

Original Article

Use of Steel Wool - A Novel Method to Debride the Second Degree Burns

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Objective: To find out effectiveness of steel wool debridement in second degree burns

Study design: prospective study

Place and duration of study: From January 2008 to December 2010, plastic surgery department, Nishtar Hospital Multan

Materials and Methods: A total of 300 burn cases were admitted in burn unit / plastic surgery department, Nishtar Hospital Multan. During the study period all the details of patients regarding their Registration data, history, site of the burn, TBSA affected, degree of burn, depth of burn, presence or absence of slough in the wound, medical report, operative notes, pre and post operative photographs, duration of hospital stay and outcome were filed individually. All the data was analyzed using SPSS 11 software.

Results: We included 63 patients who had partial thickness burns. 35 patients had superficial dermal burns and 28 had deep dermal burns.

Out of 63 patients 36 were males and 27 were females. Their age ranged from 13 years to more than 65 years. (Table I) It can be best appreciated that majority of patients in our study were in the age range of 21-40 years.

Conclusion: Steel wool dermabrasion removes the necrotic tissue and reduces the inflammatory response that helps in healing and prevents transition into deep thickness burns. It also reduces the septic load of the wound. Dermabrasion with the steel wool is effective, simple, and cost effective and it negates the need of grafting in many of the patients with partial thickness burns.

Keywords: Burns, Second degree burns, Steel wool.

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Introduction

Burns are difficult to treat in developing countries like Pakistan. The exact incidence of burns here in Pakistan is not known¹ this is due to non availability or incompleteness of death registration and disease reporting. All age incidence of burns 518 per 100,000 per year. A much higher incidence of 1,388 per 100,000 per year is reported amongst children below 5 years.¹ A higher incidence of burns is also reported in squatter settlements of Karachi.² The annual incidence of burn admissions in all ages is 19 admissions per 100,000 per year (male 15.5, female 18.9).³ Burns and scalds form 5-12 % of all traumas.^{4,5} However it is estimated that Almost two million people in United State suffer from burns annually.⁶ Whereas burns is among the 15 leading causes of death in India.⁷

Over the past 50 years of burn wound management, a progressively decreasing mortality from severe burns is seen. However, increasing healthcare costs have forced health care providers to not only provide quality burn

care, but also reduce the costs associated with burn wound management.⁸⁻⁹

The normal wound repair process is coordinated and predictable series of cellular and biochemical events. However certain pathophysiological conditions alter this pre programmed course of events so that wound healing can be enhanced or impeded. Presence of necrotic tissue not only inhibits wound healing but it deepens wounds through extensive inflammatory response^{10,11} So removal of necrotic tissue is extremely essential to prevent and diminish wound sepsis and enhance wound healing. Superficial burns include the epidermis and healing is complete in less than a week.^{12,13} Partial thickness (second degree) burns involve all of the epidermis and some of the underlying dermis. Management and subsequent recovery depend on the amount of viable dermis remaining. A superficial partial thickness burn down to the papillary dermis will produce blistering; a painful pink wound bed with good capillary refill, and should heal with minimal amounts of hypertrophic scar formation in about 14-21 days. A deep partial thickness burn down to the reticular dermis

will also produce blistering, but the wound bed may be paler and less painful, and there will be reduced or absent capillary refill. The wound will take longer than 21 days to heal, and the resulting scarring is likely to be poor, with significant wound contraction.⁹

Recently, methods to treat the burn wounds have changed. In full thickness burns tangential excision is the only preferred method followed by skin graft. Although the technique is very simple but require considerable experience as it is technique dependent procedure with difficult depth evaluation and plane level control. Although it is dependent on surgeon's experience but in a third of all cases the evaluation is not accurate. For the treatment of partial thickness burns there are several methods like tangential excision, YAG laser, enzymatic debridement, dermabrasion and so on.^{13,14,15} Early excision followed by skin grafting for partial thickness burns gives not only functional but aesthetic results. The relatively inaccessible areas of body like face, axilla and perineum tangential excision has very little role and these areas are treated with silver sulphadiazine.

Surgical debridement remains the mainstay of treatment in the management of the deep partial thickness burns. Difficulties arise in the context of mixed thickness burns where preservation of dermal appendages is crucial to achieving re-epithelialisation.¹⁶⁻¹⁷ This is even more pertinent in cosmetically sensitive areas such as the head and neck region, where scar minimisation is essential. Dermal preservation and optimal wound healing remain crucial to minimising the risk of several of these potential negative sequelae. Burn wound management therefore necessitates adequate debridement of involved tissues, but also maximal preservation of viable dermal tissues to allow optimal healing and cosmesis. Dermabrasion of burn wound, first reported by Lorthioir in 1963, is a quick and simple technique which does not need extreme monitoring. In literature the several methods of dermabrasion are reported, some use dermabrader and other use sand paper. Though dermabrasion is useful but it is not practiced widely, In one case report dermabrasion was done using steel wool.

In our clinical practice we debride second degree burn wounds using steel wool and found this a very effective method in management of second degree burns. The purpose of our study is to share our experience of dermabrasion with steel wool and its advantage in our setup.

Materials and Methods

From January 2008 to December 2010, 300 burn cases were admitted in burn unit / plastic surgery department, Nishtar Hospital Multan. The burn unit is 16 bedded tertiary referral centre under the supervision of plastic/

burn surgeon having experienced nursing staff. It is also a training unit for training of residents in plastic surgery. It is the main referral centre for burn injuries in the southern Punjab. This is a prospective study. The objective of the study was to find out effectiveness of steel wool debridement in second degree burns. The effectiveness of this modality of treatment was judged on the basis of following criteria:

1. Wound healing ie. epithelisation.
2. hospital stay
3. infective load

Here in our unit we very often encounter burns without significant financial support. Keeping these problems in mind, we are using steel wool as a dermabrader to remove necrotic tissue and treatment of second degree burns. Among 300 patients 63 had partial thickness burn.

During the study period all the details of patients regarding their Registration data, history, site of the burn, TBSA affected, degree of burn, depth of burn, presence or absence of slough in the wound, medical report, operative notes, pre and post operative photographs, duration of hospital stay and outcome were filed individually. All the data was analyzed using SPSS 11 software.

Our study plan was approved by the ethical committee of our institution. All the necessary information regarding this trial was given to all the patients and attendants. A written consent was obtained from the patients/parents or guardians. We included in our study, those patients who got burns and treatment was initiated in within 24 hours; burns were second degree (either superficial dermal and/or deep dermal); total body surface area burn >40 %. We excluded the patient who had diabetes, immunodeficiency, pregnancy, and kidney diseases corrosive burns and electrical burns.

All burn patients were received in A & E department of Nishtar Hospital Multan where the resuscitation was done where every effort was made to eliminate the signs of early shock. After that patients were admitted in Burn unit. After admission in the ward, wounds were cleaned with povidone scrub and normal saline and the topical agent was applied to the wound. The dressing was changed and topical agents applied twice daily. Empirical 3rd generation cephalosporin and B-penicillin were started in all patients. Wound swab cultures from three different sites from all patients were taken, at the time of admission and then at every seventh day and then antibiotics were initiated according to the results of bacteriological examination.

During their stay in ward, Strict monitoring of intake/output was done. Where indicated, we supported our patients with blood products. In all the patients, great care was given to nutrition. Almost all the patients were given oral nutrition with occasional intravenous support in the form of amino acid infusion in few patients. .

We included in our study, those patients who had superficial dermal burns and deep dermal burns with surface area of 10-40%. Our exclusion criteria were patients with medical co morbidities, extensive superficial/deep dermal burns, patients with inhalational injury and age more than 60 years.

We divided our patients in two groups A & B. In group A, there were 35 patients who had superficial dermal burns and in group B, were included 28 patients who had deep dermal burns.

In group A, first debridement was done within 36 hours of admission with steel wool up to punctuate bleeding from the wounds, wounds covered with opsite. Dressing changed on 2nd post op day, wounds washed in ward and covered again with opsite. On 5th post op day, wounds re-evaluated and if needed debridement done again until signs of epithelization.

In group B, first debridement was done within 36 hours of admission with steel wool up to punctuate bleeding from the wounds, wounds covered with opsite. Dressing changed on 2nd post op day, wounds washed in ward and covered again with opsite. On the 5th day, we did repeat debridement with cover of antibiotics and extensive post op care. On 5th post op day, wounds re-evaluated and if needed debridement done again until the wounds became prepared for grafting. After grafting first dressing changed on 5th post op day and after successful graft take 2-3 dressings done on alternate days in ward.

We followed the method of Flanagan M.³⁶ for measuring Wound Length, Width, and Area. We measured the longest length and width, regardless of head-to-toe orientation and multiplied the 2 measurements to obtain the area in squared centimeters (cm²), i.e.

Area (in centimeter square)= length x width

We measured the wound progression³⁷ by calculating percentage rate of change by a simple statistical calculation that uses the following formula:

1. Baseline (week 0) wound size (OA or overall OA size) measurement as the original size.
2. Subtract the next wound size OA or overall OA size measurement (interim) taken from the baseline.
3. Divide by baseline wound measurement and multiply by 100 %.

Formula for Healing %age in in burn wound.

$$\frac{\text{wound area an admission day} - \text{Area on 2}^{\text{nd}} \text{ time}}{\text{Baseline wound area an admission day}} \times 100\%$$

Baseline wound area an admission day

At the time of change of dressing details regarding the condition of the wound such as signs of wound infection, condition of surrounding unburned tissues, discharge, smell, necrotic tissue and state of epithelialization was noted by our consultant burn surgeon on every 3rd day and was recorded with a ruler and photographed.

Subjective factors such as pain and local irritation were recorded regularly.

During the follow up period we recorded the colour and texture of skin. During that period details with photographs were recorded in individual files. Among 63 patients 52 patients available for follow up 6 months or more. Among remaining 11 cases, 7 patients were followed up for 2 month or less and 5 patients never come for follow up.

No mortality recorded in these patients during hospital stay.

Results

We included 63 patients who had partial thickness burns. 35 patients had superficial dermal burns and 28 had deep dermal burns.



Out of 63 patients 36 were males and 27 were females. Their age ranged from 13 years to more than 65 years. (Table I) It can be best appreciated that majority of patients in our study were in the age range of 21-40 years.

Table I: Age and Gender of (n=63)

Age range in years	Males	Females	TOTAL
13-20	4	3	7
21-30	11	9	20
31-40	13	8	21
41-50	7	2	9
51-65	4	1	5
>65	1	-	1

According to the total body surface area of burns , we categorized our patients as given in table 2 & 3.

Table II. TBSA Group A patients

N=35	TBSA%AGE
5	10-20 %
13	21-30 %
17	31-40 %

Etiology of these patients were mostly accidental flame injury in which the prime factor was negligence in kitchen. Three of our patients had flame burn from stove accident. One of our patient was addict. Six patients had scald burns and all of them had a similar history of spillage of boiling milk. Seven patients suicidal burns.

In patients who had superficial partial thickness burns ,28 patients had good wound epithelisation and 7 of these patients got STSG. Hospital stay was 7-15 days in these patients with average of 11 days. All patients with deep dermal burns got late STSG. Hospital stay was 25-30 days in these patients.

Discussion

Early removal of necrotic tissue stops inflammatory response and initiate wound healing. Best results for treatment of deep dermal burns are achieved by tangential excision followed by grafting. The surgical excision of the partial thickness burns is done primarily. Surgical excision is cumbersome in inaccessible areas. Although in literature tangential excision is the best available method for the treatment of deep dermal burns and 3rd degree burns. But this procedure is having multiple problems like extensive post op monitoring, increased risk of post op septicemia, laboursome dressing and difficult plane control level of tangential excision. Though the tangential excision is simple but it requires sufficient experience.^{16-17,18}

Dermabrasion has been recognized as a method which can remove the necrotic tissue since the time of Lorthioir (1963).¹² In literature several methods have been used. We are performing dermabrasion with store-bought steel wool since 2008. Every wire in steel wool is rigid so when we scrape superficial or deep dermal wound we give microcuts, and every scrape will excise part of necrotic tissue. We scraped the wound until punctuate bleeding starts .We repeated the same procedure until the wound either starts to epithelise or is prepared for the Split thickness Skin Graft. In our experience we applied skin graft on deep dermal burns and at later date when the wound was healthy. We did not used immediate grafting to cover wound as in our experience regeneration of new epidermis is unexpected rather beyond expectation, so in our experience we recommend the skin graft should not be performed immediately.

Advantages¹⁹⁻²⁵ of STEEL wool dermabrasion in our experience.

1. Easy to perform
2. Inexperienced personnel even can perform it
3. Accurate dermabrasion is possible with damaging the deeper layers
4. Easily repeatable
5. Difficult areas like face, perineum, axilla etc. are easily debrided.
6. Preoperative blood loss is minimal
7. Cost effective
8. Post op monitoring is easy
9. Operation duration is short
10. Hospital stay is short
11. Patient compliance

As compared to other techniques of dermabrasion like machine dermabrasion or sand paper, dermabrasion with steel wool has been found to be far more superior. As electrical dermabrader is technique dependent and cost is very high. Steel wool is available for just rupees 5 while electrical dermabrader cost \$ 10,000-\$20000 dollars, that is not feasible in country like Pakistan. Although sand paper is cheap and effective but in literature granuoma formation occurs because of the sand ablated from sand paper. Feng Y,Huo R .et al pointed out that dermabrasion improve the microcirculation secondary to the massage effect of steel wool dermabrasion and prevent thrombus formation but it lacks the evidence.²⁶⁻²⁸

Table III. TBSA Group B patients

N=28	TBSA%AGE
7	10-20 %
9	21-30 %
12	31-40 %

Conclusion

We suggest that steel wool dermabrasion removes the necrotic tissue and reduces the inflammatory response that helps in healing and prevents transition into deep thickness burns. It also reduces the septic load of the wound.

Long term aesthetic results are superior and many authors have given the similar results.In case of hands and face we got excellent results with good colour and texture.

In our experience dermabrasion with the steel wool is effective, simple, and cost effective and it negates the need of grafting in many of the patients with partial thickness burns.

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