

Diagnosis of Pacemaker Lead Infection Using Transoesophageal Echocardiography: A Case Report

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Abstract

Introduction: Vegetative lead infection is an uncommon complication of permanent pacemaker implantation. The diagnosis is difficult using conventional imaging methods. **Clinical Picture:** An elderly Indian woman with a history of diabetes mellitus developed Staphylococcus aureus infection after implementation of a permanent pacemaker. Following a non-diagnostic transthoracic echocardiogram, transoesophageal echocardiography was performed and showed a large vegetative mass attached to the pacemaker lead within the right atrium. **Treatment:** The pacemaker was removed and intravenous vancomycin administered for six weeks. **Outcome:** She was discharged well but demised two months later from a second episode of septicaemia. **Conclusions:** Pacemaker lead infection remains a challenging management problem. Transoesophageal echocardiography can facilitate its diagnosis.

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Key words: Endocarditis, Lead infection, Pacemaker, Transoesophageal echocardiography

Introduction

The expanding indications for permanent cardiac pacing mandate an awareness of the potential complications associated with device implantation. After failure of pacing and sensing, infection is the most frequent pacemaker-related complication, with reported rates of between 1% to 7% in older studies¹ and <1% in more recent series.² Pacemaker lead infection has, however, been reported only sporadically³⁻⁹ and as a few small series.^{10,11}

The incidence of pacemaker lead infection may be underestimated as the diagnosis can be difficult, particularly when there is no obvious inflammation of the generator pocket in patients treated intermittently with antibiotics.⁷ Although transthoracic echocardiography (TTE) is generally performed whenever a pacemaker-related infection is suspected, its sensitivity for diagnosing pacemaker endocarditis is low.¹⁰ Recent reports have indicated the superiority of transoesophageal echocardiography (TEE) over transthoracic echocardiography in diagnosing pacemaker lead infection.^{7,8,11}

We highlight a case where TEE was instrumental in making the diagnosis of pacemaker endocarditis, and briefly review relevant literature on this entity.

Case Report

A 70-year-old Indian woman with a history of diabetes mellitus received a permanent pacemaker (Prodigy, Medtronic Inc., Minneapolis, MN) with a single ventricular lead for complete heart block. Wound healing was poor and secondary suturing of the generator pocket was performed 33 days after implantation. Two months post-procedure, she was readmitted for fever occurring over the last 24 hours. The 12-lead electrocardiogram showed native sinus rhythm at a rate of 73 beats per minute. Chest X-ray revealed clear lung fields, a normal cardiac silhouette and the pacemaker generator in the left subclavicular region with a single electrode terminating in the right ventricular apex. She had normochromic, normocytic anaemia with a predominantly polymorphonuclear leukocytosis of 32 x 10⁸/ml and the erythrocyte sedimentation rate was 45 mm

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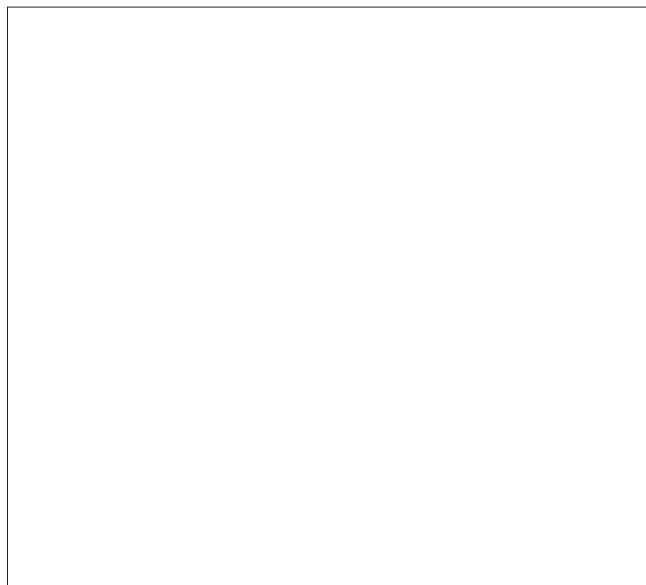


Fig. 1. Transoesophageal echocardiogram with the transducer oriented in the horizontal plane, showing a 4-chamber view of the heart. The vegetation (arrow-head) is seen attached to a pacemaker lead (arrow). LA: left atrium, RA: right atrium, LV: left ventricle, RV: right ventricle.

in the first hour. Blood cultures showed sustained methicillin-resistant *Staphylococcus aureus* bacteraemia. The generator pouch was also inflamed and cultures grew the same organism. TTE indicated possible aortic valvular abscess and she was referred specifically for TEE.

TEE using a biplane probe (Hewlett-Packard Co., Andover, Massachusetts) was performed under sedation with 2 mg of intravenous midazolam and topical pharyngeal anaesthesia. Cardiac chamber sizes and function were normal. There was no abscess formation in the mitral-aortic intervalvular fibrosa. A large mass measuring 8 x 4 mm was seen attached to the pacemaker lead within the right atrium immediately adjacent to the tricuspid valve. Visualisation of this mass was optimal from mid-oesophageal views of the right atrium (Figs. 1 & 2) which revealed multiple filiform extensions with independent motion (Fig. 2). There were no vegetations on the tricuspid valve leaflets or anywhere else along the course of the lead, including the superior vena cava. There was very mild tricuspid regurgitation. The findings were considered typical of an infected vegetation, and explantation of all pacemaker hardware advised.

The pacemaker was subsequently removed via external traction as thoracotomy was declined and the patient given intravenous vancomycin at therapeutic levels for six weeks. She was discharged apparently well but returned to hospital two months later in shock from recurrent staphylococcal septicaemia. Appropriate antibiotic therapy was commenced but she succumbed after two weeks.

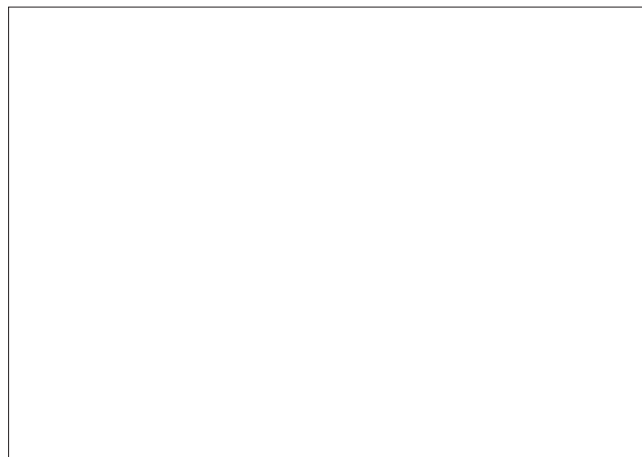


Fig. 2. Transoesophageal echocardiogram with the transducer array oriented vertically showing the vegetation (arrow-head) within the right atrium. Note the irregular filiform extensions of the vegetative mass. The pacemaker lead is not clearly visualised in this section. Ao: aorta, other abbreviations as in Figure 1.

Discussion

Pacemaker lead infection is a rare but potentially fatal complication of permanent pacemakers. Although no formal criteria define pacemaker endocarditis, this entity is generally characterised as continuous bacteraemia originating from an infected focus on the pacemaker electrode tip, the tricuspid valve or right atrial wall in contact with the electrode.¹² We believe, as do others^{4,10} that vegetative lead infection should be included in the spectrum of pacemaker endocarditis because firstly, the pacemaker wire is often invested by endothelium or fibrous tissue^{13,14} and secondly, the natural history of these conditions is very similar.^{10,11} Previous studies of pacemaker-related septicaemia have probably underestimated the incidence of lead infection or endocarditis since definitive diagnosis, based on the superseded von Reyn criteria,¹⁵ was not possible without first explanting the pacemaker system. Additionally, suitable imaging techniques for visualising macroscopic lead infection, in particular TEE, were not available then. In the largest series reported to date, only 2 of 44 patients diagnosed to have pacemaker endocarditis had a TEE examination.¹⁰

A precise diagnosis of pacemaker-related septicaemia is critical as an infected pacemaker left *in situ* is associated with a mortality rate of up to 66%.¹ A high mortality is also observed in patients with retained infected leads¹⁶ or pacemaker endocarditis in the absence of pocket infection.¹⁰ Pacemaker leads are usually infected by direct extension from the generator pocket, as is likely in our patient, or less frequently, from haematogenous seeding.¹⁷ In one series, local complications at the generator pocket were present in 6 of 7 patients with surgically confirmed pacemaker lead endocarditis.¹¹

Unlike native-valve endocarditis, Staphylococci are the most frequent organisms causing pacemaker infection, accounting for more than 80% of cases in most series.^{2,10,11,17-}

²⁰ Early infections, as in our patient, are usually caused by *S. aureus* and late infections by *S. epidermidis*. Predisposing factors may be local, such as postoperative haematoma, necrosis and erosions of the generator pocket or systemic, including diabetes mellitus, neoplasia, corticosteroid and anticoagulant use and bacteraemia from intravenous catheters.² Identifiable predisposing conditions in this patient were diabetes mellitus and poor wound healing which necessitated further surgery.

Once the pacing system is infected, there is a general consensus that the entire apparatus should be explanted.^{2,3,10,18,19} Strategies employing either a short course of antibiotics followed by concurrent implantation of a new pacing system and explantation of the infected system, or prompt removal of the pacemaker followed by 2 weeks of antibiotic therapy before implanting a new unit, are feasible.^{19,20} Eradication with antibiotic treatment alone is difficult as bacteria colonise microscopic cracks on the lead surface, which provide a nidus for recrudescence.²¹ Attempts to preserve an infected system will therefore most likely fail and in the process endanger the patient's life, prolong hospitalisation and increase costs.²⁰ Although a conservative strategy has occasionally been successful,^{22,23} none of the cases reported had documented vegetative lead infections.

Removal of the pacemaker may require thoracotomy with or without cardiopulmonary bypass.^{2,13,17} The presence of an electrode within the cardiovascular system provokes a fibrous reaction, causing neoendothelialisation and scarring of up to 80% of all intravascular portions of the lead.²⁴ Consequently, the electrode becomes firmly embedded within both the ventricular endocardium and venous channel, rendering its removal via external traction challenging.¹⁴ Using modern extraction devices, however, most leads can be removed percutaneously, thus avoiding surgical morbidity.¹⁴ In this case, the electrode was easily extruded by simple manual traction since it had been implanted for only 2 months.

In the setting of pacemaker endocarditis, most authors have reported TTE to be insufficiently sensitive for diagnosis.^{6-8,11} In one consecutive series of 44 patients with pacemaker endocarditis defined by strict criteria, TTE detected vegetations in only 43% of patients.¹⁰ This is inferior to the 62% overall sensitivity of TTE,²⁵ probably because pacemaker endocarditis occurs in the echocardiographically less accessible right heart. The sensitivity of TTE also depends on the size of the vegetation and the quality of the examination.^{3,5} Interrogation from non-conventional windows, such as the right parasternum,

may be necessary to optimise the sensitivity of TTE.¹¹ TEE, on the other hand, has become increasingly useful as a diagnostic technique in the evaluation of suspected infective endocarditis. TEE is superior to TTE for 3 reasons:

- 1) its ability to overcome inadequate acoustic windows,
- 2) the improved spatial resolution minimises artifacts and reverberations produced by the pacemaker leads, and
- 3) higher resolution imaging of the superior vena cava and right atrium.¹¹

The utilisation of TEE in the diagnosis of pacemaker lead infection was first reported in 1989 by Zehender et al⁶ who described a case in which multiple vegetations along the course of the electrode were missed by TTE. Vilacosta et al¹¹ reported 7 patients with proven electrode infection in whom both TTE and TEE were performed. TTE detected pacemaker lead vegetations in only 2 patients whereas TEE visualised vegetations in all 7 cases.

The reported experience with TEE has almost exclusively been with monoplane imaging.^{6,11} Recently, Tighe et al⁹ advocated the use of multiplane TEE which allows a greater number of imaging planes and enhances spatial appreciation of anatomy. They reported a case where both TTE and monoplane TEE imaging failed to identify the pacemaker lead vegetations, whereas these were readily detected by multiplane TEE. A biplane instrument, used in this case report, can however duplicate the entire range of scan planes afforded by a multiplane probe, although transducer manipulation is simpler with the latter.

Given the high mortality rate in patients with pacemaker endocarditis,^{10,16} the diagnosis of lead infection by TEE should prompt strong consideration of pacemaker removal. Conversely, explantation may not be justified in the absence of a TEE-demonstrable vegetation in a patient in whom the generator pocket is not inflamed as cases of non-pacemaker related bacteraemia have been treated conservatively with success.¹⁷ Although percutaneous removal techniques are not contraindicated,¹⁴ it appears logical to adopt a direct surgical rather than a "blind" method, especially when septic pulmonary embolism may occur.⁴

Consideration to preventive measures is also warranted given the morbidity of pacemaker endocarditis. Based on the conflicting results of relatively small studies,^{26,27} current guidelines do not mandate the use of prophylactic antibiotics for procedures performed through surgically scrubbed skin, including cardiac pacemaker implantation.²⁸ However, a recent meta-analysis of 7 prospective randomised controlled trials, suggests that systemic antibiotic prophylaxis for pacemaker implantation significantly reduces the incidence of potentially serious infective complications.²⁹ Infection appears to be more common when the operator is inexperienced, the procedure is

prolonged, or after a repeat operation for non-infective complications.²⁷ In the absence of more detailed recommendations, it may be justified under these circumstances to use prophylactic systemic or local antibiotics.

This report highlights a rare potential for lead infection following permanent pacemaker insertion. The diagnosis of this clinically obscure entity can be readily made using TEE, which should therefore be considered in all patients with an implanted pacemaker with bacteraemia or suspected endocarditis.

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