ORIGINAL ARTICLE

Psoriasis and daily low-emission phototherapy: effects on disease and vitamin D level

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ABSTRACT

Background/Purpose

Hospital-based phototherapy is a widely accepted treatment modality in psoriasis patients. It, however, requires several hospital visits weekly, interfering with (school)work. Home ultraviolet (UV) treatment has been proven effective before but is only available in certain countries, and safety aspects play a part in reluctancy to prescribe this treatment. Patients, however, are usually keen on the use of phototherapy as it is effective and gives them the possibility of reducing the amount of topical treatment needed. In this study, we assess the effectivity of a low-emission UV device used daily.

Methods

Sixty-two patients were treated for 6 months either with daily low-emission UV treatment and mometasone ointment 0.1% or with mometasone ointment 0.1% alone. Psoriasis severity scores, quality of life, vitamin D level, and blood pressure were monitored every 2 months during the study.

Results

Patients treated with daily low-emission UV treatment showed a significant improvement in psoriasis severity, quality of life, amount of steroid ointment used, and vitamin D levels.

Conclusion

Daily low-emission UV therapy is an effective treatment for psoriasis patients, diminishing the amount of steroid ointment needed and improving disease activity, quality of life, and vitamin D scores. Further investigation, however, is necessary.

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Psoriasis is a chronic disease in which all therapeutic strategies aim to reduce the symptoms and burden of the disease. Mild symptoms can mostly be improved with topical corticosteroids, vitamin D and their analogs, or other local anti-inflammatory ointments. The more widespread and severe disease is usually treated with phototherapy or systemic immunosuppressants. Although some patients remain in a stable phase of the disease throughout their lives, most of them experience regular relapses and it is often necessary to switch between the treatment regimes and/or to adapt previously effective treatments.

Phototherapy is a well-established and effective treatment option in mild to moderate psoriasis. Most patients currently undergoing phototherapy are treated with a narrowband ultraviolet B (UVB) (TL-01 lamps) or psoralen and ultraviolet A therapy. The treatment can either be given in outpatient settings two to three times a week or, if applicable and reimbursed, at the patient's home. This latter therapeutic option allows patients to continue with their own lifestyle and daily-life obligations and, thus, is often preferred among employed patients. However, in many countries, this therapeutic modality is unavailable.

For this reason, some patients turn to tanning studios or use sunbeds at home to treat their psoriasis. These machines mostly emit ultraviolet A, which is known to be less effective in the treatment of psoriasis than UVB. The self-treatments, therefore, result in repeated, less efficient exposures to these sources, sometimes for an extended period of time. The regular hospital-based treatment would normally be terminated after a few months in order to minimize the risk of possible side effects, such as skin aging and the development of skin cancer.

Psoriasis appears to be a part of a systemic health problem. Recent research has shown that psoriasis patients may have an increased risk of cardiovascular conditions and osteoporosis. It is, however, still uncertain whether these comorbidities are an epiphenomenon, or must be attributed to a systemic increased inflammatory condition in these patients (1–5). Interestingly, psoriasis patients also seem to have a lower vitamin D blood level than healthy controls (6). This lower vitamin D concentration can help understand the presence of various comorbidities in psoriasis. Vitamin D is a strong immunomodulatory and anti-inflammatory mediator, which has been shown to be associated with protection against certain forms of cancer, osteoporosis, and possibly hypertension (7). As a consequence, a therapeutic strategy in psoriasis that increases vitamin D concentration in the body and suppresses skin symptoms directly might contribute to a better disease management and long-term reduction of associated conditions.

We have examined the utility of a low-emission ultraviolet (UV) device that has been developed for personal use at home. The device can be placed in a shower and used while taking a shower. In this study, we show that daily utilization of this device cannot only serve as a maintenance therapy of psoriasis but also leads to significantly improved disease control. In addition, the use of this device results in a considerable increase of vitamin D levels in the blood of treated patients.

MATERIALS AND METHODS

The study design was approved by the Medical Ethical Committee of the VU University Medical Center and was performed in accordance to the Declaration of Helsinki (2008). To assess the value of the low-intensity UVB treatment at home, an open, controlled, randomized study was conducted. Patients were divided in two groups: control and home UV treatment. The control group was treated with mometasone furoate ointment 0.1% and emollients only; the UVB group was allowed to use mometasone furoate ointment 0.1% and emollients, but was asked to make daily use of the home UV device (Dermasun Helios, Dermasun Medical BV, Amsterdam, the Netherlands), preferably while showering (Fig. 1).

Fig. 1. The home ultraviolet B (UVB) device (Dermasun Helios, Dermasun Medical BV, Amsterdam, the Netherlands).

The UV device only emits a limited amount of UVB (Fig. 2). One standard erythemal dose (SED) is reached after 4.5 min (if the skin is continually exposed in the same area at a distance of 40 cm). In patients with a fair skin type, skin redness can develop after two SED, the equivalent of 9 min of continuous treatment of the same skin area. However, our patients were instructed to slowly turn around during showering and therefore the UV dose that reached each part of the skin was much lower. Patients were also instructed to set the timer to 7 min, after which the device would turn off automatically.

At the beginning and every 2 months during a 6-month period, patients were asked to fill in two different quality of life (QoL) questionnaires [Dermatology Life Quality Index (DLQI) and Skindex-29] at each visit, and the activity of the psoriasis was scored and documented with photographs. The amount of consumed mometasone ointment 0.1% was monitored by weighing of ointment tubes and the patients' blood pressure was measured.

To ascertain that the low-emission UV output was enough to induce a biologic effect, the first 40 patients were asked to undergo serum vitamin D measurements at baseline, after 2 months (t = 1), and 4 months (t = 2). The inclusion of the patients was carried out from October to December 2011 and study duration was set to 6 months in order to minimize the confounding exposure to natural UV. Patients were also asked to refrain from sunny/tanning holidays and from use of solaria or tanning beds. Vitamin D status was measured by determination of 25-OH-D3 level in serum. In order to minimize the inter- and intra-measurement error, the serum samples were collected, centrifuged, and stored in a biobank at −80°C for simultaneous measurement at the end of the study.

Sample size calculation

Based on unpublished, preliminary results, an improvement of 20% is expected in patients receiving phototherapy compared with no improvement in patients in the control group. Assuming a mean Psoriasis Area and Severity Index (PASI) value of 10 ($\sigma = 3$) for all patients, the expected 20% improvement in the treatment group would lead to a mean PASI value of 8. For a power of 80% with a two-sided independent sample t-test, a sample size of 36 patients in each group would be necessary at a significance level of 5%. To compensate for possible dropouts (10%), a sample size of 40 patients would be needed.
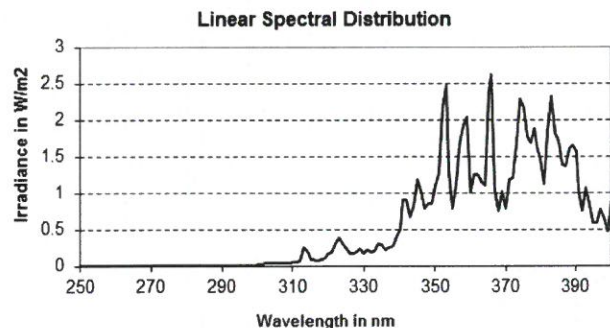
Patients

Sixty-two patients were included in the study and randomized into two different groups. Patients predominantly had a Fitzpatrick skin type 2; none had a skin type 4 or higher (Table 1).

Exclusion criteria were current use of systemic immunosuppressants or in the 2 months prior to inclusion, history of skin cancer, use of phototoxic medication, active psoriatic arthritis, concurrent photosensitive skin diseases, pregnancy, and oral supplementation with vitamin D.

One patient had predominantly scalp psoriasis and agreed to shave his head to participate in the treatment

Fig. 2. Linear spectral distribution of the home ultraviolet (UV) device.

Table 1. Characteristics of patients included in the study

		All patients	Control	UV treatment	P value
Sex	M	44 (71%)	21 (70%)	23 (72%)	1.000
	F	18 (29%)	9 (30%)	9 (28%)	
Age	Mean (± SD)	41.1 (12.3)	38.1 (10.9)	43.8 (13.1)	0.069
BMI	Mean (± SD)	26.7 (5.5)	26.6 (4.4)	26.8 (6.3)	0.873
Skin type	1	8 (13%)	2 (7%)	6 (19%)	0.069
	2	48 (77%)	27 (90%)	21 (66%)	
	3	6 (97%)	1 (3%)	5 (16%)	

BMI, body mass index; F, female; M, male; SD, standard deviation; UV, ultraviolet.

group. For the patients with concurrent, but not predominantly scalp psoriasis, scalp lesions were not taken into account for the PASI score.

Randomization was performed by letting patients draw a blinded, unmarked envelop from a stack of 80 (40 for control group, 40 for home UV treatment group) with a note inside allocating them to a treatment group. During the randomization, 30 patients were assigned to the control group and 32 patients to the UV treatment group. Seventeen patients dropped out of the study (11 control, 6 UV treatment) for various reasons including: ineffectiveness of treatment (3 patients), development of arthritis complaints needing systemic treatment (2 patients), unwillingness to participate in the appointed group or adhere to follow-up appointments (11 patients), and inability to pay the transportation cost to attend the checkups (1 patient). Two patients (one control, one UV treatment) had received TL01 phototherapy prior to inclusion in the study. All other patients were using topical steroids and/or emollients as treatment. At the time of inclusion, no patient had arthritis complaints requiring nonsteroidal anti-inflammatory drugs or systemic immunosuppressants for their psoriasis or other conditions.

Statistics

For the two groups, longitudinal measurements of PASI scores, amount of mometasone ointment 0.1%, DLQI and Skindex-29 scores, blood pressure, and vitamin D levels were analyzed by a mixed model with fixed effects for group, time, and two-way interaction, and a random intercept for subjects. Statistical analyses were performed using SPSS (version 20, IBM Corp., Armonk, NY, USA). A P value < 0.05 was considered to indicate statistical significance, a P value < 0.1 a statistical trend.

Data were analyzed based on the intention-to-treat principle: all data from a patient were included until dropout.

RESULTS

Sixty-two patients were included (18 female, 44 male; ages 19–66) and randomized. Body mass index, a potential confounder for severity of psoriasis, and level of vitamin D had a normal distribution between the groups.

PASI scores

After an initial improvement of PASI scores in both groups (2 months after inclusion), PASI scores of patients in the home UV treatment group decreased significantly ($P = 0.007$) as opposed to the scores of control patients,

Table 2. Mean difference between study groups in amount of change (after 6 months – baseline) in PASI, DLQI, and Skindex-29

	P value*	Mean difference[†] [95% CI]
PASI	0.049	−1.8 [−3.6 to −0.01]
DLQI	0.300	−1.3 [−3.8 to 1.2]
Skindex-29	0.062	−225 [−462 to 13]

*Using the two samples independent *t*-test.
[†]UV treatment – control.
CI, confidence interval; DLQI, Dermatology Life Quality Index; PASI, Psoriasis Area and Severity Index.
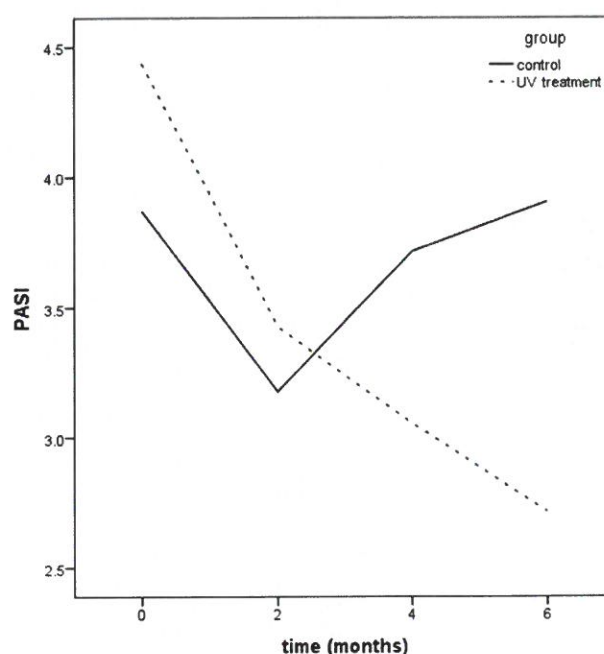

Fig. 3. Courses of mean Psoriasis Area and Severity Index (PASI) scores during treatment for the ultraviolet (UV)-treated and the control group.

which increased again. A comparison of the change in PASI scores between baseline and after 6 months yielded the same significant difference (Table 2). The mean PASI scores for both groups during treatment are shown in Fig. 3.

Application of corticosteroid ointment

Although patients did not have a significant different treatment strategy ($P = 0.305$), a trend was seen in the amount of mometasone ointment 0.1% that was consumed between the groups (mean of 38.0 vs. 78.8 g/2 months,
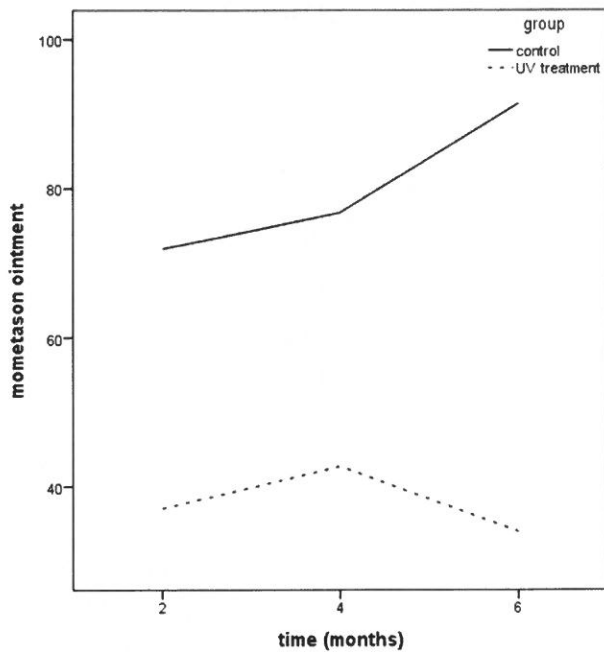
Fig. 4. Mean amount of mometasone ointment 0.1% used during the study period for the ultraviolet (UV)-treated and the control group (g/2 months).

$P = 0.061$), when comparing the mean amount over the whole follow-up period (Fig. 4).

Blood pressure

Blood pressure was measured in both groups but did not show any significant difference between the treatment groups. No correlation was found between blood pressure and serum vitamin D.

QoL

QoL questionnaires (Skindex-29 and DLQI) were filled out by the patients every 2 months or at the moment of exit from the study. A clear trend was seen in the changes of DLQI scores ($P = 0.083$): the scores of patients in the control group fluctuated between 6.1 and 4.4, whereas the scores of patients in the UV treatment group decreased from 6.6 to 3.3 (Fig. 5a). For the Skindex-29 score, a similar but significant ($P = 0.008$) effect was observed between the patients in the home UV treatment group and controls (Fig. 5b). Changes between baseline and after 6 months were not significant between the two groups (Table 2).

Vitamin D

Conventional phototherapy induces vitamin D. As the UV source in this study had a low emission, vitamin D levels
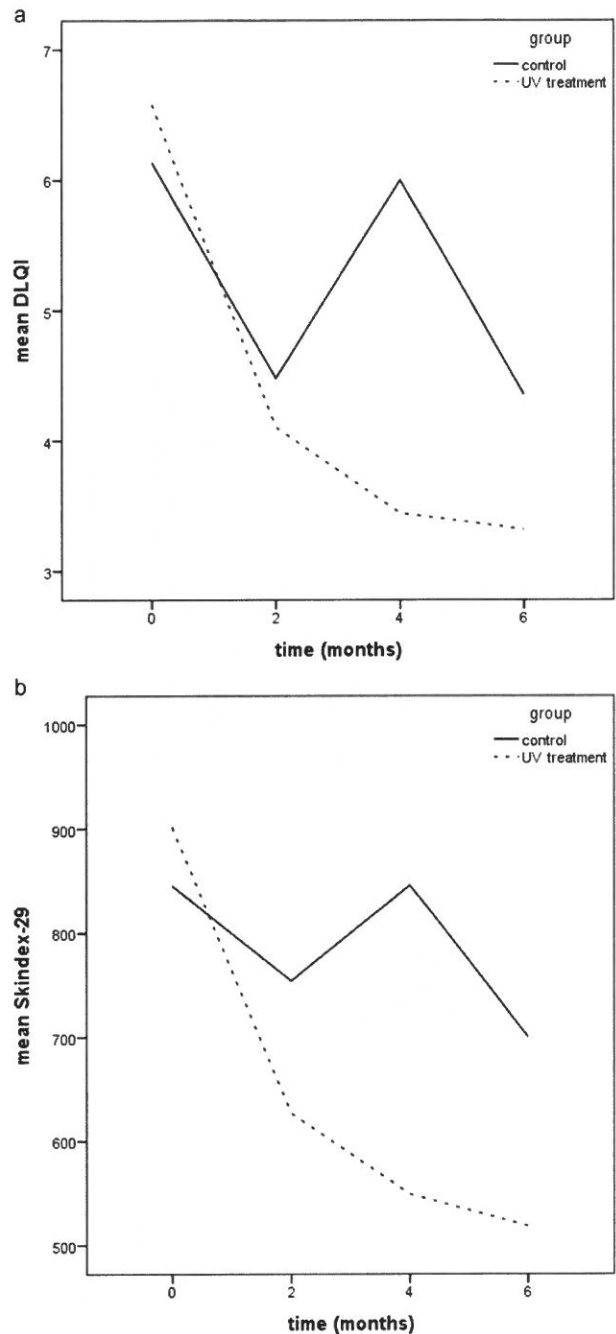

Fig. 5. Courses of quality of life as assessed by Dermatology Life Quality Index (DLQI; a) and Skindex-29 (b) during the study period.

were measured to demonstrate biological effect. In the first 40 included patients, vitamin D (25-OH-D3) in serum was measured.

Significant differences in vitamin D levels between the groups were found in the course of the treatment

($P < 0.001$) and when ignoring time effect ($P = 0.042$). After the summer, both groups started with comparable and acceptable levels of cholecalciferol ($\mu = 73.2$ nmol/ml for controls and $\mu = 72.6$ nmol/ml for the UV treatment group). During the winter period, a strong drop was seen in the vitamin D levels of patients in the control group ($\mu = 57.7$ nmol/ml), while the home UV treatment group showed a clear rise ($\mu = 91.3$ nmol/l) that approximated the 25-OH-D3 level recommended in the Netherlands (100 nmol/l).

DISCUSSION

Unfortunately, because of the strictly planned termination of the inclusion period, we were unable to accomplish the aimed inclusion of 40 patients per group as described in the power calculation. Patients in the home UV group, however, did show a statistically significant reduction in their PASI scores after 2 months of treatment. The scores kept diminishing, even after 6 months of treatment, although by that time the most dramatic improvement had already set in.

During the study, a clear initial improvement occurred for both groups within the first 2 months. After 2 months, the PASI scores in the control group worsened. This is most likely due to the fact that when given a new treatment and entering a study, patients started positively with consistent use of the mometasone ointment 0.1%. After the phase of worsening, however, the psoriasis may be too extensive to be sufficiently treated with topical steroids, such as mometasone ointment.

PASI scores on entering the study were relatively low: UV treatment group 44.4; control 3.87. When psoriasis is relatively mild, PASI scores are less sensitive to detect small changes. Further investigations should also use alternative scoring methods, for example, the National Psoriasis Foundation Psoriasis Score (8).

The effectivity of low-emission UV treatment for patients with severe psoriasis needs further elucidation. The safety aspects of phototherapy use in patients with low PASI scores should not be minimalized. With daily use for 7 min, this device, however, yearly emits a comparable amount of UVB with a course of hospital-based phototherapy for 3 months. Preliminary results also suggest a safer profile than conventional phototherapy (Franken SM, Spiekstra S, Witte B, Pavel S, Rustemeyer T., in prep.). Nevertheless, it is advisable to perform regular skin checkups in accordance with conventional phototherapy protocol.

No adverse events were reported in either treatment group. Patients in the UV treatment group did not report any redness or sunburn after start of treatment.

A clear trend was seen in the difference of the total amount of consumed ointment between the two groups ($P = 0.061$). Patients were instructed to use this ointment only once a day for their psoriasis lesions, if they deemed this necessary. Patients were all experienced psoriasis patients and had used local steroid ointments before. The home UV treatment group clearly had a lower need for use of steroid ointments (mean of 38.0 vs. 78.8 g per/2 months).

Overall, this should be regarded as a positive therapeutic effect that provides patients with a 'therapy break' and lessens the social hindrance patients can experience as a result of using ointments. The reduced costs of ointments can run to a substantial amount depending on which ointment is the standard therapy in each country.

Vitamin D levels improved significantly in the home UV treatment group as opposed to the lower levels observed in the control group (Fig. 6). Although the reduction of vitamin D serum level was to be expected (the study was conducted as much as possible in the winter), these results are quite striking.

These results prove that although the UV device emits a low amount of UV, its dose is substantial enough to sort a biological effect.

Although psoriasis patients usually expose themselves to the sun more than healthy persons, they often have lower
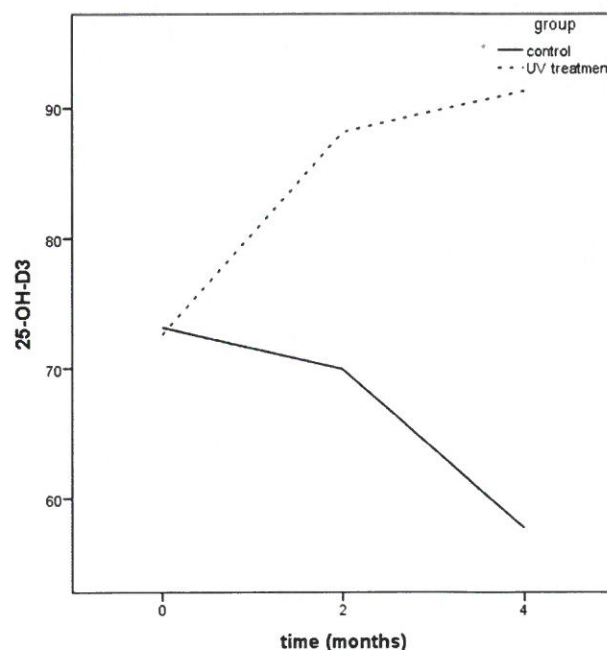

Fig. 6. Course of mean vitamin D (25-OH-D3) level rise in the ultraviolet (UV) treatment and the control group during the study period.

vitamin D level (9). The reason for this reduced serum concentration is not known, but in multiple studies, a correlation is suggested between vitamin D levels and the risk of cardiovascular disease, osteoporosis, and some forms of solid cancers (colon, prostate, etc.) (10, 11). A natural rebalancing of vitamin D levels in the home UV treatment group might therefore have other long-term benefits for psoriasis patients, although these need to be studied further.

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