

# Speckle tracking echocardiography (STE) in the assessment of patients with myocarditis

## Echokardiografia metodą śledzenia markerów akustycznych w ocenie pacjentów z zapaleniem mięśnia sercowego

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### Abstract

We report the case of a 38-year-old patient admitted to the hospital due to myocarditis, which first symptom was chest pain lasting many hours. Laboratory tests showed significantly increased markers of myocardial necrosis and inflammatory parameters. Coronarography showed no abnormalities of the coronary arteries. Based on the tests performed so far, myocarditis was suspected. In the next step, echocardiography was performed, including the assessment of deformation using the speckle tracking echocardiography. The study showed significantly reduced values of longitudinal strain within the segments of the inferior, lateral and apical walls. Left ventricular ejection fraction was preserved. Initial diagnosis of myocarditis was confirmed by cardiac magnetic resonance.

Key words: myocarditis, speckle tracking echocardiography, global longitudinal strain, cardiac magnetic resonance

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### Case report

A 38-year-old patient, previously untreated, was admitted to the hospital after hours of retrosternal pain radiating to the arms. The pain was preceded by a two-day upper respiratory infection. On admission, physical examination revealed no significant abnormalities.

Laboratory tests found significantly elevated cardiac troponin I (cTnI) levels [3,382 ng/L; normal (N) < 16 ng/L] that were further elevated at a check-up examination (cTnI

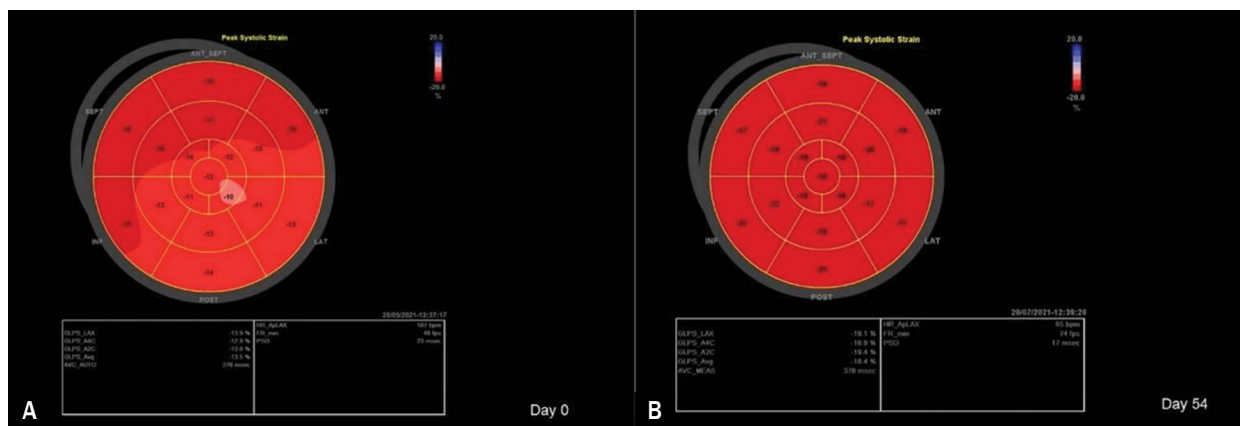
12,634 ng/L). Findings of other tests included elevated C-reactive protein (CRP) levels (50 mg/l; N < 5.0 mg/L) and leukocytosis with smear including granulocytes [white blood cells (WBC) 16,000/μL, granulocytes 86%].

Electrocardiography revealed 79/min sinus rhythm, peaked T waves in V3–V5 leads with ST elevation in many leads.

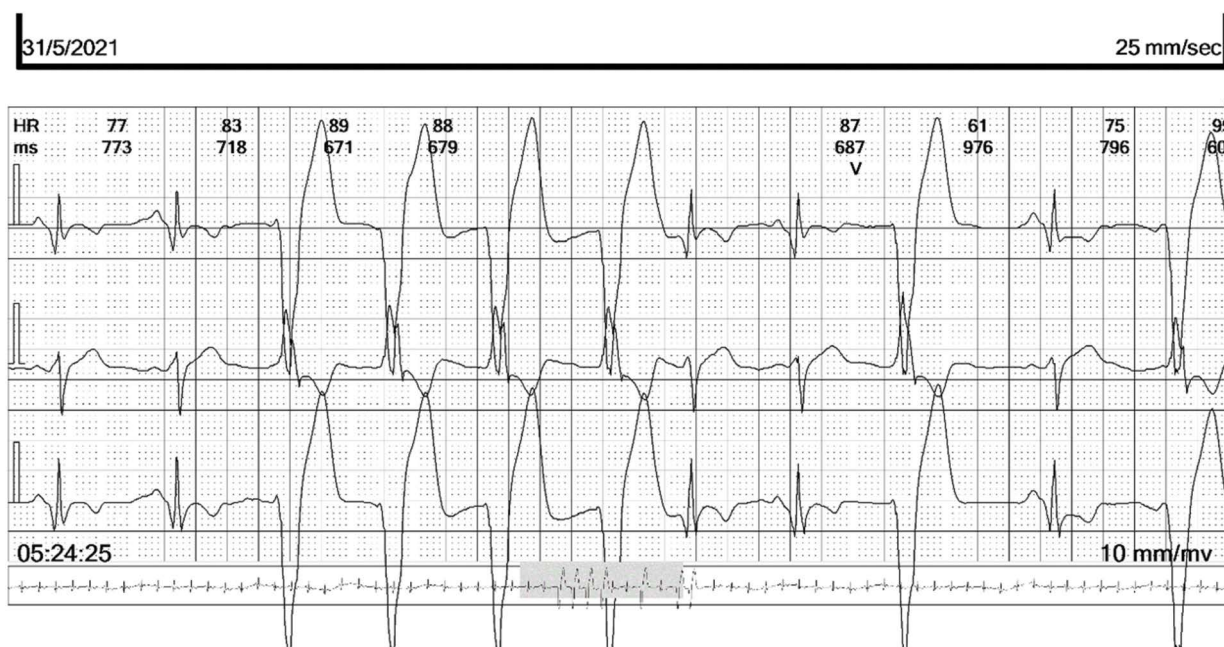
As recent myocardial infarction was suspected, coronary angiography was performed – normal coronary arteries were observed.

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**Figure 1.** The assessment of left ventricular longitudinal strain using speckle tracking echocardiograph (STE): **A.** Assessment in the acute phase of the disease – visible, significantly reduced longitudinal strain within the inferior, posterior, lateral, and apical wall segments and reduced GLS (13.9%); **B.** follow-up echocardiogram performed after 54 days found normalisation of longitudinal strain and a significant increase in GLS – 19.1%



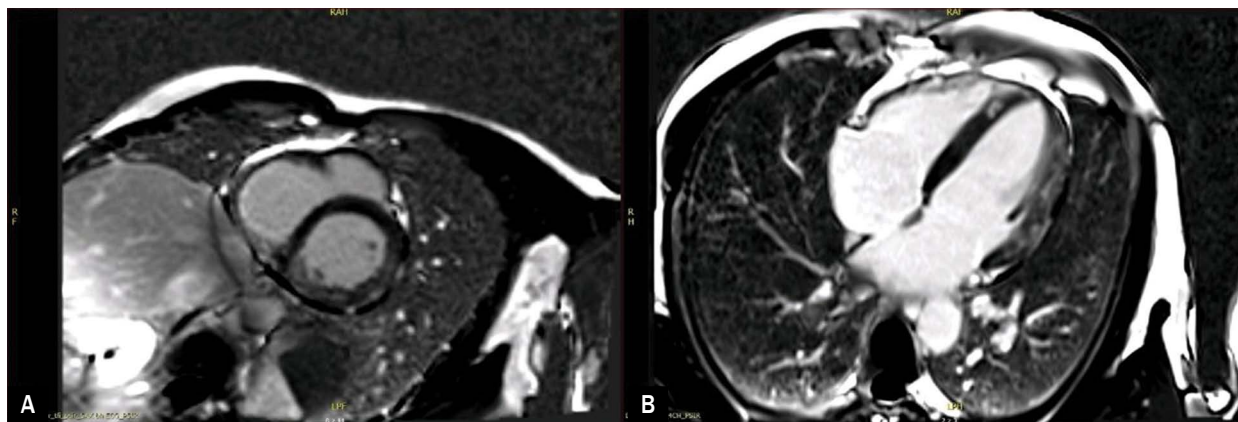
**Figure 2.** 24-hour Holter recording. A visible episode of active ventricular rhythm (4 beats) and additional single ventricular beats

Echocardiography (echocardiogram) found mild left ventricular hypertrophy and mild hypokinesia of the left ventricular inferior and posterior walls, whereas ejection fraction (EF) was normal (55–60%). Strain assessment using speckle tracking echocardiograph (STE) revealed significantly reduced longitudinal strain within the inferior, posterior, lateral, and apical wall segments and a reduction in global longitudinal strain (GLS) – 13.9% (Figure 1A).

The 24-hour Holter recording found sinus rhythm with an average heart rate of 74/min, additional ventricular beats, and a single episode of active ventricular rhythm (4 beats) with a heart rate of 85/min (Figure 2).

The cardiovascular magnetic resonance imaging (CMR) was performed to complete the evaluation and revealed the presence of areas of intramural and subendocardial late contrast enhancement (LCE). These areas were located in the lateral and inferior wall segments as well as in the apical segment of the left ventricular anterior wall (Figure 3). This area coincided with the reduced longitudinal strain visualised by echocardiography (Figure 1A).

Eight weeks later, the patient underwent a follow-up echocardiogram which revealed the absence of significant abnormalities; longitudinal strain values (both segmental and global) were normalised (Figure 1B).



**Figure 3.** Magnetic resonance imaging – late contrast enhancement (CMR–LCE) assessment: **A.** Cross-section (short axis) – visible areas of LCE within the inferior, posterior, and lateral wall; **B.** 4-chamber view – clearly visible areas of LCE, involving the lateral wall and a local focus within the apical segment of the interventricular septum

## Discussion

Myocarditis may mimic various acute cardiac conditions. The course of the disease can vary from asymptomatic to sudden cardiac death [1]. Clinical symptoms include chest pain, dyspnoea, decreased exercise tolerance, syncope, and arrhythmias. The lack of characteristic symptoms makes it difficult to make a correct diagnosis quickly. Patients are frequently admitted with a diagnosis of recent myocardial infarction and they undergo invasive evaluation for coronary artery disease, as in the reported case [2].

The gold standard for the evaluation for myocarditis remains myocardial biopsy and histopathological evaluation according to the Dallas criteria [3]. Due to its invasiveness, this method is used only in the case of exceptional clinical indications.

CMR evaluated according to the Lake Louise criteria is one of the most useful imaging examinations that are used in the evaluation for myocarditis. Myocarditis is indicated by the presence of 2 out of 3 criteria: myocardial oedema, hyperaemia (early contrast enhancement) or myocardial fibrosis (LCE). These criteria are complemented by the assessment of the distribution and extent of LCE, T1/T2 mapping techniques, and assessment of extracellular volume fraction [4, 5].

Regardless of the key role of CMR, echocardiography is usually one of the first examinations performed when CMR is suspected. The diagnosis may be supported by contractile abnormalities that do not coincide with typical areas of coronary artery vascularisation. Extending the echocardiographic assessment to include the strain assessment using STE may be a useful tool. This method enables quantitative measurement of global and regional systolic function of individual left ventricular segments, especially in patients with preserved ejection fraction [6].

In patients with acute myocarditis and preserved left ventricular ejection fraction there is a reduction in longitudinal strain, which was also observed in the reported patient. The reduction in strain may be visible regardless of the presence of damage to the subendocardial region imaged using CMR. However, the segments in which CMR reveals the damage have reduced longitudinal strain values compared to those without the observable damage [7].

Kostakou's study [8] also revealed significantly reduced GLS in patients with myocarditis and normal left ventricular ejection fraction. As in the patient in question, the segments with reduced longitudinal strain corresponded to the location of LCE during CMR. This makes STE a useful tool to assess regions of fibrosis in the left ventricle [8]. In another study, longitudinal strain measurements during STE and CMR were proven to be highly reproducible. There was also a high correlation between GLS measurements imaged using STE and CMR [9]. In patients with acute myocarditis, longitudinal strain correlates significantly with the severity and location of myocardial oedema imaged during CMR [10].

## Conclusions

Echocardiography along with longitudinal strain assessment is a valuable tool for an initial evaluation in patients with acute myocarditis. In the recovery period, this method can be useful in monitoring myocardial regeneration without the use of CMR as shown in the reported case.

## Conflict of interest

The authors declare no conflict of interest.

## Funding

None.

## Streszczenie

W tekście przedstawiono przypadek 38-letniego pacjenta przyjętego do szpitala z powodu zapalenia mięśnia sercowego, którego pierwszym objawem był wielogodzinny ból w klatce piersiowej. W badaniach laboratoryjnych stwierdzono znacznie podwyższony poziom markerów martwicy mięśnia sercowego i parametrów stanu zapalnego. W badaniu koronarograficznym nie wykazano żadnych nieprawidłowości w tętnicach wieńcowych. Na podstawie dotychczas przeprowadzonych badań podejrzewano zapalenie mięśnia sercowego. W kolejnym etapie wykonano badanie echokardiograficzne, w tym ocenę deformacji za pomocą echokardiografii metodą śledzenia markerów akustycznych. Wykazano również znacznie zmniejszone wartości odkształcenia podłużnego segmentów ściany dolnej, bocznej i wierzchołkowej. Frakcja wyrzutowa lewej komory była zachowana. Wstępne rozpoznanie zapalenia mięśnia sercowego potwierdzono w badaniu metodą rezonansu magnetycznego serca.

Słowa kluczowe: zapalenie mięśnia sercowego, echokardiografia metodą śledzenia markerów akustycznych, globalne odkształcenie podłużne, rezonans magnetyczny serca

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