Clinical predictors of mortality from infective endocarditis ☆

J. Michael Smith [a,b], Robert R. So [a], Amy M. Engel [c,*]

[a] Department of Surgery, Good Samaritan Hospital, 375 Dixmyth Avenue, Cincinnati, OH 45220, USA
[b] Cardiac, Vascular, and Thoracic Surgery, Inc., 4030 Smith Road, Cincinnati 45209, USA
[c] E. Kenneth Hatton, MD, Hatton Research 11-J, Institute for Research and Education, Good Samaritan Hospital, 375 Dixmyth Avenue, Cincinnati, OH 45220, USA

Abstract A cohort study with prospective data collection was conducted to determine which risk factors and outcome variables are statistically significant clinical predictors of mortality from infective endocarditis. A study was performed from an eleven-year, hospitalization cohort ($N = 11{,}230$) in which the data were collected prospectively. The study examined 21 potential risk factors and 14 outcome variables. The risk factors were categorized into these various groups: patient factors, cardiac factors, co-morbidities, operative factors, infectious factors, and complications. The outcome variables were categorized into operative factors, infectious factors, and complications. Inclusion criteria included patients with endocarditis ($N = 87$). Longer operative time, operative complications, and postoperative complications. Overall mortality was 11.5 percent ($N = 10$). Endocarditis patients who died were significantly older ($p = 0.023$) and had a longer pump time ($p = 0.017$) than those who survived. Endocarditis patients who died were more likely to experience an unstable hemodynamic status ($p = 0.012$). There was a significant difference between survival and non-survival of patients with endocarditis on nine outcome variables. They were more likely to require a re-operation for bleeding ($p = 0.034$). Renal complications ($p = 0.016$), neurological complications ($p = 0.004$), pulmonary complications ($p = 0.001$), intra-operative complications ($p = 0.035$), and IAPB ($p < 0.001$) were all more likely to occur in endocarditis patients who died. There are risk factors that serve as predictors of mortality from infectious endocarditis. These include age greater than 65 years, longer pump time, and unstable hemodynamic status.

Outcome variables that reflected significant mortality included operative complications and post-operative complications. These factors may identify those patients with infective endocarditis eligible for more aggressive treatment.

Introduction

Infective endocarditis is a serious, often fatal illness. There are 10,000 to 15,000 newly diagnosed cases each year.[1] It continues to be a challenging disease to manage despite the major advances in diagnostic technology, improvements in antimicrobial selection, and advances in surgical techniques. Endocarditis remains a disease with a high mortality rate, with in-hospital mortality rates in the contemporary era of nearly 20%.[2] Netzer et al. reported that factors predictive of long term mortality included age greater than 55 years, congestive heart failure, and the initial presence of few symptoms of endocarditis.[3] They also found that early valve replacement has the potential to improve long-term survival. Chu and colleagues focused on early, independent determinants of in-hospital death from infectious endocarditis. Wallace et al. identified clinical findings within 48 h of admission that influenced both short and longer-term outcomes.

Clinicians caring for patients with endocarditis need to be able to accurately identify patients who are at highest risk for death early in the course of their illness. It is also important to determine the prognostic factors that improve long-term survival outcome. The present study will focus on potential risk factors of endocarditis that may result in mortality. This study will also examine outcomes other than mortality that result from endocarditis.

Methods

A cohort study from an eleven-year, prospective hospitalization cohort ($N = 11,230$) was conducted. Nurses, physicians, and perfusionists collected data on 225 variables during admission. Data were grouped into demographic, medical history, postoperative, perfusion, and procedure sections. Using a series of crosschecking questions, two individuals audited all data forms for completeness and consistency. To further ensure accuracy and consistency, a physician audited a random 10% of patient forms. Data then were entered into an interactive multi-institutional database (Patient Analysis and Tracking System, Axis Clinical Systems, Portland, OR).

Included in the study were patients age 18 and above diagnosed with infective endocarditis between October 1993 and February 2004 ($N = 87$). The study examined 21 potential risk factors. The continuous risk factors included age, creatinine level, pump time, cross-clamp time, body surface area (BSA), and annulus size. Categorical risk factors included gender, other systemic diseases, significant associated disorders, diabetes, previous cardiac surgery, operative category, cor sinus CP site, urgent surgical procedure, hemodynamic status, New York Heart Association functional class (NYHA), cardiac pathology, drugs wean,

procedure site, surgical procedure, infection, vegetation valve, abscess valve, and type of prothesis.

The 14 outcome variables other than mortality were total hours on ventilator, intensive care unit (ICU) length of stay, total length of hospital stay, reoperation for bleeding, arrhythmias, positive blood culture, positive cultures (blood, urine, venous line, arterial line), renal complication, wound complications, neurological complications, pulmonary complications, low output, intra-aortic balloon pump (IAPB), pulmonary hypertension, and intra-operative complications.

To generate the unadjusted risks of each potential risk factor, Chi-square, or Fishers exact test when appropriate, and t-tests comparing survival and non-survival patients with each of the 21 risk factors were performed. Multivariate regression was used to generate the adjusted risk for the significant risk factors. Chi-square, or Fishers exact test, and t-tests were also conducted comparing survival and non-survival patients with each of the 14 additional outcomes. We used SPSS (SPSS Corporation, Chicago, Illinois) statistical software to perform the analyses.

Results

In-house mortality occurred in 11.5 percent ($N = 10$) cases. Univariate analysis on potential risk factors revealed three significant risk factors (Table 1). Endocarditis patients who died were significantly older ($p = 0.023$) and had a longer pump time ($p = 0.017$) and were more likely to experience an unstable hemodynamic status ($p = 0.012$). Mortality was significantly greater in patients older than 65 years of age, who had pump times longer than 216 min, and in those who were hemodynamically unstable defined as patients who were treated with intravenous pressors or inotropes during their index admission. There was no significant difference in mortality for endocarditis patients in the remaining 18 risk factors. Multivariate regression was used to generate the adjusted risk for the three significant risk factors. Regression analysis revealed a significant difference between endocarditis patients with hemodynamic status (RR = 10.5, 95% CI = 1.9–56.9, $p = 0.006$) and pump time (RR = 0.99, 95% CI = 0.98–0.99, $p = 0.025$). Age was not significantly different between the two groups in the multivariate analysis (RR = 0.95, 95% CI = 0.89–1.0, $p = 0.075$).

There was a significant difference between survival and non-survival of patients with endocarditis on six outcome variables (Table 2). Endocarditis patients who died were more likely to require a re-operation for bleeding ($p = 0.034$). Renal complications ($p = 0.016$), neurological complications ($p = 0.004$), pulmonary complications (0.001), intra-operative complications ($p = 0.035$), and IAPB ($p < 0.001$) were all more likely to occur in endocarditis