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Towards more efficient burn care: Identifying factors associated with good quality of life post-burn

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ABSTRACT

Background: As minor burn patients constitute the vast majority of a developed nation case-mix, streamlining care for this group can promote efficiency from a service-wide perspective. This study tested the hypothesis that a predictive nomogram model that estimates likelihood of good long-term quality of life (QoL) post-burn is a valid way to optimise patient selection and risk management when applying a streamlined model of care.

Method: A sample of 224 burn patients managed by the Burn Service of Western Australia who provided both short and long-term outcomes was used to estimate the probability of achieving a good QoL defined as 150 out of a possible 160 points on the Burn Specific Health Scale-Brief (BSHS-B) at least six months from injury. A multivariate logistic regression analysis produced a predictive model provisioned as a nomogram for clinical application. A second, independent cohort of consecutive patients ($n = 106$) was used to validate the predictive merit of the nomogram.

Results and discussion: Male gender ($p = 0.02$), conservative management ($p = 0.03$), upper limb burn ($p = 0.04$) and high BSHS-B score within one month of burn ($p < 0.001$) were significant predictors of good outcome at six months and beyond. A Receiver Operating Curve (ROC) analysis demonstrated excellent (90%) accuracy overall. At 80% probability of good outcome, the false positive risk was 14%.

The nomogram was validated by running a second ROC analysis of the model in an independent cohort. The analysis confirmed high (86%) overall accuracy of the model, the risk of false positive was reduced to 10% at a lower (70%) probability. This affirms the stability of the nomogram model in different patient groups over time.

An investigation of the effect of missing data on sample selection determined that a greater proportion of younger patients with smaller TBSA burns were excluded due to loss to follow up.

Conclusion: For clinicians managing comparable burn populations, the BSWA burns nomogram is an effective tool to assist the selection of patients to a streamlined care pathway with the aim of improving efficiency of service delivery.

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1. Background

Like many burn centres worldwide, the Burn Service of Western Australia (BSWA) manages burns across the spectrum of severity with minor burns (15% TBSA or less), comprising 90% of the case-mix [1–3]. As the majority of published burns treatment evidence focusses on the minority of patients with the most severe injuries there is limited evidence available to match a service-wide range of injury severity.

A stratified model of care that recognises the importance of patient groups based on expected to outcome can promote efficiencies, cost-benefits, quality results and sustainability of the burn service [3–5]. Post-injury quality of life (QoL) is the dominant outcome for burns patients and for major burns this is associated with burn severity [6–8]. Streamlined models of care that aim to concentrate resources on patients with more severe burns are based on the general expectation that minor burns have a better prognosis than major burns. However there are individuals with minor burns who display systemic consequences and report ongoing problems after their wounds have healed [9–16].

Identifying the characteristics of patients that progress quickly to a good functional recovery provides an increased level of certainty when designing fast-track programmes for specific patient groups. Prediction of patient functional outcomes is often a multifactorial process involving though not limited to, age and gender of patient; wound size, depth, location and healing time of the burn; and psychosocial issues including body image and family support [17,18]. Pre-existing physical comorbidities and the development of complications post-burn significantly predicts functional outcome beyond patient demographic and medical features in children but not adults [19,20].

In the pursuit of a comprehensive predictive algorithm, no known studies have incorporated early patient self-assessment of the impact of their burn or its relevance to their post-burn QoL recovery. The addition of standardised patient-reported progress in the first months after injury as an independent variable in a predictive model may enhance the accuracy of a long-term recovery forecast. Predictive algorithms are employed in calculation devices known as nomograms and have previously been used to calculate the likelihood of patients developing hypertrophic scar [21,22].

Our group has demonstrated that patients with upper limb burns ≤15% TBSA who fail to attend six month review appointments have good QoL [10]. Further, minor burn patients who heal within two weeks and are discharged with a self-management package reported good QoL and satisfaction with care when reviewed at one month using a posted Burn Specific Health Scale-Brief (BSHS-B) survey in place of hospital follow-up [3,23]. This model of care has now been adopted as standard clinical practice by the BSWA. An early version of a predictive nomogram based on a cohort of 121 RPH burn patients demonstrated proof of concept [3]. This study describes the development and validation of a nomogram that predicts the likelihood of patients attaining good QoL at six months and beyond that may be used to justify early discharge and follow-up by mailed QoL survey for appropriately low-risk patients thereby producing improved efficiencies and cost-savings for health services.

2. Methods

2.1. Study design

This is a descriptive cohort study.

2.2. Study samples

Data for the study was retrieved from a secure Royal Perth Hospital (RPH) burns database which stores burn patient outcome information procured prospectively as part of routine clinical practice [24]. The sample used to produce the BSWA burns nomogram comprised burn patients, with available data, managed at RPH between January 2006 and December 2009. Validity of the nomogram was examined using a second independent sample of burn patients who presented to RPH with a burn between January 2010 and October 2012.

Eligible participants were required to have BSHS-B data obtained up to one month post-burn as well as at six months or more post-injury. Other than the lack of available outcome data no specific exclusion criteria were applied to either sample.

2.3. Study tool

The BSHS-B is a reliable and valid tool which can give valuable insight into a breadth and depth of burn patient experience assessing four main domains describing Physical Function, Work, Interpersonal Relationships and Treatment Regimens [17,25–27]. Each question is answered on a Likert scale of 0–4 with a maximum total score of 160 points and a high score indicative of a good outcome. A recent validation study found the BSHS-B performed similarly in minor burns as had previously been shown in major burns [23].

The target for recovery from minor burn, a total score of 150 points or more on the BSHS-B at six months, presents a conservative estimate of full recovery from burn as it is based on reference data obtained from a sample of the non-burned population of Western Australia [28,29].

The pattern of recovery after minor burn is typically non-linear, characterised by a fall in a patient's functional outcomes around the time of injury, followed by a return to near baseline levels by six months post-burn [30,31]. BSHS-B scores from a mostly minor burn cohort appear to plateau from one month onwards indicating that outcome at this time-point is a strong predictor of later recovery [28].

2.4. Data analysis

All calculations were conducted using the STATA statistical software version 12 [32].

2.4.1. Description of sample groups

The baseline characteristics (age, gender, %TBSA) and outcomes (surgical intervention, BSHS-B) of the groups for the final nomogram development and the nomogram validation were described using summary statistics. Where continuous data was not normally distributed the summary values are described using the median and interquartile range. Categorical data is represented using proportions.

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