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Blood transfusions in severe burn patients: Epidemiology and predictive factors

Guosheng Wu [a,1], Mingzhu Zhuang [b,1], Xiaoming Fan [a,1], Xudong Hong [a], Kangan Wang [a], He Wang [a], Zhengli Chen [a], Yu Sun [a], Zhaofan Xia [a,*]

[a] Department of Burn Surgery, Changhai Hospital, The Second Military Medical University, Shanghai, People's Republic of China
[b] Department of Blood Transfusion, Changhai Hospital, The Second Military Medical University, Shanghai, People's Republic of China

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ABSTRACT

Background: Blood is a vital resource commonly used in burn patients; however, description of blood transfusions in severe burns is limited. The purpose of this study was to describe the epidemiology of blood transfusions and determine factors associated with increased transfusion quantity.

Methods: This is a retrospective study of total 133 patients with >40% total body surface area (TBSA) burns admitted to the burn center of Changhai hospital from January 2008 to December 2013. The study characterized blood transfusions in severe burn patients. Univariate and Multivariate regression analyses were used to evaluate the association of clinical variables with blood transfusions.

Results: The overall transfusion rate was 97.7% (130 of 133). The median amount of total blood (RBC and plasma), RBC and plasma transfusions was 54 units (Interquartile range (IQR), 20–84), 19 units (IQR, 4–37.8) and 28.5 units (IQR, 14.8–51.8), respectively. The number of RBC transfusion in and outside operation room was 7 (0, 14) and 11 (2, 20) units, and the number of plasma was 6 (0.5, 12) and 21 (11.5, 39.3) units. A median of one unit of blood was transfused per TBSA and an average of 4 units per operation was given in the series. The consumption of plasma is higher than that of RBC. On multivariate regression analysis, age, full-thickness TBSA and number of operations were significant independent predictors associated with the number of RBC transfusion, and coagulopathy and ICU length showed a trend toward RBC consumption. Predictors for increased plasma transfusion were female, high full-thickness TBSA burn and more operations.

Conclusions: Severe burn patients received an ample volume of blood transfusions. Fully understanding of predictors of blood transfusions will allow physicians to better optimize burn patients during hospitalization in an effort to use blood appropriately.

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* *Corresponding author*. Tel.: +86 21 31161821; fax: +86 21 65589829.
E-mail addresses: drwuguosheng@sina.cn (G. Wu), zmz_smmu@sina.com (M. Zhuang), fxm_smmu@sina.com (X. Fan), hxd_smmu@sina.com (X. Hong), wkasmmu@163.com (K. Wang), wh_smmu@sina.com (H. Wang), czl_smmu@sina.com (Z. Chen), sy_smmu@sina.com (Y. Sun), xiazhaofan_smmu@163.com (Z. Xia).
[1] These authors contributed equally to the article.

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1. Background

Severe burn patients usually experience anemia throughout the entire duration of burn care and multiple factors contribute to this complication including surgical management of wounds, red blood cells (RBC) sequestration, direct erythrocyte damage, nutritional deficiencies, bone marrow dysfunction, and iatrogenic factors such as blood loss from dressing changes and laboratory draws. Thus, to date, large amounts of blood transfusions became the major and indispensable method to combat the blood loss and impaired erythropoiesis [1]. However, blood transfusions were not a benign treatment. The use of blood products is associated with various adverse events such as infections, immunosuppression, transfusion-related acute lung injury and transfusion errors [2]. Moreover, previous studies reported that the amount of transfused blood was independently associated with increased mortality [3–5].

Concerning the risk/benefit ratio of blood transfusions, physicians propose restricting the blood utilization in critical illness. As a special critical illness population, the strategies to restrict blood use should be based on not only hemoglobin level but also a good knowledge of blood transfusions in burn patients. Because of limited literature systematically analyzing blood utilization in severe burn (>40% total body surface area (TBSA)) patients, we aimed to describe blood transfusions in this population at a single burn center in Shanghai to be able to improve the clinical appropriateness of blood utilization in burn patients.

2. Methods

This is a retrospective study conducted at the burn center of Changhai Hospital from January 2008 to December 2013. Changhai hospital is a tertiary general hospital and its burn center is equipped with 67 beds and mainly responsible for the treatment of burns in Shanghai and other areas of east China.

165 adult severe burn patients (aged 18 and over) with burn area over 40% TBSA were admitted to the center during this period. Those patients with incomplete medical records and those who presented more than 72 h after injury were excluded from this study. One woman who was pregnant was also excluded. Eventually, 133 patients were included in this study. Patient demographics, etiology of burn, burn extent, comorbidities, concomitant injuries, blood transfusions and outcomes were reviewed.

Treatment strategies commonly used for severe burn patients in China were used in this center, including rapid establishment of airway and ventilator support, sufficient fluid resuscitation during the shock stage, early extensive escharectomy and skin grafting used for coverage of deep wounds, infection control, active management of complications, routine use of antacids and gastric mucosal protective agents, and early administration of enteric nutrients [6].

Blood transfusions were performed based on the clinical judgment of attending physician or the medical consultant in this center. The indications for administration of RBC included anemia (hemoglobin <7 g/dL) and clinical symptoms such as hypotension, hypoxia, fatigue, and low urine output, while indications for the transfusion of plasma were hypoproteinemia and coagulation disorders. The diagnosis of coagulopathy is based on laboratory abnormalities such as prothrombin time (PT) ≥16.3 s or activated partial thromboplastin time (aPTT) ≥45 s or an international normalized ratio (INR) ≥1.5, which represent our local laboratory's definition of coagulopathy. Three patients with cardiac history transfused for a hemoglobin between 7 and 10 g/l were not considered separately. One unit of any kind of component (RBC and plasma) equals to 200 ml in this study.

All of the statistical analyses were made by IBM SPSS Statistics 21. All variables across groups were compared using the independent-sample t test, Fisher test, and the Mann–Whitney test, when appropriate. Univariate and Multivariate regression analyses were used to evaluate the association of clinical variables with blood transfusions. p Values <0.05 were considered statistically significant. Variables showing a $p < 0.05$ on univariate analysis were included in the multivariate model. In addition, Stepwise regression was applied to the multivariate regression analysis in order to adjust the confounding factors. The inclusion criteria was 0.1 and the exclusion criteria was 0.15.

3. Results

3.1. General characteristics

The characteristics of the enrolled 133 patients are shown in Table 1. The average age for all patients was 41.4 ± 14.1 years (range 18–86 years). 99 (74.4%) were males and 34 (25.6%) were females. The overall affected burn size was 70 (50, 87.5)% TBSA (range 40–98.5%) and the full-thickness burn size was 30 (13, 60)% TBSA (range 0–98%). The Flame (n = 108) was the most frequent cause of burns, followed by scald (n = 14), chemical (n = 10), and electrical (n = 1). At the time of admission, 35.3% of patients had pre-existing diseases or concomitant injuries, and the most common ones were pulmonary blast injury (16.5%) and hypertention (9.8%). There were more females with cardiac disease compared with males (8.8% vs. 0), and more males than females had brain injury (5.1% vs. 0). No patients had pre-existing cogulopathy, but 67 patients developed coagulopathy. In all, 55 (41.4%) patients presented to the burn center from the scene, and 22.6% patients transferred from another hospital within 24 h after injury and 36.1% within 72 h. Inhalation injury was found in 99 (74.4%) patients. Tracheostomies were performed in 82 (61.7%) patients, and 32.3% of patients had escharotomies during their first 48 h. More males (66.7%) underwent tracheostomy than females (47.1%). Median length of hospital stay (LOS) was 46 days (IQR, 24–80.5), with a median of 26 days (IQR, 12.5–46.5) in intensive care unit (ICU). 29 of the 133 patients died (21.8%) during their hospital stay.

Of all 133 patients, 115 (86.5%) received RBC transfusion and 130 (97.7%) received plasma transfusion. Three patients did not receive any kind of blood. Fifteen patients received plasma transfusion only. As shown in Fig. 1, with the number of severe burn patients fluctuated from 29 (2008) to 25 (2013), the total number of RBC consumption ranged from 689.5 units (2008) to 602 units (2013) and the total plasma amount decreased from 1326.5 units (2008) to 798 units (2013). Among all patients, the

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