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Original Article

Physicians based emergency medical services for the management of burn injuries in trauma centers of the center region of Saudi Arabia: evaluation of physicians' knowledge and experience

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Abstract: Background: Medical services at trauma centers regularly encounter severe burn patients but prehospital care of these patients in Saudi Arabia is comparatively unexplored. This study evaluates the knowledge and experience of physicians working in trauma centers of Qassim province of Saudi Arabia for the management of patients with burn injuries. Methods: This is a cross sectional study performed on 204 physicians working in the trauma centers of Qassim province. Physicians' knowledge and experience were assessed via administration of validated questionnaires and the data were analyzed using SPSS software. Results: Among total studied physicians, only 35.3% and 24.0% gave the right answer to the question on the diagnosis of burn skin in depth/extent for adults and pediatric patients, respectively. Importantly, 93.6% physicians responded correctly for first aid treatment. For the parkland concept, 62.2% responded correctly, however, only 22.5% understand the colloid fluid concept. The 74% physicians knew the methods of fluid revival for mass burn injuries and about half of studied physicians showed right knowledge for intubation for breathing for mass burn injuries. Only 47.5% physicians understand the concept of electrolyte disorder. Conclusions: This is the first study from the central region of Saudi Arabia that analyzed the knowledge and experience of physicians working in trauma centers for the management of patients with burn injuries. Overall data showed that ~60% physicians working in trauma centers have knowledge for handling the patients with burn injuries but the rest needed counseling, therefore proper training sessions for them are needed for management of burn patients.

Keywords: Physicians, emergency medical services, burn cases, trauma centers, Saudi Arabia

Introduction

Burn injuries are commonly occurring at any time that increases the morbidity and mortality worldwide [1]. Recently, the World Health Organization (WHO) reported that burn injuries cause 180 million deaths yearly in all over the globe [2]. Although in recent years, the death rate of burn patients has been reduced but still more than 70% of deaths associated with burn injuries are reported especially in developing countries [1, 3]. It is now well established that the incidence of burn injuries is relative low in high income countries as compare to those countries where income turn-over is less [4, 5]. Despite of the high income of the countries, the

burn victims required extra preventive measures, high social and economic costs [5, 6]. Impact of burn injuries on the burns victims is extremely devastating, not only increases the mortality but also produces skin scar marks, mental stress and reduces the quality of overall lifestyle of the affected individuals [7]. Burn injuries not only occur due to domestic activities such as cooking, electricity, etc., but also occur due the exposure of chemical, fireworks and factories fire outputs and so on [8]. Moreover, burn injuries also occur because of several other factors including economic status, age, and also education [8, 9]. The management of burn patients requires high skilled interprofessional team including surgeon, intensivisit, burn specialist, dietitian, physical therapist, nurses, wound care specialists, pulmonologist and plastic surgeon but an accurate assessment of burn depth at the time of admission always play an important role in making decisions whether to go for dressings or surgery [10]. Keeping the burn victims stable, burn specialist doctors have been taking care of any possible concomitant injuries such as injuries associated with inhalation, carbon monoxide, cyanide toxicity, trauma, oxygenation, intubation, smoke inhalation, impaired consciousness, co-intoxication, hypothermia, *etc.* [10, 11]. Other than these, prehospital recommendations are inconsistent regarding the method and accuracy of the estimation of the total burned surface area, the amount of fluid volume to be infused precociously and the type of analgesia to be administered [12-14]. Patients with burns injuries require special care with long recovery time, if burn injuries will not manage in their initial treatment then lead to more complications, higher mortality and longer hospitalization [11, 15]. All these implications for the burn victims suggesting that the management of burn injuries patients is not simple as they are not directly admitted to the special care burn units, but they have been referred and transferred from emergency or trauma centers, where their initial treatment has been managed by the physicians working in these centers. Therefore, the knowledge and practical skills of these physicians in these trauma centers are extremely important to manage the initial treatment of burn victims. Despite of these, only few epidemiological reports on burns victims from Saudi Arabia were reported and most of them were localized and were reported from specific regions of the country [16, 17]. This study was designed to evaluate the knowledge and experience of physicians working in emergency or trauma centers of the center region of Saudi Arabia for the management of patients with burn injuries. To the best of our knowledge, this is the first study from the central region of Saudi Arabia showed that physicians working in the central region of Saudi Arabia required training sessions from the experts for handling the patients with severe burn injuries under emergency conditions.

Methods

Study setting, design and ethical approval

This study was conducted from January 2019 to March 2019 on 204 physicians working in the Emergency Department of Primary Health care centers and Main hospitals of Qassim province of Saudi Arabia. The Qassim province is located at the heart of the country occupied about 59,000 km^2 area with a population of more than 1,400,000 and this region is well known as the richest region per capita in the country (**Figure 1**). It has more than 400 cities, towns, villages, and Bedouin settlements, ten of which are recognized as governorates including Buraidah, Unaizah and Ar Rass. This central part of the country has several hospitals and primary healthcare centers and most of them are operating by the Ministry of Health and the Ministry of Defense, and also several others are under the management of private sectors [18]. The main hospitals of the regions are King Fahd Specialist Hospital, Buraidah; King Saud Hospital, Onaizah; Children's Hospital, Buraidah; Buraidah Central Hospital, Buraidah; Dr. Sulaiman Al-Habib Hospital, Buraidah; Qassim National Hospital, Buraidah; Security Forces Hospital, Buraidah and so on [18]. This is descriptive cross-sectional study was designed to evaluate the knowledge and experience of physicians working in trauma centers of the region for the management of patients with burn injuries. We have also consulted the burn center database for the identification patients managed by the studied physicians who may have missed our initial search strategy for the complementary data. Ethical approval of the study was taken from the Medical Ethics Research Committee, Qassim University (Ethical approval #2018-10-02) and informed con-

Figure 1. Map of Saudi Arabia showing Qassim region.

sents were obtained from all physicians involved during their assessment using administered questionnaires.

Data collection instrument

A validated questionnaire was directly administrated to the physicians and asked to respond to the questions within 30 minutes as published previously [19, 20]. All involved physicians were assured that their responses would be collected anonymously, reducing the potential for bias introduced by self-reported results. The contents of the questionnaire included knowledge of diagnosis for burn pathology, diagnosis of burn skin in depth, extent of burn shock, first aid for burn injury for both adults and pediatric patients, questions about burn injury in eyes, questions on fluid resuscitation and its associated applications involving the Parkland formula, colloid fluid concept, electrolyte disease, management of inhalation, intubation, transportation of case with mass burn injuries.

Estimation of sample size

The estimated sample size was 244, which was obtained by statistical calculation from the official Saudi Ministry of Health records for the physicians with a 95% confidence level and a 5% margin of error.

Data management and statistical analysis

The collected datasets were processed and analyzed using the Pivot Table, data analysis within MS excel version 2010. Descriptive statistics such as percent frequencies for true or false values, mean and standard deviation (SD) were employed for the presentation of categorical and continuous variables to summarize respondent characteristics. Moreover, the data were further statistically analyzed by the Student t-test or ANOVA analysis for statistical comparison between the groups using SPSS statistical data software (IBM, TX, USA). $P<0.05$ was considered significant as described previously [21].

Results

Physicians' job categories, workplace, qualifications and experience

Basic characteristics of the participated physicians have been summarized in **Table 1**. Out of 204 total participants, 47.5% were general physicians, 28.9% were family physicians, whereas 9.8%, 7.3%, and 6.3% were consultants, residents and internists, respectively. Among them 63.7% were working in the trauma centers of primary healthcare centers, whereas 36.3 physicians were working in main hospitals of Qassim region of Saudi Arabia. As far as their qualifications were concerns, out of 204 physicians, 36.8% were holding master degrees, 63.2% were having bachelor degrees only. Not only have these, we have also estimated their working experiences, 50.5% physicians were having more than 5 years working experiences in the trauma centers and rest were juniors having less than 5 years working experiences in the trauma centers.

Table 1. Participants' types, workplace, qualification and working experience

Study participants	Parameters	Participation	
		n	%
Types	Consultants	20	9.8
	Family physicians	59	28.9
	General physicians	97	47.5
	Residents	15	7.3
	Internists	13	6.3
	Total	204	-
Working	Primary Health Centers	130	63.7
	Main Hospitals	74	36.3
Degrees	Master's	75	36.8
	Bachelors	129	63.2
Experience, Years	>5 years	103	50.5
	≤0 years	101	49.5

n, number of participants, %, percentage of participants.

Physicians' knowledge of burn pathology and first aid application for adults and pediatric patients

Physicians' knowledge of burn pathology and first aid application for adults and pediatric burn patients have been summarized in **Table 2**. Out of 204 physicians, 132 (64.7%) were wrongly responded to the question on the diagnosis of burn skin in depth and extent for adults burn skin patients and their knowledge was found to be the same for pediatric burn skin patients as well as. Only 49 (24.0%) physicians responded correctly to the question on the diagnosis of burn skin in depth and extent for pediatric burn patients. These findings clearly indicate their lack of knowledge for the treatment of adults and pediatric patients with burn skin in the trauma centers. Regarding first aid treatment for burn injuries, 191 (93.6%) physicians knew to use fresh cool was good for the treatment and have responded correctly, whereas still 13 (6.4%) physicians did not know about fresh cool water treatment as a first aid at the trauma center. Most importantly, 187 (91.7) physicians working in Qassim regions knew the remedies such as fish sauce, tooth paste, butter, *etc.*, not good to cover the burn wound and were responded correctly.

Physicians' knowledge for the treatment patients with mass burn injuries

Table 3 summarizes the tested knowledge of studied physician's for handling the cases with mass burn injuries. The management of fluid in patients with severe burn injuries are extremely important for their treatment in their initial stages therefore the working physicians knowledge was tested by asking the questions on parkland concept, colloid fluid concept, fluid revival methods, intubation for breathing, electrolyte disorder, burn shock pathology for handling the patients with mass burn injuries. Regarding knowledge of the parkland concept, 127 (62.2%) physicians responded correctly and understand this concept to handle mass burn injuries patients. However, only 46 (22.5%) physicians gave the right answer on colloid fluid concept and the rest 158 (77.4%) physicians were unaware of colloid fluid concept. Regarding the methods of fluid revival during mass burn injuries, 151 (74%) physicians responded correctly and understood well about the fluid revival methods. About half of studied physicians showed right knowledge for intubation for breathing during mass burn injuries. Question on the electrolyte disease, 107 (52.5%) physicians responded wrongly, whereas the rest 97 (47.5%) physicians understand the concept of electrolyte disorder. Question on the knowledge to understand whether surgery needed or not, 128 (62.8%) physicians gave the right answer. Regarding the transportation of mass burn severe cases with inhalation intubation, 108 (52.9%) responded correctly, whereas 96 (47.1%) physicians responded wrong.

Discussion

This study analyzed the knowledge and experience of physicians working in trauma centers of the central region of Saudi Arabia for the management of patients with burn injuries. Number of studies have proven that the initial burn injuries management and suitable initial application of first aid markedly reduce the levels of burn injuries and improve the quality of life of burn patients [22]. Physicians working in trauma centers are the first to handle almost all patients with burn injuries therefore their knowledge and working experience play a fundamental role for diagnosis, prognosis, treatment and shifting them to their specialized burns care wards. It is important for us to point out that the knowledge levels of physicians in trauma centers for the application of first aid and the initial management for burn injuries are

Table 2. Participant's knowledge of burn pathology and first aid application for adults and pediatric patients

Participant's knowledge		True		False		*P* value, True vs False
		n	%	n	%	
Diagnosis of burn skin in depth and extent	Adults patients	72	35.3	132	64.7	P<0.05, Significant false knowledge
	Pediatric patient	49	24.0	155	76.0	P<0.05, Significant false knowledge
Diagnosis of eye burn injury in depth and extent	Adults patients	61	29.9	143	70.1	P<0.05, Significant false knowledge
	Pediatric patients	42	20.6	162	79.4	P<0.05, Significant false knowledge
First aid application	Cool water	191	93.6	13	06.4	P<0.05, Significant true knowledge
	Covering of burn wound	187	91.7	17	08.3	P<0.05, Significant true knowledge

n, number of participants, %, percentage of participants.

Table 3. Participant's knowledge of fluid revival, breathing injuries and mass burn injuries

Participant's knowledge	True		False		*P* values, True vs False
Parameters	n	%	n	%	
Parkland concept	127	62.2	77	37.7	P<0.05, Significant true knowledge
Colloid fluid concept	46	22.5	158	77.4	P<0.05, Significant false knowledge
Fluid revival methods	151	74.0	53	26.0	P<0.05, Significant true knowledge
Intubation for breathing	105	51.4	99	48.5	P>0.05, Insignificant true knowledge
Electrolyte disease	97	47.5	107	52.5	P>0.05, Insignificant false knowledge
Plasma concentration in injury sites	100	49.0	104	51.0	P>0.05, Insignificant false knowledge
Surgery needed	128	62.8	76	37.2	P<0.05, Significant true knowledge
Transportation of mass burn cases with inhalation intubation	108	52.9	96	47.1	P<0.05, Insignificant true knowledge

n, number of participants, %, percentage of participants.

varied from regions to regions worldwide [23-25]. Specifically, insufficient knowledge of physicians in emergency burn management has been reported in numerous countries particularly the countries at their developing phases [19, 26-28]. In 2018, a survey concluded by Lam et al. on the physicians working in the trauma departments in Vietnam showed that a significant number of physicians showed lack of knowledge for handling the patients with burn injuries [19]. Another survey performed in Turkey, showed only 22% of total physicians knew about burn classification and the most disturbing thing was that 96% physicians from them had not sufficient knowledge of burn first aid and initial management [26]. In Saudi Arabia, a survey was conducted in 2016 by Alomar et al. on 408 physicians working in pediatric trauma centers, only 40% of total studied physicians had knowledge about the use of fresh cool water as a first aid treatment for patients with burn injuries [27]. Not only have these, 97% of them had insufficient knowledge for an initial application of the treatment as the majority of them answered that home remedies like ice, oils, fish sauce, toothpaste, etc. could be used for burn wound covering [27]. Further analysis of this survey analyzed that 85% of such physicians had not taken part in the first aid training and had no knowledge how to apply the first aid application for pediatric patients with burn injuries [27]. In 2018, a study performed on the Taiwan population showed physicians working in their trauma centers had enough knowledge and experience for handling mass burn injury patients [28]. Importantly, physicians in these preliminary local/main hospitals had knowledge for setting up personnel, professional and telemedicine association to maximize the function of the trauma centers of Taiwan for the management of the burn care system [28].

In view of these, this study determined the knowledge of 204 physicians working in the trauma centers of Qassim region of Saudi Arabia for initial handling of patients with burn injuries. The majority of participants were general physicians and family physicians and few of them were consultants, residents and internists. Among participating physicians, 63.7% were working in the trauma centers of primary healthcare centers, whereas 36.3% working in the trauma centers of main hospitals. While

asking the question on the analysis of burn pathology for adult and pediatric patients, the majority of them responded wrong and they showed that they didn't know how to diagnose the burn skin in depth. These findings clearly indicate their lack of knowledge for the treatment of adults and pediatric patients with burn skin in the trauma centers. Previous studies showed that first aid treatment for burn cases is crucial for their rest of treatment, especially the use of running cold water [22, 29]. In this study, we determined that 93.6% physicians knew to use fresh cold water is good for the treatment and have responded correctly and 91.7% physicians also knew that the remedies such as fish sauce, tooth paste, butter, *etc.*, have not been recommended to cover the burn wounds. These novel findings clearly indicated that the physicians working in the trauma centers of Qassim region have thorough knowledge for the treatment of burn cases with first aid applications. It has now been well established fact that patients with severe burn injuries faced fluid loss, which has known as one of the main factors for increasing the mortality rate of burn patients, therefore effective fluid resuscitation or recovery has now been considered as one of the keystones for the treatment of burn patients especially in their initial stages [30]. The fluid resuscitation for burn cases have been managed by understanding the parkland concept, colloid fluid concept, fluid revival methods, intubation for breathing, electrolyte disorder, burn shock pathology [31, 32]. In parallel, the studied physician's knowledge was tested on these parameters. Regarding knowledge of the parkland concept, 62.2% physicians understand this concept to handle mass burn injuries patients and to manage their fluid loss. However, only 22.5% physicians gave the right answer on the colloid fluid concept and were unaware of the colloid fluid concept. Regarding the methods of fluid revival during mass burn injuries, 74% physicians understood well about the fluid revival methods. Furthermore, about 50% of studied physicians showed the right knowledge for intubation for breathing during mass burn injuries, whereas only 47.5% physicians understand the concept of electrolyte disorder. These findings clearly indicate that the physicians working in the central region of Saudi Arabia required training sessions from the experts for handling the patients with severe burn injuries under emergency conditions.

Conclusions

This study analyzed the knowledge and experience of physicians working at emergency departments in the central region of Saudi Arabia for the management of patients with burn injuries. The data analysis concluded that only 35.3% and 24.0% of them knew the diagnosis of burn skin in depth for adults and pediatric patients, respectively. Importantly, 93.6% physicians knew the use of a first aid application in the initial stage of treatment. Interestingly, 74% physicians knew the methods of fluid revival for the treatment of severe burn cases. In total, a large group of studied physicians were unaware about parkland concept, colloid fluid concept and have no understanding for the concept of onset of electrolyte disorders, therefore they need counseling from the field experts for management of burn patients at trauma centers.

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Disclosure of conflict of interest

None.

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References

[1] Jeschke MG, van Baar ME, Choudhry MA, Chung KK, Gibran NS and Logsetty S. Burn injury. Nat Rev Dis Primers 2020; 6: 11.
[2] https://www.who.int/news-room/fact-sheets/detail/burns (Last accessed on May 01, 2021).
[3] Olaitan PB and Jiburum BC. Analysis of burn mortality in a burns centre. Ann Burns Fire Disasters 2006; 19: 59-62.
[4] Forbinake NA, Ohandza CS, Fai KN, Agbor VN, Asonglefac BK, Aroke D and Beyiha G. Mortality analysis of burns in a developing country: a CAMEROONIAN experience. BMC Public Health 2020; 20: 1269.
[5] Stokes MAR and Johnson WD. Burns in the Third World: an unmet need. Ann Burns Fire Disasters 2017; 30: 243-246.
[6] van Rijn OJ, Bouter LM and Meertens RM. The aetiology of burns in developed countries: re-

view of the literature. Burns 1989; 15: 217-221.
[7] Spronk I, Legemate C, Oen I, van Loey N, Polinder S and van Baar M. Health related quality of life in adults after burn injuries: a systematic review. PLoS One 2018; 13: e0197507.
[8] Warby R and Maani CV. Burn Classification. StatPearls. Treasure Island (FL): StatPearls Publishing; 2020.
[9] Edgar DW, Van Daele U, Spronk I, van Baar M, van Loey N, Wood FM, Kazis LB and Meirte J. Seeding the value based health care and standardised measurement of quality of life after burn debate. Burns 2020; 46: 1721-1723.
[10] Al-Mousawi AM, Mecott-Rivera GA, Jeschke MG and Herndon DN. Burn teams and burn centers: the importance of a comprehensive team approach to burn care. Clin Plast Surg 2009; 36: 547-554.
[11] Greenhalgh DG. Management of burns. N Engl J Med 2019; 380: 2349-2359.
[12] Kessides MC and Skelsey MK. Management of acute partial-thickness bums. Cutis 2010; 86: 249-257.
[13] Yu SX, Wang XY, Zhang JP and Zhou J. Advances in the research of fluid resuscitation and its monitoring in burn patients. Zhonghua Shao Shang Za Zhi 2013; 29: 554-557.
[14] James DL and Jowza M. Principles of burn pain management. Clin Plast Surg 2017; 44: 737-747.
[15] Stander M and Wallis LA. The emergency management and treatment of severe burns. Emerg Med Int 2011; 2011: 161375.
[16] Almarghoub MA, Alotaibi AS, Alyamani A, Alfaqeeh FA, Almehaid FF, Al-Qattan MM and Kattan AE. The epidemiology of burn injuries in Saudi Arabia: a systematic review. J Burn Care Res 2020; 41: 1122-1127.
[17] Almutlaq BA, Jarman A, Alfraihi R, Albasher G, Alotaibi RM, Alqahtani AS, Al-Qahtani WS, Elasbali AM and Ahmed HG. Skin burns in Saudi Arabia: causes, management, outcomes and quality of life after skin burns. Int J Burns Trauma 2020; 10: 28-37.
[18] https://en.wikipedia.org/wiki/Al-Qassim_Province (Last accessed on May 31, 2021).
[19] Lam NN, Huong HTX and Tuan CA. Knowledge on emergency management for burn and mass burn injuries amongst physicians working in emergency and trauma departments. Ann Burns Fire Disasters 2018; 31: 138-143.
[20] Baxter CR and Waeckerle JF. Emergency treatment of burn injury. Ann Emerg Med 1988; 17: 1305-1315.
[21] Rasheed Z, Al-Rashidy M, Al-Raqibah A, Al-Moqbel A, Al-Bakri A, Al-Harbi A, Rasheed N and Al Abdulmonem W. Experience of cancer patients for the usage of complementary and alternative medicine therapy. Open Access Maced J Med Sci 2020; 8: 521-527.
[22] Cuttle L, Kempf M, Liu PY, Kravchuk O and Kimble RM. The optimal duration and delay of first aid treatment for deep partial thickness burn injuries. Burns 2010; 36: 673-679.
[23] Guest JF, Fuller GW and Edwards J. Cohort study evaluating management of burns in the community in clinical practice in the UK: costs and outcomes. BMJ Open 2020; 10: e035345.
[24] Moghazy AM, Kamel MH and Farghaly RM. Assessment of family physicians' knowledge as an indicator of burn management knowledge among non-burn practitioners in Ismialia, Egypt. Ann Burns Fire Disasters 2014; 27: 31-36.
[25] Viana FO, Eulálio KD, Moura LKB, Ribeiro IP and Ramos CV. Primary Health Care professionals' knowledge about initial care for burn victims. Rev Bras Enferm 2020; 73: e20180941.
[26] Kut A, Tokalak I, Başaran O, Moray G and Haberal MA. Knowledge, attitudes, and behavior of occupational physicians related to burn cases: a cross-sectional survey in Turkey. Burns 2005; 31: 850-854.
[27] Alomar M, Rouqi FA and Eldali A. Knowledge, attitude, and belief regarding burn first aid among caregivers attending pediatric emergency medicine departments. Burns 2016; 42: 938-943.
[28] Kuo LW, Yen CI, Fu CY, Pan CH, Hsu CP, Hsiao YC, Hsieh CH and Hsu YP. The role of preliminary hospitals in the management of a mass burn casualty disaster. Burns 2018; 44: 800-806.
[29] Purdue GF, Arnoldo BD and Hunt JL. Acute assessment and management of burn injuries. Phys Med Rehabil Clin N Am 2011; 22: 201-212.
[30] Haberal M, Sakallioglu Abali AE and Karakayali H. Fluid management in major burn injuries. Indian J Plast Surg 2010; 43: 29-36.
[31] Benicke M, Perbix W, Lefering R, Knam F, Ipaktchi KR, Tannapfel A, Neugebauer EA and Spilker G. New multifactorial burn resuscitation formula offers superior predictive reliability in comparison to established algorithms. Burns 2009; 35: 30-35.
[32] Lang TC, Zhao R, Kim A, Wijewardena A, Vandervord J, Xue M and Jackson CJ. A critical update of the assessment and acute management of patients with severe burns. Adv Wound Care (New Rochelle) 2019; 8: 607-633.