Cardiac Device-Related Endocarditis Complicated by Spinal Abscess

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Background: *Infective endocarditis is the most serious manifestation of cardiac device infection and metastatic seeding of distant sites has been reported. However, the association between device-related endocarditis and spinal abscess has not been fully described.*

Methods: *We reviewed hospital records at three high-volume cardiovascular referral centers from January 2005 to October 2010. Device-related endocarditis was confirmed in all cases with positive blood cultures and transesophageal echocardiogram revealing lead and/or valvular vegetations. Six patients with spinal abscesses in association with device-related endocarditis were identified.*

Results: *A total of 384 patients met the clinical criteria for device-related endocarditis. Among these, infection was complicated by spinal abscess formation in six (1.5%) cases. The mean age of patients was 69.3 ± 11.8 years (47–82 years). The predominant clinical manifestations in these six patients included a recent history of fever (six), malaise (four), and neurological or meningeal signs (five). Spinal abscesses were diagnosed by magnetic resonance imaging in two and computed tomography scans in four of the cases. The causative pathogens were methicillin-resistant Staphylococcus aureus (three), methicillin-sensitive S. aureus (one), coagulase-negative Staphylococci (two), and Enterococcus fecalis (one). All patients underwent complete device removal with no procedure-related complications. Two patients died in the hospital, two were discharged with permanent neurological deficits, and the remaining two recovered with no permanent neurologic sequelae.*

Conclusion: *Device-related endocarditis must be considered in patients who present with a spinal abscess and bacteremia. Early recognition of this scenario is imperative in order to avoid permanent neurological sequelae and patient mortality. Early imaging, appropriate parenteral antimicrobial therapy, and expedited removal of all cardiac hardware are pivotal for optimal management. (PACE 2012; 35:269–274)*

pacemaker, defibrillators, infection, endocarditis, spine, abscess

Introduction

Device-related endocarditis has been recognized since the early 1970s, yet it remains a devastating condition that may be associated with multiple complications including the development of septic emboli.[1–3] The relationship between bacteremia and distant foci of infection has been highlighted.[1,4] However, despite knowledge of the prevalence and complications associated with device-related endocarditis, the association with spinal abscess has not been fully explored.

Implantation of cardiovascular implantable electronic devices (CIED), both pacemakers (PMs) and implantable cardioverter-defibrillators (ICDs), is increasing. However, benefits of these devices may be eclipsed by increasing rate of device infections.[5,6] A review of the National Hospital Discharge Survey from 1996 to 2003 demonstrated that there was a 3.1-fold increase in the number of hospitalizations attributed to CIED infections.[1,7] Another analysis revealed a 124% increase in CIED infections among Medicare beneficiaries from 1990 to 1999, with the incidence of device-related endocarditis increasing from 0.26 to 0.39 cases of 1,000 beneficiaries.[1,8] More recent data indicate that the incidence of device-related endocarditis is approximately 1.14 of 1,000 device-years.[1] As the rate of CIED implantation and associated infectious complications increases, healthcare practitioners should expect more frequent and varied clinical presentations.

Device-related endocarditis is associated with a high cost, including both resource utilization and mortality. The mean hospital length of stay (LOS)

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for patients who experience device infections, including device-related endocarditis, ranges from 14.4 to 19.6 days and the total cost associated with these hospitalizations ranges from $33,149 to $55,003.[9] The mortality rate associated with cardiac device-related endocarditis ranges from 31% to 66% if the implantable device is not extracted, and 13%–21% in the setting of complete device removal combined with antimicrobial therapy.[10,11]

The rising incidence of CIED infections emphasizes the importance of accurate and prompt identification of the varied clinical presentations associated with this complication. We summarize our experience with patients presenting with CIED-related infective endocarditis complicated by spinal abscess formation. The prompt recognition and expedited management of this clinical scenario is pivotal in avoiding serious sequelae, such as paraplegia and patient mortality.

Methods and Results

We reviewed hospital records dating from January 2005 to October 2010 at three high-volume cardiovascular referral centers. Patients with concomitant spinal abscess were identified in a cohort of 384 patients with device-related endocarditis. The diagnosis of device-related endocarditis was based on the modified Duke criteria.[12] These criteria have also been validated in cases of device-related endocarditis in a recent publication from Mayo Clinic.[13] Briefly, device-related endocarditis was present if there was persistent bloodstream infection, documented by positive blood cultures, and a lead vegetation documented by echocardiography. A spinal abscess was documented with noninvasive imaging (either computed tomography (CT) or magnetic resonance imaging [MRI]) in all cases.

Six patients with device-related endocarditis and spinal abscess were identified. A transesophageal echocardiogram (TEE) revealed the presence of lead vegetations in all patients and all six had positive blood cultures. The patient demographics and clinical course are summarized in Table I. The mean age of the group was 69 ± 12 years (range, 47–82 years). The predominant clinical presentation of these patients (three male, three female) included a recent history of fever (six), malaise (four), and neurologic or meningeal signs (five). Only one patient had a recent local procedure to the spine, receiving epidural injections for chronic lower back pain. The pathogens isolated were *Staphylococcus aureus* in four patients, coagulase-negative staphylococci in one patient, and both *Enterococcus fecalis* and coagulase-negative staphylococci in one patient. Methicillin resistance was present in three of the four patients with *S. aureus* infection. A spinal abscess was confirmed by MRI in two cases and CT scan in the remaining four patients. Complete device extraction was performed in all patients and none had procedure-related complications. All patients were treated with prolonged parenteral antibiotics. Surgical decompression of the spinal abscess was performed in three of the six cases. Partial neurologic recovery occurred in only one patient, while one patient had continued paraplegia and the third one expired 5 months later due to continued downhill course, including recurrent fever. Two patients did not undergo surgical decompression since they had local pain but no neurologic findings. These patients' symptoms improved with removal of their CIED hardware and a prolonged course of intravenous antibiotic therapy. The sixth patient with acute paraplegia did not undergo surgical decompression at the request of the family. This patient died during the hospitalization.

Illustrative Cases

Case One

A 65-year-old female had a past medical history (PMH) significant for coronary artery disease (CAD) status post percutaneous coronary intervention (PCI), ischemic cardiomyopathy (ejection fraction 30%), a cerebrovascular accident (CVA), and previous oral surgery for oral carcinoma. She had undergone ICD placement in April 2008. The patient presented to an outside hospital in May 2010 with altered mental status, slurred speech, unsteady gait, fever, chills, and malaise. Blood cultures were positive for methicillin-sensitive *Staphylococcus aureus* (MSSA). TEE demonstrated multiple vegetations attached to the ICD leads. The patient was started on Vancomycin and transferred to our institution for management of the CIED infection. The patient developed worsening back pain over the next 2 days that included the entire lower lumbar zone. The patient was switched to Cefazolin and Gentamicin. The infected ICD and leads were extracted using a laser sheath. After device removal, a spinal MRI was performed to evaluate the back pain and revealed a spine abscess in the lumbar region (Figs. 1 and 2). Neurosurgery evaluated the patient and recommended conservative management due to the absence of neurological deficits. The patient's lower back pain gradually improved and she was discharged home approximately 1 month later without any permanent neurological deficits. The patient was well at 1-month, 2-month, and 1-year follow-up.

Table I.

Clinical Characteristics of the Six Patients with a Spinal Abscess Associated with Device-Related Endocarditis

Case No.	Age (Years)	Device	Pathogen	Risk Factor(s)	Neurological Signs or Deficit	Management	Outcome
One	65	ICD	MSSA	Heart failure, history of cancer, ICD, *S. aureus*	Lower back pain	Complete device extraction IV antibiotics Surgical decompression of abscess not performed due to absence of neurological deficits	No neurological deficits Well at 1-year follow-up
Two	47	Dual-chamber PM	MRSA	Diabetes mellitus, *S. aureus,* oral anticoagulation	Acute paraparesis	Complete device extraction IV antibiotics Surgical decompression of abscess performed	Paraplegia Patient doing well otherwise.
Three	74	ICD	CoNS	Heart failure, ICD	Lower back pain	Complete device extraction IV antibiotics Surgical decompression of abscess not performed	No neurological deficits Well at 2-month follow-up. Awaiting reimplantation pending resolution of spinal abscess
Four	82	Dual-chamber PM	MRSA	Diabetes mellitus, *S. aureus*	Bilateral leg weakness	Complete device extraction IV antibiotics Family declined surgical decompression of spinal abscess	Patient died during hospitalization
Five	81	CRT-PM	MRSA	Diabetes mellitus, heart failure, *S. aureus*	Meningeal signs initially, the patient proceeded to develop paraplegia	Complete device extraction IV antibiotics Surgical decompression of abscess performed	Patient died 5 months after hospital discharge while at a skilled nursing facility
Six	67	ICD	Enterococcus fecalis and CoNS	Heart failure, diabetes mellitus, ICD	Paraplegia	Complete device extraction IV antibiotics Surgical decompression of abscess performed	Experienced partial recovery from neurological deficits Patient was well at follow-up.

PM = pacemaker; ICD = implantable cardioverter defibrillator; CRT-PM = cardiac resynchronization therapy pacemaker; MSSA = methicillin-sensitive *Staphylococcus aureus*; MRSA = methicillin-resistant *Staphylococcus aureus*; CoNS = coagulase-negative staphylococcus; IV = intravenous.

Case Two

A 47-year-old female with PMH significant for diabetes mellitus (DM), chronic renal insufficiency, previous CVA, and sick sinus syndrome (SSS) requiring the placement of a dual-chamber PM in 2003, presented to an outside hospital in February 2005 with complaints of fever and bilateral leg weakness. Initial workup leukocytosis (white blood cell count 18.3 $\times 10^9$/mL) and blood cultures were positive for methicillin-resistant *S. aureus* (MRSA). The patient had acute kidney injury with a creatinine level of 3.4 mg/dL

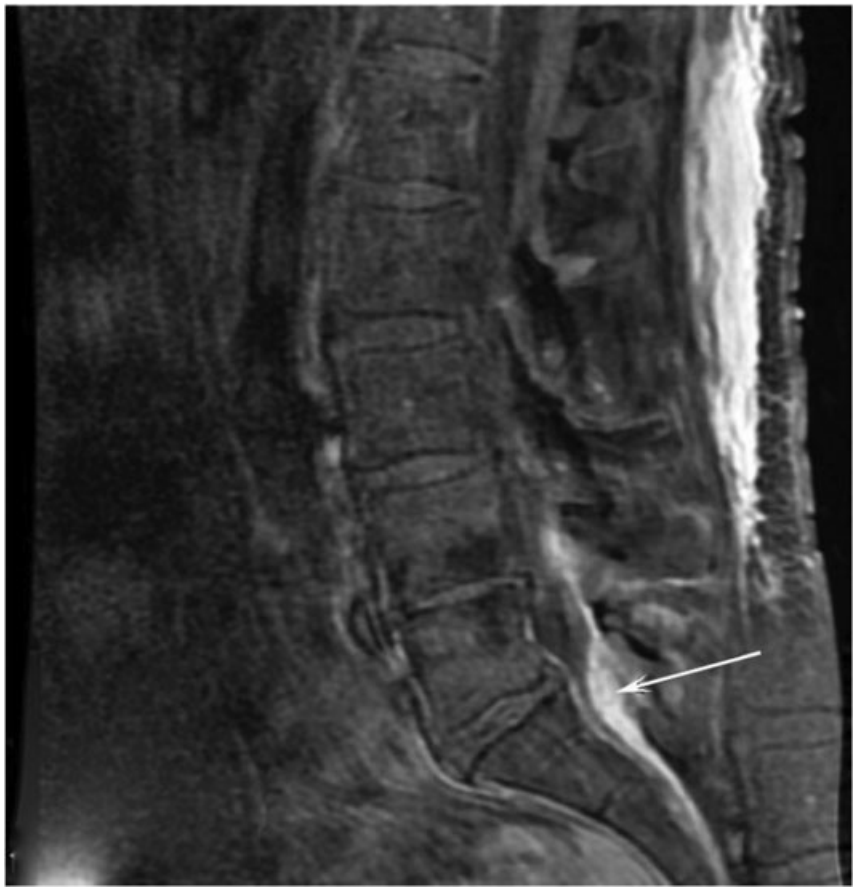

Figure 1. *MRI from case one. Sagittal view of the spine. The arrow demonstrates a spinal abscess in the lumbar region.*

(elevated from her baseline of 1.2–1.5). Her condition quickly deteriorated and she developed acute paraparesis. A CT myelogram was performed and demonstrated a complete block at T 7–8 thoracic spine and a right para-spinal mass. She was transferred to our facility the next day for the management of this epidural abscess. The patient had surgical decompression of this abscess 1 week after admission. Due to persistently positive blood cultures for MRSA, a TEE was performed and showed a 1 × 0.7-cm mobile mass on the right ventricle (RV) lead and an ejection fraction of 60%. Six days later, the patient underwent complete device removal and the leads were pulled using only manual traction. The patient received a 6-week course of antibiotic consisting of 42 days of parenteral Vancomycin and oral Rifampin, and first 14 days of intravenous Gentamicin. The patient was discharged to a local rehabilitation facility. She had a follow-up visit 5 months after her initial presentation, and was doing well. Her primary care physician kept her on chronic oral Bactrim therapy for chronic suppression.

Discussion

There has been an unprecedented increase in the rate of CIED implantation over the past two decades. Unfortunately, this was accompanied by an unanticipated rise in the rate of CIED infection, both local pocket and systemic infection, as well.[1,5,7,14] Consequently, it is exceedingly important that clinicians recognize the varied clinical manifestations associated with CIED infection. We present the first case series linking CIED-related endocarditis with the presence of a spinal abscess.

Several risk factors have been associated with the development of CIED infections and device-related endocarditis.[15–17] Clinical risk factors include immunosuppression, the use of oral anticoagulation, and medical comorbidities, such as advanced heart failure, DM, and history of cancer. There are also device-related factors, such

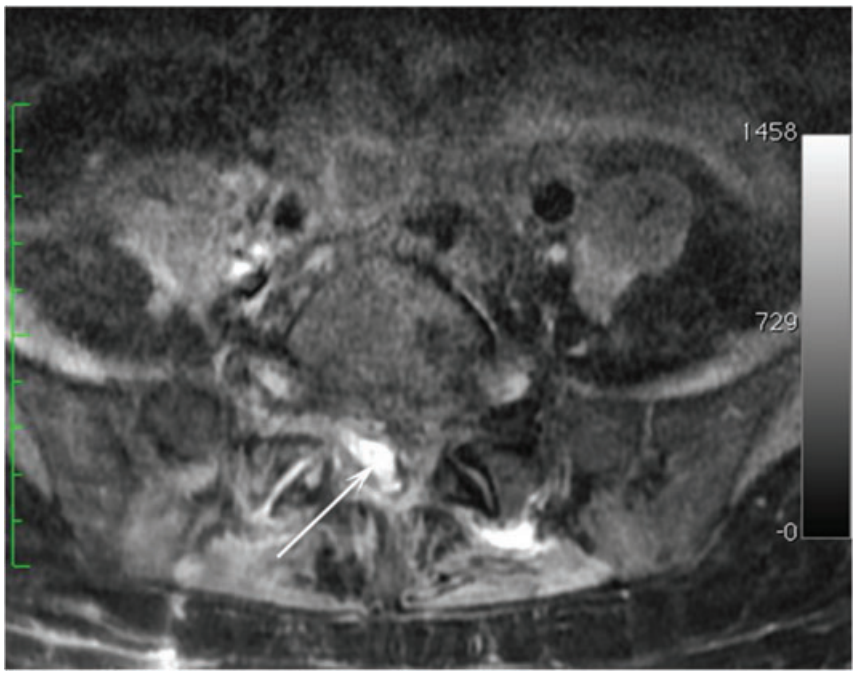

Figure 2. *MRI from case one. Cross-sectional view of the spine. The arrow demonstrates a spinal abscess in the lumbar region.*

as recent device revision or replacement, the type of CIED (ICD infection risk > pacemaker infection risk), and operator inexperience. Moreover, the microbiology of the organism responsible for bloodstream infection, particularly *S. aureus*, also influences the risk for CIED-related endocarditis and metastatic complications. All of our patients had several of these known risk factors,[1] including serious comorbid conditions, such as diabetes, heart failure, and cancer. Half of our patients had ICDs, whereas the remainder had either dual-chamber PMs or a cardiac resynchronization therapy pacemaker (CRT-PM) device.

Gram-positive organisms are frequently associated with CIED infections and device-related endocarditis. Most of these infections are caused by the *Staphylococcus* species, followed by *Enterococci* and *Streptococci*.[1,5,9,14–16] All of our patients with spinal abscesses had blood stream infection with gram-positive cocci. It is debatable whether the spinal abscess was the initial source of bloodstream infection or represented metastatic seeding from the cardiac source. Only one of our six patients had a local spine procedure, that is, epidural injections that may have been the portal of entry for local infection. The initial source of bacteremia in the other cases is unclear. However, discerning the precise source of bacteremia in these complicated cases may be a moot point, as it does not influence the management decisions. Two of the three patients with bacteremia and spinal abscesses with MRSA in our series died. Mortality in these cases highlights the importance of including device-related endocarditis in the differential diagnosis of patients who present with bacteremia with gram-positive cocci, particularly *S. aureus*, and have an implanted cardiac device.

It is not surprising that *S. aureus* is the pathogen most commonly associated with metastatic infectious complications following device-related endocarditis.[4] It is estimated that up to 34% of the patients with device-related endocarditis will develop infected metastatic foci.[18] The most frequently reported site of hematogenous seeding include septic pulmonary emboli, septic arthritis, osteomyelitis, and spondylitis.[4] Metastatic foci may recur if they are overlooked at initial presentation and unless all infected hardware is removed.

Although fever (86%–95%) and chills (76%) are reported by most patients diagnosed with CIED-related endocarditis,[1,4] the clinical presentation can be more indolent or subtle, especially in patients who have received previous antimicrobial therapy.[1,4] In these cases, clinical symptoms may not suggest underlying CIED-related endocarditis. It should be noted that the majority of the patients with CIED-related endocarditis have no inflammatory changes at the CIED pocket site,[19] as seen in our case series. Therefore, arriving

at the correct diagnosis may be a challenging process. Thus, presence of a nonspecific illness, bacteremia, or abscess in patients with cardiac devices should raise the suspicion for an underlying CIED infection and device-related endocarditis. For these reasons, American Heart Association guidelines recommended that all patients with CIED and positive blood cultures should undergo TEE as part of their diagnostic evaluation.[1]

Signs and symptoms related to spine involvement can also be nonspecific. In our series, four of the six patients initially presented with neurological deficits or meningeal signs in addition to fever and chills. However, others simply presented with low back pain, a common complaint in elderly population with degenerative joint disease. Therefore, we strongly recommend that a new or worsening back pain in CIED recipients with bacteremia should be taken seriously and investigated further by CT or MRI imaging. In some of our cases, we could not conclude with certainty whether the spinal abscess or the CIED was the initial focus of the infection. However, regardless of the etiology, prompt administration of parenteral antimicrobial therapy and removal of all CIED hardware is necessary for optimal management.[1,4,10]

Conclusion

Device-related endocarditis should be excluded in all patients with CIED who present with a spinal abscess. The early recognition and prompt intervention is imperative in order to avoid permanent neurological sequelae and patient mortality. Imaging with CT or MRI, prolonged parenteral antimicrobial therapy guided by *in vitro* susceptibility testing, and complete removal of all CIED hardware are the key management interventions to achieve cure.

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