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The effectiveness of narrowband ultraviolet b phototherapy for the treatment of moderate to severe psoriasis in adult patients

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ABSTRACT

Psoriasis is a chronic skin condition influenced by genetics and the environment. It affects 57.8 per 100.000 people in 2019. The severity of psoriasis is assessed using the Psoriasis Area Severity Index (PASI), with scores above 10 indicating moderate to severe disease. Treatment options for psoriasis including systemic therapies and phototherapy. Patient satisfaction remains suboptimal, with adherence rates to systemic therapy as low as 40%. Narrowband ultraviolet B (NB-UVB) phototherapy is preferred for its safety. This review aims to evaluate the effectiveness of NB-UVB phototherapy in treating moderate-to-severe psoriasis in adults. Descriptive analysis was the method that journal used, search of online databases was conducted and found 12 relevant articles meeting criteria, published in English between 2014 and 2024, focusing on patients with moderate to severe psoriasis receiving NB-UVB phototherapy. Our review found that NB-UVB phototherapy, whether used alone or in combination with adjuvants, effectively treats moderate to severe psoriasis vulgaris in adult patients. Combining NB-UVB with adjuvants can further improve its effectiveness. However, further research is needed to assess its effectiveness across different age groups and to optimize treatment strategies based on individual patient characteristics and disease severity.

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INTRODUCTION

Psoriasis is a chronic inflammatory disease characterized by skin inflammation, influenced significantly by genetic factors and autoimmune triggered by environmental factors such as

trauma, infection, and certain medications (Ngao & Udey, 2019; Rendon & Schäkel, 2019). Throughout the world, there were 4,622,594 cases of psoriasis in 2019. The incidence rate according to age standards in 2019 was 57.8 per 100,000 people (Damiani et al., 2021). In Indonesia, the prevalence of psoriasis has reached 2.5% (Purnama Sari et al., 2022). In psoriasis research in Indonesia in 2019-2020, the Dermatology Life Quality Index (DLQI) questionnaire was used and it was found that out of 24 patients, the biggest risk factor for psoriasis patients was trauma (koebner phenomenon), which was reported in 15 patients (62.5%), and the quality of life from 11 patients (45.8%) were affected (Naufal et al., 2021).

Various comorbidity conditions include diabetes, cancer, hypertension, obesity, metabolic syndrome, hepatic disease, infections, dyslipidemia, and osteoporosis (Matos et al., 2016). The assessment of psoriasis severity has been based on classification, distinguishing between mild and moderate to severe forms. Individuals with Psoriasis Area Severity Index (PASI) scores below 10 would be classified as having mild psoriasis, whereas those surpassing 10 on any of these scales would be categorized as having moderate to severe psoriasis (Salgado-Boquete et al., 2021).

Treatment selection is influenced by factors such as disease severity, current health conditions, and healthcare accessibility. Patients with moderate to severe symptoms can be managed with phototherapy, and systemic therapies such as methotrexate, cyclosporin, acitretin, and biologic agents (Kim et al., 2017). A study of methotrexate showed that 40% of patients experienced an increase of 75% in the Psoriasis Area score and Severity Index (PASI), but unfortunately this drug is not permitted in children and has hepatotoxic effects. Same with methotrexate, cyclosporine can quickly cure psoriasis symptoms, but it has many serious side effects with long-term use, such as hypertension, nephrotoxicity, and non-melanoma skin cancer. Whereas in acitretin, it has good efficacy with low doses and rare side effects, but is teratogenic, so female patients are asked not to have plans to become pregnant within 3 years after stopping this drug. Different from the others, biological agents has very high potential in the treatment of psoriasis and is still being widely studied, especially if other treatments fail or experience side effects. However, unfortunately the high price is an obstacle to its use (Kim et al., 2017; Zhu et al., 2022). Despite the numerous options of treatment available, many patients remain unsatisfied with the result. Systemic therapy is reported with a notably high incidence of nonadherence, reaching up to 40% (Matos et al., 2016). Due to its demonstrated efficacy and safety benefits in various randomized controlled trials, narrowband UVB (NB-UVB) therapy is preferred as the first-line treatment option.

Notably, NB-UVB therapy is suitable for a wide range of patients, including children, pregnant women, and breastfeeding women with no increased risk of skin malignancy associated with its use (Kim et al., 2017; Matos et al., 2016).In comparison to other UVB therapies, NB-UVB is also approximately ten times less likely to cause erythema compared to broadband UVB (BB-UVB) (Elmets, 2023). Therefore we aim to discuss the effectiveness of phototherapy NB-UVB for the treatment of moderate to severe psoriasis in adult patients.

RESEARCH METHOD

This literature review aims to discuss the effectiveness of phototherapy NB-UVB for the treatment of moderate to severe psoriasis in adult patients. This literature review used descriptive analysis for assess the effectiveness of NB-UVB and conducted by collecting articles from several online databases such as PubMed, ProQuest, Wiley, ScienceDirect, Cochrane, and Taylor & Francis Online with keywords such as "Phototherapy", "Ultraviolet B" or "UV-B" and "Psoriasis". Among these six search engines, there are 12 articles used (Figure 1). The inclusion criteria include original literature published in English, literature published between 2014 to 2024, also full text and open access, moderate to severe psoriasis patients (PASI Score ≥10), adult patients, use PASI score as parameter and patients receiving NB-UVB phototherapy. The exclusion criteria was literature published on 2014 and below, mild psoriasis patients, not use PASI score as parameter, children

and elderly patients, allergic to NB-UVB and/or adjuvant therapy, pregnant and/or breastfeeding women, patients who had immunosuppresive disease or using immunosuppressive medications, use topical/oral psoriasis therapy before treatment (within 2 weeks for topical and within 4 weeks for oral therapy). From each article, we took data on title, source, sample size, methods, duration of treatment, results, and side effects.

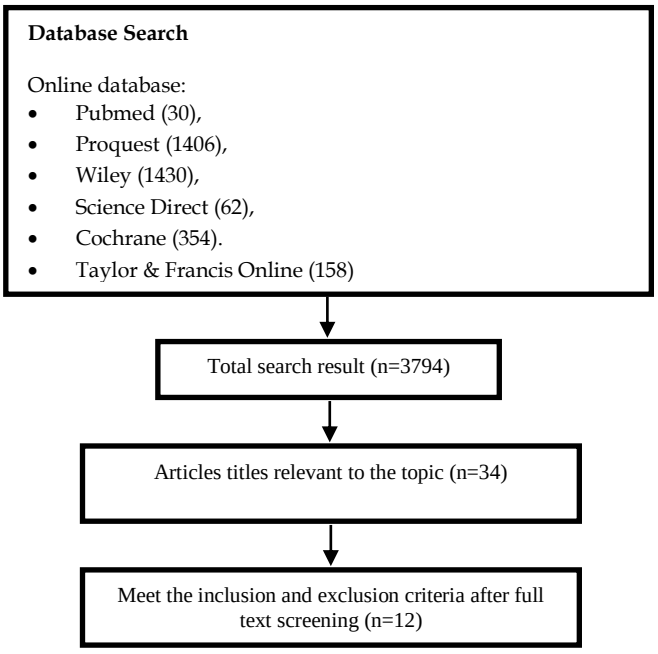

Figure 1. Article screening flow

RESULTS AND DISCUSSIONS

Psoriasis is a chronic inflammatory disease defined by skin inflammation, influenced significantly by genetic factors and autoimmune triggered by environmental factors such as trauma, infection, and certain medications (Ngao & Udey, 2019; Rendon & Schäkel, 2019). Psoriasis vulgaris, sebo-psoriasis, pustular psoriasis, guttate psoriasis, small plaque psoriasis, inverse psoriasis, and erythrodermic psoriasis are some of the subtypes of psoriasis that can be distinguished based on clinical features. About 90% of cases are thought to be persistent psoriasis of the plaque variety. Erythematous, itchy plaques covered in silvery scales are indicative of this. Large regions of the skin, most frequently the scalp, extensor surfaces of the limbs, and the trunk, are affected by these plaques, which frequently combine (Rendon & Schäkel, 2019).

Based on the PASI score, a score below 10 indicates a mild degree, while above 10 indicates a moderate to severe degree. The PASI assessment aims to assess the redness, thickness and erosion of psoriasis lesions. The ranges used for interpretation are score 0 for no lesions, score 1 for the range 1-9%, score 2 for the range 10-29%, score 3 for the range 30-49%, score 4 for the range 50-69%, score 5 for the 70-89% range, and a score of 6 for the 90-100% range (Manchanda Yashpal et al., 2023). Psoriasis Area and Severity Index (PASI) must improve by at least 75% which indicates a successful treatment (Philipp, 2014). Topical treatments such as corticosteroids, retinoids, vitamin D analogs, and calcineurin inhibitors are typically effective in controlling mild psoriasis (Kragballe et al., 2014).

When a patient is resistant, adding phototherapy should be taken into consideration. NB-UVB is mostly used to treat psoriasis. Several articles regarding NB-UVB can be seen in Table 1. BB-UVB is an option that may be used, however numerous studies have shown that NB-UVB is

more effective and tolerable than BB-UVB. In photochemotherapy, UVA (PUVA) and 8-methoxypsoralen are combined. PUVA is recommended for pustular, palmoplantar, and generalized psoriasis as well as moderate to severe plaque psoriasis. The therapeutic impact of UV radiation in psoriasis may be attributed to immune suppression, altered cytokine expression, and cell-cycle arrest (Kragballe et al., 2014). If topical medications and photochemotherapy do not provide significant relief, or if comorbidities must be treated, a systemic drug is recommended. Possible treatments include fumarate, retinoids, cyclosporine, and methotrexate. It had an alternative treatment, such as biologics. This therapy is very useful in patients who have failed other systemic therapies, whose side effects are intolerable, or who have comorbidities (Kim et al., 2017).

Table 1. Characteristic of each articles

Title	Source	Sample Size	Research Methods	Duration of treatment	Main Outcomes	Side effect
Ultraviolet B radiation therapy for psoriasis: Pursuing the optimal regime.	Matos et al. , 2016	Didn't descibe	Observational study	Three-times weekly regimen over 10 weeks	A statistically significant difference (NB-UVB 78.5% vs BB-UVB 73.9%) in PASI reduction	A 5-year follow-up study on patients treated with NB-UVB was a small population got basal cell carcinoma
The efficacy and safety of targeted narrowband UVB therapy: A retrospective cohort study	Esen Salman et al., 2019	24 patients with age 39.42 ± 14.08 (14–72)	Observational Study	25 session of treatment	Patients that achieved PASI 75 in PUVA and NB-UVB had similar outcomes in percentage (80% and 76.7%, respectively; p>0.05),	Erythema
Assessment of efficacy and safety of UV-based therapy for psoriasis	Li et al., 2022	a total of 2120 psoriasis patients with median age of subjects was 41.5 years	Randomized controlled trial	Didn't describe	Combination of PUVA plus vitamin D and UVB plus systemic drugs is the most effective and safest phototherapy recommendation for psoriasis	Erythema
Narrow band ultraviolet-B versus Goeckerman therapy for psoriasis with and without acitretin	Çaliskan et al., 2015	NB-UVB was used in 52 of the courses (31 NB-UVB alone, 21 NB-UVB + acitretin)	Observational Study	3 times a week and increase 20% each session, also used in 52 courses (31 NB-UVB alone, 21 NB-UVB+ actretin)	A statically significant difference between Gookerman therapy groups and NB-UVB group, but not Acitretin+ NB-UVB Group in PASI 75	Erythema
Tazarotene gel with narrow-band UVB phototherapy: A synergistic combination	Dayal et al., 2018	Thirty patients	Observational Study	Twice a week on non-consecuti	96.67% of patients getting Tazarotene Gel + NB-UVB and 6.67% of patients receiving	Erythema in both groups

Title	Source	Sample Size	Research Methods	Duration of treatment	Main Outcomes	Side effect
in psoriasis				ve days for 3 months.	monotherapy experienced complete clearance	
Efficacy and safety of apremilast and phototherapy versus phototherapy only in psoriasis vulgaris	Morita et al., 2022	A total of 42 patients were enrolled in the study (combination therapy group: 29, monotherapy group: 13)	Randomized controlled trial	8 weeks 52 weeks	- Apremilast+NB-UVB resulted in significantly greater PASI 75 accomplishment rates at 4 and 8 weeks compared to monotherapy (NB-UVB) (p=0.031). - The PASI score in NB-UVB + Calcipotriol ointment had significant in 2-12 weeks (p <0.05)	Erythema Perlessional irritation
Calcipotriol/betamethasone ointment compared to narrow-band UVB in plaque psoriasis: first clinical and ultrasonographic study	Polańska et al., 2019	58 consecutive patients (26 (44.8%) women and 32 (55.2%) men)with age from 19 to 65 years (mean, 44.8 years).	Observational study	2 weeks	PASI was decreased by 85% in the calcipotriol/betamethasone group and 82% in the NB-UVB group.	Erythema
Efficacy of oral methotrexate (MTX) monotherapy vs oral MTX plus narrowband ultraviolet light B phototherapy in palmoplantar psoriasis	Ara et al., 2020	Didnt't decribe	Clinical trial	10 mg MTX weekly and twice weekly for 12 weeks	The mean PASI Palmoplantar Psoriasis score was considerably lower after MTX+NB-UVB than after MTX monotherapy (mean reduction of 12.19 ± 0.65 points vs. 10.39 ± 2.49 points; p=0.001).	Erythema in combination group (31.1%)
Sitagliptin and Narrow-Band Ultraviolet-B for Moderate Psoriasis (DINUP)	Lynch et al., 2022	A total of 118 patients were randomizer	Randomized control and clinical trial	24 weeks	PASI score in Sitagliptin (100 mg)+NB-UVB, were considerably greater than when NB-UVB was taken alone (p = 0.044). significant -1.0 [95% CI -2.0 to 0.0.	Erythema: grade 2 erythema in NB-UVB alone (33%)

Title	Source	Sample Size	Research Methods	Duration of treatment	Main Outcomes	Side effect
Combining biologic and phototherapy treatments for psoriasis: safety, efficacy, and patient acceptability	Farahnik et al., 2016	268 patients had been placed on combination therapy (etanercept (234), adalimumab (24) and ustekinumab (10)) patients among all the trials, with an average age of 43 years	Case control	at least 4 weeks or at least one dose of an additional systemic agent at some point during treatment	- m-PASI reduction of 86% (NB-UVB+ Adalimumab 80 mg) vs 53% (NB-UVB alone) - NB-UVB + Ustekinumab were PASI: 78% PASI 75 (p=0.007) - 89% (NB-UVB+ Etanercept (50 mg) vs 68%(NB-UVB alone) (p<0.001)	Erythema Herpetic eruption and erythema Erythema
Diagnosis and management of psoriasis	Kim et al., 2017	Didn't descibe	Literature review	Didn't descibe	Infliximab may be the most effective biologic, followed by etanercept, ustekinumab, and adalimumab	Erythema
Psoriasis treatment: Faster and long-standing results after bathing in geothermal seawater. A randomized trial of three UVB phototherapy regimens	Eysteinsdóttir et al., 2014	68 patients fulfilled all criteria and were enrolled in the study	Randomized controlled trial	6 weeks	PASI: 68-77% patients with PASI 50-75 in 6 week vs 16.7% in monotherapy	Erythema

Efficacy Comparison of NB-UVB Monotherapy and Other Treatment Strategies

a. BB-UVB

In recent years, BB-UVB is not often used because NB-UVB is already available. Based on studies, 75% of patients treated with BB-UVB achieved PASI 75. The National Institute for Health and Care Excellence (NICE) Clinical Guidelines state that NB-UVB was not statistically more effective than BB-UVB, but there was a trend toward NB-UVB at the end of treatment when comparing the two regimens. A statistically significant difference (78.5% vs 73.9%) in PASI reduction was observed with a three-times weekly regimen over 10 weeks (Matos et al., 2016). Multiple studies have also examined BB-UVB's efficacy. According to a study by Toll et al., out of 15 patients, 3 had a complete response and 5 had a nearly complete response.28 psoriasis patients in Lapidoth et al. experienced a 73% decrease in their PASI. 20 patients were compared between high-dose and low-dose BB-UVBs in an experiment by Kemeny et al.; the high-dose group showed a 93% improvement, while the low-dose group showed an 84% improvement. Salman, *et al*. investigated the efficacy of NB-UVB to psoriasis in 13 patients (56.5%) who had a moderate or better response (Matos et al., 2016)

b. PUVA

Phototherapy approaches have been demonstrated to be beneficial in the treatment of pustulosis and palmoplantar psoriasis in several investigations. In order to compare the efficacy of PUVA and local NB-UVB, Sezer et al. performed a right-left comparative research on 25 patients.

The results showed that the improvement rates for PUVA and local NB-UVB were 85% and 61%, respectively. (Esen Salman et al., 2019)

Patients that achieved PASI 75 in PUVA and NB-UVB had similar outcomes in percentage (80% and 76.7%, respectively; p>0.05), according to a non-randomized study conducted in Vietnam by Van et al. Patients in the PUVA group, however, had cumulative UV radiation exposure that was significantly higher. The NB-UVB group had a greater rate of relapse than the PUVA group six months later (p>0.05). In individuals receiving PUVA treatment, the severity was higher. There were four individuals with grade 2 or 3 erythema in the PUVA group and none in the NB-UVB group. Nair and Jayapalan found that 50% of patients treated with PUVA and 75% of those treated with NB-UVB obtained illness remission, which is comparable to the findings of Van et al. PUVA patients experienced adverse effects at a higher rate (75%) than NB-UVB patients. (Van et al., 2019)

In addition, research on PUVA combination therapy is also being carried out. In a meta-analysis study, Li et al. compared five different phototherapy approaches: UVB, PUVA, cPUVA (PUVA + adjuvant therapy), cUVB (UVB + adjuvant therapy), and cAB (PUVA + UVB). All these regimens showed higher effectiveness than UV monotherapy. cPUVA combined with calcium or vitamin D derivatives shows remarkable efficiency in improving skin lesions associated with moderate to severe psoriasis. However, on the contrary, the combination of PUVA and UVB actually increases erythema. The combination of PUVA plus vitamin D and UVB plus systemic drugs is the most effective and safest phototherapy recommendation for psoriasis (Li et al., 2022)

Based on previous studies, NB-UVB showed superiority compared to BB-UVB for PASI reduction. In addition, PASI reduction of PUVA had higher rates than NB-UVB. Relapse events occurred more frequently in NB-UVB patients. Though, erythema was seen more often in patients treated with PUVA.

Efficacy of Combination Therapy of NB-UVB with Adjuvant Treatments
Pharmacology Therapy

a. Acitretin

Acitretin is considered the best drug to take besides NB-UVB to maximize its safety, effectiveness, and tolerability. Patients who received acitretin with NB-UVB (62 vs. 39%) had a higher percentage of PASI 75 responses than patients who received NB-UVB alone, according to a retrospective study by Aliscan et al. However, this percentage is not significant if measured statistically. When combined with NB-UVB, acitretin did not provide results related to PASI 75. In the combination of acitretin with NB-UVB, the amount of phototherapy was less than with NB-UVB alone, but the results were not significant (P=0.051) (Çaliskan et al., 2015)

b. Tazarotene

According to studies, tazarotene addresses the three main pathogenic aspects of psoriasis: hyperproliferation of keratinocytes, aberrant keratinocyte differentiation, and infiltration of inflammatory cells. While NB-UVB irradiation only decreases cell proliferation at a higher dose, a recent study by Luo et al. discovered that a single treatment with tazarotene can limit keratinocyte proliferation and boost Tazarotene Induced Gene 3 (TIG3) on mRNA expression. Conversely, tazarotene gel and NB-UVB combine to inhibit keratinocyte proliferation and boost TIG3 expression in vitro. Dayal et al. found that tazarotene gel considerably increases the therapeutic efficacy of NB-UVB irradiation by comparing the monotherapy and combination groups. 96.67% of patients getting combination therapy and 6.67% of patients receiving monotherapy experienced complete clearance (Dayal et al., 2018)

c. Apremilast

When topical and other medications have not sufficiently treated moderate to severe plaque psoriasis (psoriasis vulgaris), apremilast is an effective treatment. Apremilast reduces inflammation by suppressing Phosphodiesterase-4 (PDE4), which raises intracellular cyclic adenosine monophosphate levels and controls the expression of inflammatory chemokines and cytokines. Morita, *et al.* compared phototherapy as monotherapy and combined phototherapy-

apremilast. Combination therapy resulted in significantly greater PASI 75 accomplishment rates at 4 and 8 weeks compared to monotherapy (p=0.031). There were no differences between PASI 50 and PASI 90 achievement rates at weeks 4 and 8 between the two groups. In the combination therapy group, adverse events occurred more frequently (19 patients out of 56) than in the monotherapy group (4 patients out of 7) with 5 events of skin disorder in the combination group and 1 event in the monotherapy group. Some previous clinical studies found that apremilast monotherapy is inadequate for psoriasis vulgaris. On the other hand, a clinical investigation combining NB-UVB phototherapy with apremilast administration showed outstanding efficacy (Morita et al., 2022)Click or tap here to enter text.

d. Steroid

The gold-standard first-line treatment for mild to moderate psoriasis, as defined by American and European clinical standards, consists of two compounds: calcipotriol, a vitamin D analog, and betamethasone dipropionate, a high-potency corticosteroid. Phototherapy is often indicated when patients do not respond to topical medications or when the illness is severe and involves more than 10% of the body area. In order to assess topical therapy with NB-UVB in patients with moderate to severe psoriasis, Polanski et al. constructed a prospective observational trial incorporating two compounds: betamethasone dipropionate 0.5 mg/g and calcipotriol 50 µm/g. Each treatment was equally effective in reducing the PASI and Target Lesion Score (TLS) values. PASI was decreased by 85% in the calcipotriol/betamethasone group and 82% in the NB-UVB group. 47 (81%) of the 58 patients obtained PASI 75; of them, 86% (26/30) in the ointment group and 70% (21/28) in the NB-UVB group did so. 10 patients (17%) in all, 5 in the UVB group (17.8%) and 5 in the calcipotriol/betamethasone group (16%), achieved PASI 90 (Polańska et al., 2019)

e. Calcipotriol ointments

The first line of treatment for localized persistent plaque psoriasis is topical vitamin D analogs. Calcipotriol is one of them; its ability to suppress cell proliferation and promote differentiation has been demonstrated both in vitro and in vivo. In a study by Veien et al., calcipotriol (50 µg/g twice a day) and tacalcitol ointment (4µg/g once a day) were employed. The results showed that, over the course of two weeks, calcipotriol significantly outperformed tacalcitol in terms of erythema, erosion, thickness, and plaque target score. The plaque-cleaning effect of calcipotriol plus NB-UVB is 90% more effective (Polańska et al., 2019)

f. Methotrexate

Methotrexate (MTX) and NB-UVB have been the subject of numerous research examining both combination and single therapy for palmoplantar pustulosis (PPP) and chronic plaque-type psoriasis. Patients with moderate to severe recalcitrant PPP who were older than 12 years old were randomly assigned to either oral MTX or oral MTX phototherapy + NB-UVB (311 nm) for a duration of 12 weeks in a 1-year prospective clinical trial by Ara et al. After 12 weeks, the mean PASI Palmoplantar Psoriasis (m-PPPASI) score was considerably lower after MTX plus NB-UVB than after MTX monotherapy (mean reduction of 12.19 ± 0.65 points vs. 10.39 ± 2.49 points; p=0.001). MTX plus NB-UVB was observed to reduce more quickly and effectively than MTX alone (PASI 75 was reached by 89% of patients as opposed to 85% of patients), suggesting that it could be used as a first-line systemic therapy for PPH (Ara et al., 2020)

g. Sitagliptin

A transmembrane glycoprotein called dipeptidyl peptidase-4 (DPP-4) is elevated in psoriasis and expressed in keratinocytes. DPP-4 inhibitors can thereby partially restore keratinocyte differentiation in vivo and decrease proliferation in vitro. This bolsters the idea that DPP-4 inhibitor therapy may be used to treat psoriasis. An inhibitor of DPP-4 is sitagliptin. Lynch et al. conducted a research in which 60 people received NB-UVB and sitagliptin 100 mg daily, while 58 patients received NB-UVB alone. One of the study's parameters was changes in PASI (ΔPASI) after 24 weeks. When sitagliptin and NB-UVB were taken together for 24 weeks, the

reduction in PASI was considerably greater than when NB-UVB was taken alone (p = 0.044). Since sitagliptin does not impair the immune system, it can be prescribed to psoriasis patients for whom immunosuppressive medications are contraindicated (Lynch et al., 2022)

h. Biologic agent

The use of biologics in the treatment of psoriasis has greatly improved, despite the possibility that some patients may not respond well to them and that others may eventually lose their effectiveness due to "biologic fatigue." Agents working together have the potential to work synergistically and are frequently more effective than one agent working alone (Farahnik et al., 2016). According to a study by Farahnik et al., there is evidence that combination therapy for psoriasis can be beneficial. Of the eight trials, six of which were controlled and two of which were uncontrolled, one showed enhanced clinical benefit; one controlled trial only showed enhanced benefit in patients who adhered to the NB-UVB treatment regimen; and one head-to-head trial revealed no benefit. In 234 patients, the combination of NB-UVB and etanercept was investigated (Farahnik et al., 2016)

Most of the data that were analyzed showed that the use of biologics in conjunction with phototherapy treatments was more effective than monotherapy for individuals with moderate to severe psoriasis. Most studies assessed the combination of NB-UVB and etanercept. Etanercept 50 mg once or twice weekly showed benefits; no new side effects were reported. A meta-analysis of pivotal phase III trials indicates that infliximab may be the most effective biologic, followed by etanercept, ustekinumab, and adalimumab, however there is no predetermined order in which to begin or cease using biologics (Kim et al., 2017). While there isn't an approved regimen for treating moderate to severe psoriasis that combines phototherapy and a biologic drug, the outcomes of multiple pertinent research support the efficacy of this combination of treatments (Farahnik et al., 2016)

Non Pharmacology

a. Bathing in geothermal seawater

Psoriasis sufferers are currently being treated in treatment facilities around Europe using water-based therapy that involves natural thermal springs, hot springs, mineral water, or seawater. According to studies conducted by Eysteinsdóttir et al., silica mud and microorganisms that thrive in the geothermal seawater of Iceland's Blue Lagoon are bioactive and can strengthen normal skin's protective layer and delay ageing. In a research published in 2012, Eysteinsdóttir, et al. evaluated NB-UVB therapy and two treatment regimens in 68 patients. One of the regimens included bathing in geothermal saltwater in addition to NB-UVB therapy for patients with chronic plaque psoriasis. Compared to patients treated with NB-UVB therapy alone, patients who received combined treatment shown a stronger response (90% reduction in PASI score) in areas inadequately exposed to NB-UVB radiation ($p<0.05$). Furthermore, a longer remission and a lower total NB-UVB dose were the outcomes of the combo therapies. As demonstrated by the notable decreases in PASI scores that occurred as early as week 1 and the noticeably higher percentage of patients attaining PASI 75 as early as week 1, the combinatiosn of bathing in geothermal seawater and NB-UVB therapy had a rapid onset of action (Eysteinsdóttir et al., 2014)

Table 2. Combination therapy of NB-UVB with adjuvant treatments

No.	Group of combination systemic therapy	Combination Therapy of NB-UVB with Adjuvant Treatments	Source	Comparison with NB-UVB
1.	Retinoid	NB-UVB + Acitretin	Çaliskan et al., 2015	Improvement in PASI: PASI reduced 62% vs 39%
		NB-UVB +	Dayal et al.,	Erythema: Both groups in equal numbers

No.	Group of combination systemic therapy	Combination Therapy of NB-UVB with Adjuvant Treatments	Source	Comparison with NB-UVB
		Tazarotene	2018	Improvement: a. skin lesions: more adverse effects in the combination group b. PASI: complete clearance: 96.67% vs 6.67%
2.	Immunosuppressant	NB-UVB (311 nm) + Methotrexate (10mg)	Ara et al., 2020	Erythema: 31.1% vs 0% Improvement: a. Skin lesions: irritation, itching, blister, atrophy, scaling b. PASI: reduced the mean of m-PPPASI (p=0.001)
		NB-UVB + Steroid cream	Polańska et al., 2019	Improvement in PASI: 81% patients reached PASI 75 with a two-compound ointment containing calcipotriol 50 µm/g and betamethasone dipropionate 0.5mg/g
3.	Selective PDE4 inhibitor	NB-UVB + Apremilast	Morita et al., 2022	Improvement: a. Skin lesions: 5 events vs 1 event b. PASI: better result in the combination group
4.	Vitamin D analog	NB-UVB + Calcipotriol ointment	Morita et al., 2022	Improvement: a. Skin lesions: perilesional irritation b. PASI: significant in 2-12 weeks ($p < 0.05$), peak at 4 weeks ($p<0.001$) 7.41 % in the mean time of 52 days
5.	DPP-4 inhibitor	NB-UVB + Sitagliptin (100mg)	Lynch et al., 2022	Erythema: grade 2 erythema in NB-UVB alone (33%) Improvement in PASI: significant -1.0 [95% CI -2.0 to 0.0 at 24 weeks.
		NB-UVB + Adalimumab (80mg)	Farahnik et al., 2016	Improvement in PASI: - 95% reached PASI 75, 75% reached PASI 90, 55% reached PASI 100 - m-PASI reduction of 86% vs 53%
6.	Biologic Agent	NB-UVB + Ustekinumab	Farahnik et al., 2016	Improvement: a. Skin lesions: 1 of 10 patients herpetic eruption b. PASI: 78% PASI 75 (p=0.007)
		NB-UVB + Etanercept (50mg)	Farahnik et al., 2016	Improvement in PASI: - 53.3%-100% reached PASI 75, 16.2%-57.6% reached PASI 90, 24.2-26% reached PASI 100 - m-PASI reduction 89% vs 68% ($p<0.001$)
7.	Geothermal Seawater	NB-UVB + Bathing in Geothermal Seawater	Eysteinsdóttir et al., 2014	Erythema: 17-21% of patients at the biopsy site in each group Improvement: a. Skin lesions: 1 patient in polymorphous light eruption b. PASI: 68-77% patients with PASI 50-75 in 6 week vs 16.7% in monotherapy

No.	Group of combination systemic therapy	Combination Therapy of NB-UVB with Adjuvant Treatments	Source	Comparison with NB-UVB
				Remission: After 6 months therapy, The result of remission had 30% patients with NB-UVB+Bathing in geothermal seawater and 56% with bathing in geothermal seawater only.

Effectivity of using NB-UVB for Psoriasis

The length of the remission period is influenced by several factors, including age, prior systemic therapy use for at least six months, and three or more cycles of phototherapy. A multivariate study verified that a shorter remission length is independently influenced by the number of cycles and systemic therapy history (Ryu et al., 2014). Through T-cell apoptosis, NB-UVB phototherapy produces a prolonged period of remission. An imbalance between Th17 and Treg (Regulatory T cells and helper 17) cells is responsible for the development of psoriasis. The duration of remission is shortened by NB-UVB phototherapy, which increases Treg cells and lowers Th17 cells. Together, these elements prolong the remission. Psoriasis patients may need several cycles of phototherapy, as the condition is difficult to treat and has a tendency to relapse regularly. The length of these cycles, however, can be reduced during remissions because they are not closely correlated with the severity of the disease at first or the number of treatments taken. A specific level of radiation exposure is required to attain near-clear skin or a considerable improvement in the PASI score. (Ryu et al., 2014).

Another article states that improvements in skin density and epidermal thickness are seen in psoriatic skin alterations following 20 radiation treatments. Skin density increased from a median of 11.145 to 21.210, while epidermal thickness dropped from a median of 0.289 to 0.204. These changes were statistically significant (Odrzywołek et al., 2023). Nair and Jayapalan report that in the NB-UVB group, the median cumulative dosage (range: 6.000–23.330) needed to achieve PASI 75 was 8.390 mJ/cm2, and the median number of treatments was 15 (range: 12-30). The median dosage that produced asymptomatic mild erythema was 968 mJ/cm2 (range: 800–1,065). At the median dosage and number of sessions, symptomatic erythema and pruritus occurred at 732 mJ/cm2 (410–1,172) and 10.5 treatments (5–16), respectively. The dose at which erythroderma occurred was 453 mJ/cm2 (range 410–496), and the median number of exposures was 6 (range 5–7) (Nair & Jayapalan, 2015).

Parlak et al.'s study states that NB-UVB phototherapy was given to Group 1 (NB-UVB percentage dose protocol) and Group 2 (NB-UVB fixed dose methodology) for three sessions each week. Regarding the initial PASI of patients in Groups 1 and 2, there was a 75% improvement noted in both groups (22.00 ± 11.64 and 29.75 ± 10.53, respectively, P=0.02) (Parlak et al., 2015).

Figure 2. Comparison of NB-UVB with NB-UVB and Tazarotene for Psoriasis (Dayal et al., 2018)

Two patients have reported a clinical improvement in their target plaques, as shown in Figure 2. At baseline, 2.47 ± 0.68 target plaque scaling was obtained with NB-UVB + Tazarotene (Group A), whereas 2.46 ± 0.69 target plaque scaling was obtained with NB-UVB alone (Group B). According to the assessment of treatment response overall, 96.67% of target plaques in Group A received complete clearance, or grade 0. In comparison, Group B's objective plaque removal rate was only 6.67%. A further 3.37% of target plaques in Group A demonstrated marked response, or around 75% improvement, compared to 93.33% of target plaques in Group B (Dayal et al., 2018).

CONCLUSION

NB-UVB phototherapy is an effective treatment for moderate to severe psoriasis vulgaris among adult patients. Previous studies have shown that NB-UVB, whether used alone or in combination with adjuvants, is beneficial for the treatment of psoriasis. The use of adjuvants with NB-UVB can enhance the effectiveness of treating psoriasis. However, this research is limited to adult patients, considering that psoriasis can occur from childhood to older age. The implications of the research in theory and practice are provide more real results in shorter time and minimal side effect compared to others; the dosage of oral and topical medications can be reduced, so the side effects of these medications can be reduced; and the use of wavelengths and energy from NB-UVB can be adjusted depending on needs and can also be considered for patient comfort. This research can be a source of research materials because NB-UVB was an alternative therapy that is practical, effective and has minimal side effects also can combined with other therapies that can be developed into other skin therapies besides psoriasis. Hence, further research is still needed to better understand the effectiveness and potential side effects of NB-UVB, whether used with combination or as monotherapy, to maximize effectiveness while minimizing side effects.

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