A study of community-associated methicillin-resistant *Staphylococcus aureus* in patients with pyoderma

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ABSTRACT

Background: Health care–associated methicillin-resistant *Staphylococcus aureus* (HA-MRSA) are resistant to multiple antibiotics, therefore infections caused by them are difficult to treat resulting in high morbidity and mortality. While most of the research activities and public health initiatives are focused on HA-MRSA, the newly emerging pathogen, community-associated methicillin-resistant *Staphylococcus aureus* (CA-MRSA) is gaining in significance in respect to patient morbidity. There is a significant paucity of data regarding CA-MRSA in the developing parts of the world. **Aim:** To study the proportions of HA-MRSA and CA-MRSA infections among patients with culture-proven *S. aureus* infection and to find out how many of these patients showed presence of MRSA in nasal cultures of healthy contacts. **Materials and Methods:** Clinical details of 227 patients were recorded in the study, such as the duration and recurrence of the infection, history of antibiotic intake, and the presence of other medical illnesses. A pus swab was taken from each lesion and sent for culture and sensitivity. If the culture grew *S. aureus*, they were screened for methicillin resistance. A swab from the anterior nares of the healthy contact of each patient, whenever available, was collected and it was screened for MRSA. **Results:** Furunculosis was most common among the primary pyodermas (53/134; 39. 5%). Out of 239 pus culture samples obtained from 227 patients, 192 (84.58%) grew *S. aureus*; of these 150 (78.12%) were methicillin-sensitive *S. aureus* (MSSA), whereas 42 (21.98%) were MRSA. Out of the 42 MRSA isolated, 33 turned out to be CA-MRSA (78%) and 9 (22%) were HA-MRSA. Nasal swabs of healthy contacts of 34 MRSA patients were cultured. Out of them, two grew MRSA in the culture. **Conclusion:** The isolation rate of *S. aureus* was high in our study. Furthermore, our study, although hospital based, clearly indicated the substantial magnitude of the CA-MRSA problem in the local population.

Key words: CA-MRSA, furunculosis, HA-MRSA, pyoderma, *Staphylococcus*

INTRODUCTION

Primary pyodermas tend to have a characteristic morphology and course, are caused initially by a single organism, and arise in normal skin. They are most frequently caused by coagulase-positive staphylococci or β-hemolytic streptococci. Secondary pyoderma originates in diseased skin as a superimposed condition, which results in an acute or chronic intermingling of the underlying skin disease and the infection. They may not follow a characteristic course and the role of the bacterial infection may be difficult to assess.[1]

Staphylococcus aureus is one of the most important causes of skin infection and also some times of serious fatal systemic disease. *S. aureus* shows a high rate of carrier state in the general population (anterior nares 35%, perineum 20%, axillae 5%–10%, and toe webs 5%–10%)[2] Changes in the bacterial surface receptors is the factor that is responsible for

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staphylococcal resistance against beta-lactamase resistant penicillins such as methicillin and cloxacillin.[3]

The emergence and dissemination of methicillin-resistant *Staphylococcus aureus* (MRSA) is a global concern in both health care and community settings.[4] MRSA was initially recognized as a purely health care–associated pathogen. However, its epidemiology is now changing, and it has been increasingly found in healthy individuals without conventional risk factors for MRSA acquisition.[5]

Health care–associated MRSA (HA-MRSA) is resistant to multiple antibiotics, therefore infections caused by them are difficult to treat resulting in high morbidity and mortality. Although most of the research activities and public health initiatives are focused on HA-MRSA, community-associated MRSA (CA-MRSA) is gaining significance as a newly emerging pathogen visavis patient morbidity. Most of the published reports of CA-MRSA are from the developed nations, and there is a paucity of data from the developing parts of the world.[6] Therefore there is a definite need to study the prevalence of CA-MRSA and its importance against the relatively better-known HA-MRSA in patients with pyoderma in this part of the world.

MATERIALS AND METHODS

This was a cross-sectional study conducted from November 1, 2009, to May 30, 2011, after obtaining approval from the institutional ethics committee, in accordance the Helsinki Declaration. Patients with pyoderma attending the outpatient section and admitted in the inpatient sections of, and patients referred from other departments to the Department of Dermatology were explained about the study and their participation was requested. Two hundred and twenty-seven patients of all age groups having pyoderma, primary or secondary and their healthy contacts who gave informed consent to participate were included in the study. Patients who were on systemic antibiotics in the preceding two weeks were excluded from the study. Clinical details of the patients including recurrence of the infection and the presence of other medical illnesses including diabetes, renal diseases, liver diseases, and HIV infection were recorded. Swabs from patients and their healthy contacts were sent for culture and sensitivity. The specimen was transported immediately to the microbiology laboratory.

In the microbiology laboratory a direct smear was made from the specimen on a clean, grease-free glass slide and was stained by Gram stain. The specimen was also inoculated on the blood agar and MacConkey agar and was incubated at 37°C. After overnight incubation, the culture plates were examined for any growth. The isolate was identified based on colony morphology and biochemical tests. Antibiotic susceptibility testing was performed by Kirby– Bauer disk diffusion method. If the culture grew *S. aureus* these were screened for methicillin resistance by cefoxitin (30 µg) sensitivity. A *S. aureus* isolate showing a zone of inhibition less than 20 mm for cefoxitin was considered as MRSA.

The *S. aureus* isolate was also screened for methicillin resistance by oxacillin screen agar. The medium contained 6 µg/mL oxacillin. The test isolate was spot inoculated on the oxacillin screen agar and incubated at 37°C for 24 h. If even a film of growth was present it was considered as MRSA. ATCC *S. aureus* (25923) was used as negative control and ATCC MRSA (43300) was used as positive control. Persons with MRSA infections that met all of the following criteria were considered as CA-MRSA infections:[7]

- Diagnosis of MRSA was made in the outpatient setting or by a culture positive for MRSA within 48 h after admission to the hospital
- No medical history of MRSA infection or colonization
- No medical history in the past year of:
  - Hospitalization
  - Admission to a nursing home, skilled nursing facility, or hospice
  - Dialysis
  - Surgery
- No permanent indwelling catheters or medical devices that pass through the skin into the body.

A swab from the anterior nares of one healthy contact of each MRSA patient, whenever available, was collected and screened for MRSA.

RESULTS

The parameters studied were pus culture and sensitivity, screening for MRSA, and nasal swab culture from healthy contacts.

In the present study, out of the 239 pus culture samples obtained from 227 patients, 134 (56.06%) were primary and 105 were secondary pyoderma (43.93%). The age of patients ranged from 7 months to 70 years with a mean age of 30.7 years [Table l]. In our study, pyodermas were most common in the age group of 0–10 years, more so in the first 5 years of life (18.82%).

Furunculosis was the most common primary pyoderma (39.5%), seen predominantly in the age group of 21–30 years and 31–40 yrs. Among the secondary pyodermas, eczema with secondary infection was most common (43.8%), followed by scabies with secondary infection (15.23%). Males (64.31%) outnumbered females (35.69%) in this study. There was no difference in the type of pyoderma according to gender. Out of the 105 secondary pyoderma lesions, 48 (45.71%) had a history

Table 1: Frequency (in numbers) of pyoderma in relation to age (years)

Diagnosis	0-5	6-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	Total
Bullous impetigo	9	1	1	1	0	0	0	0	0	12
Impetigo contagiosa	9	6	4	1	1	1	0	0	0	22
Folliculitis	5	0	6	10	1	0	0	0	0	22
Furunculosis	4	2	6	13	12	8	3	5	0	53
Ecthyma	3	1	3	1	0	0	0	0	0	8
Cellulitis	1	1	2	5	1	3	1	2	1	17
Lesions with secondary infection	14	7	13	14	23	14	6	10	4	105
Total	45	18	35	45	38	26	10	17	5	239

of recurrence within a year. Twenty-five out of 53 patients with furunculosis, 9 out of 22 patients with folliculitis, 9 out of 22 with impetigo contagiosa, and 8 out of 12 bullous impetigo had history of recurrences. Cellulitis and ecthyma had the least recurrences.

Out of 239 pus culture samples obtained from 227 patients, 192 (80.33%) grew *S. aureus*; of these 150 (78.12%) were methicillin sensitive *S. aureus* (MSSA), whereas 42 (21.98%) were MRSA [Table 2]. Among others, two grew *Enterococcus* species and two *E. coli,* and five grew *Streptococcus pyogenes.* A total of 15 cultures showed growth of normal flora and 23 showed no growth. Out of the 42 MRSA isolated, 33 turned out to be CA-MRSA (78.57%) and 9 (21.4%) were HA-MRSA, as per the criteria described. Of the patients from whom HA-MRSA were isolated, two were health care workers. Nasal swabs of 124 healthy contacts of patients with pyoderma, who share the same house, were taken. Nasal swabs of contacts of MSSA cases grew one MRSA and one MSSA in the culture. Nasal swabs of healthy contacts of 34 MRSA cases were obtained. Out of them two grew MRSA in the culture. One healthy contact had MRSA grown in nasal swab culture where the index patient had normal flora in culture [Table 3].

DISCUSSION

Most Indian studies show impetigo to be the most common pyoderma among children as well as adults.[8,9] A study from Mumbai showed the predominance of folliculitis (58.8%) and furunculosis (33.3%).[10] Another from Pondicherry, which included only primary pyoderma patients, found impetigo contagiosa to be the commonest.[11] Studies from India and Singapore show the frequency of primary and secondary pyodermas to be similar to that in our study.[8,12]

A study from Jodhpur shows pyodermas to be commonest in the first decade of life, similar to our study.[13] In contrast, the Singapore study showed pyodermas to be common between 10–30 years of age, possibly due to different population demographics and better economic conditions leading to a better standard of hygiene at home.[12]

A total of 25 out of 53 furunculosis patients, 9 out of 22 folliculitis patients, 9 out of 22 impetigo contagiosa patients and 8 out of 12 bullous impetigo patients gave a history of similar complaints in the past. Cellulitis and ecthyma had the least recurrences. Out of those 48 patients, 19 were known diabetics. Very few studies according to our knowledge have referred to recurrence of pyoderma. The high recurrence indicates poor compliance to treatment and possibly a high level of colonization in the community.

Most of the studies done abroad found *S. aureus* to be the commonest organism (46%–83%) isolated with varying proportions of MSSA and MRSA, except a study done only on school children, which found β-hemolytic streptococci to be the commonest causative agent.[12,14-17] In India, *S. aureus* was the commonest etiological agent (45%–81%) for primary pyodermas found either singly or in association with other organisms, followed by β-hemolytic streptococci, even in studies done on children.[8,10,13,18-21]

Analyzing individual primary pyodermas, *S. aureus* was also the commonest organism found in nonbullous impetigo,[22] bullous impetigo,[23] folliculitis, furunculosis and carbuncles, whereas erysipelas and cellulitis were usually caused by β-hemolytic streptococci.[24] A study from Pondicherry showed *S. aureus* to be the commonest strain isolated in all cases of pyoderma except in two out of three cases of ecthyma, from which β-hemolytic streptococci were isolated.[11]

Aramburu *et al*. reported 58 CA-MRSA cases , of which 41 cases (71%) had skin infection and 17 (29%) were colonised.[25] A study done by Takizawa *et al*. from Japan on 54 children (7 months to 10 years of age) with impetigo contagiosa showed 54 different strains of *S. aureus*, of which 11 strains (20.4%) were CA-MRSA. The remaining 43 strains were MSSA. Another study done by the same authors in 2004 showed 30 *S. aureus* strains from 30 children with bullous impetigo. Five strains (16.7%) were CA-MRSA and the remaining 25 strains were MSSA.[26] Katopodis *et al*. from Greece conducted a study between 2003 and 2009 in which 180 CA-MRSA were isolated out of 309 *S. aureus*

Table 2: Results of 239 pus swab cultures from the 227 patients

Bacterial growth in pus culture	No.
Methicillin-sensitive *S. aureus*	150
Methicillin-resistant *S. aureus*	42
Enterococcous	2
Escherichia coli	2
Streptococcous pyogenes	5
Normal flora	15
No growth	23
Total	239

Table 3: Nasal swab culture results of healthy contacts

Organism grown in pus culture from index patient	Organism in nasal swab of the patients' healthy contacts				Total
	MSSA	MRSA	Normal flora	No growth	
MSSA (65/150)	1	1	53	10	65
Streptococcus pyogenes (1/5)	0	0	1	0	1
MRSA (34/42)	0	2	30	2	34
Normal flora (10/15)	0	1	9	0	10
No growth (13/23)	0	0	11	2	13
Escherichia coli (1/2)	1	0	0	0	1
Total	2	4	104	14	124

MSSA: Methicillin-sensitive *Staphylococcus aureus,* MRSA: Methicillin-resistant *Staphylococcus aureus*

patients, mostly from children more than 3 months of age.[27] A Cambodian study found that 32% of the MRSA isolated were CA-MRSA. The common causes observed for CA-MRSA were over-the-counter antibiotics, substandard and overcrowded living accommodation, lack of hygiene, high frequency of staphylococcal skin sepsis in the community, frequent scratching, and insect bites.[28] In India, there are very few studies about relative importance of CA-MRSA and HA-MRSA. In a study by Shenoy *et al*., a total of 83 CA-MRSA were isolated from abscesses and other skin infections from persons without any risk factors for MRSA infection.[29] All these studies were hospital based and conducted in tertiary care centers. It is expected that tertiary care center-based studies would show a higher frequency of HA-MRSA compared with CA-MRSA, than primary care and population-based studies. Majority of these studies show MSSA to be more common than MRSA and CA-MRSA to be more common than HA-MRSA, similar to our study. Probably a community-based study will show an even higher frequency of CA-MRSA vis-à-vis HA-MRSA.

In a study done by Lamoro-Cordoso *et al*. from Brazil comprising 1192 children, nasal swabs were cultured and 371 were *S. aureus* and of those, 14 were MRSA.[30] A study done by Dudareva *et al*. among 232 asylum seekers in Germany who were screened for MRSA by nasal swab; five nasal swabs showed MRSA.[31] Stevens *et al*. from Alaska did a study on 316 patients of whom 32 had *S. aureus* skin infection, 90 had no history of skin infection and 194 were household members (healthy contacts) of patients. Nasal swabs were taken for culture and showed that 13% had MRSA, 26.9% had MSSA, and 60.1% were not colonized with *S. aureus*. The patients were observed for skin infections for three consecutive years and it was found that patients who developed MRSA in their nasal swab had more chances of developing skin infections than MSSA and non-*S. aureus* infected patients.[32] A case–control study from Nan province in Thailand in the year 2008 showed that neonates exposed to nurses who were nasal carriers of *S. aureus* had the highest risk of illness. Three out of 34 health care workers had positive culture of *S. aureus* from their nasal swabs.[33] Chatterjee *et al*. from Chandigarh found that the overall prevalence of *S. aureus* nasal colonization was 52.3% and that of MRSA was 3.89%, indicating high rates of nasal colonization of *S. aureus* and MRSA.[34] However, studies from Brazil and Germany showed a comparatively lower rate of nasal carriage of MRSA. We found a low rate of nasal colonization of MRSA that was not significantly higher among contacts of patients of pyoderma. In fact, one healthy contact had MRSA grown in nasal swab culture whereas the patient had normal flora in culture, indicating clearly that the source of the MRSA was not the patient.

To our knowledge, very few studies have assessed the carrier state for the healthy contacts of patients with pyoderma. The inclusion of a higher number of contacts per patient could possibly have led to a better, and a statistically significant correlation. Furthermore, nasal swabs from the patients themselves would have added value to the study. Even then, our study, though hospital based, clearly indicated the substantial magnitude of the CA-MRSA problem in the population.

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Conflicts of interest

There are no conflicts of interest.

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