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CASE REPORT

CLINICAL CASE

Diagnostic Pathway From Incidental Mass to Metastatic Melanoma

Role of Multimodal Imaging and Medical Therapy

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ABSTRACT

We present a case of detection of a right atrial mass during surveillance echocardiography, mimicking myxoma. Cardiac magnetic resonance and computed tomography revealed infiltration into the pericardium, suggesting malignancy. Abdominal computed tomography showed multiple liver masses that were histologically positive for metastatic amelanotic melanoma. Under immunotherapy adequate remission was achieved. (J Am Coll Cardiol Case Rep 2024;29:102146)

HISTORY OF PRESENTATION

We describe a case of an asymptomatic 79-year-old male patient presenting for annual surveillance echocardiography. On physical examination, blood pressure, heart rate, and oxygen saturation were within normal limits, and heart and lung auscultation appeared normal. Electrocardiography showed a stable sinus rhythm.

LEARNING OBJECTIVES

- To point out the diversity of cardiac masses, extending far beyond thrombus and myxomas up to malignancies, such us sarcomas, angiosarcomas, and metastatic tumors.
- To underline the complementary value of multimodality cardiovascular imaging for the establishment of the correct diagnosis and guidance of the appropriate therapeutic decision.

PAST MEDICAL HISTORY

The patient underwent an annuloplasty ring operation 6 years ago because of severe mitral regurgitation, as well as a pulmonary vein isolation for paroxysmal atrial fibrillation. A dual-chamber pacemaker was implanted 2 years ago. The rest of the patient's medical history remained clear.

INVESTIGATIONS

A right atrial mass measuring 25 × 30 × 28 mm was detected, which was not present 9 months ago (Video 1A). The mass exhibited moderate homogeneous echogenicity, being attached to the fossa ovalis of the interatrial septum, mimicking myxoma or thrombus (**Figure 1A**, Videos 1B and 1C). Laboratory chemical

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ABBREVIATIONS AND ACRONYMS

CCT = cardiac computed tomography

CMR = cardiac magnetic resonance

diagnostics including cardiac, kidney, and liver parameters revealed no significant findings.

Cardiac surgery was scheduled, and cardiac computed tomography (CCT) was performed to exclude relevant coronary artery disease. Unexpectedly, CCT revealed infiltration of the adjacent inferior-septal basal pericardium by the mass, which was highly indicative of a malignant process such as cardiac sarcoma or metastasis (**Figures 1B and 1C**). Relevant coronary artery disease was excluded.

Cardiac magnetic resonance (CMR) was scheduled for tissue characterization, confirming infiltration of the pericardium (**Figure 1D**, Video 2A). CMR also showed contrast uptake into the mass during first-pass perfusion imaging (**Figure 1E**, Video 2B). Late gadolinium enhancement imaging exhibited an inhomogeneous pattern. The mass appeared hyperintense on T_1-mapping and T_2-weighted black blood images (**Figures 1G and 1H**).

Abdominal CT demonstrated multiple suspicious liver lesions as well as enlarged periportal and mediastinal lymph nodes and metastatic soft tissue proliferation in the mediastinum.

Ultrasound-guided liver biopsy was performed, and histopathology showed liver tissue infiltration by ovular (to fusiform) tumor cells with variable-sized nuclei, irregular fibrous network, and neoangiogenesis with atypical mitoses (**Figures 2A and 2B**). In addition, the tumor exhibited a positive immunohistochemical reaction for SOX10, confirming melanoma (**Figure 2C**).

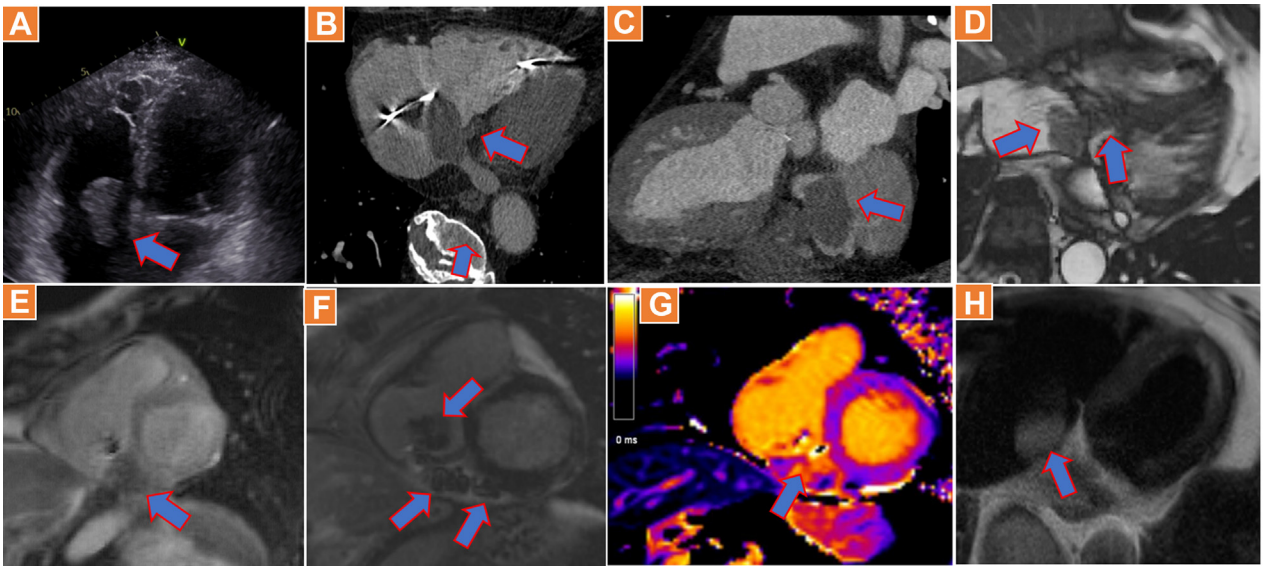
MANAGEMENT

The patient was started on pembrolizumab based on the histology findings.

DISCUSSION

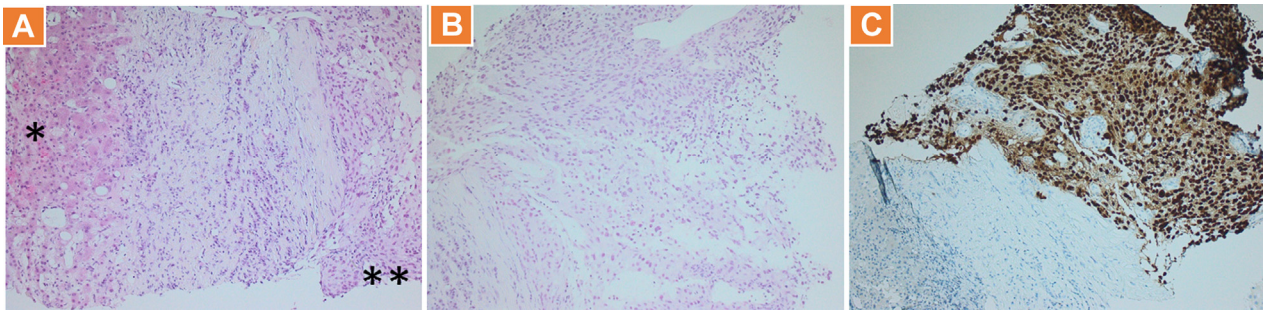
Cardiac masses include thrombi, vegetations, calcifications, or other rare lesions, such as tumors (primary or metastatic). The acquisition of imaging data in cardiology begins with transthoracic echocardiography and expands with transesophageal echocardiography and cross-sectional imaging techniques

FIGURE 1 Echocardiography, CT, and CMR Images



(A) Echocardiography shows right atrial mass (blue arrow), attached to the fossa ovalis. (B) Computed tomography transverse view shows infiltration of the pericardium (blue arrow), compatible with cardiac sarcoma or metastatic disease. (C) Computed tomography sagittal view show infiltration of pericardial tissue (blue arrow). (D) Cardiac magnetic resonance cine image transverse view shows myocardial infiltration (central blue arrow). (E) Cardiac magnetic resonance first-pass perfusion short-axis view shows reduced perfusion (blue arrow) of the tumor compared to myocardium. (F) Late gadolinium enhancement shows inhomogeneous enhancement (blue arrows). (G) T_1 mapping shows hyperintense appearance (blue arrow). (H) Inversion recovery image T_2-weigthed image shows hyperintense tumor (blue arrow).

FIGURE 2 Histopathological Images and Immunohistochemistry Staining

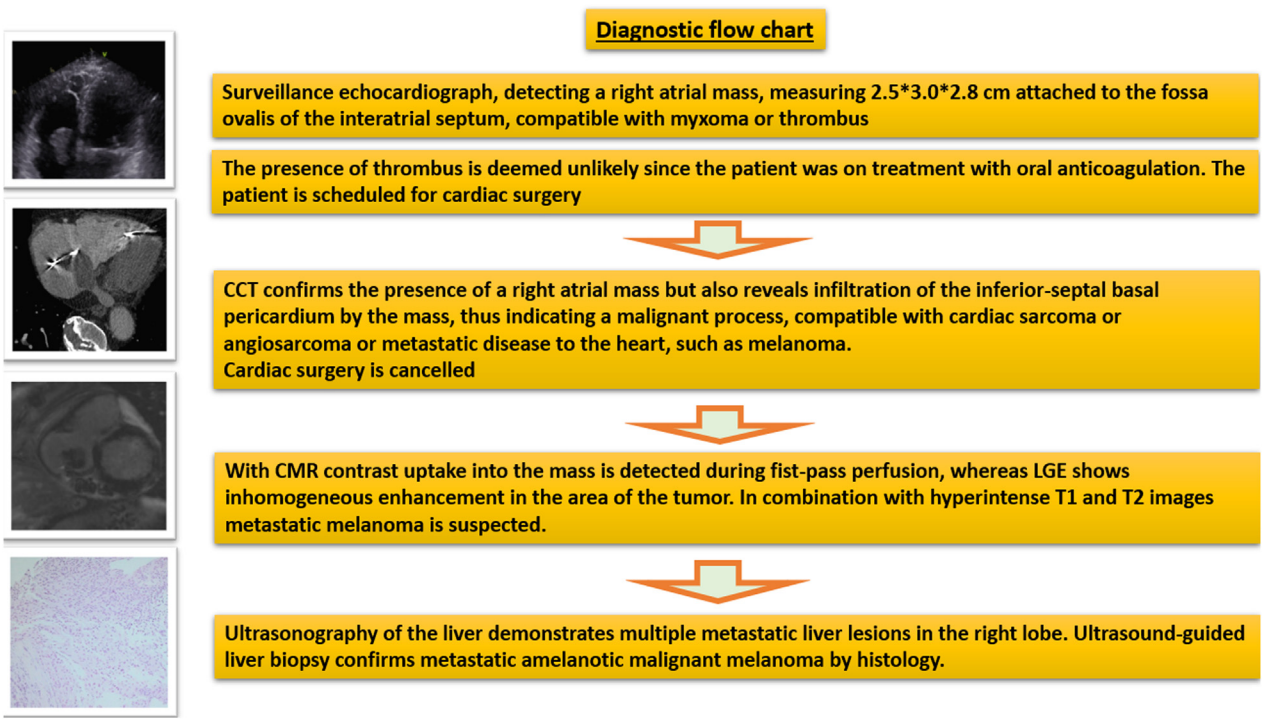


(A) Hematoxylin and eosin staining of the liver biopsy shows normal liver parenchyma (left side, *) and tumor tissue (right side, **). (B) Hematoxylin and eosin staining at higher digital magnification shows tumor tissue. (C) SOX10 immunohistochemistry staining allows us to establish a diagnosis of amelanotic melanoma.

including CCT and CMR. The differentiation of cardiac tumors requires a combination of imaging modalities followed by histology.[1] Therefore, echocardiography represents the first-line diagnostic tool.

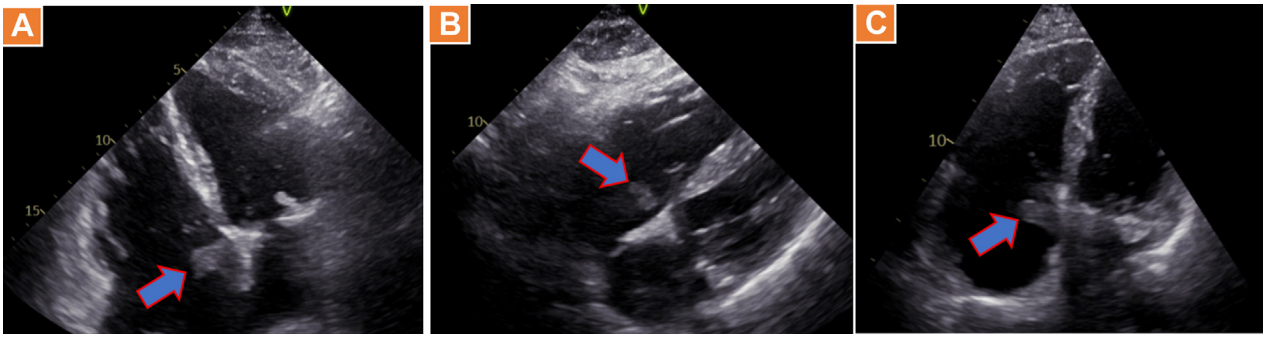
The echocardiographic evaluation includes mass size, localization and modality of attachment to the cardiac walls, shape, surface, and mobility.[2] Malignancies may appear sessile, owing to the infiltration of adjacent structures with irregular shape. Angiosarcomas are the most common primary cardiac tumors, originating from the right atrium and infiltrating the pericardium, thus representing a possible differential diagnosis to metastatic

FIGURE 3 Diagnostic Flow Chart



CCT = cardiac computed tomography; CMR = cardiac magnetic resonance; LGE = late gadolinium enhancement.

FIGURE 4 Follow-Up Echocardiography



Follow-up echocardiography of the patient at 3 months demonstrating tumor regression (after 3 immunotherapy cycles): (A) 4-chamber view; (B) subcostal view. Follow-up echocardiography after 6 months demonstrating slight regression; (C) 4-chamber view. The blue arrows indicate the metastatic melanoma in all three panels.

melanomas. Metastases can be located in several intracardiac structures, frequently emerging from the inferior vena cava to the right atrium. However, location opposite the inferior vena cava ostium may also be suggestive of malignancy.[3] Thus, a solid diagnostic approach to exclude malignancy of right atrial masses is recommended.

CMR imaging is a useful tool for the tissue characterization of cardiac masses.[4] The versatility of CMR offers anatomical localization of cardiac masses and illustrates the vascularity of the structure and the presence of fibrotic or necrotic tissue without radiation exposure.[5] In addition, CMR can accurately differentiate between tumor and thrombus,[6] providing high accuracy for the differentiation between tumor types.[5] First-pass perfusion using T_1-weighted imaging and late gadolinium enhancement sequences are used for the assessment of the tumor vascular supply and fibrosis. In addition, T_1- and T_2-weighted images aid tissue characterization.

Like CMR, CCT can also be used for the assessment of cardiac tumors, evaluating perfusion by contrast enhancement pattern, morphology, and infiltration of adjacent structures.[6] In addition, CCT can detect remote metastases and concomitantly exclude relevant coronary artery disease. In our case, the role of CCT was crucial because it detected pericardial infiltration indicative of malignancy, thus completely changing the further diagnostic and therapeutic course. It also detected extracardiac metastases, including those used for tissue biopsy in the liver (**Figure 3**).

Biopsy represents the cornerstone of oncologic diagnostics and can be performed under ultrasound guidance from various organs, such as in our case (liver). Regarding metastatic amelanotic melanoma, we described a case arising as an incidental finding during surveillance echocardiography in a patient without history of malignancy. According to large epidemiologic registries, around 10%-26% of patients are initially diagnosed with stage IV (metastatic) melanoma, whereas the most common sites of metastasis involve the skin, subcutaneous tissue, liver, lungs, bones, and brain.[7] Amelanotic melanoma is a rare variant (~10% of all melanomas) carrying poor prognosis due to delayed diagnosis.[8]

Melanoma frequently spreads distantly through angiogenesis, dissemination, or colonization of the target organ. Metastases have been described in various organs, including the heart. The amelanotic melanoma represents a rare subtype with worse prognosis, largely due to delayed diagnosis because of lack of pigmentation.[8] Regarding therapy, pembrolizumab, a humanized monoclonal antibody directed against programmed death receptor 1 has been shown to suppress and reverse melanoma growth in long-term surveillance studies of patients with advanced disease.[9]

FOLLOW-UP

In our case, the immunotherapy was well tolerated, which is in line with recent data.[10] Follow-up echocardiography after 3 and 6 months demonstrated relevant regression of the melanoma (Videos 3A to 3C), measuring 13 × 11 × 7 mm and 11 × 9 × 6 mm, respectively (**Figures 4A to 4C**).

CONCLUSIONS

The present case report underlines the importance of multimodal cardiovascular imaging for the correct

diagnosis of cardiac masses, guiding the initiation of specific therapies.

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KEY WORDS cardiac magnetic resonance, computed tomography, echocardiography, histology, immunotherapy, transesophageal echocardiography

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