5. Wound Healing

5.1 Use of the Askina® Hydro Dressing for Moist Wound Treatment in Routine Dermatological Application

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Introduction

Askina® Hydro is a novel hydrocolloid wound dressing which has entered the German market in the mid of the year 2000 and is characterized by an especially high water binding capacity thereby fulfilling the needs to ensure an optimum „moist wound healing“. This advantageous, meanwhile well established principle of wound treatment was recognized as early as in the year 1962 under preclinical conditions in an animal model [1, 2].

Wound care will always have to consider a) the precise wound etiology and related pathogenetic co-factors b) the morphological wound appearance (including depth, size, anatomical localization, surrounding) in relation to the time course of the lesion; and c) the psycho-socioeco-

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nomic situation of the patient. The vast majority of skin wounds challenging the dermatologist's care may be divided into the following two categories: 1. the so-called „ulcus cruris“ (syn. lower leg ulcer) as a mostly chronic wound with a heavily impaired healing tendency and a varicose etiology in more than 80% of cases (Table 1); 2. fresh, i.e. acute and sub-acute wounds derived from dermatological surgery, such as full- and split-skin excision defects, undergoing a generally uncomplicated healing process.

Chronic, treatment-refractory „ulcus cruris“ is defined as an ulcer not healing within 12 months or showing no healing tendency within 3 months [3]. The prevalence of „ulcus cruris“ is at an estimated rate of 0.1 to 0.3% in the general population and of 2% in the subgroup of persons elder than 80 years [4]. Any „ulcus cruris“ will demand a meticulous diagnostic investigation with regard to the underlying causal factors then to be eliminated or treated, respectively [4, 5]. The corresponding diagnostic techniques and strategies are beyond the scope of this article focussing upon selected aspects of the local wound management.

The ancient concept to adapt the local treatment of such chronic wounds rather distinctively in terms of a consecutive, phase-wise sequel of different procedures – comprising a) initial débridement as well as antiseptic cleansing b) subsequent induction of granulation, and c) final stimulation of epithelization – has been transformed more and more to the nowadays view of performing an adequate, well practicable, uniform „wound-phase-bridging“ semi-occlusive hydrocolloid treatment [2].

We now report about our experience concerning the application of Askina® Hydro a) in 20 patients with mostly surgical skin wounds, b) in selected cases of chronic leg ulcers, and c) moreover we present corresponding in vitro data.
Table 1: Differential etiology of „ulcus cruris“: selection of common and essential causes and co-factors to be considered. In a considerable percentage of cases various causes do combine rendering a multifactorial disease etiology.

Material, methods and patients

* * *

Askina® Hydro: material qualities
Askina® Hydro is a sterile, self adhesive, bilayered wound dressing composed of
a) a thin skin-coloured, polyurethane foam outside and
b) a 1 mm thick hydrocolloid inside as a polyisobutylene matrix containing a natural carboxymethylcellulose polymer.
The latter is derived from the psyllium husk plant also known as planta-go ovata which is highly absorptive for the wound exudate. The wound dressing is permeable to oxygen and water vapour but impermeable to microorganisms.
Method of Askina® Hydro application
Fresh excision beds from taking split- and Reverdin-skin transplants were first treated by saline-soaked compresses for several minutes to stop bleeding, then carefully dried in the surrounding in order to apply Askina® Hydro. In some cases this first wound dressing was completed by a circular bandage exerting a mild compression. The first change of the dressing was performed after 3 to 5 days.

Chronic leg ulcers of various etiologies were treated conventionally with regard to the underlying causes. The local wound management comprised an initial antiseptic treatment for only a few days, followed by repeated Askina® Hydro dressings over a period of up to two to three weeks in order to achieve an optimum granulation for subsequent skin transplantation.

In all cases the general guidelines for the application of Askina® Hydro were followed (Table 2).

![Askina® Hydro Wound Dressing - Guidelines]

<table>
<thead>
<tr>
<th>Indications</th>
<th>Contraindications</th>
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<tr>
<td>Management of moderately to heavily exuding, partial to full thickness skin wounds, e.g. venous leg ulcers, arterial ulcers, pressure ulcers, burns I* and II*, donor sites, abrasions</td>
<td>very dry/necrotic wounds (e.g. burns III*, arterioopathy IV*), thick necroses should be removed before the application of Askina® Hydro</td>
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<tr>
<th>Dressing Application</th>
<th>Special Note of Caution</th>
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<td>- cleanse the wound (saline or Ringer solution)</td>
<td>The use of Askina® Hydro for local wound management does not replace the need for regular causative wound treatment modalities specifically targeting the pathogenetic conditions underlying to the wound processes (e.g. compressive treatment of venous stasis leg ulcers or standard decompressing nursing care for pressure sores)</td>
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<td>- dry the skin surrounding and clean it from any creams</td>
<td>- apply Askina® Hydro ensuring a 2 to 3 cm margin beyond the wound edges</td>
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<tr>
<td>- dressing changes after 24 hrs to 7 days depending upon the degree of exudation</td>
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Table 2: General recommendations for the application of Askina® Hydro
Patients

The major cohort comprised n = 20 patients with surgical wounds: There were n = 11 patients with superficial wounds derived from taking split thickness skin grafts (ages 70 ± 8, 58 to 81 years), n = 4 patients with wound beds from Reverdin transplant excisions (70 to 86 years), n = 4 patients with secondary healing after skin tumor excisions (64 to 86 years), n = 1 patient with a non-surgical traumatic skin abrasion wound (75 years-old).

In vitro testing

Human HaCaT keratinocytes were provided by N.E. Fusenig (German Cancer Research Center, Heidelberg) and routinely grown in Dulbecco’s Modified Eagle’s Medium (DMEM) supplemented with 10% fetal calf serum, 2% L-glutamine, and 1% antibiotic/antimycotic solution under a humidified atmosphere containing 5% CO₂ at 37 °C.

Complete culture medium without cells was incubated with Askina® Hydro for 72 hours. The HaCaT cultures were then exposed to this Askina® Hydro-pretreated medium for up to 48 hours. The culture supernatants were harvested at defined time points to determine the concentration of IL-1α released from the keratinocytes by a commercially available ELISA kit (Immunotech, France) [6].

Results

Clinical outcome

In the group of n = 20 patients treated with Askina® Hydro for surgical wounds, the hydrocolloid treatment supported an optimum wound granulation and epithelization in all cases. Two typical examples of our observations are depicted in Fig. 1 and 2 illustrating the healing process of split thickness skin wounds of various depths under the beneficial conditions of the Askina® Hydro treatment.

The Askina® Hydro dressings proved to be highly effective and were well tolerated. Moreover, the application of Askina® Hydro was characterized by an especially favourable practicability. The obvious advantageous
Fig. 1: Fresh donor site of a split thickness skin-graft at the left thigh of a 65 years-old patient (A). Fourteen days later: Askina® Hydro dressing in place (B) and removed (C) revealing a progressed status of epithelization. Nineteen days after surgery; when Askina® Hydro (D) was taken off (E), a completed, stable reepithelization became visible (F). Note, the skin-coloured polyurethane outerface of Askina® Hydro, and its polyisobutylene inside, the „natural-brown“ presentation of which (E) relates to the hemi-cellulose-fibre ingredients from plant origin (Plantago ovata, syn. Psyllium bush). These Psyllium bush fibres are highly hydrophilic providing an extraordinarily strong absorption capacity of Askina® Hydro for wound secretions. 

features of Askina® Hydro confirmed by our experience are listed in Table 3.

Askina® Hydro was found to be highly adaptive to the body contours, when modelled to the wound site by exerting a mild hand pressure also
Fig. 2: Fresh excision bed from taking Reverdin transplants at the right thigh of a 74 years-old patient (A). The Askina® Hydro dressing is applied immediately after the dermato-surgical procedure (B). Fifteen days later: Askina® Hydro is taken away (C). The wounds are nearly completely closed with a still thin, transparent, shiny epithelial cover (D). Take of Reverdin transplants in the lower leg ulcer (lateral, E, and medial, F, aspects, respectively). The surrounding of the ulcers was protected by zinc ointment.

ensuring an increased plasticity of the dressing matrix material while taking up the patient's body temperature. In selected anatomical localization with challenging body surface shapes, e.g. strong convexities, we used a special technique to achieve a nevertheless perfect fit of the dressing by performing radial incisions and dart-like pasting of overlapping edges (Fig. 3B).
Features of Moist Wound Healing by Askina® Hydro

1. Oxygen- and vapour-permeable occlusion providing moistening, temperature constancy, and acid pH regulation of wound micro-environment:
   a) autolytic débridement,
   and stimulation of:
   b) angiogenesis,
   c) formation of granulation tissue, as well as
   d) epithelialization
2. Strong absorption of wound secretion (by a non-degradable hemi-cellulose)
3. Atraumatic change of wound dressing (non-wound-adhesive)
4. Pain reduction
5. Protection against invasion of microorganisms and dirt
6. High comfort in wearing and changing wound dressings:
   - self-adhesive to the intact skin surrounding of the wound; adaptive to body contours; no necessity for secondary bandage
   - high absorption power without releasing hydrocolloid remnants into the wound (see above)
   - long intervals (up to seven, even ten days) between changes of the wound dressing, thereby providing economical efficiency.
   - (shower-)water-resistance
   - low risk of sensitization (low degree of allergenicity)
   - easy practicability for the patient treating him-/herself
   - cosmetically highly acceptable skin-coloured outer face

Table 3: Characteristics of Askina® Hydro as confirmed by the present clinical application study in more than 25 patients.

In some selected patients with varicose leg ulcers (n=6), Askina® Hydro was successfully used to achieve wound conditioning for subsequent skin transplantation. Noteworthy, at the beginning of this treatment the ulcers appeared to increase slightly in size which we attributed to the removal of crusts and necroses from the lesional edges. Even in a case of a very deep skin wound reaching the underlying bone structures Askina® Hydro proved to be highly useful to stimulate and sustain the formation of granulation tissue (Fig. 3 A–D).

Exposure of keratinocyte cultures with Askina® Hydro
Human HaCaT keratinocytes were exposed to medium which had been incubated with Askina® Hydro in defined ratios (dressing area/medium volume) for 72 hours before. Under this condition and at all time points tested during the subsequent 48 hours, the concentration of IL-1α released from the keratinocytes into the culture supernatant did not significantly exceed those concentrations of the untreated control (Fig. 4). Thus, there was no indication for any cytotoxicity, confirming in vitro the clinically evident dressing’s compatibility with the epithelial cell compartment.

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Fig. 3: Large area of skin wound reaching the depth of skull bone (A) as sequel from radical excision of a progressed, de-differentiated cutaneous squamous cell carcinoma (G3) with multiple satellite metastases in a 75 years-old patient. Because of chronic myeloid leukemia the patient had to be treated continuously with cytostatic drugs, such as hydroxyurea. Under these conditions of an extremely complicated and delayed wound healing process the application of *Askina® Hydro* (B) led to a complete wound closure by a vital granulation tissue within 3 months (C). There was a re-appearance of a few papules and nodules in the surrounding, which histologically proved to be metastases of the carcinoma (D; hematoxylin-eosin, 200×). Again these tumors were excised. The patient was administered a systemic cancer-protective treatment with interferon-α and tretinoin, and now is carcinoma-free without any indication for lymphogenic or hematogenic carcinoma metastases. Note, the special mode of application of *Askina® Hydro* in a highly convex globe-like body surface, such as the bi-temporoparietal site (B). In this case *Askina® Hydro* was used in its 20 × 20 cm presentation.
Fig. 4: In vitro testing of Askina® Hydro demonstrating its excellent compatibility with human keratinocytes as the major cell population contributing to epithelization under in vivo conditions.

**Comment**

Wound healing is a highly complex biological process which under regular natural conditions occurs well coordinated resulting in wound closure at a maximum speed [7], a process which may be accelerated only by a few elaborate artificial measures, e.g. surgical techniques of tissue adaptation and autologous skin transplantation. However, wounds may be induced and wound healing may be impaired by a large number of endogenous, exogenous and even iatrogenic factors resulting in chronic lesions. Any successful treatment approach for chronic, delayed healing wounds will have to target the underlying causes on the one hand [4, 5], and to provide an adequate local wound management on the other hand.

Since many years the skin is an attractive organ to investigate wound healing phenomena. One reason is the organ’s overt advantage to be studied by simple inspection. As a sequel from these research efforts various biological skin substitutes produced by cell culturing techniques [8–14] as well as recombinant growth factors, such as recombinant platelet-derived growth factor (rhPDGF-BB, becaplermin) [15, 16], are now available for practical treatment purposes, although still restricted to well defined indications. The future may bring even gene therapeutic
approaches, provided that biological safety issues and ethical concerns will be resolved [17–19].

Today, the application of semipermeable hydrocolloid dressings is a broadly established routine procedure of local wound management to achieve an optimum moist healing condition [2]. In this regard, we have hereby presented our excellent clinical experiences with the use of Askina® Hydro as a relatively novel dressing material. The Askina® Hydro dressing is, due to its ingredient *psyllium husk*, characterized by an extremely high absorbing capacity, i.e., 1 g of the hydrophilic *psyllium*-muciloid is able to absorb more than 40 g of water [20]. It may be interesting that because of this extraordinary water binding capacity *plantago ovata* has been widely and safely used also as a laxative in general medicine for many years. Moreover *psyllium* applied as a nutritional adjunct was recently shown to lower blood glucose in diabetic patients [21] as well as serum total cholesterol and LDL-cholesterol significantly [22].

In conclusion, our present clinical application study demonstrated Askina® Hydro to be a very effective, extremely well tolerated and highly practicable dressing for the moist wound treatment of the whole spectrum of split- and full-thickness, fresh and chronic skin lesions provoked by exogenous and endogenous causative factors. Askina® Hydro provided an optimum autolytic débridement, support of granulation and epithelization, and as an elegant novel dressing was very well accepted by the patients, nurses and physicians.
References