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Case Report

Right ventricular hypertrophy and hypertrabeculation misdiagnosed as a right ventricular mass on echocardiography

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ABSTRACT

Isolated right ventricle (RV) hypertrophy, anomalous muscle bundles, heavy trabeculations, a redundant hypertrophic papillary muscle, and variations in the shape and thickness of the moderator band (MB), with or without RV hypertrophy, may be confused with a cardiac mass on echocardiography. Therefore, multiple off-axis echocardiographic images and further cross-sectional imaging with cardiac magnetic resonance or computed tomography coronary angiography (CTCA) must be considered in order to avoid unnecessary surgery. We present a case of 65-year-old man with atypical chest pain was referred to our facility for CTCA to evaluate RV mass that was seen on echocardiography, and to evaluate his coronary arteries before attempting a surgical excision of the mass. The echocardiography showed an RV mass that was causing a minimal inflow obstruction. The CTCA showed nonobstructive coronary artery disease, RV hypertrophy, markedly focal thickening of the MB with multiple thickened trabeculations, and muscle bundles extending from the MB to the free wall of the RV. However, but there was no specific feature to suggest a cardiac tumor.

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Case report

A 65-year-old man presented to an outside hospital with a 3-month history of exertional shortness of breath and atypical chest pain. Although, his medical history consisted of hypertension and smoking (tobacco), but he had no history of coronary artery disease or malignancy. His physical and cardiac examinations were unremarkable, without a cardiac murmur or abnormal heart sounds. The echocardiography re-

vealed a right ventricular (RV) mass measuring 2.7 cm × 2.7 cm, with a minimal inflow obstruction (Fig. 1A and B). The RV systolic function was mildly reduced with no significant valvular lesion, resulting in an otherwise unremarkable echocardiographic examination.

Subsequently, this patient was referred to our hospital for the management and possible surgical excision of the RV mass. The cardiovascular medical oncology multidisciplinary meeting recommended an electrocardiogram-gated computed tomography coronary angiography (CTCA) to assess

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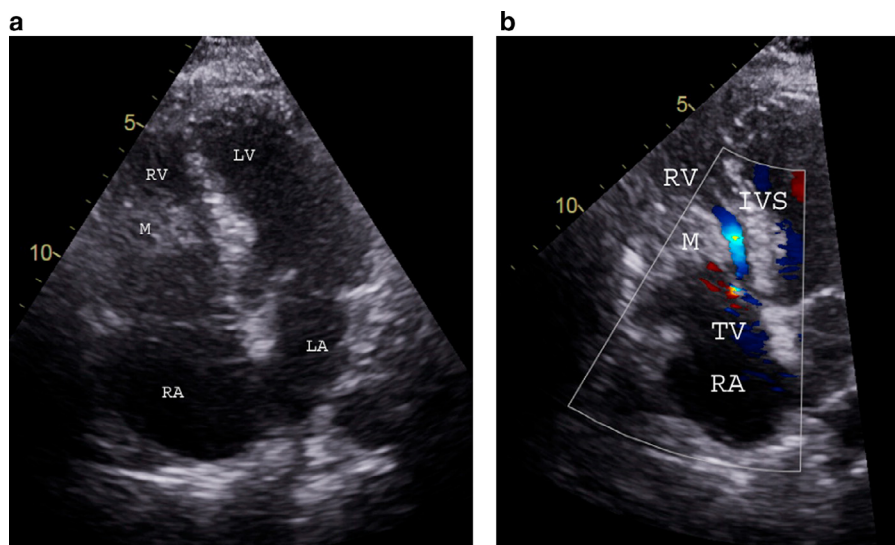


Fig. 1 - (A) Two-dimensional echocardiographic image. Apical 4-chamber view showing an RV mass (m); RV = right ventricle, RA = right atrium, LV = left ventricle, and LA = left atrium and (B) Color flow apical 4-chamber echocardiographic view with optimization of the RV showing an RV mass with evidence of a partial inflow obstruction; RV = right ventricle; TV = tricuspid valve; RA = right atrium; IVS = interventricular septum.

this patient for coronary artery disease, and to preoperatively evaluate the RV mass. The CTCA revealed a nonobstructed coronary artery, focal thickening of the RV moderator band (MB), a thickened RV wall associated with severe hypertrophy of the RV myocardium, and an abnormally thickened muscle bundle (Fig. 2A-C). Overall, the CTCA findings were consistent with isolated RV hypertrophy and an abnormal focal thickening of the MB and muscle bundles, with no specific feature suggesting a cardiac neoplasm.

This diagnosis was explained to the patient, and he was discharged with a recommendation for a follow-up and repeated echocardiography. The previously anticipated but unnecessary surgery was subsequently cancelled.

Discussion

The imaging of the complex RV geometry is a challenging task. The RV is triangular from side to side and crescentic in cross-section. It is thinner than the left ventricle with a characteristic coarse trabecular pattern due to the trabeculae carneae. The RV is made up of 3 components: the inlet, apical trabecular portion, and outlet portion. Additionally, it has 2 muscle bands. The ventricular-infundibular band is a muscular fold separating the pulmonary valve from the tricuspid valve. Additionally, there is a septomarginal band, the MB, which is a myocardial fold extending from the septum to the free wall of the RV that supports the anterior papillary muscle [1]. The MB crosses the RV cavity toward the septal side, out of the main blood flow stream so that it does not obstruct the blood flow. The MB is present in the majority of normal hearts, but it does have several variations in thickness and shape.

On echocardiography, the MB appears as a thick, dense, band-like structure across the RV cavity that connects the lower interventricular septum and the anterior papillary muscle [2]. Anatomically, the distinctive RV features include trabeculae, an MB, a well-developed infundibulum, multiple papillary muscles, an atrioventricular valve leaflet with a septal papillary attachment, and a lack of fibrous continuity between the tricuspid valve and the pulmonary valve [3]. In the RV, anomalous muscle bands are common, and they are not usually responsible for any significant functional disturbances. In contrast to the MB, an anomalous muscle bundle may cross the main channel of the RV resulting in obstruction due to the posterior location, which places it in the main blood stream traveling from the tricuspid valve to the pulmonary valve [4].

In order to assess patients with suspected RV masses, multiple imaging modalities can be used alone or combination. Echocardiography remains the main modality for imaging patients with suspected cardiac masses due to its availability and low cost. However, it does have several limitations, such as its poor acoustic window in some patients and lack of tissue characterization. An RV evaluation using echocardiography in a patient suspected of having an RV mass must include multiple off-axis imaging planes in order to avoid the misinterpretation of an anomalous muscle band or tendon as a mass. Thus, cardiac magnetic resonance (CMR) imaging is a suitable reference test for the quantification of the RV volume and ejection fraction, as well as myocardium and tumor characterization. A CTCA represents a robust alternative to an RV evaluation of a suspected RV mass if CMR is not available at the expense of contrast and radiation administration [5].

A tumor can cause RV failure by direct invasion and by myocardial replacement with tumor infiltration, cavity obliteration, or limiting tricuspid motion [6]. The RV has the potential

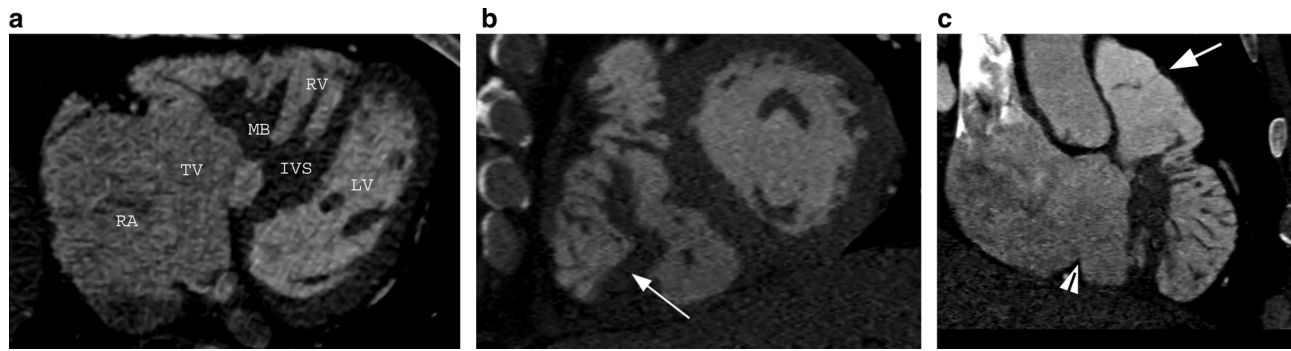


Fig. 2 – (A) Multiplanar reformatted 4-chamber computed tomographic image demonstrating a markedly thickened moderator band (MB) and severe focal interventricular septum hypertrophy (IVS), with no definitive right ventricular (RV) mass; RA = right atrium and TV = tricuspid valve. (B) Reformatted short axis computed tomographic image showing a markedly thickened muscle bundle extending longitudinally across the right ventricle (RV) creating a double-RV appearance (arrow). (C) Reformatted computed tomographic image: vertical longitudinal axis of the right ventricle (RV) demonstrating a thickened muscle bundle extending beneath the tricuspid valve (arrow head) to the RV outflow tract, but not obstructing the pulmonary valve (arrow).

to be involved in many tumor conditions, including primary benign tumors (such as myxomas and rhabdomyomas), primary malignant cardiac tumors (such as angiosarcoma and metastatic diseases), as well as nonmalignant cardiac masses (such as thrombi) [7]. Isolated RV hypertrophy is rare, and it must be differentiated from a pulmonary valve stenosis and ventricular septal defect. Even though hypertrophic cardiomyopathy usually involves the left ventricle, concomitant RV involvement has been reported [8].

Our case highlights several important points. First, abnormal hypertrophy of the MB and anomalous muscle bundle may mimic a cardiac mass, and this must be the part of the differential diagnosis of an RV mass. Second, heavy trabeculations, prominent and redundant hypertrophic papillary muscle, and variations in the MB shape and thickness must be differentiated from other pathologic entities, such as primary or metastatic tumors, thrombi, or vegetation. Therefore, an echocardiographic evaluation of a patient with an RV mass must include multiple off-axis planes in order to avoid a misdiagnosis of normal variants as a pathologic condition. Moreover, cross-sectional imaging using CMR, or a CTCA if CMR is not available, must be considered in order to avoid unnecessary surgery.

REFERENCES

- [1] Dupont MV, Dragean CA, Coche EE. Right ventricle function assessment by MDCT. *AJR* 2011;196(1):77–86.
- [2] Ho SY, Nihoyannopoulos P. Anatomy, echocardiography, and normal right ventricular dimensions. *Heart* 2006;92(Suppl 1):i2–i13.
- [3] Restivo A, Cameron AH, Anderson RH, Allwork SP. Divided right ventricle: a review of its anatomical varieties. *Pediatr Cardiol* 1984;5(3):197–204.
- [4] Lucas RV, Varco RL, Lillehei CW, Adams P, Anderson RC, Edwards JE. Anomalous muscle bundle of the right ventricle. Hemodynamic consequences and surgical considerations. *Circulation* 1962;25:443–55.
- [5] Sanz J, Conroy J, Narula J. Imaging of the right ventricle. *Cardiol Clin* 2012;30(2):189–203.
- [6] Ports TA, Schiller NB, Strunk BL. Echocardiography of right ventricular tumors. *Circulation* 1977;56(3):439–47.
- [7] Kim MJ, Jung HO. Anatomic variants mimicking pathology on echocardiography: differential diagnosis. *J Cardiovasc Ultrasound* 2013;21(3):103–12.
- [8] Mittal SR. Isolated right ventricular hypertrophic obstructive cardiomyopathy. *J Assoc Physicians India* 2010;58: 249–250.