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Transfusion requirements as a surrogate marker of mortality and morbidity in adults with severe burns: A retrospective cohort study

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ABSTRACT

Objective: Although blood transfusion is necessary for addressing anemia, coagulopathy, and systemic inflammation, transfusions also carry risks that may influence morbidity and mortality. This study, of patients with burns treated at a tertiary care centre, was conducted from October 2024 to May 2025. It aimed to investigate the association between blood and blood product transfusion requirements and clinical outcomes in adult patients with severe burns. Additionally, the study identified other predictors of mortality, and examined the prognostic role of common biochemical markers and complications in determining patient outcomes.

Material and Methods: This retrospective cohort study analyzed 82 eligible adult patients with burns. Patients were considered eligible if they were 18 years of age or older, were admitted for acute burn injury and had complete clinical and laboratory data. Demographic, clinical, laboratory, and transfusion data were retrieved from electronic medical records. Cox proportional hazards regression was used to identify independent predictors of mortality, while Kaplan-Meier analysis assessed survival trends.

Results: Participants were grouped into survivors (n=33) and non-survivors (n=49). Non-survivors required higher total volume of red blood cells (11 vs. 6 units), fresh frozen plasma (11 vs. 5 units), and platelets (4 vs. 0 units), particularly in the intensive care unit (ICU) setting. Compared to survivors, non-survivors also had elevated creatinine levels, lower platelet counts, and higher rates of complications such as pneumonia and dialysis. Cox regression confirmed total body surface area burned as the strongest independent predictor of mortality.

Conclusion: High transfusion requirements in the ICU are associated with increased mortality in patients with severe burns and may serve as a surrogate marker for disease severity. These findings support the need for restrictive, individualized transfusion strategies and underscore the importance of integrating transfusion parameters into early risk assessment and prognostic models in burn care.

Keywords: Burns, blood transfusion, blood product transfusion, burns management

INTRODUCTION

Burn injuries remain a significant global public health issue, contributing significantly to morbidity, mortality, and long-term disability, particularly in low and middle-income countries (1). According to the World Health Organization, approximately 180,000 deaths annually are attributed to burns, with the vast majority occurring in resource-limited settings (2). Despite advancements in resuscitation, wound care, surgical techniques, and critical care, the prognosis in patients with severe burns continues to be influenced by a range of clinical and biochemical factors.

Early and accurate prognostication is essential for guiding treatment intensity, triage decisions, and allocation of healthcare resources, particularly in intensive care settings. Various scoring systems have been developed to predict mortality and outcomes in patients with burns, incorporating factors such as age, total body surface area (TBSA), inhalation injury, and comorbidities (3). However, recent studies have increasingly focused on the prognostic utility of routine clinical and laboratory parameters, such as serum creatinine, platelet count, and coagulation markers (4,5). These parameters, which are readily available in most settings, may serve as early indicators of systemic deterioration and risk of poorer outcomes.

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Blood transfusion practices in patients with burns are typically guided by clinical and laboratory indicators of physiological need, particularly the assessment of end-organ perfusion. Although transfusion therapy carries well-established risks and complications, approximately 25% of patients in intensive care unit (ICU) receive transfusions, often to address anemia-related complications (6). Patients with major burn injuries present with substantial transfusion requirements due to multiple factors, including intraoperative blood loss, hemodilution from fluid resuscitation, suppressed erythropoiesis, increased hemolysis, and iatrogenic blood loss associated with frequent laboratory testing (7,8).

We conducted a comprehensive analysis of patients with burns admitted to a tertiary care burn unit, comparing survivors and non-survivors across demographic, clinical, laboratory, and treatment variables. The primary objective was to evaluate the impact of blood and blood product transfusion on survival outcomes. Secondary objectives included identifying other key predictors of mortality and examining the prognostic role of common biochemical markers and complications in determining patient outcomes. These findings aim to inform clinical decision-making and contribute to the refinement of prognostic models in burn care.

MATERIAL and METHODS

Ethical Consideration

The Institutional Ethics Committee approval for this study (2025/010.99/13/29) was provided by the Scientific Research Ethics Committee of University of Health Sciences Türkiye, Kartal Dr. Lütfi Kırdar City Hospital on 26 February, 2025. Data handling complied with applicable data protection regulations. This study has been conducted in accordance with the principles set forth in the Helsinki Declaration.

Study Design and Setting

This retrospective cohort study, conducted from October, 2024 to May, 2025, used data from the medical records of eligible patients with burns treated at a tertiary care centre between 1st of January 2008 and 1st of December 2020. This centre serves as a regional referral unit for patients with moderate to severe burn injuries.

Study Population and Eligibility Criteria

A total of 82 adult patients with burns who were admitted to the tertiary care centre between 1st of January 2008 and 1st of December 2020 and met the eligibility criteria were included. Inclusion criteria were age ≥18 years, admission for acute burn injury, and availability of complete clinical and laboratory data. Patients were excluded if they were <18 years, had incomplete records, or were admitted for non-burn-related conditions. Patients were categorized into two groups based on in-hospital survival status: Survivors (n=33) and non-survivors (n=49).

Data Collection and Variables

Clinical and demographic data were retrieved from electronic medical records and included age, sex, body weight, and American Society of Anesthesiologists (ASA) physical status classification. Burn characteristics were recorded according to burn type, degree of burn, and TBSA burned. TBSA was estimated at the time of initial presentation to the burn center, prior to fluid resuscitation, using the Lund and Browder chart which is a standardized and widely accepted method for burn size estimation (9,10). All assessments were performed by experienced burn care physicians who had undergone formal training in TBSA estimation. To minimize interobserver variability, the same physician team conducted the assessments throughout the study period. Data on interventions and complications included the need for mechanical ventilation, dialysis, development of pneumonia, sepsis, wound infections, and requirement for surgical procedures e.g., debridement, grafting, fasciotomy/escharotomy. Comorbidities and pre-existing conditions were systematically recorded for all patients at the time of admission using standardized medical history forms. These data included, but were not limited to, cardiovascular disease, diabetes mellitus, chronic respiratory conditions, and renal impairment. Hospital metrics were evaluated as ICU and total hospital length of stay, number of dressing changes, and total operation hours. Laboratory investigations at admission and the final time point prior to death or discharge included serum creatinine, hemoglobin, hematocrit, platelet count, international normalised ratio (INR), and troponin levels. Transfusion data included the total number of units administered for red blood cells (RBCs), fresh frozen plasma (FFP), platelets, and albumin. Transfusion details were recorded across different clinical settings (operating theatre, ICU, and general ward).

Statistical Analysis

Continuous variables were summarized as medians with interquartile ranges or means with standard deviations. Normality was checked visually using histograms. Categorical variables were presented as counts and percentages. Comparisons between survivors and non-survivors were performed using the Mann-Whitney U test for non-normally distributed continuous variables or Student's t-test for normally distributed continuous variables, and the chi-square or Fisher's exact test for categorical variables. A p-value of <0.05 was considered statistically significant.

Survival analysis was conducted using the Kaplan-Meier method, with survival curves compared using log-rank test. Associations between risk factors and mortality were assessed using a multivariable Cox proportional hazards regression model that included all selected variables in a single model. Hazard ratios (HR) with 95% confidence intervals were reported. Variables

included in the Cox model were selected based on clinical relevance and univariate analysis results. All statistical analyses were performed using STATA 17 (College Station, TX).

RESULTS

Baseline Characteristics of the Participants

Table 1 outlines the baseline characteristics of 82 eligible patients with burns who were admitted to the tertiary care center between 1st of January 2008 and 1st of December 2020. The cohort included 17 females (20.7%) and 65 males (79.3%). Of these, 33 patients survived (4 females and 29 males) while 49 were deceased (13 females and 36 males). The median age of survivors was 29 years compared to 75 years in the deceased group. In terms of ASA classification, 82% of survivors were classified as ASA I, whereas 47% of the deceased were calssified as ASA III.

Five individuals amongst the survivors sustained first-degree burns, while none of the deceased had first-degree burns. Among the non-survivors, 43% sustained second- to third-degree burns, and 16% sustained third-degree burns. In contrast, 9% of survivors had second- to third-degree burns, and 15% sustained third-degree burns. The median TBSA affected was statistically significantly higher in the deceased group [54.0 (45.0, 65.0)] compared to the alive group [38.0 (31.0, 40.0)]. Additionally, the predominant burn mechanism differed between the two groups: Most survivors sustained electrical burns, whereas flame burns were the most common among the non-survivors group.

Laboratory Investigations and Transfusion Requirements

Table 2 summarizes the laboratory values at admission and final measurement prior to death or discharge, comparing survivors and non-survivors. On admission, survivors had a lower median creatinine level (0.72 mg/dL) compared to non-survivors (1.10 mg/dL). This difference persisted at the final measurement, with survivors having a median creatinine of 0.62 mg/dL versus 1.65 mg/dL in non-survivors (p<0.001). Hemoglobin levels were similar between groups, both at admission (16.34 g/dL in survivors vs. 15.18 g/dL in non-survivors) and at last reading (10.26 g/dL in survivors vs. 10.03 g/dL in non-survivors). On admission, both groups had a median INR of 1.21, but by the final measurement, non-survivors had a higher INR of 1.54 compared to survivors (INR 1.18). Survivors had significantly higher platelet counts on admission (median 270 $x10^3$/µL) compared to non-survivors (172$x10^3$/µL), and this trend continued at the final measurement (311$x10^3$/µL vs. 144$x10^3$/µL).

Regarding transfusion requirements, the number of RBC and FFP units administered in the operating theatre and the ward was similar between groups. However, non-survivors required significantly higher number of RBC and FFP units in the ICU compared to survivors. The total median RBC transfused were 6 in survivors and 11 in non-survivors, while the total median FFP units were 5 in survivors and 11 in non-survivors (Table 3).

Interventions and Complications

Table 4 presents the interventions and complications observed among surviors and non-survivors. In the survivor group, 23 individuals (70%) required mechanical ventilation for a median

Table 1. Baseline characteristics of the participants

Factor	Level	Survivors	Non-survivors	p-value
n		33	49	
Age, median (IQR)		29.0 (25.0, 47.0)	75.0 (48.0, 84.0)	<0.001
Gender	Female	4 (12%)	13 (27%)	0.11
	Male	29 (88%)	36 (73%)	
Weight, mean (SD)		77.3 (5.5)	75.9 (5.8)	0.28
ASA	1	27 (82%)	14 (29%)	<0.001
	2	3 (9%)	12 (24%)	
	3	3 (9%)	23 (47%)	
Burn degree	1	5 (15%)	0 (0%)	<0.001
	2	20 (61%)	20 (41%)	
	2-3	3 (9%)	21 (43%)	
	3	5 (15%)	8 (16%)	
TBSA, median (IQR)		38.0 (31.0, 40.0)	54.0 (45.0, 65.0)	<0.001
Burn type	Electric	28 (85%)	18 (37%)	<0.001
	Flame	5 (15%)	31 (63%)	

ASA: American Society of Anesthesiologists, TBSA: Total body surface area, IQR: Interquartile range, SD: Standard deviation.

duration of 3 days, compared to all 49 individuals (100%) in the deceased group, who required mechanical ventilation for a median duration of 11 days. Additionally, dialysis was needed in 14 individuals in the deceased group compared to 3 individuals in the survivor group. Pneumonia was reported in 33% of survivors and 78% of non-survivors. Sepsis occurred in all individuals from both groups.

Notably, all survivors developed wound infections, whereas 47 out of 49 non-survivors experienced wound infections. Furthermore, all patients with flame burns in both groups underwent fasciotomy/esharotomy. The median number of debridement grafts was higher among survivors than non-survivors.

Regarding hospital stay metrics, the median hospital length of stay was 46 days in the survivor group and 11 days in the non-survivor group. The median ICU length of stay was 27 days for survivors and 11 days for non-survivors.

Cox Proportional Hazard Regression Analysis

Table 5 summarizes the Cox proportional HRs for various variables independently associated with mortality. Individuals with flame burns had a 1.11 times higher hazard of mortality compared to those with electrical burns, though this was not statistically significant (p=0.913). Males had a 1.48 times higher hazard of mortality compared to females. Third-degree burns were associated with nearly a threefold higher hazard of mortality compared to first- and second-degree burns, but this can be attributed due to small sample size, as only 5 survivors and 8 non-survivors had third degree burns. Patients with TBSA burns of 39-43%, 44-55%, and 56-100% had hazard ratios of 9.07 (p=0.008), 14.76 (p=0.001), and 46.00 (p<0.001), respectively,

Table 2. Admission and final time point laboratory investigations

Factor	Survivors	Non-survivors	p-value
N	33	49	
Troponin level, median (IQR)	0.04 (0.03, 0.05)	0.07 (0.07, 0.08)	<0.001
Admission creatinine, median (IQR)	0.72 (0.66, 0.90)	1.10 (0.78, 1.46)	<0.001
Admission INR, median (IQR)	1.21 (1.10, 1.33)	1.21 (1.10, 1.34)	0.96
Admission haematocrit, mean (SD)	49.45 (6.27)	46.04 (9.72)	0.087
Admission hemoglobin, mean (SD)	16.34 (2.00)	15.18 (3.16)	0.071
Admission platelet, median (IQR)	270.00 (226.00, 340.00)	172.00 (139.50, 256.50)	<0.001
Last creatinine, median (IQR)	0.62 (0.55, 0.83)	1.65 (1.04, 2.32)	<0.001
Last INR, median (IQR)	1.18 (1.10, 1.26)	1.54 (1.23, 1.98)	<0.001
Last hematocrit, mean (SD)	30.66 (3.93)	30.58 (4.74)	0.94
Last hemoglobin, mean (SD)	10.26 (1.28)	10.03 (1.59)	0.50
Last platelet, median (IQR)	311.00 (214.00, 380.00)	144.00 (107.00, 192.00)	<0.001

IQR: Interquartile range, SD: Standard deviation, INR: International normalised ratio.

Table 3. Comparison of total transfusion rate in OR and ICU

Factor	Survivors	Non-survivors	p-value
N	33	49	
OR RBC, median (IQR)	3.0 (2.0, 4.0)	4.0 (1.0, 6.0)	0.74
OR FFP, median (IQR)	2.0 (2.0, 4.0)	2.5 (1.0, 6.0)	0.74
ICU RBC, median (IQR)	2.0 (2.0, 3.0)	8.0 (6.0, 12.0)	<0.001
ICU FFP, median (IQR)	2.0 (2.0, 3.0)	8.0 (5.0, 10.0)	<0.001
ICU platelet, median (IQR)	0.0 (0.0, 0.0)	0.0 (0.0, 10.0)	0.014
Ward RBC, median (IQR)	1.0 (0.0, 1.0)	1.0 (1.0, 2.0)	0.053
ICU albumin, median (IQR)	8.0 (4.0, 12.0)	8.0 (3.0, 8.0)	0.18
Total RBC, median (IQR)	6.0 (4.0, 7.0)	11.0 (8.0, 19.0)	<0.001
Total FFP, median (IQR)	5.0 (4.0, 7.0)	11.0 (6.0, 14.0)	<0.001
Total platelet, median (IQR)	0.0 (0.0, 5.0)	4.0 (1.0, 11.0)	0.003

OR: Operating room, RBC: Red blood cells, FFP: Fresh frozen plasma, ICU: Intensive care unit, IQR: Interquartile range; SD: Standard deviation.

compared to those with burns covering 0-38% TBSA. Lastly, patients with elevated creatinine levels at admission had a 1.58 times higher hazard of mortality compared to those with normal creatinine levels.

Kaplan-Meier Curves

Figure 1 illustrates the Kaplan-Meier survival function for the overall study population, showing a steady decline in survival probability over time. A sharp drop in survival probability is observed early on, indicating higher mortality rates during this initial period. The curve eventually stabilizes at approximately 0.25, signifying that 25% of individuals remain event-free (i.e., alive) by the end of the observation period.

When stratified by burn grade (Figure 2), survival curves demonstrate clear differences between the groups. Patients with first-degree burns exhibited the highest survival probability at 1.0, indicating that no events (deaths) occurred in this group throughout the observation period. In contrast, patients with second degree burns showed a steeper decline, though survival probabilities remained better compared to patients with third-degree burns. The third-degree burn group experienced the

Table 4. Interventions and complications

Factor	Level	Survivors	Non-survivors	p-value
n		33	49	
Mechanical ventilation	No	10 (30%)	0 (0%)	<0.001
	Yes	23 (70%)	49 (100%)	
Mechanical ventilation duration, median (IQR)		3.0 (0.0, 12.0)	11.0 (7.0, 19.0)	<0.001
Pneumonia	No	22 (67%)	11 (22%)	<0.001
	Yes	11 (33%)	38 (78%)	
Sepsis		33 (100%)	49 (100%)	
Dialysis	No	30 (91%)	14 (29%)	<0.001
	Yes	3 (9%)	35 (71%)	
Wound infection	No	0 (0%)	2 (4%)	0.51
	Yes	33 (100%)	47 (96%)	
Fasciotomy/escharotomy		28 (100%)	18 (100%)	
Debridement graft, median (IQR)		5.0 (4.0, 6.0)	2.0 (0.0, 3.0)	<0.001
Number of dressing, median (IQR)		13.0 (9.5, 20.0)	4.5 (3.0, 7.0)	<0.001
Total operation hours, median (IQR)		6.0 (5.0, 7.0)	5.5 (3.0, 7.0)	0.32
Hospital length of stay, median (IQR)		46.0 (36.0, 65.0)	11.0 (7.0, 19.0)	<0.001
ICU length of stay, median (IQR)		27.0 (14.0, 30.0)	11.0 (7.0, 19.0)	0.002

ICU: Intensive care unit, IQR: Interquartile range.

Table 5. Cox proportional hazard regression

Variable	Level	Hazard ratio	LCI	UCI	p-value
Burn type	Electric	Reference	-	-	-
	Flame	1.11	0.18	6.72	0.913
Gender	Female	Reference	-	-	-
	Male	1.48	0.66	3.31	0.341
Age		1.02	0.99	1.05	0.175
Burn degree	Grades 1&2	Reference	-	-	-
	Grade 3	2.80	0.81	9.63	0.103
Total body surface area	0-38%	Reference	-	-	-
	39-43%	9.07	1.77	46.53	0.008
	44-55%	14.76	3.02	72.30	0.001
	56-100%	46.00	8.46	250.25	0
Creatinine	Normal	Reference	-	-	-
	High	1.58	0.63	3.97	0.326

most pronounced decrease in survival probability, particularly in the early phase, with a markedly shorter median survival time. The separation between the survival curves for different burn degrees remains distinct throughout the observed period, highlighting the impact of burn severity on survival outcomes.

DISCUSSION

This retrospective cohort study aimed to evaluate the impact of blood transfusion on survival outcomes and identify predictors of mortality in patients with burns. Additionally, it sought to examine the prognostic role of biochemical markers and complications in influencing outcomes. This study analysed the characteristics, complications, and survival outcomes of 82 individuals with burn injuries treated in a tertiary care setting.

The management and outcomes of burn injuries remain a critical area of study due to the significant morbidity and mortality associated with such trauma. In our study, non-survivors required higher volumes of RBCs, FFP, and platelets in the ICU, underscoring the resource-intensive nature of managing severe burn injuries. These findings support the adoption of a restrictive RBC transfusion strategy in patients with severe burns. A multicentre study conducted by Du et al. (9), involving 474 patients across three institutions, identified a threshold of six units for extraoperative RBC transfusion. Their analysis demonstrated that each additional RBC unit was associated with an approximate 2.96-fold reduction in mortality risk; however, this survival benefit plateaued once transfusion volumes exceeded six units. In our study cohort, the median RBC transfusion volume in the ICU was eight units in the non-survivors group, compared to two units in the survivor group. This disparity may have contributed to the elevated mortality rate observed in our cohort and reinforces the concept that RBC transfusion beyond six units offers limited survival benefit.

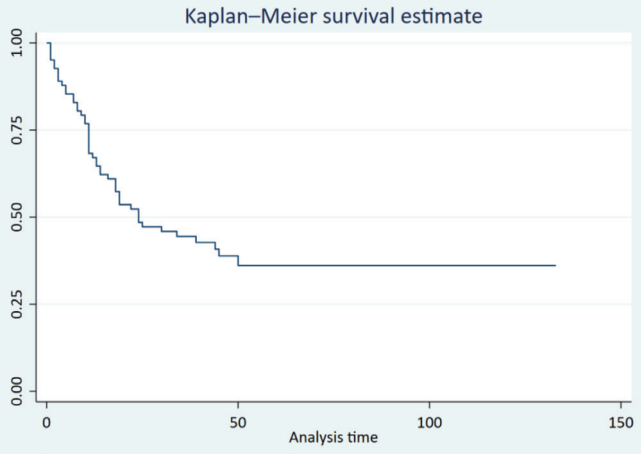

Figure 1. Kaplan-Meier curve for survival.

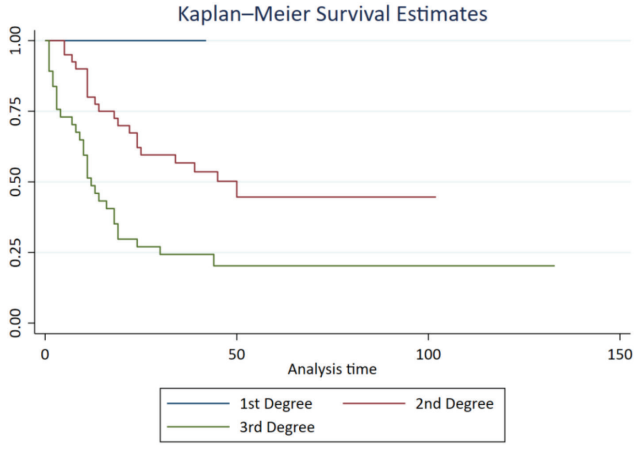

Figure 2. Kaplan-Meier curve for survival by burn degree.

In our study, non-survivors admitted to the ICU required a median platelet transfusion volume of 8 units, compared to 2 units in the survivors group. Thrombocytopenia is a common complication in patients with burns, often resulting from sepsis, coagulopathy, systemic inflammation, and various medical interventions, necessitating platelet transfusions. Notably, all patients in both groups-survivors and non-survivors- developed sepsis. While platelet transfusion is often a clinical necessity, it is not without risks. Platelet activation and subsequent release of pro-inflammatory mediators play a key role in initiating and amplifying systemic inflammation and contributing to atherosclerotic processes (11). Consequently, platelet transfusions may exacerbate a hypercoagulable state, thereby increasing the risk of thrombotic events, infections, and ultimately, a poorer overall prognosis (12,13). In our cohort, non-survivors also demonstrated higher rates of complications i.e., pneumonia and a greater need for interventions, including mechanical ventilation and dialysis. Interestingly, survivors underwent more frequent surgical interventions, suggesting that aggressive surgical management may be beneficial in selected patients, even those with severe burns (14).

Our findings align with and expand on existing evidence that older age, greater TBSA burned, higher burn severity, and systemic complications are strongly associated with increased mortality in patients with burns. Prior studies have demonstrated a sharp increase in mortality risk as TBSA increases, particulary beyond 44% (15). Consistent with these findings, our study showed that most survivors were younger and had a smaller TBSA compared to non-survivors. Additionally, cox proportional hazard analyses identified TBSA as a strong predictor of mortality, with HRs increasing substantially as burn severity escalated. This highlights the critical need for early and accurate assessment of burn extent to effectively prioritize care and predict outcomes. Moreover, both age and TBSA are key risk factors for sepsis in

severely burn patients (16), highlighting the importance of vigilant clinical observation to improve recovery and reduce sepsis-related fatalities. Furthermore, survival analysis using Kaplan-Meier curves illustrated the impact of burn severity on outcomes, with first-degree burns associated with the highest survival probability and third-degree burns showing the steepest decline in survival, particularly in the early post-injury period. Deeper burns are more likely to lead to infection, delayed healing, and systemic inflammation (17). These findings emphasize the importance of early intervention and tailored management strategies for burn patients, particularly those with extensive or high-grade injuries.

In our study, electrical burns were more common among survivors, while flame burns predominated in non-survivors. Although flame burns and male sex were associated with higher mortality risks, these findings were not statistically significant. In a review of 101 patients with electrical burns, renal injury requiring hemofiltration was associated with an approximately 12-fold higher risk of death. Consistent with these findings, our study demonstrated that renal function markers (e.g., creatinine) and coagulation markers (e.g., INR) were strongly associated with poor outcomes. These observations highlight the importance of early recognition and aggressive management of systemic complications, particularly renal dysfunction and coagulopathy in improving survival in patients with severe burns.

Study Limitations

While this study provides valuable insights, it has several limitations. The retrospective design is inherently susceptible to incomplete or missing data, and the single-centre setting and small sample size limit the external validity and generalizability of the findings. No power analysis was performed due to the retrospective nature of the study, and all eligible participants were included. Although important confounders such as comorbidities were not incorporated into the analysis, this was due to an insufficient number of outcome events, as a minimum of six events per predictor variable is generally recommended to maintain model stability. Future research should focus on prospective, multicentre studies to validate these findings and examine additional variables not assessed in this study, such as inhalation injury and time to surgical intervention.

Moreover, there is a critical need for prospective research to define optimal transfusion strategies that carefully balance the benefits of correcting physiological deficits with the risks of transfusion-related complications in critically ill burn patients. The timing of FFP administration is a critical factor in interpreting transfusion practices and clinical outcomes. In this retrospective study, the total amount of FFP administered was recorded over the entire course of the ICU stay; however, the day-specific breakdown was not consistently documented across all cases and was therefore not analyzed separately. We believe that prospective data collection with precise timing of transfusions would enhance future research on this topic.

While our findings highlight an association between transfusion volume and mortality, we did not comprehensively investigate the determinants of transfusion requirements. Although we collected relevant clinical and laboratory data—including weight, INR, RBC, platelet count, hemoglobin, and hematocrit—our primary aim, given the limitations of the dataset, was to assess prognostic associations rather than model predictors of transfusion need. Future prospective studies should use multivariable approaches to identify predictors of transfusion volume and define optimal transfusion strategies that balance the benefits of correcting physiological deficits with the risks of transfusion-related complications in critically ill burn patients.

CONCLUSION

The observed association between higher transfusion volumes and increased mortality highlights the need to refine transfusion thresholds in burn care. Over-transfusion may contribute to adverse outcomes such as infection, thrombotic complications, and organ dysfunction, particularly in patients with pre-existing risk factors such as elevated creatinine or thrombocytopenia. TBSA remains the strongest independent predictor of mortality, however transfusion requirements may serve as a dynamic and modifiable indicator of clinical trajectory. Integrating transfusion volume with other predictors including burn depth, renal function, and coagulation parameters can enhance early risk stratification and support individualized treatment strategies.

Ethics

Ethics Committee Approval: The Institutional Ethics Committee approval for this study (2025/010.99/13/29) was provided by the Scientific Research Ethics Committee of University of Health Sciences Türkiye, Kartal Dr. Lütfi Kırdar City Hospital on 26 February, 2025.

Informed Consent: Retrospective study.

Footnotes

Author Contributions

Surgical and Medical Practices - A.S., S.Y., E.H.Ü.; Concept - A.S., S.Y., M.A., E.H.Ü., N.E.T., A.M.E., T.Ş., G.F., K.T.S.; Design - A.S., M.A., E.H.Ü., N.E.T., A.M.E., T.Ş., G.F., K.T.S.; Data Collection or Processing - S.Y., M.A., E.H.Ü., N.E.T., A.M.E., T.Ş., G.F. ; Analysis or Interpretation - A.S., S.Y., M.A., N.E.T., K.T.S.; Literature Search - A.S., S.Y., M.A., E.H.Ü., N.E.T., A.M.E., T.Ş., G.F., K.T.S.; Writing - A.S., S.Y., M.A., E.H.Ü., N.E.T., A.M.E., T.Ş., G.F., K.T.S.

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