

## Survival and Associated Risk Factors in Mechanically Ventilated Burn Patients: A Cross-Sectional Study

# Siamak Rimaz<sup>1</sup>, Vahideh Abdi<sup>1</sup>, Cyrus Emir Alavi<sup>2</sup>, Sanaz Masoumi<sup>1</sup>, Mahsa Sadeghi<sup>1</sup>, Mohammadreza Mobayen<sup>1</sup>, Parissa Bagheri<sup>3\*</sup>

<sup>1</sup>Burn and Regenerative Medicine Research Center, Guilan University of Medical Sciences, Rasht, Iran <sup>2</sup>Razi Clinical Research Development Unit, Guilan University of Medical Sciences, Rasht, Iran <sup>3</sup>Medical Education Research Center, Education Development Center, Guilan University of Medical Sciences, Rasht, Iran

\*Corresponding author: Parissa Bagheri Address: Medical Education Research Center, Education Development Center, Guilan University of Medical Sciences, Rasht, Iran. Tel: +98 9112812842; e-mail: parissabagheri@yahoo.com Received: October 09, 2024 Revised: February 05, 2025 Accepted: February 23, 2025

## ABSTRACT

**Objectives:** This study aimed to determine the survival rate and identify associated risk factors in mechanically ventilated (MV) burn patients.

**Methods:** This cross-sectional analytical study was conducted at Velayat Hospital, a burn and plastic surgery referral center affiliated with Guilan University of Medical Sciences, between March 2011, and September 2020. Data were retrieved from electronic medical records and analyzed using SPSS software (version 24.0). Patients discharged alive or lost to follow-up were treated as censored observations in a time-to-event analysis. **Results:** The mean age of survivors was 19.03 $\pm$ 30.21 years, compared to 42.54 $\pm$ 19.30 years in the non-survivors. Men comprised 78.9% (n=30) of survivors and 64.9% (n=155) of non-survivors. The mean intensive care unit (ICU) survival time was 18.33 $\pm$ 1.36 days (median=12 $\pm$ 1.24 days). There were significant differences between survivor and non-survivor groups in terms of age, length of stay, presence of comorbidities, inhalation injury, sepsis, acute respiratory distress syndrome (ARDS), and acute kidney injury (AKI) (p<0.05). The Kaplan-Meier analysis demonstrated a significant difference in survival probability between MV and non-MV groups (p=0.028), with a higher survival probability observed in non-MV patients.

**Conclusion:** Age, length of stay, renal failure, ARDS, and sepsis were associated with increased mortality risk in MV burn patients. While these findings highlighted critical prognostic factors, causal inferences require further investigation through longitudinal or interventional studies to guide targeted therapeutic strategies.

Keywords: Burns, Mechanical ventilation, Survival, Prognosis.

Please cite this paper as:

Rimaz S, Abdi V, Emir Alavi C, Masoumi S, Sadeghi M, Mobayen MR, Bagheri P. Survival and Associated Risk Factors in Mechanically Ventilated Burn Patients: A Cross-Sectional Study. *Bull Emerg Trauma*. 2025;13(2):2-8. doi: 10.30476/beat.2025.104399.1549.

#### Introduction

Durn injuries represent one of the most D devastating and economically burdensome traumatic events, characterized by damage to the skin or soft tissues [1, 2]. These injuries often lead to prolonged hospitalization, high costs of wound management, and significant morbidity and mortality rates [2-4]. These factors impose substantial socioeconomic burdens on affected individuals and communities [5-7]. According to the World Health Organization (WHO), burnrelated injuries caused approximately 265,000 deaths globally in recent years, with 96% occurring in low- and middle-income countries [8]. Notably, burns rank among the leading causes of disabilityadjusted life-years (DALYs) in developing nations [9]. In Iran, burns are the 8<sup>th</sup>-leading cause of death and the 13<sup>th</sup>-leading cause of disability [10].

While advances in clinical care have significantly reduced burn mortality rates over the past three decades [11], survivors frequently face long-term physiological complications [12, 13]. For patients with major burns (>20% total body surface area [TBSA]), mechanical ventilation (MV) is required in approximately one-third of cases [14, 15]. However, MV carries significant risks, including ventilatorassociated pneumonia (VAP), acute lung injury, and nosocomial infections, all of which contribute to increased morbidity, prolonged hospitalization, and higher mortality rates [15-18]. The decision to initiate MV remains complex, relying on both clinical and hematologic parameters [19].

Previous studies highlighted the multifactorial nature of outcomes in burn patients requiring MV. For instance, A Saudi Arabian study reported a 20% mortality rate in this population, with inhalation injury and acute physiology and chronic health evaluation (APACHE-II) scores as key predictors [20]. Similarly, a Malaysian study identified higher TBSA, early systemic inflammatory response syndrome (SIRS), and MV as significant mortality risk factors [21]. Data from Sultan Ismail Hospital (n=525 over 7 years) further highlighted older age, greater TBSA, and MV requirement as independent predictors of mortality [22]. Furthermore, severe inhalation injuries, particularly when requiring MV, were consistently linked to elevated mortality [23].

Despite these findings, critical knowledge gaps persist regarding the interplay of risk factors such as MV duration, pre-existing comorbidities, and specific burn characteristics. This study aimed to address these gaps by analyzing survival trends and identifying modifiable risk factors in mechanically ventilated (MV) burn patients. Using data from a regional burn referral center, the present study aimed to provide evidence-based insights to optimize clinical decision-making and improve outcomes in this high-risk population.

#### **Materials and Methods**

This cross-sectional analytical study was conducted at Velayat Hospital, a regional burn care and plastic surgery referral center affiliated with Guilan University of Medical Sciences (Rasht, Iran). Data were collected from March 21, 2011, to September 21, 2020.

#### Participants

The study included adult patients over 20 years of age with second- or third-degree thermal or chemical burns affecting 20-80% of total body surface area (TBSA) who were admitted to the hospital within 24 hours post-burn and remained hospitalized for more than 7 days. Exclusion criteria consisted of patients with multiple traumas, those extubated within less than 24 hours of intubation, and cases with incomplete medical records. From an initial pool of 453 screened patients, 135 met all inclusion criteria and were enrolled in the study.

Demographic and clinical data were retrieved from the hospital information system (HIS). This information encompassed sex, age, TBSA, cause of the burn, inhalation injury status, length of hospital stay (days), and presence of comorbidities. Documented complications comprised sepsis, ventilator-associated pneumonia (VAP), acute kidney injury (AKI), and acute respiratory distress syndrome (ARDS). The time-to-event analysis was based on the duration from hospital admission until either discharge or death, measured in days.

The minimum required sample size was calculated based on a study by Ismaeil *et al.*, where the median survival for deceased and recovered groups was reported as 38 days and 8 days, respectively [20]. The required sample size was estimated by assuming an effect size of approximately 5 days, a significance level of 0.05 ( $\alpha$ =0.05), and a power of 80%. Considering a 10% dropout rate, the minimum required sample size was 53.

All analyses were performed using statistical software (SPSS version 24.0; IBM Corp). Continuous variables were reported as mean±standard deviation (SD), while categorical variables were presented as frequencies and percentages. Group comparisons between survivors and non-survivors were conducted using appropriate statistical tests: The Chi-square test or Fisher's exact test for categorical variables, and independent samples t-tests for continuous variables. Survival probabilities were estimated using Kaplan-Meier analysis with logrank tests to compare MV and non-MV patient groups, with statistical significance set at p<0.05 for all analyses.

The study protocol received ethical approval from the Ethics Committee of Guilan University of Medical Sciences (code: IR.GUMS.REC.1400.567), ensuring compliance with ethical standards for human subjects research.

Table 1. Relationship between demographic variables and mortality				
Patient Characteristic	All patients n (%)	Survivor n (%)	Non-survivor n (%)	<i>p</i> value
Age groups (years)	38.6±20.36	30.51±19.69	46.75±21.30	< 0.001
Sex				
Male	87 (64.4)	27 (77.1)	60 (60.0)	0.68
Female	48 (35.6)	8 (22.9)	40 (40.0)	
Comorbidity				
Yes	24 (17.8)	2 (5.7)	22 (22.0)	0.030
No	111 (82.2)	33 (94.3)	78 (78.0)	
Length of stay (days)	12.88±21.28	14.19±27.40	11.85±15.17	< 0.001
TBSA %				
20-39	37 (27.4)	13 (37.1)	24 (24.0)	0.65
40-59	54 (40.0)	16 (45.7)	38 (38.0)	
>60	44 (32.6)	6 (17.1)	38 (38.0)	
Mechanism of burn				
Hot liquid	11 (8.1)	1 (2.9)	10 (10.0)	0.345
Scaled	119 (88.1)	32 (91.4)	87 (87.0)	
Electrical	4 (3.0)	2 (5.7)	2 (2.0)	
Others	1 (0.7)	0 (0.0)	1 (1.0)	
Inhalation injury				
Yes	73 (54.1)	21 (60.0)	52 (52.0)	0.014
No	62 (45.9)	14 (40.0)	48 (48.0)	

#### Results

After applying rigorous screening criteria, 135 patients were enrolled in this study. Table 1 presents the baseline demographic characteristics of the study participants. The sample comprised predominantly male patients (n=87, 64.4%) compared to female patients (n=48, 35.5%). The mean age of the patients was 38.6 years. The mean duration of hospitalization was 12.88±21.28 days, with an overall mortality rate of 12.5%. Statistical analysis revealed significant differences (p<0.001) between survivors and non-survivors in terms of age, hospitalization duration, comorbidity prevalence, and inhalation injury

incidence (Table 1).

Further analysis demonstrated significant betweengroup differences (p < 0.05) for several critical complications, including sepsis, ARDS, and AKI showed (Table 2).

Table 3 summarizes the results of survival probabilities among MV burn patients in the ICU, comparing survivors and non-survivors. The analysis revealed a mean survival duration of  $18.33\pm1.36$  days (median=12±1.24 days) for ICU patients. Kaplan-Meier analysis demonstrated a statistically significant difference in survival probability between groups (p=0.028), with non-MV patients showing significantly better survival outcomes (Figure 1).

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

Patient Characteristic	All patients	Survivor	Non-survivor	<i>p</i> value
	n (%)	n (%)	n (%)	
Infection				
yes	104 (77.0)	25 (71.4)	79 (79.0)	0.359
no	31 (23.0)	10 (28.6)	21 (21.0)	
Sepsis				
yes	33 (24.4)	3 (8.6)	30 (30.0)	<0.001
no	102 (75.6)	32 (91.4)	70 (70.0)	
ARDS				
Yes	57 (42.2)	2 (5.7)	55 (55.0)	< 0.001
No	78 (57.8)	33 (94.3)	45 (45.0)	
VAP				
Yes	70 (51.9)	17 (48.6)	53 ()	0.665
No	65 (48.1)	18 (51.4)	47 ()	
AKI				-
Yes	46 (34.1)	1 (2.9)	45 (45.0)	< 0.001
No	89 (65.9)	34 (97.1)	55 (55.0)	

فرم کامل تمام مخفف ها باید زیر جدول بیاید.

**Table 3.** Survival probability function in burn patients under mechanical ventilation hospitalized in the intensive care unit in two groups, deceased and survived.

Variables	<b>Estimate±SD</b>	Lower Bound	Upper Bound
Mean survival	18.1±33.36	15.66	21
Median survival	12.0±1.24	10.55	14.44



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

#### Discussion

The present study analyzed survival outcomes in MV burn patients, and the results showed that the presence of inhalation injury was a significant predictor of mortality. Lip *et al.*, claimed that inhalation injury was one of the critical factors determining survival in these patients [21], which was in agreement with the findings of the present study.

Consistent with Garren et al., our findings confirmed that the inhalation injury significantly increased the likelihood of prolonged mechanical ventilation [24]. Inhalation injury encompasses a spectrum of pulmonary damage caused by inhaling toxic substances during fires or other similar events [23]. It not only increases mortality risk in burn patients but also necessitates heightened clinical vigilance, particularly for those requiring ventilatory support. Current evidence supported the use of targeted antibiotics for confirmed infections in these patients, while corticosteroid therapy offered no demonstrable benefit [25]. The patient was diagnosed with sepsis, and ARDS was also a sign of non-survival of the patient under ventilator. The findings of the present study were consistent with a previous systematic review of 8,200 burn patients across 33 studies [26], which identified mechanical ventilation, renal failure, sepsis, and pre-existing conditions (notably diabetes) as key mortality predictors. In the present research, the concurrent diagnosis of sepsis and ARDS in ventilated patients was strongly associated with fatal outcomes, further underscoring the critical

nature of these complications.

Our analysis identified demographic factors such as advanced age and prolonged hospital stay as significant predictors of mortality among ventilated burn patients. These findings were consistent with previous studies, such as Lip et al., who reported a clear association between advanced age and increased mortality [21]. Queiroz et al., in their multivariate analysis of 293 burn patients, found that both age and mechanical ventilation were associated with mortality [27]. Heyland et al., reported that extended hospitalization (mean duration=17 days) significantly affected the mortality rate of patients [28]. While these observational findings highlighted important clinical correlations, they failed to establish causation. Future prospective studies are required to further elucidate these relationships and guide optimal clinical management strategies.

The present study identified infection as a significant predictor of survival outcomes in MV burn patients. These results aligned with established literature demonstrating a significant association between AKI and mortality in burn patients requiring ICU admission and mechanical ventilation (27). AKI represents a frequent complication in burn ICU patients, contributing to increased mortality rates [29, 30]. Several risk factors were identified for AKI development in this population, including advanced age, extensive or complex burn injuries, the presence of multiple organ failure, and sepsis [23]. Notably, our data corroborate these findings, showing the presence of old age and sepsis, in turn,

lead to an increased risk of mortality in mechanical ventilation patients. As a result, the presence of AKI with these factors significantly increases mortality risk, underscoring the critical importance of AKI prevention and management in this patient population.

According to the results, there was no correlation between TBSA and the degree of burns with mortality rate. However, a review of similar studies indicated that TBSA and burn severity could be associated with mortality risk in burn patients. One possible explanation for this discrepancy is the difference in inclusion and exclusion criteria. In the current study, patients with severe burns ( $\geq$ 80% TBSA, second- and third-degree), who have a high mortality risk, were excluded to minimize confounding factors. Additionally, the sample size in the present study was significantly smaller than in comparable studies, which might also account for the differing results.

The mortality rate was higher in burn patients under MV. Lip et al.,'s study found that MV was associated with poorer survival in burn patients [21]. Another study by the same researcher in 2019 also showed that mechanical ventilation was associated with increased mortality in burn patients [22]. Similarly, Talizin et al., [26] and Queiroz et al., [27] demonstrated a significant association between MV and increased mortality in burn patients. Güldoğan et al., [31] further supported this trend in a study of 224 patients with burns covering  $\geq$ 30% of TBSA, where MV exposure was associated with higher mortality. In the present study, the intersection of Kaplan-Meier survival curves suggested dynamic changes in survival probabilities over time. This phenomenon might reflect variations in the timing of complications or recovery patterns. For instance, MV patients might initially benefit from intensive supportive care, leading to higher short-term survival rates, but later face elevated risks due to nosocomial infections or multi-organ failure. Further research is required to clarify the underlying factors contributing to this dynamic change.

This study had several limitations that should be acknowledged. First, as a single-center study, the findings might lack generalizability to other clinical settings. Second, the relatively small sample size compared to similar studies might reduce the statistical power and limit the robustness of the conclusions. Although we conducted stratified analyses for key variables, including age, sex, TBSA, burn mechanism, inhalation injury, hospitalization duration, infection frequency, sepsis, VAP, AKI, and ARDS, this study did not account for other potential confounders that might affect the outcomes. Notably, the absence of data on pre-existing comorbidities (e.g., diabetes, cardiovascular diseases, or chronic respiratory conditions) and mechanical ventilation duration, which are known to significantly influence patient recovery and survival, represents a critical limitation.

Another limitation of this study was the use of Kaplan-Meier survival analysis, which failed to account for competing risks (e.g., mortality or interfacility transfers). These competing events could preclude the primary outcome (hospital discharge) and could potentially bias survival probability estimates. Future studies should incorporate competing risk models, such as the Fine and Gray subdistribution hazard model, to provide a more accurate analysis of length of stay and related outcomes. Moreover, while we implemented manual record review and diagnostic verification procedures, potential documentation inaccuracies in medical records may have introduced bias. Although these measures reduced misclassification risk, residual confounding remains a possibility that could not be completely eliminated.

Furthermore, as a descriptive study, the findings were limited to identifying associations rather than establishing causal relationships. Although significant associations were observed between mortality and factors such as age, TBSA, and sepsis; these relationships should be interpreted with caution. Future prospective cohort studies or interventional trials would be necessary to confirm these associations and elucidate potential causative mechanisms.

Future studies should address these limitations by incorporating comprehensive data on preexisting comorbidities and MV duration, including additional clinically relevant variables, and utilizing larger, multi-center cohorts to improve generalizability. Such methodological enhancements would help distinguish true independent risk factors from potential confounding variables among the observed associations. Furthermore, these improvements would provide more definitive evidence regarding the causal relationships between identified risk factors and clinical outcomes in burn patients.

The findings of the present study identified significant associations between mortality risk and several clinical factors—including advanced age, prolonged hospitalization, renal failure, ARDS, and sepsis in MV burn patients. The survival probability was significantly higher among nonventilated patients. However, as a descriptive analysis, these findings could not establish causal relationships. Future prospective longitudinal studies or interventional trials are recommended to validate these observed associations, elucidate potential causal mechanisms, and inform evidencebased treatment strategies for optimizing outcomes in this vulnerable patient population.

### Declaration

Ethics approval and consent to participate: This retrospective study was approved by the Ethics Committee of Guilan University of Medical Sciences (code: IR.GUMS.REC.1400.567). As the research utilized anonymized data from the hospital information system, the ethics committee waived the requirement for individual patient consent. All patient identifiers were removed before data analysis to ensure confidentiality.

#### Consent for publication: Not applicable.

**Conflict of Interest:** The authors declared no personal or financial conflicts of interest related to this work.

**Funding:** The authors confirmed that there was no financial support for the research, authorship, or publication of this article.

#### References

- Chen B, Zhao J, Zhang Z, Li G, Jiang H, Huang Y, et al. Clinical characteristics and risk factors for severe burns complicated by early acute kidney injury. *Burns*. 2020;46(5):1100-6.
- Tolouei M, Bagheri Toolaroud P, Letafatkar N, Feizkhah A, Sadeghi M, Esmailzadeh M, et al. An 11-year retrospective study on the epidemiology of paediatric burns in the north of Iran. *Int Wound J.* 2023;20(9):3523–30.
- **3.** Ghanbari A, Masoumi S, Leyli EK, Mahdavi-Roshan M, Mobayen M. Effects of flaxseed oil and olive oil on markers of inflammation and wound healing in burn patients: A randomized clinical trial. *Bull Emerg Trauma*. 2023;**11**(1):32-40.
- Feizkhah A, Mobayen M, Habibiroudkenar P, Toolaroud PB, Pourmohammadi Bejarpasi Z, Mirmasoudi SS, et al. The importance of considering biomechanical properties in skin graft: Are we missing something? *Burns*. 2022;48(7):1768–9.
- Lopes MCBT, de Aguiar Júnior W, Whitaker IY. The association between burn and trauma severity and in-hospital complications. *Burns*. 2020;46(1):83–9.
- 6. Mobayen M, Torabi H, Bagheri Toolaroud P, Tolouei M, Dehnadi Moghadam A, Saadatmand M, et al. Acute burns during the COVID-19 pandemic: A one-year retrospective study of 611 patients at a referral burn centre in northern Iran. *Int Wound J.* 2023;**20**(8):3204–11.
- Bagheri Toolaroud P, Nabovati E, Akbari H, Tamimi P, Mobayen M, Rangraz Jeddi F. Evaluation of

the effectiveness of a smartphonebased educational intervention on the outcomes of children's burns: A randomized controlled trial. *Int Wound J.* 2024;**21**(1):e14642.

- WHO. Burn, Fact sheets [Internet]. 2018 [cited 2021 July 17]. Available from: https://www.who.int/ news-room/fact-sheets/detail/burns
- Forbinake NA, Ohandza CS, Fai KN, Agbor VN, Asonglefac BK, Aroke D, et al. Mortality analysis of burns in a developing country: a CAMEROONIAN experience. *BMC Public Health.* 2020;20(1):1–6.
- Jafaryparvar Z, Adib M, Ghanbari A, Leyli EK. Unplanned readmission after hospital discharge in burn patients in Iran. *Eur J Trauma Emerg Surg.* 2019;45:365–71.
- 11. Norouzkhani N, Ghazanfari MJ, Falakdami A, Takasi P, Mollaei A, Ghorbani Vajargah P, et al. Implementation of telemedicine for burns management: Challenges and opportunities. *Burns*. 2023;49(2):482-4.
- 12. Rangraz Jeddi F, Nabovati E, Mobayen M, Akbari H, Feizkhah A, Osuji J, et al. Health care needs, eHealth literacy, use of mobile phone functionalities, and intention to use it for self-management purposes by informal caregivers of children with burns: a survey study. BMC Med Inform Decis Mak. 2023;23(1):236.
- Liang CY, Wang HJ, Yao KP, Pan HH, Wang KY. Predictors of health-care needs in discharged burn patients. *Burns*. 2012;38(2):172-9.
- 14. Kennedy JD, Thayer W, Beuno R, Kohorst K, Kumar AB. ECMO in major burn patients: feasibility and considerations when multiple modes

Authors' Contribution: SR: Study conception and design; VA: Data collection, Data analysis, and interpretation; CEA: Study conception and design; SM: Drafting of manuscript; MS: Data analysis and interpretation; MM: Study conception and design; PB: Drafting of manuscript, Data analysis and interpretation. All the co-authors contributed to this paper and are responsible for all aspects of the work and approved the final manuscript.

Acknowledgments: This study was conducted as part of an MD thesis program at Guilan University of Medical Sciences. The authors gratefully acknowledge the support and assistance provided by the Burn and Regenerative Medicine Research Center of Guilan University of Medical Sciences throughout this research project.

of mechanical ventilation fail. *Burns Trauma*. 2017;**5**:20.

- **15.** Chung KK, Rhie RY, Lundy JB, Cartotto R, Henderson E, Pressman MA, et al. A survey of mechanical ventilator practices across burn centers in North America. J Burn Care Res. 2016;37(2):e131–9.
- 16. Ji Q, Tang J, Li S, Chen J. Survival and analysis of prognostic factors for severe burn patients with inhalation injury: based on the respiratory SOFA score. BMC Emerg Med. 2023;23(1):1.
- Brusselaers N, Logie D, Vogelaers D, Monstrey S, Blot S. Burns, inhalation injury and ventilatorassociated pneumonia: Value of routine surveillance cultures. Burns. 2012;38(3):364–70.
- Glas GJ, Horn J, Hollmann MW, Preckel B, Colpaert K, Malbrain M, et al. Ventilation practices in burn patients—an international prospective observational cohort study. *Burns Trauma*. 2021;9:tkab034.
- Ismaeil T, Almutairi J, Alshaikh R, Althobaiti Z, Ismaeil Y, Othman F. Survival of mechanically ventilated patients admitted to intensive care units. Results from a tertiary care center between 2016-2018. Saudi Med J. 2019;40(8):781–8.
- 20. Ismaeil T, Alramahi G, Othman F, Mumenah N, Alotaibi L, Baazim H, et al. Survival analysis of mechanically ventilated patients in the burn unit at king abdulaziz medical city in Riyadh 2016-2019. Int J Burns Trauma. 2020;10(4):169-73.
- 21. Tan Chor Lip H, Tan JH, Thomas M, Imran F-H, Mat AT. Survival analysis and mortality predictors of hospitalized severe burn victims in a Malaysian burns intensive care unit.

Burns trauma. 2019;7:3.

- 22. Lip HTC, Idris MAM, Imran F-H, Azmah TN, Huei TJ, Thomas M. Predictors of mortality and validation of burn mortality prognostic scores in a Malaysian burns intensive care unit. *BMC Emerg Med.* 2019;19(1):1–7.
- You K, Yang H-T, Kym D, Yoon J, Cho Y-S, Hur J, et al. Inhalation injury in burn patients: establishing the link between diagnosis and prognosis. *Burns*. 2014;40(8):1470–5.
- 24. Garren BN, Akhondi-Asl A, DePamphilis MA, Burns JP, Sheridan RL. Factors Associated With Mechanical Ventilation Duration in Pediatric Burn Patients in a Regional Burn Center in the United States. *Pediatr Crit Care Med.* 2022;23(11):e536–40.
- **25.** Herndon DN, Barrow RE, Linares HA, Rutan RL, Prien T, Traber LD, et al. Inhalation injury in burned patients: effects and treatment. *Burns*. 1988;**14**(5):349–56.
- **26.** Talizin TB, Tsuda MS, Tanita MT, Kauss IAM, Festti J, Carrilho CMD de M, et al. Acute kidney injury and intra-abdominal hypertension in burn patients in intensive care. *Rev Bras Ter Intensiva*. 2018;**30**(1):15-20.
- 27. Queiroz LFT, Anami EHT, Zampar EF, Tanita MT, Cardoso LTQ, Grion CMC. Epidemiology and outcome analysis of burn patients admitted to an intensive care unit in a university hospital. *Burns*. 2016;42(3):655–62.
- **28.** Heyland D, Cook D, Bagshaw SM, Garland A, Stelfox HT, Mehta S, et al. The very elderly admitted to

ICU: a quality finish? *Crit Care Med*. 2015;**43**(7):1352–60.

- **29.** Folkestad T, Brurberg KG, Nordhuus KM, Tveiten CK, Guttormsen AB, Os I, et al. Acute kidney injury in burn patients admitted to the intensive care unit: a systematic review and meta-analysis. *Crit care*. 2020;**24**(1):2.
- 30. Wu G, Xiao Y, Wang C, Hong X, Sun Y, Ma B, et al. Risk factors for acute kidney injury in patients with burn injury: a meta-analysis and systematic review. *J Burn Care Res.* 2017;38(5):271–82.
- **31.** Güldoğan CE, Kendirci M, Gündoğdu E, Yastı AÇ. Analysis of factors associated with mortality in major burn patients. *Turk J Surg.* 2019;**35**(3):155-64.

**Open Access License** 

All articles published by Bulletin of Emergency And Trauma are fully open access: immediately freely available to read, download and share. Bulletin of Emergency And Trauma articles are published under a Creative Commons license (CC-BY-NC).