

Original article

Preoperative screening for nasal carriage of methicillin-resistant *Staphylococcus aureus* in patients undergoing general thoracic surgery

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Abstract

Objectives: Nasal carriage of methicillin-resistant *Staphylococcus aureus* (MRSA) is a risk factor for surgical site infections (SSIs). However, few studies have evaluated the rate of nasal carriage of MRSA and its effect on SSIs in patients undergoing general thoracic surgery. We investigated the importance of preoperative screening for nasal carriage of MRSA in patients undergoing general thoracic surgery.

Patients and Methods: We retrospectively analyzed 238 patients with thoracic diseases who underwent thoracic surgery. We reviewed the rates of nasal carriage of MRSA and SSIs.

Results: Results of MRSA screening were positive in 11 of 238 patients (4.6%), and 9 of these 11 patients received nasal mupirocin. SSIs occurred in 4 patients (1.8%). All 4 patients developed pneumonia; however, MRSA pneumonia occurred in only 1 of these 4 patients. No patient developed wound infection, empyema, and/or mediastinitis. SSIs did not occur in any of the 11 patients with positive results on MRSA screening.

Conclusions: The rates of nasal carriage of MRSA and SSIs were low in this case series. Surveillance is important to determine the prevalence of MRSA carriage and infection in hospitals, particularly in the intensive care unit. However, routine preoperative screening for nasal carriage of MRSA is not recommended in patients undergoing general thoracic surgery.

Key words: methicillin-resistant *Staphylococcus aureus*, preoperative screening, surgical site infection

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Introduction

Staphylococcus aureus is a well-known dangerous bacterium affecting humans¹. Since methicillin-resistant *S. aureus* (MRSA) was first isolated by Jevons and Barber^{2, 3}, it has shown a progressive increase in prevalence across hospitals and communities^{4, 5}. Clinically, MRSA-associated infections are difficult to treat owing to the high antibiotic resistance of MRSA strains. Recently, MRSA-associated surgical site infections (SSIs) are considered serious medical complications, and appropriate screening and prophylactic intervention are recommended in patients undergoing open heart and orthopedic surgery^{6–9}. Previous studies have investigated the duration of hospitalization, medical costs, and patient outcomes associated with SSIs^{10, 11}. However, to our knowledge, only 1 study has investigated the efficacy of screening for and prophylaxis against nasal carriage of MRSA in patients undergoing general thoracic surgery. Unfortunately, the results of that study were inconclusive¹². We investigated the prevalence rate of nasal carriage of MRSA and the rate of SSI-induced comorbidities in patients undergoing general thoracic surgery.

Patients and Methods

Patients: Between April 2014 and December 2017, 279 consecutive patients with thoracic diseases underwent surgical treatment at the Chuno Kosei Hospital in Gifu, Japan.

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Of these 279 patients, 238 (85.3%) underwent screening for nasal carriage of MRSA. MRSA screening using anterior nares swabs is routinely performed in all patients scheduled to admit to the intensive care unit (ICU) postoperatively, as part of an ongoing Chuno Kosei Hospital surveillance program. Screening was not performed in 41 patients among the patients who did not plan to enter the ICU. We retrospectively analyzed the clinical data of patients undergoing screening. The following data were collected for each patient to determine the usefulness of preoperative screening of nasal carriage of MRSA: demographics, diagnosis, surgical procedures, results of nasal swabs, and occurrence of SSI. This study was approved by the Chuno Kosei Hospital Ethics Committee for Clinical Research (approval No. H30-3).

Preoperative and perioperative management: Nasal swabs were obtained from the patients who were referred to our department. Patients who showed positive results on MRSA screening received treatment with 2% mupirocin ointment. Bronchoalveolar lavage fluid cultures were examined in patients who underwent preoperative bronchoscopy. However, no patient underwent intensive preoperative skin preparation with the use of chlorhexidine gluconate soap, even among those with positive results on MRSA screening. All patients received prophylactic antimicrobial treatment with a single dose of cefazolin (1 g) that was administered preoperatively (an hour before the surgical incision was made). Additional doses were administered every 3 hours intraoperatively. Postoperative prophylaxis was administered 8 hours after the last intraoperative administration of the drug.

Postoperative management: Chest radiographs were obtained on each postoperative day. Blood tests including complete blood cell counts and serum levels of C-reactive protein (CRP) were performed on postoperative days 1, 2, 3, 5, 7, and 9. Chest computed tomography (CT) was not routinely performed.

Additional tests were performed for further evaluation depending on the patient's clinical course rather than for the assessment of all abnormal symptoms and signs that suggested SSIs. Patients with fever or an elevated white blood cell count or CRP underwent additional testing including whole body CT, serum procalcitonin levels, β -d-glucan assay, *Aspergillus* and *Candida* antigen testing, as well as sputum and blood cultures for the assessment of infections. Broad-spectrum antibiotics were administered until the results of the aforementioned tests were obtained. Antimicrobial therapy was changed as necessary according to the results of these tests.

Table 1 Patient characteristics

Age (years)	69 (15–91) ^a
Sex (Male/Female)	158/80
Body mass index (kg/m ²)	21.5 (13.0–34.7) ^a
Smoking history (+/-)	146/93
Diabetes mellitus (+/-)	30/208
Oral hypoglycemic agents	22
Insulin	6
Hemodialysis (+/-)	2/236
Oral corticosteroids	7/231
Oral immunosuppressant	3/235
MRSA infection history (+/-)	0/238

^aMedian (minimum–maximum).

Results

Details regarding patient characteristics and preoperative diagnosis and surgical procedures are shown in Tables 1 and 2, respectively. Results of screening for nasal carriage of MRSA were positive in 11 of 238 patients (4.6%). Details of nasal cavity cultures are shown in Table 3. Nine of these 11 patients were treated with nasal mupirocin ointment. Successful decolonization was not confirmed in any patient. Two patients could not be administered mupirocin because the drug supply was discontinued. SSIs occurred in 4 of 238 patients (1.8%). All 4 patients developed pneumonia, and only 1 of these 4 patients developed MRSA pneumonia. However, all patients were successfully treated with antibiotic therapy. No patient developed wound infection, empyema, and/or mediastinitis. The 4 patients who developed pneumonia were all heavy ex-smokers (>40 pack year), but denied any underlying disease or risk factors as shown in Table 1. These 4 patients underwent lobectomy for primary lung cancer. SSIs did not occur in any of the 11 patients with a positive result on MRSA screening, regardless of whether they received nasal mupirocin treatment.

Discussion

SSIs negatively affect patient outcomes by increasing morbidity and mortality rates and diminishing patients' quality of life. SSIs lead to cost escalation related to prolonged hospitalization, with additional expenditure involving medical personnel and treatment costs¹¹. Therefore, various screening and prophylactic methods are being explored to prevent SSIs. According to the American Society of Health-System Pharmacists guideline, an ideal antimicrobial agent for surgical prophylaxis should fulfill the following criteria: (1) prevent SSIs, (2) prevent SSI-related morbidity and mortality, (3) reduce the duration of hospitalization and

Table 2 Preoperative diagnosis and surgical procedures performed in the study population

Primary lung cancer	152 (63.9%)
Metastatic lung cancer	23 (9.7%)
Lung benign tumor	12 (5.0%)
Lung cyst infection	1 (0.4%)
Pulmonary resections	188
Partial resection	37
Segmentectomy	15
Lobectomy	134
Pneumonectomy	2
Pneumothorax	34 (14.3%)
VATS bullectomy	34
Mediastinal and chest wall tumors	13 (5.5%)
Thymothymectomy	6
Tumor resection	3
Biopsy	4
Malignant mesothelioma	1 (0.4%)
Extrapleural pneumonectomy	1
Acute empyema	2 (0.8%)
VATS debridement	2
Total	238 (100%)

VATS: video assisted thoracic surgery.

health care costs, (4) cause no adverse effects, and (5) not adversely affect the patient's commensal flora or that of the hospital environment¹³. Perioperative systemic prophylactic antimicrobial therapy is routinely administered for SSI prevention, and cefazolin or ampicillin-sulbactam is commonly recommended (clindamycin or vancomycin is an acceptable alternative in patients with a documented β -lactam allergy)¹³. In this study, no patient was allergic to β -lactam antibiotics, and all patients received a single dose of cefazolin (1 g). We did not adjust the dosage on the basis of a patient's weight.

The efficacy of preoperative MRSA screening and nasal decolonization is unclear; however, this issue has gained much attention in recent years^{14–17}. A randomized control trial showed the preventive effect of SSIs among *S. aureus* carriers in general, cardiothoracic, and neurosurgical patients. The effectiveness of such screening was shown in studies that were limited to patients undergoing open heart and orthopedic surgery^{6–9}. These studies were not supported by a high level of evidence, the degree of recommendation was not high even in the patients undergoing open heart and orthopedic surgery¹³. Routine screening for nasal carriage of *S. aureus* (including MRSA) is not recommended in patients undergoing general thoracic surgery, and the single study that investigated this issue could not conclusively prove the usefulness of such screening¹². Open heart surgery and orthopedic surgery are considered “clean” surgeries. However, general thoracic surgery, which is considered

Table 3 Organisms detected in nasal cavity cultures

MRSA	11 (4.6%)
MSSA	34 (14.3%)
CNS	122 (51.3%)
Corynebacterium sp.	121 (50.8%)
Others	5 (2.1%)
Negative	15 (6.3%)

CNS: coagulase-negative *Staphylococcus*; MSSA: methicillin-sensitive *Staphylococcus aureus*; MRSA: methicillin-resistant *Staphylococcus aureus*.

a “clean-contaminated” surgery, may require a different degree of perioperative asepsis.

The types of thoracic diseases and surgical procedures performed for primary lung cancer in this study are shown in Table 2. These figures are nearly similar to those reported in Japan in 2014¹⁸. The disease distribution and surgical stress are not significantly different from other studies. SSI rates in the first postoperative month reportedly vary from 1% to 5%¹⁶. Although the SSI rate in Japan is unclear, the SSI-related mortality rate (related to pneumonia and pyothorax) following lung cancer operations is very low (0.13%)¹⁸. In this study, SSI and mortality rates were 1.8% and 0%, respectively, which concurs with previous reports. We did not confirm whether decolonization was successful in our patients; thus, we could not determine the accurate MRSA colonization rate at the time of operation. Although surgery was performed in as many as 11 patients with MRSA colonization, no patient developed SSIs including those caused by MRSA. The colonization rates of methicillin-sensitive *S. aureus* and MRSA were 14.3% and 4.6%, respectively. The colonization and SSI rates were both low; therefore, we speculated that preoperative screening for nasal carriage of MRSA is not necessary in patients undergoing general thoracic surgery.

Prevention of healthcare-associated infections has been widely discussed in the literature¹⁹. Screening for nasal carriage of MRSA shows a high specificity and negative predictive value to rule out MRSA pneumonia, particularly in patients with community-acquired and healthcare-associated pneumonia²⁰. Moreover, a few reports have shown the importance of screening for nasal carriage of MRSA in patients with infections admitted to ICUs^{21, 22}. A previous report has shown that *S. aureus* nasal colonization rates decreased from 32.4% in 2001–2002 to 28.6% in 2003–2004. However, MRSA nasal colonization rates increased from 0.8% to 1.5% in the United States²³. In the present study, colonization rates of *S. aureus* and MRSA were 14.3% and 4.6%, respectively, and the MRSA colonization rates appear to have increased gradually. Another retrospective cohort

study performed in Scotland reported that selective screening in patients undergoing elective surgery or admitted to the ICU between January 2006 and July 2008 and for all adult medical, surgical, and ICU overnight admissions between August 2009 and December 2011 yielded MRSA-positive rates of 6.9% and 3.1%, respectively²⁴. Moreover, the detection rate of MRSA colonization increases with swabs obtained from multiple body sites²⁵. Reportedly, a universal protocol for MRSA screening upon admission and antibiotic stewardship is useful to reduce bacteremia and early mortality rates²⁴. The detection and treatment of MRSA colonization have improved, which consequently may have reduced infection and transmission of MRSA to other patients²⁵. Screening should be performed on the basis of changes in time flow and regionality. Additionally, surveillance of MRSA colonization may be more suitable in specific groups of patients, for example, those who are admitted to the ICU and in immunocompromised hosts, although this issue could not be adequately verified in this study.

Limitations

Ideally, a prospective trial is needed to evaluate the necessity of preoperative screening for nasal carriage of MRSA in patients undergoing general thoracic surgery. However, only a few patients demonstrate nasal MRSA colonization. Additionally, patients' characteristics and surgical procedures differ across studies; therefore, it is difficult to design such a prospective study. Thus, we performed retrospective cohort study. The retrospective design and small sample size are drawbacks of this study; thus, large-scale studies are warranted for further assessment.

Conclusions

Although it may be necessary to strengthen surveillance of immunocompromised hosts, hospitals, and medical personnel, universal preoperative screening for nasal carriage of MRSA is not recommended in patients undergoing general thoracic surgery.

Conflict of Interest: All authors have no conflicts of interest.

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