


Infectious endocarditis due to *Bacillus Cereus* in a patient with a pacemaker: case report and literature review

Endocardite infecciosa por *Bacillus Cereus* em paciente portador de marcapasso: relato de caso e revisão de literatura

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Abstract

Introduction: Infective endocarditis (IE) is an infectious process of the cardiac endothelium, often related to the use of pacemakers and valve prostheses, which may facilitate microorganism proliferation. **Case Report:** In this article, we describe the case of an 81-year-old man with infective endocarditis due to *Bacillus Cereus* related to the use of a pacemaker and perform a brief literature review. **Discussion:** *Bacillus Cereus* is a Gram-positive, aerobic, spore-forming, large, and generally motile bacterium that constitutes a rare cause of endocarditis, but few cases like this are described in the literature. **Conclusion:** Determining the etiology of IE through culture-guided methods plays a pivotal role in selecting appropriate antibiotic treatment. Maintain a high clinical suspicion for IE is paramount, especially when fever arises in patients with cardiac devices after surgical or dental procedures.

Keywords: endocardite infecciosa; bacillus cereus; bacteremia; marcapasso.

Resumo

Introdução: A endocardite infecciosa é um processo infeccioso do endotélio cardíaco, muitas vezes relacionado ao uso de marca-passos e próteses valvares, que pode facilitar a proliferação de microrganismos. **Relato de Caso:** Neste artigo descrevemos o caso de um homem de 81 anos com endocardite infecciosa por *Bacillus Cereus* relacionada ao uso de marca-passo e realizamos uma breve revisão da literatura. **Discussão:** *Bacillus Cereus* é uma bactéria Gram-positiva, aeróbia, formadora de esporos, grande e geralmente móvel, que constitui uma causa rara de endocardite, com poucos casos descritos na literatura. **Conclusão:** A determinação da etiologia da EI através de métodos guiados por cultura desempenha um papel fundamental na seleção do tratamento antibiótico apropriado. Manter alta suspeita clínica de EI é fundamental, principalmente quando surge febre em pacientes portadores de dispositivos cardíacos após procedimentos cirúrgicos ou odontológicos.

Palavras-Chave: endocardite infecciosa; bacillus cereus; bacteremia; marcapasso.

INTRODUCTION

Infective endocarditis (IE) is a microbial infectious process that occurs in the endothelial surface of the heart and may also affect the valves and heart muscle¹. Risk factors described for IE are the use of intravenous drugs, hemodialysis, degenerative valve disease, and rheumatic heart disease^{1,2}. The presence of invasive devices and prostheses is also described as a risk factor.² Clinically, IE should be suspected in patients who present with unexplained fever, night sweats, or signs of systemic disease.³ Treatment is based on antibiotics, and surgical evaluation is required in patients with aggressive or persistent infections, emboli, and valve involvement or rupture, as well as in the presence of specific infected cardiac devices³. If treatment is not instituted promptly, IE can result in irreversible complications or death⁴.

Bacillus Cereus is a Gram-positive, aerobic, spore-forming, motile, large rod-shaped bacterium. These microbes belong

to the Bacillaceae family and are widely distributed in the environment, being found largely in soil, dust, and plants. *B. cereus* produces enterotoxins that cause diarrhea and vomiting, which are responsible for food poisoning. *B. cereus* is an uncommon etiological agent of IE, with few cases described in the literature⁵. Cases of pacemaker-related *B. cereus* IE are also scarce⁶⁻¹⁴. Herein, we report a rare case of a patient with IE due to *B. cereus* in a patient with a pacemaker and perform a brief literature review.

The medical records were reviewed during the outpatient follow-up of the patient. We reviewed the literature in search of similar cases. An informed consent form was signed for the publication of her case and images. This study was approved by the Research Ethics Committee of Centro Universitário (Unichristus) (CAAE: 66920322.7.0000.5049).

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CASE REPORT

An 81-year-old man with a previous history of benign prostatic hyperplasia and transurethral resection of the prostate three months before, as well as a permanent pacemaker since 2004 with the last generator replacement in April 2021 prior to admission, was admitted to the emergency department with daily fever (Temperature 38,2°C), night sweats, drowsiness, and weight loss for three (3) months. On physical examination, cardiac examination revealed a systolic murmur on mitral focus, which was not present in the examinations before. No evidence of immunological or vascular phenomenon was found. He had multiple previous treatments for urinary tract infections without full recovery. He was then investigated and negative for multiple myeloma, CMV, HIV, toxoplasmosis, parvovirus B19, HSV, and autoimmune diseases. Vegetations were not evidenced on transesophageal and transthoracic echocardiography. Computed tomography of the abdomen was performed to rule out infection, and it was normal. There was growth of *Bacillus Cereus* in 4/6 samples of blood cultures. Given the fact that this microorganism is an uncommon agent as a cause of IE, new blood cultures were performed, and the same agent was isolated in 3/3 samples. Considering the result of all blood cultures and the temporal relationship between the replacement of the pacemaker generator and fever, it was decided to remove the entire permanent pacemaker system and transfer a temporary pacemaker to another site. Due to the absence of susceptibility tests and the known common profile of beta-lactam resistance of *B. cereus* in medical literature, daptomycin was chosen. Antimicrobial treatment with a 28-day regimen of daptomycin 8mg/kg intravenous daily was started. Unfortunately, antimicrobial step-down could not be performed due to the absence of susceptibility tests. The permanent pacemaker system was removed two weeks after antimicrobials initiation. No macroscopic vegetation was seen on the pacemaker wires. The culture from the pacemaker wires was negative. New MCPD was implanted after the end of treatment. The patient evolved afebrile two (2) weeks after the MCPD removal, with improvement of inflammatory markers and asymptomatic. After six (6) months of follow-up, a new transthoracic echocardiogram showed no vegetation.

DISCUSSION

IE is a disease that requires a high index of suspicion. Endocarditis should be suspected in patients with fever and no obvious source of infection, particularly if a heart murmur is present. It may present with systemic symptoms as initial manifestation, such as fever, sweating, and weight loss. These symptoms are usually nonspecific and can lead to a wide range of diagnostic possibilities. Initially, our case was treated as a urinary tract infection, leading to partial remission of symptoms for a week, with the return of the symptoms. Other conditions were ruled out, primarily due to the lack of specificity in the clinical picture. Multiple myeloma, CMV, toxoplasmosis, parvovirus, HSV, and autoimmune diseases were ruled out. The lack of specific symptoms can contribute to a delay in the diagnosis of IE and

subsequently hinder immediate treatment. This delay highlights the high fatality rate associated with this disease.

Cardiac devices and prostheses are commonly associated with IE, as they act as gateways to facilitate the adhesion of microorganisms. Vegetation consists of fibrin, and platelets and microorganisms can arise and become covered by a layer of fibrin and platelets, which makes it difficult for antimicrobial agents and host neutrophils to access. This layer makes it challenging for antimicrobial agents and host neutrophils to access the vegetation, creating an obstacle to effective treatment and contributing to the severe progression of the disease. This establishes a mechanism that perpetuates the infection. As a result, treating infections related to cardiac devices necessitates the removal of the device to control the infectious focus. While vegetations are commonly visualized through transthoracic and transesophageal echocardiography, their absence should not rule out the diagnosis. This absence is particularly prevalent in cases of IE involving foreign materials such as prosthetic valves, aortic tubes, or implantable electronic cardiac devices (IECDs), which constitute a growing proportion of IE cases. In the present case, no vegetation was observed, yet the possibility of vegetation existing before antibiotic therapy could not be definitively ruled out.

According to the modified Duke/European Society of Cardiology 2015 clinical criteria, our case received the diagnosis of possible IE due to the presence of 2 major and 2 minor criteria. The major criteria were the presence of microorganisms consistent with EI in persistently positive blood cultures and new heart murmur, and two minor criteria composed of (1) Predisposing heart condition or injecting drug user, and (2) Fever (temperature greater than 38°C). Unfortunately, the third criterion, which would be related to the wire cultures, resulted in a negative, probably due to the antibiotic therapy period performed before the surgery^{1,15,16}.

Usually, infective endocarditis is caused by bacteria, although more rarely, fungi, protozoa, and even helminths may also be a cause. Among bacteria, *Staphylococcus aureus* is the most common and widely related to injecting drug users (68%), with native valve infections in 66% of cases, 45% resulting from nosocomial infection, and 21% from household infection.¹⁵ Other important bacteria are *Pseudomonas aeruginosa*, coagulase-negative staphylococci – associated with early (28%) and late (20%) prosthetic valves. *Enterococcus* spp. and *Streptococcus viridans* are the most associated with home (household native) valve infection.¹⁶ Fungi, although not as frequent, may also be involved in endocarditis, such as *Candida* spp., also associated with endocarditis in injecting drug users (12%) and prosthetic valve infection after valve surgery (12%)¹⁷. Other pathogens, such as pneumococci and HACEK bacteria known as slow-growing Gram-negative bacteria, may also be related, configuring rarer cases. Infectious endocarditis due to *Bacillus Cereus* is rare, with few known cases in the literature; additionally, cases related to pacemaker infection are even rarer.

3 Infectious Endocarditis due to *Bacillus Cereus* in a Patient with a Pacemaker

Bacillus Cereus is a rare cause of IE. It is known that the antimicrobials that have one of the most effective in vitro responses to treat IE due to *B. cereus* are the following: clindamycin, vancomycin, and gentamicin while showing resistance to almost all beta-lactam.⁸ Another study performed at the University of Southern California Medical Center that the use of daptomycin inhibited 67 of 70 clinical isolates of *Bacillus Cereus* species at less than or equal to 1ug/ml and 100% of them at less than or equal to < 2 ug/ml, which justifies the use of this drug in our case.¹⁸ Furthermore, the medical literature is quite favorable about the removal and subsequent replacement of prosthetic valves and pacemakers in patients who have evolved to IE due to *B. cereus*.⁸ However, there are certain situations, as in the case of endocarditis with low virulence, in which there is no need to make this substitution since this can lead to an infectious complication that is more lethal than the initial illness itself.¹⁸ We chose to remove the pacemaker, as there was a temporal relationship between the onset of symptoms and the

pacemaker's generator replacement, which was the conducive means for the dissemination of the bacteria.

There are several limitations that should be acknowledged. Firstly, there are only a few cases of *B. Cereus* IE associated with medical devices in the medical literature. The cases of IE linked to *B. cereus* are summarized in Table 1. Secondly, vegetation was not detected through transthoracic and transesophageal echocardiography, and it is worth mentioning that other cases also did not meet these criteria.⁶⁻¹⁴ Thirdly, despite a significant duration of antibiotic therapy, the culture of wires and the generator did not yield any microorganisms. This outcome is unfortunate and raises questions about the sensitivity of the culture method or the potential impact of the antibiotic treatment. Lastly, our case meets the criteria for IE according to the modified Duke criteria. However, it's important to emphasize that the response to treatment should also be considered and valued alongside these criteria in this case.

Table 1. Description of reported cases of infectious endocarditis related to *Bacillus Cereus* in medical literature.

| Authors | Title | Year | Country | Age | Sex | Valve type | Treatment | Surgery | Clinical outcome |
|-------------------------------|---|------|---------|-----|--------|------------------|----------------------|---------|------------------|
| Block et al. ⁶ | <i>Bacillus Cereus</i> endocarditis. A case report | 1978 | SA | 51 | Female | Prosthetic valve | Tob/Chl(NR) | No | Died |
| Oster et al. ⁷ | <i>Bacillus Cereus</i> endocarditis involving a prosthetic valve. | 1982 | USA | 55 | Male | Prosthetic valve | Cli/Gen (6weeks) | Yes | Recovered |
| Sliman et al. ⁸ | Serious Infections Caused by <i>Bacillus</i> Species | 1987 | France | 43 | Female | Pacemaker | Cli(6 weeks) | Yes | Recovered |
| Steen et al. ⁹ | <i>Bacillus Cereus</i> Endocarditis: Report of a Case and Review | 1992 | USA | 34 | Male | Prosthetic valve | Van(6weeks) | Yes | Recovered |
| Yamamura et al. ¹⁰ | A case of <i>Bacillus Cereus</i> prosthetic valve endocarditis | 1994 | Japan | 43 | Male | Prosthetic valve | Amk,Min (NR) | Yes | Recovered |
| Martin et al. ¹¹ | Endocarditis by <i>Bacillus Cereus</i> in prosthetic mitral valve | 1998 | Spain | NR | NR | Prosthetic valve | Gen,Rif,Van (NR) | Yes | Recovered |
| Castedo et al. ¹² | <i>Bacillus Cereus</i> Prosthetic Valve Endocarditis | 1999 | Spain | 45 | Female | Prosthetic valve | Gen,Rif,Van (6weeks) | Yes | Recovered |
| Abusin et al. ¹³ | <i>Bacillus Cereus</i> Endocarditis in a permanent pacemaker: a case report | 2008 | USA | 69 | Female | Pacemaker | Cfz (6 weeks) | No | Recovered |
| Barraud et al. ¹⁴ | Pacemaker-associated <i>Bacillus Cereus</i> endocarditis | 2012 | France | 55 | NR | Pacemaker | Pen,Ofx (4 weeks) | No | Died |

NR: not reported; Amk: amikacin; Cfz: cefazolin; Chl: chloramphenicol; Cip: ciprofloxacin; Cli: clindamycin; Cro: ceftriaxone; Cxm: cefuroxime; Ery: erythromycin; Gen: gentamicin; Kan: kanamycin; Lm: lincomycin; Mero: meropenem; Min: minocycline; Naf: nafcillin; Ofx: ofloxacin; Pen: penicillin; Pip: piperacillin; Rif: rifampicin; Str: streptomycin; Sxt: trimethoprim sulfamethoxazole; Tob: tobramycin; Van: vancomycin.

CONCLUSION

We present a case of IE caused by *B. cereus*, which exhibited a positive clinical response to antibiotic therapy along with the removal of invasive devices. In cases involving cardiac devices, treatment frequently necessitates device removal to effectively control the source of infection, given their propensity to promote infections. Determining the etiology of IE through culture-guided methods plays a pivotal role in selecting appropriate

antibiotic treatment. A key takeaway from this case report is that IE can manifest with symptoms that lack specificity, and the presence of vegetation, sometimes crucial for diagnosis, may not always be visible during echocardiographic examination. As a result, maintaining a high clinical suspicion for IE is paramount, especially when fever arises in patients with cardiac devices after surgical or dental procedures.

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