Burned patients who die from causes other than the burn affect the model used to predict mortality: a national exploratory study

Laura Pompermaier [a,b,], Ingrid Steinvall [a,b], Moustafa Elmasry [a,b,c], Johan Thorfinn [a,b], Folke Sjöberg [a,b,d]*

[a] *The Burn Centre, Department of Plastic Surgery, Hand Surgery, and Burns, Linköping University, Linköping, Sweden*
[b] *Department of Clinical and Experimental Medicine, Linköping University, Linköping, Sweden*
[c] *The Plastic Surgery Unit, Surgery Department, Suez Canal University, Ismailia, Egypt*
[d] *Department of Anaesthesiology and Intensive Care, Linköping University, Linköping, Sweden*

ARTICLE INFO

ABSTRACT

Introduction: The Baux score– the sum of age and total body surface area burned (TBSA %)– is a good predictor of mortality has a high specificity but low sensitivity. Our aim was to examine the causes of death in patients who die with Baux scores of <100, which may explain the lower sensitivity and possibly affect the prediction of mortality.

Methods: All patients admitted to our centre for burn care from 1993 to 2015 (n=1946) were included in this retrospective, descriptive, exploratory study. The study group comprised those patients who died with Baux scores of <100 (n=23), and their medical charts were examined for the cause of death and for coexisting diseases.

Results: Crude mortality was 5% (93/1946) for the overall cohort, and a quarter of the patients who died (23/93) had Baux scores of less than 100 (range 64–99). In this latter group, flame burns were the most common (18/23), the median (10th–90th centile) age was 70 (46–86) years and for TBSA 21 (5.0–40.5) %, of which 7 (0–27.0) % of the area was full thickness. The main causes of death in 17 of the 23 were classified as "other than burn", being cerebral disease (n=9), cardiovascular disease (n=6), and respiratory failure (n=2). Among the remaining six (burn-related) deaths, multiple organ failure (predominantly renal failure) was responsible. When we excluded the cases in which the cause of death was not related to the burn, the Baux mortality prediction value improved (receiver operating characteristics area under the curve, AUC) from 0.9733 (95% CI 0.9633–0.9834) to 0.9888 (95% CI 0.9839–0.9936) and the sensitivity estimate increased from 45.2% to 53.9%.

Conclusion: Patients with burns who died with a Baux score <100 were a quarter of all the patients who died. An important finding is that most of these deaths were caused by reasons other than the burn, usually cerebrovascular disease. This may be the explanation why the sensitivity of the Baux score is low, as factors other than age and TBSA % explain the fatal outcome

* *Corresponding author at*: The Burn Centre, Linköping University Hospital, Linköping 58185, Sweden. Fax: +46 0 101033705.
E-mail address: laura.pompermaier@regionostergotland.se (L. Pompermaier).

1. Introduction

With the advances of modern burn care, mortality among burned patients is becoming less common [1], and reports suggest that it varies between 1.3% and 15% [2–5]. Mortality prediction models have been developed to aid policy decision-making for severe burns as well as to evaluate and stratify results of different treatments and from units [1,6,7].

Simple models that take account of age and percentage of total body surface area burned (TBSA %) have been shown to do well [8–10], such as the Baux score (sum of age and TBSA %), which has been widely used to predict the risk of mortality. In the original description by Serge Baux in 1961, a score of 100 indicated a 100% risk of mortality. With modern burn care, patients (even older ones) often survive larger burns than they would have done in the past, and the 100% mortality risk predicted by the Baux score has been adjusted upwards [7,8].

However, while such models are good at predicting who will survive after a burn (high specificity) they are less accurate at predicting who will die (low sensitivity) [10,11], which is exemplified by the group of patients that die despite a Baux score of less than 100 [12]. To our knowledge no study have yet systematically examined mortality in patients with a lower mortality risk (<100) Baux score. Such a study could add to our knowledge about the circumstances behind a fatal outcome, and possibly explain why the Baux score has been shown to have a low sensitivity [10].

We hypothesised that factors other than age and size of burn (such as different medical conditions) may contribute to a fatal outcome, and also as they are not related to the burn they may affect the accuracy of prediction of mortality. The aim of the present paper was therefore to describe the group of patients who die with a Baux score less than 100 in our centre between the years 1993 and 2015 and to examine to what extent the outcome of these patients affected the prediction of mortality.

2. Patients and methods

The study was approved by the Regional Ethics Review Board in Linköping (Dnr 2013/341-31)

2.1. Design and selection of patients (Fig. 1)

During this 23-year period (1993–2015) 1996 patients were admitted to the Linköping University Hospital Burn Centre. The 48 patients with severe skin diseases and the two who were given respite care in other hospitals before admission were excluded from analysis, so a total of 1946 patients were admitted with burns during the study period. Of these 93 died in the Burn Centre. Our focus is on those 23 patients who died after admission with a Baux score of less than 100.

2.2. Burn care

The patients were treated according to our standard protocol, which includes early excision and grafting, standard ventilation with 8–10ml/kg tidal volumes, fluid management using
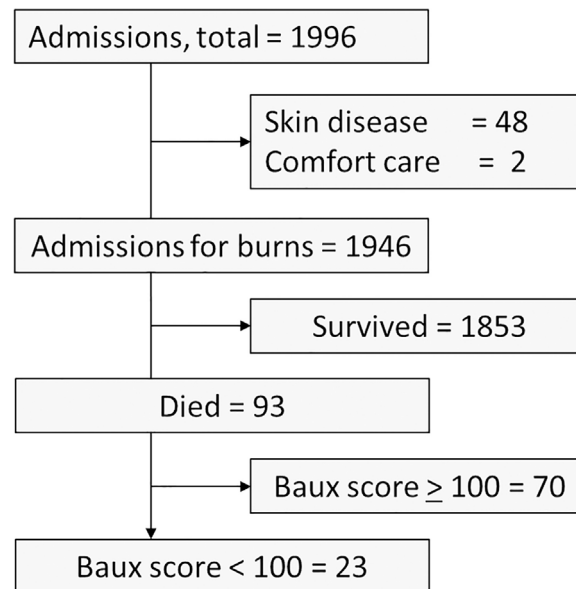

Fig. 1 – Algorithm showing selection of patients.

the Parkland formula, early enteral feeding, and laboratory assessment (also according to a standard protocol). TBSA % and percentage full thickness burn (FTB %) were recorded on admission on a detailed Lund & Browder chart and all data are entered into a database [13–16].

The practice at our centre is to initiate and maintain treatment as long as it is technically possible to cover the burns with skin grafts during a reasonable time. Respite care is only initiated early in adults in whom the Baux score exceeds 130–140 and when most of the injuries are full thickness. The main reason for deciding to withdraw treatment later during care is failure to respond to treatment and resistant multiple organ failure.

2.3. Data collection

Burn-related data were collected prospectively on a pro forma and analysed retrospectively, and were extracted from the burn unit database [17]. Variables recorded were: age, gender, percentage total body surface area burned (TBSA %) percentage full thickness burn (FTB %), and duration of hospital stay. Patients who died after discharge from the burn centre were not classified as deaths for the purposes of the present study. The Baux score was calculated by adding the age to the TBSA % [8]. The causes of death and coexisting medical conditions were identified in the patients' medical records.

2.4. Statistics

Data were analysed with the help of STATA v12.0 (Stata Corp., LP, College Station, TX, USA). Data are presented as number (%) or median (10–90 centiles) unless otherwise stated. Distribution was tested with the Lilliefors test for normality. The significances of differences between groups were assessed using the Mann–Whitney U test and the chi square test, as appropriate. Probabilities of less than 0.05 were accepted as significant.