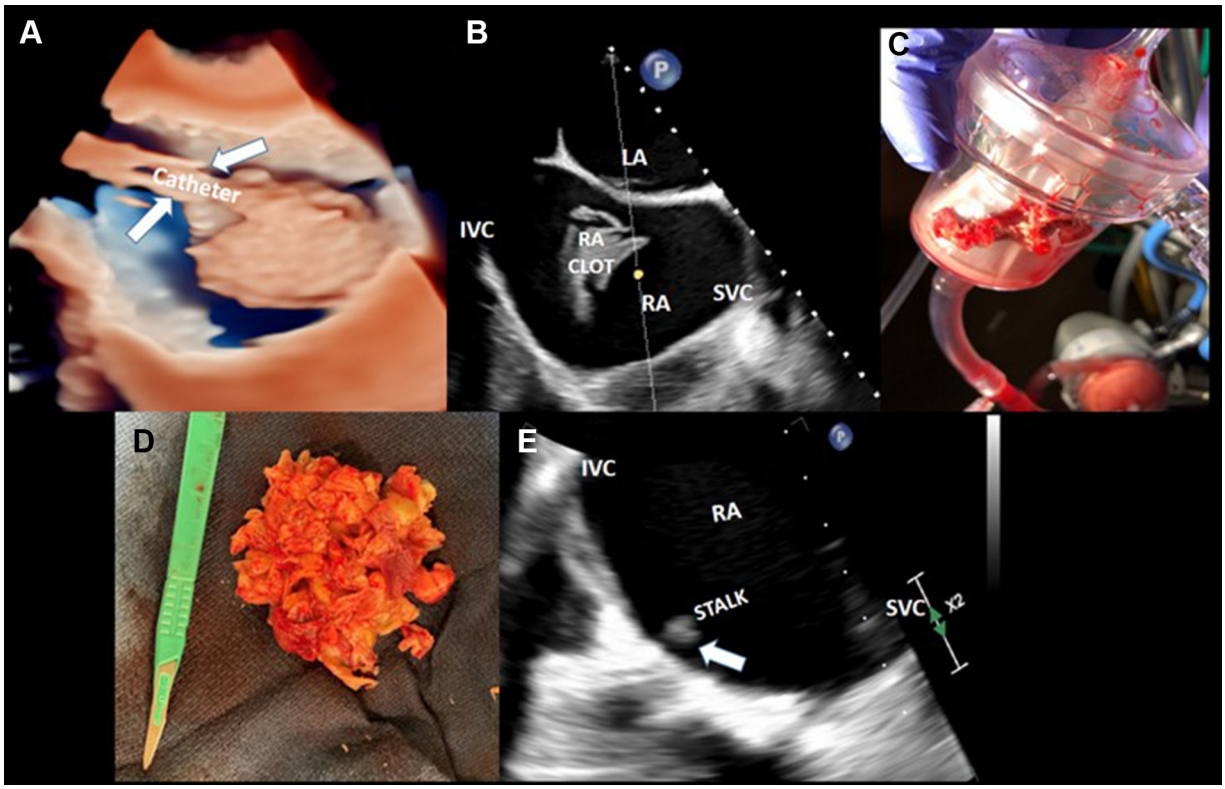

Figure 3 **(A)** Bicaval view (90°) TEE 3D rendering (TrueVue) demonstrating large-bore percutaneous aspiration of the RA clot (*arrows* identify aspiration catheter). **(B)** Bicaval view (90°) on TEE demonstrating RA clot post–percutaneous aspiration. **(C)** Canister post-thrombectomy demonstrating macerated RA clot. **(D)** Right atrial clot extracted from successful large-bore percutaneous aspiration noted in the canister. **(E)** Bicaval view TEE (120°) demonstrating a small remnant stalk of RA clot (*arrow*). *IVC*, Inferior vena cava; *SVC*, superior vena cava.

which involves the associated risks of sternotomy or thoracotomy.[13] Successful large-bore PAT of right atrial thrombi has been previously described in limited case reports.[14] In this case, this technique effectively removed the large atrial thrombus in this high-risk patient, and the pathologic diagnosis was able to be confirmed.

CONCLUSION

This case highlights the benefit of multimodality imaging in the diagnosis of intracardiac masses and showcases a unique management strategy for this challenging clinical scenario. Additional studies assessing optimal treatment of large, chronic intracardiac thrombi are needed.

SUPPLEMENTARY DATA

Supplementary data to this article can be found online at https://doi.org/10.1016/j.case.2022.08.004.

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