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Case Report

Can Salt Solution Bathing and Education Improve Skin Care for Atopic Dermatitis?

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Abstract

Atopic dermatitis (AD) is a multifactorial, chronic inflammatory skin disorder resulting from disruption of the epithelial barrier and inflammation. A wide range of treatments are currently available for AD, aimed to restore impaired skin barrier and control inflammation. In order to avoid systemic therapy, the soak and smear technique, the Wet-Wrap Treatment (WWT) with physiologic lipid-based barrier repair therapy and proactive use of topical corticosteroids, can represent an alternative and excellent option, with encouraging results. We report this strategy ("*global topical approach*") in a 12-year-old girl with severe AD, with no longer satisfactory response to topical therapy. We discuss the utility of bathing and evaluated the Hill's criteria for causation for the use of a new salts' composition to be added to water during soaking.

Keywords: Atopic eczema; Atopic dermatitis; Bath; Children; Salt solution; Treatment

Introduction

Bathing is suggested as an advantageous non-pharmacologic intervention for the regular skin care of patients with Atopic Dermatitis (AD) in the latest guidelines of the American Academy of Dermatology [1]. Indeed, regular bathing with water can not only hydrate the skin, but also remove scale, crust, irritants, and allergens [2], enhance penetration of topical agents and give emotional and social benefits to patients [3]. However, those effects can be different depending on the bathing practices, and currently there is no appropriate standard for the frequency or duration of bathing for patients with AD. Moreover, it is still unclear whether the addition of oils, emollients, and other additives to bath water may produce further benefits for management of AD. Therefore, the role of bathing as a complementary treatment strategy for AD remains a matter of debate [1].

Colloidal grain suspensions added to bath have been used for decades as adjuncts in the treatment of AD. Nevertheless, oat and wheat ingredients in cosmetics and personal care products may increase the risks of sensitization to these grains through the skin, and may result in immediate- and delayed-type hypersensitivity reactions [4]. Therefore, it has been suggested to avoid topical application of oat proteins in infants with AD [5].

Dilute bleach baths have been proposed to suppress epidermal *Staphylococcus aureus* load in patients with AD, but a recent meta-analysis suggested that although bleach baths are effective in decreasing AD severity, they do not appear to be more effective than water baths alone [6].

Bath oil can be added to the tube after the patient has soaked for 15-20 minutes in order to seal the moisture in the hydrated skin. However, patients usually add bath oil before entering the tube and this creates a film of oil over the skin, which can reduce the penetration of water into the stratum corneum and decrease the effectiveness of the soak and smear technique [7]. In line with this observation, a recent pragmatic open label trial, which randomized 483 children (aged 1-11 years) with atopic dermatitis to regular use for 12 months oily or oat-based emollient bath additives *versus* no bath additives, found no evidence of clinical benefit from including emollient bath additives in addition to standard topical eczema management strategy [8].

The question whether the addition of salts and non-irritating, non-sensitizing substances to water baths can improve skin care and long-term maintenance in children with AD remains unanswered.

Clinical Scenario

A 12-year-old Nigerian girl with eczema since infancy, diagnosed with Atopic Dermatitis (AD) associated with asthma and allergy to multiple inhalant allergens. Due to a progressive worsening eczema her sleep was seriously disturbed with consequent compromised school attendance. She was admitted to our Clinic for "progressively worsening of atopic dermatitis and severely quality of life disturbing itching".

At physical examination, she presented with dry skin all over her body and lichenification on the flexor surface of both elbows and knee joints, as well as on the inguinal and lumbar regions. The mean Scoring Atopic Dermatitis (SCORAD) score at baseline was 82 (severe diseases if SCORAD > 50). As long as the home run treatment with moisturizers and topical corticosteroid had not raised any results, we decided to start a soak and smear treatment7 and the wet-wrap therapy in addition to the topical treatment [9].

In practice, prior to any topical treatment we decided to bath the girl in a tube for 15-20 minutes using a dose of plane water sufficient to cover the entire body surface with the addition of 60 g of a new salt solution containing MgCl, $MgSO_4$, NaCl, urea, and allantoin (Idrocristalli Envicon®, Envicon Medical Italy).

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Figure 1: Total body wet wrap therapy.

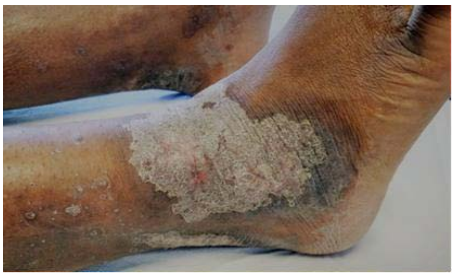

Figure 2a: Details of the ankle lesions before.

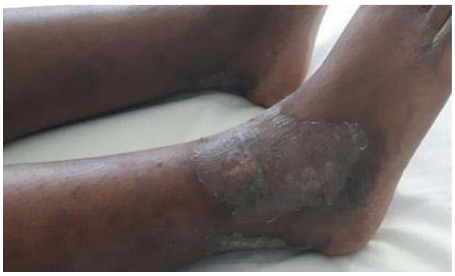

Figure 2b: After our global strategy.

Without drying the skin we than used the wet-wrap therapy [9]. This consisted first in the application on flared skin areas for 2 times a day of a topical corticosteroid (0.05% fluticasone cream, Flixoderm®, GSK) together with a the correct amount [10] of a physiologic lipid-based barrier repair emollient [11] containing an equimolar ratio of ceramide, cholesterol and ≥1 fatty acids, as well as hyaluronic acid, plus another emollient containing glycyrrhetinic acid and vitis vinifera (Envicer3® and Enviplus®, Envicon Medical Italy). Secondly, we cutted the tubular bandages (cotton wool-Envitube®, Envicon Medical Italy) to fit arms, legs, and trunk (Figure 1) and moistened them in the same warmed saline water used for the bath before application onto the patient's skin. Two other layers of dry tubular bandages were then fitted over the previous layer and kept in place for 11-12 hours. This "*global topical strategy*" resulted in an evident clinical improvement of the lesions confirmed by a mean SCORAD of 37 one week later (Figure 2a, 2b).

Discussion

We presented a case of a teenager with severe recalcitrant AD who was hospitalized for an acute flare and showed a faster response to topical treatment via wet-wrap dressing and to water baths with the addition of a new salt solution containing MgCl, $MgSO_4$, NaCl, urea, and allantoin.

There is a substantial body of evidence to show that WWT is useful for patients with moderate to severe AD to reduce disease severity and Trans-Epidermal Water Loss (TEWL) during acute flares [1,12]. On the contrary, the efficacy of salt solution baths in the skin care of AD has been studied only in a few trials, although there is anecdotal evidence of their beneficial effect on the skin of children with AD from observation studies looking at the impact of holidays taken in the Mediterranean sea [13], of bathing in magnesium rich-Dead Sea salts [14] and of balneotherapy in general [15]. Given the limited data on the addition of bleach, oat and oils and other related additives to bath water and their benefits for AD it is worth considering the possibility to add salts and skin soothing-wound healing and moisturizing agents such as allantoin and urea to the baths.

Arguments for causality using the criteria proposed by Hill in 1965 (13) can be considered for balneotherapy [16]. The *strength* (effect size), *consistency* (reproducibility), *specificity* (causation is likely if there is a very specific population at a specific site and disease), *temporality* (the effect has to occur after the cause), *biological gradient* (greater exposure should generally lead to greater incidence of the effect) have been proved in several studies since improvement in AD was repeatedly observed after exposure to specific environmental condition in Dead Sea. This strongly correlated to the duration of the exposure with higher cumulative exposure times associated with better results and enhanced remission [17-19]. However, in relation to the use, in our patient, of a particular salt solution mimicking Dead Sea, it is particularly interesting to consider *plausibility*: the plausible mechanism between cause and effect. Among the separate ions present in the Dead Sea water, chloride (212.4 g/l), and magnesium (40.65 g/l) are noteworthy. In fact, it is known that magnesium enhances the ability of the skin to retain water due to its high hygroscopic properties [20]. Magnesium salt promotes skin barrier integrity by acting on adhesion molecules E-cadherin and-integrin-mediated migration of keratinocytes [21], shows anti-inflammatory properties [22], and can inhibit the antigen-presenting capacity of Langerhans' cells [23] important for sensitization and elicitation of allergic reactions. Magnesium can be absorbed by damaged skin and transmembrane proteins could lead to its further penetration through the organ systems, where it can exert anti-inflammatory activities by tumour necrosis factor-alpha (TNF-α) and nuclear factor kappa-B (NF_kB) down regulation [24]. Indeed, the use of a Dead Sea salt solution, rich in magnesium ions, has been shown to accelerate skin barrier recovery [25], to enhance stratum corneum hydration, and to reduce transepidermal water loss, roughness and inflammation of the skin in patients with AD [26].

Furthermore, solutions made up by NaCl salt various concentrations (1% up to 30%), used in combination with artificial

UV radiation, have been shown to play a role in the maintenance of remission of AD, since the effect of combined treatment with salt water baths and UV radiation has been demonstrate to be superior to UV radiation alone [27]. In line with this observation, it has been observed that bathing the skin with mineral water with NaCl is effective in preventing disruption of skin barrier and stratum corneum water content after cumulating irritation with sodium lauryl sulphate [28]. In addition, NaCl salt has a role in reducing the load of *Staphylococcus aureus* isolated from AD skin lesions to tissue-culture [29], thus potentially contributing in the improvement of two crucial pathogenetic features of AD.

Other components of the bathing solutions need to be considered. Urea is an important hygroscopic component of the epidermis, where it participates in the maintenance of skin hydration, as part of the skin's source of natural moisturizing factor (NMF) in the outermost layers [30] and where it can reduce itching via inhibition of tryptic enzymes [31]. Recently, urea's role in skin hydration and repair has been expanded to include regulation of epidermal genes necessary for proper barrier function [32]. The rationale of using urea diluted in bath water comes from evidence showing that at low doses (≤10%), urea-containing topical formulations act as a skin moisturizer, whereas at higher concentrations (>10% urea), urea-based preparations exert a negative keratolytic action [33], and may cause problems when used in younger children due to their stinging effect [34]. Indeed, those effects have never been reported at high dilutions, such as those obtained in bathtub and in urea containing soap [35] or in non-detergent urea emulsion cleanser [36].

Allantoin is the final product obtained from the oxidation of uric acid metabolism in some vertebrates, and it is traceable in different plants. In pharmaceutical and cosmetic fields, it is traditionally used in the treatment of skin ulcers [37], thanks to its capability to remove necrotic tissue as well as promote cell proliferation and skin epithelization [38]. Moreover, allantoin associated to other compounds in a topical non-steroidal anti-inflammatory agent relieves pruritus in adult patients with mild-to-moderate AD [39]. The use of allantoin, as an additive to baths for children with AD, has never been reported, but the rationale for a beneficial effect in such patients comes from the documented anti-irritant and healing properties on the skin of this substance, with no safety concerns [40,41]. In addition, allantoin is one of the two main functional components of a plant-based antimicrobial solution of ancient formula of Chinese folk medicine, which has inhibitory activities on the inflammatory NF-$_k$B signaling pathway and therefore could be considered a promising option for the treatment of inflammatory skin disorders [42].

Concerning the others Hill's criteria for causation, coherence (i.e. the coherence between epidemiological and laboratory findings increases the likelihood of an effect), is corroborated by the epidemiological observation that giving the infant a bath or shower at least once a day is significantly inversely related to the risk of atopic eczema [43]. *Experimental evidence* is confirmed by the numerous findings of long-term efficacy of regular emollient treatment in patients with AD [1].

The last Hill's criteria, *analogy*, require, instead, randomized controlled trials to evaluate the effect of similar factors present in a bath salt solution compared with balneotherapy in the Dead Sea or bathing in different thermal spring waters [44].

In conclusion, it is possible and biologically plausible that the addition of salts (such as MgCl, $MgSO_4$, NaCl) and non-irritating, non-sensitizing substances (such as urea, and allantoin) to water baths can improve skin care and long-term maintenance in children with AD. Indeed, such agents have been shown to improve skin barrier, enhance stratum corneum hydration, and promote skin repair. However, there is still insufficient evidence-based data to state whether or not the combination of all such substances in one product may give addition benefit until further double blind studies are conducted. Education of the patients in the soak and smear technique as well as in wet-wrap therapy is an effective method for caring for severe skin conditions.

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