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Original Article

Prevalence of MRSA colonization in an adult urban Indian population undergoing orthopaedic surgery

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ABSTRACT

Introduction: Orthopaedic surgery is technically demanding, implant dependant and expensive. Infection translates into a prolonged morbidity and long-term use of antibiotics. The most common organism involved in osteo-articular infections is *Staphylococcus aureus*, and colonizes the anterior nares of 25–30% of the population. Carriers are at higher risk for staphylococcal infections after invasive medical or surgical procedures. Prevalence of methicillin resistant *Staphylococcus aureus* (MRSA) has not been assessed in patients admitted for orthopaedic surgery in the Indian setting.

Aim: To assess the preoperative prevalence of MRSA colonization in adult patients undergoing orthopaedic surgery in urban India.

Materials and methods: This is a retrospective analysis of patients from 2009 to 2013. A total of 1550 patients admitted for orthopaedic surgery were preoperatively screened with nasal and axillary swabs for MRSA. Swab-positive patients were treated with intranasal mupirocin ointment for 3 days followed by a repeat swab. A record was made of hospitalization in the year prior to surgery and the occurrence of surgical site infection (SSI).

Results: A total of 690 males and 860 females had been screened for MRSA using an inexpensive kit costing 500 Indian rupees. For MRSA, 7/1550 (0.45%) nasal swabs were positive. No patient since 2009 has had a SSI with MRSA.

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Conclusion: MRSA screening prior to orthopaedic surgery is a valuable and cost effective preoperative investigation even though the incidence is low. Mupirocin is effective in clearing MRSA from the nares and maybe used for 3 days to obtain elimination of the bacteria.

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1. Introduction

Surgical site infections (SSIs) are the third most common nosocomial infections and complicate 1–10% of operations.¹ SSI can vary from stitch abscess, superficial subcutaneous collection to deep seated infection at the fracture site and/or around prosthesis, i.e., implants. SSI is classified mainly as Superficial Incisional SSI and Deep Incisional SSI. Associated with substantial morbidity and mortality, SSIs double the length of hospitalization, and increase the cost of healthcare.² *Staphylococcus aureus* (*S. aureus*) causes 25% of nosocomial infections.³ The ecologic niche of the organism is the anterior nares, and at any given time, 25–30% of the population is colonized.^{4,5} Carriers are at higher risk for staphylococcal infections after invasive medical or surgical procedures. They are also 2 to 9 times as likely as non-carriers to have SSI.⁶ It continues to be a dangerous pathogen for both community-acquired as well as hospital-acquired infections. Strains resistant to methicillin appeared soon after its introduction in 1960.⁷ Strains of methicillin resistant *S. aureus* (MRSA) are much lower, at 1% of the total population,⁸ and are more frequent in certain subgroups of patients such as the elderly, frequently hospitalized people, immune-compromised ones and patients on dialysis. Colonization with MRSA has been shown to increase the risk of infection with MRSA, both immediately after colonization⁹ and in long-term carriers. Twenty-three percent of untreated carriers develop MRSA infections in the year following the identification of their carrier status.¹⁰ A significant reduction in SSI has been reported in cardiac surgery following the introduction of preoperative screening.¹¹ Although many studies have tried to assess the prevalence of *S. aureus* and MRSA in the anterior nares, very few have looked into the prevalence of the microbe in an orthopaedic setting.^{12–17}

The aim of this study is to assess the prevalence of MRSA in the anterior nares and axillae of patients undergoing surgery in the adult reconstructive unit of a tertiary care centre in Mumbai, India.

2. Materials and methods

This is a retrospective analysis of patients from June 2009 to December 2013; all patients treated in the adult joint reconstruction unit of the senior author had undergone a nasal and axillary swab for MRSA as a routine preoperative investigation. Staphylococci were identified morphologically and biochemically by standard laboratory procedures. For elective surgery, in case of a positive screening result, patients were treated with local application of 2% (w/w) Mupirocin USP

ointment (Bactroban Nasal®, GlaxoSmithKline) to the nares, axillae and groin, three times a day for 3 days. Patients were instructed to apply a small amount of ointment (approximately 1 cm) with a cotton-tipped applicator to each of the anterior nares in the morning, afternoon and night. After each application, the nostrils were gently massaged to distribute the ointment. A repeat swab was taken on completion of the treatment. Once the result was negative, patients were taken up for surgery. In case of emergency surgery, where it was not possible to wait for a repeat swab, the treatment was started none the less. Patients undergoing more than one procedure during the same admission were not screened at subsequent surgeries ($n = 82$). The patients were showered with chlorhexidine detergent the night before, and on the morning of the procedure. The surgeon followed standard fixed clinical practice of peroperative scrubbing and painting with chlorhexidine solution, draping and use of a constant prophylactic antimicrobial regimen. The antibiotic used was injectable cefazolin 1 g, three doses in total, 1st dose at the time of incision, 2nd dose 6 hours later and 3rd dose 18 hours after 1st dose. One of the authors reviewed the medical records to assess the MRSA swab results. The age, sex, surgery performed and history of previous hospitalization in the year prior to surgery were also recorded. The patients were tracked for a 30-day readmission period.

Infection related to an operative procedure that occurred at or near the surgical incision within 30 days of the procedure was noted. SSIs were defined by the following clinical criteria: (1) A purulent exudate draining from a surgical site; (2) A positive culture obtained from a surgical site that was closed initially; (3) A surgeon's diagnosis of infection; (4) A surgical site that requires reopening due to at least one of the following signs or symptoms: tenderness, swelling, redness or heat.

Exclusion criteria:

- Emergencies like hip dislocations and open fractures requiring debridement ($n = 58$).
- Stitch abscesses were not considered SSI.
- Allergy to mupirocin.
- Pregnant/breast feeding women.
- Disruption of the nasal and facial bones.

3. Results

From June 2009 to December 2013, a total of 1690 patients were operated in a single adult joint reconstruction unit of the hospital. A total of 1550 patients (690 males and 860 females) had been screened for MRSA. Fifty-eight patients were excluded as they were orthopaedic emergencies and an

Table 1 – Swab-positive patients.

Serial no.	Age (years)	Sex	Surgery	Nasal swab	Axillary swab	Prior hospitalization within 12 months
1	75	F	Right TKR	+	–	Yes
2	39	M	L4-5 discectomy	+	–	Yes
3	43	M	Right THR	+	+	No
4	70	M	L3 fracture stabilization	+	–	No
5	21	F	IM nailing femur	+	–	No
6	76	F	Bilateral TKR	+	+	Yes
7	55	M	Left THR	+	–	No

Table 2 – Distribution of patients by age and sex.

Age group	Males	Females	Total
>70 years	1	2	3
50–69 years	1	0	1
30–49 years	2	0	2
<30 years	0	1	1

additional 82 underwent more than one surgical procedure in the same admission and were screened only once. The mean age of the population screened was 57.31 ± 17.46 years (range: 13–98 years). Nasal swabs were positive for MRSA in 7/1550 (0.45%) patients. Two patients also had axillary swabs as positive (Table 1). The mean age of MRSA-positive patients was 54.14 ± 20.88 years (21–76 years). The distribution of patients according to age and type of surgery is described in Tables 2 and 3. One of the seven patients developed a SSI which was due to *non-mycobacterium tuberculosis*. During the same time frame, 17 patients (1%) were operated for SSI related to the primary surgery. The prime pathogen was *Pseudomonas aeruginosa*,⁸ *Staphylococcus epidermidis*,⁷ *Staphylococcus aureus*¹ and *Non-mycobacterial tuberculosis*.¹ All the infections were successfully treated with wound debridement and appropriate antibiotics. No patient since 2009 has had a SSI with MRSA.

4. Discussion

This study suggests that the nasal colonization with MRSA in urban Indian population is quite low (0.45%) and patients

above the age of 70 years were more likely to be the carriers. In the United States of America, one study estimated that MRSA colonized 1% of the general population.⁸ The prevalence of nasal carriage of *S. aureus* in the community in the USA has also been studied as part of the National Health and Nutrition Examination Survey.¹⁸ Nasal swabs were obtained from 9622 individuals, representative of the general population. It was found that 0.8% patients were colonized with MRSA. A retrospective case-control study performed using the UK General Practice Research Database¹⁹ between 2000 and 2004 estimated the average incidence of MRSA acquisition to be 15.2 cases per 100,000 population per year, which gives a similar prevalence (0.7%) to that seen in the USA and similar to our findings in this study. Current estimates of prevalence of MRSA in the UK general population lie between 0.1 and 1.5%.^{20,21}

Chatterjee et al. estimated a prevalence of 3.89% in a paediatric population in rural, semi-urban and urban Indian population.²² Another study from Delhi reported a high rate of 5.3% in children.²³ We believe we had a lower prevalence in this study because we excluded the paediatric population which are highly susceptible to colonization, and our study was limited to an urban, adult cohort.

Prolonged hospitalization and antimicrobial therapy, care in an intensive care unit, surgical procedures and close proximity to a patient in the hospital who is infected or colonized with MRSA are factors associated with nosocomial acquisition of MRSA. Three out of the 7 patients found to be swab-positive in this study had a prior hospitalization within 12 months of the screening. One of these was for a left total knee replacement, the second for a magnetic resonance imaging of the spine and the third for a cholecystectomy.

Screening mandates that if a patient is found to be colonized then a suitable treatment should be administered. In the largest randomized control trial of *S. aureus* infections in surgical patients, Perl et al. found that 81.5–100% of patients are successfully decolonized immediately after completion of nasal mupirocin treatment.²⁴ Decolonization of the anterior nares appears to prevent *S. aureus* infections among patients who are receiving dialysis, thereby decreasing complications and costs.^{22,25} Several studies have reported lower rates of SSI among patients who received mupirocin compared to historical control subjects.^{18,26} Kalmeijer et al.¹² found that eradication of nasal carriage was significantly more effective and the rate of endogenous *S. aureus* infections was 5 times lower than in the placebo group. This is in keeping with our findings. On the other hand, another study²⁷ assessing SSI found that, despite clearing 81.5% of nasal *S. aureus*, no significant effect of mupirocin was found on the outcome of SSI caused by *S. aureus*. The UK's National Institute of Clinical Excellence does

Table 3 – Type of surgery and relation with MRSA-positive status.

Type of surgery	Number of cases	Number of MRSA-positive swabs
TKR	570	2
THR	392	2
ORIF of fractures	216	0
Arthroscopy	110	0
DHS	80	0
Bipolar hemiarthroplasty	57	0
Implant removals	49	0
IM nailings	28	1
High tibial osteotomy	24	0
Discectomy + Posterior stabilization	20	2
Laminectomy	3	0
Arthrolysis	1	0

not recommend the routine use of topical antimicrobial agents for nasal decontamination aimed at eliminating *S. aureus* to reduce the risk of SSI.²⁸ Based on our experience, we believe topical mupirocin for nasal decontamination of MRSA is beneficial. We do not advocate its use for methicillin sensitive *S. aureus* strains. Studies looking at the long-term efficacy of mupirocin that have focused on nasal decolonization of *S. aureus*, including MRSA, have shown that initial clearance over several weeks is effective and that re-colonization after 3 months is high.^{29,30} It has been established that significant increases in resistance to mupirocin can occur after repeated or extended courses of mupirocin.³¹ Hence we do not advocate more than 3 days of treatment, and not more than once in a year.

SSI is a costly complication following orthopaedic surgery. Screening for MRSA is inexpensive (Rupees 500) which in the greater scheme of things is a trivial amount. No other studies have looked into the cost saving benefit of this preoperative investigation in orthopaedic surgery. VandenBergh et al.³² determined the cost-effectiveness of perioperative mupirocin in cardiothoracic surgery. They suggested that due to the immense costs of a SSI, an effective intervention with a relatively cheap agent like mupirocin is likely to be cost-effective, as a risk reduction of 1% would be cost-effective already. Also, the side effects of topical mupirocin are negligible. More recently, Young and Winston³³ estimated the cost-effectiveness of a screen and treat strategy. Based on a carriage rate of 31% and a risk reduction of 48%, a saving of approximately \$1.5 million per 10,000 patients screened was predicted. In the US, where approximately 30 million surgical procedures are performed annually, extrapolation results in a potential cost savings of \$4.5 billion.

The drawbacks of this study are that it was not a randomized group and the absence of a control group to compare the results with. The MRSA identified were not routinely sub-cultured, which would have provided additional information regarding community- and hospital-acquired strains. The strength of this study lays in the fact that it is a systematic analysis of all the patients operated in a single division of a hospital in urban India. No other studies have looked into the prevalence of MRSA nasal colonization in the urban Indian population in an orthopaedic setting. The findings are an indication of the importance of this study, as there were no SSIs with MRSA following treatment of swab-positive cases with nasal mupirocin; however, the fact that these patients also received three doses of cefazolin has also to be borne in mind.

5. Conclusion

Although the prevalence of MRSA colonization in an adult urban Indian population is low, we recommend routine screening prior to elective orthopaedic surgery. Mupirocin is a cheap and effective treatment in clearing MRSA from the nares and maybe used even for 3 days to obtain elimination of the bacteria, thereby reducing the incidence of MRSA SSI.

Conflicts of interest

The authors have none to declare.

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