Infections of heart stimulating systems and implantable cardioverters-defibrillators. A problem for cardiologists and cardiac surgeons

Infekcje układów stymulujących serce i kardiowerterów-defibrylatorów. Problem kardiologów i kardiochirurgów

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Abstract

This paper presents the issue of infective endocarditis related to the infection of the implanted heart stimulating system (pacemaker) or implantable cardioverters-defibrillators. Having long-lasting experience in both implanting and extracting heart stimulating systems, the authors try to find a patient-safe consensus on management of such cases, basing on a history of a 33-year-old patient.

Key words: infective endocarditis, infection of heart stimulating systems and implantable cardioverters-defibrillators, extraction of electrodes.

Streszczenie

W pracy przedstawiono zagadnienie zapalenia wsierdzia związanego z infekcją implantowanego układu stymulującego (rozrusznika) czy kardiowertera-defibrylatora. Autorzy w oparciu o wieloletnie kardiochirurgiczne doświadczenie zarówno w implantacji, jak i ekstrakcji układów stymulujących pragną na podstawie historii 33-letniego chorego znaleźć bezpieczny dla pacjenta konsensus postępowania kardiologa i kardiochirurga w takich przypadkach.

Słowa kluczowe: infekcja wsierdzia, zakażenia układów stymulujących serce i kardiowerterów-defibrylatorów, usuwanie elektrod.

Background

Over the last decade, the prevalence of cases of infection on heart stimulating systems and implantable cardioverters-defibrillators increased by 124% [1]. This phenomenon results from an increasing number of devices implanted, significant progress in electrophysiology and growing possibilities of excitatory and conducting system prosthetic restoration. A need for removing infected stimulating systems being a reason for "electrode-related" infective endocarditis has become a challenging clinical problem. In such cases, the recommended treatment method is a guided antibiotic therapy followed by a removal of the whole stimulating system (pacemaker, PM) or implantable cardioverter-defibrillator (ICD). Totally pacemaker-dependent patients or those who need permanent ICD coverage with the device infection are a major clinical issue. An alternative to surgical removal of the infected systems is less invasive percutaneous transvenous methods involving Cook's electrode removal system, introduced in Poland by Kutarski et al. [2]. However, should these methods be used routinely in all patients? A choice of an optimal treatment method for a specific patient is an important issue for the discussion in which the authors would like to present their point of view based on long-lasting experience.

A case report

A thirty-three–year-old male patient with a history of implantation of Biotronic Leptos pacemaker in 1994 due to a sick sinus syndrome, re-do implantation of Biotronic Kairos D pacemaker with a simultaneous implantation of an atrial electrode in 1999 and second re-do implantation of Biotronic DR pacemaker in 2006, was admitted to the Department of Cardiology in December 2009 because of shortness of breath, fatigue, persistent subfebrile body tempera-

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ture or fever and chest pain. On physical examination he had signs of bilateral pneumonia. Abnormalities found on additional tests included moderate anaemia, high level of C-reactive protein, slightly raised levels of aminotransferases, sideropenia and lowered total iron binding capacity (TIBC). On the chest x-ray some resolving inflammatory changes in the left lower pulmonary field were observed. In spite of modified broad spectrum antibiotic therapy, there was no clinical improvement and the patient continued having fever. The pacemaker control revealed a lesion of ventricular electrode. Transthoracic and transesophageal echocardiography (TTE and TEE) showed an irregularly shaped shadow sized 18 × 20-25 mm localized inside the right ventricle at the end of the electrode. It entered the pulmonary trunk through the pulmonary valve to a depth of 10 mm and was considered massive vegetations (Figs. 1, 2). Due to worsening of the clinical state and suspicions of pulmonary embolism with vegetation material, the patient was transferred to the Department of Cardiac Surgery. On 22 December 2009, he was operated on cardio-pulmonary bypass (CPB) with bicaval venous cannulation and with heart beating. The infected atrial electrode was removed through the right atriotomy as well as the ventricular electrode together with huge masses of partially organized vegetations tightly adhering to it with some fragments loosely balloting in the right ventricle towards the tricuspid valve (Figs. 3-5). The ventricular electrode perforated the septal leaflet of the tricuspid valve and unfortunately tangled with its subvalvular apparatus. The removal of the atrial electrode was not very difficult in spite of a fact that

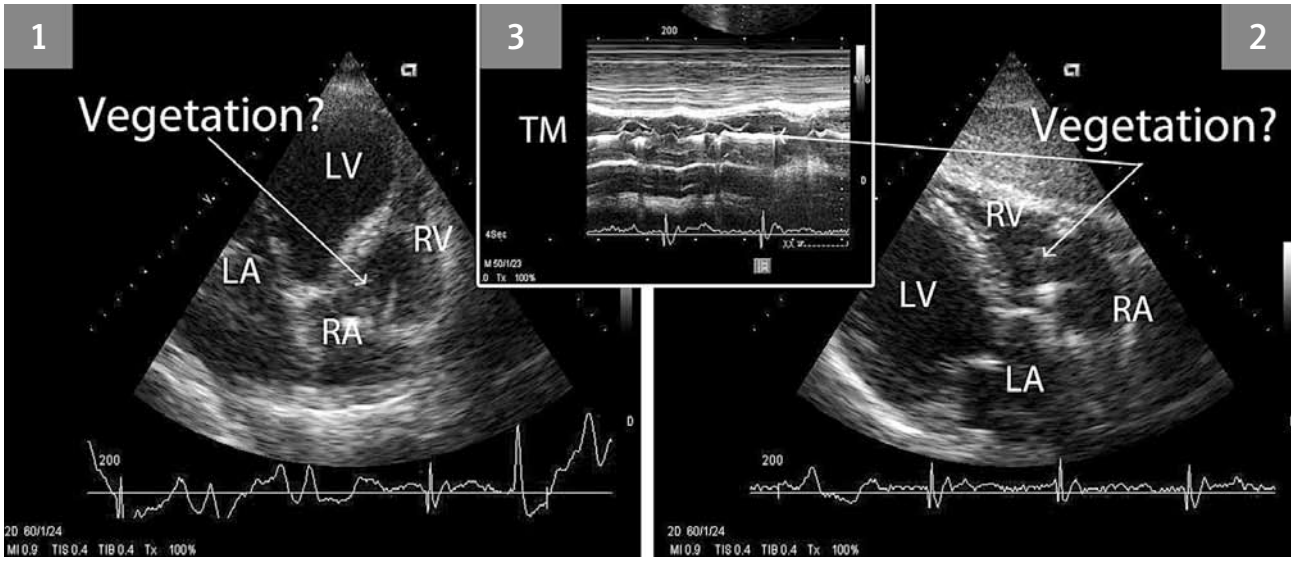

Fig. 1. Transthoracic echocardiography. Four-chamber apical projection (1), substernal projection (2) including M-mode (3). The electrode in the right atrium (RA) and the right ventricle (RV). The arrows indicate echoes suggesting the presence of vegetations. LA – left atrium, LV – left ventricle

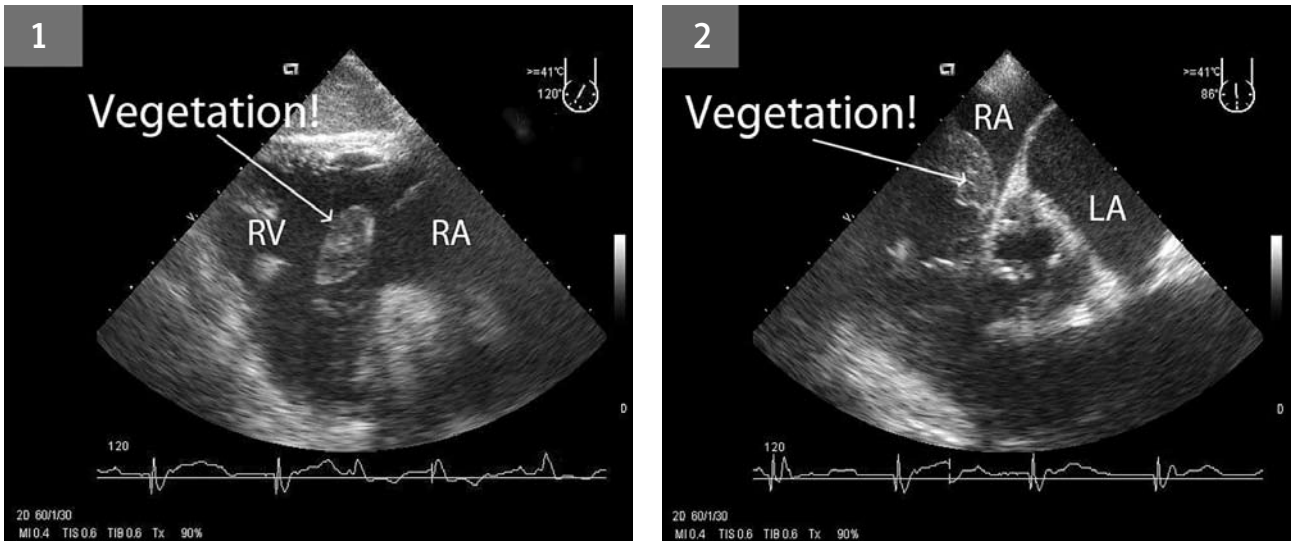

Fig. 2. Transesophageal echocardiography. Gastric projection 120° (1), and lower oesophageal projection 90° (2). In the right atrium, visible big mobile vegetations on the electrode

Fig. 3. Intraoperative photography. The electrode with huge vegetation visible in the opened right atrium

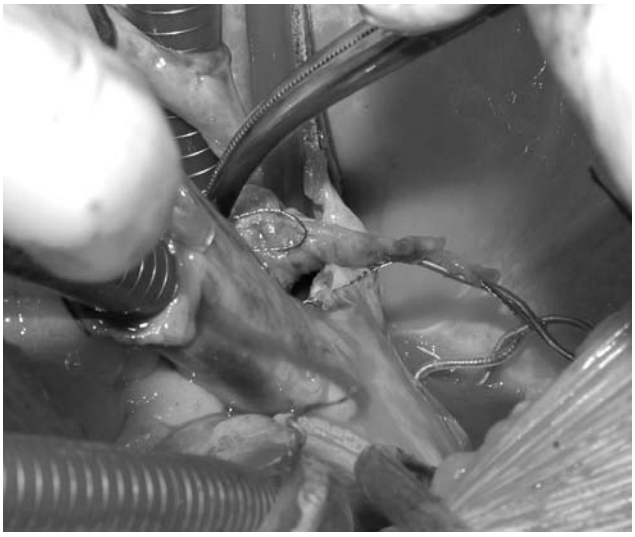

Fig. 4. Intraoperative photography. The electrode with huge vegetation visible in the opened right atrium

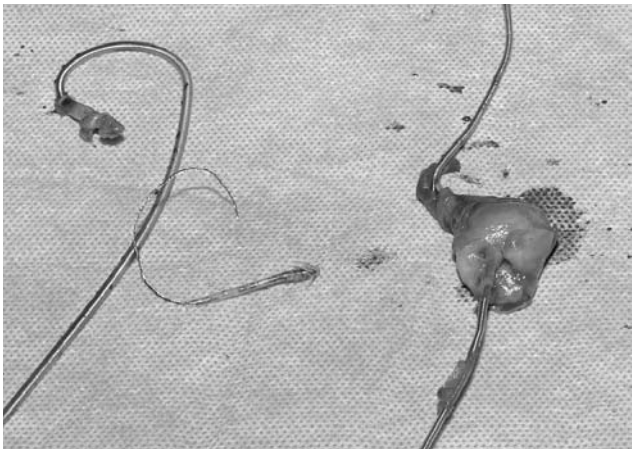

Fig. 5. The removed electrodes. Visible big vegetation

it was firmly connected with the right atrial wall and the superior vena cava wall. A tissue tunnel that was wrapping the electrode tightly and possibly contained vegetation material was also removed. After closing the sternotomy and applying the dressing, the pacemaker with proximal ends of the electrodes was easily removed. The postoperative course was uneventful and the patient stopped to have fever, however, the typical prophylactic guided antibiotic therapy was applied for 21 days. The control blood cultures taken 48 hours after the antibiotics withdrawal were negative both for aerobic and anaerobic bacteria. A twenty-four-hour ECG monitoring which was performed several times did not show any rhythm and conduction disturbances – there were no longer any indications for pacemaker implantation. The patient was discharged from the hospital in a good clinical state.

Discussion

The progress in electrophysiology resulted in many patients needing a change of the heart stimulating system e.g. implantation of additional electrodes for atrial stimulation or for desynchronization (CRT), or replacement of a pacemaker for ICD. Nowadays, these complicated and time-consuming procedures burdened with a high risk, are performed by cardiologists (not surgeons) with little practical experience [3]. Hemorrhagic complications such as hematoma in the pacemaker site, hemothorax or hemopericardium related to the heart free wall perforation, are often caused by ignorance of surgical techniques including haemostasis. These complications are frequently a commencement of the process called electrode related infective endocarditis. The following basic manoeuvres are the keystones of long-term durability of the implanted system; subclavian vein puncture (it seems that a return to basilic vein preparation is not a good idea), proper fixation of electrodes within a pacemaker site preventing them from translocation and careful management with an electrode's sheath because its perforation can trigger infection [3, 4].

The data from literature show that 10-23% of patients with infected stimulating systems will develop infective endocarditis [5, 6]. Although medical treatment alone (guided antibiotic therapy) lowers mortality rate, it still remains very high and reaches 31-66% [6, 7]. Only total removal of the infected system may significantly improve these outcome and lower mortality rates to 10-20% [5, 7]. When should the system be removed? Is it worth attempting to save it? Which method of the removal to choose: percutaneous, transvenous, surgical or a combination of the last two? These are the questions asked for years, which are difficult to be definitely answered.

Ana del Rio et al. [8] emphasize the issue of time that passed from the implantation moment. If it is shorter than 12 months, a simple traction of the electrodes should be sufficient. After this period more sophisticated methods

(e.g. locking styles) should be applied to mobilize the electrode from the right ventricle endocardium.

Analyzing a possibility of transvenous removal of electrodes many authors underline the importance of size, shape and character of adhering vegetations. Generally, there is a consensus that this method should not be used when removing electrodes with vegetations larger than 10-15 mm on TEE, because of a high risk of pulmonary embolism with torn off vegetation which may even lead to pulmonary abscess [9, 10]. According to Love et al. [11], a procedure of transvenous removal of electrodes is burdened with 1-5% risk of death in the case of PM and as high as 12% mortality rate in the case of ICD.

The study of Małecka et al. [12] based on 220 cases of PM/ICD system removals does not determine a border line size of adhering vegetations suitable for the transvenous method, especially when using the pulmonary circulation protection with Dotter's basket. This technique enables the authors to remove electrodes with 5 cm big vegetation. However, it remains uncertain if the whole vegetation material found itself in the basket. There is no evidence on lungs (e.g. scintigraphy or computed tomography) or any other organ where the fragments of such huge vegetation could potentially find their way. Should a cardiac surgeon be helpful only in the case of failure of transvenous procedure or occurrence of its complications?

The data from literature [13] show that even surgical coverage can be insufficient to save especially older patients with such complications like central vein or heart perforation (acute tamponade).

Another important problem related to a removal of infected electrodes without visual control is a possibility of the tricuspid valve iatrogenic damage [14]. The case reported by the authors of the present study can be the best confirmation of this issue. In spite of full visual control and big experience of the surgeon it was very difficult to remove the ventricular electrode (which had perforated the septal leaflet and tangled with subvalvular apparatus) together with adhering vegetations, without causing an injury of the tricuspid valve.

A method of removal of infected electrodes with big vegetations via median thoracotomy without use of CPB presented by Miralles et al. [15] seems to be an interesting compromise between indiscriminate attempts of intravenous traction regardless of clinical conditions and a more safe but very invasive cardiac surgery method. According to some authors [14], a surgical removal of grown in electrodes performed on CPB results in as high as 10% mortality rate. Basing on our experience, we believe that properly done operation of PM/ICD system removal is not burdened with such a big risk, unless it is an emergency lifesaving procedure following unsuccessful transvenous traction. Our results are much better than mentioned above and we are going to present them soon in another paper.

The challenging subset of patients with "electrode-related" infections of endocardium is those who require permanent PM stimulation or ICD coverage. What are their options? Will implantation of a temporary stimulating system within infected endocardium yield development of another infection? A suggested method is introduction of a thin electrode with retractable screw into the heart chambers via jugular or subclavian vein, and connecting it with a pacemaker located on the opposite side than a previous system. This is a kind of protection for a patient but it remains unclear if such management causes another infection within both endocardium and skin [5].

An electrode, like any other alien body introduced into infected environment, may become a perfect base for new bacterial colonies growth. A removal of infected electrodes by a cardiac surgeon via sternotomy, with or without use of CPB, allows for safe and visually controlled division of a grown in electrode together with adhering vegetations and for continuation of stimulation by implantation of external epicardial electrodes which will not have any contact with infected tissues.

An alternative to the above mentioned method can be "hybrid procedures" combining a transvenous extraction of infected electrodes and implantation of a new system using thoracoscopy. The progress in cardiac surgery and quick development of less invasive methods brings an opportunity for cooperation of surgeons and cardiologists.

The elaboration of universal algorithms of management in patients with infected PM/ICD systems should become the main target for physicians dealing with this clinical problem. And first of all we must not forget that the patient's life is the supreme value.

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