Clinical Application of Low Reactive Level Laser Therapy (LLLT) for Atopic Dermatitis

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Abstract. Patients with atopic dermatitis (AD) were treated with diode low reactive level laser therapy (LLLT), and the following results were obtained. 1) Itchy sensation decreased in 79 of 112 cases (71%) after this therapy. 2) Skin eruptions improved in 69 of 112 cases (62%). 3) There were no side effects during and after LLLT. 4) Major histocompatibility complex (MHC) class II antigen and inter-cellular adhesion molecule (ICAM)-1 expression on epidermal cells decreased after the therapy. 5) The number of CD1 positive epidermal dendritic cells did not significantly change before and after LLLT. (Keio J Med 42 (4): 174-176, December 1993)

Key word: GaAlAs diode laser therapy

Introduction

Atopic dermatitis (AD) is one of the common chronic skin diseases in which a variety of immunological disturbances have been described.1,2 Cyclosporin A,3 gamma interferon,4 and interleukin 2 were recently suggested for the management of the disease. They all act on some component of the immunological mechanism which provoke eczematous reactions. But because of side effects, we do not use these therapies as our first choice. Steroid ointment is still widely used for the treatment of AD. Steroid rosacea sometimes appears during the prolonged application of steroid. In the present study, we used a GaAlAs 830nm diode laser for the treatment of patients with atopic dermatitis. Immunohistological examination was also performed before and after LLLT.

Patients and Methods

Patients

From November 1991 to April 1993, 112 AD patients were treated with LLLT. Mean age was 18 years (3 to 45). All patients (62 women and 50 men) participating in this study had atopic dermatitis as classified according to the criteria of Hanifin and Rajka.5 The following basic features were present: A chronic or chronically relapsing dermatitis and pruritis. They were all allergic to two or more different allergens, had positive skin reactions to these allergens, elevated total immunoglobulin (lg)E levels and positive radio-allergo-sorbent tests (RASTs) for the relevant allergens. The patients had not taken oral steroids before and after LLLT.

A diode laser system (Matsushita Electrical Company, Osaka Japan) was used for the treatment of AD patients. The system emits a 60mW continuous wave beam at a wave length of 830nm. We treated the patients once a week with the diode laser for 120sec. per 100cm2 of skin lesion on the trunk, face or extremities. Use of internal or external medicines were continued without change before and after LLLT.

Evaluation of skin symptoms before and after LLLT

The evaluation of skin symptoms before and after LLLT was conducted according to the evaluation list compiled by our allergy clinic.7 The symptoms included were dry skin, follicular keratosis, pityriasic scale, excoriating marks, erythema, papules, and lichenification. Severe symptoms were graded as 3 points, moderate symptoms as 2 points, mild symptoms as 1 point, and no symptoms as 0 points. Evaluation of the itchy sensation were graded as follows: Strongest itching with impos-
GaAs systems were typically difficult to run for long periods because of the propensity of the chip to overheat. Japan Medical Laser Laboratory (JMLL), together with Matsushita Electrical Company worked on developing a new gallium aluminium arsenide (GaAlAs) system for medical application, producing an 830nm beam with 15mW. The GaAlAs chip could run in a continuous wave without overheating. This therapy is generally referred as low reactive level laser therapy (LLLT). The reports of LLLT for clinical application have been increasing. In the present study we used LLLT on the patients with AD.

AD is a chronic inflammatory skin disease. At all phases of illness, AD patients suffer from marked pruritus that is exacerbated by multiple triggers including allergens, reduced humidity, excessive sweating, and irritants such as wools, acrylics, soaps, or detergents. Recent studies suggest that allergen-triggered IgE-mediated mechanisms and delayed hypersensitivity reaction may contribute to the pathogenesis of AD. The cardinal feature of AD is pruritus. Pruritus may be related to mediator release from ongoing inflammation or allergen exposure. Thus, the control of pruritus is important for the treatment of AD. Topical corticosteroid is commonly used for the treatment on the inflammatory skin lesions. Corticosteroids should not be used for prolonged periods especially on the face, because of their side effects. A second approach in the treatment of AD is the use of agents that counteract mediators released by inflammatory cells, such as antihistamines, platelet-activating factor antagonists and leukotriene antagonists. These are routinely prescribed for the treatment of pruritus but their efficacy is limited. Recently, psoralen ultraviolet A (PUVA) therapy has been used to treat patients with chronic severe AD and who have failed to respond to ordinary treatments. The mechanism of action of PUVA therapy is thought to be anti-inflammatory by reducing the function of antigen-presenting cells. However, there is a risk of development of skin cancer. Therefore, the dosage and duration of PUVA therapy should be kept to a minimum. The mechanism of action of LLLT seems similar to PUVA therapy, because the expression of MHC class II antigen and ICAM-1 on the epidermal cells decreased after LLLT. The number of CD1 positive cells did not change before and after LLLT. From these findings we consider that the effect of the mechanism of LLLT is anti-inflammatory, without any tissue damage. There is no report about the development of skin cancer after LLLT. We therefore consider that LLLT is safer than PUVA therapy. The patients with AD manifest abnormalities in immune regulation. Based on these findings, immunomodulator (interleukin-2, interferon-gamma) therapy have recently been reported. As the therapeutic effect is transient and immunomodulator therapy is rather toxic to the patients

**Results**

**Skin symptoms before and after LLLT**

The clinical score values of skin symptoms before and after LLLT were calculated from the evaluation table used in our allergy clinic. In 69 cases out of 112 (62%), the skin symptom scores decreased more than 5 points (7.3 ± 2.1: mean ± SD) after LLLT. In 79 cases out of 112 (79%), the itchy sensation scores decreased more than 1 point (2.2 ± 0.6: mean ± SD) after LLLT.

**MHC class II, ICAM-1 and CD1 expression on epidermal cells before and after LLLT**

Before LLLT, HLA-DR positive dendritic cells were detected in the epidermis. The majority of keratinocytes were negative for HLA-DR staining. Almost all dermal infiltrating cells were HLA-DR positive. After LLLT, HLA-DR positive dendritic cells decreased remarkably in number compared with before LLLT. HLA-DR positive dermal infiltrating cells also decreased after LLLT. ICAM-1 expression was detected focally on keratinocytes before LLLT. The majority of dermal infiltrating cells expressed ICAM-1. ICAM-1 expression on keratinocytes and dermal infiltrating cells almost disappeared after LLLT. The numbers of CD1 positive dendritic epidermal cells showed no difference before and after the therapy.

**Discussion**

Diode lasers were at first restricted to gallium arsenide (GaAs) systems, which usually produced a 904 nm beam. Immunohistological examination of MHC class II, ICAM-1 and CD1 expression

Skin biopsies were performed before and 5 times after LLLT. Five AD patients agreed to cooperate in the present study. In order to avoid the influence of MHC class II, ICAM-1 and CD1 expression, no internal and external medicines except LLLT were used for the treatment of these five AD patients. Immunohistochemical stainings were performed on 6μm cryostat sections with monoclonal antibodies. Anti-MHC class II (HLA-DR) and anti-CD1 monoclonal antibodies were purchased from Becton-Dickinson. Anti-ICAM-1 monoclonal antibody was purchased from Immunotech. Reactivity was visualized using a standard biotin-avidin immunoperoxidase technique from a commercially available kit (Becton-Dickinson).
(chills, malaise, hepatomegaly, edema, pleural effusion), the potential harm of immunomodulators therapy should be seriously considered in a non-fatal disease such as AD. In the present study, we treated 112 AD patients with LLLT. There were no side effects during and after LLLT. The treatment was effective for the decrease in itchy sensation in 71% of the cases. Skin eruptions improved in 62% of the cases. Based on this evidence, we consider that LLLT may become a new therapy of choice for the treatment of AD.

References