The role of homograft in management of major burn in children

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Background
Major burns in children are associated with high mortality and morbidity in any developing countries. Excision within 24–48 h after burn is associated with decreased infection, blood loss, length of hospital stay, and mortality. The authors present a standardized method for homograft to evaluate whether the use of the homograft as a biological dressing is beneficial compared with standard topical treatment.
Patients and methods
Children aged 14 years with major partial thickness burn of 20% total body surface area of burn (TBSA) or more were included in this study. They were divided into two groups to be managed with either homograft (group A) (n=20) or treated with topical antimicrobial twice daily applications (silver sulfadiazine) (group B) (n=23). The two groups were compared.
Results
Treatment of major second-degree burns with homograft in pediatrics corrected anemia and hypoalbuminemia and decreased pain during the dressing changes. There was a significantly decrease in dressing changes in group A than in group B ($P<0.05$). Moreover, the length of stay in hospital reduced ($P<0.01$) in group A. The use of homograft decreased the risk of infection. Time of total healing, and the burn scar contracture development was different between the two groups.
Conclusion
Early excision of partial thickness burn and coverage with homograft is beneficial in children compared with the standard topical therapy.

Keywords:
biological dressing, burn, homograft, topical treatment

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Introduction

Skin is the largest organ in the human body, and no one can dispute its perceptive, regulatory, protective, and cosmetic functions [1].

Major burns in pediatrics are associated with high mortality and morbidity in any developing countries. Children with more than 40% of total body surface area burns will experience complications as a direct result of inadequate treatment and lack of resources. Early excision of burn wounds has been one of the most critical advances in modern burn care [2].

Approximately 85% of thermal injuries in the pediatric population are owing to scalds [3,4] and account for nearly 60% of all admissions to pediatric burn units [5].

Improvements in the treatment of shock, fluid resuscitation, and control of infection have been the cornerstone of recent advances in burn care and have decreased mortality rates and improved quality of life [6]).

Partial-thickness burns have been treated traditionally with topical antimicrobial agents during twice-daily dressing changes until the eschar is separated [7].

The traditional management leaves the burn wound open for long periods, increasing the potential for wound infection and exposes patients to the pain of daily cleaning and dressing changes [8].

Recently, major partial-thickness burns were treated with early excision of the burn wound to the level of vital tissue and subsequent grafting with cadaveric skin. The gold standard of operative wound coverage is autologous split-thickness skin graft. However, in patients with viable skin elements, remaining autograft is not necessary for wound healing.

Wounds remain open requiring the utilization of other methods of wound coverage which includes cadaveric allograft/homograft. Homograft serves as a biologic dressing as it ‘takes’ like a skin graft and is then rejected via cell-mediated immunity within 10–14 days later [7,8].

Patients and methods

This study included 43 pediatric patients with partial-thickness or full-thickness burn of 20% total body surface area of burn (TBSA) or more admitted to the burn unit of Menoufia University Hospital and Alhelal Insurance Hospital in the period from January 2018 to January 2020. Ethical Committee approval was obtained before the study initiation, and all patients signed an informed consent form.

Initial care: all patients with partial-thickness burn of 20% TBSA or more have been managed conservatively till stabilization of general condition, and then the patients were divided into two groups:

Group A (Figs. 1 and 2) included 20 burned children who were treated with excision and homograft within the 3–5 days of burn after the general condition became stable.

Burn excision

With general anesthesia and perioperative antibiotics administration, the patients were positioned supine in reverse Trendelenburg position.

Excision was done with Watson skin graft knife, which was continued until normal tissue is visualized. Hemostasis was achieved with epinephrine-soaked (1 : 10 000) saline and electrocautery; bleeding seen during the excision was the key to determine if all the Eschar had been removed.

Donor's selection

The donor should be free of lesions, transmissible diseases, or allergies, which might be detrimental to the recipient. Necessarily, negative serology of the donor will be one of the most important records. This is important in protection of the recipient. The donors were the parents in most cases, whereas in other cases were patients who underwent miniabdominoplasty or breast reduction in the same operation list.

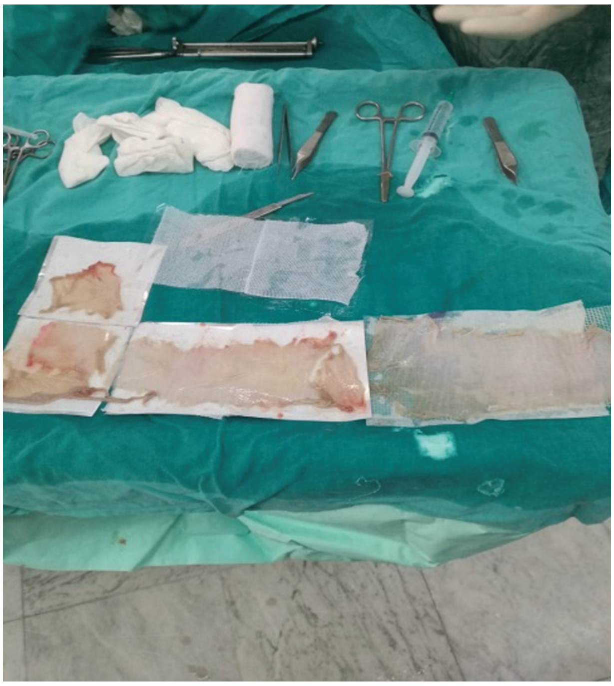
Homograft harvesting

With classic or miniabdominoplasty, breast reduction are main sources for homograft, other sources of homograft could be amputations or the utilization of any discarded skin. Initially full-thickness skin (FTS) was excised primarily; the FTS was defatted up to subdermal area, making it a thin FTS. Sometimes, we take the graft with Watson skin graft. Split-thickness grafts should not be too thick, as the thicker the graft, the less chance of take, and as the grafts are not permanent, thickness is not needed (Fig. 3).

Placement of homograft

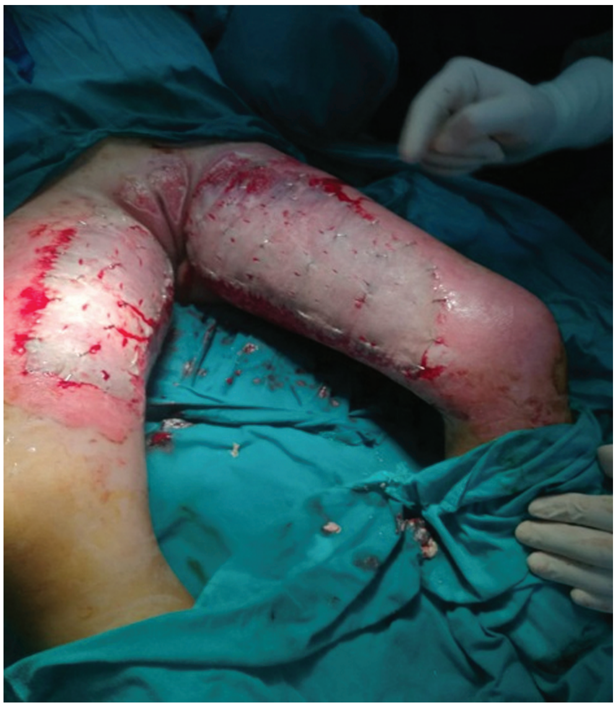
Once complete hemostasis was achieved, homografts are applied to the whole burned areas (whole TBSA of

Figure 1



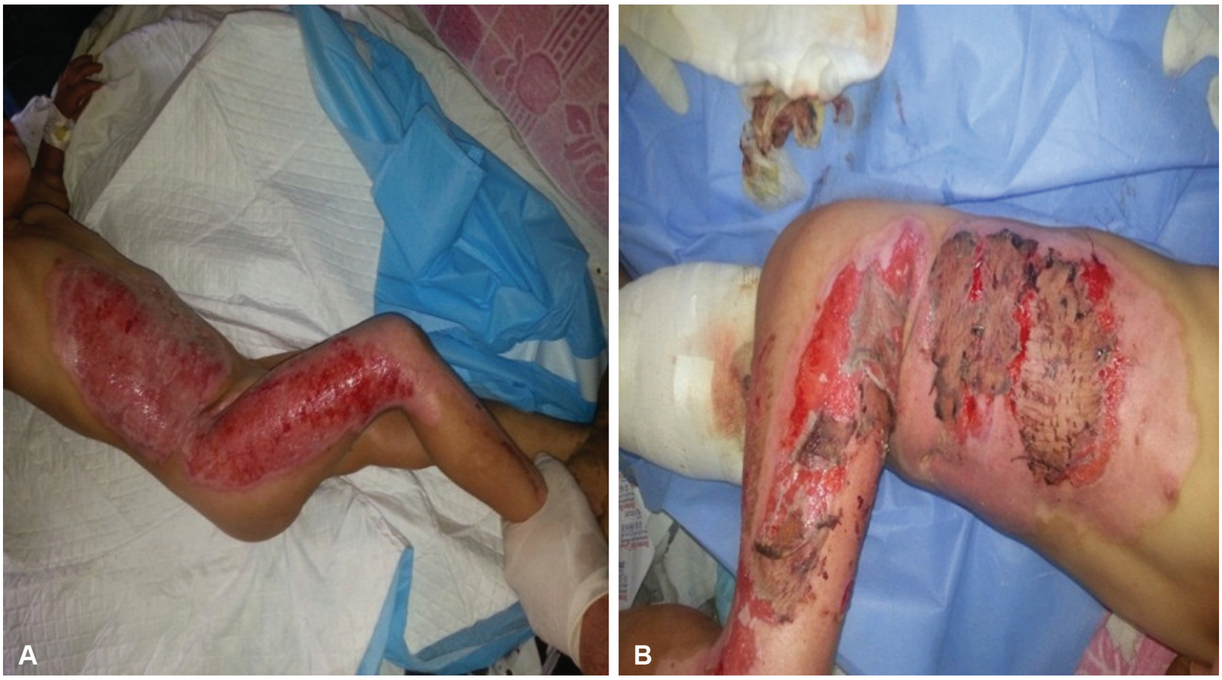
A 5-year-old female child with 25% TBSA. (a) Preoperative and (b) 10-day posthomograft application with good healing underneath. TBSA, total body surface area of burn.

Figure 2



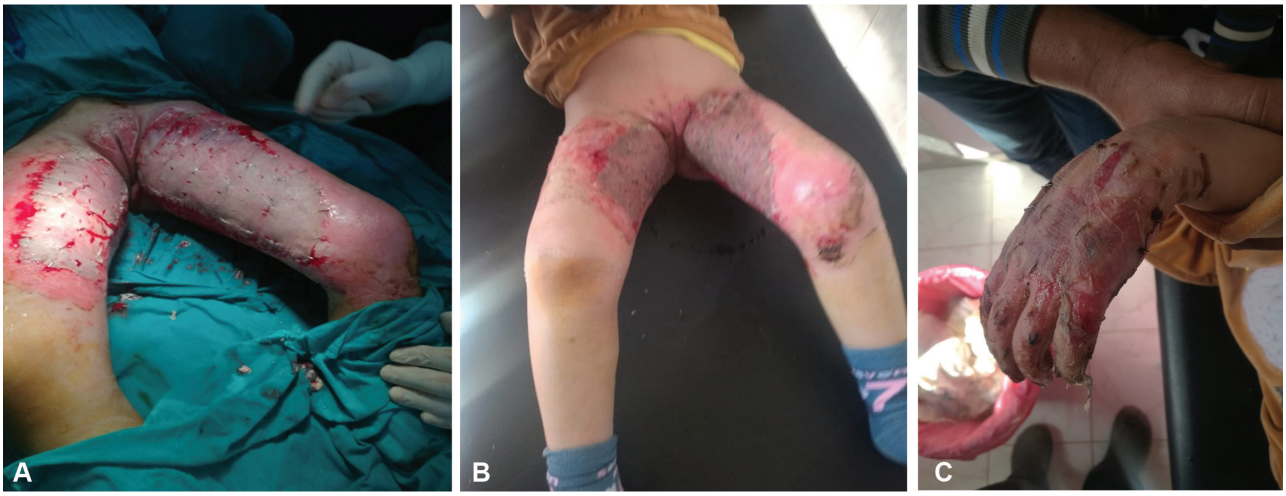
A 7-year-old female patient with 25% burn. (a,b) Intraoperative and (c) 8-day postoperative results with good healing underneath.

Figure 3



The specimen used after defatting.

Figure 4



Placement of homograft.

burn) and fixed with staples or sutures (Fig. 4). A dressing was then applied, which consists of a layer of fine Vaseline gauze, cotton mold, and a pressure garment.

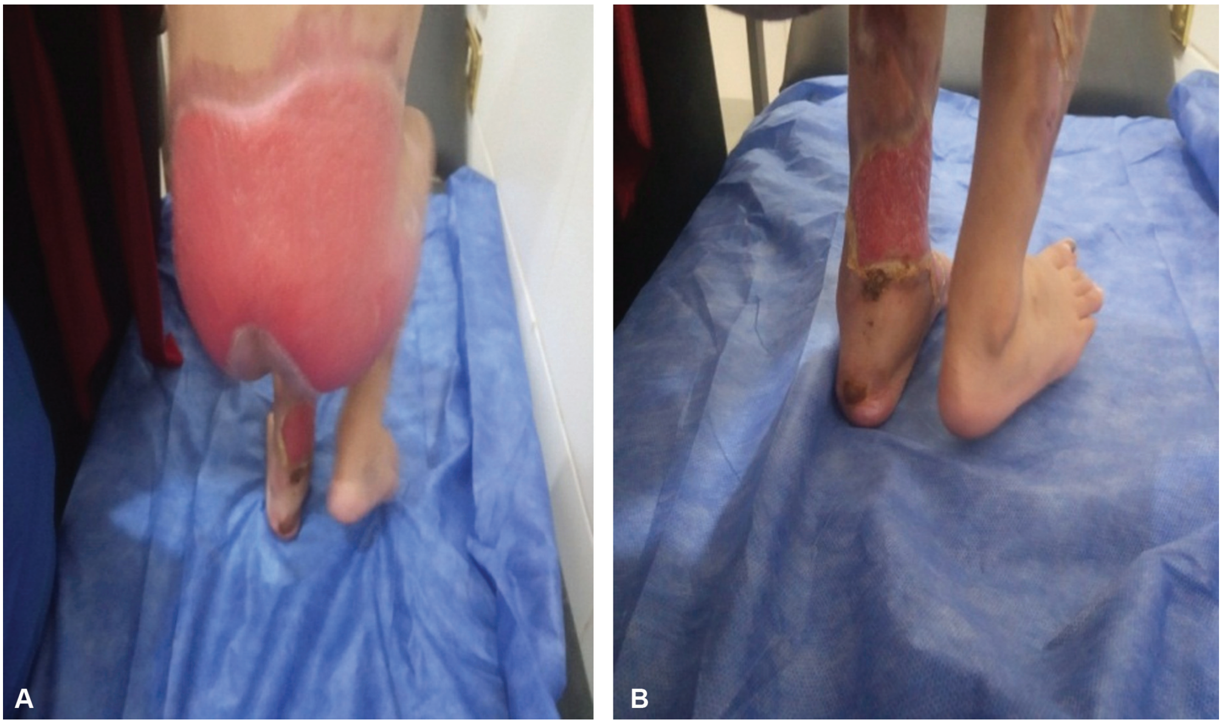
Postoperative care

Pressure garments were removed after 3 days. Grafts were inspected for any hematomas that were removed through 1 cm incisions placed in relaxed skin tension lines. For the next 5 days, the patients were asked to refrain from waking, and pressure garments were worn again until the grafts are matured in about 5 days, and then kept it exposed.

The homograft was expected to disappear within 14–21 days. Cover given by these grafts had given slow breakdown of the protein enzymatic factors of the necrotizing homograft, which certainly seems to stimulate epithelium from the deep sweat gland and hair follicle epithelium that escaped the burn destruction.

The weeks of persistence of homografts are of great value, as the homograft acts as a biological dressing, affords a viable body covering, provides respite from pain and fluid loss, and lessens the extensive care. The homograft may be lifesaving, as the patients may

Figure 5



(a,b) An 18-month-old male child of group B with 30% TBSA. 30 days after burn: notice nonhealing of burn wound and liability for hypertrophic scar. TBSA, total body surface area of burn.

produce good healing on their own and may recover to appoint allowing autografting from their own body to remaining open areas.

Group B (Fig. 5) included 23 burned children, managed with debridement and twice-daily topical antibacterial (silver sulfadiazine). The treatment continued till day 14. Then the burn was evaluated to determine which areas were not healed and were not likely to heal within 3 weeks of injury and in need for escharectomy.

Age, percent TBSA burn, length of hospital stay in days, number of operations performed, number of blood units transfused, and mortality were compared. All values were given as means±S.D. Unpaired *t*-test was used to evaluate the statistical significance of differences. A *P* value of less than 0.01 was considered significant.

Results

No significant statistical differences were found between the two groups regarding age and TBSA burned. However, treatment with homograft significantly decreased length of stay (26.7±3.2 days) compared with topical antimicrobial therapy (40.3 ±4.99 days). Number of operations, blood transfusions, and mortality were statistically significant.

In both groups, all the patients required blood transfusion mainly in the preoperative stage, and in the postoperative stage mainly in group B.

In the homograft-treated group, the mean number of blood transfusions (in unit) was ~1.4 units.

In the topical therapy-treated group, the mean number of blood transfusions (in unit) was ~2.1 units.

Four patients in the topical antimicrobial treatment group required future operative intervention for burn scar contracture. Their initial length of hospital stay was 65, 45, and 38 days. Two patients required one operation each, and two patients required revision of burn scar contractures on two separate occasions.

In the homograft-treated group, only two patient required revision for burn scar contractures. The average length of stay in hospital was 33, 42 days.

There were three deaths in the topical antimicrobial group attributed to sepsis and multiorgan failure. These patients were aged 4 years, 6, and 15 months and had TBSA of 32, 35, and 30%, respectively.

Discussion

Burn injury can be caused by heat, cold, electricity, chemicals, friction, or radiation [9]. Burns are a global public health problem, which accounts for ~180 000 deaths annually [10].

Burn injury may lead to extensive skin loss. Finding an ideal skin substitute for burn patients becomes essential [11]. The best burn wound dressing in partial-thickness and full-thickness burn is split-thickness skin autograft. However, in major burns, there is limited donor site for the skin autograft [12], and in this case, homograft is used as a temporary biological dressing [13].

Previous papers favor early excision and grafting. In this current manuscript, we present data on large (>20% TBSA) partial-thickness pediatric burns treated by excision of Eschar and coverage with homograft. This treatment led to decreased length of hospital stay. Statistical power was insufficient for improvement in mortality.

Our results now support the use of homograft after early excision of large deep second-degree pediatric burns over the use of topical antimicrobial therapy. These results coincide with the previous studies in less severely burned patients who were grafted using mostly autologous tissue. A small group of patients in both groups required future revision of burn scar contractures. The patients who required later revision of burn scar contractures appear to have had a prolonged length of hospital stay.

A continuing convenient and inexpensive source of homograft skin is panniculectomy when harvested in the operating room under sterile condition. Acceptable donors must have no jaundice, blood dyscrasia, or skin infection. The abdominal skin is prepared in the operating room, after harvesting and defatting the specimen, and then stretched over a contoured pad using towel clips.

This study aimed to evaluate the role of homograft and its effect on the general condition of the patient and locally on the burn wound in children. To achieve this objective, 20 study group children and 23 matched controls in pediatric age with deep burns, fulfilling inclusion and exclusion criteria, were included in this study. Patients in the study group were managed by early excision of burned skin with homograft replacement, whereas children in the control group were managed by sterile dressings.

The present study revealed that the postoperative percentage of total body surface area was lower in the patient study group compared with the control group, and the difference was highly statistically significant ($P<0.001$). This finding can be explained by the fact that homografts serve as a temporary wound cover [14].

The present study revealed that the postoperative albumin level was higher in the patient group than its level in the control group, and the difference was highly statistically significant ($P<0.001$). This finding comes in line with what was published by El-Tahan and Borhan [15], who performed their study on 100 patients with full-thickness burns in which 80 patients were biologically dressed by cadaveric skin and 20 patients were treated by conventional dressings, aiming to evaluate the value of homografting regarding its effect on plasma protein levels, hemoglobin values, and pain tolerance. They found that homograft corrected hypoproteinemia. This can be explained by the fact that grafts serve as physiological as well as mechanical barrier which protects the wound against protein loss [16].

The current study revealed also that there were highly statistically significant differences ($P<0.001$) between the patient and the control groups regarding pain control agents used during dressing as well as the number of dressings, where the need for anesthesia and number of dressings were lower in the patient group compared with the control group. Similarly, Roberts [17] mentioned that the use of homograft to cover burn wounds was associated with less pain and decreased analgesic dosage. Similar results were also reported by El-Tahan and Borhan [15], as they mentioned that homograft decreased pain during dressing changes. Similarly, Rose *et al.* [5] compared the use of allograft and topical antimicrobial therapy in the treatment of partial-thickness scalds with a mean of 31% TBSA. They showed a significant decrease in the meantime of healing (19 vs 25 days, respectively) and a lower pain score (1.4 vs 3.0, respectively).

The present study revealed that the postoperative hemoglobin level was higher in the patient group than its level in the control group, and the difference was highly statistically significant ($P<0.001$). Similarly, El-Tahan and Borhan [15] reported that homografting corrected anemia.

This study revealed also that there were highly statistically significant differences ($P<0.001$) between the patient and the control groups regarding the number of operations as well as the hospitalization days, as both were lower in the patient group compared with the control group. Calota *et al*. [14] studied 47 adult patients with burns of 20% TBSA or less randomized to conservative therapy versus early excision and autografting. Length of hospital stay averaged 25 and 16 days, respectively. Time away from work was one-third that of the conservatively treated group, proving that early excision leads to a more rapid functional recovery. This finding also agrees with that published by Naoum *et al*. [18], who performed their study on 16 patients treated with the application of homograft compared with 13 patients treated with the traditional approach of twice daily applications of silver sulfadiazine aiming to compare the use of homograft to topical antimicrobial therapy in the treatment of massive second-degree burns. They found that the management of major second-degree burns with homograft significantly decreased length of hospital stay. It also comes in line with that of the case report published by Abu-Bakar [19] in which he described a case of a 14-year-old boy with a 31% burn wound in whom autograft had failed and managed by a isograph from his twin. He found that the use of homograft reduces patient morbidity and overall hospital stay.

Conclusion

Our study had shown that early excision and coverage of large partial-thickness burns (20% or more TBSA) with homograft decreases length of hospital stay and may be beneficial in decreasing morbidity and mortality.

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Conflicts of interest

There are no conflicts of interest.

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