EDITORIAL COMMENT
Masses of the Heart: Perfu...
characteristics of LV thrombus, these features may be variably present (9). Both left atrial masses were myxomas. A limitation of the use of contrast for differentiating thrombus from myxoma was pointed out by the authors: whereas myxomas appeared to demonstrate partial enhancement to visual inspection, thrombi and myxomas could not be differentiated objectively on the basis of average pixel intensity in the mass relative to the myocardium. For LV masses, the clinical setting usually aids in the distinction of thrombus from myxoma in the left atrium. For example, left atrial thrombi typically occur in patients with a clinical condition associated with stasis of blood in the left atrium such as atrial fibrillation, mitral stenosis, prosthetic mitral valve, left atrial enlargement, and low cardiac output (9). A further distinctive feature is that compared with myxomas that are typically (but not always) attached to the fossa ovalis by a narrow stalk, left atrial thrombi tend to have a broad-based attachment to the posterior and lateral walls, especially within the left atrial appendage (2).

Of the 16 patients in the study by Kirkpatrick et al. (8), 3 patients had a mass in the pericardium, all of which were metastatic adenocarcinomas. The major differential diagnosis of a pericardial mass is a primary tumor versus metastatic disease (10). Metastatic tumors to the heart and pericardium occur in up to 15% of patients with malignant diseases and are 20 to 40 times more common than primary tumors (11). Carcinomas of the lungs and breast, because of their prevalence, are the most common malignant tumors that metastasize to the heart, whereas melanoma has the greatest propensity to metastasize to the heart (11). Cardiac metastases generally appear late in the course of the primary disease, and isolated cardiac involvement is rarely seen without dissemination to other organs or as the presenting symptom of a remote primary tumor (2). Nearly all primary malignant cardiac tumors are sarcomas, and angiosarcoma is the most frequent. Because angiosarcomas tend to occur in the right atrium and involve the pericardium, the most frequent clinical presentation is right-sided heart failure or tamponade (10). Operative intervention is usually unsuccessful, and the prognosis is poor (11). In the study by Kirkpatrick et al. (8), five masses were located in right-sided cardiac chambers: three were malignant and two were thrombi. Most tumors arising within the right atrium are benign (most commonly myxomas, lipomas, hemangiomas, and thrombi), whereas those extending into the right atrium from outside are malignant (most commonly hypernephroma, hepatoma, and uterine leiomyosarcoma). Right ventricular tumors are rare and when encountered are likely to be from a metastatic malignancy (12).

Magnetic resonance imaging has been a major advance in the assessment of cardiac masses. A recent article on the usefulness of MRI of cardiac and paracardiac masses concluded that there was no single feature that was both highly specific and highly sensitive for malignant tumors (13). Highly sensitive but less specific for malignant lesions were the location outside the left heart, inhomogeneity, and gadolinium enhancement. The specificity of gadolinium enhancement for malignancy increased when only moderate and strong enhancement were considered because mild enhancement was found in 8 of 19 benign tumors. Highly specific but less sensitive indicators for malignant lesions were the infiltration of adjacent compartments, tumor size $>5$ cm, and the presence of pericardial and/or pleural effusions. All inhomogeneous tumors located in the right heart with concurrent pericardial effusion were malignant, whereas homogeneous tumors located in the left heart without pericardial effusion were always benign.

Although advances in contrast-enhanced imaging may improve the distinction of thrombus and benign and malignant masses, they cannot provide a histological diagnosis that may present important information on prognosis and appropriate therapy. Transvenous biopsy of masses in the right heart has been performed with success and may guide further investigations and management, but it is not routinely performed for the more common left heart and pericardial masses (12). Future clinical applications for contrast-enhanced echocardiography will likely expand beyond perfusion imaging. There has been considerable progress in the past few years in the development of site-targeted microbubbles that attach to specific markers of disease, allowing noninvasive diagnostic ultrasound imaging of molecular and cellular processes (14). Similar targeting of microbubbles to tumor antigens may provide a useful method for diagnosing neoplasms with ultrasound, for detecting metastases, and for characterizing tumor phenotype (14). It has recently been shown that contrast-enhanced ultrasound with microbubbles targeted to markers on neovascular endothelium can noninvasively detect early tumor angiogenesis (15). Further investigations are needed to determine whether targeted imaging of angiogenic phenotype in different tumor types provides additional diagnostic and prognostic information to imaging methods already used in the clinical setting. The use of microbubbles and ultrasound for therapeutic purposes is also now being realized with the potential for both the accurate diagnosis and therapeutic intervention of cardiac masses (14). The specific role for contrast echocardiography in the diagnosis of cardiac and pericardial tumors will await further studies that include larger numbers of patients and comparison with MRI. Nonetheless, the study by Kirkpatrick et al. (8) provides clinicians with another tool to use in the preoperative diagnosis of cardiac masses.

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