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Risk Factors Associated with Methicillin-Resistant *Staphylococcus aureus* Colonization on Hospital Admission among Oncology Patients

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Abstract

A Nested Case-control study as a tertiary care facility was conducted to assess potential risk factors for colonization with methicillin-resistant *Staphylococcus aureus* (MRSA) on admission among oncology patients. Risk factors for any *S. aureus* and MRSA colonization on admission in oncology patients are consistent with previous studies in general populations. In addition, recent chemotherapy as a risk factor is a unique finding in this population.

MeSH terms

Oncology; Methicillin-Resistant *Staphylococcus aureus*; Risk Factors

Introduction

The identification of individuals at high risk for Methicillin-Resistant *Staphylococcus aureus* (MRSA) is a crucial component of infection control. General risk factors for include recent hospitalization, residing in a nursing home, antimicrobials, malignancy, and chronic skin disease.^{1–5} However, there is a lack of data on risk factors for MRSA colonization in adult oncology patients. In pediatric oncology patients risk factors include indwelling venous catheters, urinary catheters, mucosal damage, wounds following surgery, nutritional deficiencies and dialysis.^{6–7} Further study of Gram-positive bacterial infections include use of proton pump inhibitors, oral non-absorbable antibiotics, and antecedent chemotherapy with high-dose cytarabine as risk factors⁸. The purpose of this study is to identify risk factors for MRSA and *S. aureus* colonization on admission to two adult oncology services at a large urban hospital.

Methods

A retrospective case-control study was conducted at Siteman Cancer Center, Barnes-Jewish Hospital (BJH), a 1,250-bed university-affiliated, tertiary care facility located in St. Louis, MO. Anterior nares cultures were obtained on patients admitted to the leukemia/lymphoma and medical oncology units from July 1, 2004 to December 31, 2005.

Cases of MRSA detected by nasal culture were included in the analysis. General culture and gram stain was used with Kirby bauer susceptibility testing to confirm MRSA. Thirty-five of 138 patients who were MSSA positive on admission were randomly selected and included. Control patients were randomly selected in a 2 to 1 ratio from the patients with an admission nasal swab negative for *S. aureus*. Clinical and demographic data were abstracted from the medical microbiology records. Chronic skin conditions were defined as a diagnosis of dermatitis, eczema, psoriasis, or chronic ulcers. Previous antibiotic use was defined as use of antibiotics, antivirals, or antifungals in the past 30 days. Urinary drainage device was defined as having a urinary catheter or nephrostomy tube on admission.

Data were analyzed using Chi-square and Fisher's Exact test. Statistically significant and biologically plausible variables on univariate analyses were included in a multivariate logistic regression model using SPSS V. 13.0 (SPSS Inc, Chicago IL). Goodness of fit and interaction effects were examined. Separate analyses were done comparing MRSA-positive patients and all *S. aureus* colonized patients to non-*S. aureus* colonized controls. A p-value of less than 0.05 was considered statistically significant. The project was approved by the Human Research Protection Office of Washington University School of Medicine.

Results

A total of 231 patients with a nasal swab within 48 hours of admission were included (Table 1.). Five percent of patients admitted to the leukemia/lymphoma unit and 9% of the medical oncology unit patients had MRSA nasal colonization on admission.

Risk factors remained independent in the final multivariate model for any *S. aureus* colonization were over 5 admissions in the past year (Odds Ratio [OR], 4.21; 95% Confidence Interval [CI] 1.54–11.52); chemotherapy in the past 30 days (OR, 2.78; 95% CI, 1.40–5.51); surgery in the past 30 days (OR 7.74, 95% CI, 1.45–41.22); and diagnosis of chronic skin disease (OR, 4.40; 95% CI, 1.31, 14.77) (Table 2).

Independent risk factors for MRSA colonization included more than 5 admissions in the previous 12 months (OR, 2.82; 95% CI, 0.75–10.64); chemotherapy in the past 30 days (OR, 2.97; 95% CI, 1.26–7.04); antimicrobial use in the past 30 days., (OR, 2.27; 95% CI, 1.02–5.04); diagnosis of chronic skin disease (OR, 6.30; 95% CI, 1.73–22.99); and a urinary drainage device on admission (OR, 4.87; 95% CI, 1.53–15.53) (Table 2).

Discussion

This is one of the few studies to evaluate risk factors for *S. aureus* and MRSA colonization on hospital admission among adult oncology patients. Greater than five previous admissions in the last year, chemotherapy, chronic skin disease, and recent surgery were independent risk factors for *S. aureus* colonization. Chemotherapy, antimicrobials, chronic skin disease, and a urinary drainage device were found to be independent risk factors for MRSA colonization. These results support current literature and add chemotherapy as an emerging risk factor for MRSA colonization in oncology patients.

Jernigan identified previous hospitalization as a risk factor for the acquisition of MRSA, and the risk increased with the number of previous hospitalizations.³ Several other previously described risk factors for *S. aureus* and MRSA colonization were identified in this study. Chronic skin conditions increase the risk of bacterial infection, and community-acquired MRSA has been linked with skin and soft tissue infections.⁹

The presence of a urinary drainage device increased the risk of any *S. aureus* colonization. This result is consistent with published data assessing risk of hospital-acquired *S. aureus* risk.¹⁰

Antimicrobial use in the past 30 days, including use of antibiotics, antivirals and antifungals, was a significant risk factor for MRSA only. The multivariate model for all *S. aureus* colonizations did not include any antimicrobial use as a significant risk factor. However, multiple antimicrobials may be a marker for severity of illness or underlying disease.

Chemotherapy in the past 30 days as a risk factor for MRSA and MSSA colonization is a new finding. This could serve as a surrogate for hospital visits. Due to the sample size, comparing colonized patients by chemotherapy treatment could not be done. Previously identified risk factors for MRSA including HIV and renal insufficiency were not found to be significant in this population. This may be due to relatively low prevalence of these conditions in oncology populations.

This study was limited by a relatively small sample size from one healthcare facility. Therefore, generalizability of these risk factors for MRSA colonization to other healthcare settings may be limited. The retrospective nature of this analysis limits the ability to determine where colonization occurred (community versus hospital). There is also inherent confounding bias associated with case-control studies because disease and exposure have already occurred, and the completeness and accuracy of medical records should be considered. The lack of molecular typing means no distinction was made between community and hospital associated strains of MRSA.

Our findings confirm several previously reported risk factors for MRSA on admission. Chemotherapy treatment in the past 30 days is a unique factor to oncology patient. However, further study is needed to confirm this finding and identify which anti-neoplastics agents increase the risk for colonization.

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Table 1

Clinical and Demographic Characteristics and univariate analysis of oncology patients from Barnes Jewish Hospital during 2004 and 2005 tested for *S. aureus* stratified by infection status on admission.

Variables	MRSA n = 44 n (%)	MSSA n = 35 n (%)	Controls n = 152 n (%)	MRSA vs. Controls cOR	All <i>S. aureus</i> vs. Controls cOR
Demographics					
Gender					
Male	22 (50.0)	24 (68.6)	83 (54.6)	1.20 (0.61, 2.35)	0.86 (0.49, 1.49)
Age					
Under 55 years	20 (45.5)	23 (65.7)	75 (49.3)	0.86 (0.44, 1.68)	0.82 (0.47, 1.41)
> 5 Admissions in past year	8 (18.2)	7 (20.0)	7 (4.6)	4.60 (1.57, 13.53) *	4.85 (1.89, 12.48) *
Medications taken in the past 30 days					
Chemotherapy	14 (31.8)	10 (28.6)	25 (16.4)	2.37 (1.10, 5.10) *	2.22 (1.16, 4.22) *
Antibiotics	18 (40.9)	7 (20.0)	32 (21.1)	2.60 (1.26, 5.31) *	1.74 (0.94, 3.21)
Vancomycin	9 (20.5)	2 (5.7)	4 (2.6)	9.51 (2.77, 32.68) *	5.98 (1.84, 19.47) *
Comorbid Conditions					
Chronic Renal Insufficiency	6 (13.6)	4 (11.4)	3 (2.0)	7.84 (1.87, 32.80) *	7.20 (1.92, 26.98) *
Chronic Skin Disease/Wound	9 (20.5)	-	5 (3.3)	7.56 (2.38, 23.96) *	3.78 (1.22, 11.70) *
Surgery in last 30 days	2 (4.5)	4 (11.4)	2 (1.3)	3.57 (0.49, 26.12)	6.16 (1.21, 31.29) *
Admission Characteristics					
Urinary Catheter on Admission	10 (22.7)	1 (2.9)	7 (4.6)	6.09 (2.16, 17.16) *	3.35 (1.24, 9.02) *
Loss of Skin Integrity on Admin	14 (31.8)	2 (5.7)	20 (13.2)	3.87 (1.55, 9.65) *	2.10 (0.90, 4.96)

cOR - Crude Odds ratio

* Indicates statistical significance

Table 2

Final Multivariate model

Variable	MRSA vs. Controls OR (95% CI)	All <i>S. sp.</i> vs. Controls aOR
> 5 Admissions in past year	2.82 (0.75, 10.64)	4.21 (1.54, 11.52)
Chemotherapy	2.97 (1.26, 7.04)	2.78 (1.40, 5.51)
Antimicrobials	2.27 (1.02, 5.04)	-
Chronic Skin Disease/Wound	6.30 (1.73, 22.99)	4.40 (1.31, 14.77)
Urinary Catheter on Admission	4.87 (1.53, 15.53)	2.53 (0.85, 7.49)
Surgery in last 30 days	0.86 (0.09, 8.30) *	7.74 (1.45, 41.22)
Loss of Skin Integrity on Admin	2.92 (1.22, 6.98) *	1.54 (0.64, 3.72) *
Chronic Renal Insufficiency	3.31 (0.08, 13.22) *	5.52 (1.39, 22.02) *
Antibiotics in the past 30 days	1.13 (0.24, 5.34) *	1.05 (0.26, 4.29) *

* Considered but not included in final model

aOR- adjusted odds ratio.