Implantable Cardioverter-Defibrillator and Pacemaker Infections

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KEYWORDS

• Cardiac implantable electronic device • Implantable cardioverter-defibrillator
• Cardiac device infection • Pacemaker infection • Pocket infection • Endocarditis
• Bacteremia • Explantation

HOSPITAL MEDICINE CLINICS CHECKLIST

1. Cardiac implantable electronic device (CIED) infections occur in approximately 2.5% of patients with implanted devices. Rate of infection is increasing because of expansion of indications for placement, increasing patient comorbidity, and increased rates of battery replacement with implantable cardioverter-defibrillators.
2. Increased risk for infection is associated with patient factors (diabetes, renal insufficiency, congestive heart failure, chronic obstructive pulmonary disease, malignancy, and immunosuppressive medications), device factors (more complex devices with an increased number of leads), and procedural factors (generator replacement, hematoma, operator volumes, and antibiotics).
3. The most common organisms are gram-positive cocci (coagulase negative *Staphylococcus*), and initial antibiotics should include vancomycin or daptomycin.
4. Clinical syndromes include pocket infection, bacteremia without valvular involvement, and cardiac device–related infectious endocarditis.
5. Initial evaluation includes microbacterial assessment for infection, early specialist consultation, and empiric antibiotics. Patients suspected to have endocarditis should undergo transesophageal echocardiography. Needle aspiration of the device pocket should be avoided because of low yield and concern of introducing an infection.

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6. Gram-positive bacteremia in a patient with a CIED is associated with a 50% risk of device infection.
7. The duration of antibiotic treatment depends on the degree of lead and valve involvement.
8. Device removal is recommended in all cases of infected CIED and in all cases of staphylococcal bacteremia.
9. If reimplantation of a CIED is deemed warranted, a delay of 3 to 14 days beyond first negative blood culture is recommended depending on the extent of disease.
10. Mortality can be as high as 20% if infection progresses to endocarditis, hence early recognition and treatment are critical.

EPIDEMIOLOGY AND DEFINITIONS

Why are cardiac device infections an important topic for hospitalists?

In the last 2 decades, the number of implantable cardioverter-defibrillators (ICDs) and pacemakers (hereafter referred to collectively as cardiac implantable electronic devices [CIEDs]) in the United States has increased dramatically,[1] attributed to an aging population, improved technology, and an expanded range of indications for placement of these devices. With this has come an increase in the number of CIED-related infections, which are increasing at an even faster rate than implantation and have a significant impact on patient morbidity, mortality, and associated health care costs.[1] CIED infections have therefore received increasing attention in the last decade and the American Heart Association (AHA) has released recommendations for the diagnosis and management of these infections.[2] This article reviews the epidemiology and microbiology of CIED infections, predisposing risk factors, clinical presentation, diagnosis and management of patients with an infected device, and the expected clinical course and outcomes. Infections involving less common cardiac devices, such as loop recorders and ventricular assist devices, are not discussed.

What are the components of a CIED?

Permanent pacemakers and ICDs have 2 main components. The generator is a small electronic device that produces an electrical signal to stimulate atrial and ventricular activity, delivering pulses down wire leads that have an electrode tip that is implanted into the heart muscle. The generator is implanted under the skin (typically on the chest wall), and the leads are passed through the large veins into the right heart, terminating in the right atrium, right ventricle, or both. Cardiac resynchronization therapy (CRT) devices have an additional lead that is placed into the coronary sinus to pace the left ventricle as well. ICDs have the additional capability to recognize and shock ventricular arrhythmias.

How common are CIED infections?

A recent analysis of data from the Nationwide Inpatient Survey (NIS) shows a near doubling in the number of CIED implantations annually between 1993 and 2008. As seen in **Fig. 1**, this increase has been driven largely by the greater than 500% increase in the number of ICD implantations, although more pacemakers are also being implanted.[1]

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