

# The Role of Speckle-Tracking Strain Echocardiography in the Clinical Evaluation and Follow-up of Myocarditis with Preserved Ejection Fraction: A Case Report

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## Abstract

**Introduction:** Myocarditis has heterogeneous clinical manifestations and may be difficult to recognize when left ventricular ejection fraction is preserved. Speckle-tracking echocardiography may detect subtle myocardial dysfunction through global longitudinal strain (GLS) assessment.

**Case Illustration:** A 30-year-old woman presented with exertional dyspnea and preceding sore throat, followed by chest pain radiating to the left shoulder. Electrocardiography showed sinus rhythm without acute ST-segment elevation, and conventional transthoracic echocardiography showed preserved LVEF (61%). Inflammatory markers and NT-proBNP were elevated. STE demonstrated markedly reduced GLS (-4.7%), especially in lateral, posterior, and anterior segments. Cardiac magnetic resonance imaging performed 10 days after symptom onset showed subepicardial late gadolinium enhancement in the basal lateral and inferolateral left ventricular walls, supporting myocarditis.

**Discussion:** The regional distribution of impaired strain corresponded with cardiac magnetic resonance abnormalities, suggesting that STE may identify clinically relevant myocardial involvement despite normal LVEF. Serial STE showed improvement during follow-up after guideline-directed therapy and clinical stabilization.

**Conclusion:** GLS assessment by STE is a useful non-invasive adjunct for diagnosis, risk evaluation, and follow-up of suspected myocarditis, particularly when conventional echocardiography appears normal.

**Keywords:** myocarditis; global longitudinal strain, speckle-tracking echocardiography, cardiac magnetic resonance, preserved ejection fraction

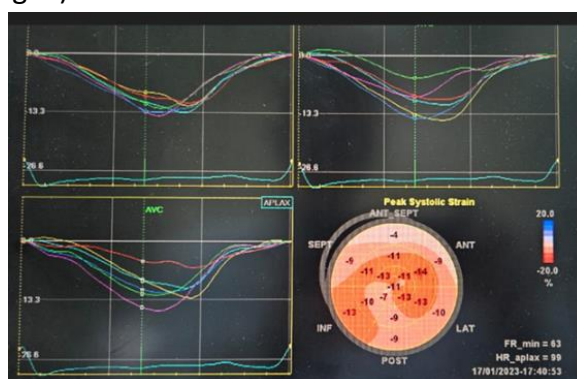
## Introduction

Myocarditis is an inflammatory myocardial disease with diverse infectious and non-infectious etiologies. Viral infection remains among the most frequently reported causes, although autoimmune, hypersensitivity, toxic, and systemic inflammatory conditions may also be involved. The clinical spectrum ranges from asymptomatic disease to chest pain, arrhythmia, acute heart failure, cardiogenic shock, and sudden cardiac death. Because signs and symptoms can mimic acute coronary syndrome or other cardiac disorders, early diagnosis may be challenging.<sup>1,2</sup>

Conventional echocardiography is commonly used as the first-line imaging modality in suspected myocarditis. However, patients may have preserved left ventricular ejection fraction (LVEF) despite regional myocardial inflammation. Two-dimensional speckle-tracking echocardiography (STE), particularly global longitudinal strain (GLS), provides a more sensitive assessment of myocardial deformation. This case report aims to describe the role of STE in detecting and monitoring myocarditis in a young adult with preserved LVEF.<sup>4,5</sup>

### Case Illustration

We present the case of a 30-year-old woman admitted to the Cardiology Department due to shortness of breath on activities after having a business trip to Yogyakarta. She works as a government staff at Ditjen Baranahan the Ministry of Defence Jakarta. She never smokes with no other cardiovascular risk factors and no previous history of cardiovascular diseases. Several days before admission, she was treated sore throat. The previous day, she felt chest pain radiating to his left shoulder. Physical examination at admission did not reveal any significant findings. The electrocardiogram showed a sinus rhythm of 89 bpm and no T waves abnormality. The initial laboratory tests revealed increased normal levels of high-sensitivity troponin T at 0.002 ng/L [normal level < 14 ng/L], N-terminal pro-B-type natriuretic peptide at 890 pg/ml and increased inflammatory markers: white blood cells at  $19.8 \times 10^9 / l$  [normal range 4.0–10.0], erythrocyte sedimentation rate at 58 mm [0–8] and C-reactive protein at 15.2 mg/dl [0–0.8]. Transthoracic echocardiography (GE Versana) did not show any contractility disorders (left ventricular ejection fraction - LVEF - 61%). The electrocardiography showed normal ECG. No ischemic nor arrhythmia shown. In the course of further diagnostics, LV performance was assessed by STE. Depressed global longitudinal strain (GLS) was noted at  $-4.7\%$  [normal range <  $-20\%$ ], with the lowest values within the lateral and the middle segments of the apical ( $-1\%$  and  $-3\%$ , respectively), posterior ( $-5\%$  and  $-3\%$ ) and anterior ( $-4\%$  and  $-3\%$ ) walls (Fig. 5).

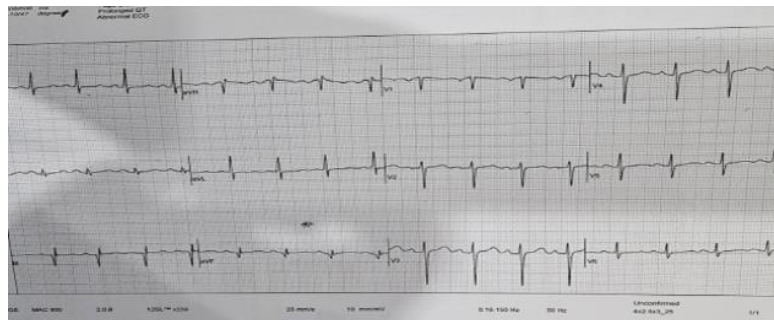


CMR was performed 10 days after the onset of symptoms to confirm the suspicion of myocarditis. In the late gadolinium enhancement (LGE) sequences, discrete and sub-epicardial areas of post-contrast reinforcement were shown within the basal segments of the lateral and infero-lateral LV walls (Fig. 6). The LV size and LVEF (61%) were normal. The localisations of areas of myocarditis shown on CMR conclusions corresponded to areas

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with depressed longitudinal strain that of STE on echo. To prevent developing LV systolic dysfunction, angiotensin receptor blocker (Uperio 50 mg once daily), Mineral corticosteroid antagonist (Spironolactone 25 mg once daily), Beta blocker (Concor 2,5 mg once daily), Atorvastatin 20 mg once daily, Ubitine twice a day, Eturool 400 mg once daily, Astaxanthin once daily and Trimetazidine twice a day were applied. Laboratory findings showed high levels of glucose and hba1c to 9.8%. She was referred to internal medicine for additional management. We added sitagliptin 2 inhibitors (Forxiga 10 mg once daily), Jardiance 25 mg once daily, Diamicron MR twice a day and Ozempic injection once a week. She was admitted for 7 days then discharged to an outpatient clinic. Currently, the patient is in good general condition. He has returned to work and began to undertake regular physical activity. Written informed consent for publication of clinical information and images was obtained from the patient. Identifying information was removed from clinical images used in this manuscript.



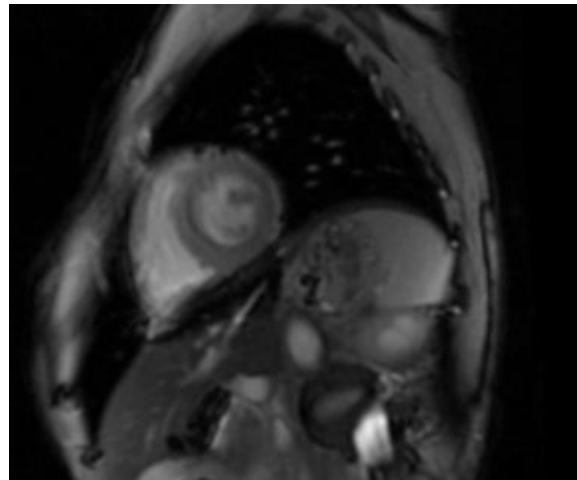
**Figure 1.** Electrocardiography findings with no abnormality.



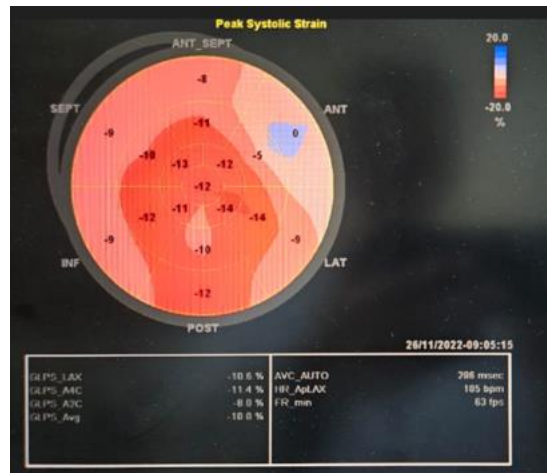
**Figure 2.** Above. a - The decreased global longitudinal strain (GLS) -4.7% on the second day of hospitalization, with the lowest values within the lateral and the middle segments of the apical (-1% and -3%, respectively), posterior (-5% and -3%) and anterior (-4% and -3%) walls. Below. The GLS echocardiography prior discharged show marked improvement.

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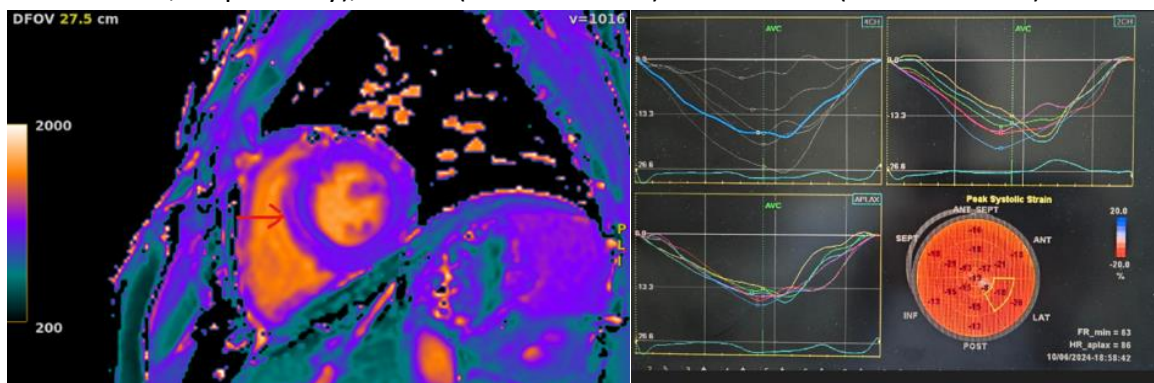
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**Figure 3.** A - CMR showed gadolinium contrast enhancement referred to myocardial scars. No edema shown means chronic period of the disease.



**Figure 4.** a - One month later, on the follow-up visit, STE showed significant improvement in LV deformation, both regional and global. The decreased global longitudinal strain (GLS) -10% on the 30 day post discharge, with the lowest values within the anterior and lateral (0% and -5%, respectively), lateral (-9% and -3%) and anterior (-4% and -3%) walls



**Figure 5.** After a 6 month course of optimal medication showed significant GLS echocardiography improvement found from the increased GLS average area.

## **Discussion**

Myocarditis should be considered in young patients presenting with symptoms suggestive of acute coronary syndrome (ACS), particularly when coronary angiography does not reveal obstructive coronary artery disease. The differential diagnosis may be challenging because myocarditis and ACS may share similar clinical manifestations, including anginal chest pain, electrocardiographic abnormalities, elevated cardiac biomarkers, and nonspecific echocardiographic findings.<sup>2-4</sup> Angelini et al. reported that among patients admitted with suspected ACS and normal coronary arteries who underwent endomyocardial biopsy (EMB), myocarditis was confirmed in a substantial proportion of cases, highlighting the diagnostic overlap between myocarditis and myocardial infarction.<sup>14</sup> Similar cases of viral myocarditis mimicking acute myocardial infarction have also been described by Dec et al.<sup>15</sup>

The diagnosis of myocarditis remains complex because clinical presentation is heterogeneous, ranging from mild chest discomfort to heart failure, arrhythmia, cardiogenic shock, or sudden cardiac death.<sup>1-4</sup> Establishing the etiology and identifying subtle left ventricular (LV) systolic dysfunction may require multimodality evaluation. EMB remains the diagnostic gold standard for histopathological confirmation of myocarditis; however, its invasive nature, risk of complications, limited availability, and sampling error restrict its routine use to selected patients, particularly those with severe, fulminant, or unexplained clinical deterioration.<sup>1-3</sup>

Cardiac magnetic resonance imaging (CMR) is currently regarded as the most accurate non-invasive imaging modality for evaluating suspected myocarditis. CMR allows assessment of ventricular function, myocardial edema, hyperemia, necrosis, fibrosis, and late gadolinium enhancement (LGE), which are important features of myocardial inflammation.<sup>[5,6]</sup> The updated expert recommendations emphasize the role of tissue characterization, including T1- and T2-based markers, in improving diagnostic accuracy for nonischemic myocardial inflammation.<sup>[6]</sup> Nevertheless, a single non-invasive imaging modality may not always be sufficient to confirm myocarditis, and CMR may be limited by availability, cost, contraindications, or patient instability.<sup>3,5,6</sup>

Conventional transthoracic echocardiography is usually the first-line imaging examination in patients with suspected cardiac dysfunction. Felker et al. demonstrated that echocardiographic findings may help distinguish fulminant myocarditis from acute myocarditis. Fulminant myocarditis is typically associated with a nondilated, thickened, and hypocontractile LV, whereas acute myocarditis more commonly presents with LV dilatation, normal wall thickness, and reduced LV systolic function.<sup>[7]</sup> However, conventional echocardiography may be insufficient in patients with preserved left ventricular ejection fraction (LVEF), as subtle myocardial dysfunction may not be detected by standard visual assessment.

In this context, speckle-tracking echocardiography (STE) and global longitudinal strain (GLS) provide additional diagnostic value. Myocardial strain imaging is a sensitive and reproducible method for assessing myocardial deformation and may detect subclinical LV

dysfunction despite preserved LVEF.[8] GLS has also been shown to provide prognostic information beyond LVEF in various cardiac conditions.[9] In inflammatory heart disease, Leitman et al. demonstrated that regional strain abnormalities corresponded with delayed enhancement on CMR, particularly in the lateral, inferior, and posterior LV segments.[10] Kostakou et al. further reported that patients with acute myocarditis may show impaired GLS despite normal LVEF, supporting the role of regional strain analysis as a marker of subclinical LV dysfunction.<sup>11</sup>

Previous studies have also shown that two-dimensional deformation analysis may correlate with myocardial edema detected by CMR in acute myocarditis.<sup>12</sup> In chronic myocarditis with preserved LVEF, multimodality imaging studies have demonstrated that GLS may remain impaired compared with healthy controls, suggesting persistent subclinical myocardial involvement even when conventional systolic parameters appear normal.<sup>13</sup> These findings support the use of STE not only as an adjunct diagnostic tool, but also as a practical method for follow-up assessment.

In the present case, the patient had preserved LVEF on conventional echocardiography, while GLS was markedly reduced during the acute clinical presentation. The regional distribution of impaired strain corresponded with myocardial abnormalities detected by CMR. Improvement of GLS during follow-up paralleled the patient's clinical recovery, suggesting that STE may be useful for monitoring disease progression and therapeutic response. This case supports the importance of GLS evaluation in suspected myocarditis, especially when LVEF is preserved and conventional echocardiographic findings are inconclusive.

## **Conclusion**

The presented case proves that GLS provides correct diagnosis, justifies the implementation of pharmacotherapy and enables a simple assessment of the treatment effects in myocarditis. STE seems to be competitive in relation to cardiac magnetic resonance imaging in the diagnosis of some diseases, such as myocarditis.

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## **Author Contributions**

AHP contributed to patient evaluation, data collection, manuscript drafting, literature review, critical revision, and approval of the final manuscript.

### **Conflict of Interests**

The author declares no conflict of interests related to this manuscript.

### **Ethical Considerations**

Written informed consent for publication of clinical details and images was obtained from the patient. A copy of the consent form is available for editorial review upon request.

### **References**

1. Kociol RD, Cooper LT, Fang JC, et al. Recognition and initial management of fulminant myocarditis: a scientific statement from the American Heart Association. *Circulation*. 2020;141(6):e69-e92.
2. Cooper LT. Myocarditis. *N Engl J Med*. 2009;360(15):1526-1538.
3. Caforio ALP, Pankuweit S, Arbustini E, et al. Current state of knowledge on aetiology, diagnosis, management, and therapy of myocarditis: a position statement of the European Society of Cardiology Working Group on myocardial and pericardial diseases. *Eur Heart J*. 2013;34(33):2636-2648.
4. Caforio ALP, Marcolongo R, Basso C, Iliceto S. Clinical presentation and diagnosis of myocarditis. *Heart*. 2015;101(16):1332-1344.
5. Friedrich MG, Sechtem U, Schulz-Menger J, et al. Cardiovascular magnetic resonance in myocarditis: a JACC white paper. *J Am Coll Cardiol*. 2009;53(17):1475-1487.
6. Ferreira VM, Schulz-Menger J, Holmvang G, et al. Cardiovascular magnetic resonance in nonischemic myocardial inflammation: expert recommendations. *J Am Coll Cardiol*. 2018;72(24):3158-3176.
7. Felker GM, Boehmer JP, Hruban RH, et al. Echocardiographic findings in fulminant and acute myocarditis. *J Am Coll Cardiol*. 2000;36(1):227-232.
8. Smiseth OA, Torp H, Opdahl A, Haugaa KH, Urheim S. Myocardial strain imaging: how useful is it in clinical decision making? *Eur Heart J*. 2016;37(15):1196-1207.
9. Kalam K, Otahal P, Marwick TH. Prognostic implications of global LV dysfunction: a systematic review and meta-analysis of global longitudinal strain and ejection fraction. *Heart*. 2014;100(21):1673-1680.
10. Leitman M, Vered Z, Tyomkin V, et al. Speckle tracking imaging in inflammatory heart diseases. *Int J Cardiovasc Imaging*. 2018;34(5):787-792.
11. Kostakou PM, Kostopoulos VS, Tryfou ES, et al. Subclinical left ventricular dysfunction and correlation with regional strain analysis in myocarditis with normal ejection fraction. *Int J Cardiol*. 2018;259:116-121.
12. Logstrup BB, Nielsen JM, Kim WY, Poulsen SH. Myocardial oedema in acute myocarditis detected by echocardiographic 2D myocardial deformation analysis. *Eur Heart J Cardiovasc Imaging*. 2016;17(9):1018-1026.

13. Kasner M, Aleksandrov A, Escher F, et al. Multimodality imaging approach in the diagnosis of chronic myocarditis with preserved left ventricular ejection fraction: the role of 2D speckle-tracking echocardiography. *IntJ Cardiol.* 2017;243:374-378.
14. Angelini A, Calzolari V, Calabrese F, et al. Myocarditis mimicking acute myocardial infarction: role of endomyocardial biopsy in the differential diagnosis. *Heart.* 2000;84(3):245-250.
15. Dec GW Jr, Waldman H, Southern J, Fallon JT, Hutter AM Jr, Palacios I. Viral myocarditis mimicking acute myocardial infarction. *J Am Coll Cardiol.* 1992;20(1):85-89.