Commentary

Tissue engineered fetal skin constructs for pediatric burns

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Abstract

The management of patients with partial thickness (second degree) burns is problematic due to the different treatments needed for varying depths of injury. A report recently published in *The Lancet* describes a novel treatment for deep second degree burns using a fetal skin construct (FSC). The authors included eight pediatric patients with small second degree burns. They showed that FSCs reduced the need for autografting of deep second degree burns, with little hypertrophy of new skin and no skin contraction. This technology is new and exciting, but in our opinion several issues must be addressed before FSCs can enter the clinical arena. All of the patients were included in the treatment group, and therefore no comparison with conventional skin substitutes was possible. There is no mention of the use of laser Doppler in any initial assessment of patients. The debridement carried out before application of the FSC is not elaborated upon, and the surface areas involved in the study were very small in most cases, which limits the relevance to patients with larger burns. The use of FSCs gives us an additional option in a range of possible treatments for this notoriously difficult-to-treat patient group.

Introduction

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 [1]. In the clinical setting the patient is unlikely to present with a wound that matches either of these descriptions, and so a thorough examination, together with use of laser Doppler, will help in the initial assessment of each wound. Considerable experience is needed to arrive at a clinical management decision.

Treatment of partial thickness burns

Established techniques

As outlined above, the initial management involves clean debridement of the blistered areas and thorough examination of the wound bed, along with laser Doppler imagery. Closing the wound quickly will help to reduce painful stimuli to the patient. Superficial partial thickness burns usually only require nonadherent dressings such as Mepitel™ (Mölnlycke Health Care, Newtown, PA, USA); mid-partial thickness burns require the use of dressings or occasionally skin substitutes such as Biobrane™ (Bertek Pharmaceuticals Inc, Morgantown, West Virginia, USA) or TransCyte™ (Advanced Tissue Sciences, La Jolla, CA, USA).

Mepitel™ is a porous, semitransparent, low-adherence wound contact layer that consists of a flexible polyamide net coated with soft silicone. The silicone coating is slightly tacky, which facilitates the application and retention of the dressing to the peri-wound area. The dressing is placed directly onto the wound and secured with a bandage. Follow up is then normally carried out in the clinic every 48–72 hours until the wound is healed, typically 14–21 days.

Biobrane™ is a biocomposite dressing made from an ultrathin, semipermeable silicone membrane mechanically bonded to a flexible knitted trifilament nylon fabric. Purified peptides derived from porcine dermal collagen are bonded to the dressing to give an adherent, hydrophilic dressing. It is applied under aseptic conditions immediately following debridement of the burn wound. The wound may be inspected through the dressing when the outer bandage is replaced. Biobrane™ is usually removed after 7–14 days once the underlying tissue is healed.

FSC = fetal skin construct.

TransCyte™ is another type of skin substitute that is used in the treatment of mid-dermal to indeterminate depth burn wounds that typically require debridement and that may be expected to heal without autografting. It consists of a polymer membrane and newborn human fibroblast cells cultured under aseptic conditions *in vitro* on a nylon mesh. Like the dressings described above, it is applied under aseptic conditions to a freshly debrided wound bed. It can also be removed at a similar time after tissue healing. Kumar and coworkers [2] showed us that, when used in children, TransCyte™ promotes faster re-epithelialization than does Biobrane™, with less need for autografting. However, a drawback is the increased cost of the dressing.

Deep partial thickness burns usually require skin substitutes but they may need excision and autografting. An important initial aim in the treatment of partial thickness burns is to prevent bacterial infection, which can lead to conversion to a full thickness burn. The incidence of conversion increases with depth of burn

Recent advances

In a recent study conducted by Hohlfeld and coworkers [3], fetal skin constructs (FSCs) were produced using a single donation of fetal skin (4 cm^2 biopsy taken from a terminated pregnancy at 14 weeks of gestation, following written informed consent from the donor patient). The cells were expanded and grown in Dubecco's modified Eagle's medium supplemented with 10% fetal calf serum and frozen in liquid nitrogen before matrix seeding on native horse collagen sheets. The FSCs were then placed on lesions after debridement and at each dressing change (every 3–4 days) for a maximum of 3 weeks. (For a more detailed description, see the original report [3].) The authors included eight pediatric patients with small second degree burns. They showed that FSCs reduced the need for autografting of deep second degree burns, with little hypertrophy of new skin and no skin contraction.

Despite the enthusiasm for this new technology, in our opinion there are several questions and issues that must be addressed. The authors mention that the FSCs were placed on lesions after debridement, but what level of debridement was this? To what level did they excise? What technique did they use – sharp debridement with a Watson knife or dermatome, or simply application of moist gauze, as in the normal initial debridement of such wounds? The study only included eight patients, all of whom received the FSC. Before we may consider introducing this new treatment into routine practice, it should be tested against the other leading dressings used in this level of injury. A randomized controlled trial should be performed comparing the different treatment options for similar deep partial thickness burns. Once this has been done we will be able to determine whether there is an overall benefit for the patient.

Apart from the use of FSCs, several other new technologies are emerging for the management of second degree burn wounds. Thus, we suggest that the ideal treatment has yet to be established and that several factors must be included in the equation, such as applicability, cost, efficacy and availability. Recent advances include use of glycerolized cadaver allograft skin for the treatment of deep partial thickness facial burns; Horch and coworkers [4] recently used this approach and found a significant reduction in hypertrophic scarring as compared with use of topical agents. Also, Rab and coworkers [5] promoted the 'Viennese concept' of the use of allogeneic cultivated keratinocytes in the treatment of tangentially excised deep partial thickness burns, the results of which are most promising. Finally, Branski and coworkers, from our unit, showed that amnion is of great benefit in the treatment of partial thickness burns to the face, resulting in significantly reduced rates of infection and hypertrophic scarring (L Branski and coworkers, unpublished data).

Conclusion

The use of FSCs gives us an additional option in a range of possible treatments for this notoriously difficult-to-treat patient group. In our opinion, Hohlfeld and coworkers [3] have reported a very interesting study that suggests significant benefit for patients. However, the value of the results is limited by the small number of patients included, the lack of comparisons or controls, and the small burn size. We feel that this treatment requires further investigation but that it must be proven to provide cost-effective benefit to patients before it may be considered for routine application in the clinical setting.

Competing interests

The author(s) declare that they have no competing interests.

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