My Approach to Cardiovascular Computed Tomography and Magnetic Resonance Imaging in the Evaluation of Cardiac Pseudotumors: A Brief Review

Roberto Vitor Almeida Torres,[1,2] Bruno Maeda Fuzissima,[1] Eduardo Kaiser Ururahy Nunes Fonseca,[1] Lucas de Pádua Gomes de Farias,[2,3] Walther Yoshiharu Ishikawa,[1,4] José de Arimatéia Batista Araújo Filho[2]

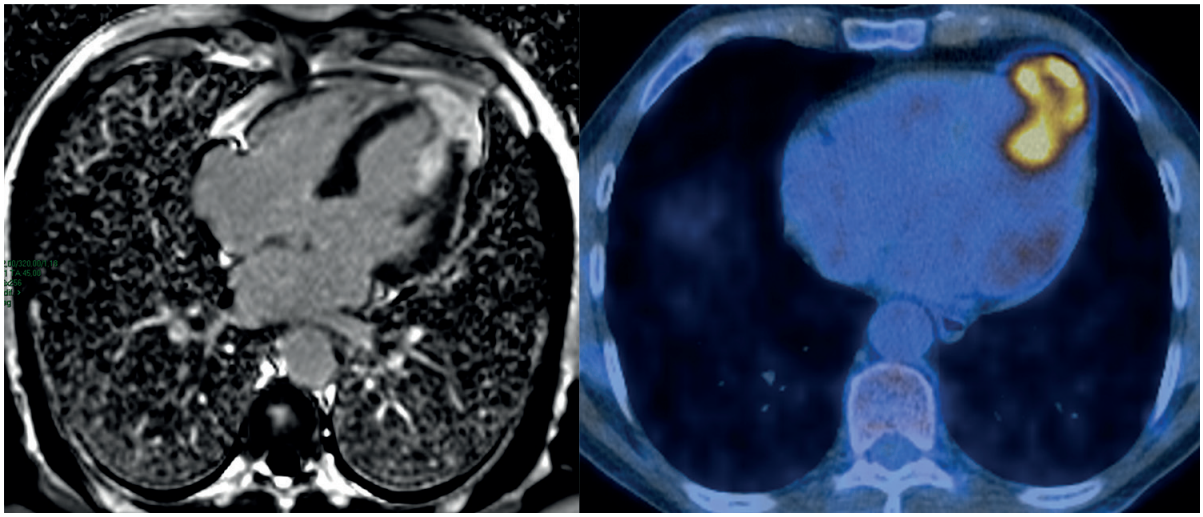
Universidade de São Paulo, Instituto do Coração,[1] São Paulo, SP – Brazil

Hospital Sírio-Libanês,[2] São Paulo, SP – Brazil

Alliança Saúde,[3] São Paulo, SP – Brazil

Departamento de Radiologia e Diagnóstico por Imagem, Hospital Israelita Albert Einstein,[4] São Paulo, SP – Brazil

Central Illustration: My Approach to Cardiovascular Computed Tomography and Magnetic Resonance Imaging in the Evaluation of Cardiac Pseudotumors: A Brief Review



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Male patient, 69 years old, undergoing investigation for a cardiac mass detected on echocardiography. Delayed-enhancement cardiac MRI in the 4-chamber plane (left) demonstrated an exophytic infiltrative lesion involving the apical portion of the left ventricle, extending to the papillary muscles. PET-CT fusion imaging (right) showed glycolytic hypermetabolism in the cardiac mass under investigation. After surgical resection of the lesion, histopathological findings confirmed the diagnosis of Rosai-Dorfman disease. CT: computed tomography; PET: positron emission tomography.

Keywords

Emission-Computed Tomography; Magnetic Resonance Spectroscopy; Heart Neoplasms

Mailing Address: Roberto Vitor Almeida Torres •
Universidade de São Paulo, Instituto do Coração. Av. Dr. Enéas Carvalho de Aguiar, 44. Postal Code: 05403-900. Cerqueira César, São Paulo, SP – Brazil
E-mail: roberto.vitor@hc.fm.usp.br

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Abstract

Cardiac pseudotumoral lesions are non-neoplastic conditions that are often overlooked in the differential diagnosis of cardiac masses. They present a variable clinical picture, ranging from asymptomatic to causing complications such as ventricular filling restriction and outflow tract obstruction. Echocardiography is the first-line imaging method but has limitations, such as dependence on the acoustic window and operator variability. However, a multimodality approach, including CT and MRI, is essential for seeking an accurate

diagnosis. CT, with its excellent spatial resolution, allows for anatomical detailing, assessment of intralesional calcifications and fat, and contributes to therapeutic planning. MRI is preferred for tissue characterization and differentiation between benign and malignant lesions. Normal anatomical structures, such as the Eustachian valve and Chiari network, can be confused with thrombi or tumors, requiring correct identification. Thrombi are common in patients with atrial fibrillation or mitral valve disease, with MRI being important for differentiating them from neoplasms. Other pseudotumoral conditions include vegetation, gossypibomas, caseous calcification of the mitral valve annulus, and lipomatous hypertrophy of the interatrial septum. The integration of advanced cardiovascular imaging modalities is fundamental for the diagnosis and management of these lesions, optimizing patient care.

My Approach To

Cardiac pseudotumoral lesions are non-neoplastic conditions that are often overlooked or not considered in the differential diagnosis of cardiac masses. These lesions present a variable clinical picture according to etiology. They may be asymptomatic or cause complications such as restricted ventricular filling, outflow tract obstruction, and embolic phenomena.

Echocardiography is still the first-line exam in the evaluation of these lesions, and it has known limitations related to acoustic window, patient biotype, or interoperator variability. Therefore, a multimodality approach that includes non-invasive tests such as cardiovascular computed tomography (CT) and magnetic resonance imaging (MRI) or, possibly, nuclear medicine adds great diagnostic value.

Cardiovascular CT is a widely available method, with excellent isotropic spatial resolution, allowing multiplanar and 3-dimensional reconstructions, and it is particularly useful in anatomical detailing of findings, in the search for intralesional calcification or fat, in evaluating the vascular supply of these lesions, and in planning possible therapeutic interventions. In turn, cardiovascular MRI presents high temporal, spatial, and contrast resolution, including dynamic tissue characterization sequences that have made it the exam of choice in the evaluation of cardiac masses, especially for precise location of these masses and differentiation between benign or malignant lesions. Steady-state gradient-echo cine-MRI assesses the relationships of lesions with intra- and extracardiac structures, as well as the mobility of intracavitary lesions or lesions adhered to valves. T1 black-blood static sequences with double inversion-recovery and T2 triple inversion-recovery and fat saturation, in addition to first-pass perfusion and delayed enhancement sequences, are also central to this differentiation. Additionally, MRI offers assessment of cavity volumes and ventricular function, allowing a quantitative evaluation of the impact that these lesions can have on cardiac function.

Thrombi (Figure 1) represent a frequent cause of cardiac masses in clinical practice, and they are the most frequent pseudotumor.[1,2] They are most commonly found in the left atrium and auricle, typically in patients with atrial fibrillation or mitral valve disease.[2] They can also be found in the left ventricle in patients with infarct sequelae and severe systolic dysfunction, or in the right atrium associated with catheters. MRI is the main exam for differentiating between hematic thrombi and neoplasms, when considering the absence of vascularization and enhancement in dynamic perfusion and delayed enhancement sequences (with long inversion time, approximately 600 ms).[2,3] In rare cases, older thrombi may appear organized, with a component of fibrosis and positive delayed enhancement; however, other morphological

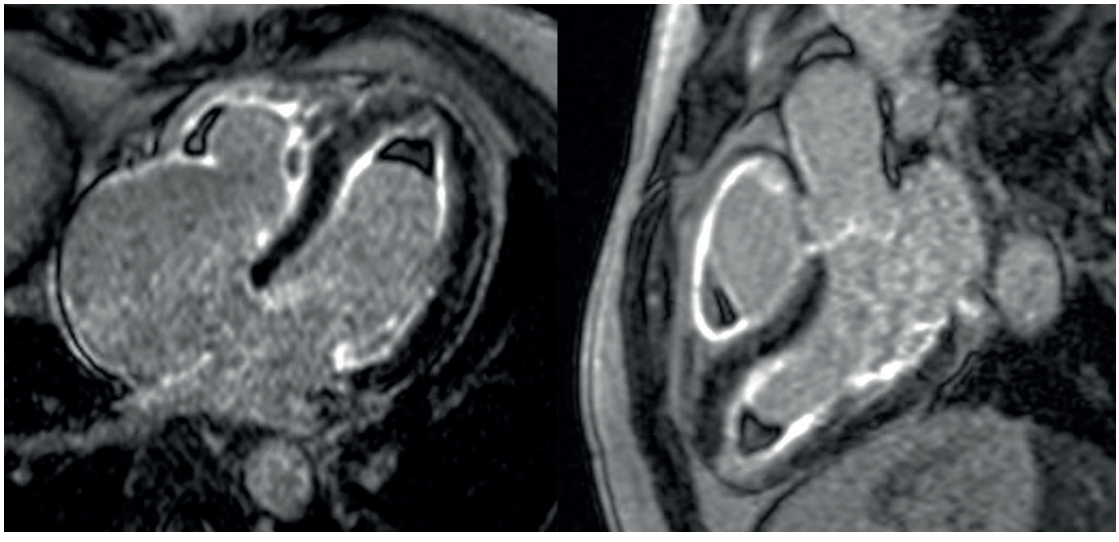

Figure 1 – *Male patient, 33 years old, with endomyocardial fibrosis with biventricular involvement and important dilation of the right atrium. Delayed-enhancement MRI showed diffuse biventricular subendocardial involvement, corresponding to fibrosis. Note images with hyposignal compatible with small cavitary thrombi, in both ventricles, the largest at the apex of the left ventricle measuring 9 × 11 mm.*

characteristics may assist in this differentiation. Normal cardiac anatomical structures or embryonic remnants such as the Eustachian valve, crista terminalis (Figure 2), moderator band, or Coumadin ridge can also generate diagnostic doubts regarding thrombi or tumors, making it essential to identify them correctly.

Other pseudotumor conditions include the following: gossypibomas (Figure 3), which are made up of post-surgical textile material; caseous calcification of the mitral valve annulus (Figure 4) with T1/T2 hyposignal and absence of gadolinium enhancement;[1] and lipomatous hypertrophy of the interatrial septum (Figure 5), a non-encapsulated nodular lesion with fat content, sparing the fossa ovalis, with a dumbbell-shaped appearance.[1,2] CT can be used to characterize fat in any lesion with excellent accuracy. Cardiac MRI is also useful in demonstrating hyperintense T1 and T2 signal and signal drop with fat saturation. Among vascular conditions, coronary aneurysms are defined as coronary dilations that exceed 50% of the diameter of the adjacent normal segment.[4] In rare cases, they can be giant and thrombosed, simulating tumors.

Erdheim-Chester disease is a rare infiltrative disease, a variant of non-Langerhans cell histiocytosis, with idiopathic

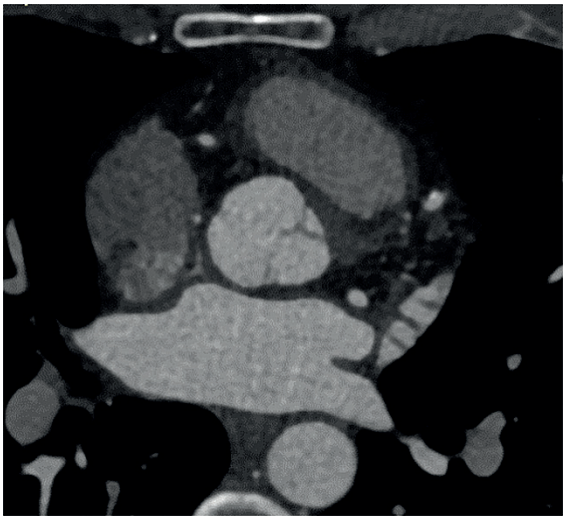

Figure 2 – *A 58-year-old woman undergoing coronary tomography angiography for evaluation of chest pain. In this patient, the presence of a prominent crista terminalis (red arrow) is evident, a normal variant, which could be confused with a pathological change.*

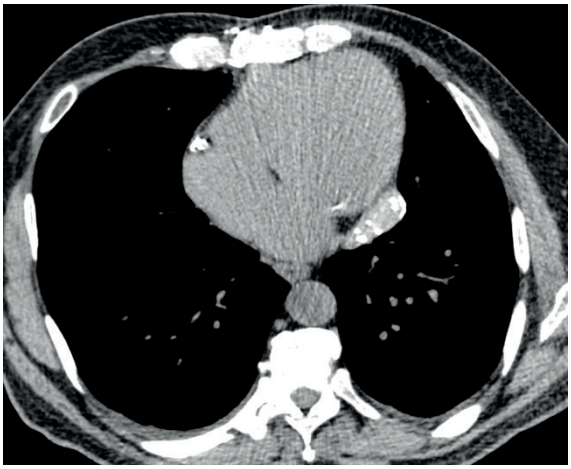

Figure 3 – *A 65-year-old man in follow-up after myocardial revascularization. Chest tomography without venous contrast shows a paracardiac mass on the left (white arrow), showing density with soft parts and a linear hyperattenuating component inside, of undetermined nature. After performing a CT-guided transthoracic biopsy, the diagnosis of a foreign body (gossipiboma) was confirmed.*

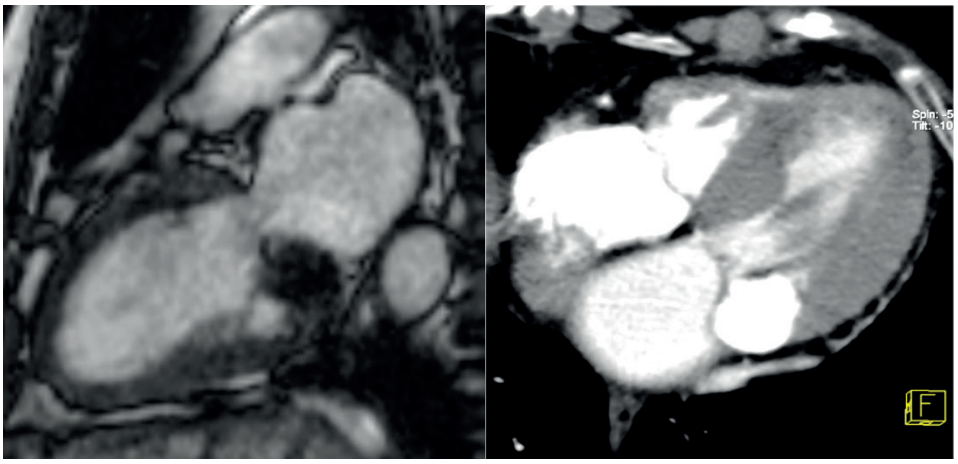

Figure 4 – *An 80-year-old patient in follow-up for moderate aortic stenosis. Cine-resonance (figure on the left) in the 2-chamber view shows a mass with low signal intensity in the posterior aspect of the mitral valve annulus. Axial plane tomography (figure on the right) shows the high calcium content in the mass. The imaging findings are compatible with caseous calcification of the mitral valve annulus.*

etiology and systemic involvement, which can affect the heart and pericardium in some cases.[5] Pericardial involvement can occur through pericardial thickening and/or effusion and cardiac involvement may reveal thickening (often with tumor-like appearance) of the atrial or ventricular walls (Figure 6), with a predilection for the posterior wall of the right atrium; it may even involve the interatrial septum or coronary sulci.[5] Another rare histiocytic proliferative disorder that can affect cardiac tissues is Rosai-Dorfman disease (Central Illustration), also known as sinus histiocytosis with massive lymphadenopathy.

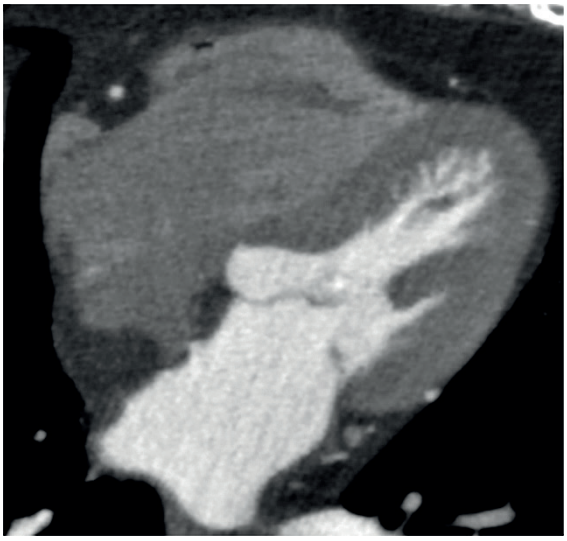

Figure 5 – *A 70-year-old female patient undergoing coronary tomography angiography for evaluation of chest pain. Axial reformatted CT images demonstrate an incidental finding of lipomatous hypertrophy of the interatrial septum. Note that the infiltrative adipose tissue spares the topography of the fossa ovalis, a typical feature of this finding.*

Infectious diseases should also be considered in the differential diagnosis of cardiac pseudotumors, with emphasis on infectious endocarditis (Figure 7). Although echocardiography is the method of choice due to the vegetations' small dimensions and great mobility, CT and MRI can be complementary methods, especially in the evaluation of some complications, such as abscesses.[3] Hypertrophy of nodules of Arantius is another imaging finding that affects the aortic valve and is differential for vegetation of infective endocarditis (Figure 8). It is characterized by a hypodense nodular image in the central regions of the valve leaflets, without additional findings suggestive of an infectious or systemic condition. More rarely, there are extracardiac infectious diseases with cardiac manifestation, including abscesses and cysts, for example, hydatid cysts (Figure 9).

When pronounced, causes of ventricular thickening must also be considered in the differential diagnosis of cardiac pseudotumors, as in cases of cardiomyopathies with a hypertrophic phenotype, mainly hypertrophic cardiomyopathy (Figure 10). Hypertrophic cardiomyopathy presents with variable myocardial thickening, which is generally asymmetrical, and cardiac MRI is the exam of choice for diagnostic confirmation and follow-up, due to its ability to characterize tissue and evaluate myocardial delayed enhancement, frequently observed in areas with greater hypertrophy.

In view of the above, although they are uncommon, cardiac pseudotumor lesions represent significant diagnostic challenges due to their capacity to mimic neoplasms. The integration of advanced cardiovascular imaging modalities, especially CT and MRI, plays a crucial role in the accurate diagnosis and management of these lesions, contributing to optimized patient care.

Author Contributions

Conception and design of the research: Torres RVA, Araújo Filho JAB; acquisition of data: Torres RVA, Fuzissima

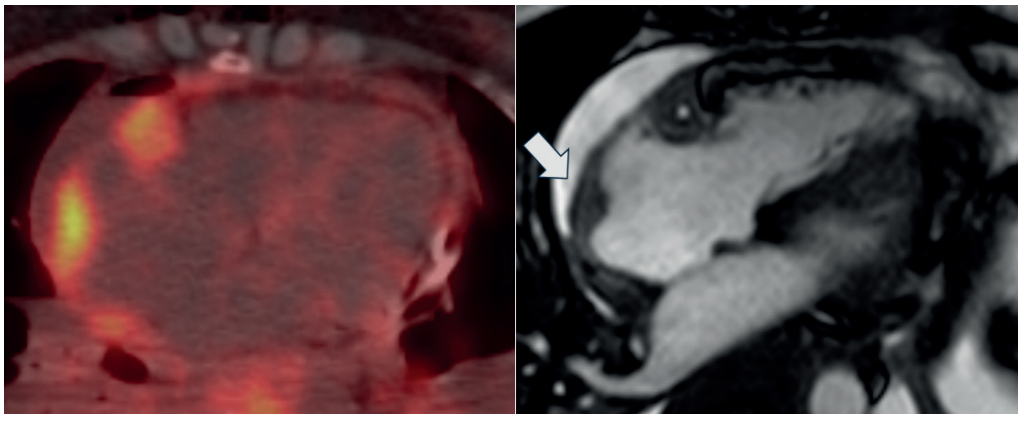

Figure 6 – *PET-CT fusion imaging (left) demonstrated tissue with glycolytic hypermetabolism in the walls of the right atrium and the right atrioventricular sulcus, with extensive involvement of the right coronary artery. The same findings were observed in the cine-resonance on the right (white arrow pointing to thickening of the free wall of the right atrium). Taken together with systemic findings (bone, lung, abdominal, head and neck), diagnosis of Erdheim-Chester disease was made. CT: computed tomography; PET: positron emission tomography.*

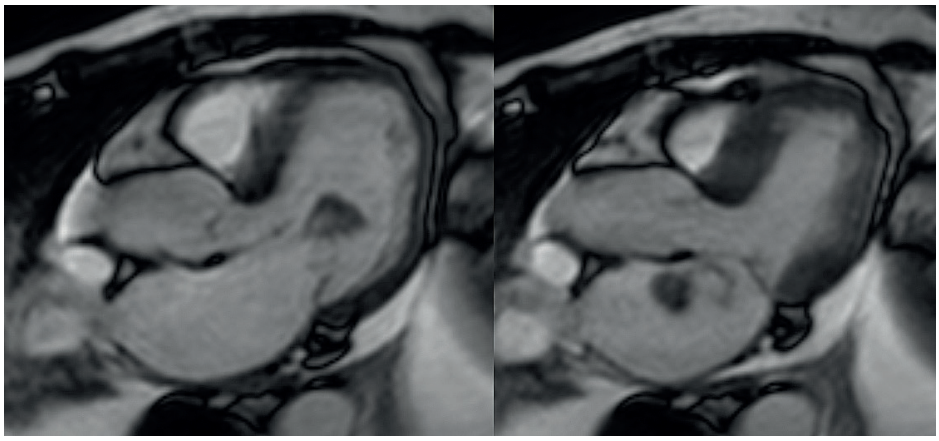

Figure 7 – *Cine-resonance images in the left ventricular outflow tract (LVOT) plane demonstrating a mobile heterogeneous mass adhered to the posterior leaflet of the mitral valve, directed towards the left ventricle in diastole, protruding into the left atrium in systole. Histopathological findings confirmed the hypothesis of infective endocarditis.*

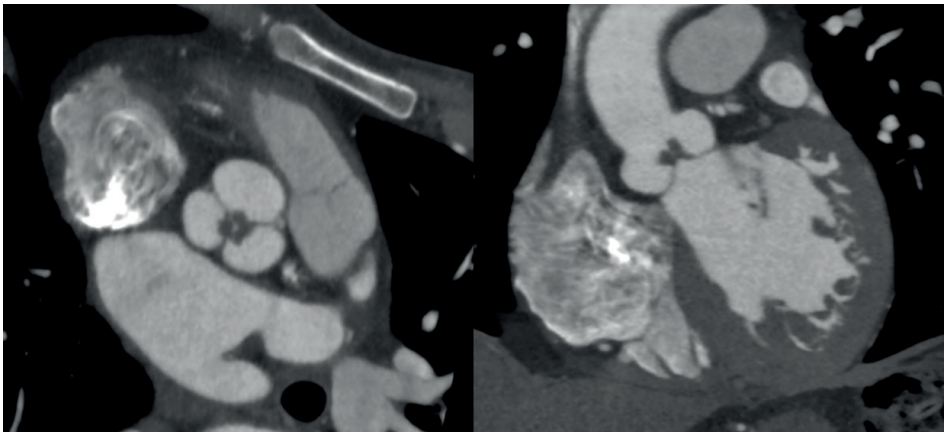

Figure 8 – *Male patient, 64 years old, with chest pain associated with dyspnea, with no history of fever or systemic symptoms. Coronary tomography angiography revealed central nodular images in the aortic valve leaflets (white arrow). In conjunction with clinical findings, this was suggestive of hypertrophy of nodules of Arantius.*

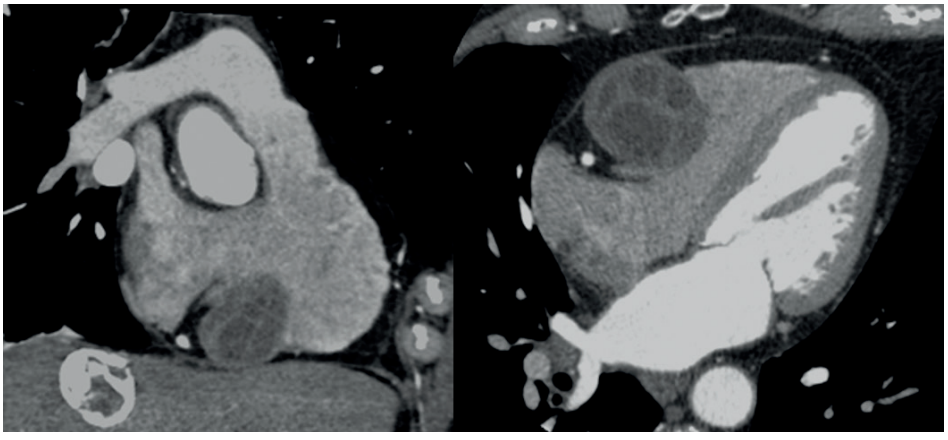

Figure 9 – *Female patient, 70 years old, with an incidental finding of a complex cystic mass in the right ventricular free wall (histological diagnosis of hydatid cyst). This patient had a previous history of hepatic hydatidosis, but the presence of cardiac involvement was not known.*

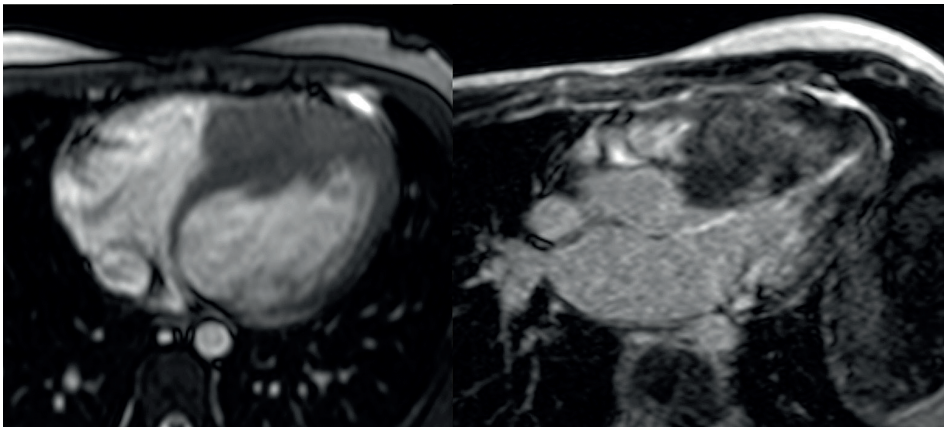

Figure 10 – *A 10-year-old asymptomatic patient, with increased thickness of the interventricular septum. His father had been diagnosed with hypertrophic cardiomyopathy and was on the waiting list for a heart transplant. MRI showed ventricular hypertrophy with the appearance of a mass in the middle and apical portions of the interventricular septum. Delayed enhancement images showed predominance in areas of hypertrophy in the 3-chamber view. Together, these findings are suggestive of hypertrophic cardiomyopathy with a pseudotumoral pattern.*

BM, Farias LPG, Ishikawa WY, Araújo Filho JAB; analysis and interpretation of the data and critical revision of the manuscript for intellectual content: Torres RVA, Fuzissima BM, Kaiser E, Farias LPG, Ishikawa WY, Araújo Filho JAB; writing of the manuscript: Torres RVA, Fuzissima BM, Kaiser E, Araújo Filho JAB.

Potential Conflict of Interest

No potential conflict of interest relevant to this article was reported.

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Study Association

This study is not associated with any thesis or dissertation work.

Ethics Approval and Consent to Participate

This article does not contain any studies with human participants or animals performed by any of the authors.

References

1. 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(1):26-43. doi: 10.1148/radiol.13121239.
2. Sparrow PJ, Kurian JB, Jones TR, Sivananthan MU. MR Imaging of Cardiac Tumors. Radiographics. 2005;25(5):1255-76. doi: 10.1148/rg.255045721.
3. Braggion-Santos MF, Koenigkam-Santos M, Teixeira SR, Volpe GJ, Trad HS, Schmidt A. Magnetic Resonance Imaging Evaluation of Cardiac Masses. Arq Bras Cardiol. 2013;101(3):263-72. doi: 10.5935/abc.20130150.
4. Anfinsen OG, Aaberge L, Geiran O, Smith HJ, Aakhus S. Coronary Artery Aneurysms Mimicking Cardiac Tumor. Eur J Echocardiogr. 2004;5(4):308-12. doi: 10.1016/j.euje.2004.02.003.
5. Costa IBSDS, Abdo ANR, Bittar CS, Fonseca SMR, Moraes ASHT, Kalil R Filho, et al. Cardiovascular Manifestations of Erdheim-Chester's Disease: A Case Series. Arq Bras Cardiol. 2018;111(6):852-5. doi: 10.5935/abc.20180218.