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Bacteriologic Spectrum and Antibiotic Susceptibility Pattern among Patients with Skin Burns - A Retrospective Study at Tertiary care Teaching Hospital, Tirupati, Andhrapradesh, India.

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Abstract

Aim: To demonstrate the prevalence of isolated aerobic microorganisms in patients with skin burns and their antibiotic susceptibilities in a tertiary care teaching center. Materials and Methods: This is a retrospective study of 348 patient's samples with skin burn wound infections at Sri Venkateswara Medical College, during the period August 2008 to August 2012. The specimens were cultured using aerobic microbiological techniques and Antimicrobial susceptibility pattern to different agents was carried out using the disc diffusion method. Results: Cultures from skin burn wound revealed Pseudomonas aeruginosae as the most common organism followed by Staphylococcus aureus, Escherichia coli and Klebsiella pneumoniae etc.. However, all the staphylococci were susceptible to Vancomycin and the gram negatives were susceptible to Imipenam. For empiric treatment Vancomycin and Imipenem appear to be a good combination in this hospital. Conclusions: Although medical centers have devoted intensive resources to improving the survival rates of burn patients, expenditures for research, prevention and education programs are to be strengthened. Our findings suggest that more attention should be paid to the importance of research, prevention and the reduction of injury severity. This study may contribute to the establishment of a nationwide burn database and the elaboration of strategies to prevent burns injury.
Key words: Skin Burns, Infection, Common Pathogens, Antimicrobial Susceptibility pattern, Antibiotic policy.

Introduction

Bacterial flora in burn patients undergoes change over period of time and is dependent upon many factors. Study of burn flora is not only helpful in locating entry of multidrug resistant bacterial strains into the unit's usual flora but also in determining current antibiotic susceptibilities. Infections remain the leading cause of death among patients who are hospitalized for burns. The risk of burn wound infection is directly correlated to the extent of the burn and is related to the impaired resistance resulting from disruption of the skin's mechanical integrity and generalized immunosuppression. 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. [1] 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. [2] 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. [3]. Although burn wound surfaces are sterile immediately following thermal injury, these

wounds eventually become colonized with microorganisms. Staphylococci located deep within sweat glands and hair follicles; heavily colonize the wound surface within the first 48 h unless topical antimicrobial agents are used. Eventually (after an average of 5 to 7 days), these wounds are subsequently colonized with other microbes, including gram-positive bacteria, gram-negative bacteria, and 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. [4]. Burn unit outbreaks of infection were attributed mainly to contaminated water and contaminated surfaces such as the patient's mattress. [5] [6]. Severe burn injury is accompanied by a systemic inflammatory response, making traditional indicators of sepsis both in sensitive and nonspecific. To address this, the American Burn Association (ABA) published diagnostic criteria in 2007 to standardize the definition of sepsis in these patients. [7] These criteria include 1. Temperature (>39°C or <36°C), 2. Progressive tachycardia (>110 beats per minute), 3. Progressive tachypnea (>25 breaths per minute not ventilated or minute ventilation >12 L/minute ventilated), 4. Thrombocytopenia (<100,000/µl; not applied until 3 days after initial resuscitation), 5. Hyperglycemia (untreated plasma glucose >200 mg/dl, >7 units of insulin/hr intravenous drip, or >25% increase in insulin requirements over 24 hours), and 6. Feed intolerance >24 hours (abdominal distension, residuals two times the feeding rate, or diarrhoea >2500 ml/day). Meeting >3 of these criteria should "trigger" concern for infection. In this initial assessment of the ABA sepsis criteria correlates with the infection. Individuals with deliberate self-inflicted burn injuries and the disabled have been shown to have more severe injuries and longer hospital stays than those with accidental injuries. [8] [9]. Very young children and the elderly have an increased risk of being burnt and have worse clinical outcomes than patients in other age groups. [10] [11]. Obese adults and those who have an underlying medical condition such as diabetes have also been shown to have higher morbidity and mortality. [12]. As a result of recent improvements in the treatment of burns, mortality rates have decreased and the victims' quality of life has improved. The extent of the burn is a major prognostic factor. [13] In this retrospective study, we aimed to determine the Bacteriologic Spectrum and Antibiotic Susceptibility Pattern among Patients with Skin Burns who were hospitalized in the Burns Unit at Tertiary care Teaching Hospital, from August 2008 to August 2012. In the present retrospective work a solemn endeavor is made and study the aerobic pathogens involved in the skin burn infections. All this has been done with a purpose to acquire some data on the pattern of burn infections prevalent in our hospital and formulate antibiotic guidelines in the light of present findings.

Materials and Methods

A retrospective study was carried out on 348 specimens with burn wound infections during the period August 2008 to August 2012 at Sri Venkateswara Medical College, Tirupati, Andhrapradesh, India. A semi-structured questionnaire was prepared to record the medical history, examination details and investigation reports from Medical Record Section at S.V.R.R.G. General Hospital, Tirupati, Andhrapradesh. Specimens/Swabs were inoculated on Blood agar, MacConkey agar and Nutrient agar (Himedia Laboratories Pvt Ltd., Mumbai). After overnight incubation the plates were examined for bacterial growth. Further identification and confirmation of organisms was done by the standard identification technique which include studying the colonial morphology, Gram's stain and Biochemical reactions.

Antibacterial Susceptibility Testing

Susceptibility testing was performed by Kirby-Bauer disk diffusion technique according to criteria set by CLSI 2009. The drugs tested for gram positive cocci were Penicillin G (10U), Ampicillin (10 µg), Oxacillin (1µg), Ciprofloxacin (5µg), Gentamicin (10µg), Amikacin (30µg), Clindamycin (2µg), Erythromycin (5µg), Novobiocin (30µg), Co-trimoxazole (1.25/23.75 µg) and Vancomycin (30µg). The drugs tested for Enterobacteriacea were Gentamicin (10µg,) Amikacin (30µg), Ampicillin (10 µg), Cefotaxime (30µg), Ceftriaxone (30µg), Ceftazidime(30µg), Ciprofloxacin (5µg), Co-trimoxazole (1.25/23.75 µg), Amoxycillin/clavulanate (20/10µg), Imipenam (10µg), Piperacillin/tazobactam (100/10µg) and Ticarcillin/clavulanic acid (75/10µg). The drugs tested for Pseudomonas aeruginosa were Gentamicin (10µg), Amikacin (30µg), Cefotaxime (30µg), Ceftriaxone (30µg), Ceftazidime (30µg), Ciprofloxacin (5µg), Co-trimoxazole (1.25/23.75 µg), Amoxycillin/clavulanate (20/10µg), Imipenam (10µg), Piperacillin/tazobactam (100/10µg), and Ticarcillin (75 µg).

Statistical Analysis

All the study data were enterd into the computer database using standard format, checked for errors and verified. Data maintained in the computer sheets were organised by SPSS version 17.0 software for Windows. Data will be peresented in aprropriate Tables by caliculating of percentage, rate etc.

Ethical Issues

The retrospective study was approved and ethically cleared by the Scientific Committee of Sri Venkateswara Medical College, Tirupati. All patient information was kept confidential.

Results and Discussion

A total number of 348 Skin burn wound infection cases were included in this retrospective study between August 2008 to August 2012. The ages of study groups ranged from 0 yrs to > 50 yrs.

Table- 1: Age Distribution of the Skin Burns Patients

	Children (0 – 14years)	Adults (15 – 49 years)	Older Adults (> 50 years)	Total
Number	80	216	52	348
Percentage	22.98%	62.06%	14.94%	100%

The occurrence of the Skin Burns in adults (62.06%) was found to be higher compared to children and elderly cases (22.98%) and (14.94%) respectively. (Table -1).

Table2: Demographic Data of patients and types of burns

I. Gender: [Number (%)]

a. Male: 112 (32.18%)
b. Female 236 (67.82%)

II. Kind of Burn: [Number (%)]

a. Flame: 202 (58.05%)
b. Scald: 62 (17.81%)
c. Electrical: 84 (24.14%)

III. Out come: [Number (%)]

a. Recovery: 256 (73.56%)
b. Partial recovery: 72 (20.69%)
c. Death: 20 (5.75%)

The Retrospective study of 348 patients admitted to the Burns Unit between August 2008 to August 2012, 112 (32.18%) were male and 236 (67.82%) were female; 80 (22.98%) were children (age under 14 years), 216 (62.06%) adults (15 - 49 years) and 52 (14.94%) older adults (over 50 years) (Table I). Of the burns 58.05% (*N* = 202) were flames, 24.14% (*N* = 84) burns from electrical and 17.81% (*N* = 62) scalds burns.. Of the patients 73.56% (*N* = 256) were discharged after full recovery and 20.69% (*N* = 72) after partial recovery; 5.75% (*N* = 20) died (Table II). Most of the patients who died were children and elderly patients. Most of the children, adults and elderly patients who died had flame burns, followed by scald skin burns. Death is mainly due to infection, hypovolaemic shock and acute renal failure as per available recorded data.

Table- 3: Overall results of the cases studied

Details of Isolation	Number	Percentage
Monomicrobial	166	47.7%
Polymicrobial	182	52.3%
Total	348	100%

Of the 348 swabs, 166 (47.7%) were monomicrobial pathogens and 182 (52.3%) were Polymicrobial pathogens. The presence of more than one species isolated from the sample was the most frequent (52.3%) while, one species were isolated (47.7%) from 166 samples. (Table 3).

Table - 4: Distributions of Isolates in various Skin Burns

S. No	Details of Isolation	Flames N %	Scalds N %	Electrical N %
1.	Monomicrobial	90 (44.55%)	24 (38.71%)	52 (61.9%)
2.	Polymicrobial	112 (55.45%)	38 (61.29%)	32 (38.1%)
3.	Total	202 (58.05%)	6 (17.82%)	84 (24.14%)

Highest infection rate was observed in Skin burns due to Flames (58.05%) and lowest rate was in Scalds skin burns (17.82%) (Table - 4).

Table - 5: Aerobic bacterial pathogens isolated from Skin Burn cases

Organisms	Monomicrobial	Polymicrobial	Number of Isolates	Percent Among the Isolates
Staphylococcus aureus	38	43	81	19.57%
Staphylococcus epidermidis	16	20	36	8.7%
Enterococcus faecalis	0	4	4	0.97%
Klebsiella pneumoniae	24	42	66	15.94%
Escherichia coli	32	57	89	21.5%
Proteus vulgaris	0	7	7	1.7%
Proteus mirabilis	0	3	3	0.73%
Pseudomonas spp.	56	72	128	30.92%

Total Number of Specimens – 348, Total Number of Isolates - 414

A total of 414 bacterial isolates were obtained, 293 (70.77%) were aerobic gram negative bacilli. While 121 (29.23%) were aerobic gram positive cocci. Staphylococcus aureus was the predominant organism isolated 81 (19.57%). Pseudomonas aeruginosae was the predominant gram negative bacilli isolated (30.92%), followed by Eschericia coli (21.5%) and Klebsiella pneumoniae (15.94%) (Table–5). A study conducted by Rajput *et al*. also showed that *P. aeruginosa* (55%) was the most common isolate in burn wound infections, followed by *S. aureus* (19.29%). [8]

Table- 6: Distributions of organisms in polymicrobial growth

S.No	Polymicrobial Growth	Cases	Percentage
1	Pseudomonas aeruginosa and Klebsiella pneumonie	26	14.29%
2	Escherichia coli and Klebsiella pneumoniae	24	13.19%
3	Staphylococcus aureus and Pseudomonas aeruginosa	32	17.6%
4	Staphylococcus aureus and Escherichia coli	26	14.29%
5	Pseudomonas aeruginosa and Staphylococcus epidermidis	24	13.19%
6	Klebsiella pneumoniae and Enterococcus faecalis	2	1.1%
7	Escherichia coli and Klebsiella pneumoniae and Staphylococcus epidermidis	16	8.8%
8	Pseudomonas aeruginosae and Proteus vulgaris	7	3.85%
9	Pseudomonas aeruginosae and Enterococcus faecalis and Escherichia coli	22	12.09%
10	Escherichia coli and Proteus mirabilis	3	1.65%

Total Number of Isolates –182

Among distribution of organisms in polymicrobial growth total number of isolates was 182 while Pseudomonas aeruginosae was commonest polymicrobial growth pattern seen followed by Eschericia coli and Klebsiella pneumonia (Table - 6)

Table-7: Antibiotic sensitivity pattern of aerobic Gram positive cocci isolated from Skin Burn cases.

Antibiotic	Staphylococcus aureus		Staphylococcus epidermidis		Enterococcus faecalis	
	S %	R %	S %	R %	S %	R %
Penicillin	0	100	14	86	-	100
Erythromycin	74.26	25.74	76.81	23.19	64.12	35.88
Clindamycin	82.16	17.84	71.33	28.67	-	-
Amikacin	86.31	13.69	76.16	23.84	-	-
Gentamicin	65.56	34.44	75.64	24.36	70.75	29.25
Ciprofloxacin	34.88	65.12	19.71	80.29	-	-
Co-trimoxazole	52.72	47.27	18.69	81.31	-	-

Oxacillin	82.16	17.84	80.63	19.37	-	-
Vancomycin	100	0	-	-	100	-
Novobiocin	-	-	100	-	-	-

In our study all Gram positive cocci showed 100% susceptibility to Vancomycin. Followed by Amikacin (86.31%), Clindamycin (82.16%) and Oxacillin (82.16%), Erythromycin (74.26%), Gentamicin (65.56%) and the least effective drug was Ciprofloxacin. And 17.84% of the isolates of Staphylococcus aureus were resistant to Oxacillin. The Gram positive bacterial isolates were found to be 100% resistant towards Penicillin (Table- 7).

Table-8: Antibiotic sensitivity pattern of aerobic Gram negative bacilli isolated from Skin Burn cases.

Antibiotic	**Klebsiella pneumoniae**		**Escherichia coli**		**Pseudomonas aeruginosae**		**Proteus spp.**	
	S %	R %	S %	R %	S %	R %	S %	R %
Ampicillin	9	91	5.46	94.54	-	-	0	100
Amikacin	96.30	3.70	92.26	7.74	84.72	15.28	84.61	15.39
Gentamicin	81.49	18.51	94.18	5.82	78.09	21.91	62	38
Cefotaxime	26.58	73.42	18.65	81.35	15.85	84.15	26	74
Ceftriaxone	34.56	65.44	28.47	71.52	28.09	71.91	80	20
Ceftazidime	21.25	78.75	26.53	73.47	65.39	34.61	46	54
Ciprofloxacin	46.21	53.79	20.79	79.21	24.26	75.74	0	100
Co-trimoxazole	48.51	51.49	32.35	67.65	13.44	86.56	0	100
Amoxyclav	29.3	70.7	24.59	75.41	14.35	85.65	0	100
Piperacillin/ tazobactam	72.74	27.26	76.58	35.42	82.43	17.57	100	0
Ticarcillin/ clavulanate	26.93	73.07	39.41	60.59	-	-	-	-
Ticarcillin	-	-	-	-	78.09	21.91	80	20
Imipenam	100	0	100	0	100	100	100	0

Among all Gram negative isolates showed 100% susceptibility to Imipenam. Klebsiella pneumoniae showed 96.30% Sensitivity to Amikacin, Escherichia coli showed 92.26% sensitivity to Amikacin, Pseudomonas aeruginosae Showed 100% sensitivity to Imipenem & (84.61%) sensitivity to Amikacin.

Discussion

Burns continue to be a major environmental factor responsible for significant morbidity and mortality in developing countries. In the present retrospective study there was also a positive correlation between type of burn and age. While scalds were seen mainly in children, the incidence of these burns could be decreased by keeping children away from hazardous environments and a public information initiative to educate parents on the potential danger of this type of injury. Flame and electrical burns were most common among adults and older adults. In our study, a positive correlation was also found between type and degree of burn, scalds usually being more superficial and flame and electrical burns deeper. Care of patients with full-thickness burns is more difficult and takes longer than care of those with less severe burns. This paper presents a comprehensive retrospective study of data from an4-year period in a Teaching Tertiary Care Hospital burn centre. We have not analyzed the changing trends in terms of outcome and we recognize that this is a centre and not population based study. Nevertheless, there are several distinctive features of our burn experience that do allow more focused preventive strategies to be identified. The seasonal variation in burn admission shows a summer peak. This peak is due to an increased number of flame burns. July, the month with the highest admission rate. This indirectly suggests that one target for education is to implement proper safety precautions during leisure activities and in particular, handling cooking devices such as gas cookers. Age and sex appear to be the major determinants of risk for serious burn injury. The peak age distribution indicates different types and patterns of burns for children and adults. Infection may be caused by factors such as a delay in admission to emergency service, introduction of non-sterile materials to the wound, covering the patient with non-sterile sheets or blankets, or increased susceptibity to NCIs because of nutritional deficits. The overall mortality rate in our burn center was 5.75%. Variations between our results and other studies are likely to be due to

different patient population and severity, various types of industrial development and cultural and life styles. [13] [14] [15] This study was carried out to know the prevalence of different bacterial aetiological agents of burn wound infections with their antimicrobial susceptibility. In the present study, monomicrobial infection occurred in 166 (47.7%) cases. Polymicrobial infection occurred in 182 (52.3%) cases. Among the monomicrobial infections, *P. aeruginosa (3.74%)* was the most common organism obtained. A study conducted by Rajput *et al*. also showed that *P. aeruginosa* (55%) was the most common isolate in burn wound infections, followed by *S. aureus* (19.29%). [16] Among the polymicrobial infections, the combination of *P. aeruginosa* and *S. aureus* was the commonest (17.6%). This is in accordance with the study conducted by Nagoba *et al*. [17]

Antibiotic sensitivity pattern

Pseudomonas aeruginosae

In the present study, among the isolates of *P. aeruginosa* were sensitive to Imipenem (100%), Amikacin (84.72%) and Piperacillin-Tazobactam (8.43%). A study by Agnihotri *et al.* showed Imipenem and Piperacillin-Tazobactam was the most effective drug against *P. aeruginosa.*[18] In the present retrospective study sensitive to Gentamicin (28.09%) and Amikacin (84.72%). This is quite alarming as aminoglycosides are the mainstay of treating *Pseudomonas* sepsis. This finding is similar to the study finding of Branski *et al*. [19]

Staphylococcus aureus

In the present study, all the MSSA were sensitive to Amikacin and Vancomycin. This finding is similar to the study findings of Sarma *et al*. [20] A high degree of Penicillin resistance was noted in our study. In the present study, all 17.84 (100%) MRSA isolates were sensitive to Vancomycin, This finding is similar to the study findings of Shehab *et al.*[21] and Revathy *et al*. [22] All the resistant isolates of *E. coli* and *K. pneumoniae* were extended-spectrum beta-lactamase (ESBL) producers. The percentage of multidrug-resistant (MDR) isolates is probably due to empirical use of broad-spectrum antibiotics and nonadherence to hospital antibiotic policy. Therefore, careful microbiological surveillance and *in vitro* testing before the start of antibiotic therapy and strict antibiotic policy may be of great help in prevention and treatment of MDR isolates in burn units and, thus, reduction of overall infection-related morbidity and mortality. Our survey resulted in detailed descriptions of the occurrence of groups of skin burns. A few specific recommendations can be suggested based on these epidemiologic features. Our ongoing efforts are to promote and support prevention program and look for changes in the incidence of burn injury. In addition, we want to study further the implications of changes in management protocols and policies on the outcomes of our treatment. It would only be such endeavors that the provision of appropriate care for our patients will improve.

4. Competing Interests

The author(s) declare that they have no competing interests.

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