Usefulness of Transesophageal Echocardiography for Diagnosis of Infected Transvenous Permanent Pacemakers

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Background Transesophageal echocardiography is superior to transthoracic echocardiography in detecting left-sided valvular vegetations. There are no data on the value of transesophageal echocardiography in the diagnosis of infected transvenous permanent pacemakers.

Methods and Results Transthoracic and transesophageal echocardiography was performed in 10 patients for whom there was clinical suspicion of infected permanent transvenous pacemakers. Transthoracic echocardiography detected pacemaker lead vegetations in 2 patients, whereas transesophageal echocardiography visualized pacemaker lead vegetations in 7 patients. Surgical confirmation was obtained in 6 of these 7 patients. Most patients had more than one pacemaker electrode in place. Local complications at the generator pocket were present in 6 patients. Staphylococcus was the predominant causative organism.

Conclusions Transesophageal echocardiography is superior to transthoracic echocardiography in the detection of pacemaker lead vegetations. (Circulation. 1994;89:2684-2687.)

Key Words • echocardiography • pacemakers

Echocardiography

Echocardiography is the method of choice for noninvasive diagnosis of infective endocarditis. Several investigations have evaluated the diagnostic value of transthoracic versus transesophageal echocardiography in the detection of valvular vegetations.1-3 Transesophageal echocardiography is better than transthoracic echocardiography in detecting left-sided valvular vegetations, but the diagnostic value of transesophageal echocardiography in right-sided endocarditis has not been superior to transthoracic echocardiography.4 To date, there are no data on the value of transesophageal echocardiography in the diagnosis of infected transvenous permanent pacemakers. The purpose of the present study was to compare the usefulness of transesophageal and transthoracic echocardiography in detecting pacemaker lead vegetations.

Methods

Study Group

We reviewed the records of 10 patients who presented to our hospital with the clinical suspicion of infected permanent transvenous pacemakers during a 2-year period ending August 1993. The patient population was highly selective because of the following restrictive inclusion criteria. All patients had to have a permanent transvenous pacemaker, prolonged (>1 month) clinical manifestations of septicemia, positive blood cultures, and no evidence of other focus of infection. Eight patients were men and 2 were women (mean age, 73 years; range, 63 to 80 years). All patients underwent transthoracic and transesophageal echocardiography.

Echocardiography

Transthoracic and transesophageal echocardiography was performed using a commercially available Toshiba SSH-160 echocardiograph. In all patients, the transesophageal study was performed immediately after the transthoracic study. Transthoracic echocardiograms were obtained with a 2.25-MHz transducer. Several transducer positions were used to record the pacemaker leads and the tricuspid leaflets: right ventricular inflow view, parasternal short-axis view, apical four-chamber view, and subxiphoid four-chamber view. Transesophageal echocardiograms were performed with a 5-MHz transducer mounted on a flexible monoplane probe. Before transesophageal echocardiography, all patients fasted for more than 4 hours. After administration of 1 to 2 mg diazepam IV and 25 to 50 mg meperidine IV and topical anesthetization of the posterior pharynx with lidocaine (10% xylocaine spray), the esophageal probe was introduced into the esophagus. The pacemaker leads and tricuspid valve leaflets were imaged from the four-chamber projection, frontal long-axis view of the coronary sinus, and gastric short-axis view. The echocardiographic diagnosis of vegetation was made only when two experienced observers agreed on the presence of a mass attached to the pacemaker leads that had different echogenicity from that of the leads.

Results

Echocardiography

Two patients had pacemaker lead vegetations that were detected with both transthoracic and transesophageal echocardiography. Four patients had pacemaker lead vegetations that were visualized only by transesophageal echocardiography and were not imaged by transthoracic echocardiography. One patient with an infected mitral prosthesis had pacemaker and tricuspid leaflet vegetations that were detected with transesophageal echocardiography and were not detected with transthoracic echocardiography.
Vilacosta et al  Echocardiography and Infected Pacemakers  2685

FIG 1. Transthoracic (A) and transesophageal (B) echocardiograms from a patient with a pacemaker lead vegetation (arrows). Note that the vegetative mass is seen only with the esophageal approach. LA indicates left atrium; LV, left ventricle; RA, right atrium; and RV, right ventricle.

All pacemaker lead vegetations were located within the right atrium. The two vegetations detected by transthoracic studies were visualized from subxifoid and right parasternal views. Transesophageal echocardiography demonstrated a lead vegetation in 5 patients with a negative transthoracic examination (Fig 1A and 1B). Two of these 5 patients had a deficient precordial acoustic window. The vegetation was localized in the joining of the superior vena cava with the right atrium in the remaining 3 patients (Figs 2 and 3). In 3 of these 5 patients with a negative transthoracic examination, there were many artifacts created by the leads that could interfere with detection of the vegetative mass through the precordial approach.

Vegetation size was measured in all transesophageal echocardiograms with this finding, and mean diameter was 18±5 mm. All vegetative masses were highly mobile.

All 7 patients with echocardiographic vegetations underwent antibiotic therapy. Rigorous susceptibility testing was a requirement for appropriate antibiotic selection. Surgical intervention was necessary in 6 of these 7 patients because of persistent bacteremia despite adequate antibiotic treatment. The seventh patient with a vegetation lead on the echocardiogram received only medical treatment, did well on follow-up, and did not require surgery. Six months later, he remains asymptomatic, and a new transesophageal echocardiogram did not visualize the vegetative mass.

Surgical findings were pacemaker lead vegetations in 5 patients and pacemaker and tricuspid leaflet vegetations in 1 patient.

Three of the 10 patients did not have vegetations on either transthoracic or transesophageal echocardiography. In 2 of the 10 patients, an alternate diagnosis was made, and the third patient was treated for endocarditis without a definitive diagnosis and despite negative follow-up transesophageal studies.

Clinical Data

The clinical characteristics of the study group are listed in the Table. The time between the last pacemaker implantation and the onset of a "septic" clinical syndrome was between 1 week and 4 months for all patients, except for the patient who had a prosthetic

FIG 2. Transesophageal echocardiographic coronary sinus view. A vegetation (arrow) is seen attached to the pacer wire. LA indicates left atrium; RA, right atrium; and RV, right ventricle.
valve endocarditis, for whom the interval was 2 years. All except 1 patient had at least two pacemaker leads; skin erosion or necrosis adjacent to the generator pocket was present in 6 patients with echocardiographically demonstrated vegetation. One patient had a fractured pacemaker lead. One patient with prosthetic valve endocarditis and pacemaker lead vegetations did not have local pocket complications, presented 2 years after the pacemaker implantation, and had positive blood cultures for *Streptococcus viridans*. Therefore, the pacemaker wire infection probably was secondary to hematogenous seeding from the infected prosthesis. Three patients had pulmonary embolism, and 1 had superior vena caval obstruction. Causal microorganisms in the 7 patients with echocardiographically demonstrated vegetation were *Staphylococcus* coagulase-negative in 5 patients; *Staphylococcus aureus*, 1 patient; and *S* coagulase-negative plus *S viridans*, 1 patient. There were no surgical deaths and no intravascular infection relapse.

### Discussion

#### Echocardiography

The improved resolution of transesophageal echocardiography results in greater sensitivity than transthoracic echocardiography for the diagnosis of left-sided infective endocarditis. A previous study suggests that transesophageal echocardiography is not superior to transthoracic echocardiography in the detection of right-sided valvular vegetations. In that study, the authors studied only intravenous drug abusers; therefore, their conclusions cannot be applied to other groups with right-heart endocarditis. We have found only a case report that examined the usefulness of transesophageal echocardiography in infected transvenous permanent pacemakers. The present study is the first that specifically compares the values of transthoracic and transesophageal echocardiography in assessing patients with intravascular infected pacemakers.

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age, y/Sex</th>
<th>Organism</th>
<th>Pacemaker Leads</th>
<th>Local Pocket Complications</th>
<th>Vegetation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>63/F</td>
<td><em>Staphylococcus cohnii</em></td>
<td>3</td>
<td>Yes</td>
<td>TTE No TEE Yes Surgery Yes</td>
</tr>
<tr>
<td>2</td>
<td>71/M</td>
<td><em>Staphylococcus epidermidis</em> and <em>Streptococcus viridans</em></td>
<td>1</td>
<td>No</td>
<td>TTE Yes TEE Yes Surgery Yes</td>
</tr>
<tr>
<td>3</td>
<td>72/M</td>
<td><em>S epidermidis</em></td>
<td>2</td>
<td>Yes</td>
<td>TTE Yes TEE Yes Surgery Yes</td>
</tr>
<tr>
<td>4</td>
<td>74/M</td>
<td><em>Staphylococcus aureus</em></td>
<td>3</td>
<td>Yes</td>
<td>TTE Yes TEE No Surgery No</td>
</tr>
<tr>
<td>5</td>
<td>80/M</td>
<td><em>S epidermidis</em></td>
<td>2</td>
<td>Yes</td>
<td>TTE No TEE Yes Surgery Yes</td>
</tr>
<tr>
<td>6</td>
<td>76/M</td>
<td><em>S aureus</em></td>
<td>3</td>
<td>No</td>
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</tr>
<tr>
<td>7</td>
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<td><em>S epidermidis</em></td>
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</tr>
<tr>
<td>8</td>
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<td><em>S aureus</em></td>
<td>2</td>
<td>Yes</td>
<td>TTE No TEE No Surgery No</td>
</tr>
<tr>
<td>9</td>
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</tr>
<tr>
<td>10</td>
<td>76/M</td>
<td><em>S aureus</em></td>
<td>2</td>
<td>No</td>
<td>TTE No TEE No Surgery No</td>
</tr>
</tbody>
</table>

TEE indicates transesophageal echocardiography; TTE, transthoracic echocardiography.
In the present report, transthoracic echocardiography detected pacemaker lead vegetations in only 2 patients, whereas transesophageal echocardiography demonstrated pacemaker lead vegetations in 6 patients and pacemaker lead and tricuspid leaflet vegetations in 1 patient. In most patients, only one transesophageal study was performed. This study confirmed the diagnosis of infected pacemaker lead, or another diagnosis was subsequently made. In 1 patient, follow-up transesophageal echocardiographic studies were negative, but because no alternative diagnosis was made, he was treated as having an intravascular pacemaker infection. Therefore, we conclude that transesophageal echocardiography is superior to transthoracic echocardiography in the detection of pacemaker lead vegetations.

In our opinion, there are three reasons why the transthoracic approach missed the masses: inadequate precordial acoustic window due to the age of the patient population, pacemaker leads produce reverberations and artifacts in the transthoracic examination that can mask or make difficult to detect a vegetation close to these structures, and the esophageal approach is better than conventional echocardiography for assessment of the superior vena cava and the upper part of the right atrium. Three of our patients had a vegetation on that location.

All transesophageal studies were performed with a single-plane transesophageal probe. Improved imaging of the pacemaker leads may be possible with biplane and multiplane transesophageal probes.

Echocardiography can detect abnormal masses associated with the pacemaker lead; however, this technique does not allow differentiation of noninfectious from infectious thrombotic masses. Thus, the term “pacemaker lead vegetation” has been used within an infectious clinical context.

Clinical Characteristics

All patients referred for an echocardiographic study to detect pacemaker lead vegetations had clinical findings that suggested an intravascular pacemaker infection, but certain features in the patients in whom the diagnosis was eventually confirmed are worthy of note: Staphylococcus was the predominant causative organism, infected transvenous pacemakers occurred mainly in patients who had more than one lead in place and who had local complications before or after replacement, and most patients required surgery.

Study Implications

The results of the present study indicate that transesophageal echocardiography is the technique of choice for the diagnosis of pacemaker lead vegetations and that transthoracic echocardiography is a very limited technique for the detection of pacemaker lead vegetations.

References

Usefulness of transesophageal echocardiography for diagnosis of infected transvenous permanent pacemakers.
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