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# Factors Responsible for Likelihood of Invasive Burn Wound Infections with Their Bacteriological Profile and Antibiotic Suspitibility Pattern

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## Abstract

*Background:* Burn injuries constitute a major health concern with respect to morbidity and mortality. Burns are a very common injury, serious burn injuries are ex-cruciatingly painful and require special care to prevent infection and reduce the severity of scarring. *Objectives:* To determine the predominant bacterial pathogens in the burn wound infection with age, sex and cause of injury, and to know the antibiotics sensitivity profiles of the isolates obtained. *Material & Method:* Burn Patients admitted within 24 hours were included. Whereas Patients admitted after 24 hours were excluded. Two burn swabs were aseptically collected on admission before the start of antibiotics. One swab was subjected for gram staining and the other for culture. All specimens were inoculated on 5% blood agar and MacConkey agar and incubated. Isolated organisms were subjected for Antibiotic Susceptibility. *Result:* Maximum patients (50%) belonged to 21- 40 years age group. and males 39 (65%) were predominant over Female as 21 (35%), Cause of burn in Maximum number of patients was fire burn 25 (41.6 %) Among single isolates *Pseudomonas aeruginosa* was leading (20.8%) followed by *Acinetobacter baumannii* (15.4%), *staphylococcus aureus* (14.1%) and *Klebsiella pneumoniae* (7.5%). Antibiotics susceptibility pattern of gram positive bacteria showed good sensitivity to Gentamycin, Linezolid, Vancomycin, Ciprofloxacin and Clindamycin. Antibiotics susceptibility pattern of gram Negative bacteria showed good sensitivity to Imipenem, Meropenem, Tobramycin, Amikacin, Kenamycin, Cefoperazone, and Tetracycline. *Conclusion:* Microbial colonization was present right from the time of admission in the majority of swabs. The commonest organism isolated was *Pseudomonas Aeruginosa* followed by *Acinetobacter baumannii, staphylococcus aureus, Klebsiella pneumoniae, Enterobacter, Enterococcus species Escherichia coli, proteus mirabilis, CONS* and *Citrobacter species.*

**Keywords:** Burn wounds, Invasive Infection**,** Pseudomonas Aeruginosa, Antibiotic Susceptibility.

## Introduction

The skin forms a defensive barrier against incursion by bacteria, fungi and viruses; any injury to the skin therefore, causes a break in the protective layer surrounding the body [1]. Thermal burns to the skin are caused by any outer heat source. This may be in the form of an exposed fire from an open fireplace or house fire, a scald from steam, hot or molten liquid, or by direct contact with a burning object such as a hot oven rack or hot cooking pan. Other types of burns consist of radiation burns (from the sun's ultraviolet rays), chemical burns and electrical burns [2]. Burn causes immune suppression.

The burn wound has a much higher incidence of infections compared with other forms of trauma because of extensive skin barrier obliteration as well as alteration of the cellular and humoral immune responses. The dysfunction of the immune system, large cutaneous bacterial load, the possibility of gastrointestinal bacterial translocation, extended hospitalization, and persistent diagnostic and therapeutic procedures all contribute to sepsis [3].

Microorganisms colonizing the burn wound originate from the patient's remote skin and gastrointestinal and respiratory flora. Microorganisms may also be transferred to a patient's skin surface via contact with contaminated external ecological surfaces, water, fomites, air, and the soiled hands of health care workers. Immediately following injury, gram-positive bacteria from the patient's internal skin flora or the external environment predominantly colonize the burn wound. Endogenous gram-negative bacteria from the patient's gastrointestinal flora also rapidly colonize the burn wound surface in the first few days after injury [2,3].

Wound colonization by yeasts and fungi usually occurs later due to the use of broad-spectrum antibiotic therapy. Microorganisms transmitted from the hospital environment tend to be more resistant to antimicrobial agents than those originating from the patient's normal flora [4].

The increase rate of burn wound infection and sepsis is due to overcrowding (such as in developing countries), inadequate sterilization and disinfection practices, gross contamination of environment, and lack of isolation facilities, inadequate hand washing and absence of barrier nursing. Patients have to stay for long period in the hospital and many intravascular and other devices are put in them. Hence they are at greater risk of acquiring hospital-acquired infection [5].

The majority organisms which remain as causative agents of burn wound infection in any burn treatment facility change over time. Gram positive organisms are initially prevalent during hospital stay of patients; then gradually become super quantity unit by gram negative opportunists that appear to have a greater susceptibility to invade [6]. This would allow early management of looming septic episodes with empirical systemic antibiotic before the results of microbiologic culture becomes available thus improving overall infection related morbidity and mortality [7].

In addition to loss of the likely cutaneous barrier to infection, coagulated protein and other microbial nutrients in the burn wound, there is loss of vascularity of the wound leading to microbial colonization. In some patients, colonization is followed by invasion of microorganisms, giving rise to burn wound infections. After the development of effective therapy for fluid and electrolyte abnormalities caused by severe burns, infection and septicemia became the most important causes of death [8].

There should be continuous observation of burn infections and increase strategies for antimicrobial resistance control and treatment of infectious complications. Hence, the present study was under taken to establish the bacteriological profile of the burn wound infection and to formulate empirical treatment guidelines for these patients, so that mortality can be prevented.

## Material and Methods

A cross sectional study in which a total of 60 burn patients admitted in burn unit was conducted in the Department of Microbiology of Maharishi Markandeshwar Institute of Medical Science and Research (MMIMSR) Mullana, Ambala Haryana.

### *Inclusion Criteria*

Burn patients admitted within 24 hours were included.

### *Exclusion Criteria*

Burn patients admitted after 24 hours were excluded.

### *Specimen Processing*

Two burn wound swab were collected aseptically on admission before the start of antibiotics and there after weekly for a maximum period of four weeks or till the patient were discharged or expired. Two Swabs were collected from the burn area and immediately transported in a sterile test tube to the microbiology laboratory; one swab was used for the gram staining and the other for culture. Wound swabs were then subjected to microbiological analysis by Gram's staining and culture. All specimens were inoculated on 5% blood agar and Mac Conkey agar plates and incubated over night at 37$^0$C. The isolates were identified by standard microbiological techniques. All the organisms isolated were subjected for antimicrobial susceptibility testing by modified Kirby Bauer method according to CLSI guide lines.

## Results

Total no of 60 patients were taken for the study and following results were observed.

**Table 1**: Shows age wise distribution**.** Out of 60 patients that were studied, the commonest age group was 21-40 years with 30 patients (50%). The second commonest and the least common age group was 0-20 years (20%) and more than 60 years (13.3%) respectively, the youngest patient being 2 month old and the oldest being 76 years old.

| Total No. of Patients | Age | No. of Patients | Percentage (%) |
|---|---|---|---|
| | 0 – 20 | 12 | 20 |
| 60 | 21 – 40 | 30 | 50 |
| | 41-60 | 10 | 16.16 |
| | >60 | 08 | 13.3 |
| **Total** | | 60 | 100 |

**Table 2**: Shows sex wise distribution of Female patients were lesser than male patients; female being 21 (35%) and males 39 (65%).

| Total No. of Patients | Sex | No. of Patients | Percentage |
|---|---|---|---|
| N=60 | Male | 39 | 65 |
| | Female | 21 | 35 |
| Total | | 60 | 100 |

**Table 3:** Illustrates cause of burn of Maximum number of patients 25 (41.6%) suffered from fire burn. Followed by 18 (30%) were due to Electric burn and the remaining 11 (18.3%) were due to thermal burn. Fourth burn chemical 6 (10 %)

| Cause | No. of Patients | | Percentage |
|---|---|---|---|
| | Stove | Other | (%) |
| Fire | 25 | - | 41.6 |
| Electric | 18 | - | 30 |
| Chemical | 06 | - | 10 |
| Thermal | 11 | - | 18.3 |

**Table 4:** Depicts organism isolated from 240 samples from 60 burn patients. Among the total 240 swabs, single organisms were isolated in 161 samples. Mixed growth was seen in 22 samples and no growth in 57 samples. Among single isolates *Pseudomonas aeruginosa* was leading (20.8%) followed by *Acinetobacter baumannii (15.4%), Staphylococcus aureus (14.1%), Klebsiella pneumoniae (7.5%), Enterobacter (2.5%), Enterococcus (1.6%), Escherichia Coli (1.2%), Proteus (1.2%), Coagulase Negative Staphylococcus (1.2%) and citrobacter species (1.2%).*

| Isolated Organism | Pure Growth | | Mixed Growth | | Total | |
|---|---|---|---|---|---|---|
| | No | % | No | % | No | % |
| Pseudomonas Aeruginosa | 50 | 20.8 | 14 | 30.4 | 64 | 26.7 |
| Acinetobacter Baumanni | 37 | 15.4 | 11 | 23.9 | 48 | 20.0 |
| Staphylococcus Aureus | 34 | 14.1 | 05 | 10.8 | 39 | 16.2 |
| Klebsiella Pneumonia | 18 | 7.5 | 08 | 17.4 | 26 | 10.8 |
| Enterobacter Species | 06 | 2.5 | 02 | 4.3 | 08 | 3.3 |
| Enterococcus Species | 04 | 1.6 | 02 | 4.3 | 06 | 2.5 |
| Escherichia Coli | 03 | 1.2 | 01 | 2.1 | 04 | 1.6 |
| Proteus Species | 03 | 1.2 | 0 | 0 | 03 | 1.2 |
| CONS | 03 | 1.2 | 0 | 0 | 03 | 1.2 |
| Citrobacter Species | 03 | 1.2 | 03 | 6.5 | 03 | 1.2 |
| No growth | 57 | 23.7 | - | - | 57 | 23.7 |
| Mixed | - | - | 22 | | 22 | 9.1 |

**Table 5:** Percentage (%) sensitivity of gram positive bacteria

| Antibiotics | Staph Aureus | Enterococcus Species | CONS |
|---|---|---|---|
| Vancomycin | 90.9% | 100% | 66.6% |
| Azithromycin | 45.5% | 20% | 66.6% |
| Clindamycin | 27.5% | 20% | 100% |
| Ciprofloxacin | 81.8% | 100% | 33.3% |
| Gentamycin | 100% | 100% | 66.6% |
| Tetracycline | 63.6% | 60% | 33.3% |
| Gatifloxacin | 45.5% | 40% | 0% |
| Levofloxacin | 36.6% | 60% | 0% |
| Penicillin | 27.2% | 20% | 66.6% |
| Rifampicin | 9% | 0% | 0% |
| Linezolid | 100% | 100% | 90% |

**Table 6**: Shows the Antibiotics susceptibility pattern of gram negative bacteria a total 44 samples isolates that were 100% sensitive to Gentamycin and Linezolid, Vancomycin, Ciprofloxacin and clindamycin

| Antibiotics | Pseudomonas Aeruginosa | Acinetobacter Baumanni | Klebsiella Pneumoniae | Enterobacter Species | Escherichia Coli | Proteus Species | Citrobacter Species |
|---|---|---|---|---|---|---|---|
| Gentamicin | 72.7% | 27.7% | 33.3% | 66.6% | 66.6% | 100% | 100% |
| Ampicillin | 80% | 38.8% | 11.1% | 33.3% | 33.3% | 100% | 50% |
| Amikacin | 90% | 90% | 100% | 83.3% | 100% | 100% | 100% |
| Cefoperazone | 70% | 16.6% | 16.6% | 50% | 33.3% | 100% | 50% |
| Ciprofloxacin | 76.8% | 11.1% | 22.2% | 66.6% | 66.6% | 100% | 50% |
| Levofloxacin | 45% | 11% | 5.5% | 16.6% | 66.6% | 100% | 50% |
| Imipenem | 95% | 33.3% | 27.7% | 66.6% | 100% | 100% | 100% |
| Meropenem | 90% | 27.7% | 33.3% | 83.3% | 100% | 100% | 100% |
| Chloramphenicol | 81.8% | 22.2% | 11.1% | 66.6% | 66.6% | 100% | 50% |
| Kanamycin | 90% | 33.3% | 11.1% | 33.3% | 100% | 100% | 50% |
| Tetracycline | 90% | 95% | 16.6% | 66.6% | 66.6% | 0% | 50% |
| Tobramycin | 90% | 66.6% | 44.4% | 50% | 66.6% | 0% | 50% |

## Discussion

Burn injuries constitute a major health concern with respect to morbidity and mortality as well as cost of management particularly in developing countries. Thermal injuries impairs the skin & normal barrier function, thus there is microbial colonization in burn wound, because of which contamination is almost unavoidable [9]. Burn wound infection is one of the frequent and severe complications in patients who have sustained burns [10]. Because of the variability of both local and systemic clinical manifestation of invasive burn wound infection, great emphasis is given on the proper identification of burn wound microbial flora by clinician treating burn wound sepsis [11].

In this study from 60 patients included, a total of 240 swabs were taken. Out of 60 Patients, majority of the patients were in age group of 21-40 years (Table 1).

Similar findings were seen by Jyotindra et al (2000), and Leila Azimi et al (2011). It was seen that males were affected more than females (Table 2).

The mode of burn injury in our study was fire injury and electric (Table 3). This result is in accordance with the study done by Leila Azimi et al (2011).

Burn research in India started to blossom during 1970s primarily with epidemiological studies. The nature and extent of the problem of thermal injuries in the vastly populated subcontinent of India was almost unknown before early 1970s.

*Pseudomonas aeruginosa* isolation was maximum in our study in both single (20.8%) and mixed (30.4 %) growth. *Acinetobacter baumanni* was the second most common isolate in both single (15.4%) and mixed (23.9%) growth. Growth of Staphylococcus was 14.1% in single isolates and 10.8% in mixed growth (Table 4). This finding is in accordance with other studies by Chaya a Kumar et al who reported *Pseudomonas aeruginosa* as the commonest isolates (34.9%) in their study and Shweta et al who reported *Pseudomonas aeruginosa* as the commonest isolates (47 %) in their study.

The high frequency of *Pseudomonas aeruginosa* might be because it is found frequently in hospital environments and burn wound are an ideal medium for their survival. *Pseudomonas aeruginosa* are inherently resistant to commonly used antibiotics and can even survive in common antiseptics (Oncul E. Ulrur A et al 2009) [12].

Regarding growth of *Acinetobacter baumanni*, it was similar to other studies who also reported higher frequency of *Acinetobacter* infections in their studies. In the study conducted by Ýlyas Yolbaþ et al (2013) Acinetobacter *baumanni* (62.3%) was the most common isolated pathogen. Similarly Harvey Chim et al (2007) also reported similar findings in their study.

The persistence of *Staphylococcus* throughout our study could be due to cross infection of micro-organisms in ICU. It may also be due to the fact that proper infection control practices were not followed by relatives of patients and by health care workers.

The antibiotic sensitivity test was performed by Kirby-Bauer disc diffusion method using commercially available discs (Hi-media). The results were interpreted as per CLSI guideline.

Resistance patterns among nosocomial bacterial pathogens may vary from country to country and also within the same country, over time. In this study antibiotics sensitivity profile of the isolates were also observed. *Pseudomonas aeruginosa* isolates in our study were susceptible to imipenem (95%) and amikacin (90%). This contrasts with the antibiotic sensitivity pattern of study done by Saha et al (2011) and similar to studies done by Vinod Kumar C.S. (2013) and Jyotindra et al (2000).

In the present study, almost all strains of *Staphylococcus aureus* showed good sensitivity to Linezolid and Gentamycin (Table 5). Chaya a Kumar et al (2010) reported 100 % sensitivity to Vancomycin and Linezolid in Staphylococcus aureus.

Similarly Acinetobacter *s*pecies showed higher rate of resistance to ciprofloxacin, amikacin, ceftazidime, and piperacillin in our study. Strains showed good sensitivity to amikacin and tetracycline. Other studies have reported high degree of resistance to almost all the antibiotics. We attribute these differences in the susceptibility of strains to differences in the patient population studied by us. Most of our patients were from surgical wards. Furthermore, our patients came from rural areas without much exposure to antibiotics.

## Conclusion

Microbial colonization was present right from the time of admission in the majority of swabs. The rate of colonization progressively increased from second and upto the end of third week. The commonest organism isolated was *Pseudomonas aeruginosa* followed by *Acinetobacter baumannii, staphylococcus aureus, klebsiella pneumoniae, Enterobacter, Enterococcus species Escherichia coli, proteus mirabilis, CONS and Citrobacter* species. All the gram-negative organisms had good sensitivity to imipenem and meropenem and resistant to commonly used antibiotics like gentamycin, and cefoperazone, levofloxacin. And all Gram positive organisms had good sensitivity to Linezolid, Gentamycin, and Vancomycin.

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