STUDY

Narrowband UV-B Produces Superior Clinical and Histopathological Resolution of Moderate-to-Severe Psoriasis in Patients Compared With Broadband UV-B

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Objective: To compare the therapeutic effectiveness of daily exposure to narrowband (NB) UV-B vs broadband (BB) UV-B with and without tar.

Design: Half-body exposures to NB UV-B or BB UV-B were given daily for 4 weeks in this comparative treatment study. Narrowband UV-B was delivered from TL-01 fluorescent bulbs and BB UV-B from conventional bulbs in the same phototherapy cabinet. Narrowband UV-B was compared using a paired treatment approach to BB UV-B above the waist and to BB UV-B with tar (Goeckerman treatment) below the waist.

Setting: General clinical research center of a university hospital inpatient unit.

Patients: Twenty-two patients with moderate-to-severe plaque-type psoriasis completed the study.

Main Outcome Measures: Clinical efficacy was measured weekly using psoriasis severity scoring. Therapeutic outcomes after 4 weeks were compared in paired biopsy samples from treated lesions using objective histopathological measures (quantitative reduction in epidermal acanthosis and keratin 16 expression).

Results: Clinical resolution of psoriasis was achieved on 86% of paired sites treated with NB UV-B vs 73% treated with BB UV-B. Histopathological resolution of epidermal hyperplasia (marked by keratin 16 expression) was achieved in 88% of lesions treated with NB UV-B vs 59% treated with BB UV-B. Epidermal acanthosis was reduced more completely by NB UV-B treatment. Clinical resolution of psoriatic lesions occurred more rapidly following NB UV-B treatment, with some patients achieving complete resolution after 2 to 3 weeks of treatment.

Conclusions: Narrowband UV-B offers a significant therapeutic advantage over BB UV-B in the treatment of psoriasis, with faster clearing and more complete disease resolution. The erythema response to NB UV-B treatment was significantly more intense and persistent compared with BB UV-B. Considerably more necrotic keratinocytes were observed in histopathological sections of skin treated with NB UV-B after a single 2.0–minimum erythema dose exposure. Treatment should be coupled with obligate minimum erythema dose testing to NB UV-B and close clinical observation during dose increases.

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In the United States, treatment of patients with moderate-to-severe psoriasis often follows a progression from topical agents to phototherapy as first-stage treatment for extensive disease, and then to psoralen with UV-A light (PUVA) or methotrexate as second-stage agents for patients whose psoriasis cannot be controlled adequately with UV-B treatment.[1,2] The introduction of phototherapy (combining UV-B and topical tar emollient) by Goeckerman in 1925 provided a landmark advance in the treatment of psoriasis.[3] The treatment for psoriasis, as recommended by Goeckerman, has been extensively modified during intervening years to include delivery of UV-B from fluorescent sources, varying treatment schedules and dosing regimens, and the use of different emollients, some containing tars or keratolytic agents.[4-11] In some carefully controlled studies, phototherapy has produced clearing of psoriasis in 60% to 100% of patients, with typical remission times of

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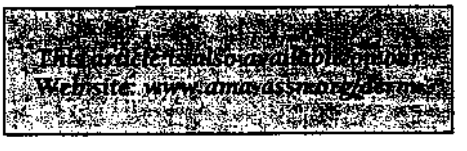
2 to 4 months following UV-B–induced clearing.[12,13] In actual practice, it is difficult to attain complete clearing of psoriasis outside the day clinic or hospital setting using phototherapy, and PUVA and methotrexate are viewed as more effective outpatient



PATIENTS AND METHODS

PATIENTS

Twenty-three adult patients (16 men and 7 women) with moderate-to-severe plaque-type psoriasis were sequentially enrolled into our study, which was approved by The Rockefeller University Hospital Institutional Review Board, New York, NY. Enrollment excluded patients with guttate, erythrodermic, or pustular psoriasis. Most patients (20 of 23) had been treated for years with various topical, oral, or photo(chemo)therapy modalities, and 3 patients were treated only with topical agents previously. As listed in the **Table**, this study group encompassed skin types ranging from type II to type V, with 10 of 23 patients having type V skin. All patients had extensive psoriasis, with 31% of mean body surface area affected (range, 10%-80%) and a mean plaque severity of 14.3 (range, 12-17) (18 is maximum in this scoring system, described below). This study population consisted mostly of patients with long-standing psoriasis, as the mean disease duration was 14.4 years (range, 4-47 years). Patients were at least 18 years of age (mean, 42 years; range, 18-72 years) and had stopped all therapy at least 2 weeks before initiating the protocol. One patient discontinued treatment (after 1 week) due to an extensive, unexplained burn on the skin treated with BB UV-B. No patients discontinued treatment due to adverse reactions to NB UV-B.

PHOTOTESTING AND TREATMENT

Minimum erythema dose (MED) testing was performed using NB and BB UV-B at 8 separate dosages. Patients with Fitzpatrick type I through III skin received 150 to 900 mJ/cm^2 of NB UV-B and 20 to 120 mJ/cm^2 of BB UV-B. Patients with type IV and V skin received 150 to 1200 mJ/cm^2 of NB UV-B and 20 to 160 mJ/cm^2 of BB UV-B. Minimum erythema doses were read 12 and 24 hours following NB and BB UV-B exposure. A test site was considered to have 1+ erythema if faint, uniform erythema was present; sharp margination of erythema was not required. Selected patients underwent a 4-mm punch biopsy of their MED sites 24 hours after exposure for histological analysis.

Patients were treated daily with NB UV-B (**Figure 1**) on the right side of the body while wearing a UV-protecting gown that covered the left side of the body and face. Patients were treated similarly with BB UV-B, with exposure to the left side of the body and face. An emollient of 3% coal tar (weight/volume) of a cholesterolized adsorbent hydrophilic ointment base (Aquabase ointment, Paddock Laboratories, Minneapolis, Minn) was applied to the left leg (BB side) daily and removed by using mineral oil immediately preceding the daily UV exposure. The patients were supplied with the cholesterolized adsorbent hydrophilic ointment base to apply to the remainder of their skin throughout the day. A specially constructed cabinet containing 36 Philips TL-01/100 W NB UV-B bulbs and 12 Light Sources FST72T12/UV-B/HO BB UV-B bulbs (bulbs evenly distributed throughout 360°) was used for this comparative study. The phototherapy unit (Spectra 311/305) delivered approximately 2.4 mW/cm^2 of NB UV-B vs 1 mW/cm^2 of BB UV-B as measured at the skin surface with a model UV-B 500C UV-B meter (National Biological Corp, Twinsburg, Ohio). Note that NB UV-B energy levels measured by this meter were multiplied by 0.74 to compensate for increased transmission of 312-nm UV-B through its bandpass filter compared with the average transmission of UV-B across the BB spectrum.

Before light treatment, patients applied mineral oil to their psoriatic plaques. Starting UV-B dosages were approximately 60% of the MED as determined by phototesting with both UV-B sources (Table). Daily dosages of NB and BB UV-B were increased by approximately 15%. If clinical signs or symptoms of burning were evident, dosages were reduced or withheld. The goal for treatment was to attain slight (or faint) erythema following each daily dose of NB and BB UV-B. During the 4 treatment weeks, patients received an average of 25 treatments (range, 20-28).

CLINICAL ASSESSMENT

On admission to the hospital, patients provided a medical history and received a thorough physical examination, which included a clinical assessment of their psoriasis. Disease activity was assessed by rating the patient's psoriasis for erythema, scaling, and induration. Each was rated from 0 to 6 (0, absent; 1, trace; 2, mild; 3, mild to moderate; 4, moderate; 5, moderate to severe; and 6, severe). Disease severity scoring was performed on 4 body zones: the right and left upper extremities and torso and both lower extremities. The scores were summed for a maximum obtainable score of 18 and a minimum of 0 for each specified body area. Clinical severity assessments (on each of the 4 body zones) were performed weekly. Patients who received a severity score of 3 or less were categorized as having clear skin or trace disease.

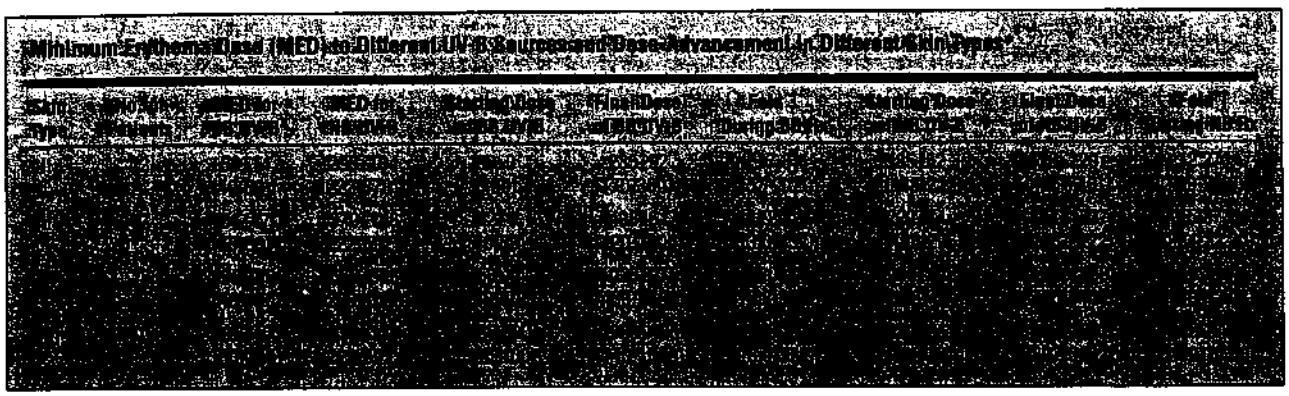
HISTOLOGICAL ANALYSIS

For histological analysis, a 6-mm punch biopsy sample of lesional skin was obtained (also performed after 4 weeks of treatment). Skin biopsies of lesional skin were performed on both the right and left sides of the body (above the waist) after 4 weeks of therapy. Skin biopsy samples were frozen in Tissue-Tek OCT compound solution (Miles Diagnostic Division, Elkhart, Ind) for histological analysis. Cryostat sections were stained with CD3 (Becton-Dickinson, San Jose, Calif), Ks8.12 (Sigma Chemical Co, St Louis, Mo), or Ki67 (Immunotech Inc, Marseille, France) monoclonal antibodies as previously described.[29] Epidermal thickness was measured on digitized micrographs using the National Institutes of Health image public domain software.[30]

STATISTICAL ANALYSIS

Quantitative measures of clinical severity or epidermal thickness in histopathological sections from paired sites were evaluated using 2-tailed paired t test comparisons. Differences in skin clearance between treatments at the end of the study were assessed using McNemar χ^2 test since the samples were dependent.

treatments.[1,11] In particular, PUVA treatment using oral methoxsalen has been shown to induce clearing in 88% of treated patients, and remissions of 4 to 6 months following cessation of treatment are typical.[14] Although treatment with PUVA is highly effective, increasing concerns about PUVA-induced cutaneous carcinomas and melanomas are likely to restrict its future use.[15,16] Furthermore, long-term therapy with methotrexate, as well as cyclosporine and other oral agents, may effectively be limited because of toxic effects to noncutaneous organs.[1]



*Data are given as mean±SD (range) millijoules per square centimeter except where noted. BB indicates broadband; NB, narrowband; and Rx, treatment.
†A range of light- to dark-brown skin was present in this group.

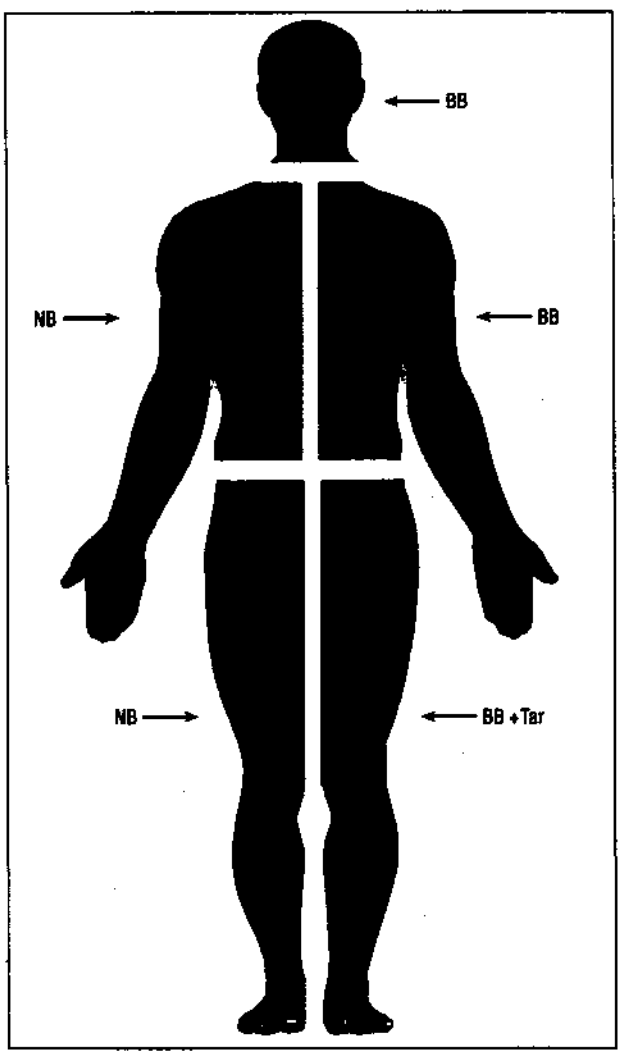


Figure 1. *Treatment protocol used to compare the effects of narrowband (NB) UV-B vs broadband (BB) UV-B or BB UV-B with tar (Goeckerman protocol).*

Given these considerations, phototherapy probably has the most acceptable therapeutic index for long-term treatment of extensive psoriasis. Understandably, efforts to maximize effectiveness of phototherapy are continuing, particularly for the treatment of "difficult" patients—those with dark skin pigmentation; extensive skin surface involvement; thick, keratotic plaques; long disease duration; and resistance to other treatment modalities. A potential advance in UV-B–based phototherapy has been the introduction of fluorescent bulbs (Philips model TL-01) that deliver 312-nm UV-B, a wavelength that seems to maximize clearing of plaques relative to its erythrogenic potential. While 313-nm UV-B has been labeled as the most effective wavelength for clearing psoriasis in "action spectrum" measures,[17,18] this is a relative designation. Significantly greater amounts of long-wave (313-nm) UV-B must be given to clear psoriasis relative to shorter wavelengths, eg, 300- to 305-nm UV-B.[18] Accordingly, treatment protocols using NB or 312-nm UV-B from fluorescent bulbs have been designed to deliver larger amounts of UV-B to the skin, with dose increases limited by the erythrogenic response.[17,19-23] In some European studies, most using 3 to 5 exposures per week in outpatients, treatment with NB UV-B has been found to be effective in clearing psoriasis.[17,19-23] Overall, its effectiveness has been superior to that of conventional BB UV-B treatment; in 1 study, it equaled the effectiveness of PUVA treatment.[24]

From previous work, it is difficult to gauge the potential usefulness of treatment with NB UV-B in patients with darkly pigmented skin or in patients with extensive psoriasis (the moderate-to-severe disease subset). Furthermore, the ability of NB UV-B to modulate pathologic inflammation and keratinocyte activation in psoriatic lesions has not been investigated. As 312-nm UV-B should penetrate skin better than shorter UV-B wavelengths,[25,26] the cellular effects of NB UV-B treatment might be somewhat different compared with conventional UV-B, where immune-modulating effects are primarily confined to the epidermis.[27,28] In this study, the response of psoriasis to conventional UV-B and NB UV-B was compared using clinical and histopathological measures of efficacy in a group of patients with recalcitrant disease (skin types II-V were represented). Treatment with NB UV-B produced significantly faster clinical responses and more complete clinical and histopathological resolution of psoriasis compared with daily treatment with conventional UV-B. We believe that NB UV-B offers a significant therapeutic advantage over conventional UV-B treatment and that this new UV modality may be a viable alternative to PUVA treatment for moderate-to-severe psoriasis, even in patients with highly pigmented skin.

RESULTS

Twenty-two patients with extensive psoriasis vulgaris were sequentially enrolled into this inpatient comparative treat-

Figure 2. *Histological analysis of 2.0–minimum erythema dose sites 24 hours after exposure to broadband UV-B (A) and narrowband UV-B (B). Arrows point to sunburn cells, which are more numerous in skin irradiated with narrowband UV-B. Bar indicates 100 µm.*

ment study. These patients would generally be considered difficult phototherapy candidates due to extensive body surface involvement, disease persistence, previous treatment with numerous other modalities, or dark skin pigmentation (10 of 22 patients had type V skin).

The study was conducted on inpatients in a general clinical research center to administer tar to a portion of the body consistently over 24 hours (Goeckerman protocol), to ensure compliance with daily UV-B treatments, and to monitor for phototoxic effects. As illustrated in Figure 1, the skin surface was divided into 4 quadrants from which 2 sets of treatment comparisons were performed. On the trunk and upper extremities, the response of psoriasis to NB UV-B vs BB UV-B treatment was compared bilaterally using only an emollient on both sides. On the lower extremities, the comparison was between the Goeckerman protocol (continuous application of tar-containing emollient plus BB UV-B) on 1 extremity and NB UV-B used only with emollients. Using this treatment strategy, NB UV-B responses could be compared with BB UV-B and BB UV-B plus tar (Goeckerman treatment), a traditional "reference standard" for phototherapy responses.

ERYTHEMA RESPONSE

Before whole-body treatment, each patient received MED testing with NB UV-B and BB UV-B. The preferred MED test site was the upper back (**Figure 2**), but occasionally other sites were tested due to disease distribution or severity. Comparative MED determinations for each patient are listed in the Table. For both UV-B sources, MED responses were first evident between 4 to 6 hours, with erythema peaking between 12 to 24 hours following exposure. The average MED for BB UV-B exposure was 72 mJ/cm^2 (median, 60 mJ/cm^2; range, 30-140 mJ/cm^2) compared with 428 mJ/cm^2 (median, 444 mJ/cm^2; range, 222-1036 mJ/cm^2) for NB UV-B exposure. To achieve a 1.0-MED reaction, exposure times were about 1 minute using BB UV-B and about 2.5 minutes using NB UV-B. As expected, most patients with type IV and V skin had higher MEDs for both BB UV-B and NB UV-B, but there were clear exceptions. Some patients with fair skin had MEDs to both BB UV-B and NB UV-B that were higher than or equal to those of more darkly pigmented patients (Table).

The erythema response produced by NB UV-B treatment was clearly different from that produced by BB UV-B treatment, particularly at doses above 1.0 MED, where more intense erythema was noted with NB UV-B treatment. Erythema produced by exposure to more than 1.0 MED of NB UV-B often persisted for a week or more, whereas erythema reactions produced by exposure to BB UV-B usually resolved within 1 to 2 days. In areas where NB UV-B was given at dosages greater than 2.0 MEDs, peeling or desquamation occurred several days following exposure, but blisters were not observed.

To better understand the cellular basis for differences in skin responses to BB UV-B and NB UV-B treatment, biopsy samples were obtained from 1.0- and 2.0-MED test sites in several patients 24 hours after UV-B exposure. "Sunburn cells," necrotic keratinocytes with a condensed nucleus and shrunken and pink cytoplasm, were detected in the epidermis following exposure to both UV-B sources. The frequency of sunburn cells was similar at a 1.0-MED exposure with NB UV-B and BB UV-B (about 1 sunburn cell per high power field). However, at a 2.0-MED exposure (Figure 2), 10 to 12 sunburn cells per high power field were detected in epidermis exposed to NB UV-B, whereas only 1 to 2 sunburn cells were detected in epidermis exposed to BB UV-B. As illustrated in Figure 2, sunburn cells in epidermis exposed to BB UV-B were located in the middle-spinous layer, whereas sunburn cells in epidermis exposed to NB UV-B were distributed throughout the spinous epidermis, including the lower portions of rete pegs (Figure 2, arrows). Ectatic blood vessels were observed in skin treated with NB UV-B, but UV-B–induced necrosis in resident dermal cells was not detected.

DOSING OF NB UV-B AND BB UV-B

We chose to deliver aggressive dosages of BB UV-B on a daily basis to maximize therapeutic responses. For BB UV-B, an initial exposure of approximately 0.6 to 0.8 MED was delivered, with daily increases of 15% unless marked erythema persisted 24 hours after the previous treatment. Mild,

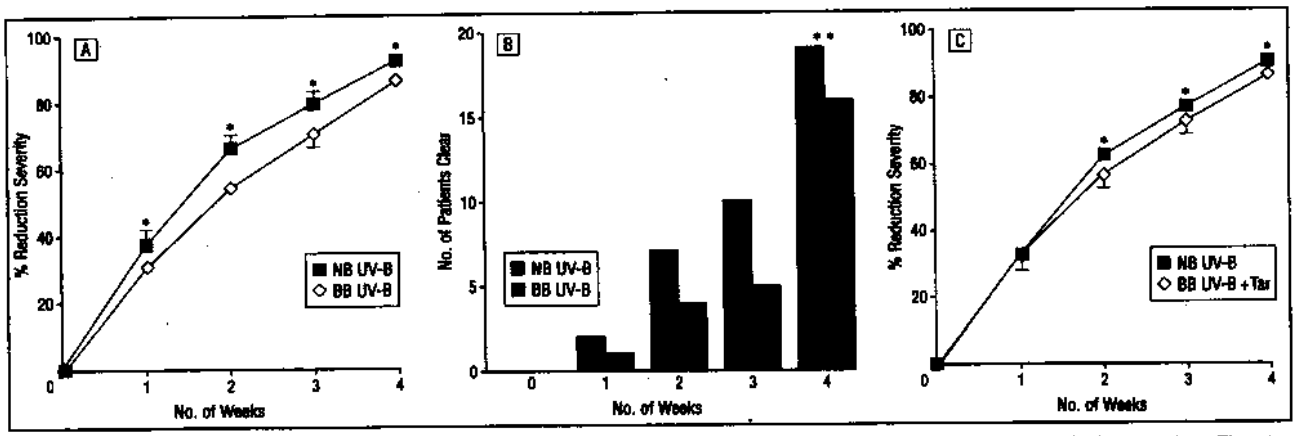


Figure 3. *Comparative rates of resolution of psoriasis using narrowband (NB) vs broadband (BB) UV-B. A and B, Data from the upper body comparison. The rate of improvement is illustrated as a reduction in the psoriasis severity score using NB UV-B vs BB UV-B with or without tar application. C, Data from the comparison on lower extremities. Bars show SE. Asterisk indicates P<.05 by paired t test analysis; dagger, P<.01 by χ^2 test analysis.*

transient erythema responses were usually attained with this "erythrogenic" dosing schedule. A single half-body exposure to BB UV-B was given to the upper and lower body quadrants without additional incremental UV-B exposure to the extremities. Initial attempts to deliver 0.8 to 1.0 MED of NB UV-B to the other half-body resulted in large areas of moderately painful erythema (usually on the trunk) that persisted for several days. This phototoxic response was similar to outcomes of phototests at more than 1.0 MED with NB UV-B, but they clearly occurred with less energy than predicted from 2×2-cm patch test sites. Accordingly, initial exposure with NB UV-B was typically in the range of 0.6 MED, with increasing UV-B exposure to about 1.0 MED during the next 2 to 3 treatments. From that point, daily increases of up to 15% were given as long as erythema responses were transient and nonpainful. Painful, burning reactions that required dose reductions or temporary suspension of dosing were encountered in some patients with NB UV-B treatment, making dosing of this form of UV-B less predictable than conventional BB UV-B. Accordingly, overall increases in NB UV-B throughout a course of treatment were less than for BB UV-B. Final doses of NB UV-B were increased by 2.3- to 9.7-fold over the starting dose in different skin types, whereas BB UV-B was increased by 7.8-fold to 20.4-fold (Table).

CLINICAL RESPONSE

Upper Body Comparisons

The ability of NB UV-B vs BB UV-B to clear psoriasis was compared on the trunk and upper extremities of patients using a paired treatment approach. On average, disease severity scores following NB UV-B exposure (**Figure 3**) were reduced by 38% after 1 week, 66% after 2 weeks, 80% after 3 weeks, and 92% after 4 weeks. These reductions in severity were significantly better than those measured with BB UV-B treatment: 31%, 54%, 71%, and 87% at respective weekly intervals ($P<.01$ for all time points). The final result achieved (Figure 3, B) was clear skin or trace disease in 19 of 22 patients treated with NB UV-B. Treatment with BB UV-B produced a similar degree of clearing in only 16 of 22 patients ($P<.01$). Another difference between these 2 forms of UV-B treatment was that maximal clearing responses were produced after fewer treatments, on average, using NB UV-B. While this difference can be appreciated from 2- and 3-week clearing responses charted in Figure 3, B, it is more dramatic when viewed in individual patients. For the patient illustrated in **Figure 4**, psoriatic plaques on the abdomen and upper extremity were largely resolved (becoming hyperpigmented patches) following 1½ to 2 weeks of NB UV-B treatment. In contrast, the same degree of improvement with BB UV-B required a total of 4 weeks' treatment. **Figure 5** illustrates resolution of psoriatic plaques in another patient with even more extensive and severe psoriasis. After only 2 weeks of treatment, this patient's right side completely cleared with exposure to NB UV-B, while the contralateral plaques only partially cleared with exposure to BB UV-B.

Lower Body Comparisons

The ability of NB UV-B vs Goeckerman treatment to clear psoriasis was compared on lower extremities using the paired approach. Overall differences between these 2 treatment approaches were less than those observed in the upper body comparison. However, a slightly faster improvement of psoriasis was measured on the side treated with NB UV-B, with statistically significant differences occurring from weeks 2 to 4 (Figure 3, C).

HISTOLOGICAL ANALYSIS

We sought to confirm our clinical impression of psoriatic plaque resolution following NB UV-B treatment by using objective histopathological measures. **Figure 6** shows micrographs of psoriatic plaques from a patient before and after NB UV-B treatment. From hematoxylin-eosin–stained sections, it can be seen that the epidermis thinned considerably after treatment, losing much of its psoriasiform patterning, and that orthokeratosis and a granular layer are restored. The number of chronic inflammatory cells in the dermis is also reduced (Figure 6, A and B). Sections stained for cycling keratinocytes with the Ki67 antibody show numerous basal and suprabasal keratinocytes with positive nuclei in pretreatment lesional skin (Figure 6, C). Following NB UV-B treatment, there is a marked reduction in the number of cycling keratinocytes, such that proliferative cells are appropriately confined to the basal layer of the epidermis (Figure 6, D).

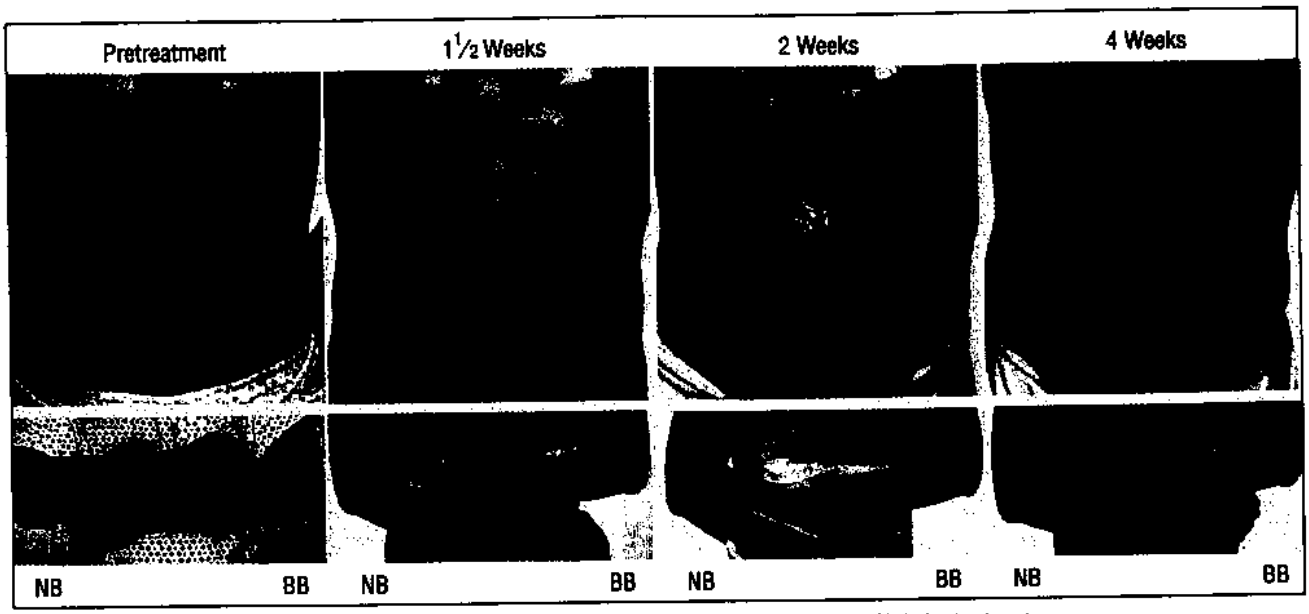


Figure 4. *Clinical responses to narrowband (NB) UV-B (patient's right) vs broadband (BB) UV-B (patient's left) during treatment.*

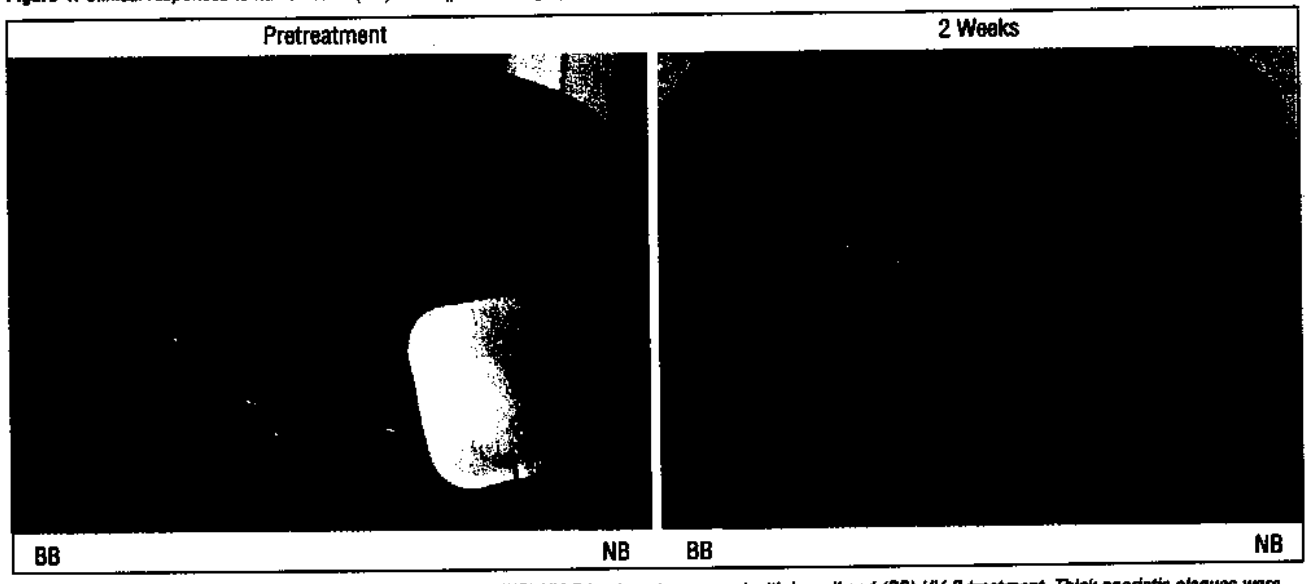


Figure 5. *Rapid response of severe psoriasis to narrowband (NB) UV-B treatment compared with broadband (BB) UV-B treatment. Thick psoriatic plaques were converted to hyperpigmented patches with no clinical evidence of psoriasis after only 2 weeks of NB UV-B treatment. Complete clearing of psoriasis was not achieved by daily treatment with BB UV-B until 4 weeks.*

To compare reversal of "regenerative" hyperplasia in psoriatic plaques following NB UV-B vs BB UV-B treatment, biopsy samples from psoriatic plaques exposed to paired, contralateral BB UV-B vs NB UV-B were studied for reversal of keratin 16 expression. Paired biopsy samples were available in 17 patients, and representative outcomes are displayed in **Figure 7**. The most common result (in 10 of 17 patients) was elimination of keratin 16 staining in suprabasal keratinocytes following both BB UV-B and NB UV-B treatment (data not shown). In 5 patients, keratin 16 expression was strongly down-regulated or eliminated in plaques exposed to NB UV-B, but suprabasal keratinocytes continued to express keratin 16 in plaques exposed to BB UV-B (Figure 7). In 2 patients, keratin 16 continued to be expressed by spinous keratinocytes following both NB UV-B and BB UV-B treatment, but epidermal acanthosis was reduced and overall keratin 16 appeared less abundant than in untreated lesional epidermis (not shown). In sum, keratin 16 expression was reversed in lesional epidermis in 88% of patients following NB UV-B and in 59% of patients following BB UV-B treatment.

In addition to studying keratin 16 expression, the mean thickness of lesional epidermis was determined before and after treatment from computer-assisted image analysis on cryostat sections. Mean (±SE) lesional epidermis thickness measured 265.0±13.4 µm before treatment vs 145.0±10.9 µm after NB UV-B treatment and 181.0±15.1 µm after BB UV-B treatment. Lesional epidermis treated with NB UV-B was thinner than the BB UV-B counterpart in 88% of paired specimens, and this posttreatment difference was highly significant ($P=.006$).

COMMENT

Treatment with NB UV-B has been considered to be a more sensible alternative to conventional BB UV-B based prima

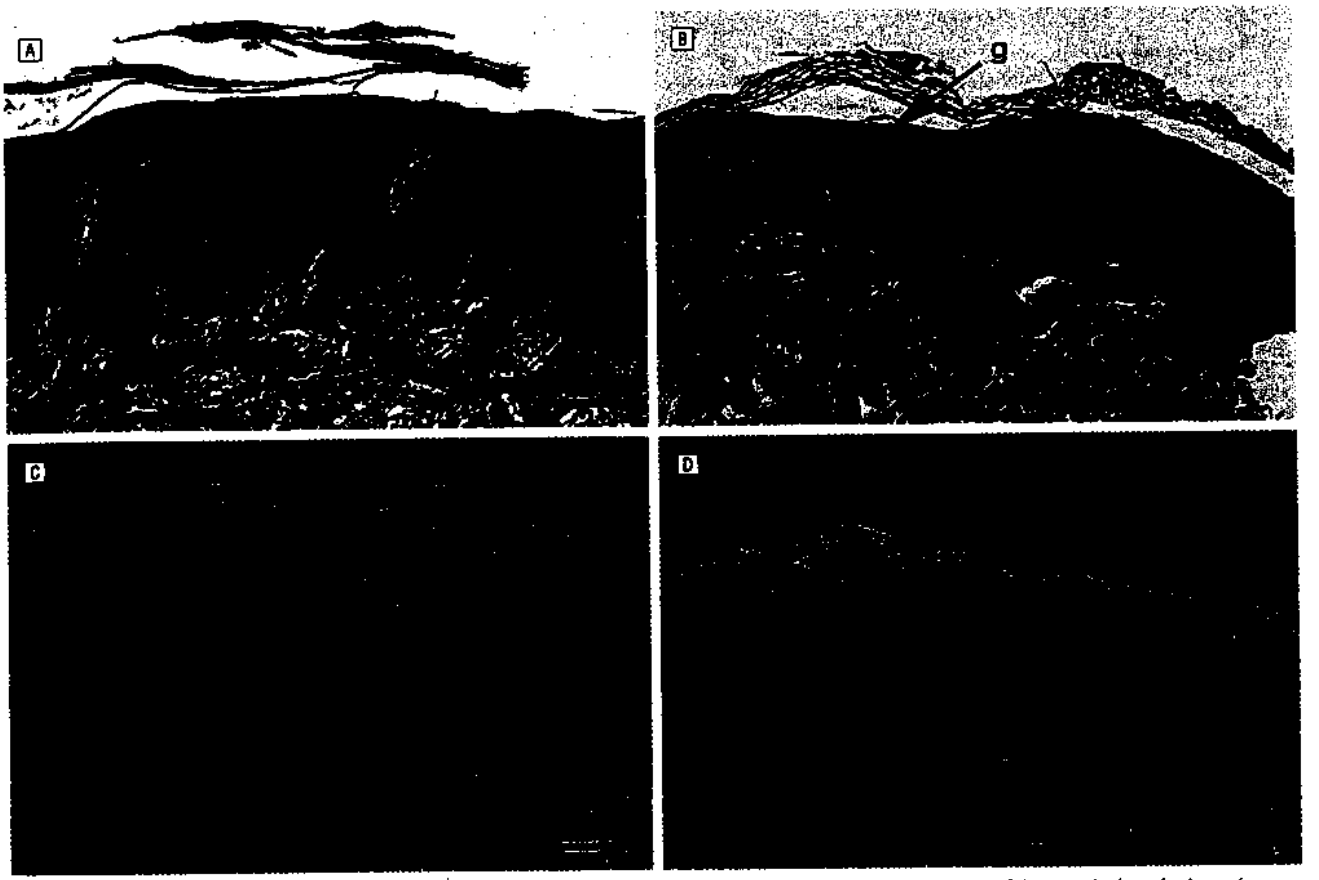


Figure 6. *Histological sections taken before (A) and after (B) treatment with narrowband UV-B (hematoxylin-eosin). Return of the granular layer is shown (g; arrow). Expression of Ki67 (proliferation-associated) nuclear antigen in cryostat sections of psoriatic lesional skin before (C) and after (D) narrowband UV-B treatment. Bar indicates 100 µm.*

rily on "action-spectrum" measures for the clearing of psoriasis. In 1 study, resolution of psoriasis was achieved by as little as 0.2 to 0.6 MED of monochromatic 313-nm UV-B, while 304-nm UV-B required 0.4 to 1.0 MED and 300-nm UV-B required 0.4 to 2.5 MEDs in individual patients. Shortwave UV-B at 290 nm produced only burning and no therapeutic improvement in psoriasis.[18] In another study, 313-nm UV-B at 1.0 MED was found to be effective in clearing psoriasis, but wavelengths of 334, 365, and 405 nm did not produce significant therapeutic benefit.[17] Accordingly, it has been argued that the choice of a therapeutic UV-B source should be based on a "phototherapy index" that considers the clearing-to-burning ratio of various sources.[31] The fluorescent bulb, which produces mostly 312-nm UV-B, satisfies these relative criteria of "optimal" efficacy, even though about 7-fold higher energy levels are required to clear psoriasis relative to 304-nm UV-B.[18]

Our results indicate that NB UV-B treatment is highly effective in producing clinical remission of psoriasis when used in patients with light-to-dark skin pigmentation who have moderate-to-severe disease (extensive surface area affected, long-standing psoriasis, or resistance to other phototbased or systemic treatment modalities). In our bilateral comparison study, 19 (86%) of 22 patients achieved clinical clearing of psoriasis on the NB UV-B treatment side. However, the 3 patients who did not achieve clearing with NB UV-B still had significant disease improvement (69%, 69%, and 71% after 4 weeks). Clinical improvement occurred faster with NB UV-B treatment, and this difference was statistically significant as early as 1 week into therapy. The overall effectiveness of NB UV-B treatment to produce clinical remission of psoriasis is virtually the same as that seen in a large cohort of patients treated with PUVA (88% of patients achieve clinical clearing after an average of 30 treatments),[14] but clearing induced by the use of NB UV-B was achieved in a shorter time frame compared with PUVA protocols. Our data and those of other investigators[17,19-23] indicate clear superiority of NB UV-B vs conventional UV-B for induction of clinical improvement or remission. Our data also establish superiority of NB UV-B treatment in reducing epidermal hyperplasia and regenerative epidermal growth, as indicated by expression of keratin 16 in suprabasal keratinocytes of lesional psoriatic skin. Based on this objective measure, hyperplastic epidermal growth was reversed in 88% of biopsy samples from psoriasis treated with NB UV-B but only in 59% of biopsy samples from psoriasis treated with BB UV-B. Our histological measures establish that NB UV-B is a "remittive" therapeutic modality that, like conventional UV-B,[32] PUVA,[29] and DAB389IL-2,[30] can reverse cellular and molecular alterations of keratinocyte differentiation that define psoriatic pathology. The cellular mechanism of action of NB UV-B has not been established in psoriasis. Companion experiments indicate that low levels of NB UV-B (30 mJ/cm^2) prevent activation and cytokine elaboration from T lymphocytes in vitro, whereas somewhat higher doses are selectively cytotoxic for T lymphocytes in vitro and in vivo (T.R.C., L.H.B., P.G., M.K., M.O., J.G.K., unpublished data, 1997). Hence, the overall antipsoriatic ac-