The Use of a New Wound Alginogel for the Treatment of Partial-thickness Hand Burns

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WOUNDS 2010;22(6):161–164

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Disclosure: Mr. Van den Plas was an employee of Flen Pharma at the time this manuscript was developed and written.

Abstract: The following retrospective analysis reports on patients with partial-thickness wounds admitted to the burn unit of the General Hospital of Athens who were treated with a new alginogel and were later compared to the burn center's standard treatment. *Methods.* Patient information from January–December 2008 was analyzed for the number of days until healing and wound bacterial loads. Wound healing was characterized as a quick onset of epithelialization and low occurrence of inflammation. *Results.* A limited number of wounds (15%) were found to be positive for wound swabs and accordingly few signs of inflammation were reported. The organisms that were retrieved from the alginogel treated wounds were *Staphylococcus aureus, Staphylococcus epidermidis, Staphylococcus hominis,* and *Acinetobacter baumanii. Conclusion.* These data are discussed and compared with the experience of the burn unit and its standard treatment.

Deep partial- and full-thickness hand burns are common and a source of potentially significant morbidity.[1] After stabilization of the burned area, the aim of subsequent care is to restore wound coverage and movement within 14–21 days of injury, as it is important to make the hand functional at the conclusion of treatment.[2,3] Ideally, functional restoration should include both fine pinch and power grip but will ultimately be determined by the individual patient's needs.[4] A nonoperative approach to most hand burns is advocated, and principles of early wound care, including antimicrobial therapy and escharotomy, must be considered.[5] Several dressing types can be used to achieve this goal, optionally in combination with a skin graft.

The gold standard in hand burn treatment is to achieve prompt closure of the wound while avoiding inflammation, cover with a dressing that does not limit hand and finger movement, and provide a warm, moist environment with antimicrobial protection. Classical moisturizing creams (eg, Bepanthol®) provide warmth and moisture, but do not offer antibacterial protection. Silver sulphadiazine and other silver based dressings provide antimicrobial treatment but may delay re-epithelialization and wound healing.[6-8]

Additionally, there are reports on development of resistance in bacteria.[9,10] Povidone-iodine is a commonly used local antiseptic in wound care. The drawback of its use is that it does not generate a moist environment, at least during the initial days of healing.[11] Since the early 1960s it has been advocated that proper moisturization is integral to wound healing.[12] Efforts have been made to integrate iodine in moisturizing ointments[13] but with limited success to date. In short, an ideal dressing should protect the wounds from infection, should restore moisture balance of the wound, and at the same time should minimally disturb wound healing. More recently, a new product has been introduced to the market that efficiently provides these characteristics.

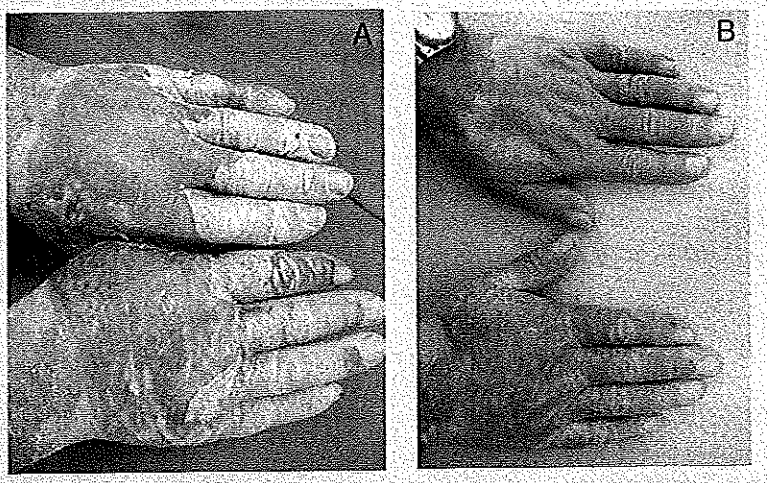

Figure 1. A) Representative example of a patient's hands that were treated with the alginogel at inclusion. B) Ten days after treatment, complete healing is seen.

The new product (Flaminal® Hydro, Flen Pharma NV, Kontich, Belgium) is a hydro-active, broad-spectrum alginogel with a biologic antimicrobial system based on two enzymes—glucose oxidase and lactoperoxidase—that are stabilized by guaiacol. The biological antimicrobial system is incorporated into a viscous alginate-polyethyleneglycol-water mixture. The alginate polymers have balanced proportions of guluronic and mannuronic acids, as well as sodium and calcium ions. The broad-spectrum antimicrobial enzyme system protects against microbial colonization without disturbing the physiological wound healing processes.[14]

The goal of this retrospective study was to evaluate the effectiveness of the alginogel in the treatment of partial-thickness hand burn injuries of patients admitted to the authors' hospital.

Methods

This retrospective analysis from the hospital's database retrieved 70 hospitalized patients (42 men, 28 women) between 17- to 87-years-old (average 46.4 ± 16.7 years) with partial- and deep partial-thickness thermal hand burn injuries. In 3 cases from 2008, the burn injury extended to the distal third of the forearm.

The burn wounds were evaluated clinically, which is the most widely used and the least expensive method of assessing burn wound depth.[15] This method relies on an evaluation of the external features of the wound such as wound appearance, capillary refill, and burn wound sensibility to touch and pinprick.[16,17] Forty seven patients were treated with the new alginogel and the outcome is compared with 23 patients who were treated with silver sulphadiazine cream, which was our method of previous standard care (reference group). In all cases, wounds were thoroughly cleansed with a mild topical antiseptic solution and wounds were debrided (when needed) before application of the products. A secondary dressing was applied on the wound surface. Other topical treatments that might influence the wound healing process were not administered.

The patient information from the database consisted of total body surface area (TBSA) recordings, documentation on wound closure time (defined as full re-epithelialization and satisfactory clinical assessment), and information on wound swabs that were taken and analyzed. All patients received oral or/and intravenous antibiotics based on wound culture results.

Statistical Analysis

Ordinal, non-paired, comparative data were analyzed by the non-parametric Mann-Whitney U-test. Non-paired categorical records were analyzed by the Fisher's exact test. Data with normal distribution were analyzed by the Student *t*-test; *P*-values of 0.05 or 0.01 were considered statistically different.

Results

The difference in TBSA and age of patients in the alginogel group compared to the reference group of silver sul-

phadiazine cream was not statistically significant ($P > 0.1$).

In the alginogel group the mean days of epithelialization and satisfying healing was 6 ± 5 days. Signs of healing in this group were apparent from the third day of treatment and progressed rapidly. Significant inflammation (limited pain and edema) for patients during alginogel treatment was not recorded. Two patients were initially misdiagnosed at admittance with deep, partial-thickness burns, which later were determined to be full-thickness. These patients underwent surgical treatment. Positive cultures in the alginogel group were seen in 7 of 47 wound swabs (15%). The following microorganisms were identified: *Staphylococcus aureus* (3 patients), *Staphylococcus epidermidis* (1 patient), *Staphylococcus hominis* (1 patient), and *Acinetobacter baumanii* (2 patients). The latter bacteria were specifically recorded during summer time.

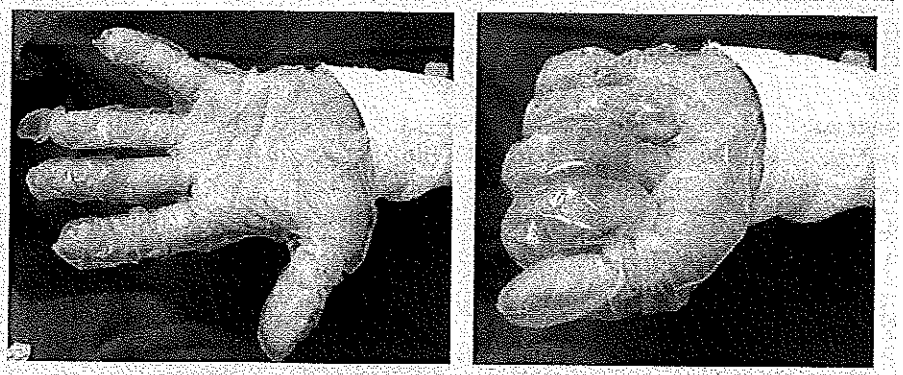

Figure 2. Example of a burned hand that was treated with a thin layer of alginogel (3 mm–5 mm) covered by a plastic glove, which allows the hand to move and facilitates physiotherapy at an early treatment stage.

In the reference group (silver sulphadiazine group), mean days of epithelialization and satisfying healing was 11 ± 11 days. Signs of healing appeared later compared to the alginogel group. In this control group one or more of the following microorganisms were found in 12 patients out of 23 patients (52%): *Staphylococcus aureus*, *Pseudomonas aeruginosa*, *Acinetobacter baumanii*, *Klebsiella pneumonia*, *Bacillus cereus*, *Staphylococcus epidermidis*, *Staphylococcus hominis*, *Fusobacterium nucleatum* (possible origin oral mucosa flora), *Candida albicans*, *Enterobacter cloacae*, *Enterococcus faecium*, *Enterococcus faecalis*, *Proteus bulgaris*.

When comparing both treatments (Table 1), there was a statistical difference in the number of patients who had a positive wound swab ($P < 0.01$), the number of patients healed within or at 14 days ($P < 0.05$), and the number of patients healed within or at 21 days ($P < 0.01$).

Table 1. Analyzed wound data.

	Positive wound swabs	Healed < 14 days	Healed < 21 days
Alginogel n = 47	7	42	47
Reference treatment n = 23	12	15	19
	$P < 0.01$	$P < 0.05$	$P < 0.01$

Discussion

The aim of this retrospective analysis on patients' data admitted at the burn unit of the authors' hospital in 2008 was to verify the effectiveness of a new alginogel. Introduction of this product to our general wound management approach was considered since it has interesting features such as bacterial load control, continual debridement, high bio-compatibility, and its optimized moisture control.[18,19] The product proved to be effective in chronic wounds,[20] but whether it would be helpful in treating acute wounds such as burns remained unclear. During the healing process of partial-thickness hand burns it is of utmost importance to restore wound coverage and movement of the injured area in order to ensure functionality at the conclusion of treatment. Satisfactory treatment outcome usually is obtained when a partial-thickness burn heals within 14 days, and definitely heals within 21 days; thereafter, an increased risk of developing hypertrophic scarring and contractures exists.[2]

It was found that the mean number of days to healing for partial-thickness hand burns treated with the alginogel was less when compared to the standard treatment (6 versus 11, respectively). Noteworthy inflammation (limited pain and edema) was not reported in the 47 patients treated with the alginogel. A limited number of positive wound swabs were reported and 4 different bacterial strains were identified compared to 13 in the reference

group. Interestingly, among the four identified bacterial stains, *Pseudomonas aeruginosa* was not encountered. Other studies have identified high prevalence of these bacteria in burns,[21,22] which are particularly problematic since they are inherently resistant to many drug classes and are resistant to antimicrobial drugs.[23] The low number of infected hand burns and limited number of identified bacterial strains in the alginogel are in accordance with the results of a recent pre-clinical study.[14]

Conclusion

The retrospective analysis of our hospital data demonstrates that the new alginogel applied on partial-thickness burn injuries of the hand yields favorable healing outcomes in addition to offering antimicrobial protection. Early onset of epithelialization, rapid wound closure, no re-admittance for inflammation, and a limited number of positive swab cultures were observed. Additionally, the new product facilitates hand and digit movement, which is an important treatment outcome. In the future, a larger patient group is warranted to verify data from this study.

References

1. Cartotto R. The burned hand: optimizing long-term outcomes with a standardized approach to acute and subacute care. *Clin Plast Surg.* 2005;32(4):515-527.
2. Hoeksema H, Van de Sijpe K, Tondu T, et al. Accuracy of early burn depth assessment by laser Doppler imaging on different days post burn. *Burns.* 2009;35(1):36-45.
3. Tredget EE. Management of the acutely burned upper extremity. *Hand Clin.* 2000;16(2):187-203.
4. Robson MC, Smith DJ Jr., VanderZee AJ, Roberts L. Making the burned hand functional. *Clin Plast Surg.* 1992;19(3):663-671.
5. Feldmann ME, Evans J, O SJ. Early management of the burned pediatric hand. *J Craniofac Surg.* 2008;19(4):942-950.
6. Atiyeh BS, Costagliola M, Hayek SN, Dibo SA. Effect of silver on burn wound infection control and healing: review of the literature. *Burns.* 2007;33(2):139-148.
7. Burd A, Kwok CH, Hung SC, et al. A comparative study of the cytotoxicity of silver-based dressings in monolayer cell, tissue explant, and animal models. *Wound Repair Regen.* 2007;15(1):94-104.
8. Van Den Plas D, De Smet K, Lens D, Sollie P. Differential cell death programmes induced by silver dressings in vitro. *Eur J Dermatol.* 2008;18(4):416-421.
9. Landsdown AB, Williams A. Bacterial resistance to silver in wound care and medical devices. *J Wound Care.* 2007;16(1):15-19.
10. Silver S, Phung le T, Silver G. Silver as biocides in .0burn and wound dressings and bacterial resistance to silver compounds. *J Ind Microbiol Biotechnol.* 2006;33(7):627-634.
11. Ioannovich J, Tsati E, Tsoutsos D, Frangia K, Papalois A. Moist exposed burn therapy. Evaluation of the epithelial repair process (an experimental model). *Ann Burns Fire Disasters.* 2000;8(1):3-9.
12. Winter GD. Formation of a scab and the rate of epithelialization of superficial wounds in the skin of the young domestic pig. *Nature.* 1962;193:293-294.
13. Vogt PM, Reimer K, Hauser J, et al. PVP-iodine in hydrosomes and hydrogel—a novel concept in wound therapy leads to enhanced epithelialization and reduced loss of skin grafts. *Burns.* 2006; 32(6):698-705.
14. De Smet K, Van den Plas D, Lens D, Sollie P. Pre-clinical evaluation of a new antimicrobial enzyme for the control of wound bioburden. *WOUNDS.* 2009;21(3):65-73.
15. Heimbach D, Engrav L, Grube B, Marvin J. Burn depth: a review. *World J Surg.* 1992;16(1):10-15.
16. Devgan L, Bhat S, Aylward B, Spence SJ. Modalities for the assessment of burn wound depth. *J Burns Wounds.* 2006;15(5):e2.
17. Watts A, Tyler MP, Perry ME, Roberts AH, McGrouther DA. Burn depth and its histological measurement. *Burns.* 2001;27(2):154-160.
18. Lacarrubba F, Patania L, Micali G. Open label evaluation of an alginates hydrogel in the treatment of leg ulcers. *Ital J Dermatol Venereol.* 2005;140(1):83-88.
19. Vandenbulcke K, Horvat LI, De Mil M, Slegers G, Beele H. Evaluation of the antibacterial activity and toxicity of 2 new hydrogels: a pilot study. *Int J Low Extrem Wounds.* 2006;5(2):109-114.
20. de la Brassinne M, Thirion L, Horvat LI. A novel method of comparing the healing properties of two hydrogels in chronic leg ulcers. *J Eur Acad Dermatol Venereol.* 2006;20(2):131-135.
21. Agnihotri N, Gupta V, Joshi RM. Aerobic bacterial isolates from burn wound infections and their antibiograms—a five-year study. *Burns.* 2004;30(3):241-243.
22. Song W, Lee KM, Kang HJ, Shin DH, Kim DK. Microbiologic aspects of predominant bacteria isolated from the burn patients in Korea. *Burns.* 2001;27(2):136-139.
23. Salehifar E, Khorasani G, Ala S. Time-related concordance between swab and biopsy samples in the microbiological assessment of burn wounds. *WOUNDS.* 2009;21(3):84-88.