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Original article

Clinical, epidemiological, and management aspects of burn injuries in Saudi Arabia – A cross-sectional study

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ABSTRACT

Background: Burns are a deleterious, but largely preventable health problem foisting physical, economic, social, emotional, and relational issues worldwide.
Methods: A cross-sectional study was conducted at the King Khalid Hospital and Prince Sultan Center for Health Services, and Prince Sattam Bin Abdulaziz University hospital in Al Kharj in the Kingdom of Saudi Arabia. The study included patients who presented themselves to the emergency department of the targeted hospitals with at least one documented burn injury between October 2018 and October 2019. The patients were followed from presentation to discharge. The etiology, location, severity, and options of treatment offered to them were recorded. The SPSS version 22.0 was used to analyze the data. Descriptive statistics were used to summarize the data as means, frequencies, and standard deviations. Categorical variables were compared using the Pearson's chi-square test.
Results: 180 patients with burn injuries were included in the study. The majority were adolescents and adults under the age of 40 (n = 171). The prevalence of first-degree burns was 12.8%, that of second-degree burns was 71.1%, and that of third-degree burns was 16.1%. The most common cause, area, and type of treatment were hot water injuries (36.1%), upper limbs (62.2%), and skin debridement respectively.
Conclusion: Adolescents and young adults are the most frequently affected by burns while skin debridement was the most common treatment offered to the patients. In this context emergency hospital staff was required to be adequately equipped and trained.

1. Introduction

Burns are deleterious, but largely preventable injuries which pose a significant health problem around the globe with 11 million new cases every year (Stokes and Johnson, 2017). 30,000 people with burns contribute to a remarkable burden on healthcare facilities around the world every day (Stokes and Johnson, 2017). In addition to physical and economic impacts burns foist social, emotional, and relational issues (Jain et al., 2017). Approximately, ≥200,000 people suffered from burns and 6,000 died of burn injuries between 2005 and 2016 in the United States alone (Litt, 2018). Most of the burn injuries are experienced by individuals aged 15–24 years, especially females (Al Mutlaq et al., 2020). Scalding is reported to be the most common burn injury in Saudi Arabia (Al Mutlaq et al., 2020). The World Health Organization (WHO) has reported regions of southern Asia, Africa, and the eastern Mediterranean to have the highest number of burn injuries in the world (Rybarczyk et al., 2017). A systematic review, including eleven studies having 3308 patients was recently conducted on burn injuries in Saudi Arabia. It was reported that the most common sufferers were younger male children, and scald injuries contributed to 52% of all burn injuries (Almarghoub et al., 2020).

Burn injuries most often happen accidentally and ninety percent of them are preventable through education and legislation (Wanjeri et al., 2018). The frequency of burn injuries varies with age, gender, and region (Al Mutlaq et al., 2020). Burn injuries trigger coagulative necrosis of these layers to a certain degree depending on the degree

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of damage, e.g. the causative agent, the extent of exposure, and the temperature range (Kaddoura et al., 2017). Causative agents of burn injuries include chemicals, electric shock, fire, flame, friction, and scalding by hot liquids (milk, oil, water).

It has been reported that the involvement of hypovolemic shock in ≥30% of the bodily surface may lead to considerable burn shock (Kaddoura et al., 2017). The hemodynamic compromise causes further damage to the body through reduced cardiac or urine output and increased systemic resistance. The severity of burn injuries can be assessed by an injury severity score (ISS) and the Glasgow Coma Scale (GCS) (Huang et al., 2019). Data on the injury severity score and conscious level associated with burn injuries are scarce in the literature. Determination of the association or relationship of burn injuries to these entities (ISS and GCS) may help management strategies. Burn injuries can be managed by fluid resuscitation, antibiotics, escharotomy, skin grafting, debridement, and treatment of stricture (Concannon et al., 2018). Severe cases of burns, especially inhalational burns, may require intubation and mechanical ventilation in an intensive care unit. 10–20% of cases of burns are complicated by inhalation injuries, which increases morbidity and mortality (Walker et al., 2015).

As literature on burn injuries from the Kingdom of Saudi Arabia (KSA) lacks, the objective of the study was to provide an update on the clinical, epidemiological, and management issues with regards to burns in the KSA.

2. Methods

2.1. Setting and design of the study

This cross-sectional study was conducted in the King Khalid Hospital and Prince Sultan Center for Health Services, and Prince Sattam Bin Abdulaziz University hospital in Al Kharj, the KSA between October 2018 and October 2019.

2.2. Study population

The study sample included 180 patients. This sample was deemed sufficient by using an Open-epi calculator to achieve a 95% confidence interval and a corresponding 5% margin of error, where the proportion of lower limb burn injuries was set to 8.9% (Kumar et al., 2018). The criteria of inclusion in this study included adult patients of both genders living in the KSA who presented themselves to the emergency department of the King Khalid Hospital and Prince Sultan Center for Health Services or Prince Sattam Bin Abdulaziz University hospital in Al Kharj between October 2018 and October 2019 with at least one documented burn injury prior to admission to the hospital. We excluded patients who incurred burns after admission to the hospital, did not present themselves with burn injuries, all other inpatients, patients who were received dead on presentation or passed away during the stay at the hospital, minors, patients for whom we couldn't get permission from their legal guardians, and patients who did not consent to participating in the study.

2.3. Data collection

All 180 patients were identified by surveying their electronic healthcare records in the timeframe of the study. The researchers followed the trail of the patients from the point of their presentation in the electronic healthcare record to the emergency department through their stay in the admissions unit to their discharge.

The researchers used the patients' electronic health records to collect information related to their demographics including variables such as age, sex, and ethnicity. The etiology of the burn injuries was assessed by determining the mechanism of the injury (heat, electricity, etc.). The severity was determined by assessing the type/grade of the burn, affected area(s) of the body, and percentage of the affected surface. We also assessed the type of treatments offered to the patients. The presence or absence of hypovolemic shock and any documentation of the Glasgow Coma Scale (GCS) score of the patients were the variables checked for assessing the prognosis of the patients during their stay at the hospital. We assessed the treatment or care the patients received such as fluid resuscitation and antibiotics, skin debridement, skin grafting, escharotomy, or intensive care. We checked the association between variables such as the extent/grade of the burns, the affected area(s), and the variables used to ascertain the severity (GCS and hypovolemia) of the burns.

Patient information obtained from the electronic health records was anonymized; any identifiable information (e.g. the full date of birth, name, and identification number) was redacted. The study had the approval of the Prince Sattam Bin Abdul-Aziz University Ethics Committee and was performed in accordance with the Good Clinical Practice (GCP) guidelines. Participants were recruited at the time of presentation at the emergency department. Written informed consent was obtained from patients prior to their enrolment in the study.

2.4. Statistical analysis

The data were collected on excel spreadsheets by independent researchers and analyzed with the SPSS v. 22.0. The Pearson's chi-square test was applied and the *P value* of ≤ 0.05 was considered significant. The results were represented as tables and charts.

2.5. Ethical considerations

The study was approved by the Medical Ethics Committee of the Prince Sattam bin Abdulaziz University with the ethical approval code 2020/03/17128. Informed consent was obtained from the patients before participation in the study.

3. Results

One hundred and eighty (180) patients with burn injuries were included in the study. The majority of the patients were adolescents and adults under the age of 40 (n = 171). 42.2% of the partic-

Table 1
Demographic characteristics of patients.

Demographic & clinical characteristics		Frequency	Percentage
Gender	Male	121	67.2%
	Female	59	32.8%
Age group (in years)	Less than 1	9	5.0%
	1 to 10	53	29.4%
	11 to 20	12	6.7%
	21 to 30	48	26.7
	31 to 40	49	27.2%
	Over 40	9	5%
Nationality	Saudi	76	42.2%
	Non-Saudi	104	57.8%
Degree of burns	1st Degree	23	12.8%
	2nd Degree	128	71.1%
	3rd Degree	29	16.1%
Degree of shock	No	159	88.3%
	1st Degree	15	8.3%
	2nd Degree	6	0.3%
ISS (Mean ± SD)		17.8 ± 10.6	
GCS (Mean ± SD)		14.9 ± 0.4	

ipants were Saudi and 67.2% of them were men. The demographic details are delineated in Table 1.

Second-degree burns were prevalent (71.1%) followed by third-degree burns at 16.1% and first-degree burns at 12.8%. The most common cause of burn injuries was hot water (36.1%) followed by gas fires (27.2%) and electrical fires (19.4%). The location of burn injuries among the participants was also recorded. 62.2% participants sustained burns in the upper limbs and 49.4% in the lower limbs. Next were burns in the area of the head (46.7%) followed by the chest (20%). These findings are summarized in Tables 2 and 3.

The total body surface area of burns amongst participants was also recorded. About 18% of all participants sustained burns that covered about 16% of the total body surface. The maximal recorded total body surface of burn injuries was about 35%.

As mentioned in the methodology, various prognosticating factors were recorded. Most participants (88.3%) did not exhibit shock. The majority (85%) of the participants underwent skin debridement. 10% of the participants required skin grafting, 1.1% required escharotomy, and 1.1% required intubation. These figures are referenced in Table 2.

Similarly, the Injury Severity Score and Glasgow Coma Scale were documented for all participants in the study. Taking reference from Table 3, there are significant associations between the injury severity scores and the area of the burn injury (head, neck, chest, genitalia, back, upper limb, lower limb, airway). However, there was no significant association between abdominal burns and the injury severity score, as evidenced by a *p*-value that exceeded 0.05. The average ISS and GCS according to the burn injuries are shown in Fig. 1.

The Glasgow Coma Scale was not significantly associated with any burn injuries by location; all the *p* values exceeded 0.0.5 as demonstrated in Table 4 below.

4. Discussion

This study was conducted to provide an update on the clinical, epidemiological, and management issues with regards to burns in the KSA. The majority of the patients were adolescents and adults.

Table 2
Causes, location, and treatment of burns.

Cause, treatment, and location of burns		Frequency	Percentage
Cause of burns	Chemical	13	7.2%
	Electrical	35	19.4%
	Fire	3	1.7%
	Flame (Gas)	49	27.2%
	Friction	3	1.7%
	Hot Milk	3	1.7%
	Hot Oil	9	5%
	Hot Water	65	36.1%
Treatment	Escharotomy	2	1.1%
	Skin Grafting	18	10%
	Debridement	153	85%
	Fluid Replacement	132	73.3%
	Intubation	2	1.1%
	Stricture	63	35%
Location of burns	Head Burn	84	46.7%
	Neck Burn	30	16.7%
	Chest Burn	36	20%
	Abdomen Burn	16	8.9%
	Pelvic Burn	0	0%
	Genitalia	12	6.7%
	Back	25	13.9%
	Upper Limb Burn	112	62.2%
	Lower Limb Burn	89	49.4%
	Air Way Burn	3	1.7%

Most of the patients presented second-degree burns. The most common cause, area, and type of treatment were hot water injuries, upper limbs, and skin debridement.

Several insights were gained on the demographics, characteristics, and locations of the burns. Similarities can be seen in the demographic distribution of burns when compared to a prospective study of burn injuries in 240 patients admitted to a University Hospital in Saudi Arabia between 1997 and 2003 (Al-Hoqail et al., 2011). In both studies men comprised the majority of sufferers of burns (70% and 59.2% respectively). The etiologies of the burn injuries were also similar across both studies – hot water scalding injuries and gas fire injuries ranked chiefly, followed by electrical fires 36.1% versus 16.3%, 27.2% versus 6.98%, and 19.4% versus 6.5% respectively. These findings are echoed by a similar much older study conducted by Jamal et al. in 1989. The authors studied 319 burn patients between 1985 and 1987 and found that scalding (hot water) injuries accounted for a staggering 56.4% of thermal injuries followed by 41.4% of patients who sustained injuries by flame (Jamal et al., 1989). The absence of electrical injuries in this pool of 319 patients could be accounted for by the fact that the use of electrical household appliances was not prevalent in Saudi Arabia in the late 1980s. The authors explained the lack of chemical and electrical burns by hypothesizing that they may have been treated in the isolated industrialized areas of Jeddah where the study was conducted. One systematic review conducted in 2010 looked at the epidemiology of burn injuries in the eastern Mediterranean region and evaluated 71 studies from 12 countries including Saudi Arabia. The authors found that flame injuries exceeded scald injuries overall, but scald injuries were more common among children (Othman and Kendrick, 2010). This could explain the results seen in our study as the majority (41.1%) of our patients were younger than 20. However, one recent study which evaluated 85 patients in a tertiary hospital in Saudi Arabia does not fit this mold. Despite the majority (33%) of patients being younger than 10, injuries by flame still accounted for almost half of all cases of burns, followed by scalds which accounted for 27% of injuries (Al Shlash et al., 2016). The fact that children significantly contribute to the demographics of burn injuries in Saudi Arabia could be accounted for by the age distribution of the Saudi population – 25.16% of Saudis were aged between 0 and 14 years in 2017. It could also signal lack of adequate safety measures for children at home. A study dedicated to evaluating the epidemiology of infant burns in the United States found that scald injuries in infants were attributed to the use of hot water during bathing as well as consumption of hot beverages and soup (Lorch et al., 2011). A similar study conducted in eastern Saudi Arabia attributed scald injuries in infants to hot water from bathing; the authors acknowledged that differences in cleaning practices in societies should not be understated (Alsalman et al., 2015). This is supported by the findings from another study where increases in scald injuries among pediatrics were observed where there was lack of hot water supply – these scald injuries were caused by hot water meant for household use (Kubilius et al., 2014). Siddiqui et al. (2015) conducted a study having 403 patients with burn injuries in Pakistan reporting scald burns as the most common. They also reported that males and younger people were the main sufferers of burns. These findings show a similarity of characteristics of burn injuries with our current findings.

Most of our participants sustained burns in the upper (62.2%) and lower limbs (49.4%), followed by the head (46.7%) and chest (20%). These results are concordant with recent epidemiological studies of burns conducted in the Netherlands and China (Menger et al., 2014; Tian et al., 2018). With regard to burn management, most (85%) of our patients required skin debridement. This is inconsistent with other reports where the majority of patients required amputation, contracture release, skin grafting,

Table 3
Comparison of mean ISS with the types and locations of burns.

Type and location of burns		ISS			*P* values
		N	Mean	Std. deviation	
Head burns	Yes	84	21.8	11.9	0.000*
	No	96	14.3	7.9	
Neck burns	Yes	30	26.8	8.7	0.000*
	No	150	16.0	10.1	
Chest burns	Yes	36	23.0	9.0	0.000*
	No	144	16.5	10.7	
Abdominal burns	Yes	16	17.3	7.0	0.990
	No	164	17.9	10.9	
Genitalia	Yes	12	17.0	7.1	0.918
	No	168	17.9	10.9	
Back	Yes	25	24.4	9.5	0.000*
	No	155	16.8	10.5	
Upper limbs	Yes	112	20.2	11.4	0.000*
	No	68	13.8	7.7	
Lower limbs	Yes	89	21.0	10.5	0.000*
	No	91	14.7	9.9	
Airway	Yes	3	9.00	0.0	0.149
	No	177	18.0	10.7	

Independent Non-parametric Mann-Whitney test applied.
* *P* value <0.05.

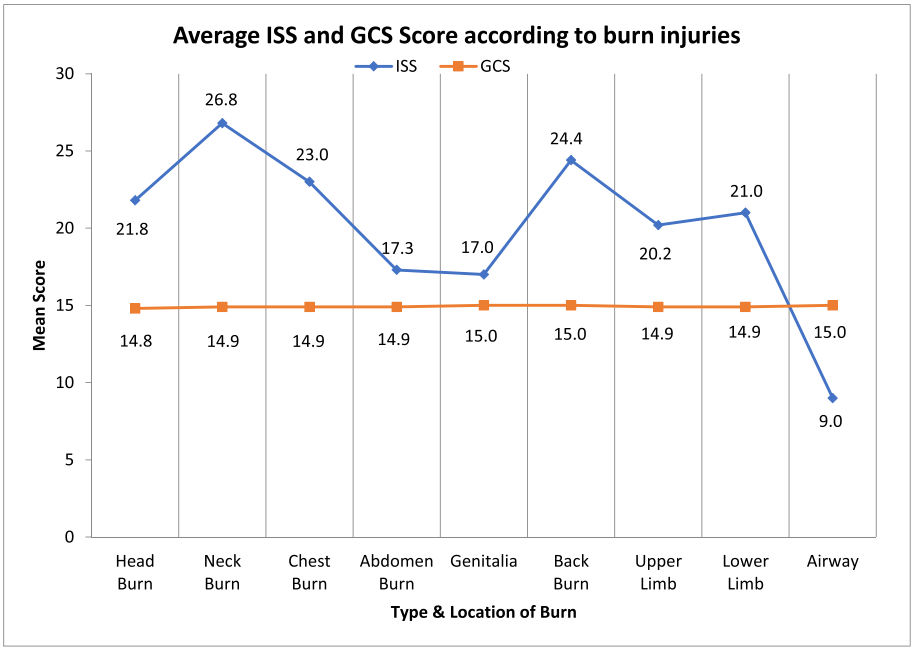

Fig. 1. Average ISS and GCS according to burn injuries.

and flap reconstruction (Al-Hoqail et al., 2011; Samuel et al., 2011; Sarma and Sarma, 1994).

The demographic trends of burn injuries reported by this study are concordant with the wider literature pertaining to burns in and outside Saudi Arabia. Differences in the etiologies of burn injuries could be accounted for by the pediatric preponderance in our study population. Nevertheless, this study remains important in describing trends in the severity and etiology of burns as it could inform health and occupational hazard policy makers in their strategic planning for the nation.

To the best of our knowledge this is one of the more recent reviews of burn injury epidemiology in Saudi Arabia. This study has a few limitations. Firstly, the locations where the burn injuries were sustained (e.g. a home setting or workplace) were not delineated. This could have been useful for health and occupational hazard policy makers in formulating strategies to avert burns in the Saudi population. Secondly, the characteristics and degree of the burn injuries were not gender stratified. Previous studies have delineated the association between electrical burns and the male gender and flame burns and the female gender (Kubilius et al., 2014). They have also shown that the TBSA burn for women is consistently higher compared to men (Al-Hoqail et al., 2011). Thirdly, the mortality of the patient population was not reported and would have been a useful value added to the literature surrounding burn injuries in Saudi Arabia. Indeed, a comparison of mortality due to burns in Saudi Arabia to the rest of the world could incentivize the healthcare direction taken in Saudi Arabia (e.g. the development of specialized burn units or centers and the

Table 4
Comparison of mean GCS score with the types and locations of burns.

Type and location of burns		GCS			*P* values
		N	Mean	Std. deviation	
Head burns	Yes	84	14.8	0.5	0.243
	No	96	14.9	0.2	
Neck burns	Yes	30	14.9	0.4	0.298
	No	150	14.9	0.4	
Chest burns	Yes	36	14.9	0.2	0.478
	No	144	14.9	0.4	
Abdominal burns	Yes	16	14.9	0.3	0.733
	No	164	14.9	0.4	
Genitalia	Yes	12	15	0.00	0.281
	No	168	14.9	0.4	
Back	Yes	25	15.0	0.2	0.388
	No	155	14.9	0.4	
Upper limbs	Yes	112	14.9	0.5	0.127
	No	68	15	0.2	
Lower limbs	Yes	89	14.9	0.4	0.474
	No	91	14.9	0.4	
Airway	Yes	3	15	0.0	0.600
	No	177	14.9	0.4	

Independent Non-parametric Mann-Whitney test applied.

implementation of specialized burn prevention programs) (Smolle et al., 2017). Patients with burn injuries who died during hospital stay were excluded from the study which might have limited the clinical outcome of burn injury results shown in the study.

5. Conclusion

The objective of the study was to provide an update on the clinical, epidemiological, and management issues with regard to burns in the Kingdom of Saudi Arabia. Second-degree burns were the most frequent (71.1%) with adolescents and young adults being the most affected age groups. Hot water, gas fires, and electrical fires remain the prevalent causes. These findings can be practiced in training and equipping emergency hospital staff to receive and manage patients adequately. In this context public health interventions are required to properly educate the wider population on how to prevent burns and their acute reactions.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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