

## Factors Affecting Mortality among Patients with Major Burn at Intensive Care Units

MANAL S. ISMAIL, D.N.Sc.; YOUSRIA A. SELOMA, D.N.Sc. and TAREK A. SHAHEEN, M.Sc.

*The Department of Emergency and Critical Care, Faculty of Nursing, Cairo University, Egypt*

### Abstract

**Background:** Critically ill patients with burn are a risk group whose outcomes are negatively affected by many factors. Among these factors are sepsis, total body surface burned area, and depth of the burn.

**Aim of Study:** To assess factors affecting mortality among burned patients at Intensive Care Units.

**Patient and Methods:** The target population in the study were the adult male and female patients admitted to the ICU and have burn more than or equal 20% over a period of six months. This study was conducted from February to August 2017 in the ICU affiliated to 185 Kasr Al-Aini Hospital for Burn and Emergency which consists of 10 rooms each room contains 4 beds. Three tools were developed by the investigator and utilized for data collection, These tools are: Tool 1: Personal background and medical data, Tool 2: Burn assessment tool, and Tool 3: Burn management tool.

**Results:** More than half (55.2%) of the studied sample died and approximately half (44.7%) discharged from the ICU. A significant statistical difference was found between died and discharged subjects regarding length of ICU stay ( $t/p$  2.04/0.04), body mass index ( $\chi^2/p$  20.395/0.002), TBSA ( $t/p$  8.20/0.000), depth of burn ( $\chi^2/p$  32.709/0.000), occurrence of wound infection ( $\chi^2/p$  20.73/0.000). No significant statistical difference was found between died and discharged patients regarding age ( $t/p$  1.7/0.08), heart rate ( $t/p$  1.96/0.054), gender ( $\chi^2/p$  0.017/0.897) and mechanism of injury ( $\chi^2/p$  0.508/0.476).

**Key Words:** Burn – Critically ill patients – Total body surface area – Depth of burn – Mortality – Infection.

### Introduction

SEVERE/major burn injuries evoke strong emotional responses in most people, including health professionals who are confronted by the specter

**Correspondence to:** Dr. Manal S. Ismail, The Department of Emergency and Critical Care, Faculty of Nursing, Cairo University, Egypt

of pain, deformity, and potential death. Pronounced disfigurement and disability have been the expected sequelae to serious burns for most of mankind's history. However, these dire consequences have been ameliorated so that, although burn injury is still intensely painful and sad, the probability of death has been significantly diminished in the well developed countries (Branski, Herndon & Barrow 2012 [1]). So that, timely and adequate management of burn injuries is paramount. Such injuries are painful and can result in mutilating and scarring, amputation or necrosis of affected tissue or, in extreme cases, death. Peripheral nervous system, vasculature, skeletal muscles, and bones could be affected at a distant site to the burn. Burns are one of the most distressing injuries and contribute to major global morbidity and mortality. Each year, approximately 450,000 people in the United States seek medical care for burns (Fonseca, Barber, Powers & Frost 2013 [2]).

As indicated by (Hinkle & Cheever [3]), infection progressing to sepsis is the major cause of death in patients who have survived the first few days after a major burn. Burn patients are at risk for infection for certain reasons: The loss of skin removes their ability to protect themselves from the environment; the longer length of stay in the hospital predisposes them to hospital-associated infections; the number and frequency of invasive procedures both in the patient room and in the operating room increase the risk of infection; and, immunosuppression that accompanies extensive burn injury places patients at high risk. Moreover, differences in burn mortality rates vary across different age groups and between the genders. For instance, fire-related burns are the sixth leading cause of death among 5-14 year olds and the eighth

leading cause death among 15-29 year olds from low and middle-income countries. In terms of the sex differences, women are usually at higher risk of burns than men, especially in the younger age groups, death from fires is the sixth leading cause of death among females aged 15-29 years (World Health Organization (WHO) 2014 [4]).

The nurse who cares for a patient with burn injury requires a high caliber of erudition about the physiologic changes that occur after a burn, as well astute assessment skills to detect subtle vicissitudes in the patient's condition. This makes each burn patient very unique and provides a variety of challenges to the patient's plan of care. In integration, the nurse provides sensitive, commiserate care to patients who are critically ill and initiates rehabilitation early in the course of care. The nurse must be able to communicate efficaciously with patients who have burn injuries, family members in crisis, and members of the entire interdisciplinary burn management team (Brunner 2010 [5]).

*The aim of the study is:*

To assess factors affecting mortality among burned patients at intensive care units within six months.

**Patients and Methods**

The target population in the study were the adult male and female patients admitted to the ICU and have burn more than or equal 20% over a period of six months. This study was conducted from February to August 2017 in the ICU affiliated to 185 Kasr Al-Aini Hospital for Burn and Emergency which consists of 10 rooms each room contains 4 beds. Three tools were developed by the investigator and utilized for data collection, These tools are: Tool 1: Personal background and medical data, Tool 2: Burn assessment tool, and Tool 3: Burn management tool.

**Results**

More than half (55.2%) of the studied sample died and approximately half (44.7%) discharged from the ICU. A significant statistical difference was found between died and discharged subjects regarding length of ICU stay ( $t/p$  2.04/0.04), body mass index ( $\chi^2/p$  20.395/0.002), TBSA ( $t/p$  8.20/0.000), depth of burn ( $\chi^2/p$  32.709/0.000), occurrence of wound infection ( $\chi^2/p$  20.73/0.000). No significant statistical difference was found between died and discharged patients regarding age ( $t/p$

1.7/0.08), heart rate ( $t/p$  1.96/0.054), gender ( $\chi^2/p$  0.017/0.897) and mechanism of injury ( $\chi^2/p$  0.508/0.476).

Table (1): Frequency distribution of the studied sample as regard demographic and medical data (N=67).

Variables	N	%
<i>Gender:</i>		
Male	43	64.6
Female	24	34.8
<i>Age:</i>		
Mean ± SD	33.1 ± 12.1	
<i>Length of ICU stay:</i>		
Mean ± SD	8.4 ± 4.8	
<i>Body mass index:</i>		
Mean ± SD	28.9 ± 6.2	
<i>Mechanism of burn injury:</i>		
Thermal	56	83.6
Ecctrical	11	16.4
<i>Patient status:</i>		
Died	37	55.2
Dischaeged	30	44.8

Table (2): Comparison of mean age, length of ICU stay, and total body surface area in relation to patient's status (N=67).

Variables	Died Mean ± SD	Discharged Mean ± SD	$t/p$
Age	35.3 ± 13.2	30.2 ± 9.9	1.7/0.08 NS
Length of ICU stay	7.3 ± 3.96	9.7 ± 5.5	2.04/0.04*
TB SA	68.3 ± 14.5	41.4 ± 11.7	8.20/0.000**

TBSA : Total Body Surface Burned Area.

\* : Significante at  $p \leq 0.05$ .

NS : No Significant difference.

\*\* : High significant difference.

Table (3): Relationship between body mass index and patient's status (N=67).

Body mass index	Patients' status		Total	%	$\chi^2/p$
	Died	Discharged			
Normal	3	9	12	35.8	
Overweight	2	0	2	2.9	
Pre-obese	21	10	31	46.2	20.395/
Obese	0	2	2	2.9	0.002 **
Obese class I	10	2	12	35.8	
Obese class II	1	5	6	8.9	
Obese class III	0	2	2	2.9	
Total	37	30	67	100	

\* : Significance at  $p \leq 0.05$ .

\*\* : High significant difference.

Table (4): Relationship between burn associated complications, depth of burn and patient's status (N=67).

Variables	Patient status				$\chi^2/p$
	Died		Discharged		
	N	%	N	%	
<b>Inhalation injury:</b>					
Present	35	94.6	6	20	38.820/
Not present	2	5.4	24	80	0.000**
<b>Infection:</b>					
Yes	34	91.9	12	40	20.73/
No	3	8.1	18	60	0.000**
<b>Burn shock</b>					
Yes	25	67.6	0	0	32.336/
No	12	32.4	30	100	0.000**
<b>Renal failure:</b>					
Yes	11	29.7	0	0	10.7/
No	26	70.2	30	100	0.001 **
<b>Depth of burn:</b>					
Full thickness burn	37	100	11	36.7	32.709/
Partial thickness burn	0	0	19	63.3	0.000**
Total	37		30		

\* : Significance at  $p \leq 0.05$ .  
 \*\*: High significant relation.

Table (5): Comparison of mean vital signs in relation to patients' status (N=67).

Vital signs	Patient status	N	Mean $\pm$ SD	t/p
Temperature	Died	37	37.7 $\pm$ 0.4	3.08/
	Discharged	30	37.5 $\pm$ 0.2	0.003**
Pulse	Died	37	114.8 $\pm$ 25.5	1.96/
	Discharged	30	104.6 $\pm$ 14.3	0.054 *
Respiratory rate	Died	37	17.7 $\pm$ 2.2	.235/
	Discharged	30	17.6 $\pm$ 1.03	0.815 NS
Systolic BP	Died	37	102.3 $\pm$ 17.5	3.56/
	Discharged	30	115.2 $\pm$ 10.3	0.001**
Diastolic BP	Died	37	57.0 $\pm$ 10.6	3.05/
	Discharged	30	65.1 $\pm$ 10.9	0.003**

\* : Significance at  $p \leq 0.05$ .  
 \*\* : High Significant relation.  
 NS : No significant difference.

### Discussion

The present study delineated the dominance of males whose burns caused by thermal injury. This finding is in agreement with that of (Queiroz et al., [6]) who conducted a study about Epidemiology and outcome analysis of burn patients admitted to an Intensive Care Unit, and found that the majority of their sample was male and their burns were thermal burn. The dominance of males "from the investigator point of view" could be due to frequent exposure to factors predisposing to burn may be as a result of the nature of their work.

As a result of exposed to explosions of natural gas cylinders which resulted in thermal injury.

The present study showed that mean age of the study subjects were young adult. Finding of the current study is in agreement with that of (Rasouli et al., [7]) who conducted a published study entitled as "factors associated with mortality in adult hospitalized burn patients" and found that the mean age of the study sample were in the young stage. "From the investigator point of view", this findings could be as a result of the majority of the subjects were young adult because of fire most commonly occur at work or in close space.

The present study showed the Body Mass Index (BMI) mean indicate as a preobese stage. The present finding is merely in agreement with (Liu et al., [8]) who carried out a study entitled as "the impact of patient weight on burn resuscitation" and found that the mean BMI was in the preobese stage. "From the investigator point of view". This findings could be as a result of obesity is a serious health hazard. Despite advances in burn care severely obese patients with large burns have higher mortality compared with normal-weight patients.

The present study delineated that both mean age of the died and discharged patients were in young stage, however no significant statistical difference was found. This finding is merely in agreement with that of (Summers et al., [9]) who conducted a published study entitled as "Characterization of the gender dimorphism following severe thermal injury" and found that there is no significant statistical difference between male and female burned patients in relation to age. "From the investigator point of view" this may be as a result of the young age groups are characterized with productivity in work also, their immunity is high regarding to disease or trauma in comparing to elderly and young children, a burn encompassing less than 20 percent of the TBSA may be considered severe. Those at the greatest risk for death are those at the extremes of age.

Consequently, the current study clarified that the mean Total Body Surface Burned Area (TBSA) of the died patients was greater than the discharged patients with significant statistical difference. This finding is supported by (Rasouli and his colleagues [7] who conducted a study about "factors associated with mortality in adult hospitalized burn patients" and found a significant statistical difference between survivors and non-survivors. Besides that (Bedri et al., [10]) conducted a study named as "a national study of the effect of race, socioeconomic

status, and gender on burn outcomes." and evaluated the effect of TBSA on the different races (Caucasian-African-American-Others) and revealed a significant statistical difference in TBSA in relation to race. "From the investigator point of view "this may be as a result of the severity of the burn is mainly related to many factors the first of them is the Total Body Surface Area (TBSA). It was common for patients with burns >20% Total Body Surface Area (TBSA) to die early from the initial cutaneous burn injury, or later from infections or other complications related to the injury.

The current study demonstrated a significant statistical difference in Body Mass Index (BMI) category in relation to patient's status. In the same line (Liu, et al., [8]) conducted a study titled as "The impact of patient weight on burn resuscitation" and reported that there is a significant statistical relationship between total sample, obese, and non-obese burned patients. On the other hand, (Tsurumi, et al., [11]) who conducted a study about "do standard burn mortality formulae work on a population of severely burned children and adults?" about Baseline characteristics of burn wound patients stratified into all patients, adult age ( $\geq 16$  years) and child age (<16 years) populations and reported that there is no significant statistical relationship regarding to Body Mass Index (BMI). With this finding, obesity was found among the great majority of the studied died subjects ranging from preobese to obese class III, also obesity play an important role increasing mortality among burned patients compared with normal weight patients.

The present study showed a significant statistical difference between died and discharged patients regarding to inhalation injury. On the same line with the findings (Bedri et al., [10]) demonstrated a comparison between (Caucasian, African, American, and others) and reported that there is a significant statistical relationship. On the other hand (Schultz et al., [17]) reported that there is no significant statistical difference regarding to inhalation injury. "From the investigator point of view "this can be as a result of, inhalation injury is also described as one of the main factors that are associated with increased mortality.

The present study proved a significant statistical difference regarding to wound infection. On the same line with the present study (Low et al., [12]) who demonstrated a comparison between Complications in diabetic and non-diabetic burns patients found a significant statistical difference regarding wound infection. "From the investigator point of view", this can be interpreted as Infections remain

the most common cause of morbidity and mortality following burn injury because of disruption of the first line of immunity (skin) and increase liability to infection.

The present study revealed a significant statistical difference among discharged and died subjects regarding burn shock. According to (Jeschke et al., [12]) the author demonstrated a comparison between (all patients, children <16yr, adults >16, <65yr, and Elderly >65yr) and reported that there is a significant a statistical difference regarding development of burn shock. This may be as a result of burn shock is a complex process not only affecting preload but also influencing cardiac output and systemic vascular resistance. The patients who developed burn shock were at high risk of mortality.

The current study demonstrated that there is a significant statistical difference in relation to renal failure between died and discharged patients. On the same line with the current result (Bedri et al., [10]) who demonstrated a comparison between (Caucasian, African, American, and other) and reported that there is a significant statistical difference between the three nationalities in relation to renal failure. From the investigator point of view, this can be as a result of when burn resuscitation is delayed or inadequate, renal ischemia can result directly from hypovolemia and increased sympathetic tone, but elevations in serum free hemoglobin, and particularly myoglobin, correlate with increased renal failure.

The present study revealed a high significant statistical difference in patient status regarding to depth of burn (full versus partial). As revealed from (Zúñiga et al., [14]) that conducted a study about "factors associated with length of hospital stay in minor and moderate burns" and showed that there is a significant statistical difference. In other studies (You et al., [15]) that conducted a study about "inhalation injury in burn patients: "And reported that there is no statistical difference between survivors and non-survivors burned patients. "From the investigator point of view" this can be as a result of the severity of a burn is classified by its depth and the layers of skin it affects. A burn can be partial or full thickness. The partial burn damages only the epidermis, which is the outer layer of skin. Full thickness, this type extends through every layer of the skin and may penetrate deeper to the layer of fat just below the skin. With severe burns, hard, avascular eschar forms, providing an environment prone to microbial growth.

Concerning assessment of patient vital signs, the mean temperature of the died patients was hyperthermia while the discharged patients was normal range with a significant statistical difference. In the same line (Davidson et al., [16]) in their study about “presenting hypertension, burn injury, and mortality in combat casualties” they concluded that there is a significant statistical difference in temperature. It is known that one of the factors that give an indication on the presence of infection among burned patients is the temperature readings. Also, hyperthermia is expected in burned patients because of the infection that occur as a result of skin loss that occur as a result of burn crises.

In the present study the mean pulse of the died subjects was tachycardia, while the discharged subject was tachycardia also but less than the died subjects with a significant statistical difference. In the same context (Schultz et al., [17]) demonstrate a study entitled as “Identification of predictors of early infection in acute burn patients” they clarified that there is a significant statistical difference between infection versus non infection patients day 4 post burn in relation to pulse. In addition to hyperthermia that is expected in burned patients, also tachycardia occur as a result of fluid loss as each 1°C increase in temperature causing increase in pulse 10b/min.

#### Conclusion:

Based on findings of the current study, it can be concluded that length of ICU stay, body mass index, TBSA, wound infection, and depth of burn were found to affect critically ill patients with burn & predisposed to mortality. A significant statistical differences between died and discharged patients regarding length of hospital stay, body mass index (category), TBSA, wound infection, and depth of burn. This necessitate careful assessment & management of critically ill patients with burn.

#### Recommendation:

- Close monitoring of critically burned patients to evaluate their conditions and to prevent early complications early.

- Availability of evidence based illustrated guidelines about management of critically ill patients with burn.

- Establishment of updated guidelines and evidence-based clinical skills to facilitate the work of the multidisciplinary team (surgery-plastic, physiotherapy, etc) who can provide the optimum care for the critically burned patients utilizing the

evidence-based guidelines (pain, infection control and feeding) guidelines.

- Development of a comprehensive tool to facilitate continuous assessment of critically burned patients.

- Availability of a unified documentation system to facilitate continuity of patients care.

- Replication of the study on a larger probability sample selected from different geographical areas in Egypt.

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## العوامل المؤثرة على الوفيات بين مرضى الحروق الكبرى بوححدات الرعاية المركزة

مما لا شك فيه أن المرضى المصابين بحروق يتعرضون إلى الكثير من العواقب الفسيولوجية والنفسية التي تؤثر سلباً على تطور حالتهم الصحية - تزيد من فترة الإقامة بالمستشفى وكذلك تكلفة الرعاية الصحية.

لذا هدفت الدراسة إلى تقييم العوامل المؤثرة على الوفيات بين مرضى الحروق الكبرى بوححدات الرعاية المركزة في إحدى المستشفيات الجامعية بالقاهرة. ولتحقيق هذا الهدف أجريت هذه الدراسة على عينة مستهدفة من ٦٧ مريض ومريضة تم دخولهم إلى وحدة الرعاية المركزة بحرق أكبر من ٢٠٪ وتم أخذ العينة في مدة ستة أشهر. وتم تنفيذ نظام وصفي لتحقيق الهدف من الرسالة - صيغ سؤال بحثي ينص على: ما هي العوامل المؤثرة على الوفيات بين مرضى الحروق الكبرى بوححدات الرعاية المركزة؟

وكان من أهم نتائج هذه الدراسة: وجود فروق ذات دلالة إحصائية فيما يتعلق بطول مدة الإقامة في المستشفى ومؤشر كتلة الجسم ونسبة الحروق (٪) والعدوى في الجرح الخاص بالحروق. وفقاً للعمر، لا يوجد فرق إحصائي معنوي بين المرضى اللذين خرجوا والمرضى المتوفين وفيما يتعلق بالمعلومات الطبية للمرضى، لا يوجد فرق إحصائي معنوي بين المرضى اللذين خرجوا والمرضى المتوفين فيما يتعلق بالسن والنوع ونبض القلب.

وبناءً على ما تم التوصل إليه من نتائج يوصى بالآتي: بإجراء فحص دقيق ومراقبة لهؤلاء المرضى وذلك لسرعة اكتشاف المضاعفات وتقليل مدة البقاء في الرعاية المركزة. كما توصى الرسالة بإتباع أحداث الإرشادات الموصى بها من ناحية مكافحة العدوى وذلك لمنع حدوث عدوى في الجروح الناتجة عن الحروق.