Case Report

Three-Dimensional Echocardiographic Documentation of Pacemaker Lead Perforation Presenting as Acute Pericarditis

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Myocardial perforation is a rare complication of permanent pacemaker insertion and is usually detected during the first month after implantation. Pericardial effusion often occurs at the same time, and as a consequence may generate difficulties in the diagnostic workup due to the various aetiologies of its origin. Computed tomography has been used for the documentation of lead perforation, but its diagnostic accuracy in comparison to echocardiographic examination has not been validated. We report a case of ventricular perforation causing pericarditis, initially undetected by computed tomography, that was finally diagnosed by means of real-time three-dimensional echocardiography.

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Lead perforation with associated pericarditis as a complication of pacemaker implantation can be detected radiographically. Computed tomography is a useful imaging method for localising the intracardiac leads, despite the anticipated artefacts related to the imaging of metal implants. In the case reported here it was not until we examined the patient with real-time three-dimensional echocardiography that the diagnosis of ventricular perforation was manifested.

Case presentation

An 83-year-old woman with a single-chamber pacemaker implanted 3 weeks before for transient 2:1 atrioventricular block presented to the emergency department complaining of low-grade fever, atypical chest pain and mild dyspnoea during the last 2 days. The clinical examination, routine biochemical and haematological tests were all unremarkable. An electrocardiogram showed sinus rhythm, 90 /min, with 1:1 atrioventricular conduction. Arterial blood gas analysis revealed mild hypoxaemia. A chest X-ray showed clear lung fields and cardiomegaly, with no evidence of lead dislodgement from the right ventricular apex. Computed tomography revealed moderate pericardial effusion. The pacing lead was visualised projecting towards the right ventricular apex. Importantly, due to the anticipated artefacts surrounding the pacemaker tip there was no clear evidence of lead dislodgement or ventricular perforation (Figure 1). Acute pericarditis was initially diagnosed and non-steroid anti-inflammatory therapy administered to the patient.

Interrogation of the device revealed a high pacing threshold (unipolar: 5 V/0.4 ms, bipolar: 3.8 V/0.4 ms) with acceptable other measurements, including typical electrocardiographic findings during pacing (left bundle branch block morphology, left axis deviation).

Transthoracic echocardiography was performed on the second day of admis-

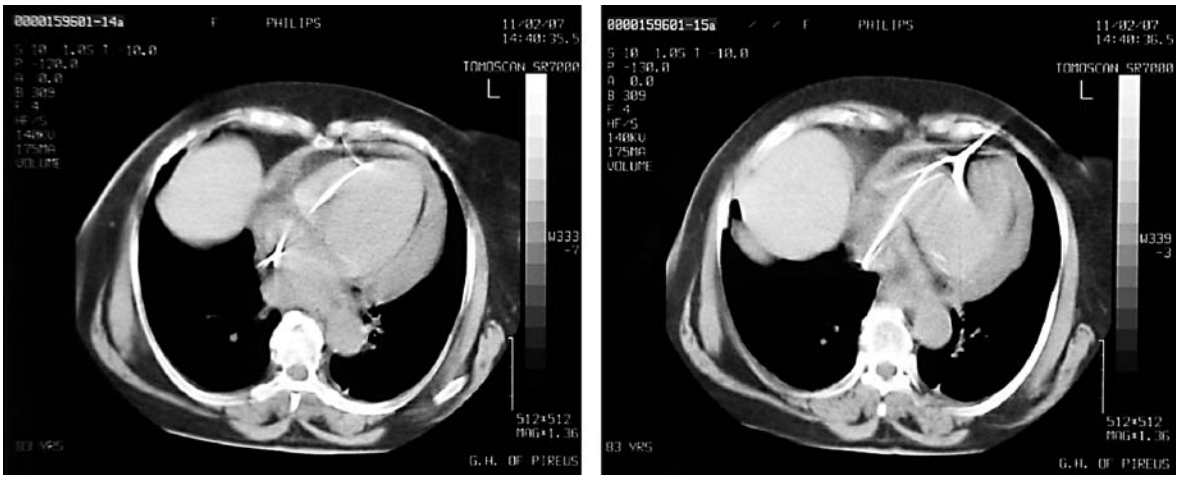

Figure 1. Serial tomographic images demonstrating the pacing wire accompanied by "star" artefacts.

sion. The initial two-dimensional echocardiogram showed a moderate pericardial effusion with no signs of cardiac tamponade. Substantial echo densities were also noted on the visceral pericardium in proximity to the right ventricular apex, a finding that was interpreted as an indication of a marked inflammatory process associated with the acute pericarditis. The echocardiographic position of the wire was not revealed by the four-chamber projection (Figure 2) and was mainly recorded from the subcostal projection. However, relatively poor imaging could not confirm or rule out a possible lead dislodgement or perforation. A real-time three-dimensional echocardiogram was decided upon immediately after the completion of the two-dimensional study. An apical pyramidal full volume dataset was acquired at first. By cropping away the anterior atrial and ventricular walls of the heart an improved visualisation of the pacing wire was obtained. A right ventricular perforation was recognised, with projection of the wire tip approximately 1 cm into the pericardial sac (Figure 3).

Non-steroid anti-inflammatory medication was replaced by corticosteroid therapy and serial echocardiographic examination revealed reduction of the effusion. A week after admission, the lead was easily removed by mild traction under the thoracic surgeon's

Figure 2. Two-dimensional four-chamber echocardiographic view with no depiction of the pacing lead excursion into the right heart chambers.

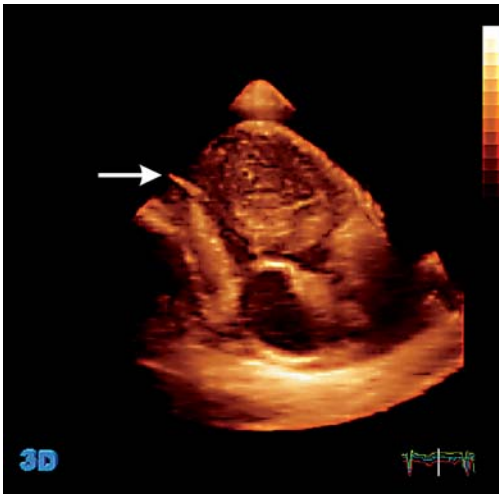

Figure 3. Three-dimensional echocardiographic confirmation of pacemaker lead perforation.

supervision, without complications. A few days later a new lead was placed at the sub-tricuspid inflow tract. The patient remained asymptomatic during one-month follow-up, with no detectable pericardial effusion.

Discussion

In this report we have described a case in which myocardial perforation of a pacemaker wire was clearly identified by three-dimensional echocardiography. Myocardial perforation is a serious complication of pacemaker implantation. It occurs in 0.1-0.8% of pacemaker implantation cases and is more common when active fixation leads are used.[1-3] It is usually detected during the first month after the procedure. Pericardial effusion is also an uncommon complication of pacemaker implantation and is strongly related with the use of active fixation leads, especially atrial ones. Apart from actual perforation of myocardial wall by an electrode, direct injury, or irritation of the visceral pericardium via immune mediated mechanisms, have been proposed as causes of post-implantation pericarditis.[4] When pericardial effusion is diagnosed after implantation, a meticulous diagnostic approach for the documentation of lead dislodgement or perforation should be performed.

Diagnosis of ventricular lead perforation may be accomplished with two-dimensional echocardiography, chest X-ray or computed tomography scan. Two-dimensional echocardiography is a valuable tool for the detection of pacing wire dislodgement or perforation. Difficulty or total failure in visualising pacemaker wires is not rare if the spatial orientation of the two-dimensional echocardiography beam does not cut across the path of the wire. Thus, the operator should obtain multiple tomographic images of the heart to confirm the diagnosis. Occasionally, computed tomography demonstrates a myocardial perforation that is not suggested by other imaging modalities.[5] However, visualisation of the wire, even with multi-detector tomographs, is commonly associated with "star" artefacts related to the metal implants, which undoubtedly affect the quality of the imaging.[6]

Nowadays, three-dimensional echocardiography might be considered complementary to a two-dimensional study despite its lower spatial and temporal image resolution. The major proven advantage of this technique is the improvement in the accuracy of the echocardiographic evaluation of cardiac anatomy and the more realistic and comprehensive view of intracardiac structures. The disadvantage of lower spatial resolution in relation to two-dimensional echo is not significant in studies aiming to display pacemaker wires, since their echogenicity is high enough to allow adequate imaging because of the sharp interface between intracavitary blood and the surface of the wire. Moreover, the entire examination can be completed rapidly using wide-angled acquisitions, thus avoiding the need for multiple two-dimensional tomographic projections.[7]

Additional information that three-dimensional echocardiography may offer in this context remains to be determined in future studies. Nevertheless, we suggest that real-time three-dimensional imaging should be integrated into the routine echocardiographic examination, especially in patients with pacemaker wires in an uncertain position, where the precise intracardiac lead excursion should always be reported.

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