

## **BACTERIAL PROFILE IN BURN WOUNDS WITH SPECIAL REFERENCE TO ANTIMICROBIAL AGENTS AND TOPICAL APPLICATIONS IN A TERTIARY CARE HOSPITAL- A 2 YEAR PROSPECTIVE STUDY**

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### **ABSTRACT**

#### **BACKGROUND**

Burn is one of the most devastating condition. It is seen in all age groups from a baby to the elderly. Burn injuries pose a big challenge to the medical fraternity. Burn injuries can have an effect on the skin, respiratory, cardio vascular, renal, haematological, G.I, musculoskeletal, eye, immune system, metabolism and nutrition. Burns may be Superficial or partial thickness where the epidermis is involved, full thickness when all the layers of skin are involved and deep burn.

#### **MATERIALS AND METHODS**

Total of 64 patients who have attended the OPD and Casualty with burn injuries and given consent for the study were studied in a period of 2 years duration in the Department of Surgery, S.C.B. Medical College and Hospital, Cuttack.

#### **RESULTS**

Burn injury is a common health hazard. These injuries are seen in low socio economic status because of poverty, overcrowding, poor condition of living and ignorance regarding precautions to be taken during fire accidents Incidence is high in females. Male burns are attributed to. Male burns may be attributed to alcohol, smoking and domestic violence which is seen in our study. Burns can be due to accidents, suicidal or homicidal. The percentage of body surface area in burns is calculated as per Wallace rule of nine's. It helps to estimate the percentage of burn and the fluid estimation is done. Burn injuries produce irreversible cell protein denaturation. Cytoplasmic coagulation, blockage of thermolabile enzymes and cell death. Most burn deaths occur in the developing world particularly in South East Asia

#### **CONCLUSION**

Burn injuries are frequently seen. They contribute to almost 20% of admissions in the tertiary care hospitals. In the present study in S.C.B. Medical College and hospital, Cuttack, Odisha female burn patients in the third decade of life was the commonest. Those patients are mostly house wives and they have a close proximity to the kitchen. Some of the deaths were dowry related and are either suicidal or homicidal. As this hospital where the study has been undertaken is a tertiary care hospital, patients are normally referred later. Hence hypovolaemic and neurogenic shock has not been properly dealt in the primary hospitals which adds to morbidity and mortality in these patients. Burn injuries can have an effect on the skin, respiratory, cardio vascular, renal, haematological, G.I, musculoskeletal, eye, immune system, metabolism and nutrition. Burns may be Superficial or partial thickness where the epidermis is involved, full thickness when all the layers of skin are involved and deep burn.

#### **KEYWORDS**

Burn Wounds, Culture and Sensitivity, Antimicrobials, Topical Application.

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#### **BACKGROUND**

Burn is one of the most devastating condition.<sup>1</sup> Burn is a type of injury to skin, or other tissues, caused by heat, cold, electricity, chemicals, friction, or radiation.<sup>2</sup> Normal skin affords an exceptionally effective barrier to the penetration of surface bacteria primarily because of its anatomical structure, antibacterial activity of its secretions and dessication of bacteria on its surface. Burn injuries produce

irreversible cell protein denaturation. Cytoplasmic coagulation, blockage of thermolabile enzymes and cell death.

Burn injury destroys this barrier and provides a favourable portal of entry for bacteria which colonise the surface of the eschar from the environment.<sup>3</sup>

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It is seen in all age groups from a baby to the elderly. Burn injuries pose a big challenge to the medical fraternity. Appropriate and judicious early intervention, treatment protocol and skilled multidisciplinary approach is the need of the hour. An estimated 500000 burn injuries receive treatment yearly in the United States. In India as per WHO, over 10 lakh people are moderately or severely burnt every year and around 1.95 lakh people die due to burns. In 2015, fire and heat resulted in 67 million injuries.<sup>4</sup> This resulted in about 2.9 million hospitalisations and 1,76,000 deaths.<sup>5</sup>

Burn is a coagulative necrosis of surface layers of the body due to denaturation of proteins.<sup>6</sup> Burns can be due to accidents, suicidal or homicidal. Various causes of burns are enumerated as follows. The percentage of body surface area in burns is calculated as per Wallace rule of nines. This rule is easy to remember but accurate in people over 16 years of age. More accurate is the Lund and Browder's charts, which take into account different proportions of body parts in adults and children. It helps to estimate the percentage of burn and the ideal fluid estimation is done routinely as per the Parkland's formula. Thermal burns are commonly seen in our hospitals during the emergency hour. They occur due to dry heat as seen with bursting of gas stoves, gas cylinders. Contact with hot metal, fire crackers etc. Scald burns are due to moist heat mostly due to pouring of hot water, milk and tea. The depth of injury is less compared with thermal burns. The long term outcome is related to the size of burn and the age of the person affected. The severity of injury is related to the intensity of the heat. which is due to temperature, length of exposure and the conduction capacity of the skin at the site of injury. Burns caused by hot liquids are usually partial thickness unless prolonged contact with the causative agent occurs.

In Chemical burns the extent and severity is dependant upon the strength and quantity of the chemical, duration of contact with acids like hydrochloric, sulphuric, nitric acid and alkalis like caustic soda and lime. Electrical burns are due to flash or direct contact with live wires. The extent of injury to the victim depends on the type of current, its voltage and the resistance of the body parts through which the current passes and the duration of contact.<sup>7</sup> Radiation burns are due to excessive doses during radio therapy or nuclear energy accidents. Human skin can tolerate upto temperature 40°C. Temperatures more than 45°C for 20 minutes causes minimal and 60°C for 1 minute causes full thickness burn. Burn injuries can have an effect on the skin, respiratory, cardio vascular, renal, haematological, G.I, musculoskeletal, eye, immune system, metabolism and nutrition. Burns may be Superficial or partial thickness where the epidermis is

involved, full thickness when all the layers of skin are involved and deep burn. Burn wounds are sterile. Various environmental factors are responsible for wound contamination. During hospital stay wound infection goes on increasing. First invaders are staphylococcus which is acquired from hospital staff and attendants or from the patient himself or herself which transmits the infection Gram positive (Staphylococcus aureus) were seen to invade the upper 1/3 of the body while the lower 2/3 showed more of gram negative organisms. In later stages wound infection was mostly from the hospital environment. Staphylococcus aureus may spread from patient to patient on the protective clothing of the staff and by dispersal into the air. E.coli and pseudomonas were the common organisms isolated from the environment which are responsible for wound infection. Bed pans, I.V. sets, bottles, basins, windows and other instruments showed gram negative organisms which are acquired from infective dressings as cross infection. Treatment depends on the severity. Tetanus prophylaxis. Pain medications, intravenous fluid therapy and tetanus prophylaxis can help patients recover soon.<sup>8</sup>

Incidence of invasive burn wound infections has decreased in recent years. Age group patients have a worse prognosis.<sup>9</sup> Infections in burn patients continue to be the primary source of morbidity and mortality. Topical antimicrobial therapy remains the single most important component of wound care in hospitalised patients. The goal of prophylactic topical antimicrobial application is to control microbial colonisation and prevent burn wound infection. In some cases these agents are used to treat incipient or early wound Wound infections caused by pseudomonas aeruginosa formerly very common have become very rare with the advent of newer effective antibiotics.<sup>10</sup> The colonisation of burn wounds by klebsiella, enterobacter, E.coli, proteus sp. and other organisms has decreased during this period causing a major septic threat to burn patients. Sepsis is the systemic manifestation of uncontrolled infection. Sepsis in the burn patient is a life threatening situation and requires early recognition and immediate therapy. Early sepsis may be difficult to recognise in a burn patient. Consequently burn wound inspection for evidence of sepsis should be done daily. The ongoing outbreak of hospital acquired infection was significantly reduced after strictly adhering to the guidelines for controls for hospital acquired infections.<sup>11</sup>

Specimens for culture are collected from atleast 3 to 4 sites and sent for examination. They are collected in clean swab sticks. Bacterias most frequently isolated from burn wounds are Staphylococcus aureus, Pseudomonas, E.coli and Enterobacter. Cross infection occurs due to breakdown of aseptic technique, staff hands contaminated baths and bed linens.<sup>12</sup> Increase in age and paediatric age group patients have a worse prognosis.<sup>9</sup> Infections in burn patients continue to be the primary source of morbidity and mortality. Topical antimicrobial therapy remains the single most important component of wound care in hospitalised patients. The goal of prophylactic topical antimicrobial application is to control microbial colonisation and prevent burn wound

infection. In some cases these agents are used to treat incipient or early wound infections.<sup>13</sup> An ideal topical agent should demonstrate activity against the commonly encountered bacteria in the burn wound. It should have a wide spectrum of action, least toxic, penetrate the eschar easily and drug resistance should be minimal even after prolonged use. They should be affordable, painless and should not stain the wound.

Prophylactic anti-microbial treatment is given to all patients admitted to the hospital because of low sanitary status of the wards and poor personal hygiene of patients. Frequent bacterial monitoring of the burn wound should be performed to determine the most likely pathogen. The antibiotic should be considered as per the culture and sensitivity report. Even tips of indwelling I.V. catheters and urinary catheter also should be cultured. There should be a good coverage of gram positive and gram negative bacteria to achieve a good success rate. It is seen that bacteria can pass through 64 layers of gauze. Closed dressings increase the risk of infection by allowing bacterial growth in the warm, humid and dark milieu beneath the dressings.<sup>14</sup> Hence culture and sensitivity should be taken after the dressings are removed and the topical agents are removed from the wound.

**Aims and Objectives**

The aims and objectives of the study are to enumerate the different causes of burns, pathogens infecting burn wounds, topical agents used for dressing and antimicrobial used for the treatment and cure of these patients.

**MATERIALS AND METHODS**

A prospective study was conducted with 64 patients in the Department of Surgery, S.C.B. Medical College and Hospital, Cuttack, Odisha from April 2014 to March 2016. According to the recommendations of American Burn Association, those who sustained minor burns (2° burn less than 10% and 3° burn less than 2%) were treated as outpatient and not included in the study. Only those patients who were admitted to this hospital and survived the stage of shock and who had sufficient follow up (minimum of 7 days) were considered eligible for the study after taking due consent from the patient. Those patients who died within seven days

of follow up were regarded as incomplete follow up and hence were excluded from the study.

The site of sampling was chosen from the basis of clinical suspicion. The areas were gently cleaned with normal saline to remove previously applied topical medications and any loose debris. Autoclaved swab sticks were gently rubbed over the wound. In all cases cultures were taken from the latter half of the first week as almost all burn wounds get infected after the third day. The swabs were then immediately transported to the laboratory and were plated within 30 minutes. No transport medium was used. Prophylactic anti-microbial treatment is given to all patients admitted to the hospital because of low sanitary status of the wards and poor personal hygiene of patients. One or more antibiotics were administered systemically in all patients from admission to the time of discharge or death. Quinolones, penicillin's, cephalosporin's alone or with an aminoglycoside and carbapenems with or without metronidazole were given. They were converted to oral form when oral feeding was given. A chosen antibiotic was continued for a variable length of time after regular culture and sensitivity examination. Antibiotics were changed only if a course of two week therapy was completed, if culture grew microbes resistant to the drug, if systemic signs of sepsis supervene in spite of antibiotics, if the drug was contraindicated by the emergence of burn complications such as renal failure, if the patient showed adverse reaction to the drug and if the patient could not afford to purchase the drug.

**Inclusion and Exclusion Criteria**-Those who sustained minor burns (2° burn less than 10% and 3° burn less than 2%) were treated as outpatient and not included in the study. Only those patients who were admitted to this hospital and survived the stage of shock and who had sufficient follow up (minimum of 7 days) were considered eligible for the study. Those patients who died within seven days of follow up were regarded as incomplete follow up and hence were excluded from the study.

**RESULTS**

A total of 64 patients were reviewed and included in the study. The different aspects of this study were documented in tables below.

Age in Years	Male	Percentage	Female	Percentage	Total	Percentage
5-10	1	1.56	2	3.13	3	4.69
11-20	2	3.13	8	12.50	10	15.63
21-30	4	6.25	22	34.38	26	40.63
31-40	2	3.13	15	23.44	17	26.56
41-50	1	1.56	4	6.25	5	7.81
>50	1	1.56	2	3.13	3	4.69
<b>Total</b>	<b>11</b>	<b>17.19</b>	<b>53</b>	<b>82.81</b>	<b>64</b>	<b>--</b>

*Table 1. Shows the Incidence of Burn in Different Age and Sex (N=64)*

Patient status (Male and female)	Number of Cases	Percentage
High	1	1.56
Middle	22	34.38
Low	41	64.06

*Table 2. Shows the Incidence of Burn in Different Socio Economic Status*

Causative Agent	Number of Cases	Male	Female	Percentage
<b>Fire</b>	49	5	44	76.56
* Flame Burns	33	3	30	67.35
* Bursting of – stoves, gas cylinders	10	1	9	15.63
* Accidental gas leak	3	0	3	6.12
* Fire accidents	3	1	2	6.12
Boiling liquid	11	2	9	17.19
Electricity	3	3	0	4.69
Chemical	1	1	0	1.56
<b>Total</b>	<b>64</b>	<b>11</b>	<b>53</b>	<b>--</b>

*Table 3. Shows the Aetiology of Burns*

Nature of Injury	Number of Cases	Percentage
Accidental	58	90.63
Homicidal	4	6.25
Suicidal	2	3.13
<b>Total</b>	<b>64</b>	<b>--</b>

*Table 4. Shows the Type of Burn Injuries*

Microbial Organisms	Organisms Isolated	Percentage
Pseudomonas aeruginosa	25	39.06
Staphylococcus aureus	19	29.68
Eschrichia coli	2	3.13
Proteus	1	1.56
Klebsiella	1	1.56
Mixed organisms	16	25

*Table 5. Shows the Organisms Isolated from Culture and Sensitivity Examination of Pus*

Topical Agent	Number of Cases	Efficacy	Percentage
Silversulphadiazine + chlorhexidine	24	11	45.83
Colloidal silver	30	16	53.33
Mupirocin	4	2	50
Framycetin	3	1	33.33
Povidone Iodine	3	1	33.33

*Table 6. Shows the Choice of Antimicrobial*

Antibiotics	Number of Cases	Efficacy	Percentage
Penicillin (Tazobactam + Piperacillin)	20	12	60
Quinolones	4	1	25
Cephalosporins	6	2	33.33
Cephalosporins + Aminoglycosides	9	4	44.44
Carbapenems (Meropenem, Imipenem)	25	19	76

*Table 7. Shows the Choice of Systemic Antibiotics*

Extent of Burn in Percentage	Total Number of Cases	Total Number of Patients Improved		Total Number of Patients Succumbed		Percentage Mortality in Each Group
		Male	Female	Male	Female	
11-20	4	1	3	0	0	0
21-30	8	2	6	0	0	0
31-40	8	2	5	0	1	12.5
41-50	16	2	7	3	4	25
51-60	18	2	4	5	7	34.03
61-70	6	0	2	1	3	50
>70	4	0	1	0	3	75
<b>Total</b>	<b>64</b>	<b>9</b>	<b>28</b>	<b>9</b>	<b>18</b>	<b>42.19</b>

*Table 8. Shows the Mortality in Burn Patients*

**DISCUSSION**

Burn injuries are common in third decade of life (26.56%) in 26 cases out of total 64 cases. Females are the most sufferers. Many of the patients in this series are house wives because of the close proximity to kitchen and dowry related

deaths. Male deaths are due to alcohol abuse, smoking and domestic violence. Burn injuries are more common in low socio economic status because of their poverty, leading to overcrowding, poor condition of living such as thatched houses and ignorance regarding precautions to be taken

during fire accidents. Household accidents are commonest amongst house wives of middle socio economic status. The small size of the kitchen and lack of precautions many a time lead their sarees or dresses to catch fire accidentally. Amongst 64 cases, 49 sustained fire injury (flame burns), out of which 33 cases were male patients (76.56%), due to flame burns (76.56%) and 30 female patients (67.35%).

This is followed by 16 patients who come with household accidents out of which there were 14 female and 2 male patients. They had suffered these burn injuries due to bursting of gas stoves and gas cylinder, accidental gas leak or fire accidents. The incidence of scalds were seen in women and small children (17.9%) and electric burns (4.69%) were comparatively much lower. They were predominantly found in males who happened to meet them as professional hazard. Electric burns are due to poor working conditions by electricians and accidental handling of live wires who require a very careful monitoring even if they appear to be small. Ninety percent of the burn cases encountered in this study were accidental in nature, either due to outbreak of fire or household accidents, electric burn etc. We had 4 cases of homicidal burns and 2 cases of suicidal burns in our study.

The culture of pus from burn wounds in this series showed a predominance of pseudomonas in 39.06% of cases as an isolated colonisation. Infection with staphylococcus showed 29.68%. Escherichia coli, proteus, klebsiella were encountered in varying numbers but their incidence is much less than that of pseudomonas and staphylococcus. Wound colonised with mixed organisms in this study was 25%. The mixed colonisation was mostly associated with pseudomonas, staphylococcus and E.coli. Out of a range of topical antimicrobial agents which are available for application in burn wounds, amorphous hydrogel wound dressing with colloidal silver is mostly chosen and found to be effective in 53.33%. Colloidal silver is now a days used in most of the centres than other topical agents. Silver seems to be the only anti-bacterial that works effectively in the treatment of burns without damaging the surrounding skin and flesh Mupirocin seems to be an effective topical antimicrobial in the present series. The high cost of this ointment could not be afforded by many of our patients who belong to lower socio economic status. In this study the efficacy of silver sulphadiazine and chlorhexidine is 45.83%. Framycetin and Povidone iodine preparations show an equal efficacy (33.33%) in this study.

Injectable Carbapenems were considered as a first choice antibiotic considering the wide spectrum of activity and less chance of resistance. Meropenem 3 gms in equally divided doses was used and found to be more effective (76%) than other antimicrobials. The dose modification was needed in patients whose renal status was impaired. Tazobactam and piperacillin showed 60% efficacy in this series but Quinolones were found to be least effective (25%) because of rampant use and early resistance. Carbapenems are beta-lactam anti-microbial. They have a broad spectrum activity. They have a good coverage against most of the organisms. Burn wounds with pseudomonas aeruginosa infections

require additional antibiotics along with carbapenems for a better coverage and early recovery.

This table shows the mortality increase as the extent of burn injury increases. The mortality among females is more compared to males in all group. Therefore the morbidity and mortality is directly proportional to the percentage of burn surface area. An increase in percentage of burn surface area also causes increase in sepsis due to proliferation of pathogens in the burn wound which later on leads to septicaemia. However mortality is due to septicemia which is because of sepsis. This leads to systemic inflammatory response syndrome and finally patient has a multiorgan dysfunction syndrome. The percentage of burns affecting the body surface area plays a key role in determining the outcome of the burn injury and the possibility of infections there in. More the percentage of burns, high is the morbidity and mortality.

### CONCLUSION

The study to establish the role of bacterial profile in burn wounds was done to know the causative organism infecting burn wounds so that an early antibiotic treatment can be initiated. Judicious use of topical applications should be done after proper cleaning of the burn wound. Bacteria usually harbour in between the wound and the topical agent. Hence the wounds should be thoroughly cleaned during every dressing and serial culture and sensitivity study done. This helps in maintaining personal hygiene, proper wound care, shorter hospital stay, early recovery and thus prevents morbidity and mortality. This series supports the excellent outcome obtained by early culture and sensitivity of the burn wound, careful consideration of the topical agent and antibiotic treatment obtaining low morbidity and good results. The highest rates occur in women 16-35 years of age. This is related to unsafe kitchen and loose fitting clothing in India.<sup>15</sup> It is also estimated that one-third of all burns in India are due to clothing catching fire from open flames.<sup>16</sup> This study also shows equal results as compared to the age, sex and cause of fire. Majority of the patients recovered as they were effectively managed in this series. Colloidal silver is found to be effective in treatment of burns in this study which is also similar to the available data.<sup>17</sup> Carbapenems are beta-lactam anti microbials. They have a broad spectrum activity. They have a good coverage against most of the organisms.<sup>18</sup> which is also seen in this study. Burn wounds with pseudomonas aeruginosa infections require additional antibiotics along with carbapenems for a better coverage and early recovery from septicaemia.

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