



Preoperative Decolonization Effective at Reducing Staphylococcal Colonization in Total Joint Arthroplasty Patients

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ARTICLE INFO

Article history:

Received 17 August 2012

Accepted 10 March 2013

Keywords:

chlorhexidine

decolonization

mupirocin

screening

Staphylococcus aureus

total joint arthroplasty

ABSTRACT

Staphylococcus decolonization prior to surgery is used to prevent surgical site infections (SSIs) after total joint arthroplasty (TJA). To determine if current treatment protocols result in successful decolonization of methicillin-sensitive *S. aureus* (MSSA) and methicillin-resistant *S. aureus* (MRSA), 106 consecutive patients were screened for nasal MSSA/MRSA colonization pre-operatively and on the day of surgery. Colonized patients used intranasal mupirocin twice a day and chlorhexidine showers daily 5 days prior to surgery. Pre-operatively, 24 joints (22.0%) were positive for MSSA colonization and 5 joints (4.6%) were positive for MRSA colonization. On the day of surgery, 3 joints (2.8%) who underwent decolonization were positive for MSSA colonization and 0 joints were positive for MRSA colonization. The reduction in MSSA colonization was significant ($P < 0.001$), while the eradication of MRSA colonization approached statistical significance ($P = 0.063$). Current decolonization protocols using intranasal mupirocin and chlorhexidine washes are effective for reducing MRSA/MSSA colonization.

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Surgical site infections (SSIs) are a life-threatening and devastating complication of total joint arthroplasty (TJA). Prevention of SSIs in orthopaedic patients is achieved by multiple methods. Factors associated with surgery, including hand washing, sterile technique, and the use of antiseptic agents, play a role in reducing infection rates [1]. Patient factors, such as obesity [2], diabetes [3], and malnutrition [4], have been associated with increased SSIs due to poor wound healing, and lifestyle modifications prior to surgery may reduce infections. Previous studies have demonstrated that pre-operative nasal screening of all TJA patients for MRSA/MSSA and subsequent decolonization of positive patients using intranasal mupirocin and chlorhexidine baths can successfully decrease the rate of SSI compared to a group of non-screened TJA patients [5,6].

Staphylococcus aureus (*S. aureus*) is the most common organism responsible for SSIs in orthopaedics [7]. Previous studies have shown that 20–30% of the population are carriers for MSSA [8,9], and 1–5% are carriers for MRSA [10]. One method for reducing *S. aureus* infections that has been reported in the literature is the decolonization of methicillin-sensitive *S. aureus* (MSSA) and methicillin-resistant

S. aureus (MRSA) colonized patients [11,12]. While it is assumed that the screening and decolonization reduced the rate of SSIs, there have been no studies in TJA patients that have directly determined if the decolonization protocol for MRSA/MSSA colonization is effective in reducing rates of colonization.

The purpose of this study was to determine if current treatment protocols using intranasal mupirocin and chlorhexidine baths result in successful decolonization of MRSA and MSSA in TJA patients.

Methods and Materials

A prospective study was conducted on 106 consecutive patients (49 females and 57 males, average age 61.72 years \pm 11.1) undergoing elective primary TJA at a single institution from March 2011 to March 2012. IRB approval (PRO09030601) was obtained prior to initiating this study. Revision TJA, TJA done for trauma, and patients who did not get a repeat swab on the day of surgery were excluded from our patient population. There were three bilateral procedures for a total of 109 TJAs, with 47 total hips and 62 total knees, and 55 left procedures and 54 right procedures. The average body mass index of patients was 30.9 kg/m² \pm 7.2, average Charlson Comorbidity Index score was 0.76, and most patients were ASA Class III (Class I = 4 patients [3.7%], Class II = 35 patients [32.1%], Class III = 68 patients [62.4%], and Class IV = 2 [1.8%]).

Patients were screened for nasal MRSA/MSSA colonization 1–6 weeks prior to surgery (range 6–42 days) using a saline moistened culture tube (BBL™ CultureSwab™ Plus, BD Diagnostics, Sparks,

Note: None of the authors listed above have a financial interest in this study. All authors have full control of all primary data and the journal may review our data if requested.

The Conflict of Interest statement associated with this article can be found at <http://dx.doi.org/10.1016/j.arth.2013.03.036>.

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Fig. 1. Nasal swabbing technique, where (A) a saline moistened swab is (B) inserted into both nares and rubbed on the septum.

Maryland) rubbed up the septum five times in both nares (Fig. 1). The screening was performed by medical assistants specifically trained to perform nares swab in the technique described. Each swab was sent to the microbiology lab and was inoculated onto CHROMagar MRSA and CHROMagar SA plates (BD Microbiology Systems, Sparks, MD), and incubated for 20–28 hours at 35–37°C. Cultures that grew on CHROMagar SA plates were MSSA colonized, while CHROMagar MRSA plates were MRSA colonized. Negative cultures were further incubated for 24 hours. After 48 hours, *S. aureus* positive mauve cultures were verified by Gram stain and coagulase testing (Staphaurex, Remel, Lenexa, Kansas). Colonies growing on both plates were MRSA, while the colonies only growing on SA plates were MSSA.

Those who were positive for MSSA and/or MRSA underwent decolonization using a standardized treatment protocol of 2% intranasal mupirocin twice a day and chlorhexidine body wash daily 5 days prior to surgery. The chlorhexidine body wash was applied by washcloth to the entire body, with special attention paid to the surgical site. Patients who were negative for MRSA and MSSA colonization did not receive any decolonization treatment. All patients in the study were then reswabbed on the day of surgery in the same technique described above. This was performed to determine if the decolonization protocol eradicated MSSA/MRSA colonization.

Statistical methods

Statistical analysis comparing pre-operative swabs to the day of surgery swabs was performed using the McNemar test. Statistical significance was defined as a $P < 0.05$. All statistical analysis was performed using Predictive Analytics Software Statistics (PASW) version 19.0 (SPSS, Chicago, IL).

Results

For pre-operative nasal swabs, 24 joints (22.0%) were positive for MSSA colonization and 5 joints (4.6%) were positive for MRSA colonization. On the day of surgery, 0 joints were positive for MRSA colonization and 10 joints (9.2%) were positive for MSSA colonization. Of the 10 patients positive for MSSA post-operatively, 6 were negative for MSSA pre-operatively, and 4 had persistently positive MSSA colonization cultures. One patient who was persistently colonized for MSSA was not compliant with the decolonization protocol. Thus, there were 3 patients who had undergone decolonization and were persistently positive for MSSA at the time of surgery. The reduction in MSSA colonization was significant ($P < 0.001$), while the eradication of MRSA colonization was 100% and approached statistical significance ($P = 0.063$) due to a small sample size (Fig. 2). The compliance rate for patients performing the decolonization protocol was 97% (only 1 patient did not comply).

Discussion

S. aureus, an organism commonly found on epithelial surfaces, is the most common cause of SSI in orthopaedic patients. Screening for MRSA and MSSA using intranasal cultures has been instituted for many orthopaedic patients. Once *S. aureus* colonization has been established, patients are most commonly treated with intranasal mupirocin ointment twice a day for 5 days prior to surgery [11,12]. This treatment is often supplemented with daily topical chlorhexidine washes using a washcloth or a scrub for 5 days prior to surgery. On the day of surgery, all patients receive perioperative antibiotics, such as cefazolin, but patients who are colonized for MSSA receive cefazolin alone and those that are colonized for MRSA receive vancomycin alone. Contact precautions are implemented at our institution when caring for MRSA colonized patients. Studies have shown that this screening and decolonization protocol is effective for reducing SSIs in TJA patients [5,6,13–15], in elective spine and sports medicine patients [16–20], and in orthopaedic trauma patients [20]. However, no study has been conducted in TJA patients to determine if the treatment protocol is effective for decolonizing MRSA and MSSA.

The results of our study demonstrate that utilizing a current decolonization protocol significantly reduces the colonization of MSSA/MRSA in nasal carriers. Three of the patients who were positive for MSSA pre-operatively and underwent decolonization were persistently positive on the day of surgery. One patient who was positive was not compliant with the decolonization protocol, so it was

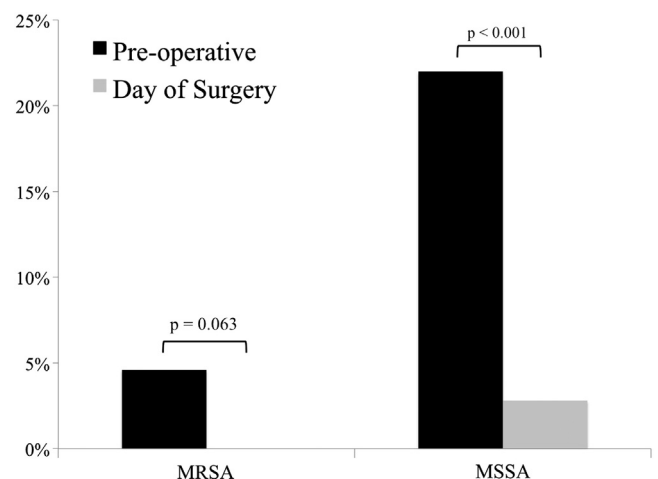


Fig. 2. Incidence of methicillin-sensitive *Staphylococcus aureus* (MSSA) and methicillin-resistant *Staphylococcus aureus* (MRSA) colonization prior to surgery (Pre-operative) and on the day of surgery. There was no MRSA colonization on the day of surgery, and there was significantly reduced MSSA colonization on the day of surgery.

expected that she would be MSSA positive at the time of surgery. Interestingly, 6 of the patients who were positive for MSSA on the day of surgery were not positive during the pre-operative screen. Additionally, only one patient developed a SSI in our study, even though this patient was negative during the initial pre-operative intranasal screening. The positive day of surgery *S. aureus* colonization and the negative pre-operative screen for the SSI patient is most likely due to the fact that the pre-operative swabs were not sensitive enough to detect *S. aureus* colonization. Studies have shown that nares swabs may only detect 54% of *S. aureus* using the culture swabs described above, but it is location of highest colonization [21,22]. Sensitivity of detection can be improved using polymerase chain reaction (PCR) instead of routine cultures [13,16,19], or swabbing of multiple sites [23].

The strength of our study is that it uniquely contributes to arthroplasty literature. No study has been conducted that directly looks at the effectiveness of the MRSA/MSSA decolonization protocol using intranasal mupirocin and chlorhexidine washes in TJA patients. For this study, we also followed a specialized protocol of nares swabbing, which included moistening the swab with saline prior to obtaining the sample. This may have increased sensitivity for detecting *S. aureus* colonization, which may explain the improved decolonization rates prior to intervention.

However, there were some weaknesses in our study. This was not a randomized study and there was no comparison group, as all TJA patients in our practice are routinely screened and decolonized for *S. aureus*, as it is accepted as our hospital's routine standard of care. There was also no control rate of *S. aureus* that could be present due to laboratory contamination. This study only evaluates the effectiveness of treatment using intranasal mupirocin and chlorhexidine body wash, but does not evaluate other treatment modalities, including oral antibiotics, such as rifampin with doxycycline [24], fusidic acid with polymyxin [17], or triclosan [15,20,25]. Finally, this study also detects the presence of MRSA/MSSA by culture swab, and not by PCR [13,16,19], which could increase sensitivity.

Despite the limitations, our study demonstrated that routine MRSA/MSSA screening in TJA patients and current decolonization protocols using mupirocin and chlorhexidine are effective for eradicating MRSA colonization and reducing MSSA colonization. Although MSSA colonization was not fully eradicated, we do not advocate for a universal decolonization protocol at this time, since this may contribute to increased antibiotic resistance. Instituting effective swabbing protocols, including moistening swabs, testing using PCR testing, and sampling multiple sites, may increase the sensitivity of detecting *S. aureus* colonization. Future action should be taken to further reduce bacterial burden prior to elective TJA to reduce SSIs.

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