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Pacemaker Lead Endocarditis Due to Multidrug-Resistant *Corynebacterium striatum* Detected with Sonication of the Device[▽]

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***Corynebacterium striatum* is a commensal of human skin and has been recently recognized as an emerging pathogen. A case of nosocomial pacemaker lead endocarditis due to a multidrug-resistant *C. striatum* strain is described, highlighting the role of sonication as a diagnostic tool in cardiac device infections.**

CASE REPORT

A 71-year-old woman, who underwent pacemaker replacement 2 months before, was admitted with a 15-day history of fever and generator site pain. She was febrile (core temperature, 38.5°C), her blood pressure was 120/80 mmHg, and her pulse rate was 76 beats/min. Erythema, warmth, tenderness, and purulent drainage were observed at the pocket site. Respiratory, abdominal, and neurological parameters were normal, and an examination of the heart showed a 2/6 systolic murmur. Laboratory analyses revealed a mild leukocytosis (11×10^9 leukocytes/liter, 85% polymorphonuclear cells) and an erythrocyte sedimentation rate correspondent to 50 mm/h. A markedly increased C-reactive protein level (8 IU/liter) was observed.

Two separate sets of blood and swab cultures obtained from purulent secretion at the pocket site yielded coagulase-negative *Staphylococcus* which showed resistance to methicillin and rifampin and susceptibility to vancomycin, teicoplanin, linezolid, and daptomycin.

A transthoracic echocardiogram revealed a mobile mass adherent to the intracardiac lead in the absence of valve vegetations. Treatment with daptomycin (6 mg/kg body weight once daily) was started, leading to a rapid improvement, as determined by clinical and laboratory findings. Blood cultures and pocket swabs, performed 72 h after the beginning of antimicrobial therapy, were sterile. Serum bactericidal activity was >1:16 (4). After 7 days of daptomycin treatment, the patient developed renal failure (clearance of creatinine, <20 ml/min), and the antimicrobial therapy was switched to intravenous linezolid (600 mg twice daily). Following this therapy, the patient again became febrile (core temperature, 39°C). Blood cultures and pocket site swabs were negative. The patient underwent device removal, and a reimplantation of a new pacemaker was performed 8 days later. On macroscopic examination, the intracardiac portion of the electrode showed the presence of a mass adherent to the lead. Four samples of lead tips were collected: two of them were analyzed by following the traditional microbiological procedures without sonication, whereas the other two samples were submitted to device sonication and then cultured. Briefly, within 1 h from the removal, two lead tips were inoculated in Trypticase soy broth (TSB) which was incubated for 24 h and analyzed for bacterial growth. The other two lead tips were vortexed for 30 s and then sonicated in NaCl solution for 5 min at a frequency >20 kHz and finally vortexed again for another 30 s. The Ultrasonik 300 bath (Ney, BarkMeyer Division, Yucaipa, CA) was used for sonication. The resulting sonication fluid was centrifuged at 3,200 rpm for 15 min, and the sediment was used for microbiological cultures. Anaerobic and aerobic sheep blood agar plates were incubated at 37°C for 5 days, and the microorganisms were identified using conventional methods. The nonsonicated cultures were sterile, whereas the sonicated samples yielded small cream-colored nonhemolytic colonies. Gram staining revealed club-shaped Gram-positive rods accounting for diphtheroid bacteria. The catalase test was positive and the urease test was negative. The strain was identified as *Corynebacterium striatum* by using the commercial system API 20 Coryne (BioMérieux, Marcy l'Etoile, France). Additional tests, such as tyrosine hydrolysis, *N*-acetylglucosamine assimilation, and phenylacetic acid assimilation, were used to differentiate *C. striatum* from *Corynebacterium amycolatum*. The isolate was confirmed to be *C. striatum* by PCR amplification of a 16S rRNA gene using a new, commercial, universal 16S rRNA-based PCR assay (SepsiTest; Molzym, Germany). Sequencing of the amplified product showed 99% identity to *C. striatum* GenBank accession numbers X81910 and AY008302, and 97.2% identity to *C. striatum* GenBank accession number X84442. The microdilution broth method and Etest strips were

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TABLE 1. Broth dilution method and Etest MICs for *C. striatum* isolated from a sonicated intracardiac device[a]

Antimicrobial drug	*C. striatum* susceptibility	MIC (μg/ml)	
		Broth dilution method	Etest
Penicillin	R	128	
Cefotaxime	R	32	
Gentamicin	R	32	
Erythromycin	R	32	
Levofloxacin	R	128	
Clindamycin	R	64	
Vancomycin	S		0.5
Linezolid	S		0.25
Daptomycin	S		0.125

[a] R, resistant; S, susceptible. MICs are based on CLSI breakpoints of *Corynebacterium* spp. (7).

used to assess the microorganism antimicrobial susceptibility pattern. Etest strips were only used for vancomycin, daptomycin, and linezolid. All samples were cultured on cation-adjusted Mueller-Hinton agar and incubated at 37°C in an ambient atmosphere for 24 h. Mueller-Hinton agar supplemented to a final concentration of 50 mg/liter calcium was used to determine daptomycin susceptibility. CLSI breakpoints for *Corynebacterium* spp. were used (7). Susceptibility to daptomycin was defined as MIC values of ≤1 μg/ml (8, 14). A multidrug-resistant (MDR) *C. striatum* strain was observed (Table 1) with a resistance to more than 3 classes of drugs and susceptibility only to vancomycin, daptomycin, and linezolid. Therapy with daptomycin was reintroduced and continued for 4 weeks after device removal in the absence of adverse events. A repeated echocardiogram was negative for the presence of lead or valve vegetation. One month after the end of the therapy, the patient was afebrile and asymptomatic.

Corynebacterium species are aerobic, nonsporulating, pleomorphic, Gram-positive bacilli that are commonly found in animals and in normal human skin (18). Among the 73 recognized species in the genus *Corynebacterium*, *C. striatum* is distinguished from other *Corynebacterium* species by its reduction of nitrates, utilization of glucose and sucrose but not maltose, failure to produce propionic acid, and decomposition of tyrosine (8). Most *C. striatum* strains are susceptible to a variety of antimicrobial agents, including beta-lactams, vancomycin, gentamicin, and rifampin; however, MDR *C. striatum* strains have been recently described (8, 14). Among the most recent drugs, daptomycin showed a marked *in vitro* activity against *C. striatum* (14). Our strain was susceptible only to vancomycin, daptomycin, and linezolid, indicating an MDR phenotype.

Although frequently regarded as a contaminant when isolated in biological samples, *C. striatum* has been increasingly identified as the causative agent of serious infections, including meningitis, arthritis, and infective endocarditis, both in immunocompetent and immunocompromised subjects (5). *C. striatum* is mainly a nosocomial bacterium, and it is strongly associated with the presence of medical devices (9). A literature search in the Medline PubMed database revealed only 17 cases of infective endocarditis due to *C. striatum* (5, 6), whereas just one report of *C. striatum* pacemaker lead infection has been described (Table 2) (11). The patient under study herein had several risk factors for *C. striatum* infection, such as her elderly age and the presence of a cardiac device.

Microbiological diagnosis is crucial for the appropriate treatment of cardiac device infections (CDIs), whose incidence has increased over the past 10 years (15). Although cultures of generator pocket site tissue and lead tips are useful in identifying the causative organisms of CDIs (1), no bacterial detection occurs in about 30% of cases (2, 17). Sonication, which is a simple and rapid method for the detection of microbial biofilms in foreign bodies, has been recently validated for orthopedic devices (12, 16), whereas its application in the setting of CDIs is still limited (10). Sonication of the device before culture could be a useful technique to improve microbiological diagnosis in CDIs (13). A recent study comparing traditional swab cultures with sonication of intracardiac devices showed that bacterial detection through sonication was more sensitive than that through traditional cultures, especially in infected devices (13). Thus, conventional cultures of intracardiac devices might be unable to detect the causative organisms of CDIs, as occurred in our case, where *C. striatum* only grew after device sonication. Whether the detection of bacteria on devices represents a true colonization, a subclinical infection, or a contamination remains an area of active investigation (3). Our case should be considered a real device infection rather than a colonization; in fact, the patient developed fever during antimicrobial therapy, and her impaired condition probably allowed a low-virulence colonizer like *C. striatum* to assume a pathogenic role. MDR *Corynebacterium* strains other than *C. diphtheriae* should be considered emerging nosocomial pathogens in the setting of CDIs. The sonication of removed devices could be crucial for microbiological diagnosis of CDIs, especially when patients are already receiving antibiotic therapy.

TABLE 2. Pacemaker lead endocarditis due to *C. striatum*

Patient from:	Sex	Age	Cause of underlying disease	Prosthetic valve	Valve involvement	Clinical presentation	Medical therapy	Surgical intervention	Dosage of antibiotic therapy	Outcome	*C. striatum* isolation
Reference 11	M	73	Pacemaker battery replacement	No	Yes (tricuspid)	Fever	Vancomycin	Pacemaker removal	Not reported	Survived	Blood, drainage pus
This study	F	71	Pacemaker battery replacement	Yes (mitralic)	No	Fever, pocket infection	Daptomycin	Pacemaker removal	6 mg/kg once daily	Survived	Device sonication

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REFERENCES

1. **Anselmino, M., M. Vinci, C. Comoglio, M. Rinaldi, M. G. Bongiorni, G. P. Trevi, and P. G. Golzio.** 2009. Bacteriology of infected extracted pacemaker and ICD leads. J. Cardiovasc. Med. **10:**693–698.
2. **Baddour, L. M., A. E. Epstein, C. C. Erickson, B. P. Knight, M. E. Levison, P. B. Lockhart, F. A. Masoudi, E. J. Okum, W. R. Wilson, L. B. Beerman, A. F. Bolger, N. A. Estes III, M. Gewitz, J. W. Newburger, E. B. Schron, and K. A. Taubert on behalf of the American Heart Association Rheumatic Fever, Endocarditis, and Kawasaki Disease Committee of the Council on Cardiovascular Disease in the Young, Council on Cardiovascular Surgery and Anesthesia, Council on Cardiovascular Nursing, Council on Clinical Cardiology, and the Interdisciplinary Council on Quality of Care and Outcomes Research.** 2010. Update on cardiovascular implantable electronic device infections and their management: a scientific statement from the American Heart Association. Circulation **121:**458–477.
3. **Baddour, L. M.** 2010. Cardiac device infection or not. Circulation **121:**1686–1687.
4. **Bergeron, M. G., M. LeBel, A. Charest, J. F. Forcier, J. Morin, and F. Vallée.** 1986. Comparative study of serum bactericidal activity of cefotaxime alone or in combination with tobramycin. Antimicrob. Agents Chemother. **29:**379–381.
5. **Bhat, Y., A. M. Bal, S. Rochow, and I. M. Gould.** 2008. An unusual case of *Corynebacterium striatum* endocarditis and a review of the literature. Int. J. Infect. Dis. **12:**672–674.
6. **Boltin, D., M. Katzir, V. Bugoslavsky, I. Yalashvili, T. Brosh-Nissimov, M. Fried, and O. Elkayam.** 2009. *Corynebacterium striatum*—a classic pathogen eluding diagnosis. Eur. J. Intern. Med. **20:**e49–e52.
7. **Clinical and Laboratory Standards Institute.** 2006. Methods for antimicrobial dilution and disk susceptibility testing of infrequently isolated or fastidious bacteria. Approved standard M-45A. Clinical and Laboratory Standards Institute, Wayne, PA.
8. **Iaria, C., G. Stassi, G. B. Costa, C. Biondo, E. Gerace, A. Noto, S. G. Spinella, A. David, and A. Cascio.** 2007. Outbreak of multi-resistant *Corynebacterium striatum* infection in Italian general intensive care unit. J. Hosp. Infect. **67:**102–104.
9. **Lee, P. P., D. A. Ferguson, Jr., and F. A. Sarubbi.** 2005. *Corynebacterium striatum*: an underappreciated community and nosocomial pathogen. J. Infect. **50:**338–343.
10. **Mason, P. K., J. P. Dimarco, J. D. Ferguson, S. Mahapatra, J. M. Mangrum, K. C. Bilchick, J. R. Moorman, D. E. Lake, and J. D. Bergin.** 17 June 2010. Sonication of explanted cardiac rhythm management devices for the diagnosis of pocket infections and asymptomatic bacterial colonization. Pacing Clin. Electrophysiol. [Epub ahead of print.] doi:10.1111/j.1540-8159.2010.02820.
11. **Melero-Bascones, M., P. Muñoz, M. Rodríguez-Créixems, and E. Bouza.** 1996. *Corynebacterium striatum*: an undescribed agent of pacemaker-related endocarditis. Clin. Infect. Dis. **22:**576–577.
12. **Piper, K. E., M. J. Jacobson, R. H. Cofield, J. W. Sperling, J. Sanchez-Sotelo, D. R. Osmon, A. McDowell, S. Patrick, J. M. Steckelberg, J. N. Mandrekar, M. Fernandez Sampedro, and R. Patel.** 2009. Microbiologic diagnosis of prosthetic shoulder infection by use of implant sonication. J. Clin. Microbiol. **47:**1878–1884.
13. **Rohacek, M., M. Weisser, R. Kobza, A. W. Schoenenberger, G. E. Pfyffer, R. Frei, P. Erne, and A. Trampuz.** 2010. Bacterial colonization and infection of electrophysiological cardiac devices detected with sonication and swab culture. Circulation **121:**1691–1697.
14. **Shah, M., and J. L. Murillo.** 2005. Successful treatment of *Corynebacterium striatum* endocarditis with daptomycin plus rifampin. Ann. Pharmacother. **39:**1741–1744.
15. **Sohail, M. R., D. Z. Uslan, A. H. Khan, P. A. Friedman, D. L. Hayes, W. R. Wilson, J. M. Steckelberg, S. Stoner, and L. M. Baddour.** 2007. Management and outcome of permanent pacemaker and implantable cardioverter-defibrillator infections. J. Am. Coll. Cardiol. **49:**1851–1859.
16. **Trampuz, A., K. E. Piper, M. J. Jacobson, A. D. Hanssen, K. K. Unni, D. R. Osmon, J. N. Mandrekar, F. R. Cockerill, J. M. Steckelberg, J. F. Greenleaf, and R. Patel.** 2007. Sonication of removed hip and knee prostheses for diagnosis of infection. N. Engl. J. Med. **357:**654–663.
17. **Viola, G. M., L. L. Awan, and R. O. Darouiche.** 2010. Nonstaphylococcal infections of cardiac implantable electronic devices. Circulation **121:**2085–2091.
18. **Watkins, D. A., A. Chahine, R. J. Creger, M. R. Jacobs, and H. M. Lazarus.** 1993. *Corynebacterium striatum*: a diphtheroid with pathogenic potential. Clin. Infect. Dis. **17:**21–25.