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Surveillance of *Staphylococcus aureus* in burn wound patients and their antibiotic sensitivity patterns

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Abstract

Background: Burns provide a suitable site for bacterial multiplication and are more persistent richer sources of infection than surgical wounds. *Staphylococcus aureus* is one of the most frequently isolated pathogens in both community and hospital practices. The objective of this study was to address the prevalence and antibiotic susceptibility patterns of *S. aureus* isolated from burn wound infections in IMS and SUM Hospital, Bhubaneswar, Odisha, India.

Methods: This study was Cross-sectional, prospective study conducted from March 2014 to May 2015. Burn wound pus sample was collected by using convenient sampling method for culture and drug sensitivity tests were performed according to the WHO standards.

Results: Out of 91 patients, bacterial infection was observed in 83.3% of which, 66 (69.5%) had *S. aureus* infection. Overall prevalence of *S. aureus* isolation was 57.8%. Most of them were sensitive to vancomycin, clindamycin, and Erythromycin, but highly resistant to penicillin G. All isolates were found to be multi drug resistant, and one isolate was resistant to all the tested drugs.

Conclusion: The current study is highly important and informative for the high level of multi-drug resistant *S. aureus* isolates in burn patients. Finally, strict consideration for *S. aureus* infection and proper usage of antibiotic policy are recommended in decreasing the incidence and occurrence of multidrug resistant *S. aureus* infections in IMS and SUM Hospital, Bhubaneswar.

Keywords: *Staphylococcus aureus*, burn wound infection, drug sensitivity, Antibiotic resistant.

Introduction

Despite many advances in burn wound care, infection over the burnt area leading to septicemia still accounts for about 75% of all deaths in burn patients. Infection on burns is also an important factor in the prolongation of hospitalization and delay in skin grafting. Bacterial isolates from wounds of burn victims are known to vary with time and geographical location in every burn unit [1]. Pathogens like Candida, Enterobacter, Acinetobacter, etc., which were quite rare in the past, are being increasingly isolated from burn wounds [2]. Avascularity of the burnt area further places the organisms beyond the reach of host defense mechanism and systemically administered antibiotics. Thus, knowledge of the pattern of the organism prevailing on the burn wounds, would allow early management of imminent septic episodes with empirical systemic antibiotic. The present study was undertaken to establish the type of aerobic bacterial infection on burn wounds and determine the changing pattern of infection according to the duration of hospital stay.

Burn wounds are a suitable site for multiplication of bacteria and are more persistent richer sources of infection than surgical wounds, mainly because of the larger area involved and longer duration of patient stay in the hospital [3]. Infection is a major cause of morbidity and mortality in hospitalized burn patients [4]. It is estimated that about 75% of the mortality following burn injuries is related to infections rather than osmotic shock and hypovolemia [5]. Microorganisms are still transmitted to the burn wound surfaces of recently admitted patients by the hands of personnel, by fomites, and to some extent by hydrotherapy. The common pathogens isolated from burn wounds are *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Streptococcus pyogenes* and various coilform bacilli [6]. *Staphylococcus aureus* was frequently isolated pathogen in both community and hospital practices. The pattern of antimicrobial susceptibility of *S. aureus* and other organisms is a worldwide change, especially in developing countries making antimicrobial agents increasingly less effective [7]. The frequency of multiple antimicrobial resistances is increasing throughout. Infections with multi drug resistant pathogens whether in hospitals or in the community increase morbidity,

decrease treatment success, reduce hospital turn-over rate and increase cost of patient care. The presence of drug resistant bacteria in the hospital environment and in patients is a great threat for public health and because of the ever increasing member of resistant strains with time, updated information on prevalence of local major pathogens and their sensitivity patterns is very helpful for health personnel responsible in the management of patients and monitoring the emergence of resistant bacteria in any given region. More than 90% of *S. aureus* produce penicillinase and are resistant to penicillin [8]. *S. aureus* is normal flora in nasal vestibule and other skin sites, especially anus and armpits of human population. Burn patients have lost their primary barrier and exposed to microorganism invasion continually and chronically in the pathogens. The dominant flora of burn wounds during hospitalization changes from Gram-positive bacteria such as *Staphylococcus* to Gram-negative bacteria like *Pseudomonas aeruginosa* [9]. However, different studies have shown that *Staphylococcus aureus* is one of the greatest causes of nosocomial infection in burn patients. The resistance of the hospital strains of *S. aureus* to methicillin remains a global problem [10]. Therefore; the aim of this study was to address the prevalence and antibiotic resistance patterns of *S. aureus* isolated from burn wound infections at IMS & SUM Hospital, Bhubaneswar, Odisha, India.

Materials and methods

This study was undertaken in IMS and SUM Hospital, Bhubaneswar, which is a tertiary care hospital in the capital city of Odisha. Patients admitted to the Burn unit of the hospital were included in the study. Proper history regarding the type of burn (flame, scald, electric, chemical burns) time since injury, coexisting illness or associated conditions, treatment obtained and duration of hospital stay were noted in a performa. The extent and severity of burn was examined by assessing total body surface area (TBSA) burnt as per Wallace rule of nine. Treatment protocol of the burn was established in accordance with the main international standards of treatment, including antibiotics; daily burn wound care with topical antimicrobial such as silver sulfadiazine; fluid resuscitation; nutritional support; surgical operations such as eschar excision and grafting. Basic measures of infection control such as staff hygiene, room isolation, periodic cultures from various parts of the burn unit and limitation of visitors were thoroughly maintained. The sample was collected periodically every 5th day for microbiological study, by two sterile moistened swabs, from the most infected part of the burn wound. Wound surface culture was repeatedly performed in the similar manner to assess the changing pattern of infection following hospital stay. In each sampling procedure, the bandages were removed, the remnants of topical antimicrobial agents were scraped away by normal saline and the wounds were

swabbed before washing and applying new topical antimicrobial agents. The samples were immediately transferred to the Microbiology department avoiding any delay in transport. One of them was inoculated on 5% sheep blood agar, MacConkey agar as well as to a nutrient broth media. Second swab was used for a preparation of Gram-stain for direct examination. The inoculated plates were incubated overnight at $35^{\circ}\text{C} \pm 2^{\circ}\text{C}$ and colonies obtained the following day were stained and then identified according to the standard protocol [3]. The antibiogram of each isolate was done using Kirby-Bauer disc diffusion method on Muller Hinton agar plate according to CLSI guidelines [3]. No zone of inhibition was designated as vancomycin-resistant and was further confirmed by detection of MIC by Hi comb MIC strips from Himedia labs [4]. For extended spectrum β -lactamases (ESBL) detection ceftazidime (30 μg) and ceftazidime plus clavulanic acid (30/10 μg) were placed on lawn culture of the organism on Mueller-Hinton agar and incubated overnight. Organism was considered as ESBL producer if there was a ≥ 5 mm increase in diameter of ceftazidime plus clavulanic disc and that of ceftazidime disc alone [4]. Complete blood count, liver function tests, renal function tests, electrolyte assays were repeatedly carried out to note the presence of septicemia, dehydration and organ dysfunction. Wound was examined for the presence of infection like-erythema or cellulitis, purulent discharge, graft loss, rapid eschar separation, necrosis of small blood vessels, edema and tenderness at the wound edges. Fever $>38.5^{\circ}\text{C}$, hypothermic or hyperthermia, hypotension, decreased urine output, and ileus suggested systemic progression of infection. Laboratory results like leukocytosis or leukopenia, thrombocytopenia, positive blood cultures, hyperglycemia also suggested an infected wound [5]. Results of the wound culture were interpreted according to the direct smear examination of the wound swab in concordance with clinical, biochemical and hematological profile of the patient.

Results

Age wise distribution of the samples

Out of 91 cases, maximum numbers of cases were in the age group of 21-40 and less number of cases in extreme age groups. Similarly, a maximum number of cases amongst male and female were in the same age groups. Number of female cases was recorded among children as well as in an old group. The details are given in Table 1.

Prevalence of bacterial isolates

Of 91 cases, 83 (86.46%) were positive for bacterial culture and sensitivity testing. Of the 83 positive cases, 70 (84.34%) had single etiology and 13 (15.66%) had mixed etiology. The results are given in Table 2.

Table 1: Study population with respect to age groups

Age groups in years	Male (%)	Female (%)	Number of cases (%)
<10	1 (1.1)	7 (7.69)	8 (8.79)
11-20	3 (3.3)	5 (5.49)	8 (8.79)
21-30	16 (17.58)	14 (15.38)	30 (32.97)
31-40	18 (19.78)	9 (9.89)	27 (29.67)
41-50	7 (7.69)	1 (1.1)	9 (9.89)
>50	2 (2.2)	8 (8.79)	10 (10.98)
Total	47 (51.65)	44 (48.35)	91 (100)

Table 3: Antibiotic resistant pattern of isolated pathogens

Antibiotic	Disc strength(in µg)	<i>S. aureus</i> 34 (%)
Penicillin-G	10 units	34 (100)
Ampicillin	10	33 (97.06)
Methicillin	5	23 (67.65)
Oxacillin	1	23 (67.65)
Cefoxitin	30	26 (76.47)
Vancomycin	30	7 (20.59)
Linezolid	30	4 (11.76)
Amikacin	30	15 (44.12)
Clindamycin	2	7 (20.59)
Erythromycin	15	16 (47.06)
Tetracycline	30	8 (23.59)
Co-trimoxazole	1.25/23.75	26 (76.47)
Cefotaxime	30	26 (76.47)
Cefotaxime+clavulanic acid	30/10	NT
Ceftazidime	30	28 (82.35)
Ceftriaxone	30	27 (79.41)
Cefepime	30	27 (79.41)
Gentamicin	10	NT
Ciprofloxacin	5	NT
Levofloxacin	5	NT
Nalidixic acid	30	NT
Imipenem	10	2(5.88)
Imipenem+EDTA	10/750	NT
Carbancillin	100	NT
Piperacillin+taboactum	100/10	NT
Cefoperazone+sulbactam	50/50	NT

Discussion

The burn wound is considered as one of the major health problems in the world [16]. In the present study, *S. aureus* was the most common isolate which is similar to other findings [17]. In contrast other studies reported that *P. aeruginosa* as a predominant organism [18]. This could be attributed to differences in geographical location and hygienic measures. At present, the overall prevalence of *S. aureus* infection was high compared to other bacterial isolates in this study. Similar reports were done [19]. This may be due to cross infection by the hand of the medical personnel, air and other materials but there was no significant association with age and sex.

Infection is the most important problem in the treatment of burn patients. The bacteriology of burn wounds is often polymicrobial in nature, and the presence of multidrug-resistant organisms is often associated with more severe clinical manifestations and poor response to antimicrobial therapy. Antibiotic sensitivity patterns served as a useful guideline for choosing an appropriate antibiotic. In the present study, drug resistant rate of *S. aureus* isolates was extremely high for penicillin and moderately for methicillin and polymyxin-B.

Conclusion

The present study has revealed the emergence of MDR strains of *Staphylococcus aureus* as the predominant etiological agents in burn wound infections in the hospital environment. The observations on the antibiogram and resistance pattern calls for the review of antibiotic policy and usage of combinational drugs in the management of burn wound infections. The observations on the emergence of ESBL and MBL strains are also significant and point toward the basis for antibiotic resistance pattern. The results have been compared with the available reports.

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Conflicts of interest

There are no conflicts of interest.

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