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ORIGINAL ARTICLE

Comparative Analysis of the Risk Factors among Survivors and Non-Survivors Burned Children

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ABSTRACT

Background: Burn trauma in children results into high mortality and morbidity with lifelong consequences. Lack of health care facilities, equipped burn centers, illiteracy, poor infra structure and involvement of girls in cooking activities at early age are potentiating factors towards high mortality.
Objectives: To determine key factors resulting into high mortality in children
Study Design: Cross-sectional study
Place and Duration of Study: Department of Paediatric Surgery Sahiwal Teaching Hospital & Sahiwal Medical College Sahiwal from 1st May 2019 to 28th February 2022.
Methodology: One hundred and eighty four patients upto the age of 12 years with more than 10% partial thickness burn and less than 10% full thickness burn and any percent electric burn were included. Age, sex, presence of inhalation injury, total burn area, development of wound infection, sepsis, mode of burn, surgical intervention and length of hospitalization were all used to predict mortality. Resuscitation was done according to ATLS guide lines on admission. Topical treatment and intravenous antibiotics were given. Fasciotomy was done wherever needed. Wound swab was taken culture sensitivity on 5th day.
Results: Overall mortality was 18.47%. Eighteen (53%) of non-survivors were 3-7 years. Mortality was high in females (61.67%). With regards to cause of burn, flame burns remained at the top in survivors (48%) while scalds in non-survivors (61.76%). 50% of patients presented with partial thickness burn (75/150) in survivors while 50% (17/34) with mixed burns in non-survivors. Mean total body surface area burn was 14.9% in survivors and 40.6% in non-survivors. Non-survivors presented late as compared to survivors. Hospital stay for survivors ranged from 1-28 days while non-survivors stayed 3-18 days before death (Mean 5.9 and 7.4 days) respectively.
Conclusion: Age less than 7 years, females, scald burn, delayed presentation, full thickness or mixed burns with burn surface area more than 40% are significant risk factors for high mortality in burned children.
Keywords: Burn, Children, Mortality, Sepsis, Scald

INTRODUCTION

Accidents and burn injuries have been reported worldwide with a high prevalence rate. Burns listed as the world's fourth most common trauma condition post road accidents and fall or abuse.[1] Incidence of death by burn injury in third world countries (TWC) or developing countries have been estimated at 11 times ascend than developed countries. Within these developing countries the incidence of burns through fire accidents is much more prevalent[2,3] and causes disability.[4] Nearly half of the population with severe burn are children under 5 years and account for 50- 80% of entire childhood burn injuries.[5]

Burns as blisters and flame injuries in school going children attributes to 60-75% of hospital emergent cases with a two-time high fold of boys being involved in such burns than girls.[6] However, there are few studies reporting high female death rate consequent to burns[7] while other studies report no variance.[8]

The gender, age, burn-surface area, presence of inhalation-injury, comorbidities, associated trauma as well as pneumonia are considered as risks for burn patients mortality with differences occurring in adults and young children.[9] There are three main reasons due to which burn patients die; chock formation due to burn within early hours of injury if not resuscitated properly and timely, respiratory failure due to inhalational injury, and multi-organ failure in days to weeks.[10]

Because of the nature of the burn injury, the immune-compromising effects of burns, long hospital stays, and intense diagnostic and therapeutic treatments, burn patients are at high risk for infection. Burned children's sepsis is a significant condition that can lead to mortality and is one of the most critical factors affecting the outcome of burns.[10,11] Burn wound infection is proportional to the depth and surface area of the burn. It's linked to a lack of resistance as a result of the skin's mechanical integrity being compromised, as well as widespread immunological suppression. Following the decline in invasive wound infection, other causes such as pneumonia and urinary tract infection (UTI) have emerged as a more major cause of high morbidity and mortality.[9]

When compared to adults, children have a larger risk of burn injuries. Burns in the paediatric age group are usually unintentional. The majority of these injuries take place at home, where most young children spend the majority of their time. Burns in children can occur for a variety of causes, including a lack of ability to identify a risky scenario, carelessness, and a lack of ability to react appropriately in a dangerous circumstance.[12] Other factors that contribute to high mortality in burned children include a lack of physiologic reserve, thin skin, technical vascular access issues, and a narrow margin for error in fluid resuscitation.

This purpose of this study is to identify risk factors related to high pediatric burn mortality in a single centre and comparison with survivors in order to improve burn care and reduce morbidity and mortality.

MATERIALS AND METHODS

This cross-sectional study carried out in Sahiwal Teaching Hospital Sahiwal from 1st May 2019to 28th February 2022. Two hundred and ten patients in total were dealt with burn injury. A total of 184 patients upto the age of 12 years with more than 10% partial thickness burn and less than 10% full thickness burn and any percent electric burn were included, 26 were excluded because they were shifted to other departments due to other systemic injury or plastic surgery for early or delayed grafting. Survivors (150) were compared to non-survivors (34) to determine what factors might predict a high risk of mortality. Age, sex, presence of inhalation injury, total burn area, development of wound infection, sepsis, mode of burn, surgical intervention (skin grafting, fasciotomy, eshcarotomy, or debridement), need for blood transfusion, presence of multi-resistant bacteria in wound, serum albumin level ≤2.0 mg/dL, platelet count 100000/mm3, and length of hospitalization were all used to predict mortality during the hospitalization. All patients were initially received in surgical emergency of the hospital. Admission criteria included total body surface area burned (TBSAB) of 10% or more, involvement of face, hand, perineum and signs of inhalation injury and electric burn with any percentage. History was undertaken for all patients

to obtain data regarding demographics and circumstances of injury. Thorough clinical assessment of the patients was done at the time of admission. Data was collected by the doctor on duty and resuscitation was done according to ATLS guide lines. TBSAB was estimated from Lund & Browder's chart.

Patients were admitted in the ward in a room dedicated for burn patients. After initial resuscitation and stabilization, burn wound was dressed under aseptic condition after fasciotomy or eshcarotomy if needed. After thorough cleaning with normal saline, all burn patients with partial thickness and complete thickness burns were coated with topical 1 percent silver sulphadiazine cream. In all patients with more than 15% burn surface area, intravenous fluids were continued according to a modified Parkland formula. All patients with burns greater than 10% and any percentage of full thickness burns received prophylactic antibiotics (penicillin group). Analgesia was given to all of the youngsters based on their individual needs. On the fifth post-burn day, wound swabs were taken for analyzing the culture sensitivity were collected from an area displaying signs of infection. Conversion of a partial-thickness burn to a full-thickness burn, increased cellulitis of surrounding healthy tissues, eschar separation, and tissue necrosis were all local symptoms of burn site infection. SPSS 25 was used for statistical analysis. The difference between the survivors and non-survivors of each variable was tested by Univariate statistical methods, and the significance is accepted when p <0.05, Chi-square test or student's t-test when appropriate.

RESULTS

In survivors, 68 were males and 82 females while in non-survivors group males were 13 and females 21. Females were slightly high in number as compared to males in both groups. On investigations, 38.23% of non-survivors were anemic and needed blood transfusion, 11 (34%) albumen transfusion, 9 (26.47%) immunoglubulins and 12 (35.29% steroid while less patients needed these therapies in survivors. Four (11.76%) of patients in survivors group underwent fasciotomy but only 2.66% in survivors at the time of admission. 10/34 (29.41%) patients due to features of septicemia got blood culture in non-survivors and found to have resistant micro organisms in 8 (23.52%) while only 3.33% in survivors. Patients needed steroids in the non-survivor group more often 12 (35.29%) as compared to the survivors. Hospital stay for survivors ranged from 1-28 days while non-survivors stayed 3-18 days before death (mean 5.9 and 7.4 days) respectively [Table 1].

Table 1: Comparison of Different Variables in Survivors and Non-Survivors Burned Patients

Variables	Survivors (n=150)	Non-survivors (n=34)
Age (1-12 years)	4.9±1.57	3.8±1.23
Gender		
Males	68 (45.33%)	13 (38.23%)
Females	82 (54.66%)	21 (61.76%)
Flame burn	72 (48%)	12 (35.29%)
Scald	68 (45.33%)	22 (64.70%)
Electric	10 (6.66%)	-
TBSAB	5-45% (mean 14.9)	16-90% (mean 40.6)
Duration between admission & injury (days)	1-3 (mean 1.5)	1-9 (mean 4.3)
Length of stay in days	1-28 (5.9±3.7)	3-18 (7.4±4.4)
Need for blood transfusion	54 (36%)	13 (38.23%)
Serum albumen <2gm/dL	21 (14%)	11 (34%)
Need for albumen transfusion	15 (10%)	11 (34%)
Platelets < 100000	15 (10%)	17 (50%)
Blood culture positive	34 (22.66 %)	10 (29.41%)
Wound Culture positive	100(66.66%)	28 (82.35%)
Multi-resistant bacteria in wound	5 (3.33%)	8 (23.52%)
Urine Culture done	36 (41.97%)	18 (52.94%)
No. of patients with fasciotomy	4 (2.66%)	4 (11.76 %)
Associated inhalational injury	6 (4%)	6 (17.64%)
Intravenous Immunoglubulin given	2 (1.33%)	9 (26.47 %)
Steroids Given	34 (22.66%)	12 (35.29 %

Sixty five (43.30%) children fell in age range 7-10 years in survivors while 18 (53%) of non-survivors were 3-7 years [Table 2]. With regards to cause of burn, flame burns remained at the top in survivors (48%) while scalds in non-survivors (61.76%). 50% of patients presented with partial thickness burn (75/150) in survivors while 50% (17/34) with mixed burns in non-survivors. Mean total body surface area burn was 14.9% in survivors and 40.6% in non-survivors. Duration between injury and admission was also variable in both groups i.e. upto 3 days in survivors but non-survivors presented considerably late upto 9 days after injury. Lack of resources, poverty and illiteracy were the possible causative factors resulting into late presentation. Six (17.64%) patients of non-survivors were having associated inhalational injury but only 4% in survivors. Seventy five (50%) from survivors had partial thickness burn while 17 (50%) presented with mixed variety in non-survivors. There was huge difference in full thickness burns in survivors and non-survivors, 5 (3.4%) and 10 (29.5%) respectively [Table 3, Fig. 1].

Table 2: Frequency of age in Survivors and Non-Survivors

Age (years)	Survivors (n=150)		Non-survivors (n=34)	
	No.	%	No.	%
< 3	15	10.0	4	11.7
3-6	54	36.0	18	52.9
7-9	65	43.3	7	20.7
10-12	16	10.7	5	14.7

Table 3: Frequency of types of burn

Type of burn	Survivors (n=150)		Non-survivors (n=34)	
	No.	%	No.	%
Superficial	30	20.0	-	-
Partial thickness	75	50.0	7	20.6
Full thickness	5	3.4)	10	29.5
Mixed	40	26.7)	17	50.0

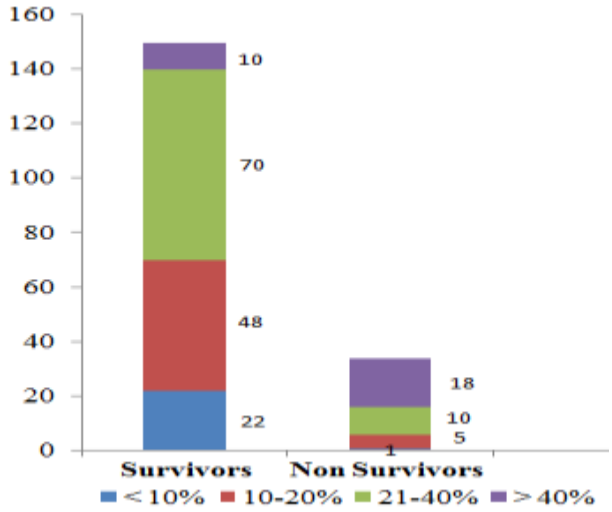

Fig. 1: Distribution of Burn Surface Area in Survivors and Non-Survivors Children

DISCUSSION

Burns are one of the most destructive and disabling traumas to humans. It continues to pose a serious threat to the well-being of the paediatric population and still has significant cosmetic and functional consequences[13], so the aim of this study was to assess the outcome of burns and associated factors resulting into high mortality. The overall death rate for children hospitalized with burns was 18.47% in our research. This result is comparable with the third world countries. A study from South India showed that 74% of burnt children improved after discharge, and 20% of patients died

while admitted.[14] Another observation in Nigeria showed that 70.1% of cases were successfully treated and discharged, while 29.9% died.[15] Lack of facilities, resources and poor infra structure in TWC result into high mortality. In developed countries situation is totally different. Arslan et al[16] mentioned 4.3 percent mortality in their study. This is higher than the literature in other high-income nations, such as Kuwait (1.3%), the United States (0.7%)[17] and Europe (1.1%), but lower than the findings by Golshan et al[18] and in South Asia 9%. The cause of the decrease in infection rates has been discovered. These countries are concentrating their efforts on creating efficient preventive measures, good antibiotic cover, nutritional support and all measures to reduce burn wound infection.

Burns are frequently observed in preschool children and children aged 0 to 4 years.[19] In our study 18 (53%) of the non-survivors fell in age range of 3-7years. In one study, the 0-4 year age group had the highest rate of burns (64.1%), which was similar to a study conducted in Israel (78.0%). Two other studies in Addis Ababa and Turkey showed that burns were most common in 0-3 years of age, accounting for 53.3% and 72.4%, respectively.[20] This similarity may be due to the fact that children of this age have stability issues and also want to discover their surroundings (environment), when children acquire motor and manipulative skills and saturation through play in the kitchen, it takes more supervision. Parental supervision is the main predisposing factors for burns in children of this age group.[19]

Burn area is also a very important variable affecting mortality. More skin loss leaves biggest burns exposed to more surgeries, surgical complications and increased mortality and increased burn area and degree of skin shedding makes donor availability small. In 53% of our children died, TBSAB was more than 40% while in 15% of the survivors only. The fact that very young children and toddlers does not have tolerance against thermal injury making them highly prone to mortality with an incidence of 30% or so.[21,22] The death rate further increases with severity of burns with a rate as high as 21 folds in cases of 25-50% burns while reaches 139 fold high in cases with 50-75% burns.[23]

Various observations suggest that scalds are the most common type of burns in youngsters (67.4%), according to a study from Israel. A comparable study in Morocco found that scalding was the leading cause of burns (83.5%)[24] and a study in Ghana found that scalding is the source of 73% of burns.[25] Similarly, the most prevalent cause of burns in our study was scald (66.70%) in non-survivors while flame burns were more common in survivors. This can be explained by the fact that children, particularly toddlers, have a lot of energy. Children under the age of six reside with their mother or caregiver. At home, children may be permitted to play in the kitchen, where they may be scalded by liquid food prepared by their parents or caretakers. Furthermore, this research re-identifies inhalation-injuries related with hot water or soup as risk factors for paediatric burn death. According to a research by Brusselaers et al[26], scalding is the most common burn in children, accounting for 60-75% of entire hospitalized burn injury patients, followed with flame as well as contact-burns.

Inhalation injury is a strong predictor of mortality.[27] Due to the small number of patients in our study we could not confirm this Inhalation injury group. Furthermore, this may also be due to several Improvement of clinical management of smoke inhalation injury Mortality in the current period, or in the area of extensive burns high, the effect of inhalation injury found in minor burns is overshadowed by an increased risk of death from extensive burns.[28] 6/34 (17.6%) of our patients in non-survivors group also had associated inhalational injury. As number is small, we are not certain how much is the contribution of inhalational injury in overall mortality in burns. Effects of inhalation injuries are largely masked by burns damage itself. However, another factor may be that it is currently not possible to do so Quantification of inhalation injury. It means that the diagnosis of inhalation injury is just "yes" or "no", there is no way to determine severity of Inhalation injury. Historically, the development of burn infection complications is the leading cause of death. During hospitalization, infectious complications can occur. Sepsis is a harbinger of a bad outcome.[20] In 28 of 34 (82.35%) in the non-survivors group wound culture was positive in our study. According to Bhatt et al[29] and Khan et al[30] burn centres had a high infection rate of 80.9% survivors, 94.1% expired patients). Infected burns are more likely to be deep. Larry Kramer's work on third-degree burns and infection[31] supports this hypothesis. This may be due to the loss of additional skin and subcutaneous layers, which play an important role in preventing infection and functioning as a barrier to keep microbes out.[32] Similarly, 50% of our non-survivor patients had a variety of burns, including full thickness and partial thickness burns.

Differences in burn care standards between middle-income and high-income countries. The cause of the decrease in infection rates has been discovered. Countries are concentrating their efforts on creating efficient preventive measures. Early wound coverage and strategies certain actions within 5 years, sepsis-related mortality was reduced from 14% to 3%.[33] Multi-resistant micro-organisms worsen the situation and result into high mortality. In our study 8 (23.52%) of 34 died patients were having multi-resistant micro-organisms on wound culture. Non-burned wound infection such as pneumonia and urinary tract infection (UTI) have become a more prominent cause of significant morbidity and mortality following the decline in invasive wound infection.[34] Eighteen (52.94%) of non-survivors in our study developed urinary tract infection while less UTI was documented in survivors.

Children's burn mortality is particularly concerning, and effective care systems and therapies have been developed over time to assist decrease the risk factors of children mortality and burn-patients. Clinical interventions such as early burn wound excision and grafting are employed to prevent sepsis complications. Prophylactic medicines, topical antimicrobials, infection management measures, and the prompt and successful closure of deep burns are all necessary for infection prevention. In addition, the development and improvement of positive-pressure ventilation systems has significantly reduced respiratory mortality.[35,36] Individuals should be informed about house fire safety as has been suggested for many years.[37] According to Hyder et al[38] legislation should be implemented to encourage the usage of smoke alarms, flame-resistant clothing for children, and water heater adjustments. Prevention methods in impoverished nations like TWC must be adapted to their local climate and focusing on factors which escalates the risks for burns.[39]

CONCLUSION

Burn injury in children is a devastating injury resulting into high mortality. Females with more than 40% TBSAB, deep burns, age less than 7years, scalds, delayed presentation, shock and sepsis are the main factors resulting into high mortality. Community education to keep the children away from kitchen and fireworks should be propagated. Medical emergency services should be improved. Health care worker should immediately start fluid resuscitation and we recommended that microbial surveillance of burn patients and hospital environment microbiological surveillance for potential nosocomial pathogens should be carried out on regular basis.

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