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Burn patient characteristics and outcomes following resuscitation with albumin

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ABSTRACT

Background: Use of colloids in acute burn resuscitation may reduce fluid requirements, but effect on mortality is unknown. We hypothesized that patients who received albumin would have similar mortality to patients who did not receive albumin.

Methods: We performed a case-controlled study of inpatients who sustained burns of ≥20% total body surface area (TBSA). Patients who received albumin during resuscitation because of increased fluid requirements (ALB) were compared to a cohort of patients matched for age and TBSA who did not receive albumin (CON).

Results: Patients with inhalation injury were significantly more likely to receive albumin (OR 4.89, 95% CI 2.58–9.30). ALB patients had significantly higher mean initial lactate (3.64 versus 2.29, $p = 0.01$), longer mean time to resuscitation (52.8 h versus 36.3 h; $p = 0.001$), and higher resuscitation volume (9.4 mL/kg/%TBSA versus 6.4 mL/kg/%TBSA for CON). Mortality was not significantly different between the two groups (OR 1.90, 95% CI 0.85–4.22). Albumin was protective in a multivariate model of mortality (OR 0.27, 95% CI 0.07–0.97).

Conclusions: Despite more severe systemic dysfunction, burn patients who received albumin did not suffer increased mortality. A novel finding is the decreased likelihood of mortality associated with the administration of albumin during burn resuscitation.

1. Introduction

Resuscitation from burn shock remains one of the essential challenges of modern burn care. Improved understanding of the physiologic derangements resulting from burn shock has improved patient survival during the period after injury. In spite of widespread understanding of this physiology, resuscitation protocols for burn-injured patients vary greatly between institutions [1,2]. Perhaps most importantly, the impact of different resuscitation protocols on late organ dysfunction and clinical outcomes in burn patients is largely unknown.

The aim of resuscitation of the burn patient is to support the patient during an initial period of relative hypovolemia driven by massive shifts from the intravascular compartment to the interstitium. The most commonly used resuscitation fluids during the first 24 h following severe burn are crystalloids; lactated Ringer's in particular is widely accepted as appropriate for initial resuscitation [1,3]. The role of colloids in burn resuscitation is less well defined [1,2]. A 1998 Cochrane review demonstrated increased relative risk of mortality in burn patients who received albumin versus patients who did not receive albumin [4]. Although the Cochrane reviewers called for urgent review of human albumin administration in critically ill patients, many burn units continue to use albumin as a component of their resuscitation strategy [5]. In fact, little further evaluation of the role of albumin in burn resuscitation has occurred.

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The goal of this case-control retrospective study was to compare outcomes in patients who did and did not receive albumin during their burn shock resuscitation. The primary outcome measure was mortality. Secondary clinical outcomes included time to resuscitation, ventilator days, and length of hospital stay. This study also compared complications between the two groups; these complications included development of ARDS, SIRS/sepsis, acute renal failure, and multisystem organ failure.

2. Materials and methods

The University of Utah Health Science Center Institutional Review Board provided approval for this project. All patients in the institution's TRACS/ABA^{TM} burn registry from 1998 to 2002 with greater than 20% total body surface area (TBSA) burn injury were reviewed. Patients who survived fewer than 48 h or who were not resuscitated on compassionate grounds were excluded. Patients who received albumin during their acute resuscitation from burn shock provided the primary study group (ALB). All inpatient burn admissions during the same time period that were within 10 years of age of each patient resuscitated with albumin were considered possible controls (CON). Controls were then selected from these age-defined subgroups based upon most similar TBSA burnt. We were unable to include inhalation injury in the matching due to a paucity of control patients with inhalation injury who matched albumin resuscitation patients appropriately by age and TBSA burnt.

Patient data acquired through chart review included age, TBSA burnt, admission serum lactate and base deficit, length of time to complete resuscitation, and fluid volume required for resuscitation. Serum lactate and base deficit were used as proxies for perfusion status in study patients, consistent with prior burn and critical care literature [6,7]. Baux index (age + TBSA burn injury) was calculated from chart review data. Chart review also provided outcome data including mortality, number of ventilator days, and hospital length of stay. Outcome data on presence of inhalation injury and development of ARDS or SIRS/sepsis were acquired from the institutional TRACS/ABA^{TM} registry.

2.1. Resuscitation protocol

The resuscitation protocol used was derived from Parkland formula calculations, and Lactated Ringer's (LR) was the primary resuscitative fluid. The protocol followed by nursing staff is shown in Fig. 1. Once patients were more than 12 h from the estimated time of their burn, those whose ongoing fluid requirement exceeded twice the volume calculated by the Parkland formula were considered candidates for resuscitation with albumin at the discretion of the attending burn surgeon. This usually consisted of altering the composition of resuscitation fluid to consist of 5% albumin at one-third the previous rate, and ongoing LR at two-thirds the current rate. As urine output improved, the total infusion rate was reduced, maintaining the ratio of albumin to LR (1:2). Albumin was stopped when patients were able to maintain urine output at their calculated hourly maintenance requirement. For the purpose of this study, patients were considered resuscitated when maintenance fluids were initiated at the patient's calculated rate (basal fluid requirement + evaporative water loss), as shown in Fig. 1. The volume of fluid required to achieve resuscitation was the amount of fluid received less urine output during the time period from admission to fluid conversion. Albumin was initiated within 24 h of injury in all patients who received albumin during resuscitation.

Presence of inhalation injury was defined by bronchoscopic evidence of carbonaceous particles in the airway, airway erythema or edema, or sloughing of tracheal or bronchial mucosa. ARDS and SIRS/sepsis were based upon identification in the institution's TRACS/ABA^{TM} registry which included any note of ARDS, SIRS/sepsis in the attending burn physician notes.

2.2. Statistical evaluation

Mean values are reported as mean ± standard deviation. Admission values of serum lactate and base excess, total hours to resuscitation, and total resuscitation volume in cases and controls were compared using paired Student's *t*-tests. Paired Student's *t*-test was also used to compare ventilator days and hospital length of stay between cases and controls. Chi square and odds ratios were used for the comparison of dichotomous outcome data between cases and controls. Multivariate logistic regression was used for the development of a mortality model. All data analysis was performed using SPSS 13.0 (SPSS, Inc., Chicago, IL). *p*-Values of 0.05 or less were considered significant.

3. Results

During the 5-year period of this review, 101 patients eligible for inclusion received albumin during resuscitation from their burn injury. All 101 patients were matched with controls based upon age and TBSA burnt. Baux index was calculated as age + TBSA burnt. The differences in age, total TBSA burn injury, and Baux index between the two groups were not statistically significant (See Table 1). Patients who received albumin had a larger mean full-thickness burn size ($p < 0.001$). Inhalation injury is another known risk for mortality in burn patients, and ALB and CON did not match well on this parameter. While 52 of the patients who received albumin were found to have inhalation injury, only 18 of the controls had evidence of inhalation injury ($p < 0.001$). Thirty-nine patients in the study were women, 20 of whom were in the group who received albumin.

Admission serum lactate and base deficit were used as proxies for tissue perfusion, with findings presented in Table 2. Admission serum lactate was significantly higher in patients who ultimately received albumin during resuscitation than it was in controls. However, mean base deficit did not differ significantly between the two groups.

Resuscitation variables compared between the cases and controls were the length of time to resuscitation and the mean fluid volume required for resuscitation (Table 2). Mean time to complete resuscitation in ALB was significantly