



Risk factors for methicillin-resistant *Staphylococcus aureus* in patients with community-onset and hospital-onset pneumonia

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Received 19 December 2012; accepted 3 May 2013

Available online 4 June 2013

KEYWORDS

Community-acquired pneumonia;
Healthcare-associated pneumonia;
Methicillin-resistant *Staphylococcus aureus*;
Nosocomial pneumonia

Summary

Objectives: The risk factors for methicillin-resistant *Staphylococcus aureus* (MRSA) pneumonia have not been fully characterized and are likely to be different depending on whether infection is acquired in the community or the hospital.

Methods: We conducted a case-control study of 619 adults hospitalized between 2005 and 2010 with either MRSA or methicillin-sensitive *S. aureus* (MSSA) pneumonia. Patients with a respiratory culture within 48 h of hospitalization had community-onset pneumonia whereas patients with a culture collected after this time point had hospital-onset pneumonia.

Results: Among patients with community-onset disease, the risk for MRSA was increased by tobacco use (OR 2.31, CI 1.23–4.31), chronic obstructive pulmonary disease (OR 3.76, CI 1.74–8.08), and recent antibiotic exposure (OR 4.87, CI 2.35–10.1) in multivariate analysis while patients with hospital-onset disease had an increased MRSA risk with tobacco use (OR 2.66, CI 1.38–5.14), illicit drug use (OR 3.52, CI 2.21–5.59), and recent antibiotic exposure (OR 2.04, CI 3.54–13.01). Hospitalization within the prior three months was associated with decreased risk (OR 0.64, CI 0.46–0.89) in multivariate analysis.

Conclusions: This study suggests there are common and distinct risk factors for MRSA pneumonia based on location of onset. The decreased risk for MRSA pneumonia associated with recent hospitalization is unexpected and warrants further investigation.

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Summary: This case-control study showed that there are common and distinct risk factors associated with MRSA pneumonia depending on whether the infection onset is in the hospital or in the community. Recent hospitalization was unexpectedly shown to be associated with decreased risk for MRSA pneumonia and warrants further investigation.

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Introduction

Methicillin-resistant *Staphylococcus aureus* (MRSA) is an important cause of both hospital-onset and community-onset pneumonia, associated with increased morbidity and use of healthcare resources compared to infections caused by nonresistant strains.^{1–3} Historically, this infection was confined largely to the healthcare setting and was associated with specific risk factors including recent hospitalization, recent intravenous antibiotics, residence in a long-term care facility, dialysis, and indwelling percutaneous catheters.^{4,5} However, over the past decade, community-onset MRSA infections in patients without traditional risk factors have emerged.⁶ Although initially microbiologically and clinically distinct, the boundaries between hospital-onset and community-onset MRSA infections have become blurred, with increasing evidence that community MRSA has spread into the hospital setting.^{7,8} Moreover, the ability to distinguish these infections and their risk factors has become increasingly difficult.^{7–9}

Predicting which patients with pneumonia are at risk for MRSA infection is important since delay in appropriate antibiotics may result in increased mortality and morbidity while overuse of empirical broad-spectrum antibiotics can create multidrug-resistant organisms and contribute to antibiotic-related complications.^{10–12} The risk factors for MRSA pneumonia, however, have not been fully described and are likely to be different depending on whether infection onset is in the community or in the hospital.^{8 13 14} We conducted a case-control study to determine which risk factors increase the likelihood of MRSA pneumonia amongst patients with *S. aureus* pneumonia. Additionally, we carried out an *a priori* subgroup analysis to determine which risk factors were associated with MRSA pneumonia in patients with community-onset and hospital-onset *S. aureus* pneumonia.

Methods

Study subjects

We studied adult patients 18 years of age and older who were hospitalized at San Francisco General Hospital between 2005 and 2010 who had either an MRSA or MSSA respiratory culture (obtained from sputum, tracheal aspirate, bronchoalveolar lavage, or pleural fluid sampling). Patients were admitted to a variety of services (Internal Medicine, Surgery, Family Medicine) and to all levels of care within the hospital (ICU, step-down, floor).

Inclusion criteria

Using modified definitions from the CDC criteria for healthcare-associated infections, patients with a *S. aureus*

respiratory culture who had at least three out of four clinical features of pneumonia (fever, leukocytosis, cough, and/or opacity on chest X-ray) and/or had a diagnosis of pneumonia documented in their discharge summary were included. Cases were defined as patients with the features listed above and a respiratory culture positive for MRSA; controls were defined as patients with the features above and a respiratory culture positive for MSSA.

Exclusion criteria

Patients with a positive *S. aureus* respiratory culture but who did not meet the criteria for a diagnosis of pneumonia were excluded.

Study design

We conducted a case-control study comparing patients with MRSA pneumonia to those with MSSA pneumonia through a retrospective chart review. We collected data on demographic features (age, sex, race), homelessness, health-related behaviors (any history of tobacco use, alcohol use, or illicit drug use), healthcare-associated features (hospitalization at our facility in the past three months and receipt of antibiotics or steroids as an inpatient at our facility in the past three months), major medical comorbidities as determined by ICD-9 coding, admission to the ICU, and death at 30 days from diagnosis. We were unable to obtain data regarding whether patients had been hospitalized at another facility other than our hospital within the past 90 days. We also determined whether patients had community-onset pneumonia (defined as having a positive respiratory culture sent within 48 h from hospitalization) or hospital-onset pneumonia (defined as having a positive respiratory culture sent after 48 h from admission). Data on pathogen strain typing and susceptibility patterns were not available.

Data analysis

We performed bivariate (Fisher's exact and Chi-square) and stratified multivariate analyses. All variables that were statistically significant in bivariate analysis or potentially important with respect to risk for MRSA were included in logistic regression analyses. All data were analyzed with STATA version 9.2.

Results

There were 1143 patients with respiratory cultures positive for *S. aureus* between 2005 and 2010. Of these, 619 patients met criteria for a diagnosis of *S. aureus* pneumonia based on the criteria described above. The majority of

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