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Community-Associated and Health care-Associated Methicillin-Resistant *Staphylococcus aureus* in Children: A Microbiological and Epidemiological Study

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Author's contributions

This work was carried out in collaboration between all authors. All authors read and approved the final manuscript.

Short Research Article

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ABSTRACT

Aims: Novel methicillin-resistant *Staphylococcus aureus* have been causing infections in the community and are now invading hospitals. In this study we aimed to determine, using epidemiological and microbiological parameters, the characteristics of circulating *S. aureus* clinical isolates.
Methods: From July 2009 to April 2012, *S. aureus* isolates from children hospitalized in Santa Casa de São Paulo, a tertiary care-center in São Paulo, Brazil, were included. All isolates grew in cultures from sterile sites and we included only one isolate per patient.
Results: Fifty-five isolates were included during the study period, 47 from blood, six from abscesses, one from pleural fluid and one from spinal fluid. Among these isolates, 34 were methicillin susceptible *S. aureus* (MSSA) and 21 were methicillin-resistant *S. aureus* (MRSA). Eleven patients were excluded (5 MSSA and 6 MRSA) because clinical charts were not available for review, reducing the total to 29 MSSA and 15 MRSA isolates. After searching for risk factor for healthcare-associated infections, 11 of the 15 MRSA isolates were epidemiologically considered health care-associated MRSA (HCA-MRSA) and 4

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community-associated MRSA (CA-MRSA). Using the microbiological classification (multiresistance), five were considered as HCA-MRSA and 10 were CA-MRSA. Interestingly, of the 11 isolates considered as epidemiological HCA-MRSA (presence of any risk factor), six had a microbiological profile (non-multiresistant) consistent with CA-MRSA circulating clones.
Conclusion: Our results clearly show that the boundaries between CA-MRSA and HCA- are increasingly difficult to determine.

Keywords: Staphylococcus aureus; MRSA; antimicrobiotic resistance; oxacillin.

1. INTRODUCTION

Staphylococcus aureus commonly colonizes humans in different anatomical sites. Traditionally it is more frequently found in the nose. However, recent evidence suggests that oropharynx could be an even more important site of colonization [1]. Some specific populations, as cystic fibrosis patients, are more commonly colonized than the general population [2]. Depending on host and pathogen factors, *S. aureus* may cause infection. Infectious syndromes include, but are not limited to respiratory, skin and soft tissue, osteoarticular and bloodstream infections. *S. aureus* is an important etiologic agent of both community- and healthcare-associated infections [1-3].

Resistance to antimicrobial agents has complicated the treatment of *S. aureus* infections. After penicillin resistance, methicillin resistance disseminated worldwide, first in the hospitals and eventually in the community [3-6]. These new community-associated methicillin resistant *S. aureus* (CA-MRSA) clones, described originally in the 1990s, have some differences when compared to the traditional health care-associated (HCA-MRSA) clones. CA-MRSA are usually resistant to less antimicrobial agents, usually only to beta-lactams and macrolides (and increasingly to clindamycin) [3-5]. These are the phenotypical implications of the presence of different Staphylococcal cassette chromosome *mec* (SCC*mec*) types. SCC*mec* is a mobile genetic element that includes *mecA* gene, responsible for methicillin resistance in *S. aureus.* CA-MRSA most commonly carry *SCCmec* types IV or V [4-6]. Some of these clones also have a specific virulence profile, frequently producing Panton-Valentine leukocidin and other typical virulence factors [4-7].

These new clones have also been reported causing nosocomial infections, substituting, at least in part, traditional health-care associated MRSA clones. In Brazil, although CA-MRSA is still not common, clones carrying SCC*mec* IV have been increasingly found in different hospitals [8-12]. Resistance to oxacillin is common in the bacterial isolates from hospitals, varying from 30-60% [9-12]. In the present study, we aimed to characterize the *S. aureus* clinical isolates regarding their epidemiological (presence or absence of risk factors for health-care associated infections) and microbiological (antimicrobial multiresistance or non-multiresistance as a surrogate for SCC*mec* type) profiles.

2. METHODS

From July 2009 to April 2012, *S. aureus* isolates from children hospitalized in Santa Casa de São Paulo, a tertiary care-center in São Paulo, Brazil, were included. All isolates grew in cultures from previously sterile sites and we included only one isolate per patient. Bacterial identification was conducted using traditional biochemical methods (Gram stain, catalase,

coagulase and DNase) and antimicrobial susceptibility testing was performed according to current Clinical and Laboratory Standards Institute criteria [13].

Methicillin-resistant isolates resistant to four or more different classes of antibiotics were considered multiresistant (HCA-MRSA by microbiological classification), whereas isolates resistant to three or less classes were considered non-multiresistant (CA-MRSA by microbiological classification) [4-6].

Clinical charts were reviewed and searched for the presence of any risk factors for health-care associated infections, including hospitalization within the previous year, chronic disease that implicates in frequent contact (≥6/year) with hospital environment, or current hospitalization for at least 48 hours. Isolates were considered as HCA-MRSA (epidemiologically) if any of these risk factors were present, and were considered as CA-MRSA (epidemiologically) if they were all absent [4-6,9-12]. The study was approved by the institutional ethics committee.

3. RESULTS AND DISCUSSION

Fifty-five isolates were included during the study period, 47 from blood, six from abscesses, one from pleural fluid and one from spinal fluid. Regarding oxacillin resistance, 34 were MSSA and 21 were MRSA. Eleven patients were excluded (5 MSSA and 6 MRSA) because clinical charts were not available for review, reducing the total to 29 MSSA and 15 MRSA isolates.

After searching for risk factor for healthcare-associated infections, 11 of the 15 MRSA isolates were epidemiologically considered HCA-MRSA and 4 CA-MRSA. Using the microbiological classification (multirresistance), five were considered HCA-MRSA and 10 were considered CA-MRSA. Interestingly, of the 11 isolates considered epidemiological HCA-MRSA (presence of one or more a risk factors), six had a microbiological profile (non-multirresistant) consistent with CA-MRSA circulating clones.

Although these novel SCC*mec* type IV MRSA clones were first reported in the community, there is increasing evidence that they are replacing traditional hospital circulating clones [8-10]. In Brazil, the Brazilian clone (SCC*mec* type III) have been disseminated nationally in hospitals, but recent evidence shows that different clones carrying a type IV cassette are disseminating as a cause of healthcare-associated infections [11,12].

Although the number of isolates included in our study is low, and we have not performed molecular typing, phenotypic susceptibility testing served as a surrogate for the SCC*mec* type, since we have previously and consistently reported the strong correlation between these parameters [11,12]. In addition, the results in the present study clearly show that the boundaries between CA-MRSA and HCA- MRSA are increasingly difficult to determine. Nosocomial isolates cause infection in patients without risk factors and community isolates invade the hospital causing health-care associated infections. In these challenging epidemiological and microbiological situation, knowledge of local and global circulating clones is paramount to ensure the appropriate preventive and therapeutic approaches.

4. CONCLUSION

Our results clearly show that the boundaries between CA-MRSA and HCA- are increasingly difficult to determine.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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