Original Research Article

A study on treatment profile and covariates of outcome of burn injury in a Tertiary Medical hospital in West Bengal

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Abstract

Background: Burns are a global public health problem due to its high mortality, morbidity and disability amongst young and middle-aged adults. **Objective**: The study was planned to understand of relevant underlying factors responsible for burn injuries, the treatment profile and covariates of outcome of burn injury. **Method:** A cross-sectional design and hospital based study was undertaken in the burn wards under the Department of Plastic Surgery in a tertiary care government hospital over a period of one year from 1st May 2020 to 30th April 2021 on patients of recent burn injuries. Data entry and statistical analysis were done using SPSS version 20.0. Descriptive statistics (frequency, percentage, mean and standard deviation) were used primarily to summarize and for analytical statistics, Chi-square was used. Univariate and multivariate logistic regression were applied and Odd's ratio(OR) and adjusted Odd's ratio (AOR) were calculated in 95 % confidence interval. **Result:** Only 22.8% patients reached hospital within 1 hour of the injury event. Application of medical ointment over the burnt skin surface was done for around one fourth (23.6%) of the study population prior to reach hospital. Mean duration of hospital stay was 40.5 days which ranged from less than 1 day to maximum 196 days. Wound infection (44.7%) followed by septicaemia (33.7%) were the two most common complications prevalent among the study population. Pseudomonas aeruginosa (38.3%) was the most common organism responsible for wound infection. **Conclusion:** The current study also found very poor outcome related to burn injuries in terms of survival (mortality rate: 39.5%), which is not related to the severity of injury only but others factors like delaying in hospitalisation, improper pre-hospital burn care is also responsible for high fatal outcome associated with burn injury.

Keyword: Burn; Mortality; Morbidity; Outcome

Introduction

Burns are a global public health problem due to its high mortality, morbidity and disability amongst young and middle-aged adults. Fire related injuries account for 6% of injury deaths and are responsible for approximately 240,000 fatalities worldwide each year – the vast majority occurs in low and middle income countries[1]. In many high-income countries, burn death rates have been decreasing, and the rate of child deaths from burns is currently over seven times higher in low- and middle-income countries than in high-income countries. Burns are among the leading causes of disability-adjusted life-years (DALYs) lost in low- and middle-income countries. Non-fatal burn injuries are a leading cause of morbidity including prolonged hospitalization, disfigurement and disability, often with resulting stigma and rejection.

South Asia is at the epicenter of the burn crisis, where more children die from severe burns than from HIV/AIDS, malaria and respiratory disease; 65 percent of those dying are girls. South-East Asia (SEAR) also accounts for more than 50% of the total number of DALYs lost globally to fire-related burns. Females in the countries of the South-East Asia Region (SEAR) have the highest fire-related burn mortality rates worldwide accounting for 27% of global burn deaths and nearly 70% of burn deaths in the region. Nearly 173 000 Bangladeshi children are moderately or severely burnt every year.

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Burns are the second most common injury in rural Nepal, accounting for 5% of disabilities. The number of DALYs lost to fire-related burns by females in the low and middle-income countries of South-East Asia (SEAR) exceeds the number lost by both sexes in any other region. Over 50% of the total number of DALYs lost globally to fire related burns are among children aged between 0–14 years and children under 5 years of age account for a little over 15% of fire-related deaths worldwide. South-East Asia (SEAR) alone accounts for just over one-half of the total number of fire-related burn deaths worldwide. Burns occur mainly in the home and workplace majority of which are preventable[1]. Thus severe burns remain a hidden health crisis in developing countries, particularly among poor women and children of South East Asia.In India alone, burns are the third leading cause of burden of disease and the seventh leading cause of death for school-aged children[2]. In India, exact number of burns is difficult to determine. According to WHO over 1000,000 people are moderately or severely burnt every year but prevention programs are almost non-existent. Estimation by Ahuja[3] suggests that India with a population of over one billion has 700,000-800,000 burns admissions annually. Burn injuries result in both local and systemic responses in the human body. Depending on the severity, burn injuries can lead to variable degrees of damage in the skin and adjacent tissues. The three zones of a burn were described by Jackson[4]. Zone of coagulation is irreversible tissue loss due to coagulation of the constituent proteins. This occurs at the point of maximum damage. Zone of stasis is surrounding zone of stasis is characterised by decreased tissue perfusion. The tissue in this zone is potentially salvageable. The main aim of burns resuscitation is to increase tissue perfusion here and prevent any damage becoming

irreversible. Additional insults such as prolonged hypotension, infection, or oedema can convert this zone into an area of complete tissue loss. Zone of hyperaemia, the outermost zone tissue perfusion is increased. The tissue here will invariably recover unless there is severe sepsis or prolonged hypo-perfusion. These three zones of a burn are three dimensional, and loss of tissue in the zone of stasis will lead to the wound deepening as well as widening.The release of cytokines and other inflammatory mediators at the site of injury has a systemic effect once the burn reaches 30% of total body surface area. Capillary permeability is increased, leading to loss of intravascular proteins and fluids into the interstitial compartment. Peripheral and splanchnic vasoconstriction occurs. Myocardial contractility is decreased, possibly due to release of tumour necrosis factor. These changes, coupled with fluid loss from the burn wound, result in systemic hypotension and end organ hypoperfusion. Inflammatory mediators cause bronchoconstriction, and in severe burns adult respiratory distress syndrome can occur. The basal metabolic rate increases up to three times its original rate. This, coupled with splanchnic hypoperfusion, necessitates early and aggressive enteral feeding to decrease catabolism and maintain gut integrity. Non-specific down regulation of the immune response occurs, affecting both cell mediated and humoral pathways.

Most of the studies on burn injury focus on nature and severity of burns, though some studies done with an epidemiological point of view have recognized burn injury as a preventable health problem associated with demographic, socio-economic, behavioural and environmental risk factors. But, most of these studies were undertaken in the developed world where prevalence of burn injury is less than the South - East Asian region. India is socio-demographically and environmentally different from those countries and also the medical set-up and behavioural characteristics of people are different here. Literature review shows very few research works on burns in India and almost none in this part of country. So, there was a need for undertaking a study for better understanding of relevant underlying factors responsible for burn injuries, the treatment profile and covariates of outcome of burn injury which would help to recommend various measures for its prevention at different levels and also to make recommendations for proper development of a comprehensive health care system to reduce the number of burn deaths and disabilities in all sections of the society.

Methods

A cross-sectional descriptive hospital based study was undertaken in the burn wards under the Department of Plastic Surgery in a tertiary care government hospital. The study was conducted for a period of one year from 1st May 2020 to 30th April 2021 on patients of recent burn injuries whose admission and outcome (in terms of discharge or death) both occurred. After initial face to face interview all the patients were followed up during their stay in the hospital and their outcome was recorded. The Institutional Ethics Committee of Medical College, Kolkata reviewed the proposal for ethical consideration and approval was obtained prior to the study. Written consent was taken from all the respondents before data collection process

The patients admitted with recent burn injuries (sustained burn within 7 days prior hospitalisation) and the patients or caregivers of the patients (in case of seriously ill patient) who gave consent for the study was included and the patients who admitted for reconstructive surgery with past history burn injury, the patients expired after getting admission before being subjected to the first face-to-face interview by himself or through his/her caregiver and the patients who were too morbid to respond and did not found to have any accompanying caregiver in three consecutive visits was excluded from this study.

A pre-designed, pre-tested semi-structured schedule was developed reviewing the questionnaires which have been used in similar earlier studies and different articles related to burn injury.The questions were directed towards gaining information regarding demographic data, social history, cause/intention of injury, associated medical conditions, type of burn injury, mechanism/circumstance of injury, pre-hospital care, presence of associated injury and other relevant factors related to the injury. Secondary data were collected from hospital records were regarding pathological and biochemical investigations, initial and definitive treatment, duration of hospital stay, complications, and outcome of the patient. The schedule was drawn up in English, translated into Bengali, and then retranslated in English with help of two separate linguistic experts to retain the original meaning after translation in Bengali. Thus semantic equivalence was ascertained. Pretesting done on 10 burn patients comparable with study population in order to identify any problems with the wording and feedback was obtained on potential difficulties when answering the questions. The participants were asked the same questions as the actual study participants. They were asked to comment on any difficulties they face in understanding the questions. No major adjustments were brought to the schedule after pretesting; only minor corrections were done in order to make the tool more simplified by removing ambiguity. Face validity for each item and content validity for each domain was ensured by taking suggestions from experts. The questionnaire was amended according to the suggestions. To ensure reliability, the questionnaire was pre-tested on 10 similar patients before the actual data collection was started and the internal consistency was analyzed by using Cronbach's Alpha Coefficient. The overall Cronbach's Alpha Coefficient value was 0.62.The researcher maintained a study logbook to record the identification information (name, unique interview number, bed number, and patient's registration) for all patients being interviewed day by day. Additional observations and reminders were also recorded in the logbook. In every visit the names and bed number of patients who had been admitted in burn wards since previous visit were noted down in the study logbook maintaining the sequence of admission register of burn ward. The study subjects were selected using systematic random sampling.

The medical records of patients were accessed on several occasions. The patient's Bed Head Ticket (BHT) was accessed to record information regarding the admission date of admission, TBSA, Depth of injury, presence or absence of inhalation injury, laboratory investigations, amount of blood transfused, treatment given including surgery, complications and outcome. When the patient was discharged, transferred or died, the ward nurses sent the BHT to the record section after few days. At this stage the file was accessed by the researcher and the above-mentioned data were transcribed.

The respondents were explained in detail the full description of the research, confidentiality and voluntary participation. Data entry and statistical analysis were done using SPSS version 20.0.The questionnaires were weighed against the database to check the accuracy of the data entry a minimum of two times. Any error found was corrected before the actual analysis. Descriptive statistics (frequency, percentage, mean and standard deviation) were used primarily to summarize and describe the data to make it more graspable. For analytical statistics, Chi-square was used where appropriate. Univariate and multivariate logistic regression were applied and Odd's ratio(OR) and adjusted Odd's ratio (AOR) were calculated in 95 % confidence interval. For all the statistical tests of significance, p value of <0.05 was considered to reject the null hypothesis.

Result

Only 22.8% patients reached hospital within 1 hour of the injury event. Majority (41.7%) reached hospital within 1 to 3 hours after the injury. 28.5% patients reached hospital within 3 to 6 hours and 7% patients reached hospital even after that. Application of medical ointment over the burnt skin surface was done for around one fourth (23.6%) of the study population prior to reach hospital. Cooling with water was done in case of 190 (47.2%) patients. Application of toothpaste (12.4%), application of mud (2%) and application of cow dung (1.5%) were also practised as first aid for wound care among the study population. Duration of hospital stay in case of majority of the patients was between 4 to 8 weeks. Around 22.6% patients stayed in the hospital for more than 8 weeks. Mean duration of hospital stay was 40.5 days which ranged from less than 1 day to maximum 196

days. Debridement was the most common (63.5%) surgery performed among the patients under the study followed by STSG (34.5%). MTP was done in case of 12 pregnant women. [Table 1]

Table 1: Distribution of study population according to treatment profile (n= 403)

	Frequency	Percentage (%)
Time Gap (Hours):		
• <1	92	22.8
• 1-3	168	41.7
• 3-6	115	28.5
• 6-24	26	6.5
• >24	2	0.5
Treatment Given:		
• Cooling with water	190	47.2
• Application of medical ointment	95	23.6
• Application of toothpaste	50	12.4
• Application of mud	8	2.0
• Application of cow dung	6	1.5
• Nothing	72	17.9
Duration of hospital stay:		
• Up to 7days	74	18.4
• 1wk-2wk	35	8.7
• 2wk-4wk	64	15.9
• 4-8wk	139	34.5
• >8wk	91	22.6
[Mean ± SD (Range)-40.5±35.04 (<1 -196) Days]		
Surgery Done:		
• Debridement	256	63.5
• STSG	139	34.5
• Limb amputation	22	5.5
• Eye amputation	5	1.2
• MTP	12	3.0
• Others	9	2.2
• No Surgery	183	45.4

Wound infection (44.7%) followed by septicaemia (33.7%) were the two most common complications prevalent among the study population. Mortality was associated with 39.5% patients of burn injuries in the study. Rest were discharged from the hospital after improvement. Pseudomonas aruginesa (38.3%) was the most common organism responsible for wound infection followed by E-Coli (26.7%). [Table 2]

Table 2: Distribution of study population according to occurrence of covariates of outcome of injury (n=403)

Variable	Frequency	Percentage (%)
Complications:		
• Wound infection	180	44.7
• Septicaemia	136	33.7
• Renal Failure	32	7.9
• Electrolyte imbalance	64	15.9
• Loss of vision	18	4.5
• Loss of limb	22	5.5
• Others	11	2.7
• No such complication	149	37
Outcome:		
• Improvement (Discharged)	244	60.5
• Death	159	39.5
(Disabilities resulted due to the injury event was not considered.)		
Organisms: (n=162)#		
• Pseudomonas aruginesa	69	38.3
• E-Coli	48	26.7
• Klebsiella	39	21.7
• Proteus Vulgaris	23	12.8
• Acinetobactor Bauminni	19	10.5
• Staphylococcus Aureus	8	4.4
• Others	12	6.6
(Not mutually exclusive # Wound culture not done in case of 161 patients and the result came negative in case of 62 patients.)		

Around 39.2% patients were transfused 1-3 units of blood and 37.7% patients were transfused 4-8 units of blood. More than 12 units of blood transfusion were given in case of 5.7 % patients. Mean haemoglobin level of the study population at admission was 11.05 gm% and on an average 4.21 units of blood transfusion was done for each patient. [Table 3]

Table 3: Distribution of study population according number of blood transfusion and percentage of TBSA burnt (n=403):

TBSA burnt	Blood Transfusion (units) Number (%)					Total Number (%)
	0	1-3	4-8	9-12	>12	
<25%	24 (18.3)	58 (44.3)	45 (34.3)	2 (1.5)	2 (1.5)	131 (100)
25-50%	10 (6.5)	57 (37.2)	63 (41.2)	12 (7.8)	11 (7.2)	153 (100)
51-75%	2 (2.8)	22 (30.5)	36 (50%)	4 (5.5)	8 (11.1)	72 (100)
>75%	16 (34)	21 (44.7)	8 (17.0)	0	2 (4.2)	47 (100)
Total	52 (12.9)	158 (39.2)	152 (37.7)	18 (4.5)	23 (5.7)	**403 (100)**
Mean (± SD) Blood transfusion = 4.21 (± 3.62) units						

Involvement of head and/or neck region, history of non cotton clothing at the time of injury and presence of associated inhalational injury found to be major predictors of adverse outcome (mortality) of burn injury in the multivariate logistic regression model. Each of these three covariates found to be associated with more than 4 times risk of mortality among the study population. Patients who reached the hospital after three hours of the injury event had 2.5 times risk of mortality with compare to the patients who reached hospital within three hours. Around three times more risk of mortality was found among the patients with third degree burn with compare to patients of first and second burn. Presence of pre-existing chronic diseases increased the risk of mortality by 2.4 times among the study population. Greater involvement of TBSA and higher haemoglobin level on admission were also found to increase the risk of mortality significantly. Duration of hospital stay was in inversely related with the mortality. [Table 4]

Table 4: Covariates of outcome of burn injury- Multivariate logistic regression model (n=403)

Independent Variables		Outcome Number (%)		AOR	Lower CI	Upper CI
		Death	Improvement			
H/O chronic diseases	Present Absent (ref)	55(13.7) 104(25.8)	57(14.1) 187(46.4)	2.374	1.137	4.955
Type of Clothing	Synthetic Cotton (ref)	93(23.1) 66(16.4)	42(10.4) 202(50.1)	4.847	2.483	9.463
% of TBSA involvement	Continuous	-		1.088	1.062	1.115
Depth of injury	3rd degree 1st& 2nd degree (ref)	72(17.9) 87(21.6)	46(11.4) 198(49.1)	3.022	1.5	6.086
Head and Neck involvement	YesNo (ref)	134(33.2) 25(6.2)	74(18.4) 170(42.2)	4.951	1.957	12.528
Smoke inhalation	Present Absent (ref)	56(13.9) 103(25.6)	57(14.1) 187(46.4)	4.652	2.204	9.817
Time elapsed before hospitalization	>3hrs <3hrs (ref)	91(22.6) 68(16.9)	52(12.9) 192(47.6)	2.548	1.324	4.906
Hb%	Continuous	-		1.312	1.119	1.493
Duration of Hospital stay	Continuous			0.951	0.934	0.968

*Nagelkerke R Square=0.57

#The model was adjusted for age, sex, presence of visual or hearing problem, cause of injury, contact time with the agent and type of pre hospital treatment.

Discussion

Most studies from the India and abroad have reported mean hospital stay ranging from 11-16 days[5,6,7] which is quite lower than the present study findings (40 days) though a study from Punjab, India[8] has reported similar finding. The reasons for the longer hospital stay in the current study may be due to the lower mortality rate in compare to those studies.

In the present study mortality was reported around 40% which was lower than the fatality rate reported by most of the studies from other part of India[9,10]. In-hospital mortality was 40 % in this study could be considered high compared to mortality rates reported around the world. Hospitals in India is not structured, equipped and staffed to provide the best quality of care for burn patients.Studies from high income countries report a much lower mortality than the current study such as 2% in Australia [34], 3% in Sweden[11] and Taiwan[12], 4% in Portugal[13] and the United States[14] and 6% in the UK[15].

As it is generally recognized that burn size is the strongest predictor of death, it may be more appropriate to report in-hospital mortality in relation to TBSA burnt. However, various studies published on burn epidemiology report TBSA and its relation to mortality in different ways that makes comparisons difficult. TBSA burnt is usually reported as mean or median, or only by various categories. Probably it will be more useful to report the distribution of TBSA in mean or median (depending of its distribution) as well as in deciles of TBSA. It will also be more useful, both for research and clinical purposes, to report in-hospital mortality by different centiles of TBSA burnt (deciles, quintiles or quartiles). When the TBSA burnt is greater than 50%, very few patients survive in India while it is not so in other countries. It is obvious that with higher percentages of TBSA involvement survival at burn centres of India is worse than developed countries[12,13].

In the present study in hospital mortality was found to be significantly associated with nylon or mixed type of clothing during the injury event, presence of inhalational injury, increased contact time with the injury agent, presence chronic diseases, higher TBSA and depth of burn, involvement of head and neck region and improper pre-hospital treatment. According to Sharma[16], compared to TBSA below 50%, the odds ratio for death for TBSA 70-89% was 4.1 and that of TBSA≥90% was 23.0. Although most of studies[9,10,17] have reported the association of TBSA burnt and death in different categorizations, all results indicate that TBSA burnt is a strong risk factor for death. The mean TBSA burnt in admitted patients was 42% and 45% of the study population had a TBSA involvement >40%. The TBSA burnt was significantly greater in females, young adults aged

15-29 years, flame burns and in intentional self-harm burns. The mean TBSA burnt reported from the other countries is variable and ranges from 10% to 48%(5)[18,19]. This variation in TBSA burnt is probably due to variations in distribution of the predictions of TBSA i.e. sex, age, mechanism and intent. Most of the other studies from India[17] show more TBSA involvement in case of female which is consistent with the present study finding Brusselaers et al[12] have reported that old age is a significant risk factor for death. The adjusted odds ratio for age of 60 and over is reported as 16.9 but only 8% of patients in the current study were 65 and over and age lost its significance in the adjusted model. Probably the higher odds ratio of the above study is due to difference in age distribution. In the high-income countries more people survive to older age and may have more co-morbidities than the older population of the current study.

In the present study delay in reaching hospital found to have adjusted odds ratio of 2.5 with compare to patients who reached hospital within 3 hours. Delayed arrival to health care may deprive patients from the benefits of emergency treatment such as resuscitation and dressing. Such patients may also be more likely to have wound contamination because of lack of dressing. Delay to hospital has been described as a significant risk factor for death by some researchers.

Conclusion

The current study also found very poor outcome related to burn injuries in terms of survival (mortality rate: 39.5%), which is not related to the severity of injury only but others factors like delaying in hospitalisation, improper pre-hospital burn care (like application of mud, cow dung, and tooth paste) is also responsible for high fatal outcome associated with burn injury. Some other factors like presence of chronic diseases like diabetes (7.7%), use of non-cotton clothing (33.5%), presence of associated inhalational injury (16.6%) is also found to be associated with high mortality among burn patients. Lack of sophisticated burn treatment facility in India is a matter of serious concern.

Limitation

As the study was undertaken in an apex referral hospital it is likely that minor burns have not attended the burns centre but reported to the other health centres in the city. Secondly, this study was undertaken in tertiary care hospital of West Bengal. The results could not be automatically generalized to other parts of India as it is a vast country with huge socio-cultural diversity within it. Thirdly, information bias leading to misclassification is theoretically likely because some patients might have denied the true intent of their injury. The need to produce a police report and the legal implications of intentional self-harm might have strengthened this probability.

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