

A study of Some Medico-Legal Aspects of Fatal Burn Cases Admitted to Menoufia University Hospital over Five Years "A Retrospective Study"

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Abstract: **Background:** Burns are considered among the most devastating injuries facing healthcare organizations globally. Low- and middle-income countries have high incidence. **Objectives:** To evaluate cases of fatal burns admitted to Menoufia University Hospital, Egypt over five years (starting from the first of January 2013 to the end of December 2017). **Results:** The total number of burn deaths was 113 cases. Males slightly outnumbered females. Victims with the age group between 20-40 years were most affected followed by those less than 10 years (35.4% and 28.3% respectively). The majority of cases were from rural areas, had more than 50% of burnt total body surface area, burn occurred mainly indoors, with accidental manner (96.5%) and mainly due to flame (85%). Septicemia was the leading cause of death. There was a statistically significant difference as regards duration of survival in relation to burnt total body surface area and cause of death. **Recommendations:** Mass education of the public should be done about safety instructions to reduce the incidence of burn injuries especially indoors. Availability of selected burn centers and detailed recording of data are mandatory.

Introduction

Burns are considered as a serious public health problem globally. They are responsible for about 180 000 deaths annually (World Health Organization, 2018). Most of these deaths occur in low- and middle-income countries (Peck and Pressman, 2013). They are considered as the fourth most common type of trauma worldwide, after traffic accidents, falls and interpersonal violence. Injuries due to burns are among the commonest causes of unnatural death in developing countries, so they have a tremendous medico-legal importance (Chesler, 2009; Othman and Kendrick, 2010; Buchade, 2011) as they are causing not only deaths but also psychological and economic impacts and permanent somatic sequelae as well (Sadeghi-Bazargani et al., 2011).

The aim of this work is to evaluate fatal burn cases admitted to Menoufia University Hospital, over five years starting from the first of January 2013 to the end of December 2017.

Materials and methods

This is a retrospective study conducted on all cases who died from burn injury admitted to Menoufia University Hospital over five years starting from the first of January 2013 to the end of December 2017.

Data were collected from patients' hospital records, primary and death medical reports done in Forensic Medicine and Clinical Toxicology department

using a questionnaire designed for this purpose. Approvals from the Menoufia University Hospital Ethical Committee and the director of Forensic Medicine and Clinical Toxicology department were taken. Confidentiality was ensured by keeping all records anonymous. Data were collected including socio-demographic data, types and causes of burn, place of occurrence, seasonal and diurnal variations, circumstances, affected total body surface area (TBSA), duration of survival and possible cause of death based on integration of the clinical information and investigations.

The collected data were tabulated and analyzed using SPSS version 17.0. Descriptive statistics as numbers and percentage were used. Associations were analyzed using Chi-square test (χ^2). $P < 0.05$ was considered statistically significant (Elliott and Woodward, 2007).

Results

The total number of burn deaths during the period of study (over five years) was 113 cases from 855 cases of burn admission with 13.2% mortality rate, showing no definite ascending or descending manner over this period. Males slightly outnumbered females (50.4% versus 49.6% respectively). The most commonly affected age group was 20-40 years (35.4%) followed by < 10 years. No statistically significant difference was

found as regards distribution of different age groups in relation to gender(**table1**).

Most of cases were from rural areas (73.5%) (**figure 1**).51.3% were married, 43.4% were single and 5.3% were unmarried(**figure2**).

As regards types of burns, the maximum percentage was due to flame burns (85%), followed by scalds (14.1%) and the least percentage was death due to electric burn (0.9%). Causes of burn revealed that 43.4 % occurred due to gas stove cylinder explosion followed by clothes catching fire (21.3%), falling of hot liquid over the body(14.1%), work place fire (10.6%), fire by kerosene stove (6.2%),pouring of kerosene over their bodies and burning themselves(3.5%)and the least was direct contact with electric current(0.9%)(**table2**).

Regarding diurnal variation; 62.8% of burn occurred during day time and 37.2% during night time(**figure 3**). The commonest place of occurrence for burn was indoors (86.7%), followed by work place (10.6%) (**figure 4**).

Seasonal variation was noticed as regards rate of burn occurrence, as the largest percentage was in winter (33.7%), followed by spring (31%), summer (26.5%) while autumn has lower rates (8.8%)(**figure 5**).

The vast majority of cases were accidental (96.5%) while suicidal manner was observed only in 3.5% of cases and there were no homicidal cases (**figure 6**).

Regarding affected total body surface area, 69.9% of victims had more than 50% of TBSA (40.7% had burns from 50%-<70%, 16.8% from 70%-90% and 12.4% of victims sustained >90% burnt surface areas) while 30.1% of victims sustained burns of less than 50% of TBSA(**figure 7**).

Considering duration of survival, one case died on arrival (0.9%), 24.8% died in less than 3 days, 39.8% of cases died 3-7 days, 25.7% died from 1-2weeks and 8.8% died after more than 2weeksafter admission (**figure 8**).

The possible cause of death based on integration of the clinical picture and investigations was most commonly septicemia (52.2%), followed by shock (23.9)(**figure 9**).

There was a statistically significant difference as regards duration of survival in relation to total body surface area burned. The majority of cases with burnt TBSA 70%-90% and >90% survived less than 3 days (68.4% and 78.6% respectively), while 61.8% of cases with burnt TBSA< 50% survived for 1-2weeks and 67.5% of victims with burnt TBSA from 50% to70% died within 3-7days (**table3**).

There was a statistically significant difference between duration of survival as regards cause of death. All cases died due to septicemia survived more than 3days, while 52% of dead cases due to respiratory failure occurred within 3-7days and 77.8% of dead cases due to shock occurred in less than 3days (**Table4**).

Table 1:Chi Square Statistical analysis of different age groups of burn deaths in relation to gender

	Gender				Total		X ²	P value
	Male		Female					
Age	N	%	N	%	N	%	2.659	0.616
<10years	13	22.8	19	34	32	28.3		
10-20years	9	15.8	5	8.9	14	12.4		
20-40 years	20	35.1	20	35.7	40	35.4		
40-60years	8	14	7	12.5	15	13.3		
>60 years	7	12.3	5	8.9	12	10.6		
Total	57	100	56	100	113	100.0		

N: number of patients, P>0.05: nonsignificance

Table 2: Types and causes of burn in cases of burn deaths

	N	%	
Types of burn	Flame	96	85.0
	Scald	16	14.1
	Electric	1	0.9
	Total	113	100.0
Causes of burn	House fire after gas stove explosion	49	43.4
	Work place fire	12	10.6
	Clothes caught fire	24	21.3
	Falling of hot liquid over the body	16	14.1
	Pouring of kerosene over their bodies and burning themselves	4	3.5
	Fire by kerosene stove	7	6.2
	Contact with electric current	1	0.9
	Total	113	100

N: number of patients.

Table3:Chi Square Statistical analysis of duration of survival in relation to percentage of burnttotal body surface area

Percentage of body surface burnt area	Duration of survival										Total N=113	X ²	P value
	<3days N=28		3-7days N=45		1-2weeks N=29		>2weeks N=10		Died on arrival N=1				
	N	%	N	%	N	%	N	%	N	%	N	%	
<50%	1	2.9	8	23.5	21	61.8	3	8.9	1	2.9	34	100	
50%-<70%	3	6.5%	31	67.5%	6	13%	6	13%	0	0%	46	100%	
70%-90%	13	68.4%	3	15.8%	2	10.5%	1	5.3%	0	0%	19	100%	
>90%	11	78.6%	3	21.4%	0	0%	0	0%	0	0%	14	100%	

N: number of patients, *: statistically significant difference (p value<0.05)

Table4: Chi Square Statistical analysis of duration of survival of burn deaths in relation to cause of death

Cause of death	duration										Total	X ²	P value
	<3days N=28		3-7days N=45		1-2weeks =29		>2weeks N=10		Died on arrival N=1				
	N	%	N	%	N	%	N	%	N	%	N	%	
Septicemia	0	0%	28	47.5%	22	37.3%	9	15.2%	0	0%	59	100%	
Respiratory failure	7	28%	13	52%	4	16%	1	4%	0	0%	25	100%	
Shock	21	77.8%	4	14.8%	1	3.7%	0	0%	1	3.7%	27	100%	
Multiple organ failure	0	0%	0	0%	2	100%	0	0%	0	0%	2	100%	

N: number of patients, * statistically significant difference (p value<0.05)

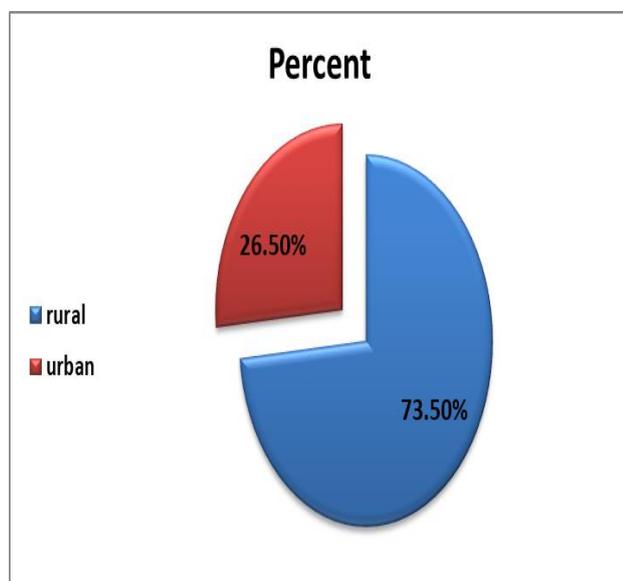


Figure 1:Residence of victims

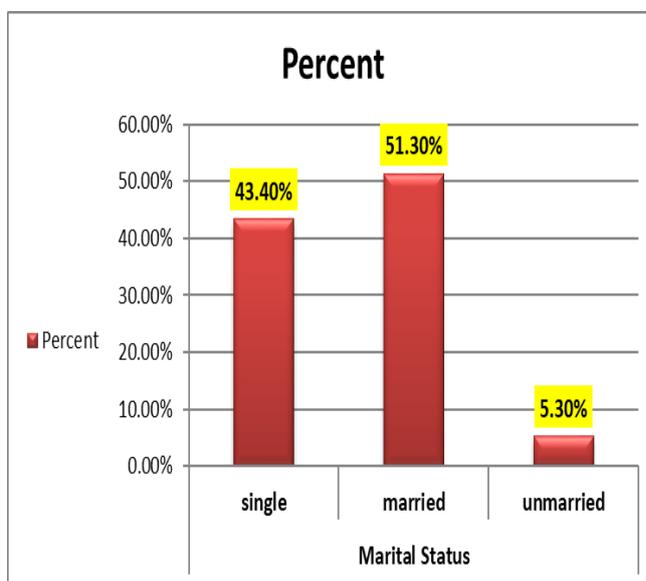


Figure 2:Marital status of victims

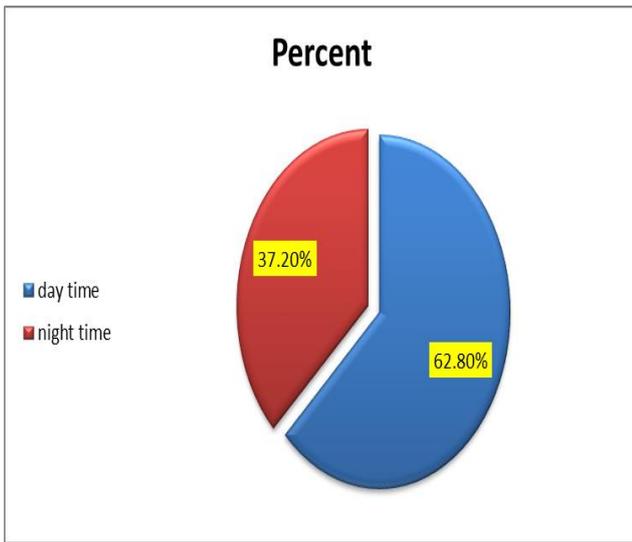


Figure 3: Diurnal variation as regards occurrence of burn

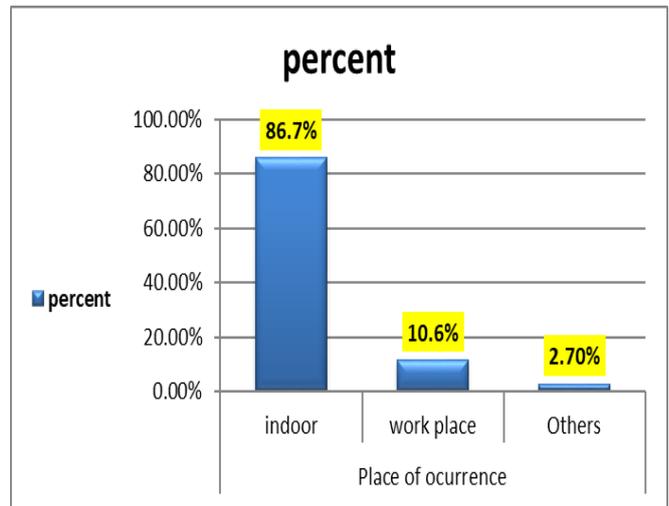


Figure 4: Place of occurrence of burn.

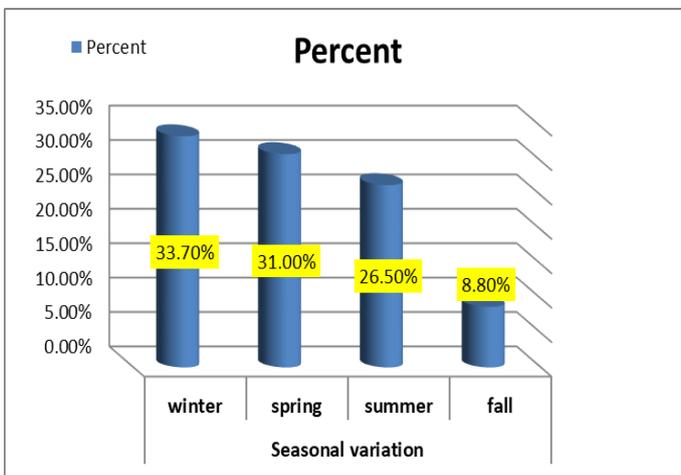


Figure 5: Seasonal variation of burn occurrence

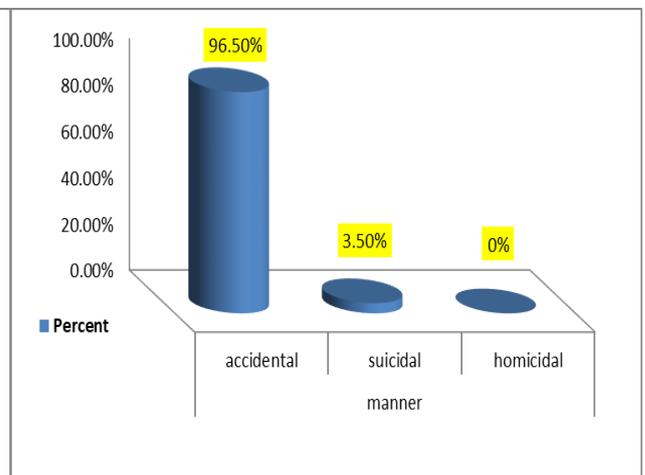


Figure 6: Manner of burn

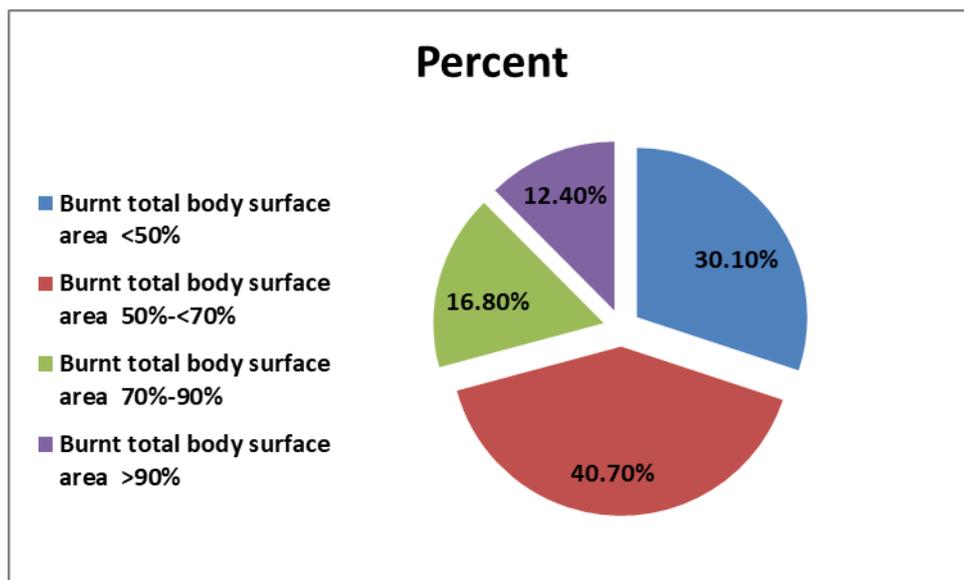


Figure 7: Percentage of burnt total body surface areas

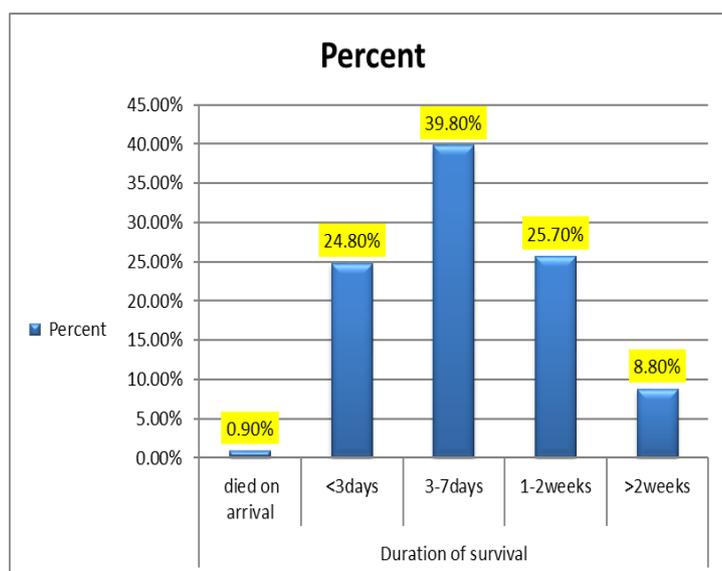


Figure 8: Duration of survival

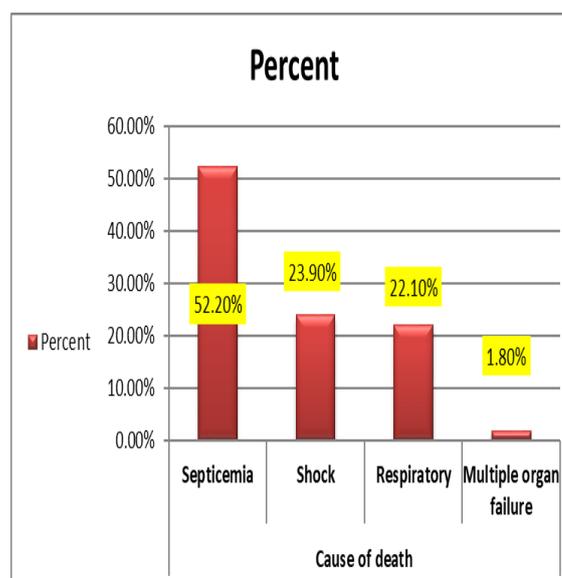


Figure 9: Causes of death in burn deaths

Discussion

A retrospective analysis of fatal burn cases admitted to Menoufia University Hospital over five years was done, in a trial to throw light on burns as an important cause of mortality.

The mortality rate over these five years of the study was 13.2%. This rate is lower than that previously detected by El Mehrat et al., (2014) in Menoufia University Hospital (18.6%) during the period 2006-2010 which may indicate an improvement in treatment protocol and patient care. But it was higher than those reported by Ho et al., (2002) who reported a mortality rate of 8.7% in a study performed in Hong Kong and Krishnan et al., (2013) from the United Kingdom who noted mortality 1.9%. These differences may be due to the nature of these countries as they are more developed and urbanized with much better health facilities.

On the contrary a much higher mortality rate (31.9%) was reported by Mabrouk et al., (2003) in Egypt. may be related to the different study population as it was conducted on geriatric burn patients (defined as 60 years and older) in comparison to the current study.

In the present study, 50.4% of the victims were males and 49.6% were females with nearly equal percentages. This can be attributed to the involvement of males in fatal burn accidents that may occur either at work place or homes. Additionally, they may try to control fire before arrival of firemen in the absence of awareness and adequate safety measures. Similarly, females are at high risk to exposure due to their involvement in domestic activities with exposure to flame while dealing with gas or kerosene stoves (Siran et al., 2017).

Male predominance was noted in many studies as by Haberal et al.,(1995) in Turkey, Kobayashi et al., (2005) in Japan and Tung et al.,(2005) in Taiwan which are considered as more industrialized countries.

On the other hand, female predominance was noted in most studies done in India as that done by

Singh et al., (1998) and Chaudhary et al., (2013). This may be due to ignorance while cooking and using unsafe fire appliances in addition to wearing the traditional synthetic sarees which catches fire easily and spread to the body. Also intentional burn is common due to family disputes and dowry reasons (Singh 2017).

In the present study, victims of burn deaths were mainly in the age group between 20-40 years followed by those less than 10 years. Similar results were noted by Singh et al., (1998) India, who reported a predominance of fatal burn cases in the age group (21-40 years) and Afify et al., (2012) (Egypt) who reported a majority of victims in the age group of 11-50 years. Increased risk of exposure to fires in the middle age may be attributed to being the age of activity and power (Zanjad and Godbole (2007); Makhdoom et al., 2015). On the other hand, the vulnerability of children to scald can be related to poor education, lack of parental monitoring and the old practices of boiling water for showers and cooking among some poor people in underserved areas (Hashemi et al., 2017; Taha et al., 2018).

In the current study, victims were mainly from rural areas. This finding was consistent with Shinde and Keoliya(2013). This may be related to the dependence on portable gas cylinders and kerosene stoves for cooking in many villages in addition to warming houses in cold weather by burning wood (Deshpande et al., 2012).

Regarding causes of burns in the present study, flame was the major cause and gas stove cylinder explosion was the most common cause of it. As many areas of Menoufia governorate are still have no domestic gas systems and still dependent on portable gas cylinders which lack safety measures and with considerable probability of gas leakage. Similar findings were estimated by Afify et al., (2012) and Chaudhary et al., (2013).

Zanjad and Godbole (2007) estimated that kerosene oil was the major cause involved in causing

flame burns and similarly Chandra et al., (2017) found that kerosene stove burst was the common source of flame burn and he explained that by the availability and low price of kerosene which make it routinely used for domestic purposes especially for poor people in rural parts of India.

Seasonal variation was noticed as regards rate of burn occurrence in the current study, as the largest percentage was in winter, followed by spring. Similar seasonal variations among burn deaths was found by Chandra et al., (2017). A higher rate of burn occurrence in winter season may be due to the need for using heating devices, burning wood and warm water for domestic purposes. (Taha et al., 2018).

In the current study, burn occurrence was mainly indoors during day time. As it is the site of domestic activities in kitchen and they are commonly performed during day time (Tripathee and Basne 2017). Similar findings were reported by Forjuoh (2006) and Hashish and Abdel-Karim (2017).

The vast majority of cases were accidental, while suicidal manner was only observed in four adult females. The scarcity of suicidal compared to accidental cases may reflect that suicidal burn is uncommon of committing suicide in Menoufia governorate, Egypt. As this is against religious beliefs, as the Islamic law consider suicide to be a criminal act onto the self (The Holy Quran). Or it may be due to underestimation of suicidal burn injuries as reporters of the incidents may not report the true mode of burn for fear of legal responsibility (Hashish and Abdel-Karim (2017). Similar findings were noted by Johry et al., (2015).

On the opposite side, these findings were not in agreement with those noted by Nath et al.,(2015)India, which showed that the majority of deaths were suicidal in nature followed by homicidal and the least were accidental. These wide differences may be due to different lifestyles, religions and cultures. As in India there was an old custom of dowry problem which may force females to commit suicide by burning themselves.

The majority of victims of the current study had more than 50% burnt total body surface area. As fatality of burn are usually increased with increasing total body surface area burns, as this indicates the incompatibility with life due to loss of the protective function of the skin(Jeschke et al., 2015). Similar findings were noted by Adamo et al.,(1995) and Zanjad and Godbole (2007).

There was a statistically significant difference as regards duration of survival in relation to burnt total body surface area. Where there was a reverse relationship between duration of survival and burnt total body surface area, as risk of mortality increases with increasing burnt TBSA (Moore et al., 2013).

Septicemia was the most common cause of death in this study. As the integrity of the skin is altered by burn injury, which is the primary barrier against pathogens. In addition, a concomitant state of systemic inflammation and immunosuppression induced by burn leads to greater susceptibility to sepsis (Schwacha, 2003; Girardot et al., 2017).

Similar findings were found by other studies as Sharma et al., (2006), Dasari et al., (2013) and Vidhate and Pathak(2017). Also Taylor et al., (2014) found a significant association between septicemia in burn cases and occurrence of death.

On the other side Barretet al., (1999) reported that respiratory complications (pneumonia, ARDS, pulmonary embolism) were the most common cause of burn deaths among adults. Nath et al. (2015) on the contrary, noted that shock was the main cause of death. These differences between results in different studies may be contributed to different circumstances, population and environments.

There was a statistically significant difference as regards duration of survival and cause of death. As all cases died due to septicemia survived more than 3days, the majority of cases died from shock occurred in less than 3days. As Shock is more common in 1-2 day period after burn injury (Mazumder and Patowary 2013). While infection needs longer duration as Gram-positive bacteria located deep within hair follicles and sweat glands, rapidly colonize the wound surface within 48 h after burn occurrence if topical antimicrobial agents are not used (Erol et al., 2004). Then these wounds are subsequently (after an average of 5 to 7 days) colonized with other microbes, derived from the host's normal flora in upper respiratory and gastrointestinal tract and/or from hospital acquired infections transferred from health care worker's (Altoparlak et al., 2004).

Conclusions

Adults and children less than 10 years were more vulnerable to burn deaths. Most of cases were from rural areas. The most common type of burns was due to flame followed by scald. The commonest place of occurrence for burn was indoors which indicate lack of safety measures and public education. The majority of victims had more than 50% burns of total body surface area. Vast majority of cases were accidental. Septicemia was the most common cause of death.

Recommendations

Mass education of the public about safety instructions is mandatory through non-governmental organizations and social groups, to reduce the incidence of burn injuries. Safety measures should be followed while cooking as wearing tight and cotton clothes to reduce liability to catch fire during cooking, not keeping a full fuel container near fire source and not turning the lights on if there is smell of butane gas in case of leakage from gas cylinders. Attention should be given to industrial security especially for domestic appliances to decrease liability for gas leakage.

Availability of selected burn centers and application of barrier nursing to reduce incidence of infection. Community education on true first-aid procedures should be done to prevent harmful effects of traditional procedures of the public as adding tooth paste and egg white over the burnt areas. Detailed recording of data in hospital records for further research are also recommended.

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الملخص العربي

دراسة بعض الجوانب الطبية الشرعية لحالات الحروق المميته والتي أدخلت مستشفى جامعة المنوفية على مدى خمسة أعوام

(دراسة مرجعية)

فاطمة شعبان قنديل

تعد الحروق من أخطر الإصابات التي تواجه الصحة العامة على مستوى العالم. وقد هدفت هذه الدراسة إلى تقييم حالات الحروق التي أدت إلى الوفاة والتي أدخلت المستشفى الجامعي بمحافظة المنوفية على مدار خمس سنوات من أول يناير ٢٠١٣ إلى نهاية ديسمبر ٢٠١٧ دراسة مرجعية . وقد كان عددهم ١١٣ حالة من بين ٨٥٥ حالة حروق قد أدخلت المستشفى في تلك الفترة بمعدل وفاة حوالي ١٣,٢%. وقد كانت نسبة المتوفون شبه متساوية في الجنسين. وكان أكثر المتوفون في الفترة العمرية ما بين ٢٠-٤٠ سنة (٣٥,٤%) يليهم الأطفال الأقل من ١٠ سنوات (٢٨,٣%). وكان معظم الحالات من الذين يعيشون في المناطق الريفية. وكانت معظم حالات الحروق ناتجة عن اللهب (٨٥%) متبوعة بحالات الحروق السلقية (١٤,١%). وكان المنزل المكان الرئيسي للتعرض للحروق. وكان الشكل العرضي هو الشكل الرئيسي للتعرض للحروق في حوالي ٩٦,٥% من الحالات. وقد عانى حوالي ٦٩,٩% الحالات من حروق بنسبة أكثر من ٥٠% من المساحة الكلية للجسم. وكان التسمم الدموي البكتيري هو السبب الأكثر إحداثا للوفاة في هذه الحالات. وقد وجدت علاقة ذات دلالة إحصائية بين الفترة الزمنية التي عاشها المرضى قبل حدوث الوفاة والمساحة الكلية للحروق وكذلك بينها وبين سبب الوفاة. وأخيرا نوصي بضرورة تثقيف العامة وتعريفهم بالإجراءات السليمة الآمنة لتقليل حدوث حالات الحروق عن طريق إتباع التعليمات الصحيحة أثناء إعداد الطعام والوجود بالقرب من مصادر اللهب بالمطابخ. كما توصي الدراسة بضرورة وجود مراكز صحية متخصصة لعلاج حالات الحروق. وأيضاً نوصي بضرورة الاهتمام بتسجيل كافة البيانات عن المرضى في ملفاتهم بالمستشفى للاستفادة منها في الدراسات المستقبلية.