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Original Article

Survival analysis of mechanically ventilated patients in the burn unit at king abdulaziz medical city in Riyadh 2016-2019

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Abstract: Background: Burn injuries are a significant cause of morbidity and mortality. For patients with extensive burn injuries, mechanical ventilation (MV) is a critical management modality. However, limited data are available regarding the outcome of burn patients receiving mechanical ventilation. This study aimed to determine the outcome in terms of mortality and its associated risk factors in burn patients who required MV. Method: A retrospective review of all consecutive burn patients, admitted to the Burn Unit and requiring mechanical ventilation at King Abdulaziz Medical City and King Abdullah Specialist Children Hospital in Riyadh, from 2016 to 2019. For each patient, demographic, clinical, and outcome variables were collected. The length of stay was calculated from the date of initiation of MV after admission into the earliest discharge date or death date. The overall mortality rate during the period of the study was also calculated. Results: A total of 356 patients have been admitted to the Burn Unit during the study period. The median age was 18 years (IQR 4-35 years), and 67% were male. Flame burn (48%) was the most frequent type of burn, followed by scald burns (33%). Of the sample, 80 (20%) were placed on MV with a median length of stay of eight days. The APACHE-II severity score for patients who required MV was 16 (SD±6) and the mortality rate was 20%. Conclusion: This study reported the hospital outcomes of burn patients requiring MV. Resources should be planned to provide ultimate management plan for burn patients to reduce the mortality rate.

Keywords: Burn, survival analysis, mechanically ventilation, mortality

Introduction

Burn injury, a frequent type of traumatic injury globally, require a multi-disciplinary approach providing intensive and long-term treatment [1]. Depending on the severity and degree of burn, patients with burn injuries generally require hospital admission, and often admission to an intensive care unit (ICU) [2-4]. A critical point of the primary evaluation of burn patients is the evaluation and control of the airway [3, 4]. Early intubation and initiation of mechanical ventilation (MV) is frequently required for burn patients [5]. The indication for MV is a complex decision based on clinical and blood parameters, in addition to the clinical experience of the attending primary health caregiver.

Literature reports a substantial reduction in burn associated mortality, mainly due to advances in the overall critical care management and the development of specialized burn care teams [5-9]. However, burn injury is still causing significant morbidity and mortality. Sepsis, inhalation injury and multi-organ failure are the most frequent causes of death in burn patients [2, 6]. The mortality rate range from 10% to 58%, depending on the characteristics of the burn injury, geographical area, and the level of advancement of the specialized burn care

teams within each country [10-12]. Several studies investigated the role of risk factors for mortality following a burn injury. Age, the extent of burn, presence of inhalation injury, and complications related to the burn injury have been identified as predictive of mortality after a severe burn [9, 11, 13].

Studies also investigated the mortality rate in patients being mechanically ventilated due to a severe burn and reported a higher mortality rate [13-15]. One study reported that, for intubated pediatric patients, the mortality rate was 22% [15]. However, there is still a significant gap in our knowledge regarding the mortality rate in mechanically ventilated patients and its associated factors. The aim of the study was to determine the survival rate of patients receiving MV and to identify the associated risk factors.

Materials and methods

Study design and selection of study sample

This was a retrospective study with a cohort of burn patients, admitted to the Burn Units at King Abdulaziz Medical City (KAMC) and King Abdullah Specialist Children's Hospital (KASCH). The Burn Units at KAMC and KACSH are considered the largest burns units, managed by specialized burns teams, in the capital of Saudi Arabia (www. ngha.med.sa/English/MedicalCities/Pages/default.aspx). We included all patients, one year old and older, admitted to the Burn Units from January 2016 to July 2019, based on the hospital admission criteria. We excluded patients with minor burn injuries, transferred, and who died at scene or in the emergency department prior ICU transfer. Data were gathered until discharged from the Burn Unit or death. A subgroup of patients who have been intubated or tracheostomized and mechanically ventilated, in the emergency department or after admission to the Burn Unit, was identified.

Study variables

For each eligible patient, data was extracted for the following variables: demographic information, date of admission, mechanism of burn injury, burn, mechanism of burn (categorized into thermal, scaled, chemical, electrical, and other groups), and type of burn (categorized as full thickness and partial thickness). The % total body surface area burn (TBSA%) was categorized in 0-29%, 30-60%, and over 60%. We collected information related to comorbidities using the Charlson Index Comorbidity Score [16]. The medical outcome and complications that developed during the hospitalization, including escharotomy, grafting, fasciotomy, sepsis and wound infection, were also collect. For the MV cohort, additional data were collected including the time of intubation, APACHE-II severity score, duration of MV and associated complications.

This research was approved by Ethics Committee at the King Abdullah International Medical Research Center and registered with protocol number SP19/173/R. there was no need for patient informed consent as we utilize the medical file in which the identification were kept anonymous.

Statistical analysis

For the descriptive analysis, mean and standard deviation (SD) were used for continuous variables if the data was normally distributed, if not, the median and Interquartile range (IQR). For categorical variables, frequency and percentage was used. The study population was categorized in two groups based on mortality, namely survivor and non-survivor groups. For the association between the demographic variables and clinical factors and between survivor and non-survivor groups, we used a chi square test or Fisher's exact tests (for numbers less than five in each group). $P<0.05$ was considered as significant. The Kaplan-Meier survival curve was done to demonstrate the probability of survival overtime for MV and non-MV patients. All analysis were done using Stata 12 software system (StataCorp L.P., College Station, TX).

Results

Description of the study population

Retrospective electronic records were obtained from January 2016 to July 2019, the sample size was 356 patients. **Table 1** demonstrates the demographic and clinical variables of the study population. The median age of all patients was 18 years (interquartile range [IQR] 4-35). The majority (57%, n=204) was in the adult age

Table 1. Relationship between demographic variables and mortality

Patient Characteristics	All patients n (%) (n=356)	Survivor n (%) (n=340)	Non-survivor n (%) (n=16)	*P* value
Age in years (median, IQR)	18 (4-35)	18 (4-35)	35 (24-48)	
Age groups (years)				0.01
Children (≤14 years)	152 (42)	150 (44)	2 (12)	
Adult (>14 years)	204 (57)	190 (56)	14 (87)	
Gender				0.10
Male	241 (67)	227 (66)	14 (87)	
Female	115 (32)	113 (33)	2 (12)	
Length of stay in Burn Unit (days)	9 (5-28)	8 (1-18)	38 (11-67)	
% TBSA				<0.01
0-29	286 (80)	284 (83)	2 (12)	
30-60	50 (14)	46 (13)	4 (25)	
>60	20 (5)	10 (3)	10 (63)	
Thickness				0.41
Partial-thickness	239 (68)	230 (67)	9 (56)	
Full-thickness	117 (32)	110 (32)	7 (43)	
Mechanism of burn				0.004
Thermal	174 (48)	161 (47)	13 (81)	
Scald	118 (33)	118 (34)	0	
Chemical	43 (12)	42 (12)	1 (6)	
Electrical	14 (3)	12 (3)	2 (12)	
Others	7 (2)	7 (2)	0	
Charlson Index Comorbidity Score				0.006
0	317 (89)	307 (90)	10 (62)	
≥1	39 (10)	33 (10)	6 (37)	

group (more than 14 years), with 67% (n=241) male. The most prevalent mechanism of burn was thermal burn (48%, n=174) with a small proportion (3%, n=14) electrical burns. Regarding the thickness, the majority (68%, n=239) had partial thickness burns. The Charlson Index Comorbidity Score indicated the majority (89%) of the sample had a zero score (P=0.006).

Description of mechanical ventilated patients

Of the sample, (22%, n=80) patients were mechanically ventilated. The median length of stay for the MV group was 38 days. The mortality rate was calculated for the whole sample, 16 patients (4.4%) died, all mechanically ventilated. The TBSA% was higher in the non-survivor group compared to survivor group (3% vs 63%) (**Table 1**).

In terms of the medical outcomes and complications among mechanically ventilated group, 56% of the non-survivor group had an Escharotomy, and 18% had Fasciotomy. Mechanically ventilated patients who died had high percentage of organ failure (68%) and sepsis compared to mechanically ventilated patients who survived (**Table 2**).

The Kaplan-Meier curve (**Figure 1**) compared the survival rates between the MV and non-MV groups. The log rank test (P<0.05) indicated a statistically significant difference between the groups' survival curves. The median length of stay was higher in the non-survivor group who had more complications (38 days) compared to the survivor group (8 days).

Discussion

The result of this study indicated that a mortality rate of 4.5% for patients admitted to the Burn Unit. The TBSA% was 63% for the non-survivor group. In total, 22% were intubated and received MV due to inhalation injury.

Table 2. Medical outcomes and complications in the mechanically ventilated group

Patient Characteristics	All patients n (%) n=80	Survivor n (%) n=64	Non-survivor n (%) n=16	*p*-value
Tracheostomy	26 (32)	20 (31)	6 (37)	0.76
Escharotomy	54 (67)	45 (70)	9 (56)	0.37
Grafting	53 (66)	46 (71)	7 (43)	0.04
Excisional debridement	57 (71)	50 (78)	7 (43)	0.01
Fasciotomy	9 (11)	6 (9)	3 (18)	0.37
Inhalation injury	38 (47)	29 (45)	9 (56)	0.57
Wound site infection	26 (32)	21 (32)	5 (31)	0.99
Organ failure	19 (23)	8 (12)	11 (68)	<0.001
Complications related to mechanical ventilation				
Ventilated associated pneumonia	42 (52)	34 (53)	8 (50)	0.99
Acute respiratory distress syndrome	6 (7)	3 (4)	3 (18)	0.09
Sepsis	24 (30)	11 (17)	13 (81)	<0.001

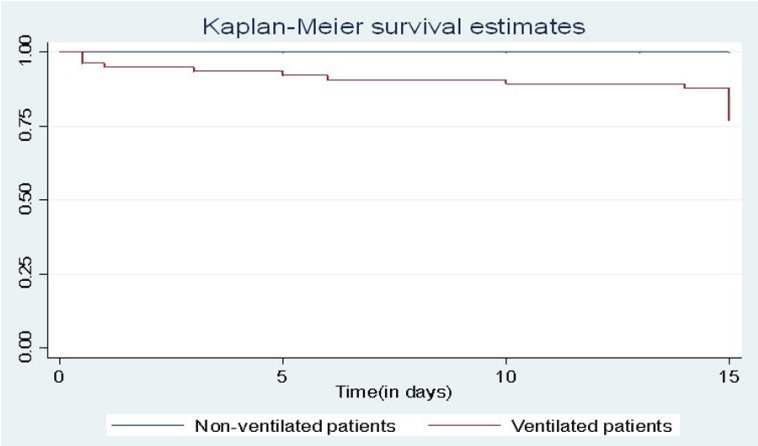

Figure 1. Survival analysis of mechanically ventilated patients admitted to the Burn unit.

Comparison with previous studies

The mortality rate in this study was low compared to other studies, ranging from 12% to 60% in developing countries [2, 5, 11, 14]. However, this finding should be interpreted with caution due to varying admission criteria and the level of advancement of medical centers in the countries. The presence of complications affects the length of stay, which affects the mortality rate. This concept was reported by several studies [7, 11]. In the current study, the median length of stay was higher in the non-survivor group who had more complications (38 days) compared to the survivor group (8 days).

The results of the current study reported similar findings to previous studies, with age, inhalation injury and large burn TBSA% associated with an increased risk of mortality [5, 7, 13]. The presence of inhalation injury and large TBSA% burn were predictive factors for burn injury related mortality [8, 11, 14]. In the present study, the adult group had a significantly higher mortality rate compared to children. Despite the difference in the mechanism of injury between the two groups, many physiological mechanisms and the immune response contribute to the high percentage of complications such infection and sepsis [10, 15, 17]. The physiological mechanisms may explain the high mortality in older group [7, 10]. Furthermore, the presence of comorbidities was higher in the non-survivor group, which could be a contributing factor for the high mortality rate in the older group.

Strength and limitation of the study

This study provides an additional information regarding mortality in patients admitted to the Burn Unit. The strength in the study was that we focused on MV patients admitted to the Burn Unit. However, some limitations are acknowledged. Firstly, this study was an observational study from a single center which may affect the generalizability of the results. In addition, the mechanism and severity of burn was different

between the pediatric and adult groups and we did not provide a separate analysis stratified by age, which could possibly introduce measurement bias. However, the aim of this study was to estimate the mortality in patients admitted to ICU, specifically mechanically ventilated patients. Comprehensive data were collected regarding the variables, including clinical and comorbidity factors, however, due to the observational nature of this study, unmeasured confounder factors could affect the validity of the results. There were some documentation errors in the medical files that may cause measurement error, however we reviewed each file manually to double check the diagnosis, and reduce the effect of the measurement error on the study.

Conclusion

This study determined the hospital outcomes of burn patients requiring MV. The mortality rate depend on the severity and degree of the burn injury. The most important factors related to mortality in burn patients were sepsis, VAP, and organ failure. Factors predictive of mortality were a TBSA% >60%, presence of inhalation injury, length of stay in the Burn Unit and the duration of intubation, Identification of the factors frequently associated with mortality could result in a reduction in mortality by providing specific and preventive care to burn victims with these factors. The identification of the risk factors will assist healthcare providers to establish a comprehensive management plan for burn patient to reduce the mortality rate.

Disclosure of conflict of interest

None.

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