






# Will 3D echocardiography replace computed tomography in the diagnostics of myocardial perforation in patients with implanted electrical devices?

Czy echokardiografia 3D zastąpi tomografię komputerową w diagnostyce perforacji mięśnia sercowego u pacjentów z implantowanymi urządzeniami elektrycznymi?

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## Abstract

We present two cases of patients who have had myocardial perforation due to implantation of the cardiac stimulating system. The first is an 81-year-old woman with a history of tachy-brady syndrome, in whom despite the suspicion of perforation in 2D echocardiographic (ECHO) imaging, computed tomography did not confirm the problem, and eventually after a few years clinical symptoms associated with perforation were revealed, which was clearly confirmed in the ECHO 3D study. In the second case, in a 62-year-old man with a pacemaker implanted because of atrioventricular block, 3D ECHO allowed for an evident diagnosis. The presented cases aim to draw attention to the potential value of 3D ECHO in the diagnosis of this type of complication.

Key words: echocardiography, pacemaker, perforation

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## Introduction

Perforation of the right ventricle (RV) of the heart constitutes one of relatively rare, though potentially lethal complications of the implantation of electric cardiac devices, both pacemakers (PM) and implantable cardioverter defibrillators (ICD). It occurs with a frequency ranging from 0.3% to 1.2% of the total number of implantations [1]. The ever-increasing number of these procedures inevitably leads to an increase in the number of such complications, which may either manifest in symptoms or remain entirely asymptomatic; it does not, however

mean that the patient is not at risk [2]. Diagnosing cardiac perforation may be a challenge, especially when it does not lead to cardiac tamponade. Standard echocardiographic (ECHO) examination with the use of the 2D method often does not suffice to properly visualise electrode displacement, and computed tomography (CT) has been so far considered to be a reference method enabling formal diagnosis. Below are 2 cases from the Department of Cardiology and Electrotherapy at the Medical University in Gdansk, the aim of which is to demonstrate the potential role of the 3D ECHO in the diagnostics of these significant complications.

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## Case report

The first case is an 81-year-old woman with a history of tachycardia-bradycardia syndrome, and a DDD-R cardiac pacemaker. After the implantation of the pacemaker, the patient did not complain of any discomfort, and PM check showed no abnormalities. After a 2D ECHO examination, performed after the implantation, physicians suspected so-called dry perforation – the tip of the electrode passed through the entire RV wall, protruding beyond it by about 2 mm; in this area, there was a discrete effusion in the pericardial sac and a small layer of fibrin. However, CT of the chest did not confirm the diagnosis. The patient was discharged and referred to further outpatient follow-ups. A similar image was visualised in the ECHO examination performed one year later, while the image of a 3D reconstruction, performed additionally, clearly showed passing of the electrode through the myocardium and rising of the pericardium during systole just above the electrode (Figure 1), which made perforation diagnosis obvious. In addition, the patient began to complain of stinging in the vicinity of the heart, which had been occurring for three months. She was finally qualified for the removal of the perforating electrode and an implantation of a new one, after which both the above changes in echocardiography and clinical ailments subsided.

The second case concerns a 62-year-old man with a history of an atrioventricular block and a DDD-R cardiac pacemaker. In the first 72 hours after the procedure, the patient reported acute chest pain; electrocardiography (ECG) showed, previously absent, elevations of the ST segment and lowering of the PR segment in leads I, II, aVL, aVF and V3–V6 (Figure 2). In addition, the level of C-reactive

protein concentration was elevated to 180 mg/L. No abnormalities in the operating parameters of the implanted device were observed. X-ray of chest showed no signs of emphysema or pathological displacement of pacemaker electrodes. After 2D echocardiography physicians suspected perforation - the tip of the electrode was located deep in the RV wall; in addition, a small layer of fibrin and fluid in the pericardial sac were present. 3D imaging show the electrode protruding beyond the free RV wall for the length of approximately 8 mm (Figure 3), which made the diagnosis of perforation obvious, and it was decided that CT was unnecessary.

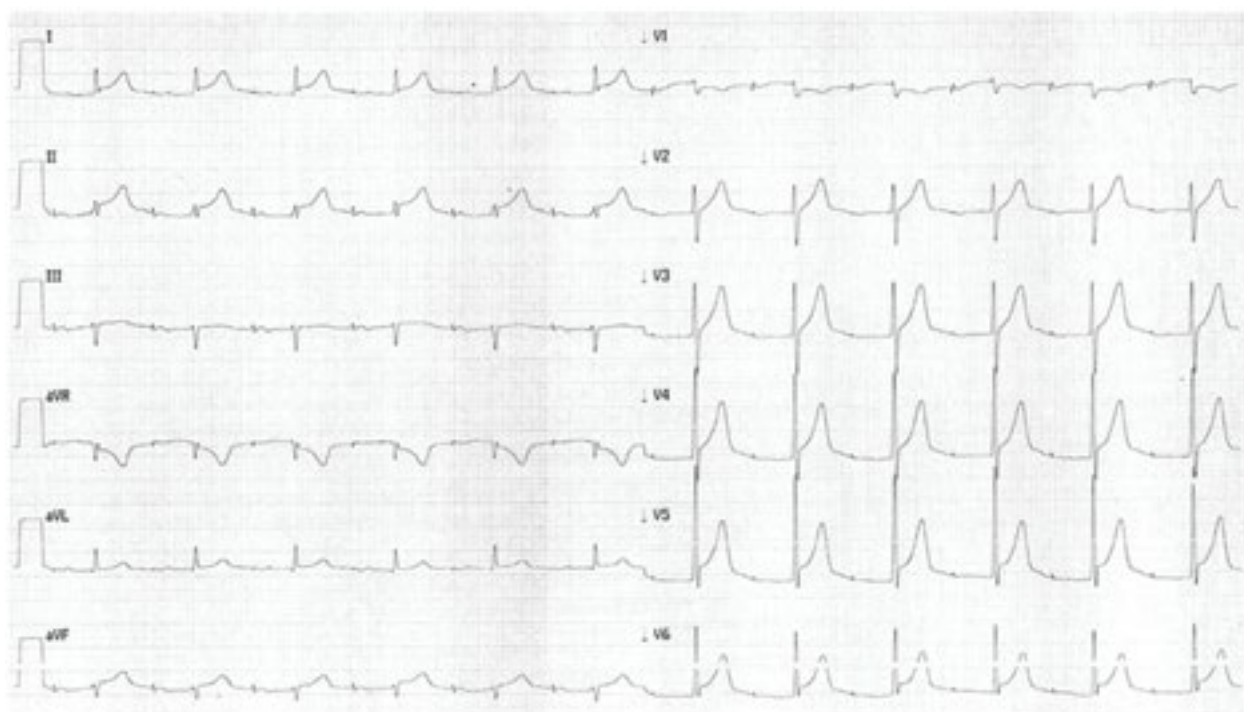
After the removal of the perforating electrode and the implantation of a new one, the ailments subsided and the above-described abnormalities were quickly resolved.

## Discussion

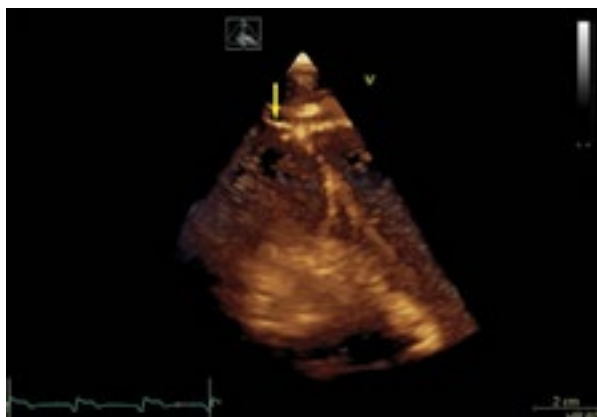
Myocardial perforation is a potentially lethal complication which leads to sudden death through the mechanism of pericardial tamponade. Regrettably, it is not always easy to diagnose this dangerous complication. Clinical symptoms accompanying myocardial perforation with the electrode of the implanted device may vary to a large extent. The ones which occur most frequently are chest pain, dyspnea, palpitations; it should be noted, however, that patients may show no symptoms at all [3]. Apart from clinical symptoms, perforation diagnosis may be facilitated by chest X-ray, ECG imaging, a check of the implanted device showing abnormalities in its operation, 2D ECHO. So far, CT examination has been the basis for formal diagnosis. The above cases show how diverse clinical manifestations in patients with perforation can be – varying from entirely asymptomatic



**Figure 1.** 3D (full volume) imaging with the use of the flexi-slice function (GE Vivid 9, 4V head). The yellow arrow indicates the site of electrode passage through the muscle of the RV and the rising of the pericardium: **A.** Visualisation of the right ventricular long axis; **B.** Visualisation of the right ventricular short axis at the level of the apex



**Figure 2.** Electrocardiography of a 62-year-old patient, performed during the period of the occurrence of the symptoms reported by him. Atrial stimulation, 72/min, normogram, ST segment elevation and lowering of the PR segment in leads I, II, aVL, aVF and V3–V6



**Figure 3.** 3D full volume imaging (GE Vivid 9, 4V head). The yellow arrow indicates the site of the electrode passage through the muscle of the right ventricle

to symptoms raising many doubts. Additionally, the performed examinations were not always helpful either. In the second case described, no abnormalities in operating parameters of the PM were revealed, despite its protrusion for the length of approximately 8 mm, which could be misleading for the clinician. In both presented patients it was the modern ECHO technique, based on 3D imaging, that

proved to be the most important examination confirming the diagnosis of a dangerous complication that perforation is. Due to the non-invasive nature of the examination as well as its increasing availability in hospital units, it should be expected that the method will significantly decrease the number of CT examinations, or perhaps even replace them in formal diagnoses of myocardial perforation as a result of electric device implantation.

## Conclusions

3D echocardiography should be considered to be a method which is very promising for diagnosing myocardial perforation by electrodes of implantable devices, which may contribute to decreasing the need to perform CT examinations, or become the sole diagnostic method for this type of perforation in some cases. As a result, proper diagnosis could be made faster and physicians could avoid exposing patients to X-rays. In addition, the costs of hospitalising such patients would be decreased, which is quite significant in the era of modern medicine.

## Conflict of interest

The authors confirm that there is no conflict of interest involving the published work.

## Streszczenie

Przedstawiono dwa przypadki pacjentów, u których doszło do perforacji mięśnia sercowego po implantacji układu stymulującego serce. Pierwszym jest 81-letnia kobieta z zespołem tachy-brady w wywiadzie, u której mimo podejrzenia perforacji w echokardiograficznym obrazowaniu 2D tomografia komputerowa nie potwierdziła problemu, a ostatecznie po kilku latach doszło do ujawnienia się objawów klinicznych związanych z perforacją, którą ostatecznie potwierdzono w badaniu echokardiograficznym (ECHO) 3D. W drugim przypadku, u 62-letniego mężczyzny z implantowanym z powodu bloku przedsionkowo-komorowego stymulatorem serca, ECHO 3D pozwoliło na ewidentne postawienie diagnozy. Celem przedstawienia przypadków jest zwrócenie uwagi na potencjalną wartość ECHO 3D w diagnostyce tego typu powikłań.

Słowa kluczowe: echokardiografia, rozrusznik serca, perforacja

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