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Screening nasal swabs for methicillin resistant *Staphylococcus aureus*: A regional burn center's experience

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ABSTRACT

Background: Methicillin-resistant *Staphylococcus aureus* (MRSA) is a pathogen that can result in substantial morbidity and mortality. Early detection of MRSA colonization by screening nasal swabs may be important in the management of burn-injured patients. However, studies examining its use in this population are limited. The aim of this study was to study the utility of admission MRSA screening nasal swabs and determine if being positive for MRSA on admission impacted outcomes.

Materials and methods: A retrospective review was conducted of burn patients who presented to a single regional burn center between June 2012 and December 2014. Electronic medical records and charts were reviewed for patient demographics and management. MRSA screening swabs were obtained from the anterior nares of burn patients upon admission. Patients without a MRSA nasal swab within 48 h of admission were excluded. Outcomes analyzed included overall length of stay, ICU admission and length of stay, mechanical ventilation, procedure count, time to excision, and wound complications after normalizing to total body surface area burn size (%TBSA).

Results: During the study period, 601 patients received a MRSA screening nasal swab upon admission. Of these, 24 patients screened positive for MRSA (4%). Patients who screened positive for MRSA had a significantly increased mean length of stay (3.95 v 2.36 days; $p < 0.05$) and number of surgical procedures (1.92 v 1.06; $p < 0.05$). Positively screened patients also had a higher proportion of wound infections (50% v 18.2%; $p < 0.05$), half of which were caused by MRSA. Subsequent graft complications were seen in 50% of patients with a wound complication. Only 2 positively screened patients were started on empiric antibiotics.

Conclusions: Burn patients who screened positive for MRSA had greater lengths of stay, more surgical procedures, and higher wound complications. Early identification of MRSA colonized patients in this patient population might allow for treatment modifications that improve outcomes. Further study is warranted in a prospective clinical trial.

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1. Introduction

Methicillin-resistant *Staphylococcus aureus* (MRSA) is a pathogen that results in substantial morbidity and mortality [1]. Since it was first described in the 1960s, rates of MRSA colonization and infection have risen [2,3]. A recent survey of US health care facilities has reported MRSA colonization rates as high as 4.1% and infection rates of 2.5% [4]. Subsequent studies examining MRSA subtypes noted an increasing prevalence of community-acquired MRSA (CA-MRSA) [5] while a meta-analysis identified a pooled CA-MRSA colonization rate of 1.3% [6]. In burn-injured patients, *Staphylococcus aureus* has been identified as the predominant species in severe burn wounds and is a leading cause of burn related morbidity and mortality [7].

The most common reservoir of MRSA colonization is the anterior nares [8]. As the skin transitions to nasal mucosa, a lack of humoral and local antibacterial defenses allow *Staphylococci* to flourish [2]. Previous work has established the association of MRSA nasal carriage with increased infection risk compared to methicillin-sensitive *Staphylococcus aureus* (MSSA) colonized or non-colonized patients [9–12]. The destruction of skin integrity by thermal injury provides a protein-rich, avascular, and sometimes necrotic environment that favors microbial colonization and proliferation [13,14]. These patients additionally present in a critical, immunocompromised state following injury that prolongs their hospital stay and further increases their susceptibility to MRSA pathogens [15].

MRSA infections range from simple skin and soft tissue infections to life-threatening bacteremia and sepsis. Virulence factors such as the superantigen toxic shock syndrome toxin 1 (TSST-1) can further facilitate host tissue and immune system adherence, evasion, and destruction [13,16]. Those who develop bacteremia secondary to MRSA have increased risk of mortality compared those with MSSA bacteremia [17]. As a result, the identification and management of MRSA infection has become paramount.

Knowledge of colonization can allow mobilization of isolation precautions, minimize transmission between patients and health care workers, and protect future patients who may use previously colonized facilities. Swab based nasal screening is the most common technique to detect MRSA colonization in patients. However, studies examining the use of MRSA screening nasal swabs in the burn population are limited. The aim of this work was to understand the association between screening positive for MRSA and outcomes in order to identify potential areas for improvement in this patient population.

2. Materials and methods

Following Institutional Review Board approval, a retrospective chart review was conducted on all burn-injured patients who presented from June 1, 2012 to December 31, 2014 at a single institution. Burn-injured patients admitted for inpatient care received a screening nasal swab culture for MRSA. Patients less than 18 years of age, who did not receive a MRSA screening nasal swab within 48 h of admission, or had a length of inpatient stay less than 48 h were excluded from this study.

Cultures were performed using the BBL CultureSwab Collection & Transport System (Becton, Dickinson and Company, Franklin Lakes, NJ) where each collection kit came with a double-headed swab tip. One swab tip was used per nostril, inserted approximately 1–2 cm into the nostril, and pressed against the mucosal surface in a clockwise or counterclockwise motion at least twice. Swabs were then carefully placed into the collection tube and later inoculated onto BBL CHROMagar MRSA plates (Becton, Dickinson and Company, Franklin Lakes, NJ) for a 24 h incubation period at 35–37 °C. The presence of mauve colored colonies along with associated gram stain, coagulase, and catalase testing confirmed the presence of MRSA. Per institution protocol, reflex confirmation and quantification was not performed on positive results. Patients who screened positive for MRSA were subsequently placed on contact isolation precautions for the remainder of their hospital stay after notifying their primary team. Additional cultures, including wound, blood, sputum, and more were obtained at the discretion of the managing team.

Hospital electronic medical records and scanned charts were reviewed for patient demographic information, clinical management and bacterial culture testing. Patients were scrutinized for associated risk factors and outcomes such as total body surface area (TBSA) burn size, age, length of stay (LOS), ICU admission, ICU length of stay, inhalation injury, mechanical ventilator support, surgical procedures performed, time to excision, readmission, and wound infection. Wound infections were diagnosed clinically by the managing-team on the basis of a described or confirmed change in wound care management. This was determined by either physical exam, a positive wound culture from the site of concern, the use of systemic or topical antibiotics targeting a suspected infection, or the described diagnosis of wound infection by the managing clinical team on retrospective chart review. Readmissions were defined as a patient who obtained a thermal injury, was managed at our institution, discharged, and subsequently re-presented for need of continued wound care.

Data was stored in Microsoft Excel (Microsoft, Redmond, WA) and analyzed using GraphPad Prism 6 (GraphPad Software, Inc., La Jolla, CA). Student's t tests were used in general for statistical comparisons unless otherwise specified. For variables such as TBSA and LOS where data are highly skewed, median and interquartiles are reported and nonparametric Wilcoxon rank sum tests were used in these instances for comparisons. For categorical variables, chi square or Fisher's exact test were used. All data is represented as mean values with standard deviation and a statistical significance set at $p < 0.05$.

3. Results

During the study period, 601 burn-injured patients received a screening nasal swab upon admission and were identified to meet inclusion criteria. Of these, 24 patients screened positive for MRSA by nasal swab (4%) while 577 patients screened