Print ISSN: 2321-6379
Online ISSN: 2321-595X
DOI: 10.17354/ijss/2016/447

Original Article

Bacteriological Profile of Burn Wounds and Their Antibiotic Susceptibility Pattern in a Tertiary Care Hospital

Sayoni Datta[1], Tapashi Ghosh[2], Devleena Sarkar[3], Nikhil Kumar Tudu[2], Tapan Kumar Chatterjee[4], Angshuman Jana[5]

[1]Postgraduate Trainee, Department of Microbiology, Bankura Sammilani Medical College, Bankura, West Bengal, India, [2]Associate Professor, Department of Microbiology, Bankura Sammilani Medical College, Bankura, West Bengal, India, [3]Student, Department of Microbiology, Vidyasagar University, Midnapore, West Bengal, India, [4]Professor, Department of Microbiology, Bankura Sammilani Medical College, Bankura, West Bengal, India, [5]Assistant Professor, Department of Microbiology, Bankura Sammilani Medical College, Bankura, West Bengal, India

Abstract

Introduction: Burn wound provides an ideal site to bacterial colonization or infection, leading to morbidity and mortality. Early identification of infection provides improved management and leads to better prognosis.

Purpose: The aim of this study was to identify the bacteriological profile of burn wounds and their antibiotic susceptibility pattern in patients admitted in the burn unit of Bankura Sammilani Medical College. A prospective study was done in the burn unit and bacteriology laboratory of the department of microbiology for 6 months.

Methods: Swabs were collected from the wounds of a total of 72 patients admitted in burn unit, after taking a thorough history and demographic data. The swabs were inoculated in appropriate culture media, and identification was done following the standard procedure.

Results: *Pseudomonas aeruginosa* (30%) and *Staphylococcus aureus* (30%) were the most common isolate from burn wounds followed by *Klebsiella* spp. (20%).

Conclusion: The finding of the study will be helpful for identifying the common bacteria causing burn wound infection and also to take proper precautions to prevent the emergence of antibiotic-resistant bacteria.

Key words: Antibiotic susceptibility, Bacteriological profile, Burn wounds, Methicillin-resistant *Staphylococcus* aureus

INTRODUCTION

Injuries and deaths due to burn are a global concern with regards to public health, accounting for an estimated 265,000 deaths annually. The majority of these occur in low- and middle-income countries and almost half occur in the WHO South-East Asia Region.[1] Approximately, 75% of deaths occur primarily because of inhalation of soot or absorption of carboxyhemoglobin in the blood, but burn wound sepsis remains an important infectious complication of burn.[2,3] In India, in the year 2013, a total of 22,177 (5.9%) deaths and 2391 injuries occurred as a result of some form of accidents due to fire. Fire accidents constituted 5.5% of the un-natural causes of accidental deaths, of which 65.7% of those killed were females who out-numbered males (34.3%).[4] The most common causes of work-related burns are contacted with chemicals or hot liquids, followed by electricity and then molten or hot metals.[5]

The primary insult from a burn is the wound itself, which has three characteristic areas of involvement.[6] The first associated area of the wound is the zone of coagulation nearest the heat source and includes dead tissue forming the burn eschar. Adjacent to this zone is the second area, known as the zone of stasis, which is viable but at risk

Access this article online

www.ijss-sn.com

Month of Submission : 06-2016
Month of Peer Review : 07-2016
Month of Acceptance : 08-2016
Month of Publishing : 08-2016

Corresponding Author: Dr. Sayoni Datta, Department of Microbiology, Bankura Sammilani Medical College, Kenduadihi, Bankura - 722 102, West Bengal, India. Phone: +91-9477142151. E-mail: drsayonidatta@gmail.com

of ischemia because of perfusion defects. The zone of hyperemia is the third area, which consists of relatively normal skin with increased blood flow and vasodilatation and minimal cellular injury. Overall, the primary concern of burn wound injuries is the moist, protein rich eschar, which is an ideal environment for microorganisms, and its avascular nature prevents immune cells and systemically administered antibiotics from being delivered.[7] Typically, the burn surface is sterile immediately following thermal injury, but after 48 h the wound is colonized with skin pathogens that typically reside in sweat glands and hair follicles before the burn.[8,9]

Risk factors for burn wound colonization or infection are the size of the burn wound, i.e., the percentage of total body surface area (TBSA) burnt and the duration of hospitalization.[10,11]

Severe burn causes a mechanical disruption of the skin allowing microbes to penetrate to the deeper tissues that act as a favorable factor for bacterial multiplication leading to infection. The organisms responsible for infections in patients with severe burns may be endogenous or exogenous and include bacteria, fungus, and viruses which can change over time in the individual patient.[12]

Microorganisms are probably transmitted to the burn wound surfaces of recently admitted patients by the hands of healthcare personnel and by fomites. The gastrointestinal tract continues to be a potential reservoir for microorganisms that colonize the burn wound surface. It is likely that endogenous microorganisms continue to be transmitted to burn wound surfaces by feces.[13] Nosocomial infection rates in burn wounds have been reported from 77 to 90 infections/100 patients or an incident density of 32-48 infections/1000 patient-days.[14] Improvements in the care of patients who suffer burns, especially initial burn shock resuscitation, airway management, burn wound care, and infection control practices has resulted in remarkably improved survival rates.[15] Outcomes appear worse with polymicrobial infections.[16]

Various bacteria can cause infection of burn wound. Historically, *Streptococcus pyogenes* was the most frequently recovered pathogen, but this has been replaced with *Staphylococcus aureus* and Gram-negative pathogens, such as *Pseudomonas aeruginosa, Klebsiella pneumoniae*, and *Acinetobacter baumannii*, with higher resistance profiles as patients stay in the hospital longer.[17-20]

There is no data regarding the bacteriological profile of burn wounds and their antibiotic susceptibility pattern in Bankura district and surrounding areas of West Bengal. The present study is undertaken to identify the bacteriological profile of burn wounds and their antimicrobial susceptibility pattern in patients admitted in Bankura Sammilani Medical College. This study will be helpful to determine the predominant microorganisms causing infection in the burn care units, and the study of their antimicrobial susceptibility pattern will help to formulate the antibiotic policy to provide relief, quick wound healing, and better management of the patients.

MATERIALS AND METHODS

This prospective study was done in the burn unit and bacteriology laboratory of the Department of Microbiology for a period of 6-months starting from 1st November 2015 to 30th April 2016. After ethical clearance, swabs were collected from a total of 72 patients admitted to burn unit. A written informed consent was taken from each patient before collecting the swab. The patients with pre-existing chronic diseases such as diabetes mellitus and tuberculosis were excluded from the study. A thorough history was taken regarding the demographic data such as age, sex, occupation, address of the patient, and mode of burn. For each patient, swabs were collected on the date of admission, and after that at 48 h interval for the duration of stay of the patient, till discharge or death of the patient. The patients, who were dead or discharged before 48 h of admission, were excluded from our study.

After removal of the bandage, the site of burn was thoroughly washed with normal saline. Remains of topical antibacterial agents used on the wound were washed. Sterile cotton swabs were smoothly rolled over the wound area aseptically, and the discharge was collected. The swabs were immediately transported to the bacteriology laboratory in sterile test tubes and inoculated without delay on MacConkey agar (HiMedia Laboratories Pvt. Ltd., Mumbai) and blood agar, using a sterile loop. After aerobic incubation at 37°C for 24 h, the Petri plates were inspected for growth of bacteria in the form of colonies. Those, which showed no colony, were noted down as no growth. The media, which showed the appearance of colonies, were processed following the standard bacteriological procedures. Colony characteristics of each type were recorded. Gram-staining was done from the colonies, and based on the findings of that, identification of bacterial isolates was done by conventional biochemical tests for identification.[21]

Antimicrobial susceptibility testing of the bacterial isolates was done by disk diffusion technique (using Kirby Bauer's method)[22] on Mueller-Hinton agar (MHA) (HiMedia Laboratories Pvt. Ltd., Mumbai) as per Clinical and Laboratory Standards Institute (CLSI) guidelines.[23]

Inoculum for each isolate was prepared by direct colony suspension in nutrient broth, the turbidity of the broth was adjusted to a 0.5 McFarland standard suspension, which contains approximately 1-4 × 10^8 colony-forming units/ml. The MHA plates were inoculated and then incubated at 37°C for overnight. On the next day, MHA plates were examined, the zone of inhibition was noted by measuring with a ruler held against the back of Petri plate and the sensitivity pattern of the bacterial isolates to various antibiotics were noted. Methicillin-resistant *S. aureus* (MRSA) strains were detected by following the CLSI guideline.[23]

The data were tabulated and statistical analyses of the data were done using SPSS Statistics 19.0 (IBM Corp. Released 2010. IBM SPSS Statistics for Windows, Version 19.0. Armonk, NY: IBM Corp.). Qualitative and quantitative data were expressed as frequency and percentage. Association between two or more qualitative variables was analyzed using Chi-square test. A two-sided $P < 0.05$ was considered to be statistically significant.

RESULTS

A total of 136 samples were collected from burn wounds of 72 patients. 120 swabs showed growth and 16 swabs showed no growth after 24 h of incubation.

Samples were collected from 55 females (76.4%) who were more affected due to burn than that of males (23.6%), who were 17 in number.

Among the patients from whom samples were collected, 33.3% (24/72) were of 21-30 years age group, 25% (18/72) were of 31-40 years age group, and 19.4% (14/72) were of 11-20 and 16.7%(12/72) were of 41-50 years age group. Patients of 10 years or less and more than 50 years were few in number which was 2.8% (2/72) each. Table 1 shows the distribution of patients according to age.

Regarding the TBSA of burn, 25% (18/72) had TBSA of burn in the range of 61-80%, 22.2% (16/72) had TBSA in between 1-20% and 21-40% each; 16.7% (12/72) and 13.9% (10/72) had TBSA of 41-60% and 81-100%, respectively.

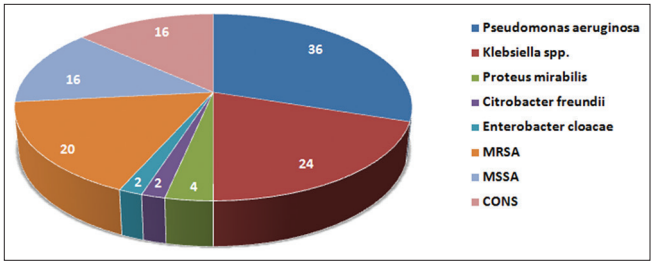
Among the bacteria isolated from burn wounds, 56.67% (68/120) was Gram-negative bacilli and 43.33% (52/120) was Gram-positive cocci. Graph 1 shows the distribution of bacteria isolated from burn wound. In the present study, *P. aeruginosa* (30%) and *S. aureus* (30%) were the most common isolates from burn wounds followed by *Klebsiella* spp. (20%). Of the 36 isolates of *S. aureus,* 20 were tested to be MRSA, and 16 were Methicillin-susceptible *S. aureus* (MSSA).

The antimicrobial susceptibility pattern of the Gram-negative and Gram-positive isolates is shown in Table 2 and Graph 2, respectively.

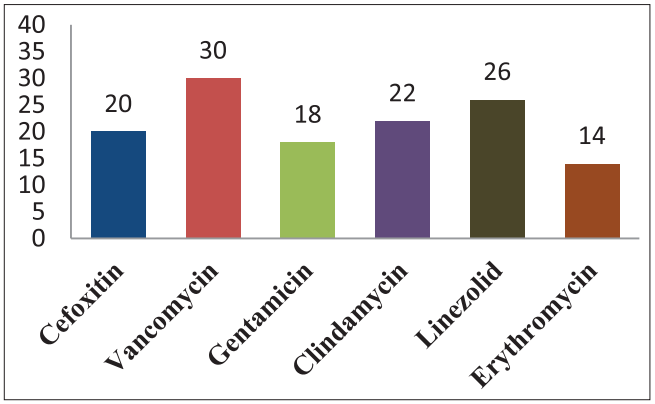
DISCUSSION

A total of 136 samples were collected for the study, of which, 120 samples showed growth. So, in this study, the overall isolation rate was 88.23% (120/136), which was near to the isolation rate of a study on burn wound infection done in Mumbai (86.28).[24]

Regarding the sex distribution of the samples collected, females (76.4%) were more in number than males (23.6%),



Graph 1: Distribution of bacterial isolates from burn wounds



Graph 2: Antimicrobial susceptibility pattern of Gram-positive bacteria isolated from burn wound of patients

Table 1: Distribution of patients according to age

Age (years)	Number of patients	Percentage
1-10	2	2.8
11-20	14	19.4
21-30	24	33.3
31-40	18	25.0
41-50	12	16.7
>50	2	2.8
Total	72	100

Table 2: Antimicrobial susceptibility pattern of Gram-negative bacteria isolated from burn wound of patients

Name of the antibiotics used	N (%)				
	Pseudomonas aeruginosa (36)	*Klebsiella* spp. (24)	*Proteus mirabilis* (4)	*Citrobacter freundii* (2)	*Enterobacter cloacae* (2)
Gentamicin	16 (44.4)	10 (41.7)	4 (100)	0	0
Polymixin B	20 (55.6)	20 (83.3)	4 (100)	2 (100)	2 (100)
Piperacillin-tazobactam	4 (11.1)	4 (16.7)	4 (100)	2 (100)	2 (100)
Levofloxacin	20 (55.6)	20 (83.3)	2 (50.0)	0	2 (100)
Meropenem	20 (55.6)	12 (50.0)	4 (100)	0	0
Netilmicin	28 (77.8)	18 (75.0)	4 (100)	0	2 (100)
Ceftazidime	20 (55.6)	20 (83.3)	4 (100)	0	0
Cefpodoxime	16 (44.4)	20 (83.3)	4 (100)	0	0

with a female to male ratio of 3.23:1. This can be attributed to females being more exposed to household fire while cooking and also suicidal and dowry deaths. This finding of female predominance in burn patients correlated with other studies done in different hospitals in India.[25,26]

The patients belonging to 21-30 years age group (33.33%) were most affected followed by age group of 31-40 years (25%). This finding may be due to the reason that most of the patients admitted to the burn unit were in this age group and also because these are the years of life more exposed to working with fire, both household and occupational.

The most of the patients who developed infection had burn of 81-100% of TBSA. Therefore, the more was the TBSA, the more was the risk of colonization and proliferation of various bacteria in burn wound.

Gram-negative bacilli (56.67%) were isolated more frequently than Gram-positive cocci (43.33%). According to the report published in various studies around the world, *P. aeruginosa* was the most common pathogen.[27-30] On the other hand, according to some other studies, *S. aureus* was the predominant organism isolated from burn wounds.[31,32] In this study, *P. aeruginosa* (30%) and *S. aureus* (30%) were equally isolated from culture of the wound swabs.

Among the isolated *S. aureus*, 55.56% (20/36) were MRSA and 44.44% (16/36) were MSSA. So, the most of the Gram-positive bacterial infections in burn wound were caused due to MRSA. This percentage of MRSA in this study was more than another study on burn wound infection, where it was shown that 39.8% isolates were MRSA.[33]

The strength of this study was that it would be helpful for better patient care in burn units, and precautionary actions to prevent the emergence and spread of resistant microorganisms can be undertaken.

The limitation of the study was that it was conducted for a short span of time; it would have been better if the study could be performed for a longer duration with a larger sample size. Furthermore, because some of the patients were dead or discharged before 7 days, we could not take another sample from them after 7 days of admission to know the bacteriological profile.

CONCLUSION

The result of the study is helpful for identifying the common causes of burn wound infections in this region. Moreover, it will be helpful to select the appropriate antibiotics in appropriate dosage to control the infection and also to prevent the emergence of antibiotic-resistant bacteria. *P. aeruginosa* and *S. aureus* were the predominant organisms in burn wound infections. According to the Centers for Disease Control and Prevention, some factors are responsible for transmission of MRSA. These factors, referred to as the 5 C's, are as follows: Crowding, frequent skin-to-skin contact, compromised skin (i.e., cuts or abrasions), contaminated items and surfaces, and lack of cleanliness.[34] High degree of occurrence of MRSA observed in this study necessitates some essential measures such as proper care of the wound, contact isolation (patients infected with MRSA), implementation of strict hospital infection control measures such as meticulous hand washing and prevention of sharing of personal items by patients, to minimize the transmission and infection of the patients in the burn unit, so as to reduce the morbidity and mortality of the patients.

REFERENCES

1. Available from: http://www.who.int/mediacentre/factsheets/fs365/en/. [Last accessed on 2016 Jun, 10].
2. Gerling I, Meissner C, Reiter A, Oehmichen M. Death from thermal effects and burns. Forensic Sci Int 2001;115:33-41.
3. American Burn Association. Burn Incidence and Treatment in the US: 2007 Fact Sheet. Available from: http://www.ameriburn.org/resources_factsheet.php. [Last accessed on 2016 Jun, 10]
4. National Crime Records Bureau. Accidental deaths and suicides in India. New Delhi: Ministry of Home Affairs, Government of India; 2013.

5. Islam SS, Nambiar AM, Doyle EJ, Velilla AM, Biswas RS, Ducatman AM. Epidemiology of work-related burn injuries: Experience of a state - managed workers' compensation system. J Trauma 2000;49:1045-51.
6. Church D, Elsayed S, Reid O, Winston B, Lindsay R. Burn wound infections. Clin Microbiol Rev 2006;19:403-34.
7. Pruitt BA Jr, McManus AT, Kim SH, Goodwin CW. Burn wound infections: Current status. World J Surg 1998;22:135-45.
8. Sharma BR. Infection in patients with severe burns: Causes and prevention thereof. Infect Dis Clin North Am 2007;21:745-59.
9. de Macedo JL, Santos JB. Bacterial and fungal colonization of burn wounds. Mem Inst Oswaldo Cruz 2005;100:535-9.
10. Wormald PJ. The effect of a changed environment on bacterial colonization rates in an established burns centre. J Hyg (Lond) 1970;68:633-45.
11. Thomsen M. The burns unit in Copenhagen. VII. Time of onset and duration of infection. Scand J Plast Reconstr Surg 1970;4:61-6.
12. Barret JP, Herndon DN. Effects of burn wound excision on bacterial colonization and invasion. Plast Reconstr Surg 2003;111:744-50.
13. Mayhall CG. The epidemiology of burn wound infections: Then and now. Clin Infect Dis 2003;37:543-50.
14. Wurtz R, Karajovic M, Dacumos E, Jovanovic B, Hanumadass M. Nosocomial infections in a burn intensive care unit. Burns 1995;21:181-4.
15. Pham TN, Cancio LC, Gibran NS. American burn association practice guidelines burn shock resuscitation. J Burn Care Res 2008;29:257-66.
16. Still JM Jr, Belcher K, Law EJ. Experience with polymicrobial sepsis in a regional burn unit. Burns 1993;19:434-6.
17. Agnihotri N, Gupta V, Joshi RM. Aerobic bacterial isolates from burn wound infections and their antibiograms - A five - year study. Burns 2004;30:241-3.
18. Altoparlak U, Erol S, Akcay MN, Celebi F, Kadanali A. The time-related changes of antimicrobial resistance patterns and predominant bacterial profiles of burn wounds and body flora of burned patients. Burns 2004;30:660-4.
19. Ressner RA, Murray CK, Griffith ME, Rasnake MS, Hospenthal DR, Wolf SE. Outcomes of bacteremia in burn patients involved in combat operations overseas. J Am Coll Surg 2008;206:439-44.
20. Oncul O, Yüksel F, Altunay H, Açikel C, Celiköz B, Cavuslu S. The evaluation of nosocomial infection during 1 - year - Period in the burn unit of a training hospital in Istanbul, Turkey. Burns 2002;28:738-44.
21. Collee JG, Miles RS, Watt B. Tests for the identification of bacteria. In: Collee G, Marmion BP, Fraser AG, Simmons A, editors. Mackie and McCartney Practical Medical Microbiology. 14th ed. London, UK: Churchill Livingstone; 1996. p. 131-49.
22. Bauer AW, Kirby WM, Sherris JC, Turck M. Antibiotic susceptibility testing by a standardized single disk method. Am J Clin Pathol 1966;45:493-6.
23. CLSI. Performance Standards for Antimicrobial Susceptibility Testing; 25th Informational Supplement. CLSI Document M100-S25. Wayne PA: Clinical and Laboratory Standards Institute; 2015.
24. Srinivasan S, Vartak AM, Patil A, Saldanha J. Bacteriology of the burn wound at the Bai Jerbai Wadia Hospital for children, Mumbai, India - A 13 - year study, Part I - bacteriological profile. Indian J Plast Surg 2009;42:213-8.
25. Gupta RK, Srivastava AK. Study of fatal burns cases in Kanpur (India). Forensic Sci Int 1988;37:81-9.
26. Singh D, Singh A, Sharma AK, Sodhi L. Burn mortality in Chandigarh zone: 25 years autopsy experience from a tertiary care hospital of India. Burns 1998;24:150-6.
27. Sharma S, Hans C. Bacterial infections in burns patients: A 3 year study at RML hospital, Delhi. J Commun Dis 1996;28:101-6.
28. Kaur H, Bhat J, Anvikar AR, Rao S, Gadge V. Bacterial profile of blood and burn wound infections in burn patients. Proc Natl Symp Tribal Health 2006:89-95.
29. Rajput A, Singh K, Kumar V, Sexena R, Singh R. Antibacterial resistance pattern of aerobic bacteria isolates from burn patients in tertiary care hospital. Indian Med 1998;19:1-4.
30. Nasser S, Mabrouk AM, Maher A. Colonisation of burn wounds in Ain Shams Univ Burns Unit. Burns. 2003;29:229-33.
31. Bhat VG, Vasaikar SD, Bauer K. Bacteriological profile and antibiogram of aerobic burn wound isolates in Mthatha, Eastern Cape, South Africa. South Afr J Epidemiol Infect 2010;25:16-9.
32. Alebachew T, Yismaw G, Derabe A, Sisay Z. Staphylococcus aureus burn wound infection among patients attending yekatit 12 hospital burn unit, addis ababa, ethiopia. Ethiop J Health Sci 2012;22:209-13.
33. Prasanna M, Thomas C. A profile of methicillin resistant Staphylococcus aureus infection in the burn center of the Sultanate of Oman. Burns 1998;24:631-6.
34. MRSA and the Workplace. The Centers for Disease Control and Prevention (CDC). Atlanta. Available from: http://www.cdc.gov/niosh/topics/mrsa/. [Last accessed on 2016 Juy, 16].

How to cite this article: Datta S, Ghosh T, Sarkar D, Tudu NK, Chatterjee TK, Jana A. Bacteriological Profile of Burn Wounds and Their Antibiotic Susceptibility Pattern in a Tertiary Care Hospital. Int J Sci Stud 2016;4(5):141-145.

Source of Support: Nil, **Conflict of Interest:** None declared.