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Transthoracic Echocardiography Versus Cardiac MRI in the Diagnosis of Acute Myocarditis

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Introduction: The diagnosis of myocarditis based on a spectrum of findings, including symptoms, clinical examination, electrocardiography, biomarkers, and echocardiography, can be non-specific. Cardiac magnetic resonance imaging (MRI), has become the primary noninvasive technique in patients with suspected myocarditis in some countries.

Case Presentation: We present a case with a typical picture of myocarditis but normal echocardiographic findings, the diagnosis of which was confirmed by cardiac MRI.

Discussion: In particular, cardiac MRI data are useful in borderline cases or in the presence of discrepancy between clinical picture and echocardiographic results.

*Keywords:*Echocardiography; Magnetic Resonance Imaging; Myocarditis

1. Introduction

Myocarditis is a disease manifested by inflammation and damage in the heart muscle (1). The cause of myocarditis is varied and comprises viral infections, autoimmune diseases, environmental toxicity, and sometimes adverse reactions to medications (2). Because of nonspecific symptoms, different modalities can be used to assess suspicious cases of myocarditis. Cardiac magnetic resonance imaging (MRI) has recently become one of the primary noninvasive imaging tools in the diagnosis of myocarditis (2) and is a more sensitive imaging modalities than echocardiography for diagnosing acute focal myocarditis (3).

In this study, we present an interesting case of myocarditis, confirmed by cardiac MRI data despite normal echocardiographic findings, to underscore the significance of employing more than one imaging approach as the unique strength of one method may offset the limitation of another.

2. Case Presentation

A 17-year-old man presented to the emergency department complaining of palpitation and chest pain over the preceding 48 hours. The patient's past medical history was unremarkable. He had stable vital signs (temperature = 37.3°C, blood pressure = 110/70 mmHg, and heart rate = 85 bpm), and his physical examination was normal. Laboratory studies illustrated a WBC count of 12.3×10^3 mL (reference range= 4-10.8 $\times 10^3$ mL), troponin I of 1.29 mg/L (reference range < 0.01 mg/L), CRP of 14 mg/L (reference = 0.1-6 mg/L), and SGOT of 111 units (reference range <40 unit).

Electrocardiography (ECG) on admission showed normal sinus rhythm at a rate of 66 bpm with diffuse ST evaluation (except for aVR). After 72 hours, a diffuse T-wave inversion was seen on ECG.

Transthoracic echocardiography 48 hours after symptom onset revealed a completely normal left ventricular (LV) systolic and diastolic study with an ejection fraction (EF) of 55%. Additionally, tissue Doppler imaging (TDI) velocities for the septal and lateral walls of the LV and also the right ventricular (RV) free wall were all normal. However, based on high clinical and laboratory suspicion of myocarditis, cardiac MRI was performed ultimately (12 hours after echocardiography): the diagnosis was definite myocarditis despite normal echocardiography.

In steady-state free-precession cine MRI sequences, there was hypokinesia of the mid lateral and mid posterior segments, associated with a mildly reduced LV systolic function (LVEF = 53%). In short-tau inversion recovery sequences, there was an increased signal intensity of the mid myocardium (especially at the lateral and septal segments), indicative of myocardial edema. The signal intensity (SI) ratio of myocardium over skeletal

muscle was 2.2 (normal reference < 2.0) (Figure 1). In early gadolinium enhancement (EGE) sequences, there were an increased signal intensity of the mid posterolateral segments, indicative of hyperemia, and a capillary leakage; moreover, the EGE ratio was 4.0 (normal reference < 4.0). In late gadolinium enhancement (LGE) sequences, multiple patchy sub-epicardial gadolinium enhancements, particularly in the apical and posterolateral segments, were seen, indicative of myocardial injury (Figure 2). Based on the mentioned findings, the cardiac MRI final diagnosis of the patient was consistent with active myocarditis. This patient was discharged after medication and in good condition without any complication.

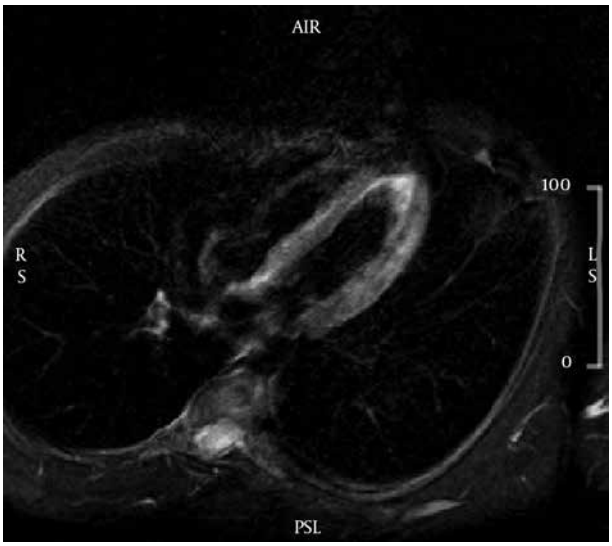

Figure 1. Short-Tau Inversion Recovery Sequence, Showing Increased Signal Intensity of the Mid Myocardium, Especially at the Lateral and Septal Segments

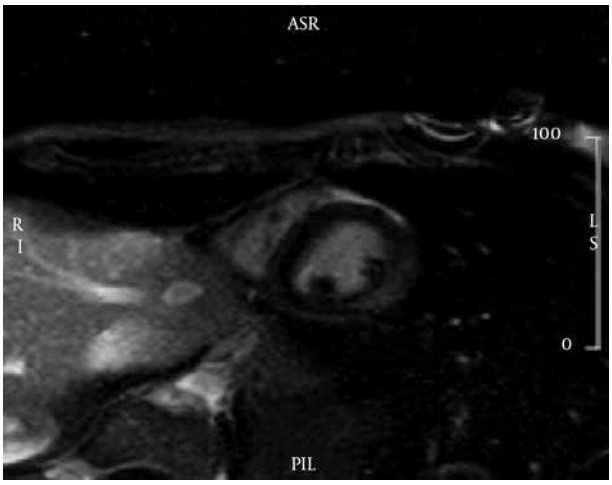

Figure 2. Late Gadolinium Enhancement Sequence, Showing sub-Epicardial Gadolinium Enhancement at the Posterolateral Segments

3. Discussion

Echocardiography has an important role in the diagnosis of myocarditis. Multiple studies have specifically assessed the role of transthoracic echocardiography (4) for the diagnosis of myocarditis. In a retrospective analysis by Pinamonti (4) among 42 patients with biopsy-proven myocarditis, 69% had LV dysfunction and 23% had RV dysfunction but interestingly among patients with chest pain or heart block as an initial presentation, echocardiography almost always showed preserved ventricular size and function. Thus, although echocardiography can assist in the diagnosis of myocarditis and be recommended as an initial diagnostic step, it is relatively nonspecific. The versatile cardiac MRI technology is helpful to identify inflammatory tissue characteristics (5).

There are three criteria for the diagnosis of myocarditis (5, 6): 1) inflammatory edema; 2) hyperemia /capillary leakage; and 3) necrosis and or fibrosis. Edema is defined as a regional or global myocardial signal intensity increase in T2-weighted images (global SI increase is defined as a signal intensity ratio of myocardium over skeletal muscle ≥ 2.0). Hyperemia/capillary leakage is defined as a global myocardial EGE ratio between myocardium and skeletal muscle ≥ 4.0 in gadolinium enhanced T1-weighted images. Necrosis or fibrosis can be evaluated using T1W images later after contrast images (LGE) and is defined as abnormal delayed myocardial enhancement without a vascular territory. Using two positive out of the three criteria yields a diagnostic accuracy of approximately 80% in diagnosing myocarditis (6).

Of course, cardiac MRI has some limitations in diagnosing myocarditis (7). T2W images have a lower signal-to-noise ratio and are, as such, incapable of detecting small regions of inhomogeneity. The involvement of skeletal muscle in systemic inflammation may limit the sensitivity of signal intensity analysis normalized to skeletal muscle. The LV outflow tract and the membranous septum may mimic septal LGE in the short axis-view and cause false-positive results. Also, the fusion of the RV moderator band to the interventricular septum can lead to a region of increased signal, representing pathological LGE.

In our patient, myocarditis was confirmed by cardiac MRI despite normal echocardiographic results. Echocardiography, albeit one of the first diagnostic modalities in detecting active myocarditis, is relatively non-specific. Cardiac MRI using quantitative T1 and T2 mapping demonstrated conclusive evidence in favor of myocarditis. Accordingly, cardiac MRI is the most promising technique for diagnosing myocardial inflammation and even subtle injuries.

Authors' Contributions

Hosseinali Basiri: Gathering of Clinical data. Azin Alizadehasl: Performing the first echocardiography, editing and completing the paper. Zahra Alizadeh Sani: Performing the CMR. Anita Sadeghpour: Performing the follow

up echocardiography, Selecting the Echo figures. Nahid Rezaeian: Writing the first draft of paper. Mohammadesmaeil Rezaei: Selecting and explaining the CMR figures.

References

1. Blauwet LA, Cooper LT. Myocarditis. *Prog Cardiovasc Dis.* 2010;**52**(4):274–88.
2. Friedrich MG, Sechtem U, Schulz-Menger J, Holmvang G, Alakija P, Cooper LT, et al. Cardiovascular magnetic resonance in myocarditis: A JACC White Paper. *J Am Coll Cardiol.* 2009;**53**(17):1475–87.
3. Magnani JW, Dec GW. Myocarditis: Current Trends in Diagnosis and Treatment. *Circulation.* 2006;**113**(6):876–90.
4. Pinamonti B, Alberti E, Cigalotto A, Dreas L, Salvi A, Silvestri F, et al. Echocardiographic findings in myocarditis. *Am J Cardiol.* 1988;**62**(4):285–91.
5. Laissy JP, Messin B, Varenne O, Iung B, Karila-Cohen D, Schouman-Claeys E, et al. MRI of acute myocarditis: a comprehensive approach based on various imaging sequences. *Chest.* 2002;**122**(5):1638–48.
6. Gutberlet M, Spors B, Thoma T, Bertram H, Denecke T, Felix R, et al. Suspected chronic myocarditis at cardiac MR: diagnostic accuracy and association with immunohistologically detected inflammation and viral persistence. *Radiology.* 2008;**246**(2):401–9.
7. Park CH, Choi EY, Greiser A, Paek MY, Hwang SH, Kim TH. Diagnosis of acute global myocarditis using cardiac MRI with quantitative t1 and t2 mapping: case report and literature review. *Korean J Radiol.* 2013;**14**(5):727–32.