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CASE REPORT

INTERMEDIATE

CLINICAL CASE

Charcoal Heart

Metastatic Melanoma Mimicking Right Atrial Myxoma

Mahmoud Ali, MD,[a] Amina Adil, MD,[a] Rahul Sawlani, MD,[b] Sana Jeffreys, MD,[c] Omar Cheema, MD,[a] Patrycja Galazka, MD,[a] A. Jamil Tajik, MD[a]

ABSTRACT

A 59-year-old woman with history of skin melanoma and complete excision presented with palpitations. Transthoracic echocardiogram revealed right atrial mass attached to interatrial septum. Cardiac magnetic resonance was suggestive of metastatic melanoma. Laboratory tests revealed elevated liver enzymes. Liver ultrasonography showed a large mass positive for metastatic melanoma by biopsy. (**Level of Difficulty: Intermediate.**) (J Am Coll Cardiol Case Rep 2021;3:1545–1550) © 2021 The Authors. Published by Elsevier on behalf of the American College of Cardiology Foundation. This is an open access article under the CC BY-NC-ND license (http://creativecommons.org/licenses/by-nc-nd/4.0/).

HISTORY OF PRESENTATION

A 59-year-old woman presented to her primary physician with worsening palpitations for the past year. On physical examination, blood pressure was 124/72 mm Hg, heart rate was 58 beats/min, and oxygen saturation was 99% on room air. Cardiovascular examination revealed nondisplaced apical impulse; normal-intensity S_1 and S_2; and no murmurs, gallops, or rubs. Lungs were clear to auscultation bilaterally.

LEARNING OBJECTIVES

- To identify cardiac manifestations and increase awareness of metastatic melanotic disease to the heart.
- To understand the role of multimodality imaging (echocardiography, cardiac magnetic resonance, positron emission tomography) as useful, noninvasive diagnostic tools in identifying cardiac masses.

The laboratory workup showed normal complete blood count, electrolytes, creatinine, pro-B-type natriuretic peptide, and ultrasensitive troponin. Her liver function test results were notable for mildly elevated alkaline phosphatase. The chest x-ray film was unremarkable. Electrocardiogram and Holter monitor for 48 hours showed normal sinus rhythm with no ectopy. Transthoracic echocardiogram revealed a right atrial (RA) mass attached to the fossa ovalis region of the interatrial septum measuring 3.5 × 3.3 × 2.3 cm (**Figures 1A and 1B,** Videos 1 and 2).

PAST MEDICAL HISTORY

The patient had a medical history of a wide local excision of skin melanoma of the left upper extremity 10 years earlier, with no evidence of residual disease. Sentinel lymph node biopsy in the left axilla showed no evidence of metastatic disease. The patient did not require any adjuvant therapy.

From the [a]Aurora Cardiovascular and Thoracic Services, Aurora Sinai/Aurora St. Luke's Medical Centers, University of Wisconsin School of Medicine and Public Health, Milwaukee, Wisconsin, USA; [b]Department of Radiology, Aurora Sinai/Aurora St. Luke's Medical Centers, Milwaukee, Wisconsin, USA; and the [c]Aurora Cancer Care/Aurora Health Care Medical Group, Racine, Wisconsin, USA.

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ABBREVIATIONS AND ACRONYMS

CMR = cardiac magnetic resonance

FDG = fluorodeoxyglucose

ICI = immune checkpoint inhibitors

MM = malignant melanoma

PD-1 = programmed death 1

PET = positron emission tomography

RA = right atrial

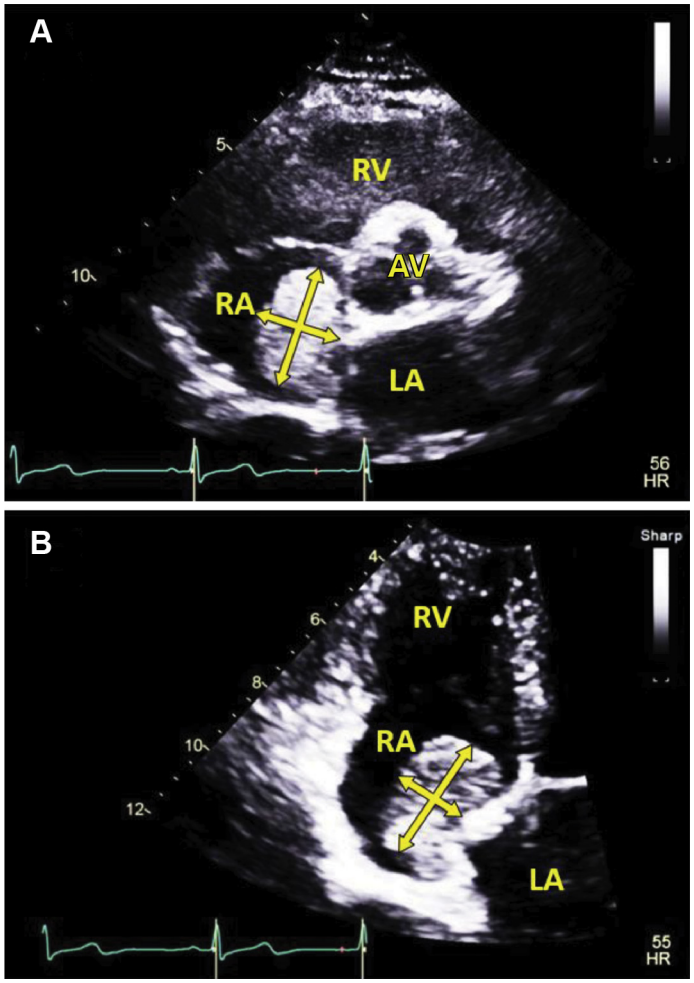
DIFFERENTIAL DIAGNOSIS

The differential diagnosis of the RA mass included primary benign cardiac masses, such as myxoma or lipoma; primary malignant mass, such as angiosarcoma; metastatic disease to the heart, such as melanoma; and RA thrombus.

INVESTIGATIONS

Further characterization of the RA mass with cardiac magnetic resonance (CMR) demonstrated that the mass was hyperintense on T_1- and T_2-weighted images, actively perfused, and had avid late gadolinium enhancement with internal hemorrhage suggestive of malignant cardiac tumor, specifically of a metastatic melanoma (**Figures 2A to 2J**, Videos 3 and 4). In the setting of elevated alkaline phosphatase, a liver ultrasonograph was also ordered and revealed a large hepatic mass in the right lobe. The findings were later confirmed with a computed tomography scan that showed a large hepatic mass with a necrotic center measuring 14 cm in diameter. Ultrasound-guided liver biopsy was positive for metastatic malignant melanoma (MM). With these findings, the patient underwent a positron emission tomography (PET)/computed tomography scan that showed fluorodeoxyglucose (FDG)-avid lesions in the liver, heart, and mediastinal and periportal lymph nodes (**Figures 3A and 3B**).

FIGURE 1 2-Dimensional Transthoracic Echocardiogram Images Showing an RA Mass



(A) Parasternal short-axis view showing the RA mass attached to the interatrial septum. **(B)** Zoomed para-apical view showing the RA mass measuring 3.5 × 3.3 × 2.3 cm. AV = aortic valve; LA = left atrium; RA = right atrium; RV = right ventricle.

MANAGEMENT

Patient had no evidence of an actionable sequence variation noted on molecular testing; hence, no targeted therapy was initiated. She was then started on immunotherapy with pembrolizumab, a programmed death-1 (PD-1) receptor blocker.

DISCUSSION

Metastatic involvement of the heart has up to 100-times higher incidence than primary cardiac tumors. It is reported that the incidence of cardiac metastasis ranges between 0.7% and 3.5% in the general population, and it is up to 14.2% in patients with advanced metastatic cancer (1).

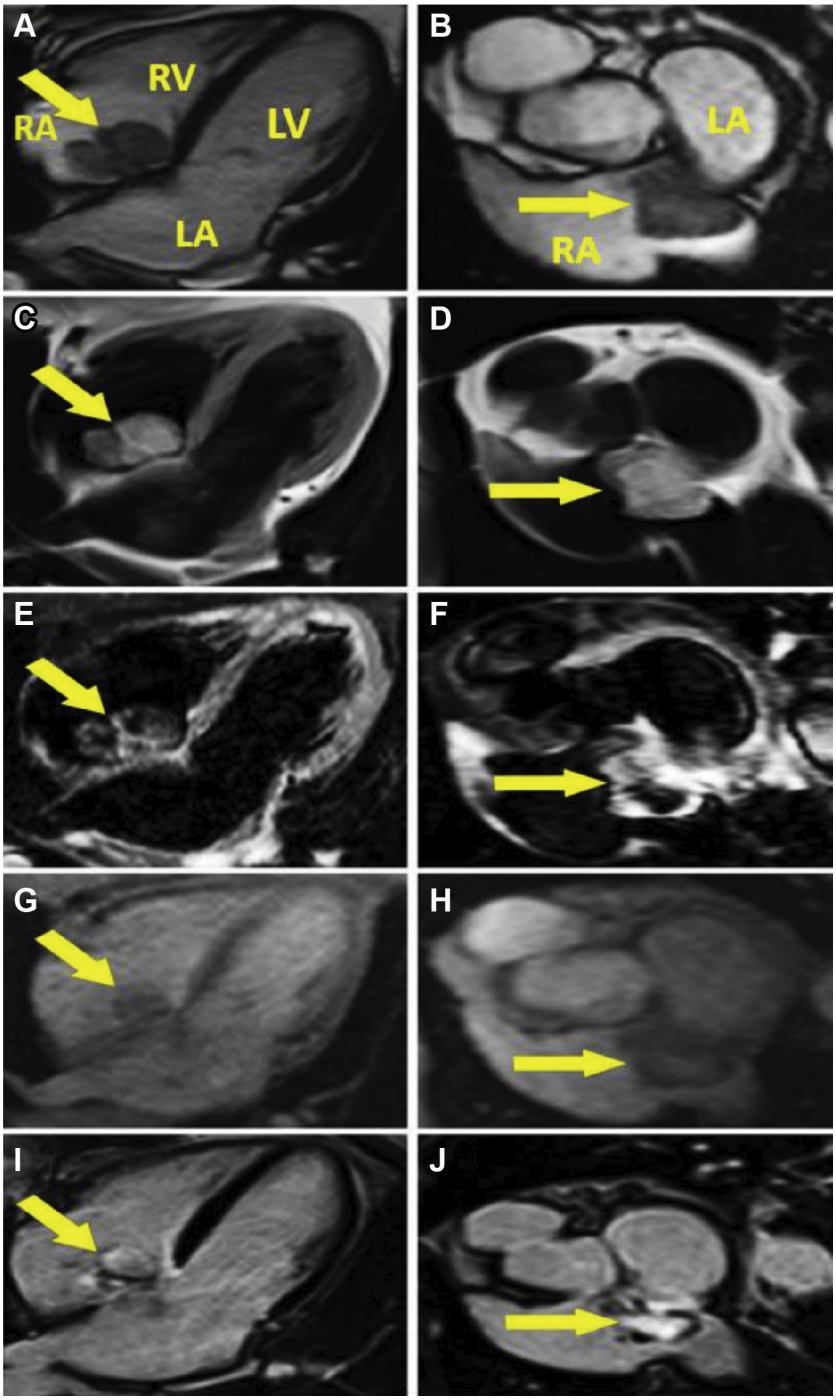
Cancer cells can metastasize to the heart by 4 routes: direct extension (eg, lung cancer), retrograde lymphatic seeding (eg, breast cancer), hematogenous seeding (eg, MM and lymphomas), or venous extension (eg, renal cell carcinoma) (1).

MM has one of the highest rates of cardiac metastases of any tumor (1,2). A review of 70 autopsies of patients with metastatic melanoma reported cardiac metastasis in 65% of the cases (3). Metastatic melanoma to the heart was originally described in 1820 by William Norris as part of the first case of melanoma in published reports (4). Metastatic melanomas have a distinguished black, mottled appearance on gross pathology, hence the term *charcoal heart* (5). MM metastases can involve any cardiac structure, but it usually metastasizes to the myocardium and endocardium of the right ventricle or atrium.

The most common clinical presentation in the case of myocardial-endocardial metastases, that is, MM, is tachycardia (6).

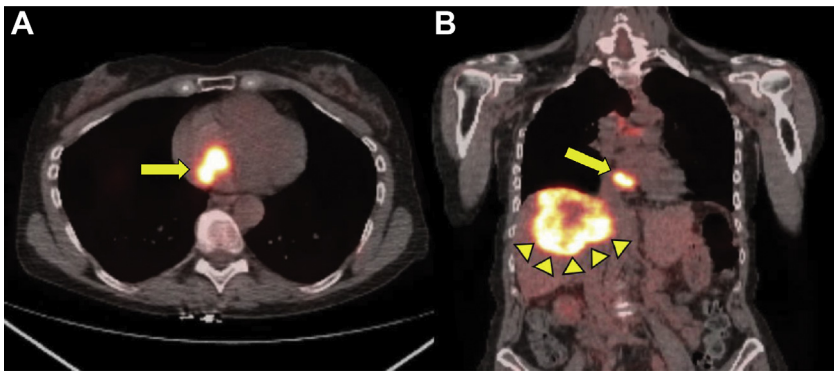
Here, we present a case of an RA intracavitary metastatic melanoma. Our echocardiography images of the mass were more typical of a primary cardiac

FIGURE 2 **Cardiac Magnetic Resonance**



(A) Steady-state free precession 4-chamber (4CH) and **(B)** short-axis (SAX) views showing a large mass in the RA **(arrow)** attached to the interatrial septum. The **(C)** 4CH and **(D)** SAX views show that this mass **(arrow)** is hyperintense on double inversion recovery (IR) images. The **(E)** 4CH and **(F)** SAX views show that this mass **(arrow)** is also partially hyperintense on triple IR images. The **(G)** 4CH and **(H)** SAX views show that this mass **(arrow)** is actively perfusing on first-pass resting perfusion. The **(I)** 4CH and **(J)** SAX views show that this mass **(arrow)** has heterogenous late gadolinium enhancement. LV = left ventricle; other abbreviations as in Figure 1.

FIGURE 3 Fluorodeoxyglucose Positron Emission Tomography



(A) Axial image of fluorodeoxyglucose (FDG) positron emission tomography (PET) showing an FDG-avid mass in the right atrium **(arrow)**. **(B)** Coronal image of FDG PET showing an FDG-avid mass in the right atrium **(arrow)** and in the liver **(arrowheads)**.

myxoma, given that the atrial mass in this case was a well-defined lesion with a smooth surface, arising from the atrial septum and adherent to it. Nonetheless, metastatic melanoma remained high on the differential diagnosis, given the patient's past medical history.

Noninvasive imaging modalities can help us further distinguish the etiology of cardiac masses. CMR is a useful, noninvasive imaging tool that can further characterize cardiac masses into benign versus malignant based on their tissue characteristics. Because of the paramagnetic properties of melanin, melanomas tend to be hyperintense on T_1-weighted sequences as compared to other metastatic cardiac tumors, which are most often hypointense or isointense on T_1-weighted images because T_1 signal characteristics on CMR are dependent on the degree of melanin present in the tumor (7). Given the patient's past medical history and the hyperintense T_1 signal with other features of malignant cardiac tumor, such as active first-pass perfusion, heterogenous delayed gadolinium enhancement and hemorrhage overall appearance on CMR of the RA tumor was suggestive of metastatic cardiac melanoma rather than RA myxoma or a thrombus. In comparison, myxomas will usually have a heterogeneous appearance on T_1- and T_2-weighted images because of varying amounts of myxoid, hemorrhagic, ossific, and necrotic tissue, and delayed enhancement can be patchy (8).

Furthermore, PET assesses the metabolic activity of tumors using ^{18}F-FDG. As shown in our case, FDG-PET can be helpful for staging malignancies, evaluating the extent of the tumor, and planning the biopsy (8).

Regarding the treatment of melanomas, immune checkpoint inhibitors (ICIs) represent a novel category of drugs that help direct the immune system to recognize and target cancer cells. PD-1 is an immune inhibitory checkpoint expressed on the surface of activated T cells. ICI can bind to the PD-1 receptor, blocking its interaction with its ligands (programmed death-ligand 1 [PD-L1)], and programmed death-ligand 2 [PD-L2]) to prevent T-cell inactivation (9). ICI is used as a first-line therapy for metastatic MM, and it showed a significant improvement in survival with or without combination with conventional targeted therapy (BRAF/MEK inhibitors) (10).

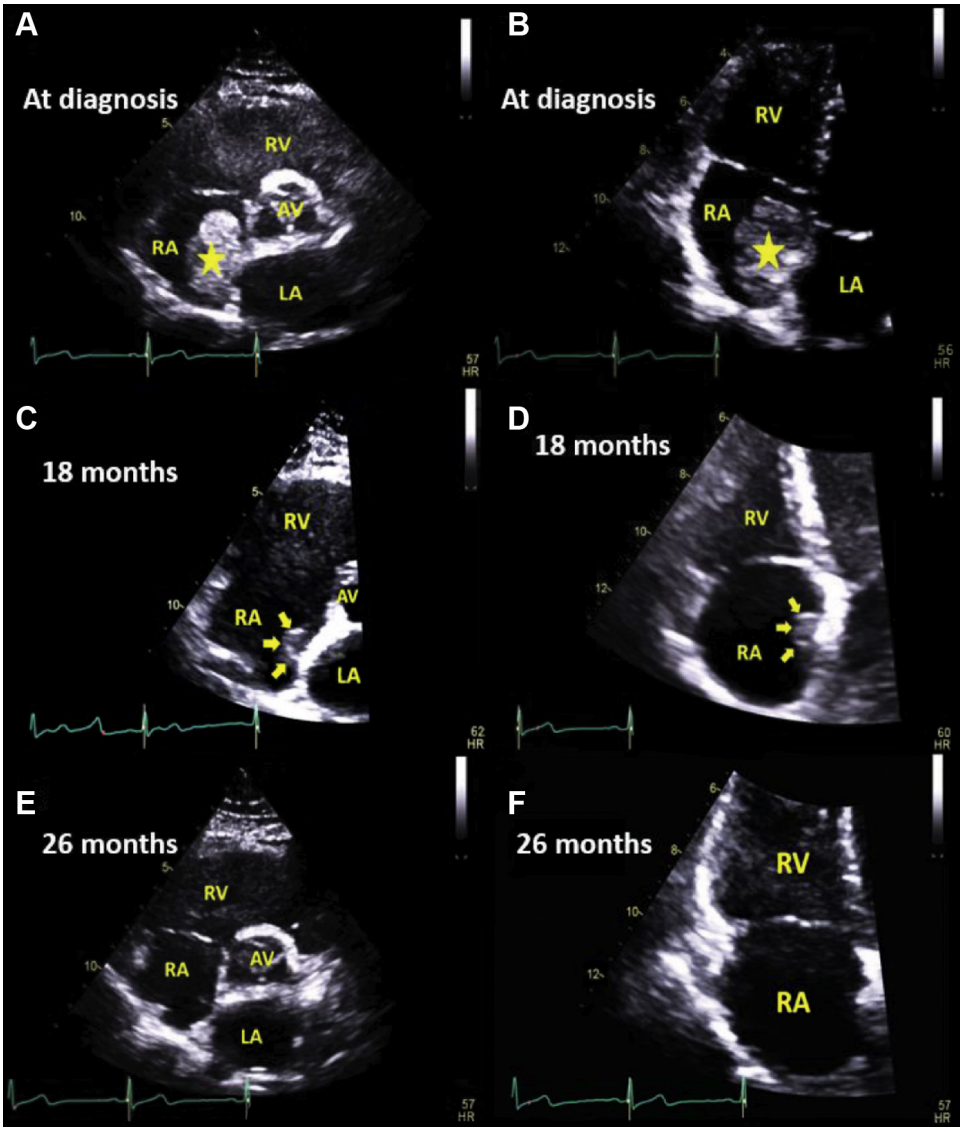
FOLLOW-UP

Patient was started on pembrolizumab (an ICI agent that blocks PD-1 receptor), with significant reduction of the RA mass noted on follow-up echocardiograms. After completion of 11 cycles of pembrolizumab, a 26-month follow-up echocardiogram showed complete resolution of the RA mass (**Figures 4A to 4F**).

CONCLUSIONS

We describe a case of a mass that resembled a primary myxoma because of its echocardiographic appearance and location but turned out to be metastatic melanoma. Multimodality imaging can aid in further

FIGURE 4 2-Dimensional Echocardiogram Images Showing an RA Mass at Different Stages of Treatment



(A) Parasternal short-axis (PSAX) and **(B)** apical 4-chamber views showing an RA mass **(yellow star)** at the time of diagnosis. **(C)** PSAX and **(D)** apical 4-chamber views showing significant reduction in the size of the RA mass at 18 months posttherapy. **(E)** PSAX and **(F)** apical 4-chamber views at 26 months posttherapy demonstrating RA mass resolution. Abbreviations as in Figure 1.

characterization of cardiac masses and can subsequently guide diagnosis and treatment.

ADDENDUM After acceptance of this work, a follow-up echocardiogram has detected a small lesion in the same region, perhaps representing recurrence.

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ADDRESS FOR CORRESPONDENCE: Dr A. Jamil Tajik, Cardiac Specialty Center, Aurora St. Luke's Medical Center, 2801 West Kinnickinnic River Parkway, Suite 530, Milwaukee, Wisconsin 53215, USA. E-mail: wi.publishing14@aah.org.

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KEY WORDS **cardiac neoplasms, metastatic heart disease, metastatic melanoma**

APPENDIX **For supplemental videos, please see the online version of this paper.**