Journal of Applied & Environmental Microbiology, 2015, Vol. 3, No. 4, 95-100
Available online at http://pubs.sciepub.com/jaem/3/4/1

DOI:10.12691/jaem-3-4-1

Bacteriological and Antibiotic Susceptibility Profile of Aerobic Burn Wound Isolates at a Tertiary Care Institute in Northern India

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Received April 05, 2015; Revised August 26, 2015; Accepted September 17, 2015

Abstract Burn injury which itself is a life-threatening event is associated with high mortality and morbidity due to associated burn wound infection (BWI). Thermal destruction of the skin barrier and concomitant depression of local and systemic host cellular and humoral immune responses are pivotal factors contributing to infectious complications in patients with severe burns. In burns involving more than 40% of the total body surface area (TBSA) almost 75% of all deaths are either due to sepsis from burn wound infection or infection related complications and/or inhalation injury. The survival rates for burn patients have however improved substantially in the past few decades due to advances in modern medical care in specialized burn centers. Improved outcomes for severely burned patients have been attributed to medical advances in fluid resuscitation, nutritional support, pulmonary care, burn wound care, and infection control practices. The present study was undertaken to provide an insight into the pattern of the nosocomial burn wound infections and their antibiotic susceptibility pattern occurring in the burn unit of Government Medical College & Hospital, Jammu. It was found that BWI was significantly common in older age group with type of burn injury, i.e., flame, scald, electric having no influence on the incidence of infection. However patients with higher TSBA were more likely to develop wound infections. There was a transition of bacterial growth form Gram-positive (*Staphylococcus aureus* being the most common) during the first week to Gram-negative (*Klebsiella species* being the most common) in the subsequent weeks of stay. With prolonged hospital stay an increased incidence of BWIs having identical antibiograms was observed.

Keywords: *burn wound, infection, antibiogram*

Cite This Article: Sarika Ghai, Amit Sachdeva, Ruchita Mahajan, Sandeep Dogra, Shashi Soodan, and Bella Mahajan, "Bacteriological and Antibiotic Susceptibility Profile of Aerobic Burn Wound Isolates at a Tertiary Care Institute in Northern India." *Journal of Applied & Environmental Microbiology*, vol. 3, no. 4 (2015): 95-100. doi: 10.12691/jaem-3-4-1.

1. Introduction

Burn injury is a major problem in many parts of the world as it is not only associated with delayed wound healing and scar formation, but may also lead to sepsis related morbidity and mortality. It is The survival rates for burn patients have improved substantially in the past few decades due to advances in modern medical care in specialized burn centers. Improved outcomes for severely burned patients have been attributed to medical advances in fluid resuscitation, nutritional support, pulmonary care, burn wound care, and infection control practices. As a result, burn-related deaths, depending on the extent of injury, have been halved in the past 40 years. [1,2] In patients with severe burns of more than 40% of TBSA, 75% of all deaths are currently related to sepsis from BWI or other infection complications and/or inhalation injury. [1,3,4] The most common sites of nosocomial infections in burn patients are the surface burn wound and the lungs. [5] Thermal destruction of the skin barrier and concomitant depression of local and systemic host cellular and humoral immune responses are pivotal factors contributing to infectious complications in patients with severe burns [6,7,8].

The burn wound surface (in deep partial-thickness and in all full-thickness burns) is a protein-rich environment consisting of avascular necrotic tissue (eschar) that provides a favorable niche for microbial colonization and proliferation. The avascularity of the eschar results in impaired migration of host immune cells and restricts delivery of systemically administered antimicrobial agents to the area, while toxic substances released by eschar tissue impair local host immune responses. Burn wound surfaces are sterile immediately following thermal injury, these wounds eventually become colonized with microorganisms. [9] Infection risk for burn patients is different from other patients in several important respects. Sources of organisms are found in the patient's own endogenous (normal) flora, from exogenous sources in the environment, and from healthcare personnel. [10] Survival in burn patients has improved tremendously with the

control and prevention of the exogenous sources of infections and with various methods of elimination of endogenous sources. [11] Gram-positive bacteria that survive the thermal insult, such as Staphylococci located deep within sweat glands and hair follicles, heavily colonize the wound surface within the first 48 hours unless topical antimicrobial agents are used.[9] These wounds are subsequently colonized with other microbes including Gram-positive bacteria, Gram-negative bacteria & yeasts derived from the host's normal gastrointestinal and upper respiratory flora and/or from the hospital environment or that are transferred via a health care worker's hands [9,10,12].

Over the last several decades, Gram-negative organisms have emerged as the most common etiologic agents of invasive infection by virtue of their large repertoire of virulence factors and antimicrobial resistance traits. [13,14] It is just not sufficient to be aware of the microorganisms that pose a problem for burn patients. To have an in-depth knowledge of the organisms that are predominant in that particular treatment facility during the particular period along with their sensitivity pattern is vital as many septic burn patients need to be treated with antibiotics before the results of microbiological cultures are available. This would be crucial to reduce the overall infection-related morbidity and mortality. The present study was undertaken to determine the pattern of nosocomial burn wound infections and their antibiotic susceptibility in the burn unit of Government Medical College & Hospital.

2. Material & Methods

This prospective observational study of bacteriology of burn wound infections was conducted over a period of one year at Government Medical College & Hospital (GMCH), Jammu which is a tertiary care hospital in northern India catering to local and referred cases from Jammu province. All consecutively admitted indoor patients with open burn wounds admitted in burn unit of GMCH were considered eligible in the study. After admission in the burn ward, those who fulfilled the inclusion criteria were enrolled into the study which included, direct indoor admission, more than 48 hrs of stay in hospital, TBSA >10%, age more than 12 yrs and valid informed consent.

To study burn wound colonization and infection, swabs were taken from open burn wounds preferably from upper and lower extremities avoiding oral, genital, scalp, and anal regions. Burn wound swabs were taken initially on admission (however patients with more than 48 hours of stay were only included in the study), followed by swabs on day 5th, second, third and fourth week respectively. They were taken before dressing changes and before administration of antibiotics wherever possible. Wound swabs were also taken whenever there were clinical signs of grafted skin infections. Urine cultures were performed once per week for those with indwelling urinary catheters and on request for those with signs and symptoms of Urinary Tract Infection (UTI). Two consecutive blood cultures at the time of spike were drawn during fever. After a burn wound swab sample tested positive, a detailed survey of the patient's immediate environment was also performed. This included collection of surface swabs from gowns of burn unit personnel, bed pans, sink surface, door handles (of the ward and the common treatment room), mattresses and side rails of bed. For large surfaces, sterile gauzes (about 8 cm by 8 cm) moistened with sterile saline were used. An area of about 30 cm by 30 cm was wiped by making vertical S-strokes to cover the entire sample area and then the exposed side of the pad was folded to make horizontal S-strokes over the same area. For small surfaces (bed rails, door handles, sink tap handles etc.), sterile cotton tipped applicator was used. The swabs were first moistened with sterile saline and rolled several times making vertical S-strokes to cover the entire sample area of around 5 cm by 5 cm [15,16,17].

The wound swab specimens were inoculated on Blood agar and MacConkey agar and were incubated at 37^{0}C for 24-48 hours. Identification of bacterial isolates was done using colony morphology, Gram-staining and conventional biochemical tests as per standardized protocols of our laboratory. The swabs from the environment were inoculated into 5 ml nutrient broth. After 24 hours of incubation at 35-37°C, the broth were sub cultured on blood agar plate and MacConkey agar.

Specimens from other sites of infection: Urine samples collected were plated on Cysteine Lactose Electrolyte Deficient (CLED) medium and incubated as above and isolates identified by standard procedures. Blood samples were inoculated in Lucoid broth and were incubated for 24 hrs then inoculated on Blood and MacConkey agar; if negative they were re-incubated and sub-cultured on 3rd and 5th days respectively. All the culture medias were procured from HiMedia Laboratories, Mumbai and were prepared in-house as per standardized protocol of the department [18].

Different panels of antimicrobial agents for Gram-positive and Gram-negative bacteria were used as per Clinical Laboratory Standards Institute (CLSI) guidelines. [14] The antibiotic disks (HiMedia Laboratories, Mumbai) used for Gram-positive isolates were: Penicillin G 10 units, Cefoxitin 30 mcg, Gentamycin 10 mcg, Ciprofloxacin 5 mcg, Cotrimoxazole 1.25/23.75 mcg, Vancomycin 30 mcg, Clindamycin 2 mcg, Erythromycin 15 mcg, Linezolid 30 mcg, Chloramphenicol 30 mcg, Tetracycline 30 mcg, Ceftrioxone 30 mcg, Cefipime 30 mcg, Oxacillin 1 mcg, Amoxycillin clavulinic acid 20/10mcg. The antibiotic discs used for Gram-negative isolates were: Ampicillin 10 mcg, Piperacillin tazobactum 100/10 mcg, Ceftazidime 30 mcg, Cefipime 30 mcg, Ceftrioxone 30 mcg, Cefuroxime 30 mcg, Amikacin 30 mcg, Imipenem 10 mcg, Gentamycin 10 mcg, Tobramycin 10 mcg, Ciprofloxacin 5 mcg, Cotrimoxazole 1.25/23.75 mcg, Chloramphenicol 30 mcg, Tetracycline 30 mcg, Colistin 10 mcg, Polymyxin B 300 units, Cefoperazone sulbactum 75 mcg.

The standard reference strains *S. aureus* ATCC 25923, *Escherichia coli* ATCC 25922 and *P. aeruginosa* ATCC 27853 were tested weekly as controls on the biochemical tests and agar plates including Mueller Hinton Agar with antibiotic discs.

3. Data Analysis

Data analysis was performed using MS Excel. Statistical significance of the relationship was ascertained by the use of Chi Square test. All *p* values were two tailed and a p value of < 0.05 was considered statistically significant.

4. Results

A total of 50 burn patients who either visited or were admitted to the Burn Center during the data collection period were included in the study. Both blood and wound swab samples were collected from all study subjects. Of the total study participants, females accounted for 25 (40%) and males accounted for 20 (60%), whereas the age ranged from 17 years to 70 years with the mean and median ages of 36.48 years and 28.40 years respectively. Among these, 45 showed evidence of burn wound infection (Group A), whereas 5 had no evidence of infection (Group B). Mean age being 36 yrs in infected group as compared to 28 years in non-infected group. These two groups were compared with respect to age, burn type, TBSA and duration of hospitalization.

There was a statistically significant (p=0.002) difference in age distribution on comparing infected patients to that of non-infected ones with non-infected group predominantly being occupied by the younger age group. As far as type of burn injury was concerned, the two groups showed no significant difference in distribution of flame, scald and electric burns. However, patients with higher TBSA were found to be more likely to develop BWIs and the relation was found to be statistically significant (p=0.0001). Patients with BWIs had a longer duration of stay in hospitals as compared to those with no signs of infection and this relationship was found to be statistically significant. (p=0.0001) (Table 1).

Table 1. Comparison of Group A (infected) and Group B (non-infected) burn patients

	(Group A) Infected	(Group B) Non-Infected	Statistical test value
Patients (n)	45	5	P 0.65
• Male	20	3	
• Female	25	2	
Age (years)			
• Range	17-70	17-40	t 2.52, p 0.002
• Mean	36.48 (14.09)	28.40 (5.41)	
Burn Type			
• Flame	28	2	X^2 2.34, p 0.31
• Scald	6	2	
• Electrical	11	1	
TBSA (%)			
• Range	14-70	14-40	t 8.13, P 0.0001
• Mean	39.13 (14.58)	17.20 (3.56)	
Hospitalization (days)			
• Range	1-30	1-15	t=9.12, p.0001
• Mean	22.68 (8.36)	9.80 (1.48)	

Gender wise distribution of burns showed comparatively higher percentages of females suffered from scald (75%) and flame burns (60%) where as males predominantly suffered from electric burns (90%). (Table 2) Comparatively higher percentages of flame burns were seen in younger age groups in both males (33.33%) and females (66.6%) (Table 2).

Table 2. Age and gender wise distribution of type of burn injury (n=50)

Age (Years)	Type of Burn Injury					
	Flame		Electric		Scald	
	Male	Female	Male	Female	Male	Female
15-25	4/9 (44%)	5/9 (55.5%)	1/1 (50%)	0	1/4 (25%)	3/4 (75%)
26-35	2/6 (33.3 %)	4/6 (66.6%)	7/7 (100%)	0	1/2 (50%)	1/2 (50%)
36-45	2/7 (28.57)	5/7 (71.4%)	1/1 (100%)	0	0	1/1 (100%)
46-55	3/6 (50%)	3/6 (50%)	1/2 (50%)	1/2 (50%)	0	0
56-65	1/2 (50%)	1/2 (50%)	0	1/1 (50%)	0	1/1 (100%)
	12/30 (40%)	18/30 (60%)	10/11 (90.9%)	2/3 (66.6%)	2/6 (33.3%)	6/8 (75%)

Gram-positive organisms were predominantly isolated from the burn wounds during the first week of admission (*S. aureus* being the most frequent isolate from 1st and 5th day of admission wound swabs whereas Gram-negative organisms were common from second week onwards with *Klebsiella sp.* being the most common isolate from the 2nd, 3rd and 4th week. Although *S. aureus* was one of the common isolate from the burn wounds (24.3%), *Klebsiella sp.* (33.3%) and *Enterobacter sp.* (34.7%) infections were more commonly associated with sepsis and UTIs (Table 3).

Table 3. Frequency of isolates recovered in BWI, UTI and blood stream infection.

Organism	BWI (n=160)	UTI (n=26)	BSI (n=9)
S. aureus	39 (24.3%)	0	0
Streptococcus sp.	9 (5.6%)	0	1 (11.1%)
Enterococcus sp.	4 (2.5%)	0	1 (11.1%)
Klebsiella sp.	51 (31.8%)	17 (65.3%)	3 (33.3%)
Pseudomonas sp.	19 (11.8%)	0	0
Proteus sp.	7 (4.3%)	0	1 (11.1%)
Enterobacter sp.	18 (11.25%)	9 (34.7%)	2 (22.2%)
Acinetobacter sp.	12 (7.5%)	0	1 (11.1%)

Environmental microbiological surveillance of potential nosocomial pathogens (Environmental swabs) revealed that almost 89% of the *Pseudomonas sp.* isolates had antibiograms similar to that of clinical isolates closely followed by *Klebsiella sp.* and *Enterobacter sp.* (69% each). However, only 29% of the Stahylococcus isolates had identical antibiograms to that of clinical isolates.

5. Discussion

The burn wound management and critical care medicine has significantly evolved over a period of time with recent advancements in critical care medicine. Still, management of burn patients remains a challenge with respect to availability of dedicated and specialized burn units as well as increasing drug resistance. Fresh burn is usually sterile but progressively becomes colonized with one or more bacterial species. The role of different bacterial species in burn pathology varies from mere colonization, local tissue sepsis, interference with healing and grafting, to invasion of the blood stream with subsequent septicemia and death. [19] The standard techniques for microbiological detection remain surface swabbing and wound biopsy culture; having its advocates and its critics. The surface swab probably remains the

work horse. It is relatively inexpensive technique that most commonly is used to provide qualitative information about the bacteria present.

A total of 50 patients were enrolled in study out of which 90% (45) showed evidence of burn wound infection whereas 10% (05) had no clinical evidence of infection. In our study BWI's (90%) was on higher side when compared to other burn units in the developed countries. [14,20] Burn wound infection was significantly common in older age group patients (p – 0.027) as compared to the younger age group. Mean age being 32 yrs in infected group as compared to 28 years in non-infected group was comparable with other similar studies. [21,22,23] Type of burn injury, i.e., flame, scald, electric did not influence incidence of infection. [24] Patients with higher TBSA were more likely to develop wound infections (39.1%) in infected group as compared to in non-infected group (17.2%). Infection attack rates among the burn patients increased with increasing burn surface area. Patients with infected wounds had longer duration of stay in hospital, mean of 22.68 days as compared to 9.80 days for those with non-infected wounds [25].

As far as pattern of bacterial organisms isolated from burn wound infections was concerned, it changed significantly during the course of admission. Gram-positive organisms were more common (82.3%) viz-a-viz Gram-negative organisms (17.6%) during the first week of admission. From 2nd week onwards Gram-negative organisms started replacing Gram-positive organisms by 100%. Of the Gram-positive organisms isolated on admission, *S. aureus* was the most common organism isolate (56%) followed by *Streptococcus sp*. (14.6%) and *Enterococcus sp*.(11.7%) Among Gram-negative organisms isolated at admission, Klebsiella *sp*. was the most common Gram-negative isolate (5.9%) followed by *Proteus sp*. (5.9%) and *Pseudomonas sp*. (5.9%) (Table 4).

Table 4. Isolates from burn at varying period of time:

S. No.	Organism isolated	Day of Admission	On 5th day	2nd week	3rd week	4th week	Total
1	*S. aureus*	19 (56%)	20 (48%)	0	0	0	39
2	*Streptococcus sp.*	05 (14.6%)	04 (10%)	0	0	0	09
3	*Enterococcus sp.*	04 (11.7%)	0	0	0	0	04
4	*Klebsiella sp.*	02 (5.9%)	09 (22%)	19 (50%)	11 (44%)	10 (45.5%)	51
5	*Pseudomonas sp.*	02 (5.9%)	04 (10%)	05 (13%)	04 (16%)	04 (18.2%)	19
6	*Proteus sp.*	02 (5.9%)	03 (7.3%)	03 (8%)	0	0	08
7	*Enterobacter sp.*	0	01 (2.7%)	06 (16%)	06 (24%)	05 (22.7%)	18
8	*Acinetobacter sp.*	0	0	05 (13%)	04 (16%)	03 (13.6%)	12
	Total	**34**	**41**	**38**	**25**	**22**	

The most common nosocomial infection developed in the burn patients was BWI (n=160) followed by UTI (n=26) and Blood stream infection (n=9). BWIs were mainly caused by *S. aureus* (24.3%) and *Klebseilla sp*. (31.8%). UTIs were dominated by Gram-negative organisms *Klebsiella sp*. (65.3%) and *Enterobacter sp.* (34.7%). Blood stream infections were homogeneously distributed between Gram-positive and Gram-negative organisms (Table 3).

The isolates from burn patients showed a moderate to severe degree of resistance to the commonly used antibiotics. (Table 5 and Table 6) In case of patients with longer duration of hospital stay, there was both an increased incidence of BWIs (including infections with MDR organisms) and increased isolation of isolates from patient environment having identical antibiograms.

Table 5. Antibiotic Susceptibility pattern of Gram-positive organisms.

Antibiotic sensitivity pattern on Admission (No. of Sensitive isolates/No. of Total isolates)														
Isolates	**P**	**Cfx**	**G**	**Cf**	**Co**	**Va**	**Cd**	**E**	**Lz**	**C**	**T**	**Ci**	**Cpm**	**Ox**
S. aureus	2/19	14/19	2/ 19	4/ 19	5/19	19/19	1/ 19	7/ 19	14/19	8/19	2/19	0	1/19	3/19
Streptococcus sp.	4/5	2/5	0	0	2/5	5/5	0	1/5	3/5	0	0	1/5	2/5	1/5
Enterococcus sp.	0	0	0	3/4	0	4/4	0	1/4	0	1/4	0	0	0	0
Antibiotic Sensitivity Pattern on Day 5														
S. aureus	3/20	12/20	1/20	5/20	8/20	20/20	1/20	6/20	14/20	7/20	1/20	0	1/20	4/20
Streptococcus sp.	2/4	2/4	0	1/4	1/4	3/4	0	1/4	1/4	0	0	1/4	1/4	2/4
Enterococcus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Abbreviations: P-Penicillin, Cfx-Cefoxitin , G-Gentamycin , Cf-Ciprofloxacin, Co-Cotrimoxazole, Va-Vancomycin, Cd-Clindamycin, E-Erythromycin, Lz-Linezolid, C-Chloramphenicol, T-Tetracycline, Ci-Ceftrioxone, Cpm-Cefipime, Ox-Oxacillin.

In our study all Gram-positive organisms were sensitive to Vancomycin (100%). A total of 74% of *S. aureus* and 40% *Streptococcus sp.* were sensitive to Cefoxitin followed by 74% and 60% respectively to Linezolid. Antibiotic susceptibility pattern of Gram-positive organisms was comparable at admission and on day 5 of admission.

Gram-negative organisms isolated from BWI at the time of admission were highly resistant to most of first, second and third line antibiotics. Susceptible was seen for to Piperacillin-tazobactum, Ceftazidime, Cefipime, Amikacin, Imipenem and Polymyxin B. On admission, 50% of *Pseudomonas sp*. and *Proteus sp*. were multidrug resistant (MDR). On 5th day of admission, 22.2% of *Klebsiella sp.* and 33.3% of *Proteus sp*. were MDR. In 2nd week, 20% isolates of *Acinetobacter sp*. were MDR and in 4th week, 60% isolates of *Klebsiella sp.*, 100% of *Pseudomonas sp*., and 67% of *Acinetobacter sp*. were MDR. In 4th week, 60% isolates of *Klebsiella sp*., 100% of *Pseudomonas sp*., and 67% of *Acinetobacter sp*. were MDR. The higher incidence of resistant isolates could be because of the inappropriate use of antibiotics as a comprehensive antibiotic policy is yet to be implemented. Environmental microbiological surveillance of potential nosocomial pathogens indicated that the inanimate environment of patients infected with either Gram-positive

or Gram-negative bacteria were frequently contaminated with the organisms, therefore surfaces and objects may likely serve as not only a primary source but also as a secondary reservoir for cross-transmission.

Table 6. Antibiotic Susceptibility pattern of Gram-negative organisms

Antibiotic sensitivity pattern on Admission (No. of Sensitive isolates/No. of Total isolates)																	
Isolates	**A**	**Pt**	**Ca**	**Cpm**	**Ci**	**Cu**	**Ak**	**I**	**G**	**Tb**	**Cf**	**Co**	**C**	**T**	**Cl**	**Pb**	**Cs**
Klebsiella sp.	0	2/2	2/2	0	0	0	1/2	1/2	0	0	0	0	0	0	0	0	0
Pseudomonas sp.	0	0	1/2	0	0	0	0	0	0	0	0	0	0	0	0	1/2	0
Proteus sp.	0	1/2	0	1/2	0	0	0	1/2	0	0	0	0	0	0	0	0	0
Enterobacter sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Acinetobacter sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antibiotic Sensitivity Pattern on Day 5																	
Klebsiella sp.	1/9	7/9	3/9	3/9	0	1/9	4/9	5/9	3/9	2/9	0	0	0	0	0	0	0
Pseudomonas sp.	0	3/4	2/4	1/4	0	0	0	1/4	0	0	0	0	0	0	1/4	3/4	0
Proteus sp.	0	2/3	1/3	2/3	0	0	0	1/3	0	0	0	0	0	0	0	1/3	0
Enterobacter sp.	0	1/1	1/1	1/1	0	0	0	0	0	0	0	0	0	0	0	0	0
Acinetobacter sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Antibiotic Sensitivity Pattern on Week 2																	
Klebsiella sp.	1/19	18/19	10/19	12/19	0	4/19	14/19	15/19	8/19	4/19	0	0	0	0	0	0	0
Pseudomonas sp.	0	3/5	1/5	2/5	0	0	1/5	0	0	0	0	0	0	0	0	0	2/5
Proteus sp.	0	2/2	1/2	1/2	0	0	0	0	0	0	0	0	0	0	0	0	1/2
Enterobacter sp.	0	6/6	3/6	4/6	0	0	2/6	4/6	1/6	0	0	0	0	0	0	0	0
Acinetobacter sp.	0	4/5	2/5	1/5	0	0	2/5	0	1/5	0	0	2/5	0	0	0	0	0
Antibiotic Sensitivity Pattern on Week 3																	
Klebsiella sp.	0	11/11	8/11	8/11	0	2/11	7/ 11	9/11	5/11	4/11	0	0	0	0	0	0	0
Pseudomonas sp.	0	1/4	2/4	1/4	0	0	0	0	0	0	0	0	0	0	0	3/4	0
Proteus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enterobacter sp.	0	6/6	3/6	4/6	0	0	2/6	4/6	1/6	0	0	0	0	0	0	0	0
Acinetobacter sp.	0	3/4	0	1/4	0	0	2/4	0	1/4	0	0	1/4	0	0	0	2/4	0
Antibiotic Sensitivity Pattern on Week 4																	
Klebsiella sp.	0	4/10	3/ 10	4/10	0	0	4/ 10	4/10	2/10	0	0	0	0	0	0	0	0
Pseudomonas sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Proteus sp.	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Enterobacter sp.	0	5/5	2/5	3/5	0	0	2/5	5/5	1/5	0	0	0	0	0	0	0	0
Acinetobacter sp.	0	1/3	1/3	1/3	0	0	0	0	0	0	0	1/3	0	0	0	0	0

Abbreviation: A-Ampicillin, Pt-Piperacillin tazobactum, Ca-Ceftazidime, Cpm-Cefipime, Ci-Ceftrioxone, Cu-Cefuroxime, Ak-Amikacin, I-Imipenem, G-Gentamycin, Tb-Tobramycin, Cf-Ciprofloxacin, Co-Cotrimoxazole, C-Chloramphenicol, T-Tetracycline, Cl-Colistin, Pb –Polymyxin B, Cs-Cefoperazone sulbactum.

For burn patient care, serial culture and sensitivity testing of blood, wound swab, body fluids should be done for each patient to guide the antibiotic therapy. Further, regular microbiological surveillance of burn units should done so that the pattern of isolations and drug resistance can help the clinicians to formulate empirical antibiotic therapy and reducing morbidity and mortality from septic events.

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