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Case Report

Management of Pediatric Partial-Thickness Burns with Lavanid Gel (Polyhexamethylen Biguanide, Polyhexanide) "Case Reports"

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Abstract

Aim: The evaluation of Lavanid gel (Polyhexamethylen Biguanide (PHMB) or Polyhexanide) in pediatric burn therapy. **Patients and Methods:** The authors present the cases of two children. **Case I:** A 6-year-old boy chemically burned his thighs, consequently necrectomy and autologous split-thickness skin transplantation were performed. The donor and grafted areas were covered with Grassolind net and Polyhexanide gel. **Case II:** Grassolind net and Polyhexanide gel was used as the dressing of a 2-year-old girl's superficial partial-thickness left forearm scald as well. **Results:** During therapy, the transplanted skins adhered completely, in addition to the reepithelialization of the burn wounds. Infection or other complications were not observed. The follow-up of the children is still ongoing, short-term results suggest that the application of Grassolind net with Polyhexanide gel is an effective burn dressing, which creates an appropriate environment for wound healing. **Conclusions:** Based on our initial experiences, the analyzed intervention could be applied in a gentle, child-friendly manner and was associated with favorable burn wound healing capabilities as well as esthetic outcomes.

Keywords: Children; PHMB; Polyhexanide; Partial-thickness burn

Introduction

Burns are the direct or indirect injury of the skin and deeper tissues due to thermal effects. Skin loss is the basis and sustenance of thermal injuries. Complete recovery can only be expected after the reconstruction of the integument's continuity. Burns are often classified by their depth (Figure 1), which depends on the triggering agent's temperature and the duration of heat contact. The severity and prognosis of burns are dependent on the patients' age and general health, along with the injuries' depth, area [1-4].

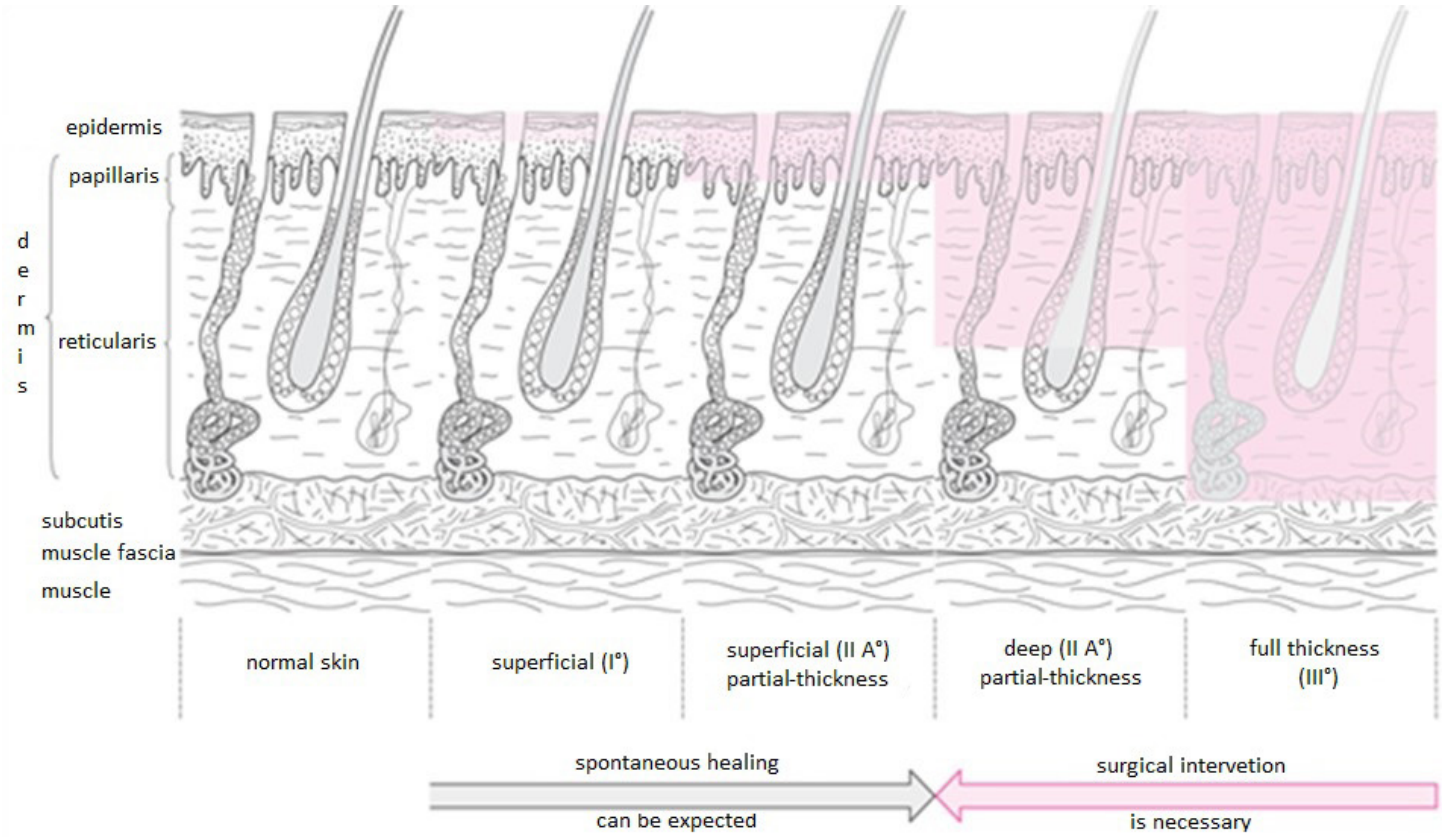

Figure 1: Burn depth classification. It is based on the recommendation of the European Burn Association (EBA) (Juhász I. Thermal Injuries [Termikus sérülések]. In: Gaál Cs. Surgery [Sebészet] Medicina 2016).

Burn Depth

Superficial thickness (I degree) burns damage the epidermis, resulting in severe pain and minimal edema. Upon physical examination, erythema can be observed, without the formation of bullaes. Generally, the triggering factor is sunlight, and they do not require any medical intervention, because healing occurs in 5-7 days without scar formation. Partial-thickness (II degree) injuries affect the dermis and have two subcategories. Superficial partial-thickness (II/1 degree) burns impact the skin's papillary layer, causing straw-yellow bullaes, which are responsible for painful, bright pink wound beds after their removal. On average, II/1 degree burns regenerate within 7-10 days, spontaneously. The reticular layer of the dermis is also involved in deep partial-thickness (II/2 degree) thermal injuries. Subsequent to bullectomy, the wound base is blotched, whitish and numb. Without medical attention, unprompted healing is incidental and slow, often resulting in extensive scarring. Full-thickness (III degree) burns disrupt the subcutis or deeper tissues. Thus, the skin becomes necrotised and painless, with a pearly and pale color. Surgical intervention is necessary for this condition because spontaneous healing should not be expected [2,4].

The Management of Burns

Conservative Therapy

An important step in the conservative treatment is the burn wound's rinsing with a disinfecting agent, then the removal of dead tissues. Thorough debridement causes considerable pain, thus the cleansing and covering of the children's burn wounds were performed under the effects of analgesic and anxiolytic drugs or general anestesia. The healing of the burn wound begins when epithelial cells travel from the healthy to the damaged areas. These cells may originate from the remaining epithelial appendages, like from the sebaceous and sweat glands' ducts' epithelial lining. Conservative treatments must facilitate this epithelialization process. In I degree burns, the therapy is strictly conservative, which can be managed in an ambulatory manner. Regardless of the burn mechanism - such as sunburn or domestic accident - several alternatives are available, like the Fenistil® and Burn Free gels®, or the Irix®, Panthenol®, and Naksol sprays®.

II/1 degree burns can also be effectively treated conservatively. Maintaining a moist environment is of utmost importance, therefore the burn wounds' and the donor and transplanted areas

were covered with saline or other solution soaked gauze sheets or various gels. Burn wounds are prone to infection and conversion, which is the deepening of the injury. Consequently, combining the treatment with antimicrobial compounds is often warranted, where an important expectation from them, is to impede wound healing as minimally as possible.

From the solutions, the usage of Octenisept® and Betadine® are most widespread in Hungary. Betadine® contains povidone-iodine, which has a remarkably wide antimicrobial spectrum; it is bactericide, fungicide and selectively virucide. Although, in our experience, it may cause a stinging feeling in children and cannot be administered to iodine sensitive individuals [4-6]. The benefits of Octenisept® include, that it stings less, and it does not discolor the wound base, thus it simplifies its evaluation. Both international and Hungarian guidelines recommend the silver sulfadiazine containing Dermazin® cream, which is antibacterial and promotes reepithelialization. Its disadvantage is, that it requires daily dressing changes, and creates a yellowish plaque on the burn, which makes depth determination difficult [7,8]. Zinc-hyaluronan (Curiosa® gel) is well-known in wound management for its cell regeneration supporting effect, which results in rapid wound closure.

A Lavanid® (PHMB, Polyhexamethylen biguanide or Polyhexanide) is a sterile, preserved gel, based on Ringer solution and characterized by good tissue tolerance. As a preservative, it contains 0,04% polyhexanide, which is accounted as one of the most popular treatments in chronic wound and burn care. Besides the cleansing and moistening of the injuries, PHMB gel is capable to heal wounds, infected with multiresistant bacteria [9,10].

In addition to the administration of different solutions and gels, wax and paraffine containing nets (Grassolind®, Klinitulle®) are also commonly used in our country, along with silicone (Safe-Tac®), that reduces or prevents the adhesion of the dressing to the wound base. Grassolind® is a woven cotton dressing, and contains paraffine. It is capable to cover large body surfaces, while it does not cause hypersensitive reactions. Meanwhile, Bactigras® dressings contain 0.5% chlorhexidine, besides paraffine. The mesh structured Inadine®'s wide antimicrobial spectrum allows the prevention and management of infected wounds [6,11,12]. Film dressings (OpSite®, Omiderm®, Tegaderm®) are suitable for the treatment of wounds without exsudation. In comparison, hydrogel dressings (Elastogel®, IntraSite® gel, NuGel®) are appropriate for the absorption of wound secretion. Materials that are able to establish the injuries' optimal moisture level are called hydroactive or hydrocolloid dressings (Hydrocoll®, Allevyn Non-Adhesive®). Antiseptic metals are not only contained in liquids and wash-off solutions but in silver impregnated wound coverings as well (Aquacel Ag®, Acticoat®). The most novel dressing type is the hydrofiber, such as Aquacel Ag foam®. It consists of an external polyurethane waterproof film layer and a multilayer absorbent surface, with a silver ion content of 1.2 % by weight. The multilayer cushion contains a sheet of foam and a plate with hydrofiber technology. It absorbs wound secretions, causing the hydrofiber layer to turn into a gel, which helps to keep the wound moist, heals wounds as soon as possible, and prevents infections. Wearing the bandage is comfortable for the patient, while its removal is painless and it does not require anesthesia [7-10,13-19]. In the management of burns, the NPWT (Negative Pressure Wound Therapy) method is becoming increasingly common, which can also improve blood supply to the affected area. It exerts negative pressure (vacuum) to help the wound edges merge, and remove infectious substances [5].

Surgical Treatment

In case of circular, large area, and deep burns, necrotomy (tension reduction incision) is required, which is aimed at improving the circulation of the affected region. In order to prevent compartment syndrome, fasciotomy is also recommended in some cases, for example in the case of electrical burns. Dead tissues are a breeding ground for toxic bacterial infections and should be removed as soon as possible by necrectomy. Tangential excision is often used, during which dead areas are removed in thin layers until a viable, spot-bleeding surface is obtained. This procedure can be performed with an electric dermatome or Humby knife. To restore the barrier function of the skin, the lack of continuity must be eliminated. Allograft and xenograft type coverages are also known, in the latter case we mostly utilize porcine skin, which is used as a temporary covering [9,10].

With the development of biotechnology and tissue culture, a huge number of products have recently been placed on the market to cover wounds. Epidermis type preparations, like Epicel®, are suitable for epidermal type coverage from autograft cultured cells. They are bred from the patient's skin, but also be obtained from allogeneic cultured cells. A dermis type preparation is AlloDerm®, an allogeneic cell-free dermal matrix with intact basal membranes, grown from human skin, which prepares the wound base for proper autograft transplantation. Integra® is an extracellular matrix made up of bovine collagen and other wound healing materials, which helps to develop a new dermis. Combined products of the epidermis and dermis types can also be used. Apligraf® for example, contains bovine keratinocytes, fibroblasts and type I collagen [5].

During an autologous transplant, the burned area is covered with Split-Thickness Skin Grafts (STSG) taken with a dermatome or Humby knife. Donor skin may come from the proximal, medial or lateral surface of the thigh, as well as from many other regions. The donor area is selected based on which region causes the least number of cosmetic problems for the patient later and can be obscured by clothing.

The essence of a meshgraft is that the skin taken from the intact donor area can be stretched into different proportions with the help of mesh dermatome, thus increasing its size. In the case of sheet-like or non-meshed grafts, the donor skin is not stretched, therefore a more beautiful cosmetic result is obtained. Transplantation of full-thickness skin gives the best cosmetic results, but the disadvantage is that it has a higher nutritional need owing to its thickness, therefore graft failure is more common [2,4,5].

Covering the transplanted skin is always necessary, for this, we can use gauze sheets, gels and various dressings soaked in the solutions described in the conservative therapeutic part for the treatment of grade II burns. Currently, keeping the wound moist or wet seems to be the best way to heal wounds.

Case Report I

The combined application of Grassolind net and PHMB gel was performed in a child who received skin transplantation for his II/2 and II/1 degree deep burn injury. The six-year-old boy was admitted to our department due to a chemical burn on his left thigh. The grade II/2 injury necessitated autologous STSGs which were covered with Grassolind net and PHMB gel, along with the donor areas. On the second day, during dressing change, no inflammatory signs or complications were observed. Seven days after transplantation, graft adhesion has been observed (Figure 2).

Figure 2: Management of the first patient. The left thigh's ventromedial II/2 degree burn injury, before **(a),** and after necrectomy **(b).** Two days after the transplantation **(c).** On the seventh day of therapy, the take of the STSG was visible **(d).**

Case Report II

A 2-year-old girl's left forearm was covered with Grassolind net and PHMB gel, due to a II/1 degree scalding. Three days after the application of the treatment combination, during dressing change, partially epithelialized areas were observed with minimal fluid leakage. The final removal of the dressing was done 8 days following the injury when complete wound closure was noted. Hereafter, we advised the local application of a greasy ointment. Three weeks after the burn, the control examination revealed scar-free healing with remarkable cosmetic results (Figure 3).

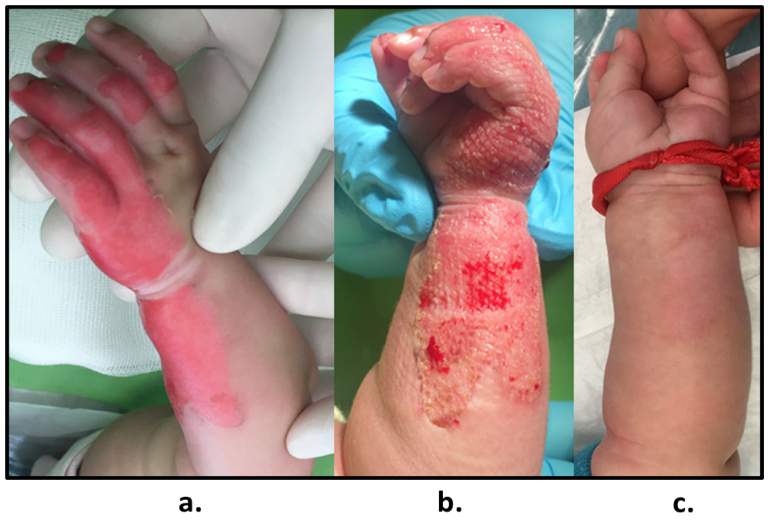

Figure 3: Photodocumentation of the second patient. A II/1 depth injury subsequent to debridement, on the left forearm's ulnar surface and extending to the fingers **(a).** The results of Grassolind net and Polyhexanide gel therapy, after three days **(b).** On the three-week control appointment, the patient presented without scarring and had excellent cosmetic outcomes **(c).**

Discussion

Thermal injuries mainly occur in families, living under inadequate social circumstances, where the risk of infection is high during reepithelialization. The management of mixed-depth burns is a constant challenge for healthcare providers, and the expert opinions are controversial regarding the efficacy of conservative treatments. Contiguous, deep thermal injuries unequivocally necessitate surgical intervention, while in the case of superficial partial-thickness burns, conservative treatment results in favorable outcomes. In the international literature, a vast amount of therapeutic options are well-known and accepted. This article provides the evaluation of an alternative dressing, with promising initial results.

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