



Outcome of Invasive Methicillin-resistant *Staphylococcus aureus* Infections in Children: Mother-to-Infant Transmission

Jonathan Cogen MD, MPH, Xiaoyan Song, PhD, MBBS & Nalini Singh, MD, MPH
Children's National Medical Center, The George Washington University Medical Center, Washington, D.C.



THE GEORGE
WASHINGTON
UNIVERSITY
MEDICAL CENTER
WASHINGTON, D.C.

Abstract

Background: Methicillin-resistant *Staphylococcus aureus* (MRSA) is an important pathogen. Its spread throughout the community is of great concern. MRSA infections in neonates and young infants are associated with significantly increased morbidity and mortality.

Objective: The purposes of this study are to characterize pediatric patients with invasive MRSA infections, to determine variables that are associated with death, and to describe two cases of mother-to-infant transmission of MRSA infections.

Methods: This retrospective, observational study included patients who were admitted to a large pediatric center in Washington DC between 2006 and 2010 and had invasive MRSA infections. Medical charts were reviewed to extract additional information on the patients. Genetic analyses (DiversiLab™, bioMerieux Inc) were performed on viable strains. Descriptive analyses were performed to describe characteristics of patients with invasive MRSA infections. Unadjusted regression analyses were conducted to determine independent predictors of death.

Results: Over the 5-year study period, 3,348 individual patients were diagnosed with MRSA infections. Of these, 116 (3.5%) patients had an invasive infection. Samples for 53 patients (45.7%) were available for genetic typing. The all-cause mortality rate in this population was 14.7% and factors such as age, resistance pattern, acquired infection-type, and history of surgery during admission were independently associated with death. Two cases of mother-to-infant transmission of MRSA infections were found in the cohort.

Conclusions: This study described a large pediatric cohort of patients with invasive MRSA infections, and revealed that the USA 300 strain accounted for a large proportion of the invasive infections. The improved knowledge of the epidemiologic and molecular characteristics of invasive MRSA infections can further aid in the development of preventative regimens and influence treatment decisions.

Introduction

- Almost 19,000 people die every year in the United States from active MRSA infections
- In 2003, 64.4% of hospital-onset *S. aureus* infections were methicillin-resistant in US intensive care units
- Because of this considerable disease burden, knowledge of the epidemiologic and molecular characteristics of MRSA infections can aid in the development of preventative regimens such as vaccines and influence treatment decisions

Objectives

- To describe the population of patients with invasive MRSA Infections at Children's National Medical Center (CNMC) from 2006-2010
- To determine variables that are associated with death in patients with invasive MRSA Infections
- To describe the genetic pattern of the MRSA isolates
- To describe two cases of mother-to-infant transmission of MRSA Infections

Methods

Study Setting and Population: This study was conducted at CNMC, and included patients with invasive MRSA infections verified by positive culture. An infection was considered invasive if found in sterile sites including blood, cerebrospinal, pleural, pericardial, and peritoneal fluid, joint/synovial fluid, bone, and surgical sites of clean procedures.

Study Design: This was a retrospective, observational study. Death was the primary outcome variable studied. Differences between patients who survived and died in this cohort were assessed for potential variables that may be associated with death.

Statistical Analysis: Descriptive analyses were performed to describe characteristics of invasive MRSA infections. Regression analyses were performed to further examine the association between death and the study variables. All statistical analyses were performed using SAS 9.1.3 (SAS Institute Inc., Cary, North Carolina).

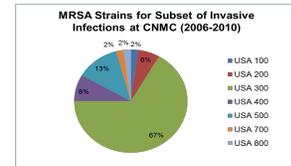
Results

- From 2006-2010, 3,348 individuals were diagnosed with MRSA infections
- Invasive infections accounted for 3.3% of all MRSA infections in the study period. By year: 2006 (3.49%), 2007 (4.01%), 2008 (3.45%), 2009 (1.72%), 2010 (3.30%)
- The sources of invasive infection included primary bacteremias (31.8%), musculoskeletal infections (22.4%), skin abscesses (19.8%), pneumonias (13.8%), cerebrospinal fluid (4.3%), peritoneal fluid (2.6%), endocarditis (2.6%), surgical site infections (1.7%) and liver abscesses (0.8%)
- 1:1 M:F ratio; for ethnicity, 65.7% were described as African-American, 11.1% Caucasian, 8.3% Hispanic, and 12.2% classified as Other/Unknown

Descriptive Statistics and Relative Risk (RR) for Study Variables

Variable	Died (N=17)	Survived (N=99)	%Died	Unadjusted RR	Unadjusted CI
Gender				1.07	0.66 - 1.75
Male	9	49	15.5%		
Female	8	50	13.8%		
Age					
0-28 Days	4	11	26.7%	2.07	0.78 - 5.52
28 Days - <1 Year	10	32	23.8%	1.82	1.12 - 2.97
1-4 Years	2	22	8.3%	0.53	0.14 - 2.05
5-18 Years	1	34	2.9%	0.17	0.03 - 1.17
Hospital-Acquired (HA) vs Community-Acquired (CA)				1.63	1.22-2.19
Hospital-Acquired	14	50	21.9%		
Community-Acquired	3	49	5.8%		
Resistance Pattern (R,S) (R,R) (S,S)				2.54	1.69 - 3.76
(R,S) (R,R)	13	30	30.2%		
(S,S)	4	69	5.5%		
History of MRSA Colonization				1.85	0.94 - 3.65
Yes	7	22	24.1%		
No	10	77	11.5%		
History of Surgery within 1 Year Prior to Admission				1.17	0.45 - 2.99
Yes	4	20	16.7%		
No	13	79	14.1%		
History of Surgery During Admission				1.87	1.08 - 3.24
Yes	9	28	24.3%		
No	8	71	10.1%		

Note: relative risks (RR) in bold indicate statistically significant differences for the study variable between patients who survived and patients who died. S,S signifies sensitivity to both clindamycin and trimethoprim-sulfamethoxazole. R,S denotes resistance to clindamycin and sensitivity to trimethoprim-sulfamethoxazole, while R,R signifies resistance to both antibiotics.



Mother-to-Infant Transmission Dendrogram



Conclusions

- In conclusion, this study described a large pediatric cohort of patients with invasive MRSA infections.
- In addition, the USA 300 strain accounted for the largest proportion of invasive MRSA infections.
- The improved knowledge of the epidemiologic and molecular characteristics of invasive MRSA infections can aid in the development of preventative regimens and possibly influence treatment decisions

Selected Bibliography

1. Kallen AJ, Mu Y, Bulens S, et al. Health care-associated Invasive MRSA Infections, 2005-2008. Journal of the American Medical Association. 2010; 304(6): 641-8.
2. Klevens MR, Morrison MA, Nadie J, et al. Invasive Methicillin-Resistant *Staphylococcus aureus* Infections in the United States. Journal of the American Medical Association. 2007; 298(15):1763-1771.
3. Song X, Perencevich E, Campos J, et al. Clinical and Economic Impact of Methicillin-Resistant *Staphylococcus aureus* Colonization or Infection on Neonates. Infection Control and Hospital Epidemiology. 2010; 31:177-182.

Contact Information

Nalini Singh
nsingh@childrensnational.org