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Original Article

Antimicrobial Susceptibility Pattern of Bacterial Isolates in Burn Patients in a Tertiary Care Center: A Prospective Study

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Abstract

Background: Burn injuries and deaths pose a major public health concern globally, especially in developing and underdeveloped countries. As burn patients have lost their primary barrier and exposed to microorganism invasion continually and chronically, *Staphylococcus aureus* becomes one of the greatest causes of nosocomial infection in burn patients though it is a normal skin flora. The cases of antibiotic resistance have increased, and resistant species such as methicillin-resistant *S. aureus* (MRSA) provide additional challenges in the form of virulence factors. Multimodal infection control concept is required to limit the spread of infection with multidrug-resistant organism including MRSA in a burn unit. The common pathogens isolated from burn wounds are *S. aureus*, *Pseudomonas aeruginosa*, *Streptococcus pyogenes*, *Acinetobacter baumannii,* and various coliform bacilli. Hence, antimicrobial susceptibility pattern of bacterial isolates in burn patients plays a key role in the management of these patients.

Materials and Methods: This prospective observational study involved the collection of wound swabs from burn patients from June 2018 to May 2019. All patients with burn wounds irrespective of age and sex, admitted through surgery outpatient department or casualty, during the period of study were included in the study.

Results: Maximum prevalence was found for *P. aeruginosa,* i.e., 37.5% followed by *S. aureus,* for which the prevalence was found to be 18.75%. The organism least commonly cultured was *Acinetobacter*; the prevalence of MRSA was found to be 57.14% and the prevalence of methicillin resistance was found to be 42.8% in patients with *Staphylococcus epidermidis*. Overall, the prevalence of methicillin resistance was 51.72%. The drugs most effective against *P. aeruginosa*, the most common isolate, were meropenem (97.62%) and piperacillin/tazobactam (90.48%) followed by gentamicin (64.29%). Meropenem and piperacillin/tazobactam showed 100% efficacy against the other Gram-negative bacilli isolated as well. MRSA isolates showed 100% sensitivity to vancomycin and linezolid closely followed by piperacillin-tazobactam combination. *Klebsiella pneumoniae* showed 100% sensitivity to meropenem and piperacillin/tazobactam.

Conclusions: The overall isolation rate was 75%. Only solitary isolates were studied. Overall, Gram-negative organisms (66.66%) were more common than Gram-positive organisms (33.33%). *P. aeruginosa* (37.5%) was the most common isolate followed by *S. aureus* (18.75%). The prevalence of MRSA was 57.14%, but all the MRSA isolates showed 100% sensitivity to vancomycin and linezolid. On antibiotic sensitivity testing, piperacillin/tazobactam (95.24%) was found to be the most effective drug against all the organisms isolated. Meropenem (99.40%) was the most effective drug against the Gram-negative organisms. Vancomycin (100%) and linezolid (100%) were the most effective drugs for the Gram-positive organisms.

Key words: Antibiotics, Antimicrobial susceptibility, Burn injuries, Gram-negative bacilli, Gram-positive organisms, Methicillin-resistant *Staphylococcus aureus*

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INTRODUCTION

Burn injuries and deaths pose a major public health concern globally, especially in developing and underdeveloped countries. They cause the injury to the largest organ of the body which is responsible for thermoregulation, homeostasis, sensation, immunological defense, and above

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all act as a barrier against infections.[1] The exact number of burns is difficult to determine in India. Judicious extrapolation suggests that we have 7–8 lakh admissions due to burns and the projected figures suggest an annual mortality rate of 1–1.4 lakhs.[2] Burn injuries are the leading cause of disability-adjusted life years in these countries.[3]

Burn wound surface provides a favorable niche for microbial colonization and proliferation, while the avascularity of the eschar causes impaired migration of host immune cells, restricts delivery of systematically administered antimicrobial agents, and releases toxic substances that impair host immune response. The organisms responsible for infections in burn patients may be endogenous or exogenous which can change overtime in the individual patient.

Overcrowding in burn unit is an important cause of cross infection which necessitates regular monitoring of bacterial species and their antibiotic susceptibility for better management. Despite intensive therapy with antibiotics both topically and intravenous, it has been estimated that about 75% of the mortality associated with burn injuries is related to sepsis followed by shock and hypovolemia, especially in developing countries.[4]

Typically, the burn surface is sterile immediately following thermal injury, but after 48 h, the wound is colonized with skin commensals. After 1 week or so, the wounds become colonized with organisms from the host's gastrointestinal or respiratory tracts or from the hospital environment.[4] This colonization, if uncontrolled, may progress to invasion with systemic complications and death.

The common pathogens isolated from burn wounds are *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Streptococcus pyogenes*, *Acinetobacter baumannii,* and various coliform bacilli.

As burn patients have lost their primary barrier and exposed to microorganism invasion continually and chronically, *S. aureus* becomes one of the greatest causes of nosocomial infection in burn patients though it is a normal skin flora.

The cases of antibiotic resistance have increased, and resistant species such as methicillin-resistant *S. aureus* (MRSA) provide additional challenges in the form of virulence factors. Multimodal infection control concept is required to limit the spread of infection with multidrug-resistant organism including MRSA in a burn unit.

Aims and Objectives

The study was carried out at Burn unit of the Department of Surgery, Shyam Shah Medical College and Associated Gandhi Memorial Hospital and Sanjay Gandhi Memorial Hospital, Rewa, Madhya Pradesh, from June 2018 to May 2019 with the following aims and objectives:

1. To estimate the prevalence of different bacteria in wounds of burn patients
2. To study the antibiotic susceptibility pattern of the isolated bacteria including MRSA.

MATERIALS AND METHODS

This prospective observational study involved the collection of wound swabs from burn patients from June 2018 to May 2019. All patients with burn wounds irrespective of age and sex, admitted through surgery outpatient department or casualty, during the period of study were included in the study.

Inclusion Criteria

All burn patients admitted to the burn unit.

Exclusion Criteria

The following criteria were excluded from the study:

- Patients who have received previous antibiotics treatment before hospitalization
- Patients with electric and with chemical burns
- Pregnant females
- Patients who could not survive after 72 h.

Sample Collection

For the purpose of sample collection, the surface of burn wound was cleaned with normal saline to prevent contamination. Each sample was collected with a sterile cotton – tip swab stick, across the entire wound surface and the sample and was transported immediately to the laboratory for culture and sensitivity test.

The samples were processed immediately in the following manner:

a. Direct microscopic examination
b. Inoculation on different culture media
c. Preliminary identification of the growth
d. Biochemical tests
e. Antimicrobial susceptibility.

Standard microbiological techniques were used identification establishing the bacterial isolate.

Antibiotic susceptibility tests

Kirby–Bauer disk diffusion method was employed to determine the susceptibility of the bacteria isolate to antibiotics according to the standard protocols.

Data entry and analysis

The quantitative data were analyzed using descriptive statistics summarized and displayed on graphs and charts.

OBSERVATION AND RESULTS

Total admissions in the burn unit were 558. After the application of exclusion criteria, 112 swabs were obtained. Swabs were taken on days 0, 3, and 7.

Maximum prevalence was found for *P. aeruginosa,* i.e., 37.5% followed by *S. aureus,* for which the prevalence was found to be 18.75%. The organism least commonly cultured was *Acinetobacter*. Swabs were taken on days 0, 3, and 7. *Pseudomonas* was obtained in maximum number throughout, but most of the organisms were cultured maximally on day 7. About 25% of swabs were found to be negative on culture [Table 1 and Graph 1].

Among the patients in whom *S. aureus* was isolated, disk diffusion method using cefoxitin disks was used to detect MRSA. The prevalence of MRSA was found to be 57.14% and prevalence of methicillin resistance was found to be 42.8% in patients with *Staphylococcus epidermidis*. Overall, the prevalence of methicillin resistance was 51.72%.

The outcome of the wound was affected by the invasion of microorganisms. In patients with positive cultures, the complications were high as compared to patients with negative cultures [Table 2].

A total of 84 organisms were isolated and *P. aeruginosa* (42) was the most common isolate followed by *S. aureus* (21). The other isolates included *Klebsiella pneumoniae* (7), *Escherichia coli* (4), and coagulase-negative staphylococci (CoNS) (7). Overall, Gram-negative organisms were predominant accounting for 66.67% of the total isolates.

Table 1: Distribution of isolated organisms from burn wounds

Cultured organism	Day 0	Day 3	Day 7	Total	Percentage
Pseudomonas aeruginosa	5	15	22	42	37.5
Staphylococcus aureus	1	4	16	21	18.75
Staphylococcus epidermidis	-	2	5	7	6.25
Klebsiella pneumoniae	-	2	5	7	6.25
Escherichia coli	1	2	1	4	3.57
Acinetobacter	-	-	3	3	2.68
Culture negative	-	-		28	25
Total				112	100

Table 2: Distribution based on wound outcome in patients with positive cultures

Wound outcome	Culture positive but not MRSA	Percentage	MRSA	Percentage
Granulation	38	55.07	7	46.67
Hypergranulation	6	8.70	3	20
Healing	16	23.19	3	20
Contracture	9	13.04	2	13.33
Total	69	100	15	100

MRSA: Methicillin-resistant *Staphylococcus aureus*

The antimicrobial sensitivity pattern of the organisms to different antimicrobials varied depending on the isolate. The drugs most effective against *P. aeruginosa*, the most common isolate, were meropenem (97.62%) and piperacillin/tazobactam (90.48%) followed by gentamicin (64.29%). The other commonly used drugs that were tested showed moderate sensitivity in the range of 50–60%. The least effective drug was ceftazidime with 30.95% sensitivity [Table 3].

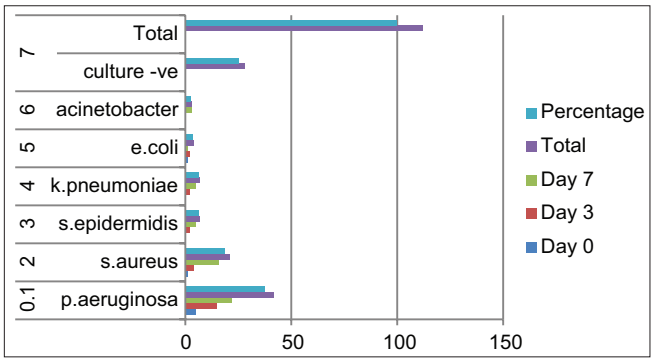
K. pneumoniae showed 100% sensitivity to meropenem and piperacillin/tazobactam. Ceftazidime and ceftriaxone followed with sensitivity of 57.14% and 28.57%, respectively. The other drugs showed high level of resistance [Table 3].

Meropenem and piperacillin/tazobactam showed 100% efficacy against the other Gram-negative bacilli isolated as well. Ceftriaxone, ceftazidime, and amikacin also showed good sensitivity against these isolates [Table 3].

Vancomycin and linezolid remained the most active drug in infections caused by Gram-positive organisms, closely followed by piperacillin/tazobactam with 95.24% sensitivity in *S. aureus* and 85.71% in *S. epidermidis*. The other drugs found to be effective against Gram-positive isolates included clindamycin (73.81%). Penicillin was least effective with a sensitivity rate of 21.43%. Others routinely used antimicrobials such as erythromycin, ciprofloxacin, amikacin, and cotrimoxazole were moderately effective [Table 4].

Methicillin resistance was tested using cefoxitin (30 ug) disk and it was found that 57.14% of *S. aureus* isolates and 42.8% of the CoNS isolates were methicillin resistant, but all the MRSA isolates showed 100% sensitivity to vancomycin and linezolid closely followed by piperacillin-tazobactam combination.

Of the total patients, 67.74% recovered with healthy wounds and were discharged. Death was reported in 29.03% of patients, whereas 3.23% of patients left against medical advice [Table 5 and Graph 2].



Graph 1: Distribution of isolated organisms from burn wounds

Table 3: Antibiotic susceptibility of Gram-negative organisms

Organism	CXM	CTR	COT	CIP	AK	GEN	MP	PIT	CAZ
Pseudomonas aeruginosa (42)									
n	NT	NT	NT	22	25	27	41	38	13
%	-	-	-	52.38	59.52	64.29	97.62	90.48	30.95
Klebsiella pneumoniae (7)									
n	0	2	0	1	0	1	7	7	4
%	0	28.57	0	14.29	0	14.29	100	100	57.14
Escherichia coli (4)									
n	1	3	0	1	2	2	4	4	2
%	25	75	0	25	50	50	100	100	50
Acinetobacter baumannii (3)									
n	NT	NT	0	1	0	1	3	3	1
%	-	-	0	33.33	0	33.33	100	100	33.33

Table 4: Antibiotic susceptibility of Gram-positive organisms

Organism	P	E	CD	LZ	VA	CIP	PIT	COT	AK	GEN
Staphylococcus aureus										
n	3	13	16	21	21	10	20	12	11	NT
%	14.29	61.90	76.19	100	100	47.62	95.24	57.14	52.38	-
Staphylococcus epidermidis										
n	2	3	5	7	7	3	6	3	4	NT
%	28.57	42.86	71.43	100	100	42.86	85.71	42.86	57.14	-

Table 5: Distribution based on patient outcome

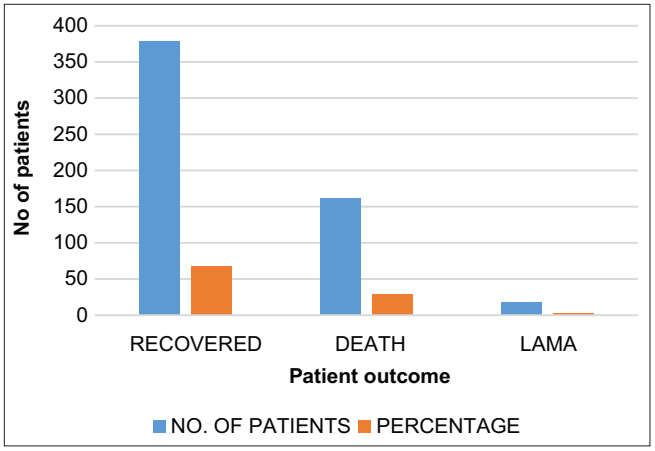
Outcome	Number of patients	Percentage
Recovered	378	67.74
Death	162	29.03
LAMA	18	3.23
Total	558	100

LAMA: Left against medical advice

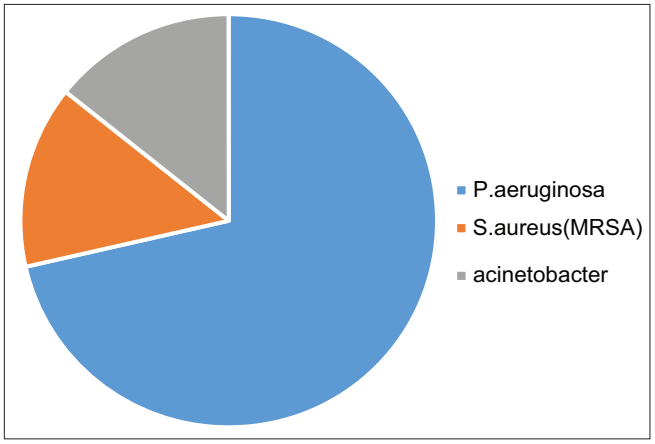
Table 6: Relation of isolated organism and patient outcome

Culture	Death	Percentage
Pseudomonas aeruginosa	5	71.42
Staphylococcus aureus (MRSA)	1	14.29
Acinetobacter	1	14.29
Total	7	100

MRSA: Methicillin-resistant *Staphylococcus aureus*



Graph 2: Patient outcome



Graph 3: Relation of isolated organism with patient outcome

Of the seven deaths reported among the culture-positive patients in this study, when correlated with the cultured organism, *Pseudomonas* was found positive in 71.42% where *S. aureus* and *Acinetobacter* were found positive in 14.29%. Infection with microorganisms was responsible for 7 (4.32%) of the total deaths (162) [Table 6 and Graphs 2 and 3.].

DISCUSSION

Bacterial infections of the burn wound still remains a major cause of morbidity and mortality in thermally injured patients. The burned patient is prey for a wide variety of microorganisms, as burns present an extensive surface

with a large mass of dead tissue and free exudation of serum which is favorable for bacterial growth. The burn site initially becomes colonized with microorganisms which if uncontrolled progresses to invasion and leads to bacteremia and sepsis, leading to mortality. For establishing the microbiological evidence, the swab culture technique was used because it is a simple, convenient, and effective.

In the present study, the overall isolation rate was found to be 75%. This was comparable with the findings of Srinivasan *et al.* (86.3%).[5] Others have reported higher isolation rates such as 95% by Kaur *et al*.[6] and 97.01% by Mehta *et al*.[7]

In our study, only solitary isolates were found. This is comparable to other studies by de Macedo and Santos,[8] Ramakrishnan *et al*., Kaushik *et al*.,[9] and Dhar *et al*.[10] who reported solitary isolation rates of 89.3%, 84%, 78%, and 58.42%, respectively.

Here, *P. aeruginosa* was the most common isolate in burn patients (37.5%). These results were similar to the results from other studies.[11-16] This is consistent with studies by Yousefi-Mashouf and Hashemi (2006). Similar finding was also reported by Dash *et al*.[17] (2013) (49.4%).

Kulkarni *et al*.[18] (2015) reported *Pseudomonas* spp. as the predominant bacteria causing burn wound infection in their study setting at Kalaburagi region in India. Agnihotri *et al*.[19] (2004) reported a high incidence of *Pseudomonas* spp. isolated in their study. *Pseudomonas* spp. (33.6%) was identified as the most common isolate in the study by Lakshmi *et al*.,[20] (2015). Similar findings on *Pseudomonas* spp. as the most common burns isolate have been reported (Ekrami and Kalantar,[21] 2007; Agnihotri *et al*.,[19] 2004).

In contrast, some other reports indicated a decrease in burn wound colonization with *P. aeruginosa*.[22] It has been opined that with the advent of antibiotics against Gram-positive organisms, a significant rise in *Pseudomonas* infection of burned patients had occurred. The prevalence of *Pseudomonas* species in the burn wards may be due to the fact that the organism thrives in a moist environment.[23,24]

The second most common isolate was *S. aureus* (18.75%), again similar to the reports from other studies.[10,23-25] This is in contrast, however, to some other studies, especially from developed countries which report *S. aureus* as the most predominant organism in burn patients.[26] *Staphylococcus* was the predominant cause of burn wound infection in the pre-antibiotic era and remains an important pathogen at present.[25] However, Srinivasan *et al.* stated that the percentage incidence of staphylococci is on the decline from 2002 to 2005.[5]

In our study, CoNS (*S. epidermidis*) were recovered at a frequency of 6.25%. This finding is similar to a study by Mama *et al.* (2014), in which they reported 14.5% CoNS isolated from wounds. CoNS being a normal skin flora and common contaminant of wound most often may be isolated[27] (Mama *et al*., 2014).

The only Gram-positive isolates were *Staphylococcus* and CoNS while Gram-negative bacteria identified were *P. aeruginosa*, *Klebsiella*, *Acinetobacter,* and Enterobacteriaceae (*E. coli*). The findings from the current study are consistent with the studies by Revathi *et al*.[28] (1998), Shahzad *et al.* (2012), Lakshmi *et al*.[20] (2015), Agnihotri *et al*.[19] (2004), Bayram *et al*.,[29] Kaur *et al*.[6] (2006), Nasser *et al*.,[30] and de Macedo and Santos.[8] Regardless of the incidence, in view of the immunocompromised status of the burned patients, it has been consistently stressed that CoNS should be considered a significant pathogen.

K. pneumoniae accounted for 6.25% of all the organisms isolated in our study. Our results were comparable with those of Kaur *et al*.,[6] Ekrami and Kalantar,[21] and Agnihotri *et al*.[18] who also reported a low incidence of this organism.

E. coli accounted for 3.57% of the total isolates. This low incidence of *E. coli* is in agreement with other studies, in which the frequency of the organism does not exceed 5%.[21] Nasser *et al.,* however, reported a higher incidence of *E. coli* (13.6%).[30] Srinivasan *et al.* stated that the prevalence of *E. coli* was on the rise from 2001 to 2004 and it has started to wean off from 2005 and 2006 in the successive years.[5]

The incidence of *Proteus* species is reported at frequencies as high as 11% to no incidence at all.[19] In our study, Proteus isolates were not obtained.

Contrary to the findings in the pre-antibiotic era, the isolation of beta-hemolytic streptococci from burn wounds has now become rare.[24] Our study is consistent with this and we found no isolate.

A. baumannii has also gained importance as an emerging nosocomial pathogen of burn wounds and is a cause for much concern due to rapid increase in resistance to a variety of antimicrobial agents.[31,32] In our study, the prevalence of *Acinetobacter* was found to be 2.68%, which is in correlation with studies conducted by Singh *et al*.[33] and Sengupta *et al*.[34]

Among the patients in whom *S. aureus* was isolated, tests were applied to detect MRSA. The prevalence was found to be 57.14% in patients with *S. aureus* infection and 42.8% in patients with *S. epidermidis*. Overall, the prevalence of MRSA was 51.72%.

According to an Indian study, the prevalence of infections caused by MRSA has increased from 12% in 1992 to 80.03% in 1999. The prevalence of MRSA infection in the study by Naqvi *et al.* was 24.6%. It is less than that reported by Mokaddas *et al.,* 1996, i.e., 74.6% and other studies conducted in Guru Teg Bahadur Hospital in New Delhi from 1997 to 2002 (Singh *et al*., 2003). Muscat, Oman, the prevalence of MRSA was about 95% during 1995–96 (Prasanna and Thomas, 1999). In another study, all isolates of *S. aureus* were resistant to methicillin at Gulhane Military Medical Academy, Istanbul, Turkey (Oncul *et al*., 2009). Authors suggested that many factors may account for increased incidence of MRSA colonization and infection. These included the use of broad-spectrum antibiotics, average length of hospital stay, and poor hospital infection control practices. A similar picture is also reflected in the present study.

The antimicrobial sensitivity testing was done by Kirby–Bauer's disk diffusion method. The drugs most effective against *P. aeruginosa*, the most common isolate, was meropenem (97.62%). *K. pneumoniae* showed 100% sensitivity to meropenem and piperacillin/tazobactam meropenem was similarly being reported by Guggenheim *et al*.[35] (2009). The current study is also consistent with findings by Bayram *et al*.[29] (2013) and Lashkmi *et al*.[20] (2015). Mundhada *et al.* (2015) reported similar findings in their study that Gram negative was susceptible to imipenem (B-lactam antibiotic) and amikacin (an aminoglycoside). Piperacillin/tazobactam (95.24%) was effective against all the isolates. Among the Gram-negative isolates, the most effective drug was meropenem showing 99.40% sensitivity. This is in accordance with a study by Guggenheim *et al.*

The drugs most effective against *P. aeruginosa*, the most common isolate, were meropenem (97.62%) and piperacillin/tazobactam (90.48%) followed by gentamicin (64.29%). The other commonly used drugs that were tested showed moderate sensitivity in the range of 50–60%. The least effective drug was ceftazidime with 30.95% sensitivity.

K. pneumoniae showed 100% sensitivity to meropenem and piperacillin/tazobactam. Ceftazidime and ceftriaxone followed with sensitivity of 57.14% and 28.57%, respectively. The other drugs showed high level of resistance.

Meropenem and piperacillin/tazobactam showed 100% efficacy against the other Gram-negative bacilli isolated as well. Ceftriaxone, ceftazidime, and amikacin also showed good sensitivity against these isolates.

Vancomycin and linezolid remained the most active drug in infections caused by Gram-positive organisms, closely followed by piperacillin/tazobactam with 95.24% sensitivity in *S. aureus* and 85.71% in *S. epidermidis*. The other drugs found to be effective against Gram-positive isolates included clindamycin (73.81%). Penicillin was least effective with a sensitivity rate of 21.43%. Others routinely used antimicrobials such as erythromycin, ciprofloxacin, amikacin, and cotrimoxazole were moderately effective.

Mehta *et al.* saw a significantly high percentage of resistance among Gram-negative bacilli to aminoglycosides, ciprofloxacin, carbenicillin, tobramycin, and ceftriaxone. However, in comparison, imipenem and combination drugs such as cefoperazone/sulbactam were found to be effective.[7]

de Macedo and Santos,[8] Singh *et al*.,[33] and Lari and Alaghehbandan[25] also reported a high degree of resistance to antimicrobial agents.

The Gram-positive isolates showed 100% sensitivity to vancomycin and linezolid followed by 94.29% sensitivity to piperacillin/tazobactam. Only 24.29% of the isolates were sensitive to penicillin.

Similar findings were seen by Lari and Alaghehbandan[25] and Kaushik *et al*.[9]

However, several other studies have observed a higher level of resistant of these organisms to these antimicrobials.

Methicillin resistance was tested using cefoxitin (30 ug) disk and it was found that 57.14% of *S. aureus* isolates and 42.8% of the CoNS isolates were methicillin resistant, but all the MRSA isolates showed 100% sensitivity to vancomycin and linezolid closely followed by piperacillin-tazobactam combination.

This is in accordance with other studies on MRSA in burn patients by Rajput *et al*.[24] and Oncul *et al*.[36] They both reported 40% incidence of MRSA. About 33.3% of the CoNS isolates were methicillin resistant. This finding is similar to that by Altoparlak *et al.* who reported 20.9% isolates of CoNS to be methicillin resistant.

Resistance to antibiotics in burn isolates reported previously has shown a gradual increase in resistance overtime as stated in their study by Agnihotri *et al*.[19] Many studies have shown that most of the organisms causing infection in burn patients are highly resistant to routinely used antibiotics as discussed by Imran *et al*.[26]

High resistance to antibiotic may be due to self-medication, inappropriate antibiotic use as a result of unavailability of guideline regarding drug selection (Mama *et al*., 2014).[27]

From the current study, it may be concluded that some of the patients may have already developed resistance to antibiotics that were administered to them. Subsequently, antibiotics administered to them prior culture may possibly affect bacteria growth and resistance. Paruk *et al.* (2012) in their study in intensive care units in South Africa reported that inappropriate antibiotics administered to patients were associated with poor patient outcome.

The resulting antibiograms give some cause for concern because the predominant bacterial isolates were relatively resistant to the commonly available, more economical antimicrobials. However, this was not entirely unexpected as hospitals are an important breeding ground for the development and spread of antibiotic resistance. This is the consequence of exposing to heavy antibiotic use, a high density of patient population in frequent contact with health-care staff, and patient attendant increase the risk of cross infection.

Relation of isolated organism and patient outcome

Of the seven deaths reported among the culture-positive patients in this study, when correlated with the cultured organism, *Pseudomonas* was found positive in 71.42% where *S. aureus* and *Acinetobacter* were found positive in 14.29%. Infection with microorganisms was responsible for 7 (4.32%) of the total deaths (162).

SUMMARY

1. The overall isolation rate was 75%. Only solitary isolates were studied. Overall, Gram-negative organisms (66.66%) were more common than Gram-positive organisms (33.33%)
2. *P. aeruginosa* (37.5%) was the most common isolate followed by *S. aureus* (18.75%), CoNS (6.25%), *K. pneumoniae* (6.25%), *E. coli* (3.57%), and *Acinetobacter* (2.68%)
3. The prevalence of MRSA was 57.14%, but all the MRSA isolates showed 100% sensitivity to vancomycin and linezolid closely followed by piperacillin-tazobactam combination. The prevalence of methicillin resistance overall among *S. aureus* and *S. epidermidis* was found to be 51.72%
4. On antibiotic sensitivity testing, piperacillin/tazobactam (95.24%) was found to be the most effective drug against all the organisms isolated
5. Meropenem (99.40%) was the most effective drug against the Gram-negative organisms. Least effective drug against Gram-negative organisms was cotrimoxazole
6. Vancomycin (100%) and linezolid (100%) were the most effective drugs for the Gram-positive organisms. Least sensitive drug against Gram-positive organisms was penicillin (21.43%).

CONCLUSIONS

To ensure early and appropriate therapy, routine microbiological surveillance and a regular update of their antimicrobial susceptibility pattern could help in prevention of the development of multidrug resistance. Among other precautions, personal hygiene of the patients and handwashing practice among health-care providers are to be emphasized and practiced routinely.

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