Meta-analysis of early excision of burns
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Abstract

Aims: This meta-analysis sought to establish if early excision and grafting is better or equivalent to the conservative treatment of burns in both children and adults with minor or major burns. The outcomes of interest are mortality, wound healing time, duration of sepsis, operating hours, complications of surgery, length of hospital stay, blood transfusion requirements and long term morbidity like joint contractures and hypertrophic scarring.

Methods: We searched MEDLINE (1966–July 2004), EMBASE (1980–August 2004) and the Cochrane Central Register of Controlled Trials (CENTRAL) with the keywords ‘early excision’ and ‘burns’. This yielded 441 articles of which 15 were randomized controlled trials. Only six trials met the inclusion criteria.

Results: There was a significant reduction in mortality with early excision of burns when compared with traditional treatment only in patients without inhalational injury (RR 0.36, 95% CI 0.20 to 0.65). The blood transfusion requirement is significantly higher in the early excision group but the length of hospital stay was significantly shorter (WMD -8.89, 95% CI -14.28 to -3.50). There was no conclusive evidence on the difference between the two groups in terms of duration of sepsis, wound healing time and skin graft take.

Conclusion: Early excision of burns is beneficial in reducing mortality (in patients without inhalational injury), length of hospital stay. The only drawback is the greater volume of blood loss.

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1. Introduction

Severe burn is a devastating form of injury, and is also a significant public health risk in developing countries. Traditionally, patients with burns have been treated with dressings and topical antimicrobial agents until the eschar separates. The granulating wound would then be covered with split thickness skin graft, a process which could take 3–5 weeks. Patients with severe burns treated in this manner are more likely to die from sepsis due to the massive release of inflammatory mediators from the burn wounds. This is further exacerbated by subsequent infection of these wounds. With the traditional approach, patients often have a prolonged hospital stay and are more prone to develop problems like joint contractures and hypertrophic scars due to the delayed wound healing process.

A paradigm shift occurred with the introduction of tangential excision of burns by Janzekovic in 1970 [1]. This technique involved removal of necrotic burnt tissue while preserving as much of the underlying viable tissue as possible. The wounds are then covered immediately with split thickness skin graft. When performed early, excision and immediate wound closure has been shown to improve survival, decrease length of hospital stay in burn patients, especially children [2–4]. The rationale for early excision of burns is that it decreases release of inflammatory mediators and bacterial colonization of wounds. This, in turn, attenuates the systemic inflammatory response syndrome (SIRS) hence reducing the occurrence of metabolic derangements, sepsis and multi-organ failure.

The opponents of early excision from the early days of early excision were mainly concerned with the massive blood loss seen after early excision. However, with improvement in intensive care management, we are now able to better manage these patients. Other reasons cited
against early excision include difficulty of assessing depth of burn in the early period and the need to use cadaveric skin for coverage after early excision. Some authors have also shown no difference in mortality when early excision was compared with more conservative approaches [5,6].

Early excision and grafting of burns is the standard of practice in most major burn centres around the world now. Our objective was to perform a systematic review of the current evidence on efficacy and safety of early excision of burns and determine if it should be applied across the board to all burn patients.

2. Material and methods

We included only prospective randomized, controlled trials in our review. The participants could be from all age groups with major or minor burns. The intervention was early excision and immediate grafting of burns with the control arm consisting of patients treated with dressings only followed by delayed grafting after eschar separation. The specific outcomes we sought were mortality, blood loss and blood transfusion requirements, wound healing time, length of hospital stay, duration of sepsis, operating room hours, and long term morbidity like joint contractures and hypertrophic scarring.

We searched MEDLINE (1966–July 2004), EMBASE (1980–August 2004) and the Cochrane Central Register of Controlled Trials with the keywords ‘early excision’ and ‘burns’. This yielded 441 articles of which 15 were randomized, controlled trials. Only six trials met the inclusion criteria stated above.

Table 1 summarizes the characteristics of these six trials [7–12]. They were all randomized, controlled trials with the method of randomization clearly stated in the methodology. Double blinding, concealment of allocation was not possible due to the nature of the intervention but the results were all analysed on an intention-to-treat basis.

The forest plot was generated using Revman 4.2.8 software. For binary (dichotomous) data, a pooled relative risk (RR) and for continuous outcomes a mean difference with 95% confidence intervals (CI) was calculated using a fixed effects model. When the continuous outcomes were reported on varying scales in different studies, the pooling of data was done using standardized mean difference (SMD). We determined potential heterogeneity by visually examining the forest plots and by using the I² statistic (Higgins 2002, Higgins 2003). If there was significant heterogeneity a random effects model was used to calculate the overall pooled estimate. A value greater than 50% was considered as substantial heterogeneity. We used intention-to-treat data when available.

3. Results

3.1. Mortality (Figs. 1 and 2)

This first Forest plot (Fig. 1) compares mortality in early excision group with traditional treatment group. The squares represent the relative risk with the horizontal lines representing the 95% confidence interval. You can see that all trials have 95% CI includes the value 1. When we pooled all the data together, the combined relative risk was 0.72 with 95% CI from 0.52 to 1.01 which shows that there was a
reduction in mortality with early excision of burns but the difference is not statistically significant when compared with traditional treatment.

Two of the studies reported mortality for patients with inhalational injury and those without separately. When we pooled the data using a subgroup analysis from these two trials (Fig. 2), we found that there was no significant reduction in mortality in patients with inhalational injury when they had their burns excised early (RR 0.91, 95% CI 0.66–1.25). However, we found a significant reduction in mortality with early excision in patients without inhalational injury (RR 0.36, 95% CI 0.20–0.65).

3.2. Blood transfusion requirements

There were five trials examining blood transfusion requirements, but two studies could not be pooled with others, as the number of units of blood transfused was reported without standard deviation or standard error [9,10]. The Forest plot showed that there was a statistically significant increase in blood transfusion requirements in patients who had early excision of burns (SMD 1.65 95% CI 0.51 to 2.80). The data from the two studies that were excluded also showed a similar trend (Fig. 3).

3.3. Length of hospital stay

Only four studies reported on the length of hospital stay. Two of the studies [10,12] showed significant decreases in days that patients stayed in hospital but the other two studies [6,11] did not show any statistically significant difference. The pooled estimate however showed that the length of hospital stay was significantly shorter in patients who had early excision of burns compared to those who did not (SMD –8.89, 95% CI –14.28 to –3.50) (Fig. 4).

3.4. Duration of sepsis

Only two trials looked at the difference in duration of sepsis between the two modalities of treatment. However, the definition of sepsis used was quite different hence the data could not be pooled. Herndon et al. [8] had a strict criteria for sepsis, using parameters like temperature,
respiratory rate, serum glucose level, platelet count, white cell count, nasogastric aspirates and positive wound cultures. With these criteria, he did not find any statistically significant difference in duration of sepsis between early excision and conservative treatment. Subrahmanyam [11], on the other hand, found that patients with early excision required a shorter duration of antibiotic treatment and less positive wound cultures, both being statistically significant.

3.5. Operating room hours and number of operations

The number of operating room hours was shorter in the early excision group in Engrav et al. [10] study but the reverse was true in Desai’s [12] study (WMD 0.70, 95% CI 0.57–0.83). The data could not be pooled as only Desai’s study reported the data with standard deviation. The study of Herndon et al. [8] was the only one that looked at the number of operations required in each group and he found that there was no statistically significant difference between the two.

3.6. Wound healing time, skin graft take and hypertrophic scarring

None of the six studies looked specifically at the length of time for burns to heal. As for skin graft-take, Subrahmanyam’s [11] study showed that it was superior in early excision group but Desai’s [12] study found no difference between the two groups. Engrav et al. [10] looked at hypertrophic scarring and he found more patients in the conservative treatment group with hypertrophic scars.

4. Discussion

Early excision of burns is now the standard of care in most major burn centres around the world. The rationale is that it reduces bacteraemia, endotoxin production and release of inflammatory mediators. This would limit the extent of sepsis and multi-organ failure which are the leading causes of death in major burn injuries. There are a number of randomized control trials comparing early excision of burns with the more traditional method of treatment, that is, dressing with topical antimicrobials till the eschar separates followed by delayed skin grafting. Our aim was to perform a meta-analysis of these trials for an objective appraisal of the evidence.

Five of the six studies chosen for this meta-analysis involved mainly the adult population with Desai et al. [12] study being the exception. Early trials by Burke et al. [5], Alexander et al. [14] and Tompkins et al. [15] have shown such excellent mortality statistics in children treated by early excision that it is difficult to contemplate randomization of this group into any other treatment modality. With early excision, it is now unusual for a child to succumb to burn injury of any size even when it is associated with inhalational injury. Other factors like better nutrition and control of sepsis play a less important role. The evidence for adults, on the other hand, is less conclusive.

This meta-analysis showed that with examination of all burn patients, the reduction in mortality with early excision was not statistically significant compared to traditional treatment of burns. The reduction in mortality with early
excision was only significant in patients without inhalational injury. A possible explanation could be that the mortality in patients with inhalational injury is usually high hence it did not make a difference whether their burns were excised early.

A more meaningful analysis could be done if we could segregate patients into different subgroups based on the percentage of burns and their age and compare the mortalities between those who had their burns excised early and those who did not. Most trials do not break down their patients into subgroups due to the small number of patients in each group.

A statistically significant increase in blood loss was seen in patients who had their burns excised early when compared to the traditional group. Desai et al. [13] showed in his review of 1662 paediatric burn patients that blood loss is significantly reduced if burns are excised within 24 h of injury or more than 16 days after the injury when compared to those excised between 2 and 16 days after injury. He attributed this to the high circulating levels of vasoactive mediators like thromboxane A2 in the first 24 h. These mediators cause vasoconstriction and hence reduce blood loss. The blood loss is also less if burns are excised after 16 days as it is a blunt debridement of a granulating bed rather than sharp removal of adherent eschar as in the case of early excision.

In Desai et al. [12], Herndon et al. [8] and Subrahmanyan’s [11] studies, it was only stated that the burns were excised within 72 h and before the 6th post burn day. It was not stated how many patients were excised within the first 24 h. If most of the patients were excised between post-burn days 2–6, our conclusion would correlate well with that of Desai et al. [12] review.

When we pooled the data on length of hospital stay from Engrav et al. [10], Desai et al. [12] and Herndon et al. [8] studies, we found that the length of hospital stay was significantly shorter in patients who had early excision. This is not surprising as patients who have their burns excised early tend to have their wounds covered earlier and hence have a shorter stay in hospital.

There was no conclusive evidence on duration of sepsis as the only two trials that reported on it drew different conclusions. This could be due to the fact that different definitions of sepsis were used in the two trials.

Out of the six randomized control trials in the meta-analysis, only one study [10] looked at cosmetic and functional outcome. In terms of cosmesis, Engrav et al. showed that burn scar hypertrophy was less prevalent in the excision group but there were more surface irregularities in this group due to the use of meshed skin grafts. They also concluded that the function of joints was more dependent of the quality of physiotherapy rather than the modality of treatment.

The main problems we encountered during the meta-analysis were the small number of randomized, controlled trials published and the heterogeneity of the patients in these trials. The participants of the trials differed in terms of age, percentage of burns and presence of inhalational injury, time of excision of burns, method of conservative treatment and outcomes measured. Another confounding factor was the fact that three out of the six studies [8,9,12] that met the criteria for this meta-analysis were from the same centre. Ideally, we would like to have randomized control trials from as many centres as possible to give us a more representative picture.

The way to circumvent the small number of patients in these prospective randomized control trials would be to perform large multi-centre trials with a strict protocol clearly defining the inclusion and exclusion criteria, treatment and specific outcome measures. However, conducting such a trial will not be ethically justifiable given our current level of knowledge of benefits of early excision.

5. Conclusion

From this meta-analysis, we can conclude that early excision of burns reduces mortality in patients without inhalational injury, increases blood transfusion requirements and reduces the length of hospital stay in patients. We were unable to draw any conclusions on duration of sepsis, operating hours, wound healing time, skin graft take and long term morbidities like hypertrophic scarring.

References


