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Original Article

Epidemiology of burn at a military hospital in Bahrain: initial experience of patient outcomes and quality indicators

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Abstract: Burn injuries are one of the most common causes of morbidity and mortality in the world. We undertook a retrospective study to analyze the epidemiology and etiology of burn injuries at the burn unit of Bahrain Defence Force-Royal Medical Services from 2015 to 2016. The epidemiological and medical information were retrieved from the burn unit's (burn ward and burn intensive care unit (BICU)) medical records. The data were analyzed in Microsoft Excel. We observed that civilians were most affected by burn injuries and men were more affected than women. The age group of the maximally burnt patients differed between the burn ward and BICU. The age group of 21-30 years and 51-60 years were maximally affected by burn injuries among patients admitted in the BICU, whereas the 1-10 years age group dominated cases in the burn ward. Flame and scald burns contributed maximally to the burn cases in both years. TBSA 0-10% was the most commonly observed burn size. The length of hospital stay decreased from 2015 to 2016, possibly because of improvements in medical infrastructure and nursing care and opening of a burn dressing room. Wound dressing, surgical debridement and skin grafting of wounds were the predominant modes of treatment. Our results show that burn injuries remain an important public health issue and increase in public awareness about burn prevention and first aid should be emphasized for reducing the frequency of burn-associated mortalities.

Keywords: Burn injuries, burn ward and burn intensive care unit (BICU), total body surface area, burn-associated mortalities, Bahrain

Introduction

Burns represent one of the most common causes of mortality and morbidity worldwide despite advances in burn-associated surgical and medical care. Globally, approximately 195,000 deaths per year are attributed to burn injuries [1]. Majority of burns occur in developing and underdeveloped countries where burn prevention and awareness programs are still not rigorously enforced [2]. Most burn-related injuries are caused by thermal energy (scalding or fire) and a minority is caused by chemical exposure, electricity, and ionizing radiation [3]. Some reports show that women and children (1-9-year-old) are at the greatest risk of acquiring burn injuries worldwide [4, 11, 13], whereas others show that occupational burn injuries were more common in young males [12, 14]. In addition to the physical distress, burn victims undergo psychological and cosmetic trauma, which might have long-lasting repercussions [5]. Therefore, the epidemiology, etiology, and outcome of burn injuries should be studied to design effective methods of prevention and awareness.

In this study, we analyzed the medical record of burn patients admitted to the burn unit (burn ward and burn intensive care unit (BICU)) of the Bahrain Defense Force-Royal Medical Services (BDF-RMS) in year 2015-2016 to understand the epidemiology and outcome of burn injuries in Bahrain.

Methods

This is a retrospective study of all patients attending the burn unit of BDF-RMS between 2015 and 2016. BDF-RMS Military hospital is

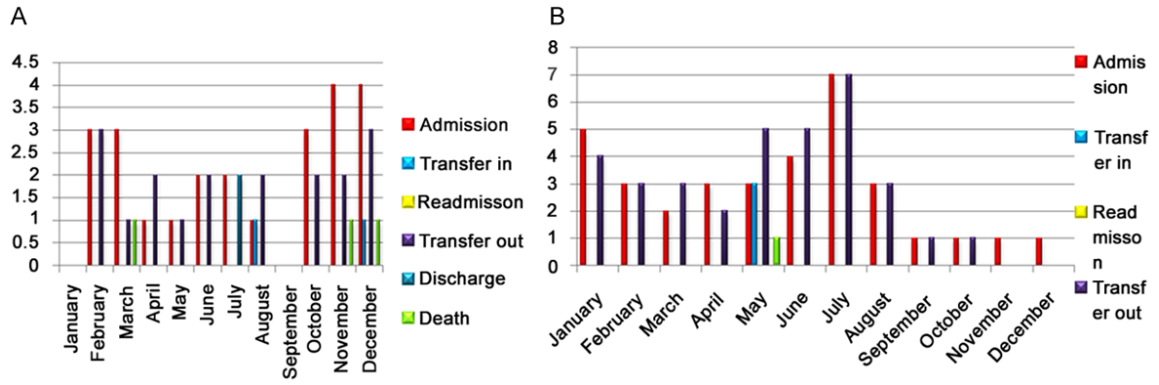

Figure 1. Patient flow in BICU in (A) 2015 and (B) 2016.

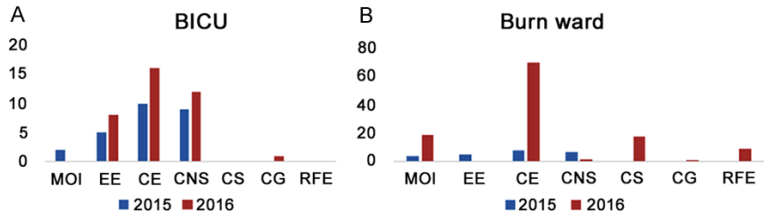

Figure 2. Patient categorization among (A) BICU cases and (B) burn ward cases in 2015 and 2016.

the 2nd largest tertiary care multispecialty hospital in Bahrain. The burn unit in BDF-RMS is one of the two tertiary care centers for treatment of all types of major as well as minor burn injuries. The unit is equipped with a dedicated 4 bedded state-of-the-art Burn intensive care unit (BICU), 8 bedded Burn ward, a dedicated state-of-the-art Burn OT with a skin-homograft storage facility inside it, dedicated burn dressing room, hydrotherapy room, dedicated space and equipment for rehabilitation (Physiotherapy and Occupational therapy). It has multidisciplinary team consist of plastic and burn surgeons, Intensive care management team-ICU intensivist and Anesthesiologist, adequate trained nursing staff, infection control team, Physiotherapy and Occupational Therapy team, dietician, and dedicated skin homograft processing and skin-cell culture lab. specialist. The burn unit in BDF-RMS is a specialized department containing the equipment, medical and nursing staffs, and monitoring devices necessary to provide special care to burn patients. The BICU is an integral unit of the hospital that treats critical burn cases, which are either referred from the Accident and Emergency Department or are transferred from the burn ward or other wards within the hospital; sometimes cases are also transferred from other hospitals. Each patient's case notes were studied and patients who had not sustained any form of burn were excluded. All epidemiological and medical information were retrieved from the burn unit's medical records.

The length of stay (LOS), defined as the time period between the day of admission to day of discharge from BICU or burn ward based on number of nights spent in hospital (Segen's, 2012), was calculated as follows: Length of stay (LOS) = day of admission - day of transfer out or discharge. The average length of stayis theaverage period in days that apatient stays in BICU or burn ward (Segen's, 2012) and is calculated as follows: Average length of stay (ALOS) = Total length of stay/Total number of transfer outpatient (Segen's, 2012).

Results

Demographics

322 patients with symptoms of burn attended the burn unit in 2015-2016 (**Figure 1**). The majority of patients admitted to the BICU belonged to the "civilian entitled" (CE) and "Civilian non sponsored" (CNS) groups in 2015 and the CE category in 2016 (**Figure 2A**). Similarly, the CE category predominated all cases admitted to the burn ward in 2015 and 2016 (**Figure 2B**). We also observed that the 21-30 years and 51-60 years age groups had higher representation among BICU attendees in 2015, whereas the 11-20 years age group

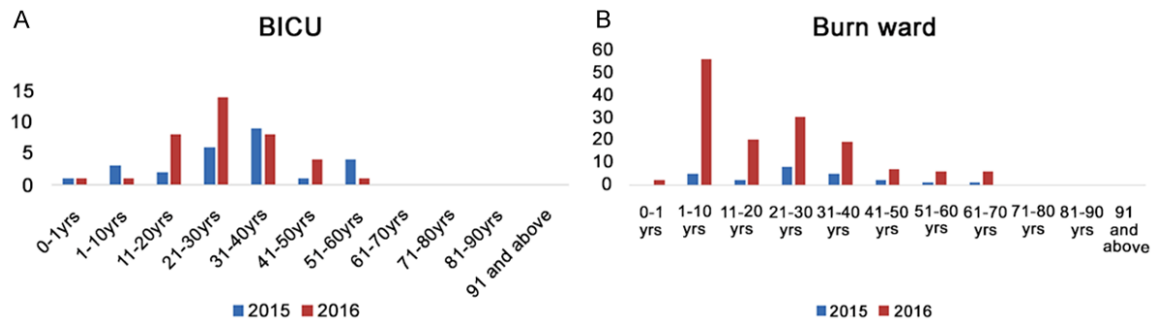

Figure 3. Age group distribution of burn victims in (A) BICU and (B) burn ward in 2015 and 2016.

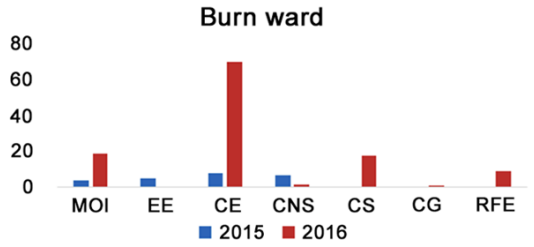

Figure 4. Patient distribution in BICU and burn ward in 2015 and 2016 based on gender.

was also highly represented in July 2016 (**Figure 3A**). In contrast, the 1-10 years age group was maximally represented in the burn ward cases in 2016, followed by the 21-30 years age group, which was reverse of what was observed in 2015 (**Figure 3B**). Males dominated the burn cases at both BICU and the burn ward in 2015 and 2016, which is consistent with earlier observations (**Figure 4**) [6, 7].

Etiology

Flame burn was the most common cause of burn injury among cases admitted in the BICU in both 2015 (56%) and 2016 (46%), followed by smoke inhalation injury (20% in 2015 and 27% in 2016). A similar trend was observed in the burn ward, where scald and flame burns comprised the two major causes of burn injuries (**Figure 5**). These observations corroborate those presented in other studies [8-10, 15].

Burn size area

The largest percentage of patients had 0-10% total body surface area (TBSA) burns (50% in 2015 and 60.6% in 2016), followed by the 11-20% TBSA category (**Figure 6**). Similar observations were made in a retrospective study in Oman, where 75% of the patients had 10% TBSA [11].

Clinical management

Among invasive procedures, central venous (CV) catheterization and arterial catheterization were most frequently used, followed by invasive ventilation (in 2015). Wound dressing changes, followed by surgical debridement of wounds plus minus skin grafting were the most common surgical procedures followed for burn injury treatment both in the burn ward and BICU (**Tables 1** and **2**).

Mortality rate

In year 2015, out of 26 patients admitted to BICU, 3 patients died constituting about 11.5% of BICU mortality rate. The major causes of burn-related deaths involved flame burn with 100% TBSA 98% TBSA flame burn with septic shock, and 35% TBSA flame burn with septicemia The primary cause of death of first two patients could be associated with very high TBSA and full thickness burn related. The third patient with 35% TBSA had other co morbidities - Renal and cardiac problem in addition to old age. in 2016, out of 37 patients admitted to BICU only 1 death was reported. Due to anaphylactic shock. Constituting 2.7% of mortality rate in BICU in year 2016. In Burn ward in year 2015 and 2016, total 259 patients were admitted and no mortality was observed. These observations indicated that improved clinical care and infrastructure and less critical patients admission might have contributed to zero mortality rates in the burn ward in two years (**Figure 7**).

Quality indicators: length of hospitalization

The average length of stay in the BICU decreased from 11.6 days in 2015 to 7 days in 2016, and from 8.3 days in the burn ward in 2015 to 5.8 days in 2016 (**Figure 8**), which was

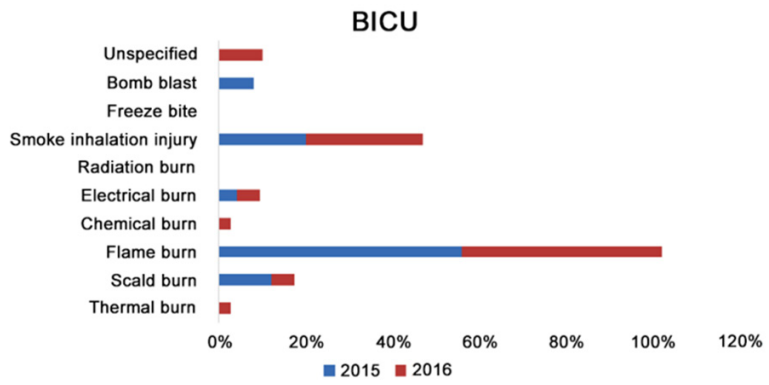

Figure 5. Patient distribution in BICU in based on etiology in 2015 and 2016.

similar to the average length of hospital stay (8.3 days) reported by [11].

Patient outcome

We observed an increase in the number of patients who visited the burn ward from 2015 (116 admitted patients) to 2016 (143 admitted patients) (**Figure 9**). While this may reflect an increase in the actual number of burn cases in Bahrain, it might also indicate an increase in public awareness about the medical treatment options available at the hospital.

Discussion

In this study, we analyzed the epidemiology and etiology of burn injuries from a retrospective study of burn cases archived in the records of the burn unit of BDF-RMS. We observed that dependent of the population who are entitled to free treatment at BDF RMS (CE category) were most affected by burn injuries and men were more affected than women. The age group of the maximally burnt patients differed between the burn ward and BICU. The age group of 21-30 years and 51-60 years were maximally affected by burn injuries among patients admitted in the BICU, whereas the 1-10 years age group dominated cases in the burn ward. Flame and scald burns contributed maximally to the burn cases in both years and flame burn cases with 100% total burn surface area (TBSA) showed the highest mortality. TBSA 0-10% was the most commonly observed burn size. The length of hospital stay decreased from 2015 to 2016, possibly because of improvements in medical infrastructure and nursing care. Wound dressing, surgical debridement of wounds, and central venous catheterization were the predominant modes of treatment.

Burn injuries are a major health problem in low and middle income countries. Meticulous documentation of cases is the key to understanding the cause and mechanism of burn, and severity of each case, which helps in determining the modes of immediate and long term therapeutic intervention and patient management and education. The burn unit in BDF-RMS maintains excellent medical records, which would assist in designing appropriate therapy and educational interventions.

We observed that males were more affected than females by burn injuries. This might represent a country or occupation-specific observation as the gender-based distribution of burn cases varies widely worldwide. Occupational burns are frequently encountered in males [12, 14], whereas household burns are more common in women of developing nations [15]. Unfortunately, our data is not categorized based on the location of acquiring the injury (at home or at work) to deduce any clear conclusions in this aspect.

Burn injuries were common in the 21-30 years age group among BICU cases; however, incidence of pediatric burn was alarmingly high in 2016. Pediatric and young adult burns Are significant global health issues. For example, in the USA and Iran, 20-29 years is the age group with the maximum number of burn injuries, whereas children less than four years of age are the most affected in Bulgaria and Lithuania [16]. Similarly, a report from the United Arab Emirates showed that 25% of the burn victims were children under five years of age [16], and children under 10 years of age constituted 22.9% of burn cases in Iran [17]. Therefore, children and young adults are at higher risk than other age groups for sustaining burn injuries and prevention strategies should focus primarily on this age group, especially because the perception of risk is not well developed among children and their behavior tend to be more exploratory and risky compared to those of adults.

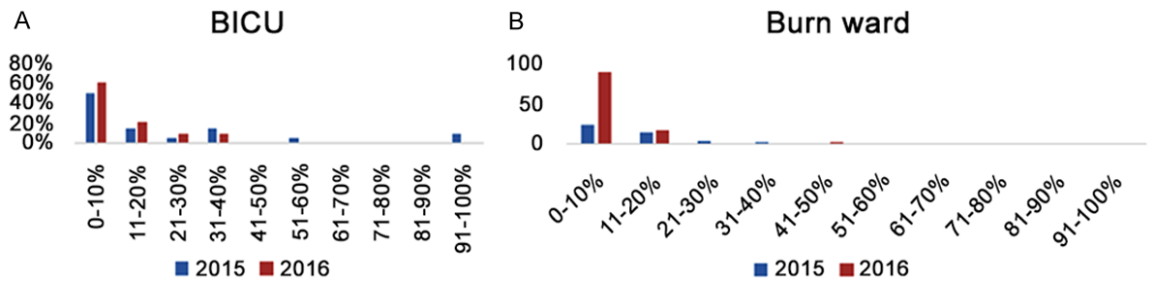

Figure 6. Patient distribution in (A) BICU and (B) burn ward based on TBSA in 2015 and 2016.

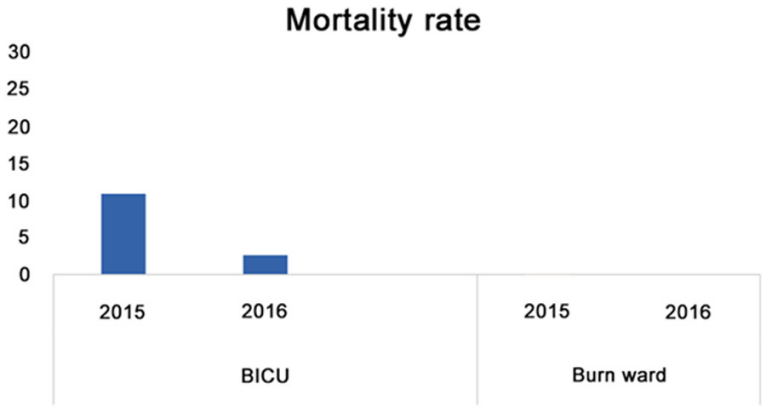

Figure 7. Mortality statistics in BICU and burn ward in 2015 and 2016.

Interestingly, the civilian entitled group comprised the largest group of burn victims, which might include burns arising from accidental, homicidal, or suicidal activities. However, our records do not specifically mention the cause of the burns. Information on the clear history of the mechanism of injury and first aid measures taken are important to consider the possibility of non-accidental injury or to decide whether potentially vulnerable patients can be safely discharged.

Among mechanisms of acquiring burn injuries, burns caused by flame and scalding were more frequent than those caused by chemical and electrical means and irradiation. This observation is common in the global scenario as it probably encompasses both household as well as professional burn hazards [8-10, 15].

Reports show an increase in burn cases during winter [18-24] or festivals (such as Diwali in India) [13]. However, the time of the year did not appear to influence the frequency of burn cases admitted to BDF-RMS. While there was a preponderance of winter-associated burns in 2016, the cases were approximately uniformly distributed throughout the year in 2015.

The degree and size of the burn wound determine the prognosis of burn victims and overall mortality. We observed that 0-10% TBSA was common among patients treated at the burn unit. This corroborates the observations of previous studies that most cases of burn injury comprise minor burns that can be treated in emergency rooms or outpatient clinics by surgical dressing or non-invasive wound debridement [4]. In fact, we observed that wound dressing was the most prevalent method of treatment in our burn unit. Highest mortality was associated with 100% TBSA, as has been reported in other studies. However, this study did not assess the frequency of occurrence of different degrees of burn wounds or derive any relationship with burn degree and mortality.

We observed that the average length of hospital stay in the BICU decreased from 2015 to 2016. This could be because lesser number of patients were admitted in 2016, or patients with minor smoke inhalation injury were admitted in 2016, or the percentage of patients with various grades of TBSA decreased from 2015 to 2016. In addition the improvements in BICU nurse training and medical infrastructure might also have contributed to this decrease. For example, 65% BICU staff nurses received basic life support (BLS) training, all nurses were trained to enter patient data in the computer for accurate record keeping, and 95% of BICU nurses completed the continuous renal replacement therapy training in 2016; the CRRT-

Table 1. Categorization of BICU cases in 2015 based on invasive procedures used

Month	CVP Catheter-ization	Arterial Catheter-ization	PA Catheter-ization	Ventilator		Intercostal Drainage (ICD)	Tracheostomy	Dialysis Catheter-ization	CVVHD Dialysis	CRRT therapy	Pace Maker	Peritoneal Drainage	Permi Catheter	PICCO Catheter	Fiberoptic Bronchoscopy
				Invasive	Non-invasive										
January															
February	1	1	0	3	0	0	0	0	0	0	0	0	0	0	3
March	3	3	0	3	0	0	0	0	0	0	0	0	0	0	2
April	1	1	0	1	0	0	0	0	0	0	0	0	0	0	1
May	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
June	1	2	0	1	0	0	0	0	0	0	0	0	0	0	1
July	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
August	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0
September	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
October	3	3	0	3	0	0	0	0	0	0	0	0	0	0	0
November	3	4	0	4	0	0	3	0	20	2	0	0	0	0	2
December	2	2	0	2	0	0	0	0	0	0	1	0	0	0	1
Total	16	18	0	19	0	0	3	2	0	2	1	0	0	0	10

Table 2. Categorization of BICU cases in 2015 based on surgical procedures used

Month	Skin Graft			Surgical Debridement	Escharotomy	Fasciotomy	Amputation	Grafted burn wound dressing changing	Wound dressing changing
	Allograft (Homograft)	Xenograft (Heterograft)	Autograft						
January									
February	0	0	0	0	0	0	0	0	0
March	0	0	0	1	1	0	0	0	0
April	1	0	0	1	1	0	0	0	0
May	0	0	0	0	0	0	0	0	0
June	0	0	0	0	0	0	0	0	0
July	0	0	0	0	0	0	0	0	0
August	0	0	0	1	0	0	0	0	5
September	0	0	0	0	0	0	0	0	0
October	2	0	1	2	0	0	0	0	21
November	1	0	1	2	2	0	0	0	15
December	0	0	1	3	1	0	0	0	6
Total	4	0	3	10	4	1	0	0	47

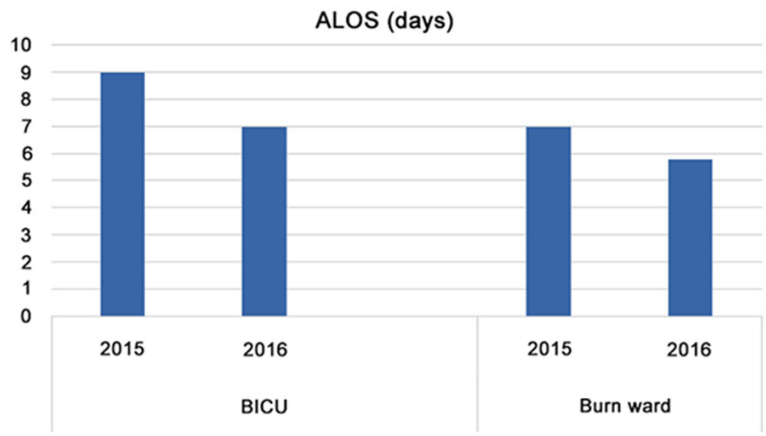

Figure 8. Average length of stay in BICU and the burn ward in 2015 and 2016.

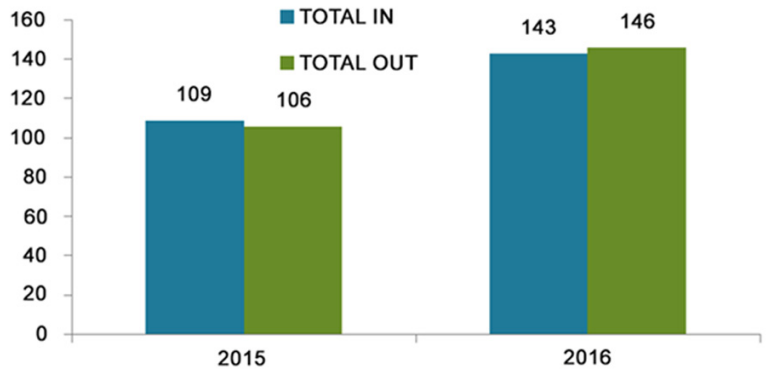

Figure 9. Graphical comparison of admission and discharge from the burn ward in 2015-2016.

Table 3. Out patients treated in burn ward dressing room

Month	Male	Female	Total
January	19	24	43
February	25	22	47
March	27	38	65
April	63	19	82
May	48	27	75
June	24	28	52
July	13	37	50
August	60	16	76
September	36	50	86
October	21	76	97
November	52	33	85
December	45	42	87
Total	429	439	868

trained nurses showed excellent performance in practice. Furthermore, an ABG machine with carboxy-hemoglobin was purchased and kept in BICU to assist the effective management of inhalation burns instantly with no waiting time. Our targets involve training all BICU nurses in BLS and 50% BICU staff in hemodialysis, reduce medication error, and computerize all aspects of patient record keeping and treatment.

The average length of stay in the burn ward also decreased from 2015 to 2016. This was partially because of the opening of a separate dressing room know as outpatient burn clinic in January 2016, which shifted the population with minor burns from being hospitalized to appearing for dressing changes as outpatients at appointed times (**Table 3**). Patients visiting the dressing room received personal care and certain patients with minor partial thickness burn were recommended to skin lab specialists for keratinocyte spray application or related therapies for expedited wound healing without skin grafting. The discharged patients could also continue to receive the rehabilitation therapy (physiotherapy and occupational therapy) during the dressing at the burn clinic till gaining maximum possible functionality of the affected burn area. This also helped to reduce the morbidity and improve the functionality of the body parts, specially limbs of full thickness burn survivors. We formulated health education brochures for discharged patients about diet, dressing, and physiotherapy as a part of an educational intervention program. The nurses were trained in CRRT, an ABG machine with carboxy-hemoglobin and a defibrillator with pacing mode were installed, and the environmental parameters in patient rooms, such as humidity, temperature, and pressure were regulated. Educational programs such as lectures on various aspects of BLS, trauma care, cardiac and renal care of burn victims, burn wound dressing, causes and complications of burn in-

juries, etc. were organized in 2016 to increase awareness and knowledge regarding burn care.

This study has several strengths and limitations. First, to the best of our knowledge, this is the first epidemiological study of burn injuries in Bahrain. Our study identifies few risk factors for burn injuries in the Bahraini population, such as preponderance of pediatric and young adult burns and flame and scald burns. However, the study lacks assessment on the anatomic location and degree of burns and information regarding the association of burns with occupation and the cause (accidental or non-accidental) of the injuries. In addition, the number of patients studied is low, and larger cohorts should be studies to understand the significance of these observations.

Conclusions

Burn injury is the most common form of health hazard worldwide with long-term physical and psychological impacts, and a vast majority of the young adult and aged population suffers from burns annually. Therefore, a detailed understanding of the causes and risk factors associated with burn injuries is critical for reducing the number of burn injuries and improving the quality of life of the victims. In this study, we retrospectively discuss the results obtained from the records of the burn unit of BDF-RMS for 2015-2016. We show that burn injury is common in children, young adults, and the aged population in Bahrain and that civilian men were more prone to acquiring burns than women. However, most of the cases involved minor burns that could be handled by wound debridement or wound dressing. Flame and scald were the main causes of burns. We also assessed the length of hospitalization as a quality indicator and observed that the average stay at the burn unit and BICU decreased from 2015 to 2016, which was partially because of opening of a dressing room in the burn ward in 2015. Thus, improvements in medical and nursing educational efforts at increasing awareness on burns both among the public and medical staff would be important in further reducing the incidences of burns and burn-related mortality.

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Disclosure of conflict of interest

None.

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References

[1] Mock C, Peck M, Krug E, Haberal M. Confronting the global burden of burns: a WHO plan and a challenge. Burns 2009; 35: 615.

[2] Pasalar M, Mohammadi AA, Rajaeefard AR, Neghab M, Tolidie HR, Mehrabani D. Epidemiology of burns during pregnancy in southern Iran: effect on maternal and fetal outcomes. World Appl Sci J 2013; 28: 153-58.

[3] Mohammadi AA, Amini M, Mehrabani D, Kiani Z, Seddigh A. A survey on 30 months electrical burns in Shiraz university of medical sciences burn hospital. Burns 2008; 34: 111-113.

[4] Peck MD. Epidemiology of burns throughout the world. Part I: distribution and risk factors. Burns 2011; 37: 1087-1100.

[5] Pruitt BA Jr, Mason AD Jr. Epidemiological, demographic, and outcome characteristics of burn injury. Total burn care, 2nd edition. New York, W.B: Saunders; 2002. pp. 16-30.

[6] Wilkinson E. The epidemiology of burns in secondary care, in a population of 2.6 million people. Burns 1998; 24: 139-143.

[7] Grout P, Horsley M, Touquet R. Epidemiology of burns presenting to an accident and emergency department. Arch Emerg Med 1993; 10: 100-107.

[8] Rea S, Wood F. Minor burn injuries in adults presenting to the regional burns unit in Western Australia: a prospective descriptive study. Burns 2005; 31: 1035-1040.

[9] Rawlins JM, Khan AA, Shenton AF, Sharpe DT. Burn patterns of Asian ethnic minorities living in West Yorkshire, UK. Burns 2006; 32: 97-103.

[10] Hettiaratchy S, Dziewulski P. ABC of burns pathophysiology and types of burns. BMJ 2004; 328: 1427-1429.

[11] Al-Shaqsi S, Al-Busaidi S, Al-Kashmiri A, Alaraimi R, Al-Buloushi T. Epidemiology of burn in Sultanate of Oman. World J Plast Surg 2016; 5.

[12] Chipp E, Walton J, Gorman DF, Moiemen NS. A 1 year study of burn injuries in a British emergency department. Burns 2008; 34: 516-520.

[13] Deshpande JD, Baviskar PK, Phalke DB. Epidemiological study of hospitalized burn patients in rural area. International Journal of Biomedical and Advance Research 2012; 3: 263-267.
[14] DeKoning EP, Hakenewerth A, Platts-Mills TF, Tintinalli JE. Epidemiology of burn injuries presenting to North Carolina emergency departments in 2006-2007. Science Direct 2009; 35: 776-782.
[15] Othman N, Kendrick D. Epidemiology of burn injuries in the East Mediterranean Region: a systematic review. BMC Public Health 2010; 10: 83.
[16] Grivna M, Eid HO, Abu-Zidan FM. Epidemiology of burns in the United Arab Emirates: lessons for prevention. Burns 2014; 40: 500-505.
[17] DiGuiseppi C, Roberts I, Wade A, Sculpher M, Edwards P, Godward C, Pan H, Slater S. Incidence of fires and related injuries after giving out free smoke alarms: cluster randomised controlled trial. BMJ 2002; 325: 995.
[18] Groohi B, Alaghehbandan R, Lari AR. Analysis of 1089 burn patients in province of Kurdistan, Iran. Burns 2002; 28: 569-574.
[19] Panjeshahin MR, Lari AR, Talei A, Shamsnia J, Alaghehbandan R. Epidemiology and mortality of burns in the South West of Iran. Burns 2001; 27: 219-226.
[20] Saadat M. Epidemiology and mortality of hospitalized burn patients in Kohkiluye va Boyerahmad province (Iran): 2002-2004. Burns 2005; 31: 306-309.
[21] Hemeda M, Maher A, Mabrouk A. Epidemiology of burns admitted to Ain Shams University Burns Unit, Cairo, Egypt. Burns 2003; 29: 353-358.
[22] Lari AR, Alaghehbandan R, Nikui R. Epidemiological study of 3341 burns patients during three years in Tehran, Iran. Burns 2000; 26: 49-53.
[23] Neghab M, RajaeiFard A, Habibi M, Choobineh A. Home accidents in rural and urban areas of Shiraz, 2000-02. East Mediterr Health J 2006; 12: 824-833.
[24] El-Badawy A, Mabrouk AR. Epidemiology of childhood burns in the burn unit of Ain Shams University in Cairo, Egypt. Burns 1998; 24: 728-732.