Role of Echocardiography in Diagnosing Metastatic Testicular Carcinoma in a Young Patient Presenting as Right Heart Failure

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INTRODUCTION

Cardiac metastasis is a fairly uncommon presenting phenomenon with an incidence rate of <0.1%.[1] The cardiac presentation of a primary testicular germ cell tumor (GCT) has been rarely reported.[2] Here, we present a case of a metastatic testicular carcinoma presenting as right heart failure in a 29-year-old man.

CASE PRESENTATION

A 29-year-old previously healthy man presented to the emergency department with a chief complaint of worsening dyspnea on exertion for 1 month and testicular swelling. He had associated symptoms of abdominal swelling and discomfort. He denied symptoms of weight loss, chest pain, palpitations, cough, nausea, vomiting, or blood in his stools. Family history was notable for a paternal uncle who had testicular cancer. He was a current one pack-per-day smoker for 10 years, but he otherwise denied illicit substance or alcohol use. Physical examination demonstrated a respiratory rate of 22 per minute, BP of 124/78 mmHg and heart rate of 102 beats per minute, jugular venous pressure of around 12 cm H2O, a firm right testicular swelling, and mild abdominal distension, with no abdominal tenderness to palpation. He otherwise had no abnormal heart sounds or lower extremity edema, and the lungs were clear to auscultation. The initial differential diagnosis included metastatic cancer involving the heart, infective endocarditis, and pulmonary embolism. Admission electrocardiography showed new-onset complete right bundle branch block (Figure 1). Computed tomography (CT) of the abdomen and pelvis revealed a heterogeneous liver with small volume ascites, right testicular mass, and inguinal lymphadenopathy. Chest CT with contrast showed diffuse lung nodules bilaterally and a right ventricular (RV) mass (Figure 2).

Because of the patient's report of testicular swelling, testicular ultrasound was performed. Ultrasound identified a right testicular mass measuring 1.5 cm in diameter. Transthoracic echocardiography (TTE) revealed a left ventricular ejection fraction of 56% with a severely dilated right ventricle, a 7.4 × 6.0 cm infiltrating and obstructive RV mass, moderate pericardial effusion, and a patent foramen ovale (Figure 3).

Cardiovascular magnetic resonance (CMR) imaging also showed a heterogeneous RV mass. No metastasis was seen on brain magnetic resonance imaging.

Left ventricular ejection fraction was obtained using the standard Simpson biplane method. The right ventricle was severely dilated in size, with severe systolic dysfunction. There was evidence of elevated tricuspid inflow gradients (peak gradient 11 mm Hg, mean gradient 7 mm Hg at a heart rate of 110 beats/min). The mass was predominantly intracavitary, extending into the RV outflow tract and RV myocardium, without inferior vena cava or other chamber infiltration. There was impingement and suspected involvement of the tricuspid valve apparatus. Contrast perfusion was not performed, because of the relative hemodynamic instability of the patient and because we performed CMR.

One day later, the CMR also showed a heterogeneous RV mass that was hyperintense on both T1 and T2 imaging. CMR also demonstrated pericardial and pleural effusions (Video 1).

No metastasis was seen on brain magnetic resonance imaging. Upon admission, the patient was hemodynamically stable, but 24 hours later his status changed. He became hypotensive with elevated lactate and liver enzymes, which were concerning for cardiogenic shock. He was intubated and placed on venoarterial extracorporeal membrane oxygenation.

Cardiology was consulted, and the patient underwent transesophageal echocardiography (TEE)–guided endomyocardial biopsy of the RV mass. Biopsy findings were consistent with a metastatic embryonal GCT. Oncology initiated chemotherapy with cisplatin, etoposide, and bleomycin. Cardiothoracic surgery was consulted, but it was determined that the mass was not resectable, because of imaging findings demonstrating infiltration of the RV free wall. The patient developed fixed, dilated pupils bilaterally, prompting urgent head CT, which showed a large posterior cerebral hemorrhage with significant mass effect, vasogenic edema, and early transtentorial herniation. Brain stem reflexes were absent. Neurosurgery were consulted and recommended against surgical intervention given his poor prognosis. After discussion with the family, a do-not-resuscitate comfort care order was instigated, and the patient passed away soon after.

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VIDEO HIGHLIGHTS

Video 1: CMR: four-chamber steady-state free precession cine imaging showing the large right ventricular mass with associated pericardial and pleural effusions. *RV,* Right ventricle.

View the video content online at www.cvcasejournal.com.

DISCUSSION

Metastatic cardiac masses, although rare, are much more common than primary cardiac tumors.[3] In general, the clinical presentation of a cardiac mass is highly variable and dependent on its size and location. In our patient, the initial presentation was with clinical signs of right heart failure, which led to the discovery of the metastatic testicular GCT. GCTs typically initially present as a firm unilateral testicular swelling that may spread to the para-aortic and mediastinal lymph nodes.[4] Cardiac metastasis of malignant testicular tumors is very rare, with a calculated incidence of <4%.[4] The right heart is typically affected after hematogenous spread via the inferior vena cava.[5]

Electrocardiographic findings are commonly nonspecific. Depending on the location of cardiac involvement, ST-segment changes may be apparent in patients with a low suspicion for acute myocardial infarction or arrhythmias.[6] In our patient, electrocardiographic findings revealed a complete right bundle branch block consistent with RV involvement.

TTE or CT is most often the first imaging modality to identify cardiac masses. Other advanced imaging modalities, such as CMR and positron emission tomography, may be used later to further characterize the mass. CMR is on par with cardiac CT for tissue characterization, such as characterization of fat tissue and edema, but CMR is superior in assessing cellular iron content.[7] However, histopathologic diagnosis remains the only means of definitive diagnosis.[8]

Figure 2 Nongated contrast-enhanced chest CT, axial slice, demonstrating a large mass (*arrow*) causing near complete obliteration of the right ventricle. There is also marked right atrial dilation and a right pleural effusion with associated atelectasis.

Options for obtaining a tissue diagnosis include surgical biopsy, direct percutaneous biopsy, and transcatheter biopsy (TCB). In patients with multiorgan involvement, lesions involving the most accessible organ should be biopsied.[9] The use of TCB has been increasingly described to establish a histopathologic diagnosis of cardiac tumors.[10] Echocardiography-guided TCB is widely used because of its excellent safety profile. As our patient was hemodynamic unstable, TCB was a safer choice to obtain a tissue specimen compared with more invasive surgical approaches. TCB is also frequently used to diagnose myocardial disorders in patients with cardiomyopathy. Although these procedures are often fluoroscopically guided, TTE and TEE help guide biopsy of the free wall and interventricular septum and additionally enhance procedural safety.[11] TEE is used in targeted TCB of cardiac masses. TTE and TEE offer the advantage of site-specific biopsy and avoiding local damage.[9] The three main echocardiographic modalities are TTE,[11] TEE,[12,13] and intracardiac echocardiography (ICE).[14] The advantages of TTE include portability, availability, and cost-effectiveness compared with TEE and ICE. Limitations of TTE include

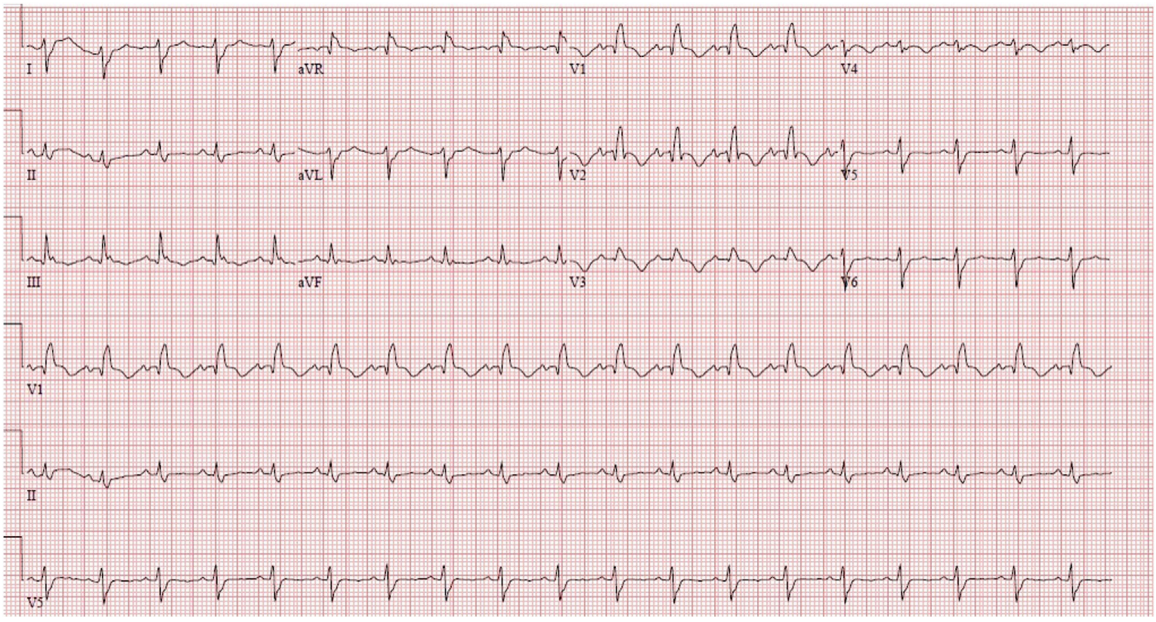

Figure 1 Presenting electrocardiogram of the patient demonstrating sinus tachycardia with right bundle branch block.

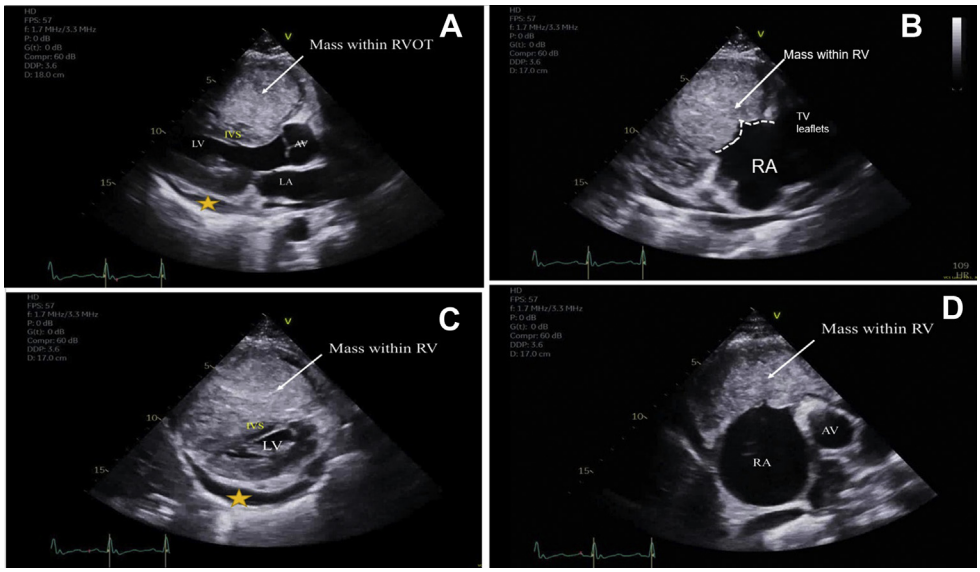

Figure 3 **(A)** Two-dimensional TTE, parasternal long-axis view, demonstrating a large mass, causing near complete obliteration of the right ventricular outflow tract (RVOT) with resultant displacement of the interventricular septum (IVS) and a relatively underfilled, small left ventricular cavity. The *yellow star* represents the small pericardial effusion. **(B)** Two-dimensional TTE, right ventricular inflow view, again demonstrating near complete obliteration of the RV cavity, involving the tricuspid valve (TV) leaflets. **(C)** Two-dimensional TTE, parasternal short-axis view at the ventricular level, showing near complete obliteration of the right ventricular cavity by the mass, displacement of the IVS, and compression of the left ventricle (LV). The *yellow star* represents the pericardial effusion. **(D)** Two-dimensional TTE, parasternal short-axis view, demonstrating near complete right ventricular cavity obliteration by the mass extending into the right ventricular outflow tract. *Ao*, Aorta; *AV*, aortic valve; *RA*, right atrium.

difficulty performing examinations in patients who are supine and the presence of poor acoustic windows in patients with chest tubes and bandages, obesity, and/or chronic lung disease.[11] TEE, which is also widely accessible, provides better image quality, especially when assessing posterior cardiac structures, which are in close proximity to the esophagus.[9] TEE is considered superior to CMR in characterizing masses that are highly mobile or adjacent to cardiac valves, such as vegetations or papillary fibroelastoma, because of spatial and temporal resolution.[7] Compared with TEE, ICE offers similar or greater image quality while also obviating the need for general anesthesia and a second echocardiographer. However, ICE carries additional risks such as access-site complications, device-related arrhythmias, thromboembolism, limited field of view, operator dependence, chances of missing extracardiac lesions, and cardiac perforation.[11] Ultimately the choice of imaging modality depends on availability, institutional experience, and the requirements of the patient.[9]

The treatment for metastatic GCT to the heart is dependent on the extent of cardiac tissue involvement. Treatment modalities include chemotherapy, radiation therapy, and surgical intervention. Outcomes are contingent upon histology and complete surgical resection of the tumor, although the perioperative mortality and 5-year survival rate (7%) remain poor.[15]

CONCLUSION

This report highlights a rare case of cardiac metastasis in an otherwise healthy young man presenting with symptoms of heart failure. Given the typically late presentation of metastatic tumors with cardiac involvement, multimodality imaging is helpful in assessment of tumor origin and burden. Both TTE and TEE provide a method to both visualize the cardiac involvement of tumor as well as to potentially guide tissue biopsies noninvasively.

SUPPLEMENTARY DATA

Supplementary data related to this article can be found at https://doi.org/10.1016/j.case.2021.11.011.

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