**Staphylococcus aureus** Antimicrobial Susceptibility of Abscess Samples from Adults and Children from the Kaleida Health System in Western New York State, 2003 to 2006

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Received 5 June 2008/Returned for modification 5 March 2009/Accepted 12 February 2010

**Staphylococcus aureus** is the most common etiologic agent of skin abscesses. The regional rate of methicillin-resistant *S. aureus* (MRSA) abscesses may reflect the prevalence of local community-acquired MRSA (CAMRSA). A retrospective study was conducted to compare the antimicrobial susceptibility patterns of *S. aureus* isolates recovered from abscesses from 2003 to 2006 from patients at hospitals of the Kaleida Health System in western New York. *S. aureus* susceptibility information was obtained from a Vitek Legacy system, and the location and source of each isolate were identified. EpInfo software was used to analyze the antimicrobial susceptibilities of all isolates and the trends in the rates of MRSA. A total of 2,848 *S. aureus* abscesses were identified by the Kaleida Health Clinical Microbiology Laboratory. Of those, 978 *S. aureus* abscess events occurred in four hospitals, including three adult facilities (547 episodes with 62 cases of bacteremia) and one children’s facility (431 episodes with 2 cases of bacteremia). The MRSA rates in adults increased from 56% (2003) to 71% (2006), and that in children increased from 26% (2003) to 64% (2006). Of the MRSA isolates in the children’s samples, more than 92% were susceptible to clindamycin. Of the MRSA isolates in the adult samples, 50% were susceptible to clindamycin in 2003 and 2004, whereas greater than 75% were susceptible in 2005 and 2006. The increased rates of MRSA abscesses with susceptibility to clindamycin may reflect the high prevalence level of CAMRSA in the western New York community. The variations in *S. aureus* susceptibilities could serve as an indicator of the changing resistance patterns within a broad urban community.

Methicillin-resistant *Staphylococcus aureus* (MRSA) has been recognized worldwide as an important health care-associated pathogen (22). More worrisome is the increasing incidence of community-acquired MRSA (CAMRSA), especially among children, young adults, and prison inmates. In some populations in the United States, MRSA accounts for greater than 60% of all *S. aureus* isolates (19, 22, 26). Emerging evidence is linking hospital strains to community-acquired strains of MRSA (4).

The recent literature shows increasing rates of MRSA colonization and serious skin and soft tissue infections in crowded environments, such as hospitals, nursing homes, sports and gymnastic training environments, and correctional and military recruiting facilities (2, 14, 16, 27, 28). Most of the cases of *S. aureus* infections described, with the exception of those in hospitals and nursing homes, are due to a new surge in CAMRSA in recent years. Most infections due to CAMRSA are described as infections of the skin and soft tissues and rarely of the bloodstream (17). CAMRSA can also cause other serious diseases, such as necrotizing pneumonitis and toxic shock syndrome, if the bacteria carry and express toxin-producing genes (7). In recent years, CAMRSA infections requiring hospital care have allowed community-acquired MRSA clones to gradually invade health care-associated settings (13, 23), such as hospitals and nursing home facilities.

It is important to know the regional trends and rates of community-acquired MRSA, so that patients with serious *S. aureus* infections will more likely receive appropriate empirical antibiotics. Initial appropriate antibiotic coverage for serious *S. aureus* infections may improve patient survival (10, 25) and, possibly, reduce the rates of occurrence of late complications of *S. aureus* infections, such as endocarditis, osteomyelitis, and septic arthritis.

Most CAMRSA infections are described as skin and soft tissue structure infections presenting as skin abscesses that require incision and drainage (11, 15, 18, 21). In 1999, Frank et al. (8) observed a high degree of correlation between CAMRSA infection and clindamycin susceptibility in 103 MRSA samples from children. Of the samples collected from children with diagnoses involving skin and skin structure infections, such as impetigo, cellulitis, wounds, and abscesses, 94% were clindamycin susceptible. Of the same samples, 87% were community acquired. Of those isolates collected from individuals without a majority of community sources of infections, the proportion of clindamycin-susceptible isolates was only 50%. The findings presented in that report suggest that the majority of CAMRSA were susceptible to this agent. Therefore, the regional rates of MRSA from abscesses with susceptibility to clindamycin may reflect the prevalence rates of local CAMRSA, and the variations in *S. aureus* susceptibility could serve as an indicator of the changing resistance patterns within a broad urban community.

**Objective.** The primary objective of the investigation described here was to study *S. aureus* abscess culture results for...
adults and children to observe the trends for CAMRSA isolates, as defined by their clindamycin susceptibilities, in the Buffalo, NY, area.

MATERIALS AND METHODS

Setting. The Kaleida Health System combines the services and resources of the Buffalo General Hospital (BGH), Millard Fillmore Hospitals—Gates Circle (MFG-G) and Millard Fillmore Hospitals—Suburban (MFH-S), the DeGraff Memorial Hospital, and the Buffalo Women and Children’s Hospital (WCHOB). Its home care division includes Advanced Home Care of Western New York and the Visiting Nursing Association of Western New York. The Kaleida Health System has more than 13,000 employees, 1,830 employees on the medical staffs, 1,828 licensed acute-care beds, 557 long-term-care beds, and 127 behavioral treatment beds. The Kaleida Health System Clinical Microbiology Laboratory handles all microbiological samples from the Kaleida Health System, Niagara Falls Memorial Hospital (Niagara Falls, NY), Lakeshore Memorial Hospital (south of the Buffalo area), various nursing homes, hemodialysis centers, and other private medical offices.

BGH is the largest hospital in western New York and is located in the downtown Buffalo area. It is the major regional tertiary referring center for all medical specialties. MFG-G is also located near downtown Buffalo. It is the regional referring center for geriatric, cardiac, and stroke care. MFH-S is a community hospital located in a suburban area (in the town of Amherst). It is a regional acute-care center for the north Buffalo region. WCHOB is the only Regional hospital designated to care for the pediatric population (individuals up to 18 years old). All four hospitals have emergency departments for urgent medical and surgical care. The study was focused on the analysis of abscess samples that cultured positive for S. aureus and with a source labeled “abcess.” The samples were from three adult hospitals and one children’s hospital (BGH, MGH-G, and MFH-S) and one children’s hospital (WCHOB).

Study design. This was a retrospective observational study, conducted from 2003 to 2006, of all cultures which were positive for S. aureus and with a source labeled “abcess.” The samples were from three adult hospitals and one children’s hospital and were sent to the Kaleida Health System Clinical Microbiology Laboratory. S. aureus identification was performed by the use of colonial morphology and latex agglutination tests (bioMerieux, Durham, NC). Antimicrobial susceptibility testing was performed with a Vitek Legacy system (bioMerieux).

Data collection. We reviewed all S. aureus abcess susceptibility reports obtained from the Vitek Legacy system. Only the first susceptibility result was selected if multiple samples from a single patient with identical susceptibilities were submitted within 1 month. Since the study was performed to observe the trends in CAMRSA incidence rates in S. aureus abcesses, those samples sent from long-term-care units and step-down units were excluded to reduce the proportion of possible S. aureus isolates originating from hospital environments. According to laboratory policy, D tests for the identification of MRSA expressing inducible clindamycin resistance in vitro (24) were performed only upon the request of clinical providers during the study period. Therefore, the test was not performed for the majority of the S. aureus abcess isolates.

Statistical analysis. Epilinfo, version 3.4.3, statistical software (CDC) was used to perform statistical analysis. A P value of <0.05 (by the Fisher exact test) was considered statistically significant.

RESULTS

From January 2003 to 31 December 2006, a total of 2,848 S. aureus abscesses were identified by the Kaleida Health System Clinical Microbiology Laboratory. Of those episodes, 547 episodes (62 [11.3%] cases of bacteremia) of S. aureus abscesses occurred in the three adult facilities and 431 episodes (2 [0.2%] cases of bacteremia) occurred in the children’s facility.

The MRSA rates in the S. aureus abcesses sent from the adult hospitals increased from 56% in 2003 to 71% in 2006, whereas those sent from the children’s facility increased from 26% in 2003 to 64% in 2006 (P < 0.05). The total number of S. aureus abcess cultures sent from the children’s facility significantly increased from 26 in 2003 to 225 in 2006 (Fig. 1). Of those S. aureus abcess cultures from adult facilities positive for MRSA, 50% were susceptible to clindamycin in 2003 and 74% were susceptible in 2006. However, more than 92% of the MRSA isolates from children were susceptible to clindamycin throughout the 4-year period (Fig. 2).

An antibiogram for the MRSA and methicillin-susceptible S. aureus (MSSA) isolates obtained from the S. aureus abcess samples from adults and children during the study period is reflected in Table 1. It shows the rates of susceptibility to commonly prescribed antibiotics, such as penicillin, cefazolin, erythromycin, clindamycin, levofloxacin, trimethoprim-sulfamethoxazole, tetracycline, gentamicin, and rifampin, for MRSA and MSSA isolates in each year (2003 to 2006). All isolates were susceptible to vancomycin and linezolid (data not listed in Table 1). All S. aureus isolates maintained a high level of susceptibility to trimethoprim-sulfamethoxazole, tetracycline, gentamicin, and rifampin.

Very low rates of susceptibility to erythromycin (6% to 15%) were observed among the MRSA isolates from both adults and children. Throughout the 4-year period, decreasing rates of susceptibility to erythromycin (from 84% to 60%) were observed in children infected with MSSA isolates; similar low rates of susceptibility to erythromycin (0% to 15%) were observed in adults infected with MRSA.

A stable low rate of susceptibility to levofloxacin (8% to 30%) of the adult MRSA isolates was also observed throughout the 4-year period; however, a decreasing rate of susceptibility to levofloxacin, from 85% in 2003 to 51% in 2006, was observed in children infected with MRSA. In children, there was a rapid increase in the incidence of levofloxacin-resistant MSSA isolates by 13% from 2005 to 2006. Interestingly, the rates of clindamycin susceptibility among isolates from adult
MRSA cases increased from 50% in 2003 to 74% in 2006. For those who had no hospitalization within the prior 60 days and for whom samples were obtained within 72 h of admission, clindamycin susceptibility rates increased from 60% (n = 63) in 2003 and 2004 to 83% (n = 125) in 2005 and 2006. For MRSA abscess samples obtained from those who had a hospital-associated history, the rates increased from 41% (n = 74) in 2003 and 2004 to 67% (n = 66) in 2005 and 2006. A high rate of susceptibility to clindamycin (92% to 100%) remained for MRSA isolates from children throughout the 4-year period. Over 90% of the MSSA isolates from both adults and children were susceptible to clindamycin.

**DISCUSSION**

Clindamycin susceptibility is a well-known surrogate marker for CAMRSA. The analysis of the susceptibility patterns, especially the patterns of susceptibility to clindamycin, of children’s *S. aureus* abscesses may be a better way to estimate regional rates of CAMRSA and has the potential to detect outbreaks of community MRSA infections. In this study, the rates of MRSA in cultures of *S. aureus* abscesses from children reflected the CAMRSA rates in the western New York region. This conclusion is based on the fact that the majority of cases of *S. aureus* abscesses were seen in the emergency department at WCHOB (6). Furthermore, more than 90% of those MRSA isolates from children were susceptible to clindamycin. The increase in the incidence of *S. aureus* isolates in the children’s hospital group (26 isolates in 2003, 225 isolates in 2006) reflects more cases of skin and soft tissue structure infections requiring incision and drainage. It is possible that an increased awareness of the high rates of CAMRSA in other pediatric hospitals might have caused providers to elect to send more clinical specimens to the Clinical Microbiology Laboratory for culture (20). We observed a disproportional increase rate of MRSA during the 4-year period of this study (from 26% in 2003 to 66% in 2006) among the pediatric population. The increased rate likely reflects the surge of CAMRSA (66%) in the western New York community over the 4-year period. One possible explanation for this disproportional increase is the emergence of multidrug-resistant CAMRSA clone USA300, although molecular typing data for confirmation of this possibility are lacking. Numerous reports have indicated that most of the upswing in the incidence of community MRSA in the United States during this study period was due to the USA300 clone (1, 11). In 2007, Faden et al. (6) reported a series of clinical and molecular characteristics of *S. aureus* skin abscesses from children from WCHOB from 12 April to 30 November 2005. Of those abscesses, all 36 strains of MRSA belonged to the USA300 clone. The higher rate of hospital admission in 2006 (data not shown) observed in the present study also suggests the involvement of the USA300 clone, which would result in an increase in the severity of infection and, thus, the need for hospital admission.

Because of the increased number of serious CAMRSA infections requiring hospital care, community-acquired MRSA clones are gradually invading hospital settings via hospital fomites, such as patient charts, door handles, and curtains (9, 12). We observed an increase in the rates of MRSA in adult *S. aureus* abscesses (from 55% in 2003 to 71% in 2006) and a
nearly parallel increase in the rate of MRSA isolates susceptible to clindamycin (from 49% in 2003 to 75% in 2006) (Fig. 2). This suggests that more adults infected with CAMRSA required hospital care, with the result being a gradual invasion of CAMRSA into the hospital environment, which may increase the proportion of MRSA isolates in hospital-acquired S. aureus infections.

Table 1 shows the antibiotic susceptibility rates for MRSA and MSSA for each potential antibiotic that could be used to treat S. aureus infections. As revealed by the high rates of MRSA over the 4-year period of the present study, traditional antibiotics, such as cephalixin, ampicillin-sulbactam, dicloxacin, and quinolones, are no longer appropriate for use for the treatment of skin and soft tissue structure infections without culture and susceptibility results. However, antibiotics such as trimethoprim-sulfamethoxazole, tetracycline, rifampin, gentamicin, and clindamycin have remained active against both MRSA and MSSA.

Rifampin and gentamicin should not be used alone to treat complicated S. aureus infections, because of the rapid development of rifampin resistance in S. aureus and the poor tissue penetration of gentamicin. In general, quinolones and tetracycline are not recommended for use for the treatment of children. Trimethoprim-sulfamethoxazole, clindamycin, and linzolid are the only oral antibiotics available for the treatment of MRSA skin and skin structure infections in children. Doxycycline is an option for older children, as CAMRSA isolates are usually susceptible to this agent (5). Use of these antibiotics in the community to treat skin and soft tissue structure infections will result in increased rates of resistance to these antibiotics in community- and hospital-acquired S. aureus infections. We observed an increase in the incidence of levofloxacin-resistant S. aureus abscesses in children. That finding may indicate that quinolone use by adults has already affected the rates of S. aureus resistance in the western New York community.

Previous reports (15, 21) have indicated that the treatment outcomes for abscesses were no different for those who received effective antibiotics than for those who did not. Those reports addressed the importance of incision and drainage for the management of S. aureus abscesses. Because incision and drainage were the most important measures for patients with S. aureus abscesses whom we studied, many cases did not require systemic antibiotic therapy, in addition to the incision and drainage.

The use of empirical antibiotic therapy has been recommended for “serious” infections in regions where the prevalence of CAMRSA is high (11), due to the potential invasiveness of CAMRSA infections. On the basis of molecular typing, CAMRSA strains causing invasive diseases have been identified in both community-onset and health care-associated infections in all surveillance areas of the United States (11). On the basis of our observations, the western New York community is no exception to the high prevalence rates of MRSA seen in other regions of the United States.

The United States Center for Disease Control and Prevention has developed strategies for the clinical management of MRSA in the community (3). Those strategies should be widely distributed to assist with the proper management of CAMRSA and to engage the whole community in efforts to prevent its spread.

ACKNOWLEDGMENTS

We thank Lynn Grucza and Qing Ma for help with the manuscript.

REFERENCES


