



Editorial

Cardiac electrical device-related bacterial infections: Prevention, diagnosis, and management

1. Introduction

Significant development in modern cardiac (or cardiovascular) electrical devices (CIEDs), including permanent pacemakers, implantable cardioverter-defibrillators (ICDs), and cardiac resynchronization therapy, is contributing to the improvement in both the survival rate and quality of life in patients with cardiac arrhythmias and/or heart failure. The number of CIED implantations has increased significantly over the past decade based on clinical evidence. However, CIED-related bacterial infections remain one of the biggest and most serious complications of their use.

2. Incidence and risk factors

In a study involving Medicare administrative data, the immediate post-procedural complications related to CIED implantations decreased between 2002 and 2005 [1]. This favorable trend may be because of operators' experience, technological improvements, and device advances such as generator downsizing and/or the use of more sophisticated equipment [2]. Hence, focusing on device-related infections, the Nationwide Inpatient Sample discharge records demonstrated that the annual rate of CIED infections remained almost constant until 2004, but increased suddenly after 2005, with a rate of 1.53% in 2004 to 2.41% in 2008 ($p < 0.001$) [3]. This study also revealed that the incidence of four major comorbidities (renal failure, respiratory failure, heart failure, and diabetes) in patients with CIED implantations similarly remained almost constant until 2004, but increased suddenly after 2005. This trend closely paralleled the increase in the rate of CIED infections. Combined with an aging population, rapid and widespread acceptance of ICD indication has been suggested as a possible cause of the increase in the rate of CIED infections. This is because the size of the ICD generator is larger, and candidates for ICD therapy are more likely to have additional comorbidities [3].

In the PEOPLE study, a multicenter prospective survey investigating the incidence and risk factors of infectious complications in CIED procedures, several characteristics (fever 24 h before implantation, temporary pacing wires, and early intervention) were identified as risk factors for infection. The study showed the efficacy of the prophylactic use of antibiotics (beta-lactam antimicrobial agents) in the recipients of CIEDs [4]. Another case control study showed that long-term corticosteroid use was



identified as an independent predictor of device infection [5]. The Medicare administrative data study suggested a significant role of physician experience in CIED implantations [2]. In this study, a significantly higher rate of ICD infections was demonstrated in patients whose device was implanted by operators in the lowest quartile of implantation volume rather than by those in the highest quartile of implantation volume.

3. Management

For superficial or incisional infections above the subcutaneous pocket without device involvement, removal of the CIED is not thought to be necessary [1]. However, even in cases with local pocket infections without any signs of systemic infection, complete removal of the entire system is recommended. Detailed managements based on each patient's condition are discussed in the following chapters in this special edition.

4. Prognosis

Once a CIED-related infection occurs, each patient should be carefully and intensively evaluated. Early diagnosis and appropriate therapy certainly provide a beneficial effect on the patient's outcome.

In one of the largest retrospective cohort studies involving data of 200,219 patients from the Medicare system, CIED-related infections were apparently associated with an increase in admissions and the long-term mortality (adjusted long-term mortality in patients with infections was 1.6- to 2.1-fold compared with those without infections) [6]. Mortality in patients with infections is reported to be in a wide range between 5% and 27% and is suggested to be higher in patients with device-related endocarditis and in those without device removal therapy [6–8]. The reported

parameters associated with mortality are systemic embolization, moderate-to-severe tricuspid regurgitation, abnormal right ventricular function, and abnormal renal function [8].

5. Comments

CIED-related infections are increasing over time, and these result in high hospital admission and mortality rates. However, the development of several new technologies has contributed to controlling this challenging problem.

In this special edition of the Journal of Arrhythmia featuring CIED-related infections, we aim to cover various aspects of this serious issue by inviting five experts in the field of CIEDs to be the main authors of each chapter. We deeply appreciate the efforts of all authors for providing manuscripts and hope that their excellent articles will maximize physicians' performances in the management of patients with CIEDs.

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