The diagnosis of pericardial disease can be difficult and often requires a multimodality imaging approach. In particular, the diagnosis of constrictive pericarditis can be challenging, and differentiation from restrictive cardiomyopathy is important for management. Currently, diagnostic evaluations focus on evaluation of pericardial thickness, septal motion, systolic and diastolic myocardial function, invasive pressure measurement, and endomyocardial biopsy in conjunction with clinical assessment for diagnosis of constrictive pericarditis (1).

Traditionally, CMR has been considered one of the preferred imaging methods to morphologically visualize the pericardium. In addition to providing reliable assessment of pericardial thickness, the physiological impact of pericardial disease can be evaluated without the need for ionizing radiation. Although, there are no established guidelines for the use of CMR in the evaluation of pericardial disease (6), the 2006 Appropriateness Criteria for Cardiac Computed Tomography and Cardiac Magnetic Resonance Imaging (7) and European Society of Cardiology guidelines on diagnosis and management of pericardial diseases (1) indicate that CMR is appropriate for evaluation of pericardial constriction. Comprehensive pericardial assessment by CMR incorporates several techniques for assessment of constrictive pericarditis. Dark blood T1- and T2-weighted fast spin echo and/or fluid-sensitive imaging is used for tissue characterization and measurement of pericardial thickness (8). Bright blood cine images are used for assessment of atrial and ventricular size and function, diastolic restraint, diastolic septal bounce, conical deformity of the ventricles, and myocardial tethering. Tagged cine images are used to evaluate for epicardial/pericardial tethering (9) and real-time cine sequences for evaluation of ventricular interdependence (10). LGE inversion recovery images can be used to evaluate for both myocardial fibrosis (11) and inflammation (12), as well as pericardial inflammation (4,5). However, not all patients will tolerate the lengthy period of time required for such a comprehensive CMR examination. Thus, protocols are often tailored to the specific question based on the clinical scenario. Further research and development are needed to both speed up image acquisitions and tailor protocols to those techniques that provide the most relevant information needed for patient management.

In this issue of JACC, Zurick et al. (2) report the correlation between presence of late gadolinium enhancement (LGE) on cardiac magnetic resonance (CMR) and degree of inflammation and fibrosis on pericardial histopathology for 25 patients with constrictive pericarditis undergoing surgical pericardectomy. The main study finding was that presence of pericardial LGE was more frequently associated with histological findings of pericardial inflammation, including increased neovascularization, fibroblast proliferation, and granulation tissue. In contrast, patients without pericardial LGE were more likely to exhibit minimal neovascularization and mild or absent inflammation. These findings expand upon smaller case studies and series (3,4), and are supportive of a recent similar study (5) suggesting that the presence of pericardial LGE may be a good marker for ongoing pericardial inflammation.

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Pericarditis is a dynamic process characterized by acute and/or chronic inflammation that may progress to organized fibrosis and calcification of the pericardium. The presentation and course of inflammatory pericarditis depend on its cause. Although most patients will develop symptoms of chest pain during the acute phase, some may present with a subacute course, or during the late chronic phase, with symptoms related to associated constrictive physiology (13). Although patients who present early in the process may be treated with anti-inflammatory agents, patients who present during the late stages have limited treatment options.

Until recently, the development of constrictive physiology was presumed a late-phase, irreversible process occurring only in patients with thickened pericardial fibrosis and calcification. However, there have been several reports of transient constrictive pericarditis in which patients with objective evidence of constrictive hemodynamics and pericardial thickening have subsequent resolution of symptoms and normalization of pericardial thickness and hemodynamics with medical therapy and observation (14,15). Treatment with anti-inflammatory agents and/or steroids led to resolution of symptoms, and suggests an earlier phase of pericardial inflammation despite the development of constrictive pericarditis. The ability to identify patients with transient constrictive pericarditis is important for management since a trial of medical therapy can be pursued prior to referral for surgical pericardiectomy. However, most cardiac imaging modalities cannot reliably distinguish between pericardial inflammation and fibrosis.

The study findings of Zurick et al. (2) suggest that LGE-CMR may be useful in differentiating between ongoing pericardial inflammation and pericardial fibrosis, thus allowing for tailored treatment options in patients with constrictive pericarditis. Patients with constrictive physiology and CMR evidence of pericardial LGE may benefit from a trial of anti-inflammatory agents, whereas patients with lack of pericardial LGE can be referred directly to pericardiectomy. In addition, LGE-CMR may be of value in monitoring the inflammatory process in patients with recurrent pericarditis, identifying patients with persistence of pericardial inflammation despite medical therapy who may need intensification or continuation of anti-inflammatory treatment. One caveat of LGE-CMR is the requirement for gadolinium contrast administration, which may be an issue in patients who have severe or acute renal failure, due to the risk of developing nephrogenic systemic fibrosis (16). Other edema-sensitive CMR techniques, such as short T1 inversion recovery and T2-weighted fast spin echo with fat saturation, may be able to provide similar information on pericardial inflammation as LGE-CMR without the need for exogenous gadolinium contrast administration. Although Zurick et al. (2) did not evaluate noncontrast CMR techniques, a study by Young et al. (5) evaluated a fluid-sensitive triple inversion recovery fast spin echo technique and noted that in 7 of 8 patients with chronic recurrent pericarditis there was evidence of increased pericardial signal that was correlated with pericardial edema and/or chronic inflammation on histology. Future studies are needed to evaluate the diagnostic performance of these noncontrast edema-sensitive CMR techniques compared with LGE for identification of pericardial inflammation. Additionally, studies evaluating the diagnostic and prognostic value of CMR pericardial tissue characterization for the management of constrictive pericarditis are needed to further define the role of these techniques.

**REFERENCES**


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