Heliyon 6 (2020) e03629

Contents lists available at ScienceDirect

Heliyon

journal homepage: www.cell.com/heliyon

Research article

Clinical patterns and early outcomes of burn injuries in patients admitted at the Moi Teaching and Referral Hospital in Eldoret, Western Kenya

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ARTICLE INFO

Keywords:
Public health
Surgery
Critical care
Emergency medicine
Clinical research
Burns
TBSA
Length of stay
Complications
Kenya

ABSTRACT

Background: Burns are the fourth most common type of trauma worldwide and a major cause of mortality and disability in developing countries. Although burns are common in Kenya, the mortality and morbidity patterns are yet to be well studied and documented comprehensively.

Objective: To evaluate burn clinical patterns, early outcomes and their associations among patients admitted with burn injuries at Moi Teaching and Referral Hospital (MTRH).

Methods: A cross-sectional descriptive study was conducted at MTRH between January 2016 and June 2017. A total of 189 patients admitted to the hospital with burns were recruited into the study. An interviewer-administered structured questionnaire and chart reviews were used to collect data on sociodemographic variables, burn clinical characteristics and early burn outcomes. Associations between patient characteristics and early burn outcomes were assessed by multivariable logistic regression.

Results: Of the 182 burn patients whose data was analyzed, the median age was 2.4 years (IQR = 5.8) years and 149 (82%) were children below 18 years. Majority (76%) of burns were due to scalds. The commonest burn locations were the trunk and upper limbs (56%). Only 40% of patients received prehospital intervention. The median Total Burn Surface Area (TBSA) was 14.5% and 74% of the patients had 2nd degree burns. The median length of hospital stay was 16 days (IQR = 28) and commonest complication was wound infection. Proportion of deaths due to burns accounted for 9.3% of the patients. A TBSA of 20%–30% ($p = 0.01$) was associated with presence of burn complications while a TBSA of >10% ($p = 0.03$) and time from burn to admission ($p = 0.03$) were associated with the length of hospital stay.

Conclusions: In our study, death was likely to occur in one in ten patients admitted with burns and TBSA was a predictor of presence of burn complications and length of hospital stay. There is a need for continued health education of the public on fire safety within the home environment for children and other vulnerable persons. Timely hospital intervention would also reduce burn complications as well as length of hospital stay.

1. Introduction

Burns are the fourth most common type of trauma worldwide following road traffic accidents, falls and interpersonal violence. About 90% of these burns occur in low to middle income countries and the incidence of fire-related injuries is estimated to be 1.1 per 100,000 population. Worldwide, approximately 265,000 deaths occur annually due to burns, with low and middle-income countries accounting for about 95% of these deaths [1]. Non-fatal burns are a leading cause of morbidity, including prolonged hospitalization, disfigurement and disability [2].

In the developing countries, the groups most vulnerable to burn injuries are children aged below five years, the elderly and individuals with pre-existing illnesses such as uncontrolled epilepsy and diabetes. In the rural areas of lower income countries, unemployment, poverty, overcrowding, low education status and lack of electrification are major risk factors for burn injuries [3]. Burn complication as well as the length of hospital stay are immediate outcomes which reflect access to quality medical care by burn patients.

The rate and nature of burn complications varies in different centers and different regions. In Nigeria some of the major complications of burns include wound infection (20–34%), anxiety and depression (65%),

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https://doi.org/10.1016/j.heliyon.2020.e03629
Received 14 January 2020; Received in revised form 3 March 2020; Accepted 16 March 2020

post-burn contractures (8.6–20%) and extremity amputation (2.1%) [4]. In Kenya, one study reported the rate of complications as 13.3% among survivors and the complication included scarring, keloids, contractures, limb amputations and post-traumatic stress disorder in order of frequency of occurrence [5].

Several studies have found that the strongest predictors of length of hospital stay are age of the patient and percentage of TBSA burned [6, 7]. Other factors associated with length of stay include female gender, inhalation injury, surgery and the depth of burn [6]. In Kenya, previous studies have found the length of stay in patients with burns to be 25.2 days/4% TBSA [8] and 25.7 ± 33.5days [9].

Although burns are common in Kenya, the mortality and morbidity patterns are yet to be well studied and documented comprehensively [5]. This is compounded by the lack of a national burn repository that would provide vital information to aid research in the management and prevention of burns. Within the Western region of Kenya, there is a paucity of local data on the patterns and outcomes of burn injuries. This study aimed to undertake a comprehensive and updated evaluation of burn clinical patterns, early outcomes and their associations among patients admitted with burn injuries at Moi Teaching and Referral Hospital (MTRH).

2. Materials and methods

2.1. Study design

This was a cross sectional descriptive study design. Patients were recruited upon admission then the information about their demographic characteristics and the characteristics of the burn injury was obtained. Following admission and treatment, the patients were followed up until discharge or death to determine the length of hospital stay and complications experienced in the course of their treatment.

2.2. Setting

The study was conducted at the Moi Teaching and Referral Hospital (MTRH) burns ward and the surgical wards that admit patients with burn injuries. MTRH is the second national referral hospital in Kenya and is located in Eldoret town in the North Rift region of Western Kenya. It has a catchment area of about 16.2 million and a bed capacity of about 1000. MTRH is also a teaching hospital for Moi University's Schools of Medicine and Nursing that offer degrees in both undergraduate and postgraduate disciplines. It is also a center for training various diplomas for the Kenya Medical Training College and University of Baraton East Africa's School of Nursing.

2.3. Participants

The study population consisted of all patients (adults and children) with moderate and severe burns admitted at MTRH between January 2016 to 30th June 2017. All patients with moderate and severe burns who were willing to participate in the study were included. Patients were informed that should they choose not to participate in the study, they would still receive the standard of care as per the hospital protocol. Patients re-admitted for burn reconstructive surgery or other follow up procedures and those who already had wound infection at admission were excluded from the study.

2.4. Procedure

An interviewer-administered structured questionnaire and chart reviews were used to collect data on sociodemographic variables, burn clinical characteristics and early burn outcomes. Before the commencement of data collection, a trained research assistant helped in identification of potential research participants for recruitment into the study. The principal investigator administered the consent process, administered the questionnaire and conducted data entry and analysis. Total Burn Surface Area was determined using the Wallace rule of sevens and nines in adults and the Lund and Browder chart in children.

2.5. Variables

Dependent variables included presence of burn complications (dichotomized as either Yes or No) and the length of hospital stay in days from the day of admission to discharge. The independent variables included age and sex of the patient, time from burn to admission, prehospital intervention, cause of burn, mechanism of injury, burn location, TBSA, burn depth, prehospital intervention and presence of comorbidities.

2.6. Data analysis

Continuous data were described using, median and interquartile range (IQR) while frequencies and proportions were used for categorical data. Statistical analysis was conducted using the software SPSS v20 for Windows, with an alpha value of 0.05 used to indicate significance. Multivariable logistic regression was used to assess associations between independent variables and burn outcomes: presence of burn complications and length of hospital stay. A p-value < 0.05 was considered statistically significant.

2.7. Ethical considerations

Ethical approval was obtained from the Institutional Research and Ethics Committee of Moi University and Moi Teaching and Referral Hospital, reference: **IREC/2015/154**, approval number **0001498**. Written informed consent was sought from all study participants before inclusion into the study. For study participants below the age of 18 years, written informed consent was obtained from the parent or guardian. There were no patients who were eliminated because of refusal to participate.

3. Results

Of the 189 patients that were admitted with burns, three absconded from treatment thus dropped out of the study before completion. At the time of conclusion of the study there were still four active respondents who had not been discharged from the hospital. The number of patients included in the final analysis was 182 (Figure 1).

The age of the patients ranged from 0.25 to 72 years with a median age of 2.4 (5.8) years. A total of 149 (82%) patients were children aged below 18 years and 109/182 (60%) were male. Majority of the patients (60%) presented within three hours of injury. Of the 182 patients that got admitted, 176 (97%) got burnt at home, 2 (1%) got burnt at work while 4 (2%) got burnt at the roadside. Scald was the most common cause of burn (76%) followed by flame (21%) with the rest (3%) being electrical and frost burns. Patients were admitted with the following burn locations: Head and neck, trunk, upper limbs, lower limbs and perineum. Notably, these occurred in combination with the most common being burns on the trunk (36%), upper limbs (26%) and lower limbs (20%).

A total of 172 (94%) of the burn cases occurred by accident. Intentional burns were either self-inflicted or caused by assault and most of them were flame burns involving adults. The mechanisms of injury included fall onto heat source (44%), spill (37%) and clothes, bedside or house on fire (19%). Only 40% of patients had received some form of prehospital intervention prior to admission, the most common being pouring of cold water on the wound. Other substances commonly applied on the burn included maize flour, raw eggs, gun oil, urine, toothpaste and transformer oil.

The median TBSA was 14.5% (11.3%). The highest TBSA that was successfully managed and discharged home was 56%. A total of 152 patients (74%) had 2nd degree while 26% had 3rd degree burns. Of the

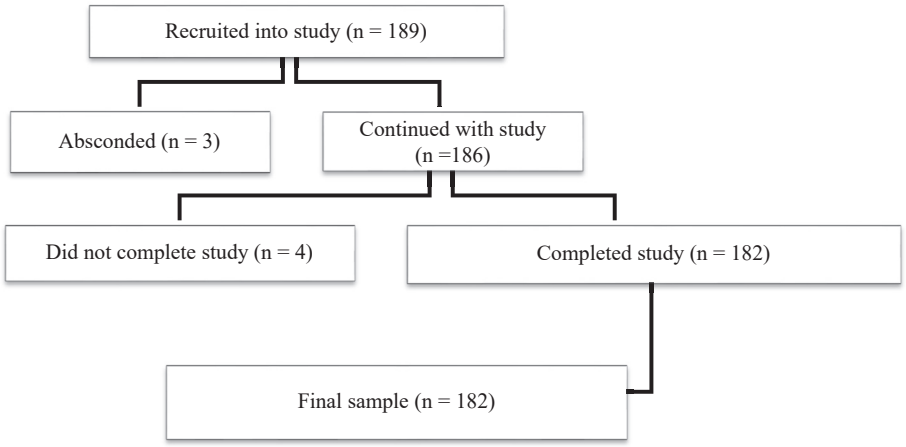

Figure 1. Patient recruitment into the study.

25 (13.7%) who presented with comorbidity, the most common included systemic infection (28%), substance abuse (20%), epilepsy (16%), trauma (12%) and others like mental illness, hydrocephalus and developmental disorders (8%).

A total of 66 patients (36.3%) developed complications while being treated for burns in the hospital. These included wound infection, anemia, electrolyte abnormalities, respiratory complications and death. Wound infection was the commonest complication, occurring in 39 (28%) of patients. Of those patients who developed complications, some had more than one complication occurring concurrently. Overall, death occurred in 17 patients (9%), most of whom had at least one or two other complications notably acute renal failure, respiratory complications, electrolyte abnormalities and sepsis. The median (IQR) length of hospital stay was 16 (33) days with a minimum stay of two days and a maximum of 203 days (Table 1). Of the 17 patients that died, their median length of hospital stay was 7 days (IQR = 17), their minimum length of stay 2 days and the maximum was 53 days.

We evaluated the association between patient characteristics and presence of burn complications. In multivariate analysis (Table 2), only TBSA of 20% to less than 30% was significantly associated with the presence of burn complications (AOR 4.96, 95% CI 1.59-15-49).

We also evaluated the association between patient characteristics and the length of hospital stay. Time from burn to admission of over three hours (AOR 2.35, 95% CI 1.08–5.11), a TBSA of 10% to less than 20% (AOR 11.27, 95% CI 1.33–9.53) and a TBSA of over 20% (AOR 3.37, 95% CI 1.19–9.49) were associated with prolonged hospital stay (Table 3).

4. Discussion

Our study showed that majority of the patients admitted with burns were children below five years. This could probably be due to their curious nature, high physical activity and unawareness of the dangers around them. Similar to previous studies [3, 9, 10, 11], most patients got burnt at home. Children spend most of their time within the home environment and especially in the kitchen where most of the accidental burns occur. Scalds were the most common cause of burn in all ages. These scalds resulted mostly from hot water and hot tea and are common during meal preparation times. Studies in Kenya [8, 10] and elsewhere [3, 12, 13] have also reported scalds as the most common cause of burns.

Patients were admitted with a combination of several burn locations, commonly involving the head, neck, trunk and upper limbs. This may reflect on the mechanism of injury which included falling on heat sources, spill injuries and children pulling on hot liquids upon themselves from a higher surface [14]. Almost all of the burns in this study were unintentional, with the few that were intentional mostly occurring in adults. Intentional burns were either self-inflicted as a suicide attempt or they involved assault. This is similar to what has been reported in other studies in Africa where over 94% of burns are unintentional [12, 15].

In this study, majority of the patients did not receive any form of prehospital intervention after experiencing burns. The use of an array of substances indicate that burn patients or their caregivers are aware that some form of first aid is necessary for burn patients prior to hospital admission. However, they may not have adequate knowledge on the necessary first aid interventions and the rationale of their use. Similar unsuitable substances have been used on burn wounds both in the developed as well as in developing countries [11]. Application of raw eggs and similar substances could result in erroneous assessment of the burn wound and subsequent improper management thus leading to complications. The public needs to be sensitized on the importance of cooling the burn using cool running water for 20 min. They should also be taught to avoid the use of creams, oils, lotions and other substances that might make burn assessment difficult besides being potentially harmful [16].

Characterization of burn severity, based on TBSA and burn depth is important as it informs choice of intervention and ultimately determines burn outcomes. Most of the patients had a fairly low TBSA and mostly 2nd degree burns. Several studies in developing countries have shown similar results of mean TBSA less than 20% with most burns seen being 2nd degree [3, 17]. The low TBSA and presence of mostly 2nd degree burns might probably explain why less adverse outcomes were noted among the patients.

While occurrence of burn complications was noted within the study, the proportion of patients experiencing these complications was generally lower than that described elsewhere in Kenya [5] and other countries [13]. Being a teaching and referral hospital, the facility where the patients were admitted offers quality care reducing the likelihood of burn complications occurring on a larger scale. Wound infection was the most common complication. Factors that contribute to wound infections in patient with burns include the immunosuppressive effect of the burns, loss of the skin barrier against infection and the prolonged hospital stay coupled with an array of procedures performed within the hospital [18].

Death is a critical complication which can occur even in moderate burns if patients do not undergo rigorous resuscitation and surgical management during admission in the hospital. In this study, the low TBSA and occurrence of mostly 2rd degree burns could be the factors that contributed to less mortality. Other factors include timely referral of burn patients to hospital within less than three hours and good surgical care for admitted patients. Early arrival of the patients in the hospital after burn injuries allows effective resuscitation and control of infection while mitigating for any other physiologic and metabolic derangements that could result in serious complications. Although death occurred in fewer patients in this study as compared to other studies [4, 5, 19], it was still at

Table 1. Sociodemographic characteristics and burn clinical patterns of 182 patients admitted with burns at MTRH.

Characteristic	N or Median	% or IQR
Age (years)*	2.4	5.8
Sex		
Male	109	60%
Female	73	40%
Time from burn to admission (hours)		
<3	107	60%
3+	70	40%
Place of occurrence		
Home	176	97%
Work	2	1%
Roadside	4	2%
Cause of burn		
Scald	138	76%
Flame	39	21%
Electrical	4	2%
Frost	1	1%
Burn location		
Trunk	105	30%
Upper limbs	91	26%
Lower limbs	71	20%
Head and neck	60	17%
Perineum	27	8%
Nature of burn injury		
Accident	171	94%
Intentional	11	6%
Mechanism of injury		
Fall onto heat source	80	44%
Spill	67	37%
Clothes, bedding or house on fire	35	19%
Prehospital intervention		
None	109	57%
Cold water	16	8%
Maize flour	16	8%
Others**	15	8%
Raw eggs	11	6%
Gun oil	10	5%
Toothpaste	5	3%
Urine	4	2%
Transformer oil	4	2%
Total Burn Surface Area (%)	14.5%	11.3%
Burn depth		
2nd degree	135	74%
3rd degree and over	47	26%
Burn complications		
None	44	24%
Wound infection	39	21%
Severe anemia	21	12%
Death	17	9%
Electrolyte abnormalities	13	7%
Respiratory complications	12	7%
Sepsis	11	6%
Hypoalbuminemia	11	6%
Acute renal failure	8	4%
Others†	6	3%
Length of hospital stay (days)	16	33

* Among the patients admitted with burns, 149 (82%) were children aged below 18 years with 131 (88%) of these aged below five years.

** Includes honey, coconut oil, petroleum jelly, dermazine ointment and brake fluid.

† Includes extremity amputation, depression and compartment syndrome.

Table 2. Factors associated with presence of burn complications among 182 patients admitted with burns at MTRH.

Characteristic	Adjusted OR (95% CI)	p value
Age of the patient (years)		
<18 (ref)		
18+	0.32 (0.08–1.41)	0.13
Sex		
Male (ref)		
Female	1.03 (0.47–2.25)	0.95
Time from burn to admission		
<3 h (ref)		
3 + hours	1.20 (0.54–2.68)	0.66
Pre-hospital intervention		
Yes (ref)		
None	1.26 (0.54–2.96)	0.59
Cause of burn		
Scald (ref)		
Flame	2.98 (0.47–18.71)	0.24
Mechanism of injury		
Fall onto heat source (ref)		
Spill	1.08 (0.17–6.86)	0.94
Clothes, bedding or house on fire	1.99 (0.25–16.09)	0.52
TBSA (%)		
<10 (ref)		
10-<20	3.28 (0.49–22.05)	0.22
20-<30	4.96 (1.59-15-49)	0.01
30+	0.94 (0.27–3.34)	0.93
Burn depth		
2nd degree (ref)		
3rd degree and over	1.85 (0.51–6.67)	0.35
Presence of comorbidity		
Yes (ref)		
No	0.31 (0.09–1.10)	0.07

a higher rate than most developed countries. In Netherlands, despite the increase in the incidence of burns over time the mortality rate has steadily decreased up to 4% which could be an indication of major improvement in their burn care, better infrastructure and the employment of multidisciplinary approach in caring for these patients [20]. In Canada, one study has reported a low mortality rate of 1% despite high TBSA among patients being managed for burns [21].

TBSA was the only factor associated with the occurrence of burn complications. In this study, a TBSA of 20% to less than 30% was significantly associated with increased likelihood of burn complications. This is similar to what has been reported in one previous study where lower TBSA was associated with fewer complications [22]. Patients with a high TBSA should be prioritized for immediate intervention following triage including advanced care in Intensive Care Unit or High Dependence Unit. In our study setting, female and paediatric patients with TBSA of more than 30% were admitted to the burns ward and received more specialized services compared to those with lower TBSA who were admitted to the general wards. This ensured that such patients received timely supportive and surgical interventions, resulting in fewer burn complications.

The length of hospital stay is a good measure of the cost effectiveness of burn care in various dimensions such as financial costs, lost work hours, lost opportunities as well as psychological and social disruption in the life of the burn patient and their family [23]. The median length of hospital stay in this study is similar to what other researchers have reported in Kenya [8, 9] and Africa [13]. However, the length of hospital stay was longer in our study compared to that reported in developed countries [24].

Table 3. Factors associated with prolonged hospital stay among 182 patients admitted with burns at MTRH.

Characteristic	Adjusted OR (95% CI)	p value
Age of the patient (years)		
<18 (ref)		
18+	0.59 (0.12–2.88)	0.5
Sex		
Male (ref)		
Female	1.74 (0.82–3.71)	0.15
Time from burn to admission		
<3 h (ref)		
3 + hours	2.35 (1.08–5.11)	0.03
Pre-hospital intervention		
Yes (ref)		
None	1.72 (0.81–3.68)	0.16
Cause of burn		
Scald (ref)		
Flame	1.98 (0.22–17.75)	0.54
Mechanism of injury		
Fall onto heat source (ref)		
Spill	3.36 (0.32–34.81)	0.31
Clothes, bedding or house on fire	3.36 (0.30–37.76)	0.33
TBSA (%)		
<10 (ref)		
10-<20	11.27 (1.33–9.53)	0.03
20+	3.37 (1.19–9.49)	0.02
Burn depth		
2nd degree (ref)		
3rd degree and over	2.03 (0.40–10.28)	0.39
Presence of comorbidity		
Yes (ref)		
No	2.44 (0.57–10.55)	0.23

*17 patients that died were excluded in this analysis.

In this study, TBSA and time to admission were significantly associated with the length of hospital stay. Each increase in TBSA by 10% was associated with increased likelihood of a longer hospital stay. This is similar to what has been reported in other studies [25]. Patients with higher TBSA were more likely to require specialized care hence prolonged hospital stay. Also, patients with higher TBSA were likely to develop complications and this would increase their length of stay. Patients who presented more than three hours after the burn had a longer hospital stay compared to those who presented to the hospital earlier. Early presentation to the hospital would enable early resuscitation and control. Previous studies found that in developing countries, late presentation was common and up to 50% of burn patients presented to hospital 24 h post injury [17, 26]. This was shown to increase the morbidity and mortality in burn patients. Other factors previously reported to be associated with prolonged hospital stay in burn patients such as age, female gender, presence of co-morbidities, cause of burn and depth of burn [6, 7] were not significant in our study. Different study settings, location and sample sizes could probably explain this difference in findings.

This study had a number of limitations. Firstly, MTRH is a referral facility that is likely to receive patients with more severe injuries requiring tertiary care thus the results of this study cannot be generalized to non-tertiary hospitals. Secondly, this being a hospital-based study, it was not exhaustive in elucidating the patterns of burns and risk factors associated with burn injuries that would be a cornerstone for burn prevention strategies in the community. Despite these limitations, the study was able to shed more insight into burn clinical patterns and factors associated with outcomes.

5. Conclusion

There is need for continued health education of the public on fire safety within the home environment for children and other vulnerable persons as well as the importance of pre-hospital intervention with cool water and prompt health care for the burned patient. Timely hospital intervention would reduce burn complications as well as length of hospital stay. Further research on the causes of wound infection and factors that influence the development of wound infection in patients with burns in MTRH would be a necessary addition to the findings in this study.

Declarations

Author contribution statement

R. Odondi: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

R. Shitsinzi and A. Emarah: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data.

Funding statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Competing interest statement

The authors declare no conflict of interest.

Additional information

No additional information is available for this paper.

Availability of data and material

The datasets used and/or analyzed during the current study are available from the corresponding author upon request.

Acknowledgements

We wish to acknowledge Dr. Sunguti Luke for assistance in the methodology and analysis as well as the Head of Department, lecturers and colleagues in the Department of General Surgery and Anesthesiology for their constructive criticism. We also acknowledge the study participants, for accepting to participate in this study.

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