Expression of the Psoriasis-associated Antigen, Pso p27, is Inhibited by Cyclosporin A

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The psoriasis-associated antigen, pso p27, can be isolated from psoriatic scale and is present in complement-activating immune complexes in psoriatic scale, and in serum from patients with psoriasis. The antigen is produced by trypsin-positive cells in the skin lesions and is shown to be a major antigen in the immune reactions in psoriasis. The synthesis of this particular antigen is reduced with the remission of inflammation in the skin lesions. In this study we followed 3 patients with severe plaque psoriasis during treatment with cyclosporin A. In all patients we observed a decrease in the expression of the antigen pso p27 during the therapy. The effectiveness of the therapy varied among the patients, but there was a clear correlation between disease activity and expression of the antigen pso p27 as demonstrated by immunofluorescence in biopsies from selected skin lesions. This observation strengthens our hypothesis that the pso p27 antigen plays an important role in the inflammation in psoriasis.

Key words: cyclosporin A; pathogenesis; psoriasis; pso p27.

PATIENTS AND METHODS

Patients and treatments

Three patients (2 men, 1 woman) volunteered to participate in this study. Each had a long history (11–17 years) of severe plaque psoriasis. One of the patients (patient 1) also suffered from moderate psoriasis-arthritis. Previously the patients had tried many kinds of ordinary topical treatments, phototherapy and systemic treatment with methotrexate, without significant response. All 3 patients received CsA 3 mg/kg/day in 2 doses/day. All other kinds of treatment except topical lubrications were stopped 4 weeks before entry into the study. We performed physical examinations with blood and urine tests according to the clinical guidelines for CsA therapy (6). The severity of the psoriasis was evaluated before starting the treatment and after 2, 6 and 12 weeks (patient 1), respectively, based on the Psoriasis Area and Severity Index (PASI) (7). One representative psoriasis plaque was selected as a reference lesion in each patient. These reference lesions were in the central part of the back of patients 1 and 2 and on the right upper arm of patient 3. The grade of scaling, erythema and thickness of the indicator lesions were determined on a scale from 1–7 for each parameter (1 absent, 2 trace, 3 mild, 4 mild-moderate, 5 moderate, 6 moderate-severe, 7 severe), with a total highest score of 21 and a lowest score of 3.

Specimens

Skin biopsies were taken from the indicator lesions as 4 mm punch biopsies. Before starting the CsA therapy we took a biopsy from the centre and the border of the plaque and from normal skin 5 cm from the border of the lesion. After 2 and 6 weeks we obtained biopsies from the centre of the indicator lesion and from normal skin. From patient 1 we also took a biopsy from the centre of the indicator lesion after 12 weeks and likewise from a new plaque on his left knee, which arose during treatment.

The specimens were shock frozen in liquid nitrogen and stored at −70°C. Thin sections (4–5 μm) of the skin biopsies were analysed with respect to pso p27 antigen using monoclonal anti-pso p27 antibodies.

Monoclonal antibodies against pso p27

The production of monoclonal antibodies (Mabs) was performed essentially as described elsewhere (8). Purified pso p27 obtained from psoriatic scale was used as antigen (9).

Immunofluorescence analyses

Thin sections of the skin biopsies were incubated with anti-pso p27 Mabs (3A3D10 and 2C7D10) diluted 1:500 in PBS, followed by incubation with rabbit anti-mouse immunoglobulin Fluorescein Isothiocyanate Conjugate (DAKO). Finally, the thin sections were examined using a Leitz fluorescence microscope.

RESULTS

Clinical evaluation

The patients participating in this study responded to various extents to treatment with CsA. The PASI score indexes are presented in Table I. Patient 1 responded immediately to the treat-
No differences between the intensity of the cells in the dermal papillae and fewer positive cells in the reticular dermis. Furthermore, we observed a high frequency of pso p27 positive fluorescence was extensive in the stratum corneum and in the scale. The fluorescence in these cells was much weaker than the fluorescence in the biopsy from the uninvolved skin. The number of positive cells in the dermis was decreased. The epidermis had become thinner and we observed a stronger auto-fluorescence in the biopsy by the same magnification (Fig. 1e). After 6 weeks a slight increase in the number of positive cells in the dermis compared with the biopsy performed after 2 weeks could be observed (Fig. 1f). The fluorescence in the stratum corneum and in the scale was even more intense. After 12 weeks when the skin was almost normalized, there was no positive fluorescence in the biopsy from the indicator lesion, except a weak fluorescence in the stratum corneum (Fig. 1g). However, in the biopsy from the new lesion on the knee which developed during therapy with CsA, we could observe a strong fluorescence both in the stratum corneum as well as in the dermis (Fig. 1h). The degree of fluorescence in this late biopsy was equal with the fluorescence in the biopsy from the indicator lesion before starting treatment with CsA. The density of mast cells was not significantly reduced during treatment and the expression of tryptase was not influenced by CyA (data not shown).

Consequently, there was a clear correlation between the response to therapy with CsA and the intensity of the fluorescence of the antibodies against pso p27. These observations are equal with the observations of patients 2 and 3. A certain amount of fluorescence was observed both in the stratum corneum and the dermis in the biopsy from patient 2 after 2 weeks, but after 6 weeks there was weak fluorescence in the stratum corneum only. Patient 3, who responded weakest to therapy among these 3 patients, after 6 weeks still had several positive cells in the dermis together with an intense fluorescence in the stratum corneum and the scale. However, the intensity of the fluorescence in these cells was much weaker than the fluorescence observed after 2 weeks of therapy.

The biopsies taken from the uninvolved skin before starting and during the CsA treatment, did not demonstrate any pso p27 positive reaction in the epidermis or the dermis. There was no change in this observation during the whole period of CsA therapy.

DISCUSSION

The initiation of psoriasis may be due to either microbial infection or physical damage to the skin or to systemic or local antigenic, autoantigenic, or superantigenic substances. Even psychological stress can be an initiating event (10). Without regard to the initiating event, psoriasis has the distinctive fea-

**Table I. PASI score, plaque index and semiquantitative expression of pso p27 antigen during treatment with cyclosporin A**

<table>
<thead>
<tr>
<th>Patient no./sex/age (years)</th>
<th>Week</th>
<th>PASI score</th>
<th>Plaque index</th>
<th>Fluorescence pso p27</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/M/45</td>
<td>0</td>
<td>37.7</td>
<td>20</td>
<td>++ + + +</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>6.2</td>
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<td>6</td>
<td>11.3</td>
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</tr>
<tr>
<td></td>
<td>12</td>
<td>3.1</td>
<td>3</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>3.1</td>
<td>14</td>
<td>+ + + + +</td>
</tr>
<tr>
<td>2/F/41</td>
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<td>32</td>
<td>15</td>
<td>+ + + + +</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>18</td>
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<td>6.5</td>
<td>3</td>
<td>+</td>
</tr>
<tr>
<td>3/M/34</td>
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<td>15</td>
<td>19</td>
<td>+ + + +</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>12.1</td>
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</tr>
<tr>
<td></td>
<td>6</td>
<td>10.4</td>
<td>10</td>
<td>+ +</td>
</tr>
</tbody>
</table>

* Now developed a new lesion with index 14 on his left knee.

**Analyses of selected skin lesions during treatment with CsA**

The immunofluorescence analyses of pso p27 antigen in skin biopsies from the centre of a selected psoriasis lesion from patient 1 is presented in Figs. 1 a, e, f and g. The biopsy taken at day 0 demonstrated extensive fluorescence in the stratum corneum and in the scale. There was a high frequency of pso p27 positive cells in the dermal papillae and fewer positive cells in the reticular dermis (Fig. 1a). After 2 weeks of CsA treatment there was still strong fluorescence in the stratum corneum and in the scale of the biopsy. The number of positive cells in the dermis was decreased. The epidermis had become thinner and we observed a stronger autofluorescence in the biopsy by the same magnification (Fig. 1e). After 6 weeks a slight increase in the number of positive cells in the dermis compared with the biopsy performed after 2 weeks could be observed (Fig. 1f). The fluorescence in the stratum corneum and in the scale was even more intense. After 12 weeks when the skin was almost normalized, there was no positive fluorescence in the biopsy from the indicator lesion, except a weak fluorescence in the stratum corneum (Fig. 1g). However, in the biopsy from the new lesion on the knee which developed during therapy with CsA, we could observe a strong fluorescence both in the stratum corneum as well as in the dermis (Fig. 1h). The degree of fluorescence in this late biopsy was equal with the fluorescence in the biopsy from the indicator lesion before starting treatment with CsA. The density of mast cells was not significantly reduced during treatment and the expression of tryptase was not influenced by CyA (data not shown).

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The biopsies taken from the uninvolved skin before starting and during the CsA treatment, did not demonstrate any pso p27 positive reaction in the epidermis or the dermis. There was no change in this observation during the whole period of CsA therapy.

**Analyses of psoriatic lesions and clinical uninvolved skin**

The binding of monoclonal anti-pso p27 antibodies to psoriatic skin from patient 1 is shown in Table I and Fig. 1. Before starting therapy with CsA, biopsies made from the centre and the border of the indicator plaque from this patient (Figs. 1a and c) showed an extensive fluorescence for pso p27 antigen. The fluorescence was extensive in the stratum corneum and in the scale. Furthermore, we observed a high frequency of pso p27 positive cells in the dermal papillae and fewer positive cells in the reticular dermis. These cells were primarily tryptase positive cells (data not shown). No differences between the intensity of the fluorescence of pso p27 in the biopsies from the centre and the border of the indicator lesions could be demonstrated. In the biopsy from the uninvolved skin there was no visible fluorescence in the epidermis or the dermis (Fig. 1d). Before therapy, similar observations were made in corresponding biopsies from patients 2 and 3.
tures of erythematous, scaly, infiltrating plaques of the skin. A main feature of psoriasis is an inflammatory reaction in the dermis with deposits of immunocomplexes and inflammatory cells.

There are generally antigens involved in immune reactions. It has never been possible to isolate an infectious agent as the cause of psoriasis, thus it is reasonable to assume that psoriasis is an autoimmune disorder. We have earlier focused on a pro-

Fig. 1. Immunofluorescence of pso p27 in skin from patient 1. The biopsies are before therapy from (a) the centre of the indicator lesion, (b) control with an irrelevant antibody, (c) from the border of the lesion, and (d) from uninvolved skin and (e) after 2 weeks, (f) after 6 weeks and (g) after 12 weeks with CsA therapy. (h) A new plaque developed on the patient’s left knee during CsA therapy.
tein antigen, pso p27, which is produced in mast cells in the skin lesions and which play an obvious role in the inflammatory reaction in psoriasis (3, 4).

The aim of this study was to investigate whether immunosuppressive treatment with CsA influenced the expression of the pso p27 antigen. The patients included in this study responded to various extents to treatment with CsA. We did not make any dose-adjustment during therapy, which could explain the various responses to therapy among these patients. Despite individual variation in response to therapy there was a clear correlation between disease activity expressed by PASI score and the plaque index of the indicator lesion. This means that the biopsies were representative for the general effect of the treatment. Furthermore, there was a good correlation between plaque index and to what extent the antigen was expressed, as demonstrated by the immunofluorescence.

Before CsA therapy there was a strong fluorescence both in the scale and the dermis. After 2 weeks there was a decrease in the intensity of the fluorescence in the mast cells of the dermis in biopsies from all 3 patients. However, the fluorescence was still strong in the stratum corneum. This could indicate that the production of the antigen is inhibited as an initial event of the CsA therapy, either as a direct effect of CsA on the antigen producing cells or indirectly through a suppression of the inflammatory process. In biopsies obtained from the clinically cured psoriasis plaque after 6 weeks with CsA therapy, there were no signs of the antigen. This indicates that the expression of the antigen is related to the activity of the disease and that the expression of the antigen is suppressed when the lesion goes into remission. This is in accordance with the results from earlier studies (4, 11).

The effectiveness of CsA in psoriatic treatment has been well established through many studies (12), especially in patients who have failed to respond to phototherapy or methotrexate therapy. The immunosuppressive action of CsA in psoriasis has not yet been fully elucidated, but CsA binds to an intracellular receptor termed cyclophilin. The CsA-cyclophilin complex inhibits the phosphatase activity of the enzyme calcineurin, which interferes with the nuclear factor of activated T-cells (NF-AT), which is an essential transcription factor for the transcription of the interleukin 2 (IL-2) gene (13). T-cell-derived lymphokines appear to play an important role in the pathophysiology of psoriasis. CsA inhibits the production of various numbers of cytokines, which have an effect on lymphocytes, antigen-presenting cells, keratinocytes and neutrophils (13). The effectiveness of CsA in psoriasis, strengthen the hypothesis of psoriasis as an immunological inflammatory skin disease.

We are led to speculate that the expression of pso p27 is induced by factors released by the inflammatory process and that the pso p27 antigen participates in the maintenance of the inflammatory process in the dermis through generation of immune complexes and activation of T-lymphocytes. In this way pso p27 plays a key role in the stationary psoriatic plaques. In accordance with this hypothesis, CsA decreases the expression of the antigen pso p27 by suppressing the inflammatory process either indirectly through inflammatory mediators or directly by inhibiting the production of the antigen.

Even if we do not know the exact action of this particular antigen, this study strengthens our earlier suggestion that the antigen plays an important role in the immunological reaction in psoriasis.

REFERENCES