Original Article

Epidemiology and outcome of acute burn patients at a new dedicated burn centre in Nepal

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Abstract

Introduction: Burn injury remains one of the biggest health concerns in the developing world. It has been regarded as a formidable public health issue in terms of mortality, morbidity and permanent disability. We aim to provide an overview of the basic epidemiological characteristics of burn patients admitted at a dedicated burn center in Chitwan, Nepal.

Methods: This was a retrospective, hospital-based observational study conducted at Chitwan Medical College Teaching Hospital (CMCTH) burn ward from September 2017 to August 2019. Patients' records from admission/discharge book, admission/discharge summaries as well as patient's individual files were reviewed to obtain the necessary data. Demographic data, clinical characteristics, treatments and outcomes were statistically analyzed.

Results: Among the 202 patients, the number of males slightly predominated that of females with a ratio of 1.02:1. The median age was 24 years, and the median total body surface area (TBSA) burned was 15%. Children less than 10 years comprised one third of all patients while more than one fifth were elderly. The commonest etiological factor was flame burn, closely followed by scald. The mortality rate was 12.38% for the period under review. Majority of the patients spent less than 10 days on admission and around one fifth needed surgical intervention aimed at earlier coverage. Binary logistic regression analysis showed that age, Body Mass Index (BMI) and total body surface area (TBSA) burnt were the major predictors of burn mortality.

Conclusions: The outcome of burn injuries is poor. Appropriate preventive & therapeutic measures need to be taken in terms of social education & provision of quality healthcare to reduce the incidence & improve the survival outcome of burn patients which should focus on children and elderly especially during the winter season.

Keywords: Burns; Chitwan Medical College; Epidemiology; Mortality; Nepal; Outcome.

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Introduction

According to WHO, burns are a global public health problem, accounting for an estimated 180,000 deaths annually (in 2018).[1] The majority of these occur in low- and middle-income countries and almost two thirds occur in the WHO African and South-East Asia regions. Burns are among the leading causes of disability-adjusted life-years (DALYs) lost in low- and middle-income countries and is also the second most common injury in rural Nepal, accounting for 5% of disabilities.[1] For the treatment of Burns/Scalds, 55,090 patients visited the outpatient department of different health centers of Nepal in the Fiscal year (FY) 2074/2075 (2018/19 AD).[2] In the FY 2073/2074

(2017/18 AD), a total of 1,348 burn patients got admitted in government hospitals: 1,159 had burn over multiple areas of the body of which 50 died.[3] The Nepalese government previously estimated that there were 2100 deaths due to burn related injuries in Nepal in the year 2008.[4] These data collected by the Department of Health Services' Health Management Information System (HMIS), however, largely underestimates burn cases that are currently being managed in Nepal and the nearby states of India.[4] Lack of a national burn registry has made this calculation even more exigent.

In Nepal, outside the capital city of Kathmandu, comprehensive burn care is provided by two medical colleges in Chitwan and Nepalgunj with teams led by Plastic Surgeons. A large proportion of 'selective' burn victims are also being treated by private hospitals and other medical colleges at different parts of the country. Severe and extensive burns are usually referred directly to the capital city where there are limited number of unoccupied beds available in government funded hospitals. A privately funded burn hospital in Kirtipur, also has been serving burn victims along with limited facility of 'available' cadaveric skin for grafting.

The incidence, pattern, as well as the overall outcome of burn wounds differ greatly between age, gender, cultures, socioeconomic status and geographical locations, even within a country. Preventive and interventional strategies for burn management, thereby, need to be tailored to and made suitable for a region being considered. This hospital-based retrospective study aims to study and analyze the epidemiological aspects of burn patients treated at Chitwan Medical College Teaching Hospital (CMCTH) during the initial two years of establishment of a dedicated burn unit.

Methods

Study setting

This was a retrospective study done at Chitwan Medical College Teaching Hospital (CMCTH), which is a 750-bedded medical college and a referral center for the population of Chitwan (around 6 lakhs) and the neighboring districts. It is the second-largest hospital in the town and the only one with a nine-bedded dedicated burn ward and a four-bedded supportive Surgical Intensive Care Unit (SICU) which is currently managed by a team led by a plastic surgeon.

Data collection

Ethical clearance for the study was obtained from the Hospital Ethical committee. Data of all the burn patients admitted at the burn ward and SICU were collected from September 2017 to August 2019. Information retrieved for the study included: patients' demographics, extent and percent of burns, cause of burns, length of total hospital stay (LOS), length of SICU stay, mortality, as well as the number and nature of operative interventions performed.

Data analysis

The quantitative data was analyzed using descriptive statistics, summarized and displayed on graphs and charts. Mean and medians of normally distributed variables were compared. Modeling was done to predict important variables for mortality and odds ratio for those variables were calculated. Data entry and analysis was done using SPSS version 17.0 (SPSS, Inc., Chicago, IL, USA) and SAS Studio Version 5.2.

Results

Demographic features of patients

In this study, there were a total of 202 cases (100 females, 102 males) with the median age of 24 years; the range was 1-97 years. Eighteen percent of our cases were older than 60 years, 76% of which were females. Females were also much older (median age 38 years) than males (median age 21.5 years) and suffered more scald (54% of total scald) and flame burn (63% of total flame burn) but much less electric (10% of total electric burn) and no chemical burn. Thirty-nine percent of our patients were of pediatric age group (<18 years) of which 87.5% were younger than 10 years.

Demographic parameters of patients are shown below in **Figure 1 to 10.**

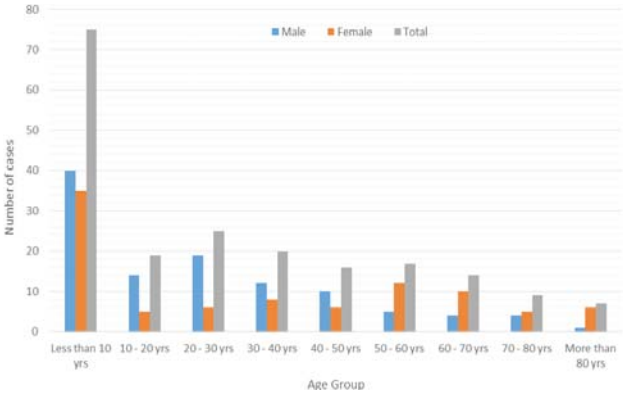

Figure 1. Patient distribution according to age group

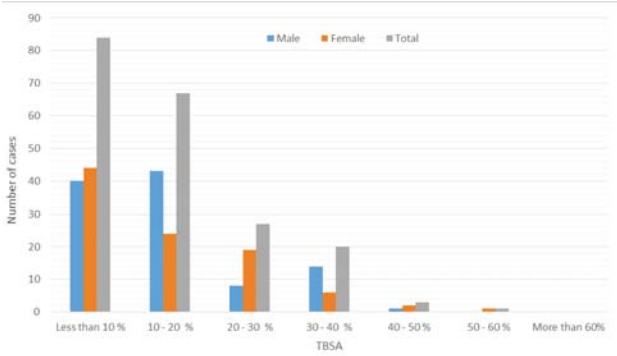

Figure 2. Patient distribution according to Total Body Surface Area (TBSA) involvement

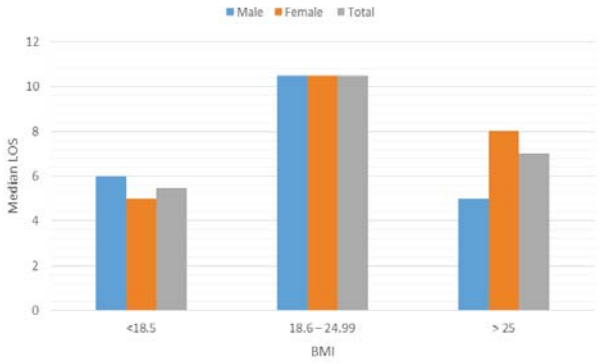

Figure 3. Median Length of Hospital Stay (LOS) in different BMI groups

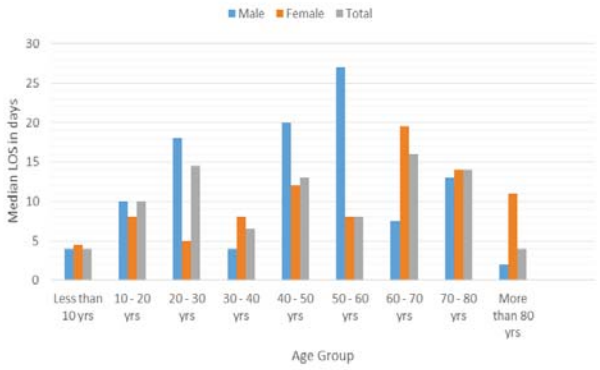

Figure 4. Median Length of Hospital Stay (LOS) in different age groups

Characteristic of the Burns

Flame burn was the most frequent cause of burns (41%) closely followed by scalds (40%). Other etiological factors were electric burn (16%) and acid burn (3%) in the descending order of frequency. Distribution of various causes of burns in various age-groups can be seen in **Figure 5**.

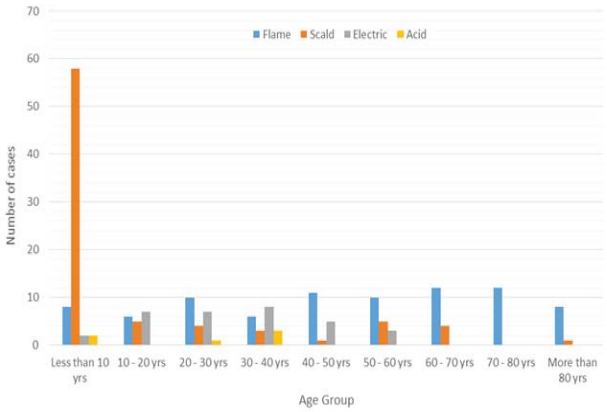

Figure 5. Patient distribution according to age group and cause of burn

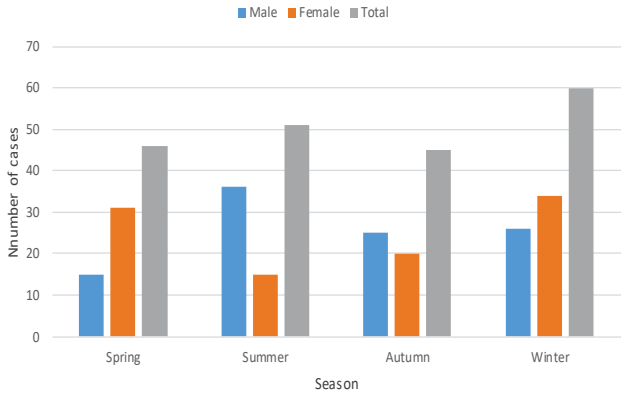

Figure 6. Patient distribution in different seasons

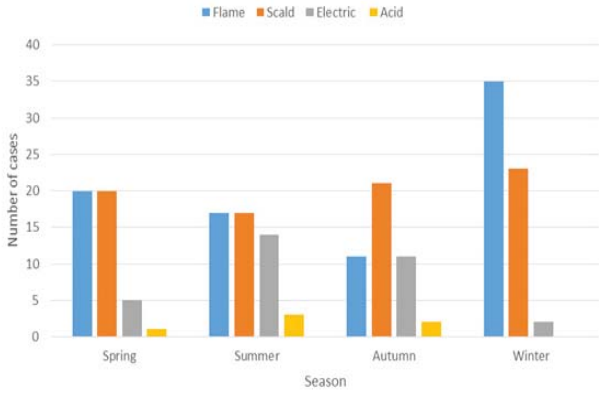

Figure 7. Patient distribution according to cause of burn in different seasons

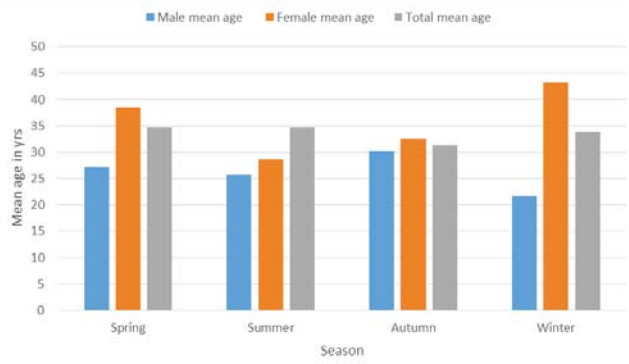

Figure 8. Patient distribution according to mean age of cases in different seasons

Scald burns were fairly distributed all throughout the year while flame burn decreased during the late summer (start of the rainy season). We also noted a higher case load of scalds (9% of all cases; 12 males and 7 females) in children ≤10 years and flame burns (8% of all cases; 3 males and 14 females) in patients older than 60 years during the winter season. Males predominated burn occurring in summer while female, who were also much older than males, outnumbered males in burn occurring in spring and winter (**Figures 6-8**).

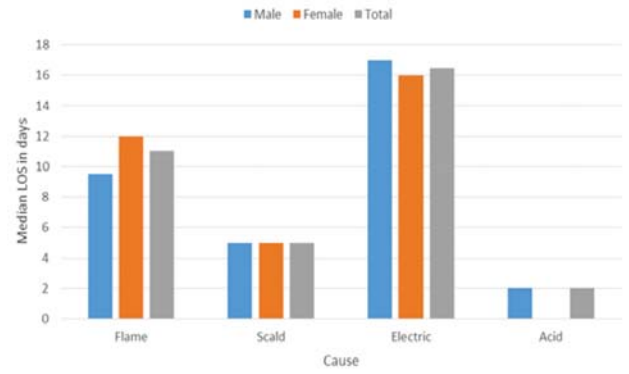

Figure 9. Patient distribution according to median length of hospital stay (LOS) for different causes of burn

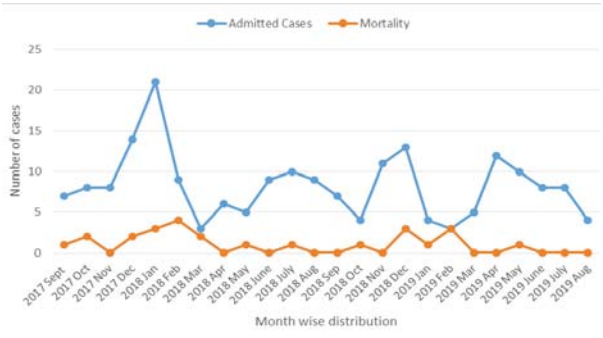

Figure 10. Seasonal variation of burn cases along with mortality

Clinical features of burn patients

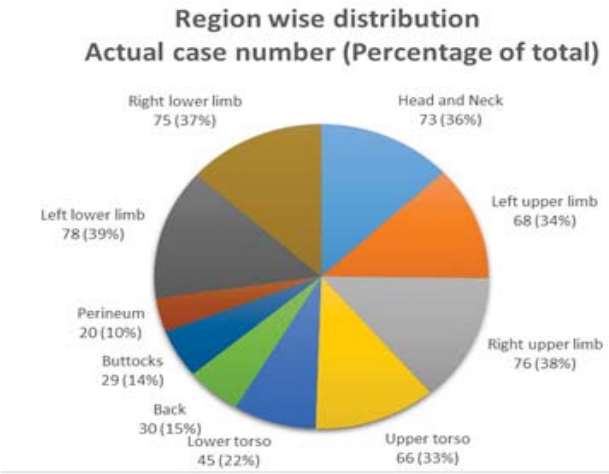

Figure 11. Region wise distribution of Burn

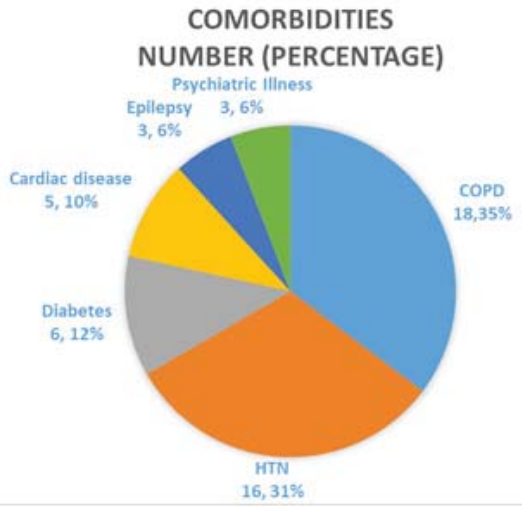

Figure 12. Patient distribution according to presence of comorbidities

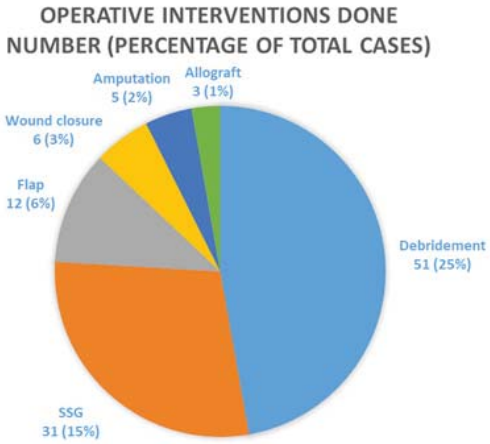

Figure 13. Patient distribution according to operations performed

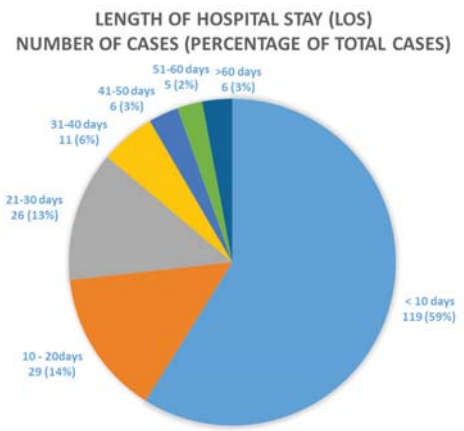

Figure 14. Patient distribution according to Length of Hospital stay (LOS)

The median hospital stay was eight days (range 1-120 days). Median length of hospital stay per percent burn was, however, not statistically different in females as compared to males (0.5 days for females and 0.6 days for males). Patients with electric burns (Median 16.5 days, Range 5-41.25 days) stayed the most in the hospital followed by flame (Median 11 days, Range 4-25 days), scald (Median 5 days, Range 2-15 days) and acid (Median 2 days, Range 1-4 days) burn in the same order. Least hospital stay was noted for patients at their 4th decade (31 to 40 years), while longest stay was noted at its adjacent decades.

No significant gender differences could be elicited for the total hospital stay (LOS) for any cause of burn.

The total mortality was 12.38% (n=25). Fourteen of our patients died due to hospital acquired chest infection, six from sepsis due to overwhelming wound infection, two from complications of inhalational injury and three from unclear causes. The mean TBSA of patients who died was 32.04 ± 11.36% as compared to 14.71 ± 9.52 % in those who survived ($p<0.05$). Flame was the predominant cause of death; followed by scald and electric injury. No patient with acid burn died. The mean length of hospital stay in patients who died was 15.08 ± 14.03 days. Of the six patients who died in SICU, four died in the 1st week and two in the 2nd week.

The outcome of another 8.4% cases was, however, unknown as they were either taken home or to some other center.

Analysis of the effects of patients' variables on mortality is depicted below in **Table 1**.

Table 1. Median age, BMI, TBSA, LOS of patients in relation to mortality (*not significant)

Mortality	Gender	Number	Variable	Median	Lower quartile	Upper quartile	P value
Alive	Female	70	Median age (years)	20.00	3.00	50.00	<0.001
			BMI	22.10	17.50	24.40	<0.001
			TBSA (%)	15.00	9.00	20.00	<0.001
			LOS (days)	7.50	3.00	24.00	<0.001
	Male	85	Median age (years)	20.00	3.00	34.00	<0.001
			BMI	22.20	17.30	24.60	<0.001
			TBSA (%)	10.00	6.00	20.00	<0.001
			LOS (days)	8.00	3.00	24.00	<0.001
Dead	Female	19	Median age (years)	71.00	60.00	83.00	<0.001
			BMI	21.60	18.70	23.80	<0.001
			TBSA (%)	40.00	20.00	40.00	<0.001
			LOS (days)	8.00	4.00	18.00	<0.001
	Male	6	Median age (years)	48.00	13.00	53.00	0.0108
			BMI	23.60	21.90	24.60	<0.001
			TBSA (%)	26.50	10.00	38.00	0.0107
			LOS (days)	16.50	4.00	50.00	0.0516*

One-fourth (n=51) of our patients underwent burn wound debridement of which around 60% (n=31) needed subsequent skin grafting while 6% (n=12) needed a much thicker tissue (flap). Various operative procedures done for the patients are shown in Figure 13.

In three children, we performed Split Skin Graft (SSG) from parental skin during their stay. The allograft protected the child's raw area for two weeks before final dissolution in the two cases where allograft was done within the 1st week. The graft lasted for just under a week in the child who was grafted later. All the children, however, survived and were discharged home.

Multiple Logistic regression (MLR) analysis was used to model the probability of dying due to burn. Wald-type statistics were used for the inference. Considering the complexities in the data set, we started our analysis from the most complex model that included all main effects that were considered to be statistically important. All variables (age, gender, cause of burn, season, BMI, TBSA, Hospital stay, LOS/TBSA and SICU stay) were included in the initial model and backward elimination techniques was used to select appropriate variables that were included in the study. The variables that were not significant were excluded.

The final model after elimination of all non-significant variables included only age, BMI and TBSA. Odds ratio estimates showed positive correlation with age and TBSA and negative correlation with BMI as shown in **Table 3**.

Table 2. Analysis of maximum likelihood estimates of burn mortality

Parameter	DF	Estimate	Standard Error	Wald Chi-Square	P value
Intercept	1	-1.7472	2.2335	0.6119	0.4341
Age	1	0.0601	0.0142	17.8497	<0.0001
BMI	1	-0.2318	0.1150	4.0625	0.0438
TBSA	1	0.1091	0.0261	17.5116	<0.0001

Table 3. Odds ratio estimate for burn mortality

Effect	Point Estimate	95% Wald confidence limit	
Age	1.062	1.033	1.092
BMI	0.792	0.633	0.994
TBSA	1.115	1.060	1.174

Discussion

Most burns are minor and are treated by primary care providers or pharmacists and do not come in contact with tertiary care hospitals and burn centers. Many of these cases heal without complications but complete healing in terms of cosmetic and functional outcome may be jeopardized in some unfortunate ones with larger and deeper burns, as it is often dependent on appropriate care, especially within the first few hours and days after the burn. A study in Taiwan has shown that adequate first aid just by water cooling decreases the length of stay in cases with burn less than 30% TBSA.[5]

Most (68%) of our patients were less than 10 years of age. Similar trend had been reported by Liu et al from the Western Regional Hospital of Nepal who showed that burns were more common in pediatric age group which accounted for 61% of their cases.[6] Khan et al from Kashmir and Nthumba et all in sub-Saharan Africa also noted that children less than 10 years were the most commonly affected group.[7,8] Brusselaers et al also found predominance of childhood burn in their systematic review of severe burn injuries in Europe.[9] Shrestha et al and Chaudhary et al showed that children under five years are more frequently injured than older children amongst pediatric burns in Nepal.[10,11] While children have an innate inquisitive adventurism that places them at risk of trauma, poor socioeconomic status, poor housing and environmental infrastructure as well as poor adult supervision places this vulnerable population at risk of burns. Burns sustained and survived in childhood may affect the individual for life as they may have to live with such complications as scarring, amputations, contractures and a lifelong risk of social exclusion and malignancy.[8] Gupta et al and Dave et al however, found the largest population of burn in the working age group in studies of various clusters all across Nepal.[12,13] Other studies conducted in Kathmandu from centers predominantly treating adult burns, reported that burns were more common among the working age group population (15–59 years).[14-19] Few studies from India mentioned the peak age of incidence as adolescence or early adulthood.[20,21]

Our study has showed predominance of male patients which is consistent with few studies conducted in Nepal[12,14,19] and elsewhere.[7,8,22-24] However, female predominance have been found in many studies as well.[6,10,15,17,18,20] Female predominance, however, is clearly seen in burn injuries occurring in winter while male child outnumbered female child in pediatric burns in our study. Reason for this could be that the patient is usually a flail female whose loose clothes catch fire while warming the buttock and thigh during the cold season. Agbenorku et al presumes the reason for pediatric male predominance to be the inquisitive and exploring nature of boys as compared to girls.[25]

Median BMI in our cases was 22.15 kg/m^2 in females and 22.4 kg/m^2 in males. While BMI did not significantly differ between the sexes, TBSA was significantly lower in women ($P < 0.001$) in both survivor and non-survivor groups. Jeschke et al noted that although BMI had no significant impact on burn outcome, it increased the risk of organ failure in females.[26] They also noted that patients with mild obesity had the best survival while morbidly obese patients had the highest mortality. Karimi et al have suggested measurement of body fat composition using bioimpedence analysis or dual-energy X-ray absorptiometry (DEXA) to detect possible differences in outcome based on body fat composition.[27]

Twelve percent (n=24) of our patients had one or more coexisting medical diseases. Chronic Obstructive Pulmonary Disease (COPD) was the most common comorbidity followed by Hypertension (HTN), Diabetes mellitus (DM) and epilepsy in the same order. Thombs et al noted that in terms of numbers of preexisting conditions, the odds of mortality increased 1.33 times (95% CI, 1.27–1.40, $P < 0.001$) for each additional medical comorbidity, controlling for demographic and burn characteristics.[28] Knowlin et al noted higher progression to mechanical ventilation and increased mortality risk in burn patients with COPD.[29] Hypertensive (17% increased risk), diabetic (26% increased risk) as well as patients with psychiatric diagnosis (42% increased risk) or valvular disease (32% increased risk) were more likely to stay longer in the hospital. Thombs et al also found that preexisting cardiovascular disease significantly increases the risk of intensive care unit admission and mortality in burn patients.[28] Hudson et al predicted that patients with preexisting psychiatric disorder were three times more likely to die and less likely to be discharged home, and more likely to go to a home hospital or rehabilitation facility.[30] Atwell et al found preexisting seizure disorder to increase hospital stay but not death unlike Thombs et al who found it to be associated with increase in both.[28,31]

Etiological factors are highly specific to each country as well as its geographic location, largely depending on the standard of living and lifestyle. The difference in ranking of different etiological factors could also be attributed to the developmental stage of the country, the age composition of the sample and whether outpatients and pediatric burns were included or not.[9] In our study, flame was the most frequent cause of burns (41%) closely followed by scald (40%).

Flame burn are reported to be commoner than scald burns by various authors, both in Nepal[6,14,17-19] and abroad.[8,32-35] Some studies in adults[12,22] and most studies in children[10,15] have, however, shown scalds as the predominant cause of burn. Most of our cases with electric injuries occurred in middle aged males whereas all acid burns occurred in males of active working age and the majority involved less than 4% TBSA. Vitriolage is not so common in this part of Nepal. Only a single case was seen by the plastic team during the two years; the patient, however, preferred to get treated at the capital city and thus was not included in this study.

The face and the hands are the anatomic region that define and drive our identity as human beings. Patients usually prefer to get treated under direct supervision even for small and superficial burn (5% of all cases) involving these areas. They however, would ultimately stay less (median LOS three days). Similarly, patients sustaining injuries of the head, upper torso and hand were the ones who stayed the least (median LOS five days vs nine days for burns involving at least one area in the lower body) in the hospital irrespective of the extent and depth of burn. Scald injuries during winter were more common in male (one third females, two third males) children (around 80% of all winter scald injuries) on both upper and lower part of the body while females sustained more flame burn of the posterior thigh and buttocks region (around 23% of all winter burns).

More than two third of our patients stayed for less than three weeks at our burn unit. Previous studies from Nepal reported the average hospital stay among the burn victims as 13-60 days and ranged from 1 to 124 days.[4] Sharma et al reported that hospital stay among female patients was significantly longer than male patients which is similar to our study (median LOS in females 8 days; males 7.5 days).[19] Shrestha et al. noted that in pediatric age group, 63% of patients stayed at the hospital for at least 20 days.[10] Patients ≥ 60 years (n=43) stayed longer in the hospital as compared to younger individuals (median LOS 12 days vs 7 days); those ≥70 years (n= 25) stayed still longer (median LOS 15 days) while those ≥ 80 years (n=11) the least (median LOS 5 days). Lower life expectancy and reluctance of family members to support prolonged hospital care of the very old individuals may be a cause for it. This fact is supported by our observation that most patients in this age group frequently die and operative interventions are usually refused and patients rather taken home after asking formal referral to better centers. Female child (≤ 10 years, n=34) stayed slightly longer (median LOS 4.5 days vs males with median LOS 4 days) as compared to males (n=36). However, the LOS/TBSA was similar in both genders (median 0.4 days in both sex). This contradicts the belief presumed by Liu et al that male children are more valued than female and families may be less willing to have female children undergo costly treatment.[6]

Financial aspect also plays an important role in determining the duration of hospital stay of patients. The lack of government subsidy, absence of local burn support group and reluctance of existing group to support patients outside the capital city has made our jobs difficult. In around 10-15% cases, however, we do charity work by mobilizing hospital fund for the poor.

The outcome (alive or dead) of the burn patients was an equally important factor in our study. We recorded a low mortality rate of 12.38%, with a decreasing trend during the second half of the study. Avoidance of postmortem and paper works for hospital deaths by care-takers as well as selection bias of severe cases by patient relatives, ambulance drivers and referring hospitals also seemed to influence hospital mortality in addition to contribution from advancement in the surgical techniques and facilities, increasing number of working manpower, an efficient early interventional protocol along with a multidisciplinary and holistic patient care approach.

Studies involving all burns and all age groups across the globe have reported variable in-hospital mortality rates including 2% in Australia, 4% in the United States, 6% in the UK, 20% in Iran, 27% in Sri Lanka and 52% in India.[20]

In view of the open nature of our Surgical Intensive Care Unit (SICU) beds and frequent cross infections and increased risk of death, we have been gradually decreasing SICU stay of our patients. Only patients with concomitant head injuries, deep and extensive burn at the outset, uncontrolled co-morbidities and suspected inhalational injuries stay at SICU till they become stable and are cleared from their related departments.

Atiyeh et al have emphasized that early excision of burned skin reduced the risk of septicemia, mortality, morbidity, hospital stay and cost of treatment.[36] Tripathee et al have predicted the factors contributing to high mortality in Nepal as lack of proper first-aid measures, time lost between the injury and initiation of proper treatment, limited supply of advanced dressing and wound care materials, poor economic status and malnutrition among the general population.[4] Ramakrishnan and Jayaraman have emphasized that lack of well trained and motivated burns surgeons can worsen the burns mortality situation in developing countries.[37]

Old age, inhalation injury and TBSA are the main risk factors for burn mortality.[38,39] Our study also showed age and TBSA along with BMI as the major risk factor for burn mortality. Other significant risk factors that are reported include female gender,[27] depth of burn and positive wound cultures.[39] Some studies, however, mention male gender as a risk factor for burn.[4,38] Jeschke et al and Karimi et al would not consider BMI as a significant risk factor for burn mortality.[26,27] Females sustain more flame burns as compared to males, and flame burns were associated with increased TBSA involved; this may be a reason for higher mortality among the female patient compared to males.[4] The mortality rate for patient with more than 40% TBSA burns is, however, estimated to approach 100% in our context.[4,18]

The results of this present study reveal novelties in terms of burns epidemiology and management, especially in most low- and middle income countries, such as Nepal, where drastic burns survivals are rare. The vast scope of improvement in preventive, curative and rehabilitative health services with focus on extreme ages is thereby reiterated in a developing country like ours.

This study does not cover all burned patients treated at CMCTH; neonatal burns as well as cases treated at surgical outpatient clinic and other wards were not analyzed. Some demographic parameters like time to receive first aid, circumstances of burn and delay in transport were not recorded due to incomplete data. Due to incomplete data in this retrospective study, outcome analysis was not done for the depth of wound. Deep burn wounds would take longer to heal and also would increase hospital stay thereby affecting the final outcome. Irrespective of depth, however, we planned to surgically intervene for all deep or converted deep burns in the second week of admission to achieve earliest possible wound coverage. Some patients were lost to follow up and so their data were not included. The result and conclusion may not be generalized to the population of Chitwan as burn patients are also managed at other hospitals in the city or taken elsewhere. Larger multi-center prospective study should be carried out in the future to precisely analyze the burden and characteristics of local burn injuries.

Conclusion

Children less than ten years were the most vulnerable victims of burns, while, adult males outnumbered females. The commonest etiological factor was found to be scald burns. The pattern of patient distribution in our study enforces the need for awareness and strategic programs to alert the parents and society members about prevention of burn injuries.

The outcome of burn injuries in Nepal has been very poor since a long time. Appropriate preventive & therapeutic measures need to be taken in terms of social education & provision of quality healthcare to reduce the incidence & improve the survival outcome of burn patients which should focus on children and elderly especially during the winter season.

More dedicated burn surgeons and equipped centers as well as properly trained nurses and paramedics are needed across the country to help reduce burns mortality. Burn registry should be maintained and coordination between district hospitals and tertiary burn centers should be established for the proper transfer of burn. Government policy should ensure quality healthcare to reduce the incidence & improve the survival outcome of burn patients which should focus on children and elderly.

Conflict of interest: None.

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