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Long term mortality in critically ill burn survivors



Stephanie Nitzschke^a, Anaeze C. Offodile II^b, Ryan P. Cauley^c,
Jason E. Frankel^d, Andrew Beam^e, Kevin M. Elias^f, Fiona K. Gibbons^g,
Ali Salim^h, Kenneth B. Christopher^{i,*}

^a Division of Trauma, Burn, and Surgical Critical Care, Brigham and Women's Hospital, United States

^b Johns Hopkins Bloomberg School of Public Health, Baltimore, United States

^c Plastic and Reconstructive Surgery, Brigham and Women's Hospital, United States

^d Department of Physical Medicine and Rehabilitation, Spaulding Rehabilitation Hospital, United States

^e Biomedical Informatics, Harvard Medical School, United States

^f Department of Obstetrics, Gynecology and Reproductive Biology, Brigham and Women's Hospital, Boston, MA, United States

^g Pulmonary and Critical Care Medicine, Massachusetts General Hospital, United States

^h Division of Trauma, Burns, and Surgical Critical Care, Brigham and Women's Hospital, United States

ⁱ Renal Division, Channing Division of Network Medicine, Department of Medicine, Brigham and Women's Hospital, Boston, United States

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ABSTRACT

Introduction: Little is known about long term survival risk factors in critically ill burn patients who survive hospitalization. We hypothesized that patients with major burns who survive hospitalization would have favorable long term outcomes.

Methods: We performed a two center observational cohort study in 365 critically ill adult burn patients who survived to hospital discharge. The exposure of interest was major burn defined a priori as >20% total body surface area burned [TBSA]. The modified Baux score was determined by age + %TBSA + 17 (inhalational injury). The primary outcome was all-cause 5 year mortality based on the US Social Security Administration Death Master File. Adjusted associations were estimated through fitting of multivariable logistic regression models. Our final model included adjustment for inhalational injury, presence of 3rd degree burn, gender and the acute organ failure score, a validated ICU risk-prediction score derived from age, ethnicity, surgery vs. medical patient type, comorbidity, sepsis and acute organ failure covariates. Time-to-event analysis was performed using Cox proportional hazard regression. **Results:** Of the cohort patients studied, 76% were male, 29% were non white, 14% were over 65, 32% had TBSA >20%, and 45% had inhalational injury. The mean age was 45, 92% had 2nd degree burns, 60% had 3rd degree burns, 21% received vasopressors, and 26% had sepsis. The mean TBSA was 20.1%. The mean modified Baux score was 72.8. Post hospital discharge 5 year mortality rate was 9.0%. The 30day hospital readmission rate was 4%. Patients with major burns were significantly younger (41 vs. 47 years) had a significantly higher modified Baux score (89 vs. 62), and had significantly higher comorbidity, acute organ failure, inhalational injury and sepsis (all $P < 0.05$). There were no differences in gender and the acute organ failure score between major and non-major burns. In the multivariable logistic regression model, major burn was associated with a 3 fold decreased odds of 5 year post-discharge mortality

* Corresponding author.

E-mail address: kbchristopher@bwh.harvard.edu (K.B. Christopher).

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compared to patients with TBSA<20% [OR=0.29 (95%CI 0.11-0.78; P=0.014)]. The adjusted model showed good discrimination [AUC 0.81 (95%CI 0.74-0.89)] and calibration (Hosmer-Lemeshow χ^2 P=0.67). Cox proportional hazard multivariable regression modeling, adjusting for inhalational injury, presence of 3rd degree burn, gender and the acute organ failure score, showed that major burn was predictive of lower mortality following hospital admission [HR=0.34 (95% CI 0.15-0.76; P=0.009)]. The modified Baux score was not predictive for mortality following hospital discharge [OR 5year post-discharge mortality=1.00 (95%CI 0.99-1.02; P=0.74); HR for post-discharge mortality=1.00 (95% CI 0.99-1.02; P=0.55)].

Conclusions: Critically ill patients with major burns who survive to hospital discharge have decreased 5year mortality compared to those with less severe burns. ICU Burn unit patients who survive to hospital discharge are younger with less comorbidities. The observed relationship is likely due to the relatively higher physiological reserve present in those who survive a Burn ICU course which may provide for a survival advantage during recovery after major burn.

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1. Introduction

Survival after major burn injury is increasingly common [1] with survival rates at a plateau [2] due to significant advances in critical care over the past decade [3]. With an aggregate in hospital mortality following thermal injury at 4.8%, the number of burn survivors has increased. Much of the current data regarding burn outcomes focuses on in-hospital mortality with very little data addressing long-term mortality [4,5]. What happens to our patients once they leave the ICU has important implications for surgeons, clinicians, patients and family members when discussing the consequences of a burn wound injury.

As there are few studies examining long term (up to one year) mortality outcomes in burn injury [6-8], little is known about long term survival risk factors in critically ill burn patients who survive hospitalization. To explore covariates associated with long term survival, we performed a two center observational cohort study of 365 critically ill burn patients who survived to hospital discharge. As observations suggest that survivors of high TBSA% burns are younger with less comorbidities [9], we hypothesized that patients with major burns (TBSA \geq 20%) who survive hospitalization would have favorable long term outcomes. The objectives of this study were: (1) to determine the relationship between TBSA and long term all-cause mortality following burn injury; and (2) to determine the association between TBSA and rehabilitation length of stay in survivors of burn injury.

2. Materials and methods

2.1. Source population and data sources

We abstracted patient-level administrative and laboratory data from two teaching hospitals and one rehabilitation center in Boston, Massachusetts: Brigham and Women's Hospital (BWH), with 793 beds, Massachusetts General Hospital (MGH) with 950 beds and Spaulding Rehabilitation Hospital (SRH) with 132 beds. Data on all patients admitted to BWH, MGH and SRH between January 1, 1998, and December 31, 2007, were

obtained through the Research Patient Data Registry (RPDR), a computerized registry which serves as a central data warehouse for all inpatient and outpatient records at Partners HealthCare sites [10,11]. Approval for the study was granted by the Partners Human Research Committee (Institutional Review Board) Protocol Number: 2010P000645.

2.2. Study population

We performed a two center observational cohort study between 1998-2007 in 365 critically ill adult burn patients who survived to hospital discharge. We included individual burn patients admitted to the hospital, age \geq 18 years, who were admitted to an ICU and were assigned a Diagnostic Related Group (DRG) classification [12] and who had a social security number. Intensive care unit (ICU) admission was determined by Current Procedural Terminology (CPT) code 99291 (critical care, first 30-74 min) assignment during hospital admission [13]. DRG classification was utilized to exclude patients assigned the CPT code 99291 who received care only in the Emergency Room and were not admitted to the hospital. During the study period, there were 422 patients in the parent cohort admitted to a burn ICU and received critical care. We excluded 57 patients who did not survive hospitalization. Thus, the analytic cohort was comprised of 365 patients who were admitted to a burn ICU, received critical care and survived to hospital discharge.

2.3. Exposure

The exposure of interest was major burn defined a priori as \geq 20% total body surface area burned [TBSA] [14] as determined by the Wallace rule of nines [15].

2.4. Covariates

Inhalation injury was determined to be present if specifically documented in the medical record as inhalational injury or smoke inhalation by history or physical. The modified Baux score was determined by age + %TBSA + 17 (inhalational injury) [16]. Categories of acute organ failure were adapted from Martin et al. [17], and defined by a combination of ICD-9-CM

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