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ORIGINAL ARTICLE

Pseudomonas aeruginosa infective endocarditis in patients who do not use intravenous drugs: Analysis of risk factors and treatment outcomes

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Background: Infective endocarditis (IE) due to *Pseudomonas aeruginosa* is rare and accounts for only about 3% of all patients with this disease. Most infections are associated with the use of intravenous drugs. Patients with *P. aeruginosa*-related IE who do not use intravenous drugs are extremely rare. We carried out a review of the literature to identify the nature and risk factors of this disease.
Methods: Patients with IE reported between 1993 and 2013 were reviewed by searching the Medline database using the keywords "endocarditis" and "*Pseudomonas aeruginosa*". All of the patients included met the definition of the modified Duke criteria.
Results: Twenty-seven patients in 22 reports were reviewed. IE associated with health care accounted for 20 patients (74%). The mean age of the patients was 53.4 years and there was a predominance of men (81.5%). Native valve endocarditis was seen in 20 (74.1%) patients. Surgery for infection control was performed in 15 (55.6%) patients and the mortality rate in patients who underwent surgery was 33.3% (five patients). A relapse of IE after

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adequate treatment was seen in nine (33.3%) patients. The mortality rate in all 27 patients was 28.6% (2/7) for those with community-acquired IE and 40% (8/20) for those with IE associated with health care. Univariate analysis showed a higher mortality rate in patients aged >60 years and in those whose source of endocarditis was related to a prosthetic device.
Conclusion: P. aeruginosa endocarditis has substantial morbidity and mortality. It is characterized by easy relapse and is highly associated with prosthetic devices.
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Introduction

Infective endocarditis (IE) caused by *Pseudomonas aeruginosa* is infrequent, accounting for approximately 3% of all patients with IE.[1] About 90% of patients with IE related to *P. aeruginosa* use intravenous drugs.[2] Patients with IE related to *P. aeruginosa* who do not use intravenous drugs are extremely rare and only a few patient reports and brief case series have been published. Most of these reports reveal that IE caused by *P. aeruginosa* may be very aggressive and has a high rate of mortality.

To provide more insights into the clinical presentations of this disease and to evaluate the prognostic factors, a literature review covering the period 1993—2013 was conducted, including one recent patient treated in Kaohsiung Veterans General Hospital, Kaohsiung, Taiwan.

Materials and methods

A systematic Medline review covering the period from January 1, 1993 to June 30, 2013 was conducted using the search terms "endocarditis" and "*Pseudomonas aeruginosa*". The search focused only on articles published in English. Two clinicians read the articles independently and decided which articles should be included in the review.

The articles were included if the patient reported met the modified Duke criteria of IE with isolates of *P. aeruginosa*.[3] These articles contained specific information on clinical, therapeutic, and outcome variables. For each patient reported, the following variables were recorded: demographic data (age and sex), clinical data (site and type of valves affected, echocardiography findings, entry site of the infection, any previous history of invasive procedures, and a relapse of the IE after completion of treatment), type of treatment (antimicrobial treatment with or without surgery), and outcome (death or recovery). A recent invasive procedure was defined as an intravascular device-related procedure within 1 year of the episode of *P. aeruginosa* IE, such as prosthetic valve replacement, central venous catheter insertion, an arterio-venous graft operation, cardiac catheterization, pacemaker insertion, and major surgery (i.e., open heart surgery), renal transplantation, biliary prosthesis implantation, and invasive urinary procedures such as cystoscopy.

IE associated with health care was defined as either nosocomial infection or non-nosocomial infection associated with health care.[4] Nosocomial infection was defined as IE developing in a patient hospitalized for >48 hours prior to the onset of the symptoms and signs of IE. Non-nosocomial infection associated with health care was defined as IE diagnosed within 48 hours of admission as an outpatient with extensive health care contact including any of the following criteria: (1) the patient had received intravenous treatment, wound care, or specialized nursing care at home within 30 days prior to the onset of *P. aeruginosa* IE; (2) the patient had attended a hospital or hemodialysis clinic or received intravenous chemotherapy within 30 days prior to the onset of *P. aeruginosa* IE; (3) the patient was hospitalized in an acute care hospital for ≥2 days in the 90 days prior to the onset of *P. aeruginosa* IE; or (4) the patient resided in a nursing home or long-term care facility.[4,5]

Community-acquired IE that was not related to intravenous drug use was defined as IE diagnosed at the time of admission (or within 48 hours of admission) in a patient not fulfilling the criteria for infection associated with health care and with no history of using intravenous drugs. Immunocompromised patients were defined as patients who were receiving long-term immunosuppressive treatment, or who had hematological disease as a result of chemotherapy. A relapse of IE after adequate treatment is defined as a new episode caused by *P. aeruginosa* within 6 months of the first episode of *P. aeruginosa* IE.

Statistical analysis

SPSS version 17.0 (SPSS Inc., Chicago, IL, USA) was used for all statistical analyses. The mean, standard deviation, median, and range were calculated for continuous variables. The χ^2 test and Fisher's exact test were used to determine significant differences between groups with categorical variables. Univariate analyses were used to determine the association between potential risk factors and mortality. Statistical significance was set at $p \leq 0.05$.

Results

In this comprehensive review of the literature from 1993 to 2013, 27 patients with *P. aeruginosa* IE were identified from 22 articles.[6—27] All 27 patients met the modified Duke criteria and none of the patients used intravenous drugs. Community-acquired *P. aeruginosa* IE accounted for seven patients (25.9%) and *P. aeruginosa* IE associated with health care accounted for 20 patients (74.1%).

The clinical characteristics of the reported patients are given in Table 1. The patients with community-acquired IE had a mean age of 50.9 years and those with IE associated

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