Cardiovascular implantable electronic device endocarditis treated with daptomycin with or without transvenous removal

Carlo Tascini, MD, Maria Grazia Bongiorni, MD, Andrea Di Cori, MD, Antonello Di Paolo, MD, Marina Polidori, MD, Enrico Tagliaferri, MD, Antonello Di Paolo, MD, Marina Polidori, MD, Enrico Tagliaferri, MD, Antonello Di Paolo, MD, Marina Polidori, MD, Enrico Tagliaferri, MD, Antonello Di Paolo, MD, Marina Polidori, MD, Enrico Tagliaferri, MD, Antonello Di Paolo, MD, Marina Polidori, MD, Enrico Tagliaferri, MD, Antonello Di Paolo, MD, Marina Polidori, MD, Enrico Tagliaferri, MD, Antonello Di Paolo, MD, Marina Polidori, MD, Enrico Tagliaferri, MD, Antonello Di Paolo, MD, Marina Polidori, MD, Enrico Tagliaferri, MD, Antonello Di Paolo, MD, Marina Polidori, MD, Enrico Tagliaferri, MD, Antonello Di Paolo, MD, Marina Polidori, MD, Enrico Tagliaferri, MD, Antonello Di Paolo, MD, Marina Polidori, MD, Enrico Tagliaferri, MD, Antonello Di Paolo, MD, Marina Polidori, MD, Enrico Tagliaferri, MD, Antonello Di Paolo, MD, Marina Polidori, MD, Enrico Tagliaferri, MD, Antonello Di Paolo, MD, Marina Polidori, MD, Enrico Tagliaferri, MD.

*Unita Operativa Malattie Infettive, Azienda Ospedaliera Universitaria Pisana, Pisa, Italy
**Unita Operativa Cardiologia II, Azienda Ospedaliera Universitaria Pisana, Pisa, Italy
***Divisione di Farmacologia e Chemioterapia, Universita di Pisa, Pisa, Italy

A R T I C L E   I N F O

Article history:
Received 20 November 2011
Revised 4 February 2012
Accepted 6 February 2012
Online 20 March 2012

Keywords:
Daptomycin
Cardiovascular implantable electronic device
Endocarditis
Transvenous removal

A B S T R A C T

BACKGROUND AND METHODS: Nine patients with cardiovascular implantable electronic device (CIED) endocarditis were treated with daptomycin after the failure of previous treatment. The blood and CIED lead cultures of 1 patient were negative. In the other 8 patients, we observed 6 monomicrobial infections and 2 polymicrobial infections. Overall, 10 strains were isolated in these patients: 4 methicillin-sensitive Staphylococcus aureus, 2 methicillin-sensitive Staphylococcus epidermidis, 1 methicillin-resistant Staphylococcus aureus, 1 methicillin-resistant Staphylococcus epidermidis, 1 methicillin-sensitive Staphylococcus hominis, and 1 Propionibacterium acnes. The CIED was removed transvenously in 7 patients. Two patients were too sick for the removal of their CIED, and were cured with 6 mg/kg of daptomycin for 60 and 110 days, respectively, without adverse events.

RESULTS: One patient died 4 days after the removal of his CIED because of a complicated abdominal aortic aneurysm. The other 8 patients were cured, with a mean follow-up of 17 ± 8 months. The removed leads were negative, after daptomycin therapy, in 4 cases out of 7. The mean ratio between peak daptomycin concentration and minimal inhibitory concentration (MIC) of the causative strains was 38.3 ± 18.5. For patients whose data were available, the ratio between peak daptomycin concentration and minimal bactericidal concentration (MBC) was 13.2 ± 3.2.

CONCLUSION: Daptomycin monotherapy may be a useful therapeutic tool in difficult-to-treat CIED endocarditis, resulting in a high rate of cures and sterilized leads removed. The ratio between peak daptomycin concentration and MIC or MBC may be useful as predictive tool for treatment success.
Cardiovascular implantable electronic device (CIED) infection is a growing problem, because more devices are being implanted. In previous years, pacemaker (PM) infection ranged between 0.13%1 and 19.9%.2 Pacemaker endocarditis accounts approximately for 10% of PM infections.3 In the United States, among Medicare beneficiaries, the rate of infection increased by 124% from 1990 to 1999.4 The incidence of CIED infections in a large survey was 1.9/1000 device/years, with an incidence of pocket infections alone of 1.37/1000 device/years and an incidence of systemic infections and endocarditis of 1.17/1000 device/years.5

Staphylococci, and especially coagulase-negative Staphylococci (CoNS), account for 60% to 80% of cases in most reported series. Methicillin resistance (MR) among Staphylococci varies among studies, but a low frequency of methicillin-resistant CoNS was reported among individuals with no healthcare contact,6 whereas a high rate of MR in CoNS is associated with a healthcare environment source.7

Coagulase-negative Staphylococci are able to produce an extracellular slime and to constitute a biofilm that functions as a virulence factor. In this way, they adhere to plastic and metallic devices such as CIEDs. Microbes in biofilm are more resistant to antibiotics and host defenses.

Daptomycin is a bactericidal cyclic molecule of a class of antibiotics, the lipopeptides. No other products from this class are in clinical use. It is active against Gram-positive microorganisms. It was approved for skin and soft-tissue infections, and subsequently for right-side endocarditis and bacteremia attributable to Staphylococcus aureus, in response to a randomized study on bacteremia and endocarditis comparing daptomycin with standard therapy.8,9 In an in vitro study comparing the ability of various antibiotics to eradicate Staphylococci embedded in biofilm, daptomycin proved to be most effective after short-term exposure.10 In earlier studies it was shown to penetrate homogenously into the core of cardiac vegetations of endocarditis.11

Nuovo Santa Chiara Hospital in Pisa is the Italian reference center for the transvenous removal of CIEDs.12,13 Because daptomycin is approved for right-side endocarditis, and is bactericidal on plankton bacteria and on slime-producing Staphylococci, we decided to use daptomycin in CIED-associated endocarditis that failed to respond to other antibiotics.

**Materials and Methods**

The medical records of patients admitted to Pisa Hospital from September 2007 to February 2010 for PM or intracardiac device (ICD) endocarditis were reviewed. Patients with CIED-associated endocarditis who had been treated with daptomycin after the failure of previous treatments were included in the study. Age, gender, predisposing conditions, and previous antibiotic therapies were reviewed. For a diagnosis of endocarditis, the modified Duke criteria were used.14 Results of blood cultures, CIED pocket material cultures, and cultures of lead tips were recorded. Dose, duration, and blood level of daptomycin were recorded. Patients were considered cured if no signs of infection were evident at least 6 months after the end of daptomycin or other antibiotic therapy initiated as domiciliary therapy after treatment with daptomycin.

All removal procedures were performed using a mechanical dilatation method and with aseptic technique. Surgical facilities were present in the electrophysiology laboratory, and cardio surgical standby was available in the Cardiothoracic Department, Azienda Ospedaliera Universitaria Pisana. Extraction procedures were performed as previously described.12,13 A new transjugular approach was used when appropriate.

At our center, we developed an approach through the internal jugular vein (a transjugular approach) to remove free-floating leads and difficult exposed leads. Free-floating leads were grasped and then exposed through the jugular vein. After the proximal ends were exposed, they were submitted to a standard procedure for exposed leads. In the presence of difficult exposed leads, the approach required slipping the lead to make it free-floating. The lead could then be exposed through the jugular vein and subsequently dilated.

The microbiology of an infection was documented by culturing on solid media (chocolate agar, McConkey agar, mannitol salt agar, or Sabouroud agar), the removed catheter leads (the proximal and distal parts), or infected material from the pocket. The tip or other parts of the leads were rolled onto the solid media. The material drawn from the pocket was spread directly on the culture plate; the leads were cultured on the plate by direct rolling. Two sets of aerobic and anaerobic blood cultures were taken after removal and in case of fever in all patients. The blood cultures system we used was BACTEC 9240 (Becton-Dickinson, Milan, Italy). For the identification of organisms, an automated system (API, Bio-Merieux, Mercy L’Etoile, France) was used.

Ratios of minimal inhibitory concentration (MIC)/minimal bactericidal concentration (MBC) of the causative strains were performed using 2-fold dilution on cation-adjusted Mueller-Hinton broth (Oxoid, Ltd., Basingstoke, Hampshire, UK) and an inoculum of $5 \times 10^5$ colony-forming units (CFUs)/mL. The plates were
incubated for 20 to 24 hours, and the MICs were read. Thereafter, clear wells were subcultivated and CFUs were counted. MBCs were defined as the lowest antibi-
otic concentration that decreased the final inoculum by ≥99.9%. For daptomycin, a Mueller-Hinton broth with 50 μg/mL calcium was used. The removal of the infected CIED was performed after at least 10 days of daptomycin therapy.

Daptomycin concentrations were measured using a high-performance chromatographic method with ultraviolet detection. Briefly, 100 μL of plasma were extracted with 200 μL of methanol, and clear supernatants were analyzed in a Waters Breeze apparatus (Waters, Milford, CT) equipped with a Waters 2476 dual-wavelength ultraviolet detector set at 214 nm. The elution of standards was obtained isocratically through a BDS C8 Hypersil chromatographic column (250 × 4.6 mm, 5 μm; Phenomenex, Torrance, CA), using an acetonitrile/phosphate buffer mobile phase.15 Creatin phosphokinase was monitored every 5 days. During each visit, patients were checked for muscle pain or toxicity.

### Ethics

Ethics Committee of the Azienda Ospedaliera Universitaria Pisana approval for this research study (protocol number 55945) was obtained on September 24, 2009.

### Results

Overall, 290 patients with CIED infection were treated at our center during the 3-year study period. Nine patients with CIED endocarditis were treated with daptomycin after the failure of previous treatments, and were included in this study. Table 1 summarizes the characteristics of patients and treatment regimens. All patients were male, and their mean age was 70 ± 12 years. One patient’s blood and PM lead cultures tested negative (patient 4). In the other 8 patients, we observed 6 monomicrobial infections and 2 polymicrobial infections. Overall, 10 strains were isolated in

<table>
<thead>
<tr>
<th>Patient no.</th>
<th>Age/Gender</th>
<th>Underlying condition</th>
<th>CIED (years)</th>
<th>Valve</th>
<th>Organism (blood or pocket)</th>
<th>Previous therapy (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>76/M</td>
<td>IHD, AMI, stent, diabetes, AVB, DFI</td>
<td>PM (6)</td>
<td>Tricuspid</td>
<td>MSSA (B)</td>
<td>CRO + G (21)</td>
</tr>
<tr>
<td>2</td>
<td>78/M</td>
<td>IHD, AMI, mechanical aortic valve, aortic valvulated tube, AF</td>
<td>PM (8)</td>
<td>Aortic, mitral, tricuspid</td>
<td>MSSA (B)</td>
<td>OXA + R (10)</td>
</tr>
<tr>
<td>3</td>
<td>74/M</td>
<td>IHD, AMI, AVB</td>
<td>ICD (2)</td>
<td>Tricuspid + P infection</td>
<td>MRSE (P), MSSE (P)</td>
<td>CLA + R (15)</td>
</tr>
<tr>
<td>4</td>
<td>77/M</td>
<td>AMI, DCM, tachycardia</td>
<td>ICD (4)</td>
<td>Tricuspid</td>
<td>Unknown</td>
<td>CC + R (15)</td>
</tr>
<tr>
<td>5</td>
<td>53/M</td>
<td>DCM, IHD</td>
<td>ICD (2)</td>
<td>Tricuspid</td>
<td>Staphylococcus hominis MS (B)</td>
<td>AMC + SXT (20)</td>
</tr>
<tr>
<td>6</td>
<td>88/M</td>
<td>SND</td>
<td>PM (1)</td>
<td>Tricuspid + P infection</td>
<td>MSSA (B, P)</td>
<td>AMC + R (15)</td>
</tr>
<tr>
<td>7</td>
<td>49/M</td>
<td>DCM</td>
<td>ICD (2)</td>
<td>Tricuspid + PE</td>
<td>MSSA (B)</td>
<td>VAN + G (12)</td>
</tr>
<tr>
<td>8</td>
<td>75/M</td>
<td>AVB</td>
<td>PM (1 month)</td>
<td>Tricuspid + PE</td>
<td>MRSA (B)</td>
<td>OXA + G (15)</td>
</tr>
<tr>
<td>9</td>
<td>63/M</td>
<td>AVB, aortic stenosis, biologic aortic valve prosthesis, aortic valvulated tube, permanent bladder catheter</td>
<td>PM (3)</td>
<td>Tricuspid, aortic prosthetic</td>
<td>MSSE (B)</td>
<td>TEC + MER (5)</td>
</tr>
</tbody>
</table>

AF, atrial fibrillation; AMC, amoxicillin/clavulanate; AMI, acute myocardial infarction; AVB, atrioventricular block; B, blood; CC, clindamycin; CIED, cardiovascular implantable electronic device; CIP, ciprofloxacin; CLA, clarithromycin; CRO, ceftriaxone; DCM, dilated cardiomyopathy; DFI, diabetic foot infection; DO, doxycycline; G, gentamicin; ICD, intracardiac device; IHD, ischemic heart disease; Lzd, linezolid; MER, meropenem; MOX, moxifloxacin; MRSA, methicillin-resistant Staphylococcus aureus; MRSE, methicillin-resistant Staphylococcus epidermidis; MSSA, methicillin-sensitive Staphylococcus aureus; MSSE, methicillin-sensitive Staphylococcus epidermidis; OXA, oxacillin; P, pocket; PE, pulmonary embolism; PIP/TZB, piperacillin/tazobactam; PM, pacemaker; R, rifampicin; SND, sinus node dysfunction; SXT, cotrimoxazole; TEC, teicoplanin; VAN, vancomycin.
these patients: 4 methicillin-sensitive Staphylococcus aureus (MSSA), 2 methicillin-sensitive Staphylococcus epidermidis (MSSE), 1 methicillin-resistant Staphylococcus aureus (MRSA), 1 methicillin-resistant Staphylococcus epidermidis, 1 S. hominis methicillin susceptible, and 1 Propionibacterium acnes. Five patients exhibited a PM infection, and 4 patients exhibited an ICD infection. Infected CIEDs had been implanted a mean of 3.1 ± 2.5 years previously, suggesting that these were late CIED infections. In only 1 case (patient 8) had a PM been implanted only 1 month before the first signs of infection. All 9 patients had endocarditis, according to the Duke criteria, involving the tricuspid valve. In 7 patients, tricuspid endocarditis was confirmed by intracardiac echocardiography. In the other 2, CIED right-side endocarditis was confirmed by transesophageal echocardiography. In 2 patients, the left valves were involved. In 1 patient, the aortic mechanical and native mitral valves were affected (patient 2), whereas in the other, only the mechanical aortic valve was affected (patient 9). In patient 4, a microorganism was not isolated, but that patient fulfilled the criteria for the diagnosis of endocarditis: vegetation according to transthoracic echocardiography, fever, a predisposing heart condition, and a positive rheumatoid factor. In all 9 patients, daptomycin was initiated after the clinical or microbiological failure of previous therapy. Daptomycin was administered at 6 mg/kg in all patients, except for patient 9, who received 8 mg/kg. Daptomycin was administered for a mean of 49 ± 32 days. Daptomycin was administered before CIED removal for 29.2 ± 27.6 days in the 7 patients in whom a CIED was removed transvenously. Daptomycin was administered as monotherapy in 6 patients. In 2 patients, piperacillin/tazobactam as empiric anti-Gram-negative therapy was combined with daptomycin. In patient 6, pathogen-directed rifampin therapy was added to daptomycin for 30 days. The extraction of the entire device was performed in 7 out of 9 patients. In patients 1 and 2, removal of the device was considered too risky. These 2 patients were cured with prolonged daptomycin therapy of an MSSA right-side endocarditis and of right and left side (prosthetic and native valve) endocarditis, respectively (Table 1). These

<table>
<thead>
<tr>
<th>Dose of daptomycin (mg/kg)</th>
<th>Associated antibiotics</th>
<th>Duration (days)</th>
<th>CIED culture</th>
<th>Treatment after extraction or end of daptomycin treatment(months)</th>
<th>CIED implantation (days from explant)</th>
<th>Outcome (months of follow-up)</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>No</td>
<td>60</td>
<td>No extraction</td>
<td>AMC (1)</td>
<td>No extraction</td>
<td>Cure (6)</td>
</tr>
<tr>
<td>6</td>
<td>No</td>
<td>110</td>
<td>No extraction</td>
<td>AMC (1)</td>
<td>No extraction</td>
<td>Cure (12)</td>
</tr>
<tr>
<td>6</td>
<td>PIP/TZB (10)</td>
<td>30 (25 before)</td>
<td>Yes, MRSE, MSSE</td>
<td>Yes (4)</td>
<td>Death on day 5 from rupture of abdominal aneurysm</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>PIP/TZB (10)</td>
<td>20 (5 before)</td>
<td>Yes, negative</td>
<td>Yes (4)</td>
<td>Cure (18)</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>No</td>
<td>90 (90 before)</td>
<td>Yes, negative</td>
<td>DO + R (3)</td>
<td>Yes (165)</td>
<td>Cure (6)</td>
</tr>
<tr>
<td>6</td>
<td>No</td>
<td>30 (20 before)</td>
<td>Yes, negative</td>
<td>AMC + DO (1), DO + R (2)</td>
<td>Yes (2)</td>
<td>Cure (24)</td>
</tr>
<tr>
<td>6</td>
<td>No</td>
<td>20 (20 before)</td>
<td>Yes, negative</td>
<td>MOX + R (2)</td>
<td>Yes (2)</td>
<td>Cure (24)</td>
</tr>
<tr>
<td>6</td>
<td>No</td>
<td>26 (15 before)</td>
<td>Yes, MRSA</td>
<td>DO + R (15 days)</td>
<td>Yes (32)</td>
<td>Cure (24)</td>
</tr>
<tr>
<td>8</td>
<td>No</td>
<td>55 (30 before)</td>
<td>Yes, Propionibacterium acnes</td>
<td>No</td>
<td>Cure (24)</td>
<td></td>
</tr>
</tbody>
</table>
Table 2 – Pharmacokinetic characteristics of patients with CIED endocarditis treated with daptomycin

<table>
<thead>
<tr>
<th>Patient no.</th>
<th>Trough concentration (mg/L)</th>
<th>Peak concentration (mg/L)</th>
<th>MIC (mg/L)</th>
<th>MBC (mg/L)</th>
<th>Peak concentration/MIC</th>
<th>Peak concentration/MBC</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>14.2</td>
<td>32.8</td>
<td>1 MSSA</td>
<td>32.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>5.5</td>
<td>19.2</td>
<td>1 MSSA</td>
<td>19.2</td>
<td>9.6</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>15.6</td>
<td>55.5</td>
<td>1 Staphylococcus hominis</td>
<td>55.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>9.1</td>
<td>28.1</td>
<td>1 MSSA</td>
<td>28.1</td>
<td>14.05</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>11.8</td>
<td>51.3</td>
<td>2 MRSA</td>
<td>25.6</td>
<td>12.3</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>8.4</td>
<td>35.7</td>
<td>1 S. epidermidis</td>
<td>35.7</td>
<td>17.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>0.5 Propionibacterium acnes</td>
<td>71.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mean</td>
<td>10.7</td>
<td>37.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SD</td>
<td>3.7</td>
<td>13.8</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

CIED, cardiovascular implantable electronic device; MBC, minimal bactericidal concentration; MIC, minimal inhibitory concentration; MRSA, methicillin-resistant Staphylococcus aureus; MSSA, methicillin-sensitive Staphylococcus aureus.

2 patients received 6 mg/kg of daptomycin for 60 and 110 days, respectively, without adverse events. Both had a blood concentration of daptomycin measured at steady state: for patient 1, that concentration was 32.8 mg/L, and for patient 2, it was 19.8 mg/L. Because both had an MIC of MSSA of 1 mg/L, ratios of peak concentration/MIC of 32.8 and 19.8 were obtained (Table 2). In the other 7 patients, the CIED was removed transvenously. In 4 cases, CIED lead tip cultures tested negative. Of these patients, 1 had an unknown infection, whereas the other 3 had previously yielded several blood cultures positive for MSSA (2 patients) and S. hominis in (1 patient). In the other 3 patients, CIED lead tip cultures tested positive, and in 2 cases, the result was consistent with the microorganisms of previous cultures. In patient 9, the CIED culture was positive for P. acnes, whereas several blood cultures were previously positive for MSSA.

In 6 patients, the CIED was reimplanted. In 4 patients, it was implanted during daptomycin therapy, in 2 patients it was implanted 2 days after removal of the infected CIED, and in the other 2 it was implanted 4 days after removal of the infected CIED. One patient died 4 days after removal of the CIED because of a complicated abdominal aortic aneurysm. The other 8 patients were cured (mean follow-up, 17 ± 8 months). Six patients were treated with other antibiotics after the removal of their CIED (Table 1).

Daptomycin blood levels were available in 6 patients. The trough mean blood concentration was 9.5 ± 4.1 mg/L, whereas the mean peak blood level was 37.1 ± 13.8 mg/L. In these 6 patients, we were able to calculate the ratio between peak concentration and MIC of daptomycin of the causative strain: this ratio was 38.3 ± 18.5, ranging from 19.2 to 71.4 (Table 2). Because we did not have the daptomycin concentration of the patient who had died 4 days after the extraction, we may speculate that the mean value of 38.3 for this ratio, as obtained in patients who were cured, may be the goal for daptomycin therapy in these patients. Values of the ratio between peak concentration and MBC for the 4 available isolates are listed in Table 2. The mean value was 13.2 ± 3.1, ranging from 9.6 to 17.8 (Table 2). No adverse event related to the administration of daptomycin was evident.

Discussion

The removal of all hardware is recommended for established CIED infections, and especially endocarditis. Attempts to apply antibiotic therapy alone have been mostly unsuccessful, at around 90% rate of failure in published series. Percutaneous lead extraction has become the preferred method for the removal of CIEDs, although it is not free of complications such as cardiac tamponade and pulmonary embolism. However, in high-volume centers, it can be relatively safe, with a high rate of success. Percutaneous lead removal may pose a risk of pulmonary embolism in cases of endocarditis with vegetation > 2 cm. In these cases, the decision relies on the patient’s characteristics and the experience of the extractor. Only patient 6 manifested vegetation of > 2 cm, and therefore he was treated for several months with antibiotics and anticoagulant before extraction.

Patients 1 and 2 were too sick for the removal of their CIED. Therefore, only antibiotic therapy was performed. These 2 patients were cured with prolonged therapy. Because of its bactericidal activity and ability to penetrate biofilm, daptomycin has been used successfully to treat prosthetic valve endocarditis in patients for whom valve removal was not a therapeutic option. But in terms of CIED-associated endocarditis, these are the first 2 cases, to the best of our knowledge, in which daptomycin was able to cure an infection without removal of the hardware. In fact, Cunha et al described a case of endocarditis cured without surgery, but only after removal of the entire PM, and the cultures of the electric wires remained positive for MSSA.

The optimal timing of device replacement is unknown, and no prospective trials have examined the time of replacement and risk for relapse of infection.
with patients 1 and 2 in our series), a bactericidal drug must be used.

A tool to measure bactericidal activity may involve the bactericidal activity of the serum. Otherwise, the ratio between the peak concentration and MBC may constitute a surrogate. For the 4 patients in whom this information was available, the mean ratio was 13.2. This ratio may be compared with the activity of that serum diluted up to 13 times that remains bactericidal. Eggiman and Waldvogel suggested that in cases of staphylococcal CIED endocarditis without the removal of the entire device, the serum bactericidal activity has to be more than 1:16, ie, a value similar to that which we found of 13.29 In the same review, they suggested more than 6 weeks of therapy, and in concordance, we report a mean value of 49 days. Prospective comparative studies need to be performed to validate daptomycin monotherapy in CIED endocarditis.

Conclusions

Daptomycin, in association with the removal of an infected device, is effective and safe in the management of CIED endocarditis. When an infected device cannot be removed, a prolonged course with daptomycin can be effective and safe. The ratio between the peak concentration and MBC may constitute a surrogate of the bactericidal activity of the serum.

References


