e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2024; 16(5); 639-643

Original Research Article

Study of the Antimicrobial Resistance Pattern of Bacterial Isolates from Burn Wound Infections in a Tertiary Care Hospital, RIMS, Ranchi (Jharkhand)

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Received: 10-03-2024 / Revised: 21-04-2024 / Accepted: 25-05-2024
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Conflict of interest: Nil

Abstract

Aim: To determine the antimicrobial resistance pattern of bacterial isolates obtained from burn wound infections in a tertiary care hospital, RIMS, Ranchi.

Material and Methods: This cross-sectional study was conducted in the department of microbiology at RIMS, Ranchi, Jharkhand, India for one and half year from January 2017 to June 2018. Burn wound samples of 180 burn patients who had nosocomial infection due to burn wound with a hospitalization period of more than 48 hours were studied. Infection was diagnosed by the attending physician, according to the standard definitionof nosocomial infection of the wound. Swabs were taken on third postburn day from areas which appear deep, areas with discharge, thick eschar, etc. The bandages were removed, the remnants of the ointment were washedaway and the wounds were swabbed and cultured as follows: A sterile cotton swab was moistened with sterile normal saline. This swab was rubbed onto the burn wound surface. The swabs were then transported for culture to Microbiology laboratory.

Results: A total of 180 cases were selected for this prospective study. Out of 180 samples, 104 (57.8%) were from females and 76 (42.2%) were from males, with a mean age of 28 years and mean total body surface area of 15%. Out of 180 samples, 168 (93.3%) were culture positive and 13 (7.2%) were sterile. Single isolates were found in 148 (82.2%) samples, whereas 28 (15.5%) and 4 (2.2%) samples yielded double and triple isolates, respectively. Burn wound sampling revealed the prevalence of gram-negative bacilli 138 (76.7%) over gram-positive cocci 42 (23.3%). Pseudomonas aeruginosa 83 (46.1%) were the predominant isolates followed by Staphylococcus spp. 42 (23.3%), Escherichia coli 29 (16.1%), Klebsiella species 18 (10%), Proteus species 5 (2.7%), and Acinetobacter species 3 (1.6%). A total of 32 (17.7%) samples showed mixed bacterial growth. Among mixed isolates, Staphylococcus aureus + Pseudomonas aeruginosa were isolated in 18 samples, Coagulase-Negative Staphylococci + Pseudomonas aeruginosa in 8 samples, and E. coli + Klebsiella spp. in 6 samples. Out of the 42 gram-positive organisms, 22 (52.4%) were found to be MRSA, and the remaining 20 (47.6%) were MSSA. All the gram-positive organisms were sensitive to linezolid and vancomycin. All the MSSA strains were also sensitive to gentamicin, whereas MRSA strains showed 81.8% sensitivity to gentamicin.

Conclusion: In conclusion, *P. aeruginosa*, Staphylococci spp., and *E. coli* were the most common species causing burn infection in our hospital. Antimicrobial therapy for burn patients should cover these pathogens although the resistance of bacteria (especially gram negative species) to the studied wide spectrum antimicrobials was too high. Preventive measures to essentially avoid infections in burn wounds should be considered by the infection control committee of hospitals.

Key Words: Burn wound infections, Pseudomonas, MRSA, Antibiotics

Introduction

Burn wound infections are a significant cause of morbidity and mortality in burn patients, posing a critical challenge due to the high risk of infection from various bacterial pathogens. The emergence of antimicrobial resistance (AMR) among these bacterial isolates has further complicated the management of burn wound infections, leading to increased treatment failures, prolonged hospital

stays, and higher healthcare costs. Understanding the trends in antimicrobial resistance is essential for developing effective treatment strategies and improving patient outcomes. [1-5] One of the most notable trends during this period is the rise in resistance among Gram-negative bacilli, particularly Pseudomonas aeruginosa and Acinetobacter baumannii. Pseudomonas aeruginosa, a common pathogen in burn wounds, has shown high levels of resistance to antibiotics such as carbapenems, aminoglycosides, and fluoroquinolones. Gram-positive bacteria, such as Staphylococcus aureus, including methicillin-resistant Staphylococcus aureus (MRSA), have also shown increasing resistance trends. [6-9] The dissemination of resistance genes among bacterial populations in burn units has been facilitated by various factors, including the overuse and misuse of antibiotics, suboptimal infection control practices, and the selective pressure exerted by the hospital environment. In addition to surveillance studies, efforts to combat AMR in burn wound infections have included the implementation of antibiotic stewardship programs, improved infection control measures, and the development of novel antimicrobial agents. [10-13]

Material and Methods

This cross-sectional study was conducted in the department of microbiology at RIMS**,** Ranchi Jharkhand, India for one and half year. Burn wound samples of 180 burn patients who had nosocomial infection due to burn wound with a hospitalization period of more than 48 hours were studied. Infection was diagnosed by the attending physician according to the standard definitionof nosocomial infection of the wound[9]. Swabs were taken on third postburn day from areas which appear deep, areas with discharge, thick eschar, etc. The bandages were removed, the remnants of the ointment were washedaway and the wounds were swabbed and cultured as follows: A sterile cotton swab was moistened with sterile normal saline. This swab was rubbed onto the burn wound surface. The swabs were then transported for culture to Microbiology laboratory. In Microbiology laboratory, a Gram-stained smear was prepared and examined for bacteria and pus cells. Then the sample was inoculated on Blood agar and McConkey agar by streaking method. Cultures were incubated for 18-24 hours at 37°C and Gram stain analyses were then performed to help identifying growing colonies. Different biochemical tests such as catalase test, culture on mannitol salt agar and coagulase test for Staphylococci and sugar fermentation tests, indole test, MR test, VP test, citrate test, urease test and oxidase test were performed for identification of bacterial species[10]. Pure colonies were prepared in saline 0.85% suspension with standardturbidity of 0.5 McFarland under aseptic conditions. Then, a plate containing Mueller-Hinton Agar culture medium was smeared with the microbial suspension usinga sterile swab. Antibiotic discs were applied as per CLSI guidelines. After 24 hours of incubation at 37°C, zone of inhibitions was measured and compared with tables of clinical and laboratory standard institute (CLSI). The results were reported as sensitive, resistant andintermediately sensitive.[11]

Results

A total of 180 cases were selected for this prospective study. Out of 180 samples, 104 (57.8%) were from females and 76 (42.2%) were from males, with a mean age of 28 years and mean total body surface area of 15%. Out of 180 samples, 168 (93.3%) were culture positive and 12 (7.2%) were sterile. Single isolates were found in 148 (82.2%) samples, whereas 28 (15.5%) and 4 (2.2%) samples yielded double and triple isolates, respectively. Burn wound sampling revealed the prevalence of gram-negative bacilli 138 (76.7%) over gram-positive cocci 42 (23.3%). Pseudomonas aeruginosa 83 (46.1%) were the predominant isolates followed by Staphylococcus spp. 42 (23.3%), Escherichia coli 29 (16.1%), Klebsiella species 18 (10%), Proteus species 5 (2.7%), and Acinetobacter species 3 (1.6%). A total of 32 (17.7%) samples showed mixed bacterial growth. Among mixed isolates, Staphylococcus aureus + Pseudomonas aeruginosa were isolated in 18 samples, Coagulase-Negative Staphylococci + Pseudomonas aeruginosa in 8 samples, and E. coli + Klebsiella spp. in 6 samples.

Table 1: Organisms isolated from burn wound swabs (n=180)

Organism isolated	No. of isolates	Percentage
Pseudomonas aeruginosa	83	46.1
Staphylococcus spp.	42	23.3
Escherichia coli	29	16.1
Klebsiella spp.	18	10
Proteus spp.	5	2.7
Acinetobacter spp.	3	1.6
Total	180	100

Out of the 42 gram-positive organisms, 22 (52.4%) were found to be MRSA, and the remaining 20 (47.6%) were MSSA. All the gram-positive organisms were sensitive to linezolid and vancomycin. All the MSSA strains were also sensitive to gentamicin, whereas MRSA strains showed 81.8% sensitivity to gentamicin.

Table 2: Antibiotic Sensitivity Pattern of Gram-Positive Organisms

Antibiotic	MSSA (n=20) Isolates	MSSA Percentage	MRSA (n=22) Isolates	MRSA Percentage
Penicillin G	04	20%	00	0%
Cefoxitin	20	100%	22	100%
Gentamycin	20	100%	18	81.8%
Erythromycin	14	70%	08	36.4%
Clindamycin	12	60%	05	22.7%
Linezolid	20	100%	22	100%
Vancomycin	20	100%	22	100%

Gram-negative isolates were mostly sensitive to colistin and imipenem. The sensitivity pattern is shown in Table 3.

Table 3: Antibiotic Sensitivity Pattern of Gram-Negative Organisms

Antibiotic	P. aeruginosa (n=83)	E. coli (n=29)	Klebsiella spp. (n=18)	Proteus spp. (n=5)	Acinetobacter spp. (n=3)
Ciprofloxacin	48 (57.8%)	18 (62.1%)	7 (38.8%)	2 (40%)	1 (33.3%)
Gentamycin	74 (89.2%)	24 (82.7%)	9 (50%)	4 (80%)	3 (100%)
Ceftazidime	58 (69.9%)	20 (68.9%)	8 (44.4%)	2 (40%)	2 (66.6%)
Cefepime	52 (62.6%)	21 (72.4%)	9 (50%)	4 (80%)	2 (66.6%)
Piperacillin + tazobactam	78 (94%)	24 (82.7%)	9 (50%)	3 (60%)	2 (66.6%)
Imipenem	81 (97.5%)	28(96.5%)	16 (88.8%)	5 (100%)	3 (100%)
Colistin	83 (100%)	29 (100%)	18 (100%)	5 (100%)	3 (100%)

Discussion

Burn injury destroys the barrier function of skin, allowing microbial colonization of wounds and even with the use of topical antimicrobials, contamination of wounds is unavoidable. Nosocomial infections are higher in burn patients due to various factors like nature of burn injury, immunocompromised status of patient, invasive, diagnostic and therapeutic procedures and prolonged ICU stay. The type and amount of microorganisms on and in the injured tissue influence wound healing. The burn site remains relatively sterile during the first 24 hrs, there after colonization of the wound by Gram negative bacteria is common. In the present study, the incidence of burn wound infection was higher in females (57.8%) which correlates with Rao *et al* (56.2%) [12] and Chaudhary *et al* (53%) [13]. In India, majority of accidental burns are domestic in nature. Suicidal burns are more common among women. A large number of homicidal cases are also reported due to occurrence of dowry deaths. *Pseudomonas aeruginosa* was found to be the commonest isolate (46.1%), Mehta *et al* [14] and Rajput *et al* [15] also reported *P. aeruginosa* as the commonest isolate with rate of isolation as 51.5% and 55% respectively. In one study in 2003 on 170 burn patients in Iran, *P. aeruginosa* was the most common infecting agent of burns (54.4%), followed by coagulase-negative Staphylococcus, *S. aureus, Klebsiella* spp., and *E. coli* with 5%, 3.26%, 1.75%, and 1.25%, respectively. [16] However, few studies reported *Staph. aureus* as the commonest isolate [17,18]. Among the polymicrobial infections, the combination of *P. aeruginosa* and *S. aureus* was the commonest (50%). This is in accordance with the study conducted by Bhama et al [19]. Methicillin resistance was seen in 52.4% of Staphylococcus aureus isolates in the present study which coincides with Ekramiet al (58%) [20]. A high degree of Penicillin resistance was noted in our study. Bhama etal [19]. reported only 4 (7.40%) isolates sensitive to penicillin on the third day and 2 (5%) sensitive on the fifth day. In present study, no resistance was observed to linezolid and vancomycin which is consistent with the results of Ekrami et al [20]. Most of the strains were sensitive to gentamycin (MSSA were 100% sensitive and MRSA were 81.8%). The findings correlate with Rao et al [12]. In the present study, among the isolates of *P. aeruginosa*, 100% were sensitive to colistin, imipenem and piperacillin +tazobactam combination. The resistance of *P. aeruginosa* to antimicrobials is a serious and major problem in burn patients in hospitals. High resistance of this

bacterium to the antimicrobial agents has complicatedthe treatment of infections caused by this bacterium, and made it one of the major medical predicaments.

Limiting irrational use of wide-spectrum antimicrobials and strict management of infections in burn injury centers help in reducing the nosocomial infections due to P. aeruginosa and MRSA. The isolation of patients in individual rooms and persistent disinfection of instruments, wearing gloves by medical and nursing staff, sterile dressings and face masks and hand washing before and after visiting patientsmay prevent the spread of MRSA. The high percentage ofmultidrug resistant isolates is probably due to empirical use of broad-spectrum antibiotics. However, at the same time in instances of clinical burn wound sepsis, the success of treatment depends on prompt administration of empirical intravenous antimicrobial therapy.

Conclusion

In conclusion, *P. aeruginosa*, Staphylococci spp., and *E. coli* were the most common species causing burn infection in our hospital. Antimicrobial therapy for burn patients should cover these pathogens although the resistance of bacteria (especially gram-negative species) to the studied wide spectrum antimicrobials was too high. Preventive measures to essentially avoid infections in burn wounds should be considered by the infection control committee of hospitals. 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.

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