The Effectiveness of Liquid Bandage as an Adhesive and Antimicrobial Agent

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INTRODUCTION

A useful dressing for wounds not only facilitates healing but also has antimicrobial properties. A new Food and Drug Administration (FDA)-approved occlusive dressing (Elastic Skin Liquid Bandage, Medpak, LLC) first introduced 3 years ago, fulfills both requirements. This product consists of an organic polymer, known as polymer A, which is applied to the wound in liquid form. Polymer A is in methylene chloride which an anhydrous halogenated aliphatic hydrocarbon that is used commercially as a solvent in many different industries including pharmaceutical manufacturing. When applied to wounds, the solvent evaporates producing a elastic, transparent and occlusive dressing. It has already been used on hundreds of wounds secondary to trauma, shave biopsies, and Mohs micrographic surgery, including on flap and full-thickness skin graft repairs.

DISCUSSION

Adhesive Uses

Although the use of a liquid bandage often obviates the need for a paper and tape bandage because it acts as a barrier and protects against microbes, the latter may be needed following surgery for a pressure bandage as well as aesthetics. Shortly after its introduction 3 years ago, the authors found that the liquid polymer dressing also serves as an effective adhesive when applying TELFA® (Kendall Company) to cover the wound (Figures 1 and 2). With this new information, a comparison study was also conducted by the authors to find out if the liquid bandage was equal to Mastisol® (Ferndale Laboratories) as an adhesive in covering wounds and applying Steri-Strips™ (3M). Study results indicated that the liquid bandage was equally effective as Mastisol with the advantage that the former is able to both aid in wound healing and affix the bandage (Figure 3). In addition, there is no need to use another product such as Detachol™ (Ferndale Laboratories) to remove the gummy substance produced as there may be with Mastisol nor is there a strong odor that is often associated with Mastisol. Any residual polymer is easily removed with soap and water.

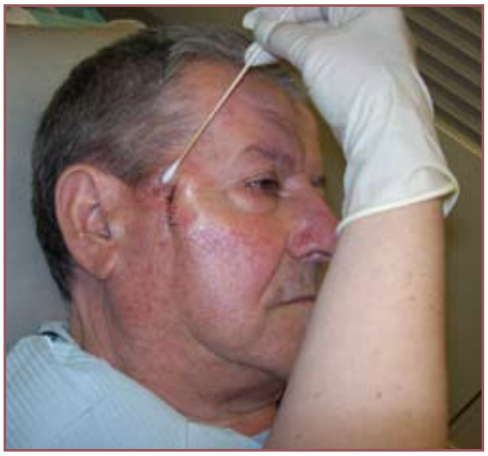

FIGURE 1A. Application of liquid bandage on and around the wound.

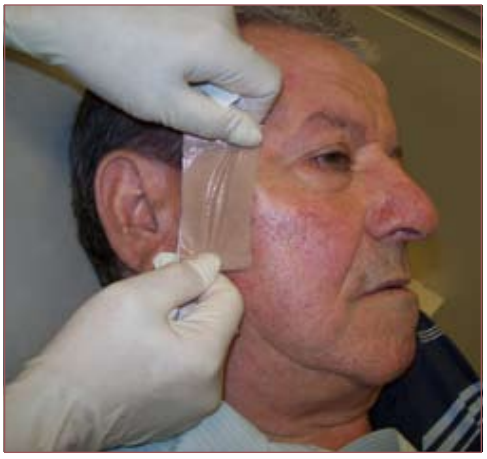

FIGURE 1B. Application of liquid bandage on and around the wound.

Therefore, it was concluded that it might be advantageous to use liquid bandage following surgery and biopsies to aid in wound healing and act as an adhesive to apply a pressure dressing, if so desired. (AUTH Q: Need reference of study)

Antimicrobial Properties

The organic liquid polymer dressing has proven to be effective

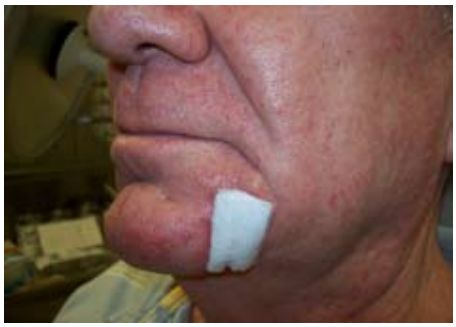

FIGURE 2. Application of TELFA using liquid bandage as an adhesive.

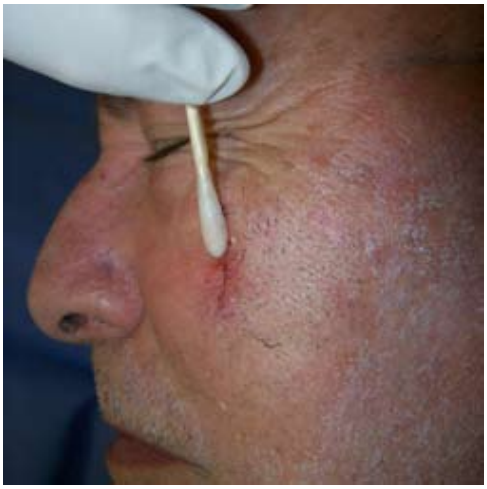

FIGURE 3A. After the removal of suture, the liquid bandage is applied for the fixation of Steri-Strips.

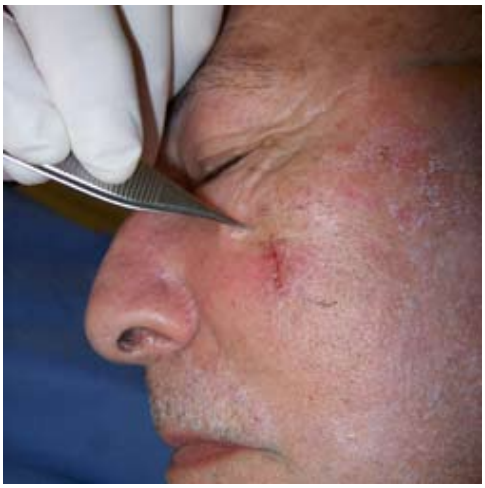

FIGURE 3B. Placement of Steri-Strips to be kept in place for 4 to 5 days.

in vitro in hindering the growth of bacterial organisms, and there is evidence supporting additional antimycotic effect on superficial fungal organisms in wound healing. Its antimicrobial properties were demonstrated with 2 different assays using the pour plate method and the enrichment method. The results of these assays confirmed the growth inhibition of *Candida albicans*, *Aspergillus niger*, *Pseudomonas aeruginosa*, and *Staphylococcus aureus*.[1]

Given its success in preventing bacterial infections in wounds, a laboratory tested the utility of this liquid bandage in inhibiting growth of the 2 most commonly encountered dermatophytes: *Trichophyton rubrum* and *Trichophyton mentagrophytes.*

Fungal culture enables the identification and quantitation of most fungus species. Results are reported in either CFUs (colony forming units) per gram for bulk specimens, or CFUs per m^3 for air samples collected on agar plates. Suspensions and dilutions were made from bulk and swab samples, incubated on appropriate media at 30 degrees Celsius for 7 days before reporting negative results. Andersen plates were also incubated at 28 degrees Celsius for 7 days. Fungi are identified morphologically, using primarily the morphology of the spores and fruiting bodies.

Initial calculated counts of *Trichophyton rubrum* and *Trichophyton mentagrophytes* were found to be $2.6X10^5$ and $1.0X10^6$ CFUs/mL, respectively. Actual counts in CFU/mL and log reductions were found to be $<5.0X10^0$ and >4.7 for *T rubrum* after contact times of 5 minutes, 1 hour, and 7 days. *Trichophyton mentagrophytes* counts decreased to $<5.0X10^0$ with a log reduction of >5.3 after 5 minutes, 1 hour and 7 days of contact. To demonstrate whether the reduction in organisms was solely a result of the liquid polymer dressing, a neutralization validation test was performed and replicated an additional 2 times. When the liquid polymer was neutralized, 100% recovery of *T rubrum* was obtained while *T mentagrophytes* was recovered at 95.8% to 100%. A limitation of this study is that fungal cultures typically require 21 days to grow and sample plates were incubated for only 7 days.

Trichophyton rubrum and *T mentagrophytes* are the most common agents of fungal infections worldwide and impact millions of individuals annually.[2,3] These organisms are primarily responsible for causing infection on the body (tinea corporis), hands (tinea manuum), inguinal region (tinea cruris), feet (tinea pedis), and the nails (tinea unguium-onychomycosis). If uncomplicated, the majority of these infections are generally treated with topical antifungals, while tinea manuum and tinea pedis may also require the assistance of products containing glycolic acid, lactic acid, or urea to reduce the amount of hyperkeratosis.[4] Many of these products have to be applied twice a day and may be quite messy and tedious, especially on the hands and feet. The liquid polymer dries instantly upon contact, forming a transparent adhesive, until it is peeled away, and would likely be more cosmetically elegant than conventional topical medications, which are in a cream or ointment vehicle. The polymer film forms a barrier to external oxygen. Fungi generally require oxygen to grow. Therefore, it is believed that this property of the polymer may contribute to its possible fungicidal behavior. Further testing with longer incubation times and *in vivo* studies are warranted.

Tinea unguium, or onychomycosis, however, requires systemic antifungal therapy and may take months, especially if there is involvement of the toenails. These systemic medications, such as terbinafine, are not without their side effects such as cutaneous eruptions and gastrointestinal disturbances with a potential for liver toxicity. For this reason, terbinafine requires screening for hepatic disease prior to administering and close monitoring of liver function in patients receiving treatment for longer than 6 weeks.[5,6] It is not uncommon for patients to have involvement of only 1 or 2 toenails; therefore the risk of these medications may outweigh the benefits. Although it is not yet known if liquid bandage will be able to penetrate the nail, it may be a feasible alternative for patients with limited involvement or those who are not candidates for systemic antifungal therapy. The nails may be partially filed to reduce thickness and increase the diffusion rate of the liquid bandage solution.

Wound Healing

These preliminary findings may suggest a novel use for this liquid polymer dressing. It has already been effective in expediting wound healing following trauma with resultant minor scrapes and burns as well as postsurgical procedures. Hsiung and Robins presented 3 cases in which liquid bandage expedited healing and prevented infection, in patients following shave biopsy of the infralabial area and Mohs micrographic surgery with subsequent rotation flap repair of the auricle and full–thickness skin graft of the nasal tip.[1] In their experience of treating over 100 patients, they have found that wound care with the polymer dressing has often been generally well-tolerated with only mild temporary stinging on initial contact if the site was not previously anesthetized and there has not been any allergic hypersensitivity. It is also more convenient and cost-effective than applying a dressing with a nonadherent pad and antibiotic ointment, since these must be changed at least daily and allergies to these products are not uncommon. Wound care on such locations as the scalp, highly mobile joints, and difficult to reach areas can often be quite difficult due to the inability of adhesion of traditional dressings. Tests have indicated that the solution is hypoallergenic. The resulting film is highly elastic, with a low softening point that is softened by normal skin temperature (33°C).

CONCLUSION

In conclusion, a new organic polymer in organic solvent has initially been found to have success in expediting healing of wounds secondary to trauma and surgical procedures. It is easy to apply and well-tolerated, forming a transparent barrier that is both functional by virtue of its antimicrobial and adhesive properties, as well as cosmetically acceptable. Recent laboratory findings suggest that it may also has anti-fungal capabilities and could hypothetically to be used to treat uncomplicated dermatophyte infections, including those that may necessitate systemic treatment. Clearly, in vivo studies are necessary to determine the clinical relevance of these findings and whether this diverse product will have a place in the dermatologist's armamentarium for the purpose of treating superficial fungal infections. Its use as an adhesive will clearly benefit patients in that it reduces the need for multiple products by acting as both an antimicrobial and an easily removable adhesive.

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