Vancomycin Paste Does Not Reduce the Incidence of Deep Sternal Wound Infection After Cardiac Operations

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Background. **Deep sternal wound infection (DSWI) is a devastating complication that increases morbidity and death in cardiac surgical patients. Vancomycin is often administered intravenously for antibiotic prophylaxis in cardiac operations. Many cardiac surgeons also apply vancomycin paste topically to the sternal edges. We examined the effect of vancomycin paste on the incidence of DSWI in patients undergoing elective cardiac operations.**

Methods. **We retrospectively reviewed the medical records of all patients from 2003 to 2015 who underwent coronary artery bypass grafting, valve, or combined coronary artery bypass grafting and valve operations at a single institution. We derived The Society for Thoracic Surgeons (STS) DSWI risk index for each patient and systematically reviewed operative, pharmacy, microbiology, and discharge records to document DSWI in these patients. Multivariate analyses were used to identify predictors of DSWI in this cohort and to quantify the effect of vancomycin paste.**

Results. **Of the 14,492 patients whose records we examined, DSWI developed in 136 patients, resulting in an overall incidence of 0.9%. After multivariate analysis, body mass index, New York Heart Association Functional Classification, and the STS DSWI risk index remained statistically significant and associated with DSWI. Although the incidence of DSWI decreased over time, the use of vancomycin paste was not associated with a reduced incidence of DSWI.**

Conclusions. **There was a marked decrease in the incidence of DSWI during the study period, concurrent with institutional implementation of revised STS antibiotic dosing guidelines in 2007 and other strategies. However, the application of vancomycin paste to the sternal edges of patients undergoing cardiac operations was not associated with a reduced risk of DSWI.**

(Ann Thorac Surg 2016;■:■–■)

Sternal wound infection is a rare but serious event after cardiac operations [1, 2]. Surgical site infection (SSI) accounts for 14% to 16% of all nosocomial infections in hospitalized patients [3]. SSIs are associated with increased morbidity and death as a result of prolonged hospitalization, extended antibiotic administration, and additional surgical interventions. Furthermore, total perioperative costs for patients with sternal wound infections have been estimated to be 2.8-times greater than for patients with an uncomplicated postoperative course [1].

During the past several decades, there has been a substantial focus on infection control, with several quality improvement and patient safety protocols being implemented in an attempt to minimize the occurrence of SSI [4]. In 2007, The Society of Thoracic Surgeons (STS) recommended the addition of a glycopeptide, vancomycin, to standard β-lactam coverage in patients with a high risk of staphylococcal infection undergoing cardiac operations [5]. In addition to routinely administered intravenous antibiotics, vancomycin paste applied directly to the sternal edges after sternotomy has been used as an adjunct to further reduce the incidence of deep sternal wound infection (DSWI). A limited number of studies to date have investigated whether the application of vancomycin paste reduces the incidence of DSWI [6–8].

We hypothesized that the use of vancomycin paste would be associated with a reduced frequency of DSWI. To explore this hypothesis, we investigated the incidence of DSWI at our institution in patients undergoing cardiac operations with sternotomy during a 12-year period to determine whether the application of vancomycin paste was associated with the prevention of DSWI.

Accepted for publication Oct 10, 2016.

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Dr Tsuyoshi discloses a financial relationship with Edwards Lifesciences.

Published by Elsevier

0003-4975/$36.00
http://dx.doi.org/10.1016/j.athoracsur.2016.10.020

Abbreviations and Acronyms

BMI = body mass index
CABG = coronary artery bypass grafting
CDC = Centers for Disease Control and Prevention
CI = confidence interval
DSWI = deep sternal wound infection
IABP = intraaortic balloon pump
MI = myocardial infarction
NYHA = New York Heart Association
OR = odds ratio
SSI = surgical site infection
STS = The Society of Thoracic Surgeons

Patients and Methods

Patient Populations

From the medical records of Brigham and Women's Hospital, an urban hospital in Boston, MA, and with Institutional Review Board approval, all adults (aged ≥18 years) undergoing primary and reoperation coronary artery bypass grafting (CABG), valve, or combined valve and CABG operations between January 1, 2003, and June 30, 2015, were identified. Text searches and individual review of the local STS database, discharge summaries, surgical records, microbiology reports, and transthoracic and transesophageal echocardiogram reports were reviewed. Excluded from further analysis were patients with a history of infective endocarditis, congenital heart disease, other than bicuspid aortic valve, ventricular assist devices, and cardiac transplant. Long-term mortality data were obtained from routine institutional follow-up protocols, from our internal research data repository, and the Massachusetts Department of Public Health and the United States Social Security Death Indices.

We use variables from the STS database to determine the STS-derived estimated risk index of DSWI in our patient population [9–12]. We also collected demographic, pharmacy, microbiology, and operative records to identify which patients received vancomycin paste and to obtain additional covariates. Vancomycin paste was only prepared by mixing 5 or 10 grams of powdered vancomycin with a small amount of sterile water. This paste was applied directly to the sternal edges at the beginning and the end of the case in an effort to reduce bone marrow bleeding. All diagnoses of DSWI were reconfirmed by independent manual record review by 2 investigators.

Definitions

We defined DSWI as an infection involving any or all of the muscle, bone, or mediastinum that occurred within 90 days of the operation, required operative intervention (incision and drainage or reexploration), had positive cultures if obtained, and the patient was not receiving antibiotics at the time of sampling, and received antibiotic treatment beyond routine perioperative prophylaxis [13]. This definition is consistent with the STS database classification of postoperative DSWI with the caveat that we specified a 90-day interval from the initial operation compared with the STS definition that uses a 30-day interval [13, 14]. Bedside procedures were not included as part of the definition of DSWIs because they usually reflected only a superficial infection.

Patient variables analyzed included age, gender, race, weight, body mass index (BMI), New York Heart Association (NYHA) Functional Classification, presence of diabetes, baseline creatinine, dialysis, peripheral artery disease, previous myocardial infarction, operation type, intraaortic balloon pump (IABP), and cardiopulmonary bypass time. These variables were defined in strict accordance to the STS Adult Cardiac Database Data Specifications [14]. We also examined the effect of the attending surgeon and the year of operation to identify institutional factors that increased the risk of DSWI.

Statistical Methods

Categoric variables are summarized by frequency and were analyzed by χ^2 and Fisher exact tests. Comparisons of potential clinical predictors of DSWI, including age, estimated STS DSWI risk, vancomycin paste use, and surgeon, among others, against the occurrence of DSWI were performed. Variables associated with DSWI or the use of vancomycin paste ($p < 0.1$) were entered into a backward stepwise logistic regression model. Variables with a p value of less than 0.05 were retained while forcing age, STS DSWI risk, and the use of vancomycin paste into the model. Model fit was assessed using the log-likelihood goodness-of-fit test. Statistical significance was assigned for two-tailed p values of less than 0.05. Statistical analysis was performed with JMP 12.0 software (SAS Institute Inc, Cary, NC).

Results

Of the 14,492 patients identified, DSWI occurred in 136 patients (0.9%). Demographic and patient characteristics of the study population are summarized in Table 1. The median calculated STS DSWI risk for the study population was 0.34% (95% confidence interval [CI], 0.12% to 0.92%). Vancomycin paste use generally increased during the study period (Table 1). In addition, there were statistically significant differences in use of vancomycin paste by age, gender, race, BMI, and other patient and operative characteristics. Without accounting for confounding factors, a DWSI was not less likely to develop in patients receiving vancomycin paste than those who did not receive vancomycin paste (0.8% vs 1.0%, $p = 0.10$). DSWI occurred (10% to 90%) at a median of 17 days (range, 6 to 68 days), with 32% of DSWIs occurring more than 30 days after the operation (Fig 1).

Patients with a DSWI had higher BMI, worse NYHA class, and were more likely to have diabetes, and chronic lung, renal, and peripheral artery disease, with a higher median calculated STS DSWI risk (0.54%; 95% CI, 0.16% to 1.5%) than patients without a DSWI (0.33%; 95% CI, 0.11% to 0.90%; $p < 0.0001$, Table 2). They were more