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Imaging findings in cardiac masses (Part I): Study protocol and benign tumors☆

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Abstract Cardiac masses represent a diagnostic challenge because decisions about treatment are based on imaging techniques. Echocardiography, magnetic resonance (MR) and computed tomography (CT) are fundamental for the detection, characterization, and staging of cardiac masses as well as for planning their treatment. Most primary cardiac tumors are benign; myxomas, papillary fibroelastomas, and lipomas are the most common. The location of the tumors and its characteristics on CT and MR orient the etiologic diagnosis in most cases.

This article describes the protocols for CT and MR studies of cardiac masses as well as the morphologic findings, predominant locations, and most useful characteristics for characterizing benign cardiac masses and establishing the differential diagnosis with malignant cardiac tumors and non-neoplastic pseudotumors.

PALABRAS CLAVE
Masas cardíacas;
Mixoma;
Fibroelastoma;
Lipoma;
Rabdomioma

Hallazgos de imagen de las masas cardíacas (parte I): protocolo de estudio y tumores benignos

Resumen Las masas cardíacas son un reto diagnóstico porque las decisiones terapéuticas se basan en los hallazgos de las técnicas de imagen. La ecocardiografía, la resonancia magnética (RM) y la tomografía computarizada (TC) son fundamentales para la detección, caracterización, estadificación y planificación del tratamiento. La mayoría de los tumores primarios son benignos; los más frecuentes son el mixoma, el fibroelastoma papilar y el lipoma. La localización del tumor y sus características en la TC y la RM orientan el diagnóstico etiológico en la mayor parte de los casos.

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Se describen los protocolos de estudio de TC y RM de las masas cardíacas, así como los hallazgos morfológicos, las localizaciones preferentes y las características más útiles para caracterizar las masas cardíacas benignas y establecer el diagnóstico diferencial con los tumores cardíacos malignos y las lesiones pseudotumorales no neoplásicas.

Introduction

Primary heart tumors are uncommon (0.002–3%) and most are benign.[1,2] Clinical manifestations are usually unspecific; they can simulate other cardiovascular diseases and can be potentially deadly due to their hemodynamic repercussion.

Most of them are initially detected through ultrasound, the modality of choice due to its availability and innocuousness. However, magnetic resonance imaging (MRI) and computed tomography (CT) provide additional information for diagnosis, therapeutic decision and surgical planning.[3,4]

Image findings in cardiac masses are presented in two parts. In this first part, the CT and MRI study protocols are described and the findings in benign cardiac masses, and malignant tumors and pseudotumoral lesions are described in the second part.

Protocols of image acquisition

Protocol with computed tomography

General overview

The CT is the complementary image modality in the study of cardiac masses in unstable patients who do not tolerate prolonged decubitus or cannot do apneas who have rhythm disorders that prevent electrocardiographic synchronization, and in patients with claustrophobia, since it is a quick technique that can be performed without cardiac synchronism.[4]

Also it is the modality of choice to detect calcifications, establish the relation between the masses and the coronary arteries and assess the primary tumor and its spread when suspicion of metastasis.[5]

Occasionally, cardiac masses are an incidental finding in examinations performed due to symptoms of unspecific thoracic pathology or during the staging of malignant neoplasms in which the study protocol is that of the suspected disease.

Study acquisition

The protocol includes the acquisition of a topogram on which the examination is planned from the cervico-thoracic union up to the diaphragm which allows assessing the vascular structures, the pulmonary parenchyma and the chest cavity; it is useful for pre-surgery planning and to analyze tumor spread to adjacent structures.[4] A series is acquired without intravenous (IV) contrast followed by a second series at 60 s after the IV administration of 100–120 ml of iodized contrast through an automatic injector, followed by a bolus of 40 ml of saline solution with a flow of 3–4 ml/s.

The acquisition parameters depend on the characteristics of the machine. In a 64-detector machine, adequate images are obtained in patients weighing over 80 kg, with a collimation of 64×0.625, a rotation time of 500 ms, 300 mA and 80 or 100 kV. The studies can be performed with or without electrocardiographic synchronism.[5]

Magnetic resonance protocol

General overview

MRI is a complementary modality to ultrasound in the study of cardiac masses. It is an objective, reproducible, innocuous modality, with a high temporal and contrast resolution which allows us to use wide fields of vision to analyze the heart and the remaining thoracic structures.[3,5]

MRI examinations will be performed preferably in 1.5 or 3.0 T machines, with surface phase-coupled antennas and electrocardiographic synchronization.

Study acquisition

The usual study protocol consists of (Table 1):

1. Multiplanar locator with electrocardiographic synchronization and in respiratory apnea in order to know the position of the heart in the thorax.
2. Functional sequences, cine-MRI, of ''white blood'' based on gradient echo (GE) (fast imaging with steady-state precession, SSFP). They are sequences with mixed T2 and T1 weighting (T2/T1), with great differentiation in the signal intensity of the blood and the myocardium which facilitates the detection of intracavitary lesions. In addition, its high temporal resolution allows us to obtain cine-MR images with electrocardiographic synchronization in order to analyze the functional repercussions of the masses and quantify the ventricular function.
3. Morphological and tissue characterization sequences, of ''black blood'' based on turbo or fast spin echo (TSE), usually with double or triple inversion pulse to improve the intracavitary flow cancelation. T1- and T2-weighted sequences will be obtained and optionally, fat-suppression sequences.
4. First-step perfusion during IV administration of gadolinium chelates. Ultrafast T1-weighted sequences in GE with high temporal resolution to analyze the arrival of the contrast bolus, and assess myocardial perfusion.[6]