EFFECTIVENESS OF SUPRATHEL® APPLICATION IN PARTIAL-THICKNESS BURNS, FROSTBITES AND LYELL SYNDROME TREATMENT

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The skin is the largest organ of the human body consisting of several layers possessing different properties and performing different physiological functions. The loss of skin integrity caused by a trauma or disease may provoke acute physiological and immune disorders that may even be fatal. The following properties are primarily taken into account when choosing the appropriate burn wound dressing: support of the epithelialisation process, pain and patient discomfort reduction, and treatment costs. The aim of the study was to assess the usefulness of Suprathel in the treatment of partial-thickness burns and frostbites and Lyell’s syndrome and to determine the preferable time of Suprathel application to the wound.

Material and methods. At The Eastern Poland Burn Treatment and Reconstructive Surgery Centre, Suprathel was used in 21 patients: 11 men and 4 women with wound burns, 5 men with frostbites and 1 woman with Lyell’s syndrome. Dressings were applied within 96 hours of injury.

Results. Treatment results depended on the time of Suprathel application to the wound and on the type of injury. Among 9 partial-thickness burn patients treated within 24 h of injury, the epithelialisation time was up to 14 days in 7 patients and up to 21 days in 1 patient, and skin grafting was necessary in 1 patient. In one of the 2 partial-thickness burn patients treated on the second day after injury, the epithelialisation time was 21 days, and skin grafting was necessary in the other of these 2 patients. Among 4 partial-thickness burn patients treated on the second day after the injury, the epithelialisation time was 21 days in 2 patients and skin grafting was necessary in 2 patients. Among the 5 frostbite patients, the epithelialisation time was up to 14 days in 3 patients and up to 21 days in 2 patients. In 1 patient with Lyell’s syndrome, the epithelialisation time was 21 days.

Conclusions. Suprathel is a good dressing that can perform the function of a temporary epidermal substitute in partial-thickness burns and frostbites and in Lyell’s syndrome. The dressing should be applied within 24 hours of injury, when there is the least exudate from the wound and the wound is not infected. Therapeutic effectiveness of Suprathel decreases along with a delay of its application to the burn wound and with increasing burn depth.

Key words: partial thickness burns, frostbites, Lyell syndrome, wound dressing, skin substitute

The skin is the largest organ of the human body consisting of several layers, which possess different properties and perform different physiological functions. The most important task of the skin is the creation of a barrier between the external environment and the body. Its other functions include: immune protection of the body, the sense of sensation and the ability to conduct regeneration and healing processes (1).

The loss of skin integrity caused by a trauma or disease may result in acute physiological and immune disorders that may even be fatal. One of the most common causes of skin loss is a burn trauma; others include ulcerations, mechanical traumas, dermatological disorders
or disorders with dermatological origins such as Lyell's syndrome (1).

The last few decades saw a significant progress in understanding the molecular and cellular processes taking place in the course of healing of acute and chronic wounds. This provided the grounds for the introduction of multiple innovations in the treatment of chronic and acute wounds, such as the use of recombinant growth factors or skin substitutes, which helped accelerate healing and improved the ultimate aesthetic and functional outcomes (1).

The basic objective of wound treatment is to obtain such tissue regeneration that would involve the reconstitution of structural and functional properties of the damaged skin layers to a level which is as close as possible to the pre-traumatic local condition (1).

The traditional method of treatment of burn wounds by daily changes of dressings and application of locally acting antibacterial substances is associated with substantial discomfort for the patients and medical personnel (3).

When choosing an appropriate burn wound dressing, the following properties are primarily taken into account: support of the epithelialisation process, the reduction of pain and patient discomfort, and treatment costs (2).

One of such dressings which display the properties of the natural epithelium is Suprathel. This is an absorbable new-generation dressing based on a co-polymer of three compounds: lactide, trimethylene carbonate and ε-caprolactone (4). The specific structure and chemical composition of the dressing guarantee its elasticity, water permeability, transparency after application to the wound and biodegradability (2, 7). Suprathel is used in the healing of mainly partial-thickness and also superficial burns (1).

Elasticity makes it possible to apply the dressing to the wound at the sites which are difficult to treat, and also ensures that the dressing will closely adhere to all the curves and depressions on the damaged skin surface (2, 7).

Water permeability prevents accumulation of exudate in the wound whilst at the same time creating the optimum humid environment contributing to wound epithelialisation (4, 7).

Dressing transparency enables constant control of the healing process, whereas the biodegradability eliminates the need for dressing removal before the end of the burn wound epithelialisation process. This increases treatment comfort for burn patients, reducing their exposure to stress and pain associated with frequent dressing changes. Moreover, it minimises pain during the necessary dressing changes as it does not require the removal of the layer directly adhering to the wound (2, 3, 7).

The study objective was to evaluate the usefulness of Suprathel in the treatment of partial-thickness burns and frostbites and Lyell's syndrome and to determine the preferable time of Suprathel application to the wound.

MATERIAL AND METHODS

At the Eastern Poland Burn Treatment and Reconstructive Surgery Centre, Suprathel was used in 21 patients: 11 men and 4 women (one 8-year-old girl) with wound burns, 5 men with frostbites and 1 woman with Lyell’s syndrome. Patients qualified for treatment with Suprathel were those with partial-thickness burns diagnosed on the basis of a macroscopic evaluation.

Dressings were applied within 96 hours of injury. Before Suprathel application, the wound was washed with water with a detergent, and debridement was performed, so as to apply Suprathel directly onto the undamaged skin layers. A single layer of paraffin-soaked gauze and then a dressing of sterile gauze creating an absorptive layer were applied on top of Suprathel.

The absorptive layer of the dressing was changed daily and the condition of the remaining layers and the burn wound was inspected on a daily basis. Suprathel was removed at places where it peeled off from the wound by itself.

RESULTS

The results of treatment in function of the time of Suprathel application and the type of injury are presented in tab. 1.

Patients with partial-thickness burns:
1. Dressing application within 24 hours of injury – 9 patients:
   a) epithelialisation of the wound within 14 days – 7 patients (fig. 1-5),
### Table 1. Summary of the results of treatment with Suprathel

<table>
<thead>
<tr>
<th>Patients with partial-thickness burns – dressing application within 24 h of injury</th>
<th>Patients with partial-thickness burns – dressing application 24-48 h after injury</th>
<th>Patients with partial-thickness burns – dressing application more than 48 h after injury</th>
<th>Frostbite</th>
<th>Lyells syndrome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>9</td>
<td>2</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Epithelialisation within 14 days</td>
<td>(fig. 1-5)</td>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Epithelialisation within 21 days</td>
<td>(fig. 10-12)</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>No epithelialisation – skin grafting</td>
<td>(fig. 7-9)</td>
<td>1</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

Fig. 1. Thermal burn of hands – status on admission, after wound washing and cleaning

Fig. 2. Suprathel application

Fig. 3. Clinical status 4 days after burn injury

Fig. 4. Clinical status 8 days after burn injury

Fig. 5, 6. Clinical status on day 19 of treatment
b) epithelialisation of the wound within 21 days – 1 patient,
c) no epithelialisation; deep burn, skin grafting necessary – 1 patient (fig. 7-9).

2. Dressing application on the second day after injury – 2 patients:
a) epithelialisation of the wound within 21 days – 1 patient,

b) dressing removal necessary – 1 patient.

3. Dressing application more than 48 hours after injury – 4 patients:
a) epithelialisation of the wound within 21 days – 2 patients (fig. 10-12),
b) dressing removal necessary – 2 patients.
Effectiveness of suprathel® application in partial-thickness burns, frostbites and Lyell syndrome treatment

Frostbite patient
1. dressing application within 24 hours of injury:
   a) epithelialisation of the wound within 14 days – 1 patient (fig. 13-17).

Patient with Lyell’s syndrome:
1. Dressing application on the 3rd day (fig. 18-20):
   a) healing after 3 weeks.

DISCUSSION

Dressings used in the treatment of skin defects can be divided into temporary and...
permanent ones. Permanent dressings include biological, synthetic and synthetic-biological dressings (9, 10).

Temporary dressings provide transient protection of the wound until its closure or coverage by the patient’s own skin layers. During the time of healing, the dressing should help reduce pain, absorb exudate and protect the wound from drying.

In burn treatment, temporary dressings find several applications: treatment of donor areas and superficial and partial-thickness burns until their epithelialisation, temporary protection of deep wounds until skin graft application and as a test for acceptance of an autograft. The most important property of those dressings is the temporary wound closure, which should provide protection from mechanical injury and drying and constitute a physical barrier for microorganisms (10).

Biological dressings include: xenogeneic grafts (from pig skin), allogeneic skin grafts and allogeneic amniotic grafts. Live grafts have the highest biological value, followed by frozen grafts and grafts kept in glycerol (9). Currently in Poland, it is impossible to cover wounds with live allogeneic grafts, since none of the Polish tissue banks sees the need for using this type of grafts in the treatment of patients with extensive skin defects. Live allogeneic skin grafts heal both into the granulation tissue and the excision wounds; they best perform the role of a skin substitute in conservative treatment. In Western countries, they represent the golden standard in temporary coverage of deep burns. Allogeneic skin grafts kept in glycerol are dead and play the temporary role of a biological dressing that will not heal into the wound, similarly to allogeneic amniotic dressings. The main drawback of biological dressings is their potential for transmitting infections (9, 10).

Synthetic dressings are made of artificial materials and are available in the form of single- or double-layer membranes. The most popular single-layer dressings usually consist of a layer of a semi-permeable material, which is to provide mechanical protection against microorganisms and prevent fluid loss through the wound. An example of such a dressing is Suprathel, which finds its application in the healing process as an epithelium substitute. The next type of dressings in this group is hydrocolloid dressings that absorb excess exudate and help create and maintain a wet environment in the wound, which helps the epithelialisation process. Another group is dressings made of hydrofibres that absorb wound exudate and are used as a temporary film for wound coverage. They can also be used in combination with silver ions, thus enhancing their properties with an antibacterial action (8, 9, 10).

Biobran is an example of a double-layer dressing which is designed to substitute the skin. The lower layer, which is created by a nylon mesh, is to facilitate the ingrowth of collagen-vascular elements producing the granulation tissue, whereas the upper external silicone layer is to act as the epithelium, limiting excessive evaporation and constituting an antibacterial barrier (9, 10).

All synthetic dressings have occlusive properties, which contributes to infection if they are applied to a contaminated wound, especially when necrotic tissues are present. Hence, constant monitoring of the healing process during their use is very important (9, 10).

Permanent dressings cannot be considered dressings in the strict sense; they should rather be considered implants or combinations of tissue grafts with implants. Substitutes of the epithelium, dermis and both these layers combined are currently available. Covering an extensive wound only with the epithelium does not ensure stability of the newly formed keratinocyte layer, healing is incomplete, and the epithelium is susceptible to mechanical injury and easily cracks. The above problem is associated with the absence of dermis (9).
Dermis substitutes consist of allogeneic dermis without dermis cells (AlloDerm). A thin graft of allogeneic epithelium is applied on top of this dressing (9).

The group of permanent double-layer dressings includes Integra, which consists of layers of collagen and chondroitin sulphate creating a matrix for the host’s own cells, and of silicone constituting a temporary substitute of the epithelium. A limitation to general use of these products is their fairly high price and high risk of formation of seromas or haematomas if such dressings are used on acute wounds. Another drawback of such dressings is the frequent need for reoperation (8, 9).

An ideal dressing that would constitute a skin substitute should have the following properties: infection prevention, resistance to hypoxia, acceptable cost, easiness of preparation, storage and application, variable thickness, absence of antigenicity, enabling long-term wound stability and its complete coverage, supporting epithelial and dermal renewal, resistance to abrasive forces, and general availability. Since none of the known dressings possess all these properties, each wound requires an individual evaluation of the case in order to select the most appropriate dressing (8).

When choosing the appropriate dressing for the process of burn wound healing, the following properties are primarily taken into account: support of the reepithelialisation process, reduction of patient’s discomfort, and minimisation of pain and treatment costs. Many dressings with the above properties have recently been developed. In particular, semi-permeable dressings which preserve humidity have gained importance. Nevertheless, many of these dressings have certain drawbacks, such as insufficient adherence to the wound, the risk of systemic action of the bacterial substances contained in the dressing or pain upon dressing change (6). Summing up, a modern dressing must play the role of a substitute of the damaged skin layers until the time of their regeneration (8).

According to the contemporary standards of burn treatment, these wounds should be closed as soon as possible (3, 7). One of the most common forms of thermal injury is second-degree (partial-thickness) burns. Although generally acceptable and used treatment rules are in force in the treatment of superficial and deep burns, the treatment of partial-thickness burns still presents clinical problems.

In contrast to deep burns that require debridement and coverage with a skin graft, superficial burns heal spontaneously within 10–14 days (6). Damage to superficial layers of the skin in partial-thickness burns prompts the search for dressings which would constitute a substitute of the damaged epithelium until the burn wound is covered by the patient’s own keratinocytes originating from skin appendages and wound edges (3, 5).

In this study, the treatment and coverage of partial-thickness burn wounds and frostbites with Suprathel was associated with a considerable reduction of pain in comparison with the treatment with the use of conventional dressings. Similar effects can be obtained only with the use of biological dressings such as amnion or allogeneic keratinocytes. Like Suprathel, biological dressings enable wound protection until its reepithelialisation; however, as it has already been mentioned, their use is limited and associated with a risk of infection transmission (7).

Owing to its properties, Suprathel closely adheres to the wound surface immediately after its application for the whole duration of its use, even at the problematic sites. Since it is not necessary to change the dressing daily, the healing process is accelerated, as there is no secondary mechanical damage to the keratinocytes migrating to the wound surface, which is associated with the removal of a dressing adhering to the wound (2, 7).

During the treatment, the patients reported a subjective reduction of the pain. Dressing transparency makes it possible to continuously monitor the wound healing process (2, 7). Pain reduction and accelerated healing increase treatment comfort for the patient, shorten the hospitalisation and lower the hospitalisation costs (2).

Infections under Suprathel are observed only if the dressing is applied to the burn wound with a delay after the injury, if necrotic tissues are left intact and in deep burns. Therefore, it is important to apply Suprathel to the wound as soon as possible after the injury, with thorough prior debridement. Dressing transparency makes it possible to easily identify the infection sites. Treatment is based on selective dressing removal, potential re-
moval of purulent exudate and the local application of a bactericidal substance.

In the case of small infection areas, they may become epithelialised from the edges covered by the epithelium. Conversion of the burn to a deep one may require skin grafting. It should also be added that the lack of the need to change the dressing reduces the risk of superinfection of the wound (2, 7).

In Lyell’s syndrome, the skin is damaged in a similar fashion to partial-thickness burns. The immediate use of Suprathel at the sites of epithelium separation represents a proven alternative to an epithelial substitute, reducing the risk of infection and creating good conditions for the epithelialisation process.

No allergic reactions were observed during the use of Suprathel in the treated patients (2, 7).

The positive results of treatment with Suprathel provide new possibilities in the approach to the treatment of partial-thickness burns, creating conditions that enable wound healing within 14-21 days (4).

CONCLUSIONS

1. Suprathel is a good dressing that can perform the function of a temporary epidermal substitute in partial-thickness burns and frostbites and in Lyell’s syndrome. Its elasticity allows treatment of wounds at problematic locations such as fingers and toes. Additionally, the lack of the necessity of removing Suprathel until the wound has healed minimises the pain associated with dressing change.

2. The dressing should be applied within 24 hours of injury, when there is the least exudate from the wound and the wound is not infected.

3. Therapeutic effectiveness of Suprathel decreases along with a delay of its application to the burn wound and with increasing burn depth.

REFERENCES


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