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Major article

Effect of perioperative mupirocin and antiseptic body wash on infection rate and causative pathogens in patients undergoing cardiac surgery

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Introduction: Preoperative nasal mupirocin has been shown to reduce surgical site infections (SSIs) in patients undergoing cardiac surgery. We analyzed the effect of mupirocin plus antiseptic body wash on SSI rate and etiology.

Methods: Prospective SSI surveillance was done for patients undergoing cardiac surgery before and after implementation of mupirocin nasal ointment and chlorhexidine/octenidine body wash.

Results: Overall SSI rate was 8.6% (81 out of 945) for the control and 6.9% (58 out of 842) for the intervention cohort ($P = .19$). In multivariable analysis, the study protocol was associated with an odds ratio of 0.61 (95% confidence interval, 0.41-0.91; $P = .015$) with regard to any SSI. This effect was exclusively due to a reduction in superficial SSIs and was observed both in patients with preoperative and postoperative treatment initiation. Coagulase-negative staphylococci (CoNS), the most commonly isolated pathogen, were found in 37% and 48% ($P = .19$) of patients in the control and the intervention cohort, respectively. CoNS were methicillin resistant in 69% of cases.

Conclusions: Mupirocin and antiseptic body wash reduced the rate of superficial but not deep or organ/space SSIs. Postoperative patient treatment may be critical in reducing the risk for superficial SSI, presumably due to a reduction of bacterial skin load. A high proportion of SSI was due to methicillin-resistant CoNS and thus not covered by routine perioperative antimicrobial prophylaxis.

Surgical site infections (SSIs) are hazardous complications following cardiac surgery, contributing substantially to postoperative morbidity and mortality as well as increased costs.[1] Published rates of SSI following cardiac surgery have ranged from 3%-10.7%.[2-5] Most common etiologic pathogens are *Staphylococcus aureus*, coagulase-negative staphylococci (CoNS), and gram-negative bacteria.[2,3,5,6]

In general surgery as well as in cardiothoracic surgery, a decrease in the SSI rate for patients receiving perioperative nasal mupirocin, independent of *S aureus* carriage, has been demonstrated.[7,8] Others found that this effect was only seen in *S aureus* carriers.[9,10] Hence, nasal application of mupirocin has been advocated in patients undergoing cardiac surgery in the absence of documented negative testing for *S aureus*.[11] The role of preoperative antiseptic whole body wash or showering is more ambiguous. In a randomized controlled trial by Bode et al,[12] SSIs were significantly reduced in *S aureus* carriers who used chlorhexidine soap as well as mupirocin nasal ointment preoperatively. A recently published review[13] concluded that there is no clear evidence supporting preoperative showering or bathing with a skin antiseptic to reduce SSIs.

Regarding octenidine, no studies on the prevention of cardiac SSI have been performed thus far. However, octenidine has been shown to be at least equally potent as chlorhexidine concerning its antiseptic properties and it has been successfully used as an

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alternative to chlorhexidine for care of the insertion site in patients with central venous catheters.[14-16] Furthermore, daily bathing with octenidine resulted in a reduction in carriage rate of methicillin-resistant *S aureus* (MRSA) in intensive care patients.[17]

We primarily evaluated the effect of mupirocin nasal ointment and preoperative chlorhexidine/octenidine wash on SSI rates based on our standardized prospective surveillance protocol, adjusting for potential confounding factors in a quasiexperimental study. Secondly, we analyzed SSI cases in terms of infection depth and spectrum of causative pathogens.

METHODS

Setting

For our analysis, we included all cardiac surgery patients undergoing sternotomy procedures, including coronary artery bypass grafts and valve repairs in our tertiary care institution. Heart transplantation and pacemaker surgery were not included. All patients undergoing surgery between June 2009 and December 2010 constituted the control cohort, whereas those undergoing surgery between April 2011 and July 2012 were assigned to the intervention cohort. Patients with surgical interventions between January 2011 and March 2011 were excluded because the prospective SSI surveillance was interrupted during this period.

Intervention

During April 2011 an intervention was started with the intention of reducing SSIs consisting of the following protocol. Patients were to receive a twice daily application of mupirocin ointment (Bactroban, GlaxoSmithKline, Brentford, United Kingdom) in both nares and a once daily whole body washing or showering using a liquid soap with chlorhexidine digluconate 4% (Lifo-Scrub; B. Braun Medical AG, Melsungen, Germany). For bedridden patients, octenidine hydrochloride impregnated washing gloves (Octenisan wash mitts; Schuelke & Mayr GmbH, Norderstedt, Germany) were used instead of the chlorhexidine soap. Health care workers were instructed to start the treatment on the day of hospital admission or as soon as the decision for surgery was made. The intervention was to last for a minimum of 5 days and was allowed to be continued postoperatively. Some patients did not receive the intervention as recommended. Particularly in the case of emergency surgery, the intervention was only started after surgery or not done at all. Therefore, execution and duration of the protocol was assessed for each study patient. Screening for *S aureus* carriage was not routinely performed. No other infection control measure was implemented between June 2009 and July 2012.

Surveillance of SSIs

Prospective surveillance of SSIs was performed according to the protocol of the Swissnoso Surgical Site Infection Surveillance Module (Swissnoso). The protocol is based on Centers for Disease Control and Prevention definitions with the modification that isolated osteomyelitis of the sternum without concomitant mediastinitis is considered a deep incisional SSI.[18,19] Of note, the Swissnoso protocol features postdischarge surveillance by means of a telephone interview with at least 5 attempts to reach the patient within 30 days after the surgical intervention, or after 1 year if implants, including sternal plates and wire cerclages, were involved. Only patients with complete follow-up were included in our study. In case of suspected SSI, the treating physician of the patient is contacted in addition.

The data set for each patient included the following variables: age, sex, body mass index, American Society of Anesthesiologists score, duration of the intervention, wound contamination class, timing of preoperative antibiotic prophylaxis, fatal outcomes, and reinterventions. Additionally, the National Nosocomial Infections Surveillance score was calculated.[20] In case of SSI, the depth of the infection (superficial incisional, deep incisional, or organ/space), latency between operation and SSI, as well as the causative organisms were registered. All suspected SSI cases were reviewed by a board-certified infectious disease specialist. For the identification of relevant pathogens, microbiology results from operative samples and wounds were evaluated with respect to significance for infection according to the Centers for Disease Control and Prevention definitions.[19]

Statistical analysis

We performed a quasiexperimental before-and-after study design to compare SSI rates of patients with and without the study protocol. The outcome variable of interest was the occurrence of any SSI at the cardiac surgical site. We further distinguished between superficial incisional SSI—affecting the skin and subcutaneous tissue—and deep SSI, including deep incisional and organ/space SSI.

Categorical data were tested for differences using χ^2 or Fisher exact tests, whereas continuous variables were tested using Kruskal-Wallis or the Student *t* test, as appropriate.

Potential confounders among patient characteristics with *P* values $<.05$ in univariable analyses were considered for inclusion in multivariable models based on clinical judgment, with final models representing those that best balanced parsimony and fit. The limited number of outcomes was factored in when building the models to prevent overfitting.[21]

Furthermore, for the group with documented intervention, patients with and without SSI were compared regarding duration and the time of treatment initiation, either before or after surgery.

We used STATA (version 12.1, StataCorp, College Station, Tex) for statistical analyses. A *P* value $<.05$ was considered statistically significant.

Ethics approval

SSI surveillance was considered a quality control measure and was therefore exempt from ethical approval in the framework of the Swissnoso national SSI surveillance protocol. All patients were informed of the SSI surveillance and had the possibility to opt out. Perioperative nasal mupirocin ointment and antiseptic body wash were introduced as a standard of care for all patients.

RESULTS

Among all 1,787 study patients, 945 (52.9%) belonged to the control cohort and 842 (47.1%) to the intervention cohort. Of the 842 patients in the intervention cohort, 646 (76.7%) received the intervention protocol. Patient characteristics of the 3 patient groups are shown in Table 1.

Outcome parameters for the patient groups are shown in Table 2. Overall, 139 patients experienced an SSI accounting for an incidence of 7.8%. Crude SSI rate was similar between patients in the control cohort (81 out of 949; 8.6%) and those in the intervention cohort (21 out of 196; 10.7%) not receiving treatment ($P = .34$). In contrast, the infection rate was lower in treated patients (37 out of 646; 5.7%) than in nontreated patients (21 out of 196; 10.7%) within the intervention cohort ($P = .016$). This was exclusively due to a reduction in superficial incisional SSIs (10 out of 646; 1.5% vs 8 out of 196; 4.1%) ($P = .032$).