

# Clot or Not?



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## INTRODUCTION

Cardiac masses are rare, with a prevalence of 0.15% in echocardiographic series.<sup>1</sup> The differential diagnosis for cardiac masses includes primary cardiac tumors, cardiac metastases, vegetations, thrombi, fluid-filled lesions, and artifacts.<sup>1</sup> These entities have widely different implications for management and prognosis, highlighting the importance of accurately identifying the etiology of a cardiac mass. Echocardiography is a key tool for the identification and diagnosis of cardiac masses, relying on the appearance and location of the mass. Multimodality imaging permits the integration of echocardiography and other noninvasive imaging modalities to improve the characterization and differentiation of cardiac masses. This integrated approach allows tissue characterization without the use of a cardiac biopsy and its associated risks.

We report a case of multiple right ventricular (RV) cardiac masses characterized using an integrated imaging approach.

## CASE PRESENTATION

An 85-year-old cachectic man, an ex-smoker, presented to the emergency department with a 3-month history of progressive exertional dyspnea. His medical history was notable for laryngeal cancer resected in 2010 and recent diagnosis of invasive urothelial carcinoma without prostatic invasion, status post resection with curative intent 3 months before presentation.

His blood pressure on arrival was 121/64 mm Hg, with a heart rate of 77 beats/min and mild hypoxemia. Laboratory values revealed stable high-sensitivity troponin T of 20 ng/L (upper limit of normal, 15 ng/L) and prostate-specific antigen of 1.2  $\mu\text{g/L}$  (upper limit of normal, 4.0  $\mu\text{g/L}$ ).

On point-of-care ultrasound, the emergency physician identified RV masses, raising the differential diagnosis of tumors versus thrombi. Computed tomographic angiography described extensive bilateral lobar and segmental arterial filling defects compatible with pulmonary emboli, accompanied by masslike filling defects

within the RV cavity and features of right heart strain. Low-dose thrombolysis was considered but withheld because of the non-thrombotic echocardiographic appearance of the masses and the patient's hemodynamic stability.

Formal transthoracic echocardiography revealed moderate RV enlargement with global hypokinesis and multiple large masses in all segments of the right ventricle (inflow, body, and outflow). Masses were adherent to the lateral free wall, the septal aspect of the tricuspid annulus, the papillary muscles, and the RV apex (Figures 1 and 2, Videos 1 and 2).

The masses were multilobulated and had similar echogenicity to the myocardium without independent mobility. No right atrial or inferior vena cava masses were observed (Figure 3).

There was secondary mild tricuspid valve inflow obstruction (mean transtricuspid gradient, 2 mm Hg at 80 beats/min) (Figure 4) and moderate tricuspid regurgitation (Video 3), with an estimated pulmonary artery systolic pressure of 59 mm Hg. There was a small circumferential pericardial effusion without echocardiographic features of tamponade (Figure 1, Video 1).

The constellation of these echocardiographic findings suggested tumor rather than multiple thrombi; however, superimposed thrombi could not be excluded.

To further characterize the masses, cardiac magnetic resonance imaging (MRI) was performed. Cardiac MRI confirmed the location and burden of the RV masses (Figures 5 and 6, Videos 4 and 5).

Tissue characteristics were consistent with tumor without superimposed thrombi: T1 isointense (Figure 7A), T2 hyperintense (Figure 7B), first-pass perfusion positive (Figure 7C), and late gadolinium enhancement (LGE) heterogeneously positive.

The patient died of his disease within 1 month of diagnosis of cardiac involvement.

## DISCUSSION

Echocardiography is the first-line imaging modality for cardiac masses because it is a portable, widely available, noncontrast, and dynamic technology. It can also be used by nonechocardiographers to enhance their clinical assessments.<sup>2</sup>

In this case, in view of the point-of-care ultrasound and computed tomographic results, a presumptive diagnosis of multiple pulmonary emboli was made, and the emergency department physician considered low-dose thrombolysis<sup>3</sup> on the basis of the "clot" burden and RV strain. Appropriately, formal echocardiography was performed given the uncertainty of the etiology of the masses. The imaging findings on echocardiography, particularly the heterogeneity of the RV masses, their distribution, and motion synchronous with myocardium, suspected invasion of the RV lateral wall, as well as the thickened pericardium, suggested tumor rather than thrombi. Therefore, thrombolysis was deferred on the basis of the echocardiographic findings.

Considering our patient's history of recent urothelial carcinoma, cardiac metastases were strongly suspected. We proceeded to

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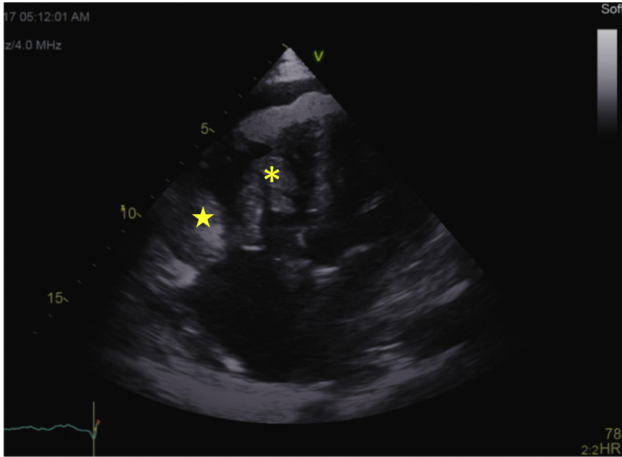
Keywords: Right ventricular masses, Cardiac tumor, Cardiac thrombus, Cardiac metastases

Conflicts of interest: Dr. Rudski has a minor holding in GE stock outside of a managed portfolio. All other authors reported no actual or potential conflicts of interest relative to this document.

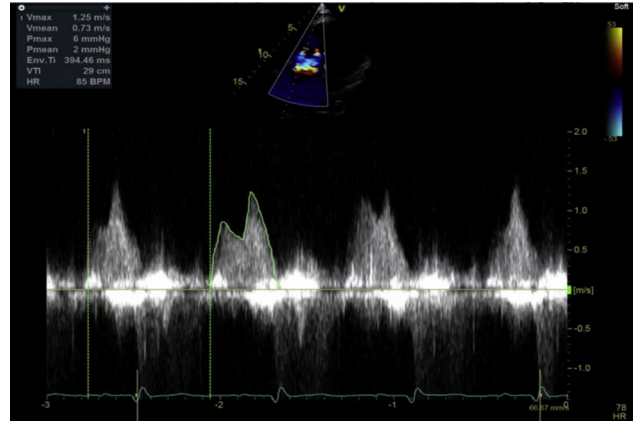
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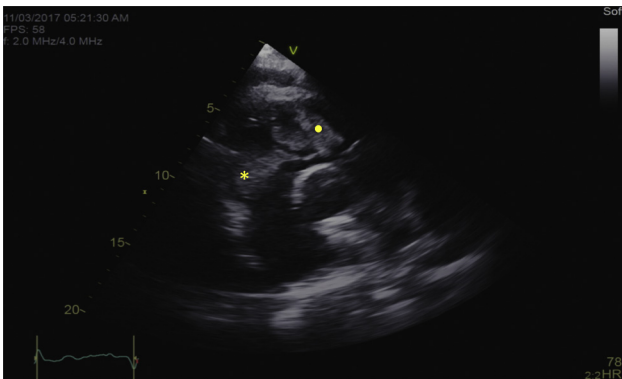
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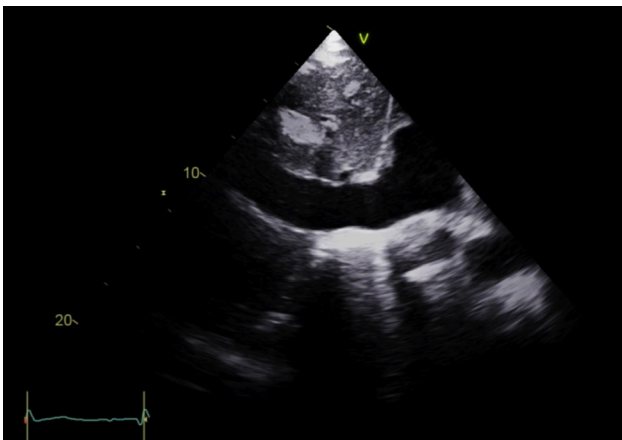
**Figure 1** Apical four-chamber view demonstrating a heterogeneous mass adjacent to the lateral RV free wall, possibly invading the myocardium (*star*). There were separate heterogeneous, multilobed masses on the papillary muscles (*asterisk*). Moderate RV dilation was noted. There was a small pericardial effusion.



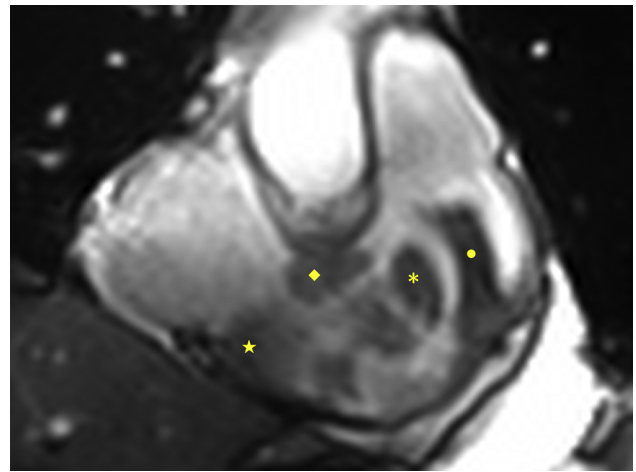
**Figure 4** Mild RV inflow obstruction (mean transtricuspid gradient, 2 mm Hg at 80 beats/min).



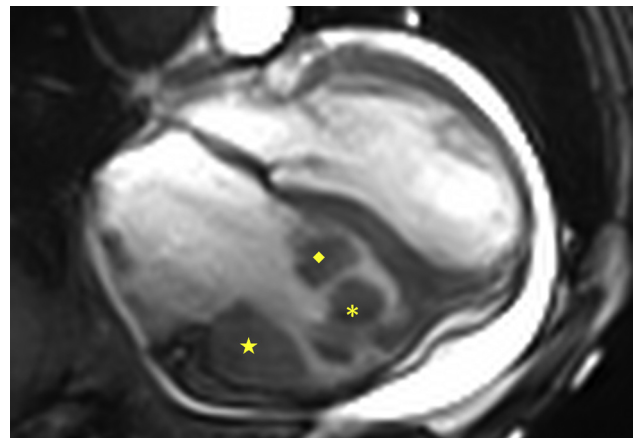
**Figure 2** Off-axis view demonstrating the masses on the papillary muscles in the RV body (*asterisk*) and a separate mass originating in the RV apex extending into the right ventricular outflow tract (*solid circle*). The masses were not independently mobile.



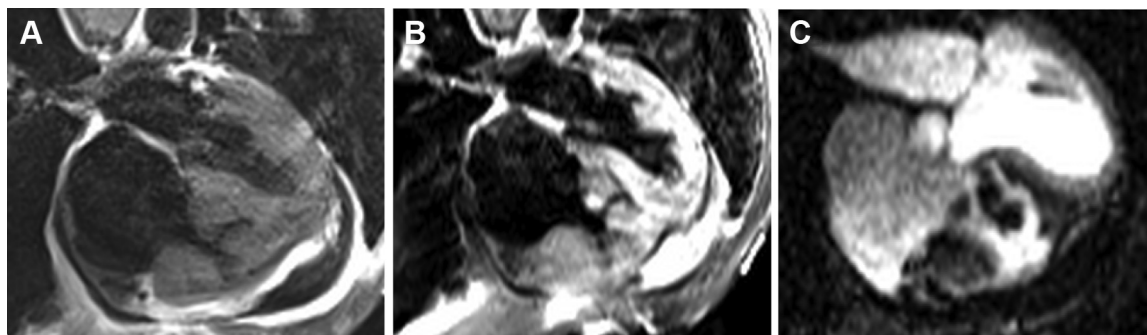
**Figure 3** Plethoric inferior vena cava (25 mm) without luminal masses.



**Figure 5** RV inflow and outflow steady-state free precession MRI sequence demonstrating the RV masses isointense to the myocardium originating from the base of the papillary muscles (*asterisk*), right ventricular outflow tract (*solid circle*), RV lateral wall (*star*), and tricuspid valve annulus (*diamond*).



**Figure 6** Four-chamber steady-state free precession MRI sequence demonstrating the RV masses isointense to the myocardium originating from the base of the papillary muscles (*asterisk*) and RV lateral wall (*star*) and tricuspid valve annulus (*diamond*).



**Figure 7** (A) T1-weighted sequence demonstrating the masses are isointense to the myocardium. (B) T2-weighted sequence demonstrating heterogeneous hyperintensity of the RV masses. (C) Positive first-pass perfusion following administration of gadolinamide (0.1 mmol/kg).

perform cardiac MRI to further characterize the masses, with the goal of establishing a noninvasive tissue diagnosis. MRI permits differentiation between thrombus and tumor. The appearance of thrombi depends on the acuity of the thrombi. Acute thrombi appear hyperintense on T1 and T2 sequences because of the presence of oxygenated hemoglobin. Subacute thrombi appear hyperintense on T1 imaging and hypointense on T2 imaging because of the paramagnetic effects of methemoglobin and the loss of water content. Over time, the methemoglobin is replaced by fibrous tissue, and the thrombus continues to lose water content, leading to the hypointense appearance of chronic thrombi on T1- and T2-weighted imaging. In contrast, most tumors are isointense on T1 and hyperintense on T2 sequences. Being avascular, acute and chronic thrombi do not perfuse on first-pass perfusion imaging. Conversely, tumors, being vascular structures, will perfuse on first-pass perfusion imaging. Tumors may heterogeneously enhance on late gadolinium sequences, but thrombi do not usually enhance with LGE. If a fibrous rim develops around the chronic thrombus, it can peripherally enhance on LGE.<sup>4</sup> Therefore, the tissue characteristics of our patient (T1 isointense, T2 hyperintense, first-pass perfusion positive, LGE heterogeneously positive) were consistent with tumor.

Cardiac computed tomography (CT) and cardiac positron emission tomography are two other imaging modalities that can also be considered to characterize cardiac masses. Cardiac CT is recognized for its high spatial resolution. An advantage of CT is the ability to identify areas of calcification. Calcified tissue is not susceptible to radiofrequency pulses and will therefore remain hypointense on all sequences on MRI. Conversely, areas of calcification are easily identified on CT.<sup>5</sup> The diagnostic advantage of positron emission tomography is twofold; first, it can distinguish metabolically active tissues from non-metabolically active tissue (most benign masses), and second, it can identify recurrence of the primary tumor and distant metastatic foci.<sup>6</sup> In our case, positron emission tomography may have offered additional insight by confirming the masses were metabolically active and identifying recurrence at the primary site or other metastatic lesions.<sup>1</sup>

Cardiac involvement in urothelial carcinoma is rare. The prevalence in autopsy studies is 3.9%.<sup>7</sup> Only a small number of cases have been identified before autopsy, with a total of 15 cases having been reported. Cardiac metastases from urothelial carcinoma most frequently involve the right ventricle (eight of 15 cases), but they have also been reported in the left ventricle, pericardium, and right atrium.<sup>8,9</sup> Identification of cardiac metastases in urothelial carcinoma has significant prognostic implications. Hattori *et al.*<sup>8</sup> described

a poor prognosis associated with cardiac urothelial metastasis, with most patients dying shortly after their diagnosis or their first clinical encounter.

In the context of the patient's clinical history of urothelial carcinoma, the masses likely represent cardiac urothelial metastasis. Biopsy was considered to confirm the diagnosis but deferred given the age and poor prognosis of the patient, as well as a persistent thrombocytopenia.

## CONCLUSION

Multimodality imaging is useful in differentiating thrombi from cardiac tumors. Differentiating intracardiac thrombus from tumor in patients with an active malignancy has significant implications for management and prognosis. In this case, echocardiography significantly altered the early management of this patient in deferring thrombolysis and suggesting the etiology of the masses as tumors. Cardiac MRI allowed the confirmation of the RV masses as cardiac tumors, likely urothelial metastases, conferring a poor prognosis.

## SUPPLEMENTARY DATA

Supplementary data related to this article can be found at <https://doi.org/10.1016/j.case.2017.09.010>.

## REFERENCES

- Motwani M, Kidambi A, Herzog BA, Uddin A, Greenwood JP, Plein S. MR imaging of cardiac tumors and masses: a review of methods and clinical applications. *Radiology* 2013;268:26-43.
- Spencer KT, Kimura BJ, Korcarz CE, Pellikka PA, Rahko PS, Siegel RJ. Focused cardiac ultrasound: recommendations from the American Society of Echocardiography. *J Am Soc Echocardiogr* 2013;26:567-81.
- Sharifi M, Bay C, Skrocki L, Rahimi F, Mehdipour M. Moderate pulmonary embolism treated with thrombolysis (from the "MOPETT" trial). *Am J Cardiol* 2013;111:273-7.
- Pazos-López P, Pozo E, Siqueira ME, García-Lunar I, Cham M, Jacobi A, et al. Value of CMR for the differential diagnosis of cardiac masses. *JACC Cardiovasc Imaging* 2014;7:896-905.
- Kassop D, Donovan MS, Cheezum MK, Nguyen BT, Gambill NB, Blankstein R, et al. Cardiac masses on cardiac CT: a review. *Curr Cardiovasc Imaging Rep* 2014;7:9281.

6. Shrikanthan S, Sunkar M. Utility of FDG PETCT in assessment of cardiac masses. *J Nucl Med* 2012;53(suppl 1):1446.
7. Bussani R, De-Giorgio F, Abbate A, Silvestri F. Cardiac metastases. *J Clin Pathol* 2007;60:27-34.
8. Hattori S, Miyajima A, Maeda T, Takeda T, Morita S, Kosaka T, et al. Metastatic urothelial carcinoma to pericardia manifested by dyspnea from cardiac tamponade during systemic chemotherapy: case report and literature review. *Can Urol Assoc J* 2012;6:E184.
9. Nakashima Y, Tanioka K, Kubo T, Yamasaki N, Yamasaki I, Syuin T, et al. Metastatic cardiac tumor from urothelial carcinoma detected by transthoracic echocardiography: a case report. *J Med Case Rep* 2015;9:257.