

Treatment of Refractory Cases of Atopic Dermatitis with Acidic Hot-spring Bathing

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The incidence of refractory atopic dermatitis has increased in teenagers and young adults. The purpose of this study was to control the skin symptoms of such patients in daily life. Seventy patients repeatedly took a 10-min 42°C acidic hot-spring bath twice daily. The skin symptoms were improved in 76% of cases. In 30 of 42 responders examined *Staphylococcus aureus*, detected on the skin surface, disappeared or decreased through balneotherapy. In contrast, *S. aureus* remained unchanged in 8 of 10 non-responders examined. Thus, the balneotherapy using acidic hot-spring water may be useful for controlling the skin symptoms of acute flares of refractory cases of atopic dermatitis. **Key words:** *Staphylococcus aureus*; skin surface pH; serum LDH.

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During the clinical course of atopic dermatitis, acute flares recur due to physical and psychogenic stress, allergic reactions and skin infections (1). The possible involvement of *Staphylococcus aureus* has been emphasized as one of the causes of skin infections (1, 2). In Kusatsu-spa, Japan, bathing in acidic hot-spring water was used for the treatment of leprosy and syphilis in former days (3). Over the past 7 years, patients with refractory atopic dermatitis have received this balneotherapy. We here report its effectiveness, without side-effects, in acute flares of refractory cases of atopic dermatitis.

MATERIAL AND METHODS

Patients

From June 1990 to November 1996, 70 patients with atopic dermatitis (43 males and 27 females), aged between 12 and 80 years (median 23 years), were elected to be hospitalized to receive balneotherapy using acidic hot-spring water at Kusatsu. The atopic dermatitis in all but 5 cases occurred while the patients were still under 20 and had been refractory to various treatments, including steroid ointment therapy, over a long period of time. The periods of suffering from the disease ranged from 1 to 34 years (median 16 years). Sixteen patients were complicated with bronchial asthma and 3 patients had cataracts. Although all patients had already been diagnosed and treated by at least two dermatologists in other hospitals, we reconfirmed the diagnosis according to the criteria of Hanifin & Rajka (4). At the time of admission, all patients had acute flares of atopic dermatitis but had not used topical or oral antibiotics or topical corticosteroids for at least 1 month.

Balneotherapy

As a control, the patients were allowed only a hot plain-water shower twice a day to observe the effects of hospitalization on their skin symptoms and pruritus during the first week. Then, they started taking a 10-min 42°C hot-spring bath twice daily, as described previously

(5). They squatted with bended knees, soaking in water up to their chins in a bathtub about 1 meter deep filled with hot-spring water at 42°C. When the face was affected, the face was splashed with hot-spring water, scooped with the hands. Immediately after bathing, white petrolatum was applied to the dried skin. The components dissolved in the hot-spring water were H⁺ 10.1, Na⁺ 53.7, K⁺ 16.0, Mg²⁺ 39.0, Ca²⁺ 72.0, Fe²⁺ 14.5, Mn²⁺ 1.4, Al³⁺ 39.0, F⁻ 12.0, Cl⁻ 343.0, SO₄²⁻ 611.0, HSO₄⁻ 206.0, H₂SiO₃ 250.0 and HBO₂ 8.2 mg/kg water, and the pH was 2.0.

Clinical evaluation

Before and after balneotherapy, patients were assessed clinically on the basis of the severity of skin lesions. For the most severe lesion in each patient, a severity score was calculated as the sum of scores from 0–3 for the following criteria: erythema, edema, papules/vesicles, exudation and excoriation. According to this scoring system, the maximum attributable score was 15 and the severity of the disease was classified as very severe, 13–15; severe, 10–12; moderate, 7–9; mild, 4–6; and faint, 0–3. When the severity score was decreased by 3 or more, resulting in the reduction of at least one severity classification grade, the patient was judged to be improved. Pruritus, which was assessed according to the patients' subjective symptoms, was estimated to be either improved or not improved.

Laboratory examinations

Serum levels of LDH and IgE in addition to circulating eosinophil numbers were checked every 2 weeks (6).

S. aureus

S. aureus on the skin surface was examined by a modified version of the contact-plate sampling technique of Williams et al. (7). Briefly, 10 cm² contact plates filled with TGSE agar (Nissui Pharmaceuticals, Tokyo) were applied directly to the skin at 9 a.m. before bathing. After aerobic incubation at 37°C for 48 h, the numbers of colonies of *S. aureus* were counted. When the numbers of colonies were 0, 1–10, 11–100 and >100/cm², the results were expressed as (–), (+), (2+) and (3+), respectively. Samplings were repeated from the same elbow flexural area at 2-week intervals.

Skin surface pH

Nine patients with atopic dermatitis and 9 control healthy subjects gave their informed consent to participate in this study. The two groups were age- and sex-matched (patients: 7 males, 2 females, median age 25 years; controls: 7 males, 2 females, median age 25 years). Before and at 6 points after a 10-min 42°C hot-spring bath, the skin surface pH was determined. A 1-cm² filter paper was placed on the skin surface of the elbow flexural area, and 0.1 ml of distilled water (pH 7.0) was then dropped onto it. After 2 min, the pH of the filter paper was measured using a compact pH meter (HORIBA, Tokyo). To avoid possible circadian changes in skin surface pH, experiments were performed at 9 a.m. each day.

Statistical analysis

Student's t-test was used and significance was set at $p < 0.05$.

RESULTS

Of 70 cases, total numbers of mild, moderate, severe and very severe cases were 6, 49, 8 and 7, respectively. In all cases, the

skin symptoms and pruritus were not changed through a 1-week observation period, allowing only a hot plain-water shower. The skin symptoms in 76% of cases (53) were judged to be improved because their severity scores were decreased by at least 3 points after balneotherapy; their severity scores were 6 mild, 39 moderate, 6 severe, and 2 very severe before starting bathing but 12 faint, 33 mild, 7 moderate, and 1 severe after repeated bathing. Furthermore, pruritus was improved in 64% of the 53 responders. Pruritus was not changed in the remaining 17 cases (10 moderate, 2 severe, and 5 very severe), whose skin symptoms were not improved. The period of hospital treatment ranged from 22 to 204 days (median 60 days).

In the 53 responders, the serum LDH levels were significantly decreased from 4.00 ± 1.87 (mean \pm SD) $\mu\text{kat/l}$ to 3.02 ± 1.04 $\mu\text{kat/l}$ by balneotherapy ($p < 0.005$), while those not changed were from 4.21 ± 1.57 $\mu\text{kat/l}$ to 4.65 ± 1.66 $\mu\text{kat/l}$ in the 17 non-responders. The serum LDH levels before balneotherapy were not significantly different between the responders and non-responders. The serum IgE levels and circulating eosinophil numbers were not changed by balneotherapy in either the responders or non-responders. However, the serum IgE levels in the responders before balneotherapy ($6,370 \pm 6,420$ $\mu\text{g/l}$) were significantly lower than those in the non-responders ($10,510 \pm 1,670$ $\mu\text{g/l}$) ($p < 0.05$). There was no significant difference in the circulating eosinophil numbers before balneotherapy between the responders and non-responders.

Fig. 1 shows the changes in *S. aureus* on the skin surface through balneotherapy in 52 of 70 cases. Although measurements were repeated every other week, the results are shown as a comparison between before (pre-treatment sampling) and after balneotherapy (final sampling). Of the 42 cases showing improvement, *S. aureus* was detected in 34 cases but not in the other 8 cases before balneotherapy. However, they disappeared in 20 cases and decreased in 10 of the 34 cases through balneotherapy. In contrast, the numbers of *S. aureus* on the skin surface were not changed in 8 of the 10 patients whose skin symptoms were not improved.

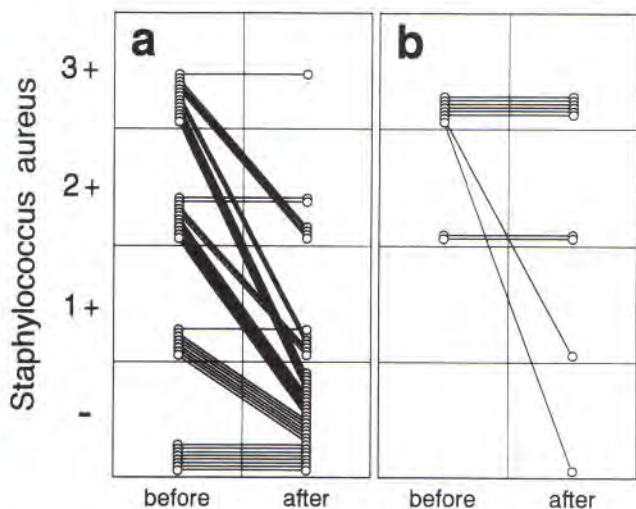


Fig. 1. Changes in *S. aureus* on the skin surface before and after balneotherapy. (a) Results of the 42 cases whose skin symptoms were improved. (b) Results of the 10 cases whose skin symptoms were not improved.

The changes in the skin surface pH are shown in Fig. 2. The skin surface pH values before starting the 10-min 42°C hot-spring bath regimen in the 9 patients with atopic dermatitis and 9 control healthy subjects were 4.6 ± 0.5 and 4.9 ± 0.3 , respectively. The skin surface pH of the patients with atopic dermatitis was significantly decreased and returned to a level similar to that in the controls in 150 min.

DISCUSSION

In this study, we have shown the benefit of balneotherapy using acidic hot-spring water for the treatment of acute flares of refractory atopic dermatitis in teenagers and young adults. However, this therapy could not affect a complete cure in the patients. To avoid the effects of hospitalization itself or other possible factors (9), patients were allowed only to take a hot plain-water shower, which produced no changes in the skin symptoms or pruritus during the first week. Although not conclusive, the acidic hot-spring water acted against *S. aureus*, since this organism on the skin surface disappeared or showed a decrease in number after therapy in the responders but did not change in the non-responders. Pruritus was improved in 64% of the responders but it was not changed in the non-responders, suggesting that the improvement of pruritus was followed by the improvement of skin symptoms.

Although the skin symptoms were estimated only by inspection, their improvement was supported objectively by a significant decrease in serum LDH level. Mukai et al. (6) reported that serum LDH levels and circulating eosinophil numbers correlated well with the clinical severity in patients with atopic dermatitis but that serum IgE levels did not. The results of serum LDH levels in this study supported their findings. However, the numbers of circulating eosinophils were not decreased through balneotherapy in the responders. Before balneotherapy, the serum IgE levels in the non-responders were significantly higher than those in the responders, indicat-

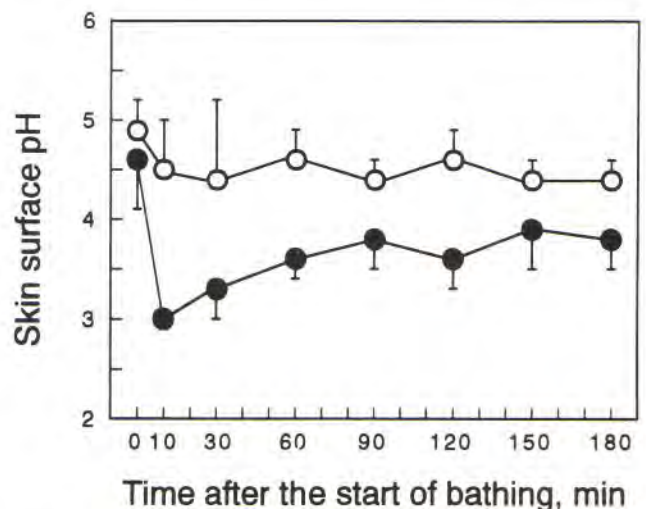


Fig. 2. Changes in the skin surface pH after a 10-min hot-spring bath at 42°C . Closed circles show the results of the 9 patients with atopic dermatitis and open circles show those of the 9 control healthy subjects. Each point represents the mean \pm SD. The differences between the patients and controls at 10, 30, 60, 90 and 120 min were significant ($p < 0.05$).

ing that this balneotherapy regimen would not be effective in severe cases.

It is now widely accepted that patients with atopic dermatitis are prone to cutaneous *S. aureus* infection during phases of exacerbation, and increased density of *S. aureus* was found to correlate well with the severity of skin manifestations (1, 10). Therefore, the reduction of *S. aureus* number by systemic or topical antibiotics improves the skin symptoms in patients with atopic dermatitis (10). There is, however, still controversy regarding whether increased presence of bacterial eczematoid skin lesions is the result of severe skin inflammation (11). On the other hand, the growth of *S. aureus* is optimal when cultured in a pH range of 7.0–7.5 and a temperature of 30–37°C (10). Thus, we checked the pH on the skin surface (8). There were no differences of the skin surface pH between patients with atopic dermatitis and control healthy subjects. The pH (4.9 ± 0.3) of the control healthy subjects in this study is consistent with that in previous reports (8). After a 10-min hot-spring bath at 42°C, the skin surface pH of the patients with atopic dermatitis was decreased significantly in comparison with that of the control healthy subjects and remained low up to 150 min. The reduction of skin surface pH of patients with atopic dermatitis was considered to be due to the remains of hydrogen ions along with some other components dissolved in the hot-spring water. This decrease in the skin surface pH may contribute to preventing the growth of *S. aureus*.

Bathing for hydration of dried skin, soaking in tepid water for 25 to 30 min 2 to 3 times per day, followed by the immediate application of a lubricating ointment or cream is one of the most effective general measures for treatment of atopic dermatitis (9). In Japan, we customarily enjoy hot-spring bathing as a leisure activity (5, 12). The hot-spring water used in this study was too acidic and made the skin drier, so white petrolatum was applied immediately after bathing. No other side-effects were noted during the course of this study. While the mechanism of the usefulness of this balneotherapy for refractory cases of atopic dermatitis may be due to an action against *S. aureus*, the possible effects of components dissolved in the hot-spring water were not fully clarified. Thus, further controlled and/or blinded studies will

be needed to verify and explore the effects of Kusatsu acidic hot-spring bathing therapy in atopic dermatitis.

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