SCIENTIFIC ARTICLE

Burns in Sri Lanka: analysis of pattern of burns and initial management steps of patients admitted with burns to Teaching Hospital Kandy

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Abstract

Introduction

Burn injuries range from minor superficial burn to a deep life-threatening injury. Minor burns are treated with first aid, in an out of hospital setting, while major burns require more specialized treatment in specialized centres. Sri Lanka has only one designated "Burns" unit at National Hospital, Colombo, with limited bed capacity. Teaching hospital Kandy is the second-largest hospital in Sri Lanka providing services to a large population within the central province and adjacent provinces. Kandy district accounts for an urban to the rural population distribution of approximately 12.4% to 81.4% with an estate population of 6.2%. With its unique sociocultural, religious and economic inequalities, there is a scarcity of information on the incidence, causes and outcomes after burn injuries. This preliminary survey was to obtain reliable data on the epidemiology of burns victims, the pattern of burn, the circumstances associated with the injury and management steps carried out during the initial period and to justify establishing a unit for the care of patients with burns in Kandy Hospital.

Methodology

A prospective observational study was carried out among all patients admitted to Teaching Hospital, Kandy with burn injuries over six months. Data were collected using a pre-tested questionnaire, completed by the investigators.

Results-Of the 46 victims, the majority were females (74%, $p<0.05$) and 50% were between the ages 18-55years. The majority were ethnic Sinhalese (69%) and 52.2% were transferred patients from satellite hospitals.

Most of the burns were accidental (n= 43,93.5%) and 82% occurred in households. 91.3%(n=42) were thermal burns while flame burns caused 54.4%. Electrical(n=3,6.5%) and chemical burns(n=1,2.2%) were rare. Cooking related incidents accounted for 65% of the incidents of flame burns. 50%of the adults(n=23) and 83% (n=5) of children sustained major burn injuries. 24%sustained facial burns and 10.8%(n=5) inhalational injuries, 7(25%, $p<0.05$) required endo-tracheal intubation and management in an intensive care unit.

Over 64% (n=18, p=0.13) of the patients with major burns had not received any form of local first aid care for the injury, and all burns were left uncovered until surgical dressings were applied. Hypothermia prevention strategies were not implemented on 92.8%($p<0.05$). Only 67% utilized the Parkland formula to calculate the resuscitation fluid volume.

Conclusion

The predominant proportion of patients admitted to Teaching Hospital Kandy were adult females who suffered household accidental flame burns, many of them being classed as major.

Awareness programmes need to be planned and implemented to improve knowledge on the prevention, first aid and initial management of burns for general public and health care workers.

These patients may benefit from a specialized burns unit at Teaching Hospital Kandy.

Introduction

Burns is a worldwide health problem, resulting in an estimated 180,000 deaths annually, major proportion taking place in lower-middle-income countries, nearly sixty-five percent occurring in South-East Asia and Africa [1].

An estimate of the incidence of burn injuries in India varies from 100000 to 2 million annually, with approximately 50 000 fatalities. In Pakistan, burns injuries were found to be the second leading cause of disability and the eleventh leading cause of premature death.[2] In Sri Lanka, the estimated burn-related injuries account for 10000 injuries and 100 deaths[3].

Only three published articles from Sri Lanka were available to us. These studies were carried out in the Eastern Province with a marginally different ethnic and socio-economic and cultural environments. Selladorai et al in 2013 studied patients admitted to Batticaloa Hospital-the leading hospital in the

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eastern province. In their study, 41% of the burns were of suicidal intent. [4] and deep burns (n=46, 73%) were more frequent. Main sources of accidental burns were traditional lamps (n=18, 51%) and kerosene oil cookers (n=9, 26%). Similar findings were observed in a study conducted by Laloe in 2002 and Lau in 2006[3,8].

A national burn management guideline was published by the College of Surgeons of Sri Lanka in 2007. However, there is no information available on the degree of adherence to these guidelines, nor of outcomes.

With one specialized centre for patients with burn injuries in the country, with a limited number of available beds, most of such patients are treated at major tertiary care centres and peripheral units. This study intended to obtain information on the circumstances associated with the causation of the injury, the epidemiological data of the victims, initial resuscitation and management steps carried out by the emergency department and surgical unit doctors at Teaching Hospital Kandy, and to assess the need for a special burn management unit at Kandy Teaching Hospital to enable clinicians to provide a better quality of care.

Methodology

This prospective observational study was carried out among all the patients admitted to the emergency treatment unit, surgical unit, paediatric surgical unit and plastic surgery unit at Teaching Hospital Kandy with burn injuries over six months from 1.2.2019 to 30.7.2019. Data collection was done within 24 – 48 hours of the admission of the patient to the hospital.

Data on demographic details were collected using a pre-tested questionnaire completed by the investigators interviewing the subjects. Information on initial management steps was obtained by studying their hospital notes, after obtaining informed written consent from the patient or the next of kin.

The first part of the questionnaire covered the following areas: Demographic data of the burn victim, the mechanism, source, pattern and severity of the burn injury. The second part of the questionnaire was designed to identify the initial management steps carried out in the treatment of the burn victim (e.g. first aid, initial management according to ATLS protocol and burn specific management steps).

Statistical analysis was performed using SPSS version 25, in terms of frequencies and percentages for respective categories. Significance was calculated with Pearson's Chi-squared test and the Fisher Exact test.

Ethical clearance was obtained from the Ethical committee of Teaching Hospital Kandy (THK/ERC/16/2019).

Results

Patient demographics

A total number of 46 patients were studied. Demographic data of the study population are given in Table-1. The Demographic data reveals that a significant proportion (p=0.001) of the victims were females (74%, n=34), while males comprised 26% (n=12). Sixty-nine percent were ethnic Sinhalese, while 50% were young and middle-aged adults (18-55 years). Approximately half of the patients (52.2%, n=24, p=0.831) reaching Kandy Hospital were transferred patients from satellite hospitals, while 47.8%(n=22) were direct admissions to the hospital.

Table 1. Demographic data of the study population (n=46).

Category		Number (%)
Gender	Male	12(26%)
	Female	34(74%)
Age – range 6 months to 78 years	< 10 years	5(10.8)
	10-18	5(10.8)
	18-35	13(28.2)
	35-55	10(21.7)
	55-65	8(17.4)
	>65	5(10.8)
Ethnicity	Sinhalese	32(69.5)
	Tamil	6(13.1)
	Muslim	8(17.4)
Marital status	Married	30(65.2)
	Unmarried	16(34.8)
Occupation	Housewife	20(43.5)
	Unemployed	5(10.8)
	Chef/ cook/helper	3(6.5)
	Self employed	3(6.5)
	Schooling	5(10.8)
	Garment factory workers	2(4.3)
	Drivers	2(4.3)
	Mechanic/ electrician	2(4.3)
Mode of admission to hospital	Direct	22(47.8)
	Transferred	24(52.2)

Pattern of Burn Injuries

Data on mechanism of burn injuries, source of burn and the injury pattern observed are presented in table 2,3 and 4 respectively.

Table 2. Mechanism of burn injuries

Category		Total Number (Percentage)	Number of males (%)	Number of females (%)	Significance (males and females)
Type of burn	**Thermal burns**	**42(91.3)**	**9(21.4)**	**33(78.6)**	*p=0.0004
	Hot liquids- scalds	19(41.3)	5(26.3)	14(73.7)	*p=0.039
	Flame burns	23(50)	3(13)	21(87)	*p=0.0001
	Contact with hot surfaces	1(2.2)	1(100)	-	
	Electrical burns	**3(6.5)**	**2(66.7)**	**1(33.3)**	-
	Chemical burns	**1(2.2)**	**1(100)**	-	-
Mechanism of burns	Accidental	43(93.5)	10(32.5)	33(67.5)	*p=0.0006
	Suicidal	3(6.5)	1(33.3)	2(66.7)	-
Place of burn	Household	38(82.6)	7(18.4)	31(81.6)	*p=0.0001
	Workplace	7(15.2)	5(71.4)	2(28.6)	**p=0.452
	Outdoors	1(2.2)	-	1(100)	-

p value calculated using *Pearson's chi squared test and **Fisher exact test. p<0.05 considered significant.

Table 3. Source of Burn

Category		Frequency (percentage from all burns n= 46)	Major burns frequency (percentage from all burns n=46)	Minor burns frequency (percentage from all burns n=46)	Significance- major and minor burns
Hot liquids n=19(39.6)	Hot water	14(30.4)	6(13)	8(17.4)	*p=0.791
	Hot oil	5(9.2)	3(6.5)	2(4.3)	**p=0.999
Flame burns n=23(50)	Kerosene cookers	4(8.7)	2(4.3)	2(4.3)	-
	Kerosene traditional lamp	3(6.5)	3(6.5)	-	-
	Gas cookers (liquid petroleum)	8(17.3)	6(13)	2(4.3)	**p=0.282
	Wood stove	3(6.5)	2(4.3)	1(2.2)	**p=0.999
	Falls into litter burning pits	2(4.3)	2(4.3)	-	-
	Petrol	1(2.2)	-	1(2.2)	-
	Suicidal attempt with kerosene	2(4.3)	2(4.3)	-	-
Contact with hot surface	Hot oven	1(2.2)	-	1(2.2)	-
Electrical n=3(6.5)	Damaged wire	2(4.3)	2(4.3)	-	-
	High-tension wire associated electrical and flame burn	1(2.2)	1(2.2)	-	-
Chemical n=1(2.1)	Battery acid ingestion	1(2.2)	1(2.2)	-	-

p value calculated by Pearson's chi-squared test and Fisher exact test. P<0.05 was considered as significant BSA- Burn surface area. *Significance calculated between major burns and minor burns with Pearson's chi square and Fisher's exact test accordingly

Table 4. Injury Pattern

Category		Frequency (Percentage from all cases n = 46)
Burn surface area (BSA) – adults	<10 %	6(13)
	10-20%	11(23.9)
	20-30%	6(13)
	30-50%	10(21.7)
	>50%	7(15.2)
Burn surface area – children	<10%	1(2.1)
	10- 20%	5(10.8)
Special areas of burn	Inhalational injury	5(10.8)
	Face	11(23.9)
	Eyes	1(2.1)
	Perineum	4(8.7)
	Hands	14(30.4)
Degree of burns	1º only	2(4.3%)
	1º and 2º	16(34.8%)
	2º and 3º	27(58.7%)
	4º	1(2.2%)
Severity of burns - Adults	Burns requiring in hospital treatment Major burns Intermediate 10-20% BSA	33(79.2%) 23(57.5%) 10(21.7%)
	Minor < 10% BSA	7(15.2%)
Severity of burns – Children (<12 years)	Major >10% BSA	5(10.8%)
	Minor <10% BSA	1(2.1%)

p value calculated by *Pearson's chi-squared test and **Fisher exact test. P<0.05 was considered significant. BSA- Burn surface area.

Table 5. Initial management of major burn victims (n= 28)

Management step		**Frequency (% form total major burns n=28)**	**Significance**
First aid at the site of injury	Burn cooling with cold running water	9(32.1)	*p=0.131
	Application of aloe vera	1(3.6)	
	None	18(64.3)	
Covering the burn area until proper wound dressing is done	None	28(100)	*p<0.05
Analgesia	Morphine	26(92.9)	*p=0.0004
	NSAIDs	5(17.9)	
	Paracetamol	6(21.4)	
Fluid resuscitation – calculation of volume	Parkland formula used	19(67.8)	*p=0.059
	Other non-standard regimes	9(32.1)	
Type of fluids used for initial resuscitation (first 24 hours)	Hartmann's solution only	14(50)	*p=0.023 (between Hartmann +/- collois and 0.9% saline +/- dextrose
	Hartmann's solution, albumin and FFP	6(21.4)	
	0.9% saline only	7(25)	
	0.9% saline and dextrose	1(3.6)	
Wound dressing at ward/ operating theatre	Silver sulfudiazine	15(53.6)	
	Acticort	10(35.7)	
	Collagen	3(10.7)	
Escharotomies	Upper limbs	6(21.4)	
	Lower limbs	5(17.9)	
Tetanus toxoid (adults)	Given	15(65.2)	*p=0.144
	Not given	8(34.8)	
Antibiotics	Given	28	p<0.05
Hypothermia prevention	Warm fluids used for resuscitation	2(7.1)	**p=0.0004
	Warming blankets	2(7.1)	
	None	26(92.8)	
Requirement of ICU care	Ventilation and airway protection	7(25)	*p=0.008

p value calculated using Pearson's chi-squared test or Fishers exact test. P<0.05 was considered as significant.

Table 2- reveals that a significant majority of burns were caused by thermal injuries (91.3%, p<0.05), while significant mechanism being accidental burns (93.5%, p<0.05) occurring in households (82.6%, p<0.05). It is also evident that, in all categories significant majority affected are females.

Table 3- represent data on the source of the burn injury. It is shown that the commonest source of burn injuries was related to cooking (32.5%) that caused flame buns, commonly catching fire onto their loose-fitting garments. Of them the commonest source was the liquid petroleum gas cooker (17.3%). Females were the victims of all the burns related to hot oils, gas cookers and wood stoves. Only females attempted suicide with kerosene oil. Hot liquids were the only source of burn injuries among children <12 years in our study group.

Table 4 - represent the data on pattern of injuries.

Interestingly, significant number of patients admitted 79.2%(p=0.0001) required in-hospital treatment [5] while 50%(n=23) of adult patients admitted to Kandy hospital have sustained major burn injuries, that is they have suffered >20% of the body surface area burn(partial thickness or more) or had burns involving special areas of the body or suffered inhalation injury [5] 25% requiring intubation and ICU care, whom should ideally be managed in a specialized centre for burn management. Approximately 15% suffered >50% burn surface area and 10.8% was associated with inhalational injury, which are predictors of high mortality and poor outcome [6]. Of the children admitted 5(83.3%, p=0.219) had major burns (burn involving >10% BSA or involvement special areas)[5].

Initial management of major burns

Data on initial treatment steps within first 24 hours of injury are indicated in table 5.

Remarkably, all patients with major burns were prescribed analgesics, as pain is a significant complication of burns. However, 64% (p=0.13) have not received any form of first aid at the site of injury or the local hospital. Surprisingly, none of the burn areas was covered with sheets though is a recommended method to reduce pain by reducing airplay on the wound. Strategies to prevent hypothermia, which is another common complication with major burns that increase the severity of burns, hence the morbidity,5 were not employed in the initial management of a significant majority of patients (92.8%,p<0.05)in our study population even after the admission to hospital. Though Parkland formula is the recommended formula to guide the fluid requirement in the initial 24 hours, it was used only at 67% of the time while >30% used nonstandard regimes for fluid resuscitation (p=0.023), which could have an impact on the outcome. Furthermore, >25% had received only 0.9% saline (p= as the resuscitation fluid, though it is Hartmann solution with or without colloids is considered the fluid of choice.[5],[6] Additionally, all patients were prescribed antibiotics even though it is not indicated, however, tetanus toxoid is indicated in all adult patients with burns if not recently immunized,[5] but it was only practised on 65%. Many of these omissions may be attributed to a lack of knowledge and training specific to burn victims' management among first contact health care professionals, which should be addressed accordingly. Significant number of patients (n=7,25%, p<0.05) required ICU admission. Therefore, it would be beneficial and tranquil to train these professionals if a separate unit and staff are allocated for specific management of burns.

Discussion

Burn injuries that are the fourth leading cause of traumatic injury worldwide remains a significant, preventable cause of morbidity and mortality in Sri Lanka.[7] Understanding the epidemiology and the socio-economic factors influencing their causation is fundamental to implementing preventive efforts. Though the exact burden is not known, a study published by Lau YS, 2006 suggests that burns account for 10000 injuries and 100 deaths, costing US$1 million annually in Sri Lanka. [3]

We have studied 46 burn victims who were either directly admitted or referred from hospitals in the periphery of the Teaching Hospital Kandy.

Similarly, to studies conducted in the Eastern Province in Sri Lanka,[3],[4],[8] most burn victims were young (18 to 35 years, 28.2%) or middle (35-55years,21.7%) aged females(p=0.001). Most of the burns, over 80% (p<0.05) were in their homes and over 40 %, while they were cooking. This result might be related to the fact that, culturally, females of this age group do most of the cooking and household chores. This pattern is similar to observations from other regions of South Asia and Oman with adult females being affected at home in their kitchens.[2],[8],[9] Many incidents of flame burns associated with cooking were due to flames spreading to their loose-fitting flammable garments, especially synthetic clothes.[2],[3]

Our study revealed that thermal burns accounted for 91% of the cases. Of them, > 50% (52.2%, p=0.0001) were caused by flame burns. With the common source being kerosene cookers, gas (liquid petroleum) cookers and wood stoves. This was in contrast to the observations of Pirasath et al 2013, Lau 2006, Laloe 2002 (all conducted in Eastern province) that suggested that traditional kerosene lamps were the main source of the fire.[3],[4],[8] In our study, only 3(6.5%) victims had burns from the traditional kerosene lamp. This finding

may be due to differences in the socioeconomic and cultural backgrounds in the two provinces. Ethnically, Eastern Province has most Tamils -39.5%, followed by 36.9% Sri Lankan Moors and 23.2% Sinhalese. In contrast, in the Central province, 65.35% are Sinhalese, 19.92% Indian Tamils and 9.2 % Sri Lankan Moors. [11]The poverty headcount index of 11.3% in Batticaloa-one of the poorest districts (7.3% in the eastern province) and 5.5% in Kandy (5.4% in the central province) reveals the difference in economic status between residents of the two provinces.[12] The lower socioeconomic state and limited availability of electricity in rural areas in the Eastern Province probably necessitate the use of traditional kerosene lamps as the sole means of lighting. [3]

Of note is the burn prevention campaign pioneered by Dr Wijaya Godakumbura that established the safe bottle lamp foundation in Sri Lanka. This expanded world-wide and focused mainly on replacing unsafe kerosene bottle lamps to the safer and inexpensive version designed by him –called this Sudeepa (su -good, Deepa-light). This is an example of aetiology-based approach in the prevention of injuries, highlighting the importance of nationwide epidemiological studies.

Chemical burns(n=1,2.1%) were rare in our study population. Males were among two-thirds of the electrical burn victims and they all occurred at the workplace, suggesting the need for better protection for such workers.[2],[8],[9],[10]

When the circumstance of injury is considered, our study revealed a low incidence of suicidal or deliberate self-harm related burns (6.5% n=3) compared to an alarmingly high rate of suicidal burns (41% [4] and 25% [8]) observed in studies conducted in the Eastern province.[4],[8] This may again be attributed to the socioeconomic status, the general level of trauma experienced during the wartime (Eelam war in Northern and Eastern Provinces of Sri Lanka from1983-2009) and poor coping strategies.

Scalds or the burns related to hot liquids were the only type of injury that was observed among children less than 10 years. Sixty percent of injured children were males. As a group, they constituted only 10.8% of all burns, which is different to results revealed in other previous international studies. Studies conducted by Al-Shaqsi et al 2016 and Li et al 2017 showed that preschool children (under 6 years old- majority males) were at the highest risk of burns (67% and 34.7% respectively).

Primarily these children have also sustained scalds. Their unawareness of the danger, curiosity and easy susceptibility of their skin for burns may be regarded as the factors that contributed.[9,10] Our results have to be taken in the context that there are reduced numbers of admissions of paediatric patients to TH Kandy. These patients are directed to the Srimavo Bandaranaike Children's' Hospital, located within the province.

In contrast to previous international studies, where a majority of the admissions were due to burns involving less than 20% total body surface area(BSA) [8,9,10], 50% of the victims of our study had suffered over 20 % BSA burns resulting in 57.5% of major burns among adults (BSA >20% and/or involvement of special areas i.e. face, eyes, perineum, joints and hands or presence of inhalational injury) and 80% of the major burns in children <10 years. (BSA>10% and/or involvement of special areas or presence of inhalational injury). More than 58% of the victims suffered full-thickness burns (30 or more), while 7 victims (25% of major burn victims, $p<0.05$) required ICU care. Additionally, around 80% of the victims required in-hospital treatment($p=0.0001$).

This finding may be a reflection of the nature of admission to our hospital in that 52.2% are transferred from satellite hospitals, thus clustering more severely injured patients in this second largest tertiary care facility in Sri Lanka, implying a need for a specialized burn unit to the hospital, for better patient care. However, this need would have properly identified if the outcome of these patients, in terms of mortality, rate of infection and morbidity were studied as well.

Concerning the initial management of major burn victims, striking deficiencies were noted in some areas. Namely, not providing any type of first aid at the site of injury (64.3%, $p=0.13$)(especially in the form of burn surface cooling, that plays a significant role in reducing pain, depth of injury, oedema formation, infection and morbidity),[5]not covering the burn area for pain relief (to prevent the airplay on the wound) until proper wound scrubbing and dressing is done at the theatre(100%), non-adherence to standard fluid resuscitation regimes (occupying non-standard regimes without using Parkland formula for fluid calculation (42.3% $p=0.059$) using only 0.9% saline for fluid resuscitation (25%), and ignorance on prevention of hypothermia, in management of a significant proportion of patients (92.8%, $p=0.0001$).

Reasons for these shortcomings and the non-uniformity of care may be attributed to lack of awareness, lack of knowledge or failure to recognize the importance of these aspects of management by the public in the case of first aid and medical teams at peripheral hospitals. This re-emphasizes the importance of establishing a specialized unit and a dedicated team for better management of burn victims as well as the importance of training and teaching all grades of medical personnel.

Our sample size was small (46) as we limited our study to six months, feasible to the study group given their necessity to move from one hospital to another after a specified period by the Department of Health. One other limitation of the study includes analysing only the management steps during the first 24 hours of the admission due to the same reason of time constraints. It would have been more informative and would have provided a better justification for the need of a specialized unit for burn care to the facility if the subjects' outcome was studied in terms of morbidity and mortality related to the injury.

Conclusion

The predominant proportion of patients admitted to Teaching Hospital Kandy are adult females who suffered major accidental flame burns, many of which are preventable. Awareness programmes need to be planned and implemented to improve knowledge on the prevention, first aid and initial management of burns for general public and health care workers serving in peripheral hospitals. These patients may benefit from a specialized burns unit, but further studies should be conducted to analyse the outcome of these patients to justify the requirement of a specialized unit at Teaching Hospital Kandy.

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