The Hand Burn Severity (HABS) score: A simple tool for stratifying severity of hand burns

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ABSTRACT

Hand burns represent a unique challenge to the burns team due to the intricate structure and unrivalled functional importance of the hand. The initial assessment and prognosis relies on consideration of the specific site involved as well as depth of the burn. We created a simple severity score that could be used by referring non-specialists and researchers alike. The Hand Burn Severity (HABS) score stratifies hand burns according to severity with a numerical value of between 0 (no burn) and 18 (most severe) per hand.

Three independent assessors scored the photographs of 121 burned hands of 106 adult and paediatric patients, demonstrating excellent inter-rater reliability (r = 0.91, p < 0.0001 on testing with Lin’s correlation coefficient). A significant relationship was shown between the HABS score and a reliable binary outcome of the requirement for surgical excision on Mann–Whitney U testing (U = 152; Z = 9.8; p = 0.0001). A receiver operator characteristic (ROC) curve analysis found a cut off score of 5.5, indicating that those with a HABS score below 6 did not require an operation, whereas those with a score above 6 did. The HABS score was shown to be more sensitive and specific that assessment of burn depth alone.

The HABS score is a simple to use tool to stratify severity at initial presentation of hand burns which will be useful when referring, and when reporting outcomes.

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1. Introduction

Hands are usually exposed and thus susceptible to thermal injury either in isolation or as a result of more widespread burns. Although comprising a small percentage of the total body surface area (%TBSA), their anatomical complexity and importance in daily activities renders successful treatment following a burn difficult. Hand involvement is considered to be the leading cause of functional impairment following a burn, especially when occurring in conjunction with larger burns [1–8]. The hand is reportedly involved in between 39% and 90% of all burns admissions [5,6,8–13].

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Improving survival rates following burns [14,15] have led to a shift of focus to improving outcomes. The aim is to restore, as far as possible, the pre-injury functional ability of burn survivors and maintain an acceptable quality of life [4,8,11,16–18]. In addition, the visibility of hand scars can be a major source of psychosocial distress and anxiety to patients, thus aesthetic outcomes are also important to address [5,9].

For these reasons hand burns are regarded as severe injuries. The current practice advocated by both the British Burn Association (BBA) and the American Burns Association (ABA) is that all but the most minor burns require treatment in a specialist Burn Centre [5,6,9,13].

Achieving optimal results following hand burns is therefore essential, and tools are being developed and are in existence to evaluate these. However, before outcomes can be assessed in any meaningful way, it is desirable to classify the initial injury severity, so as to provide a context for the end results. Severity has traditionally been determined by assessing the depth and size of the burn. The traditional measurement of size, %TBSA, is a blunt tool for describing a burn to an area that may only fall between 0 and 3% TBSA per hand, according to the standard Lund and Browder chart or up to 2.12%TBSA when calculated based on the DuBois formula for calculating body surface area [19,20]. Indeed it is not so much the size of the burn that is important in hand burns, but the location affected and whether it crosses a joint.

A Hand Burn Severity (HABS) score was devised for the purposes of quickly describing the severity of a hand burn, either at the point of referral, or for research or outcome measurement purposes. An ideal score should be easy to use; reproducible; enable prospective or retrospective scoring for research purposes; and be expressed simply. In addition, we aimed for its predictive abilities to be assessed by comparing it with a simple measure of outcome: in this case the requirement for surgery.

2. Materials and methods

2.1. Devising the HABS score

A score was devised whereby the hand is divided into three anatomical areas, shown in Fig. 1. Zone A is distal to the metacarpal-phalangeal (MCP) joints; Zone B is over the MCP joints; Zone C is proximal to the MCP joints, up to the proximal wrist crease. It was felt that the three areas were broad anatomical zones that could be easily identified by all users of the score and would each have distinct difficulties following a burn.

The volar and dorsal aspect of each hand is assigned a score for each of the three anatomical areas according to the depth of the burn: 0 for no burn; 1 for superficial partial thickness (first degree) burn; 2 for deep partial thickness (second degree) burn; 3 for full thickness (third degree) burn. This produces a possible total score of 18 per hand, as demonstrated in Fig. 1.

2.2. Validating the HABS score

A retrospective review was carried out as part of an internal service evaluation of our department’s outcomes following hand burns. For the purposes of validating the HABS score, all consecutive adult and paediatric patients presenting with any burns involving the hand (either in isolation or as part of a larger burn) between March and November 2012, were identified from our burns database by the code “burn to wrist and hand”. Patients whose burn did not extend distal to the distal wrist crease, or who did not have admission photographs were excluded. A mixture of electronic photographs, the electronic burns database, and theatre records were retrospectively reviewed.

Patients seen during this time were assessed and treated according to our standard treatment protocol, allowing for clinical judgement. We aim for early excision and grafting where possible, in burns that are clearly deep dermal to full thickness. The exception to this may be full thickness burns isolated to the phalanges or palm (Zone A), which are often treated expectantly. Superficial or indeterminate depth burns are treated with non-adhesive dressings or skin substitutes, and reviewed until healing is achieved. If the burns fail to heal within two weeks, late excision and grafting may be carried out.

Admission photographs were taken for patient records of all hand burns presenting to the unit. Trained medical photographers were available between 9 am and 5 pm took the photographs wherever possible. If not available, the photographs were taken by the nurse admitting the patient, using a departmental camera. Photographs were taken of any burned area, including the dorsum and palm of the hand, but were not otherwise standardized. The admission photographs
were retrospectively reviewed and scored according to the HABS score by three independent burns doctors. The doctors were informed of the age and sex of the patient, and the mechanism of the burn.

The primary objective was to see whether the HABS score correlated with the eventual severity of the burn. The outcome measure chosen was whether or not the patient had surgical excision of the burn and skin grafting to the hand. This acted as a surrogate primary endpoint for severity, with the assumption that more severe burns would require surgical excision and grafting. The information about surgery was gathered following the severity scoring by examining electronic theatre records during that time period. The requirement for surgical excision and grafting was chosen as a simple marker for the severity of the burn because it was reliably recorded and obtained retrospectively.

All statistical analysis was performed using SPSS (SPSS Inc. IBM corporation). A Mann–Whitney U test was performed to examine for a significant relationship between the HABS score and the likelihood of requiring surgical excision and grafting. Inter-rater reliability was tested by examining Lin’s correlation coefficient.

Predictive value was assessed by receive operator characteristic (ROC) curve analysis to determine how well the HABS score could predict the need for surgery compared with simple depth analysis alone.

3. Results

There were 168 patients who were coded as having a wrist or hand burn during the study period. Of these, 62 were excluded because they did not have burn distal to the distal wrist crease, or had no admission photographs of their hand burns on the electronic database. Following this, the admission photographs of 106 patients, with a total of 121 burned hands, were assessed. The demographic information pertaining to these patients is summarized in Table 1. Age range was from six months to 86 years old, with a mean of 26 years. Children under 16 years represented 41%, with the vast majority of these being below five years (36/43). Seventy-five patients had isolated hand burns, seven had hand and forearm only burns, with the remaining 24 patients having burns over multiple anatomical sites, including the hand. The distribution of aetiology of the burn is shown in Fig. 2.

The three independent assessors recorded HABS scores for each patient. For those patients who had burns to both hands, the HABS score from the worst hand was used. Therefore a total of 318 HABS scores were recorded. The mean HABS score, of a possible maximum of 18, was 3.9 (range 1–15).

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<th>Table 1 – Demographic information about patients studied.</th>
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<td><strong>Total hands</strong></td>
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<td><strong>Number of patients</strong></td>
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<td><strong>Age range (mean)</strong></td>
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Patients were then divided into two groups: those who later underwent tangential excision and split skin graft to the hand (defined as “operation”) and those whose hand healed without an operation (defined as “no operation”). The requirement or not of an operation was taken as a substitute marker of severity. Twenty patients underwent an operation to their hands and 86 were managed non-operatively.

The mean HABS score was 8.2; median 8; range 3–15 for the operative group. The mean HABS score was 3.0; median 3; and range 1–10 for the non-operative group. The distribution of HABS scores for each group is shown in Fig. 3 as a box tail plot and in Fig. 4 as a bar chart demonstrating the frequency of each score.
The relationship between the HABS score and the risk of needing an operation was significant on Mann–Whitney U testing (U = 152; Z = 9.8; p < 0.0001). The risk of needing an operation based on initial HABS score could thus be predicted (Fig. 5). For example, a score of 6 conferred a 50% chance of requiring surgical excision and a score of 11 or more meant the patient was 100% likely to need surgical excision and grafting.

When the burns were assessed according to the depth alone (superficial partial thickness, SPT; deep partial thickness, DPT; full thickness, FT), the deepest burn was recorded for each patient. The depth also correlated with the likelihood of requiring a operation. This was also significant on Mann–Whitney U testing (U = 131; Z = 11.21; p < 0.00001). As there were only three broad categories, however, it was a less specific predictive tool than the HABS score. For example, although 44 patients with full thickness hand burns (i.e. 66%) later required surgery, 23 patients with full thickness burns to the hand did not (Fig. 6).

A ROC curve analysis established a HABS score cut off of 5.5, indicating that those with a score below 6 would not require surgery, and those with a higher score would. The HABS score was shown to be more sensitive than depth alone for predicting likelihood of requiring surgery (area under curve = 0.82 for depth and 0.92 for HABS) (Fig. 7).

Inter rater reliability, tested with Lin’s correlation coefficient showed a strong correlation between three independent scorers (r = 0.91, p < 0.0001, Fig. 8).

4. Discussion

The management of hand burns is influenced by local factors including depth of injury, and the specific location on the hand (dorsal or palmar, involving joints or not). Patient factors including age, pre-morbid status, smoking and concomitant injuries must also be considered. The overriding aim when addressing hand burns is timely wound healing to enable the eventual restoration of optimal hand function [2,7,9,13]. Superficial and minor burns may heal quickly with no residual scarring and no impairment on functional ability [8,11,21]. When treating relatively minor superficial burns non-operatively, it is essential to ensure thorough debridement of non-viable tissue, meticulous wound hygiene, appropriate topical treatments and dressings, and elevation and splinting where indicated [8,9].

There are a range of opinions on the best management of deeper hand burns to expedite healing and limit the need for complex future reconstruction [16]. Proponents of early excision and grafting of deep hand burns report reduced healing time and therefore fewer scars, and early initiation of rehabilitation with improved outcome [5,22,23]. Palm burns are given a slightly longer time frame to heal spontaneously—not only because they tend to do so quite well but because the idiosyncrasies of glabrous skin make its excision and grafting significantly challenging and so, where possible, this is
avoided [2,9,17,21]. Additionally unnecessary excision of palmar skin may cause damage to the underlying Pacinian corpuscles and therefore reduce sensation once healed [7].

Others prefer a more expectant approach, protecting the hands in the meantime with antimicrobial dressings. This, they argue, enables the maximum healing possible, reducing over-zealous debridement, and producing fewer scars, while still allowing for early mobilization [21,24]. However some argue that favourable outcomes are the result of good early physiotherapy rather than surgical timing, which does not produce a significant difference in outcome [7,25]. The above demonstrate the complexities of dealing with hand burns and the need for specialist management where appropriate.

Initial assessment of the burn is often carried out by non-specialists, who must assess burn severity and communicate this to the receiving unit. The referring clinician may understandably have limited experience of hand burns, making the decision about whether to refer difficult. Utilizing a scoring system will also provide the referring clinician a useful tool to communicate to the patient the potential severity of their injury and likely need for surgery. Furthermore, the appropriate utilization of specialist resources and impact on the patient and their family on having to travel to distant units, must be weighed up against the need for specialist attention in a dedicated burns unit by the referring clinician and the burns team. When considering hand burns, as previously discussed, size alone is not a good indicator of severity. Similarly, our study of the correlation between depth and outcome showed that only 66% of patients with full thickness burns on initial assessment required surgical excision and grafting. The HABS score was therefore both more specific and (on ROC curve testing) more sensitive (with a greater area under the curve) than assessment of depth alone. The HABS score therefore offers a triage tool that will give the referring clinician and receiving unit more information about the severity of the hand burn, and the likelihood of need for surgical excision: thus helping the decision making process.

The HABS score is also useful to differentiate burn severity when carrying out outcome studies or service evaluations. Not all hand burns are alike: far from it due to the high concentration of important structures within a confined part of the body. Therefore, in order to evaluate outcomes, the HABS score is a useful first step to define the initial severity in an accurate way. Applying a numerical value to the initial injury would allow for outcomes to be risk adjusted and mitigate against selection bias when outcomes are reported. Outcomes of all aspects of medicine are becoming increasingly important and steps to make them meaningful, and ensure

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**Fig. 7** – Receiver operator characteristic (ROC) curve for HABS score and burn depth (HABS area under curve = 0.92, burn depth area under curve = 0.82).

**Fig. 8** – Scatterplot demonstrating good inter-rater reliability between three scorers.
the comparison of similar initial injuries or illnesses are paramount for accurate reflection of results.

There are limitations to the study, and to the HABS score itself. The study was carried out retrospectively using photographs, which would not enable for dynamic assessment of the burn, such as capillary refill time. Furthermore, due to the erratic presentation time of burns patients, admitting photographs were taken by a mixture of trained medical photographers and nursing staff, and were not standardized. However, the strong inter rater reliability and correlation with outcome showed that despite the well-recognized limitations when using photographs to assess burns, the score still provided useful information [26]. Furthermore, telemedicine is becoming an increasingly important part of the referral process. Similarly, early depth assessment by even the most experienced burn surgeon is known to be reasonably unreliable [4,7-9]. The HABS score is only as reliable the person carrying out the depth assessment, yet because it is the product of both the depth and the area, the sum of both these things provides more information than depth alone. Despite these limitations we found that the scores of three doctors with a range of between six months and six years’ experience in managing burns injuries correlated well. It may be argued that a more complex score (for example applying a weighting score to the dorsal skin which is thinner and more likely to need excision and grafting than that of the palm) would have an even higher predictive value. We decided not to make the score more complex, bearing in mind its intended use by referring non-specialist units in an emergency situation, and a wealth of other factors that would need to be taken into consideration (co-existent injuries, patient co-morbidities) to obtain an accurate score. Far from being a simple accessible way of describing and assessing initial severity it would be akin to a complex prose description of the burn and patient, negating its initial purpose.

The HABS score is a universal tool that provides useful prognostic information on initial assessment and helps to stratify severity of injury and provides prognostic information about burns in a complex area of the body.

5. Conclusion

The HABS score provides a simple to use and accurate way of describing the severity of a hand burn. It has been shown to correlate with a simple binary outcome measure of the need for surgical excision and grafting. Furthermore it demonstrates excellent inter-rater reliability despite the well-documented difficulties in depth assessment of burns on presentation. We believe it will be a useful tool for the referral process to burns units and will be invaluable for stratifying severity of injury when examining outcomes following these challenging burns.

Authors’ contributions

All authors have made substantial contributions to all of the following: (1) the conception and design of the study, or acquisition of data, or analysis and interpretation of data, (2) drafting the article or revising it critically for important intellectual content, and (3) final approval of the version to be submitted.

Conflict of interest

All authors declare no financial or personal associations that could inappropriately influence this work.

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