Assessment of Minimal Erythema Dose of Narrow Band Ultraviolet-B in A Sample of Iraqi Patients with Vitiligo and Psoriasis

Abstract

This research aims to determine MED among a group of vitiligo and psoriasis patients from Iraq, which will serve as a guide for planning NBUVB treatment dosing schedules. A total of 21 patients were tested for MED; 13 females and 8 males. Their ages ranged between 9 and 60 years with an average and standard deviation of 23.2+ 14.7 years. Fifteen patients had vitiligo while six patients had psoriasis. Their skin types were III in 10 patients and IV in 11 patients. The result revealed the MED ranged from 350 to 600 mJ/cm^2. The average and standard deviation was 448.1+ 87.6 mJ/ cm^2.There were no statistically significant differences (p- value: 0.709788457) between males (457.5 ± 119.133mJ/ cm^2) and females (442.307± 66.351mJ/ cm^2) and between patients with psoriasis (430± 84.616 mJ/ cm^2) and patients with vitiligo (455.333± 90.54 mJ/ cm^2) (p-value: 0.562717918). Also there were no significant differences (p-value: 0.958068696) between patients with skin type III and IV (447 ± 89.697mJ/ cm^2), (449.09 ± 89.939 mJ/ cm^2) respectively. In conclusion_MED is a simple and does not time consuming procedure that can be performed as a guide in determining NBUVB dosing schedules. Gender, disease (vitiligo or psoriasis) and skin types III and IV did not have significant effects on MED.

Keywords: Narrow Band Ultraviolet-B, Vitiligo, Psoriasis, Minimal Erythema Dose

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1. Introduction

Ultraviolet light includes a narrow band in the electromagnetic band comprising wavelengths between (100- 400 nm), (UVC: 100– 280 nm; UVB: 280–320 nm; UVA: 320–400 nm) [1]. The Earth's atmosphere absorbs UV light of shorter wavelengths, permitting just UV light of lengthier wavelengths (UVA, UVB, and a lesser quantity of UVC) that spread to the Earth's superficial layer [2]. UV light from the sun has been recognized as a treatment for both dermatological and systematic illnesses for centuries. Nevertheless, narrowband UVB (NBUVB) is a slightly current but effective addition to dermatological practice. In 1903, Dr. Niels Finsen conducted the first study on the usage of ultraviolet (UV) radiation by means of skin diseases remedy. Goeckerman followed suit in 1925 [3]. Phototherapy is defined as a secure and efficient therapeutic method that uses ultraviolet radiation (UVR) to treat specific diseases. Because UV has an immunosuppressive effect on cutaneous T cells and cytokines, it has been utilized in dermatology to treat a variety of skin conditions, including as vitigo, atopic dermatitis, and psoriasis [4]. UV phototherapy employs a specific spectrum of UV light, which can be divided into three irradiation ranges: ultraviolet A (UVA), psoralen ultraviolet A (PUVA), and ultraviolet B (UVB). Broadband UVB (BB-UVB) at 280–320 nm and narrowband UVB (NB-UVB) at 311-313 nm are both included in the UVB category of phototherapy as revealed in Fig. (1) [5, 6]. NBUVB has been demonstrated to have less adverse effects and be more clinically tolerated than the previously discussed UV phototherapy [7, 8].

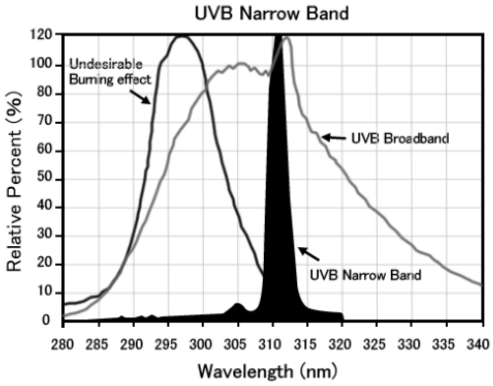

Figure (1): UV wavelength properties for narrowband (peaks at 311nm), in addition to broadband ultraviolet spectrum.

Two approaches are commonly used to plan the dosage of NBUVB. The first includes using preset dosages depending on patient's skin category; the most widely used is the Fitzpatrick skin kind measure as shown in table (1) [9, 10].

Table (1): Skin kind depending on Fitzpatrick's Scale:

• Type 1- Always burns, never tans
• Type II- Always burns, sometimes tans
• Type III- Sometimes burns, always tans
• Type IV-Rarely burns, always tans
• Type V-Moderately Pigmented Skin (Asian)
• Type VII-Black Skin (African)

The second approach relies on determining each patient's minimal erythema dose which is known as skin susceptibility to UV emission from an exact light source and is d known as the lower dose which needed (J/cm^2) to obtain minimal perceptible erythema at the site of photo-testing in the skin [10 11]. The MED's visual detection is subjective and can be affected by many of variables, containing the light source, the increments employed, the region exposed to radiation, and prior UV exposure [12]. After irradiation, it is often assessed 24 hours later, two to three times per week. The therapy is initiated at 70% of the minimum erythema dose, and increased by 20% increments. After that, the dosage is raised in successive sessions. This procedure was stopped when the individuals' skin turned clear or nearly transparent [13].

In this research aims to determine the MED as a guide for dose calculation of NBUVB administered to patients with vitilgo and psoriasis treated at our center.

2. Patients and Methods

The study was done at the department of dermatology, Medical City Teaching Hospital, Baghdad during four months. Patients with psoriasis and vitiligo consulting the department for NBUVB phototherapy were included in the study. Patients had a history of photosensitizing complaints or cancer with severe pain from claustrophobia was dismissed from the study. Additionally. individuals have segmental vitiligo or a history of spontaneous repigmentation not included. The certain patients were directed to stop every prior management before NBUVB monotherapy. A complete general, systemic, and dermatological examination was carried out, taking into description the amount of depigmented macules, site of connection and the near percentage of body superficial area involved. Twenty one patients participated; 13 females and 8 males. Their ages ranged between 9 and 60 years with an average and standard deviation of 23.2+ 14.7 years. Fifteen patients had vitiligo while six patients had psoriasis. Their skin types III in 10 patients and IV in 11 patients.

Phototesting was carried out using the whole body cabinet of UVB TL 01 Philips lamp emitting 311nm UV light. The device was set at a power of 2 milliwatt/ square centimeter (mW/cm^2) and energy range from 200-600 mJ /cm^2. Calibration of UVB lamps spectrophotometer with traceability to national standards to ensure accurate irradiance measurement. calibration is performed by comparing the lamp output to a reference spectrophotometer with known spectral characteristics, allowing calculation of instrumental constants to convert measured voltages to irradiance values (W/m^2) by using eq.1

$E=K\times V$

Where: E = radiation value in W/m^2, V = voltage measured by the meter in volts, K = calibration constant in W/m^2/Volts

The test was conducted on the forearm. The arm was covered with a black cloth that had a hole measuring 2×2 square centimeters. The rest of the body was also covered. NBUVB at a dose of 200 mJ/cm^2 was used to irradiate the skin beneath the hole. The hole was then repositioned to expose another area, and the NBUVB dose was increased by 50 mJ/cm^2. Six areas were irradiated with increments ranging from 50 to 100 mJ/cm^2. The maximum dose per site was 600 mJ/cm^2 (table:1). The dose range of 200 to 600 mJ/cm^2 with 50 mJ/cm^2 increments was selected based on a combination of scientific evidence from previous studies, manufacturers' recommendations, and clinical considerations regarding patients' skin sensitivity, with the goal of achieving a precise dose gradient that allows for accurate and safe determination of the threshold for skin redness.

The photo-tested sites were evaluated and photographed 24 hours later (figure 1, 2). with a digital camera (Sony 18.2 megapixels).

3. Statistical analysis

The results are shown as numbers, range and average ± SD. The data were calculated by using Microsoft Office Excel 2010 considered two tailed, "t" test, the probability level ≤ 0.05 as the lesser limit of important difference among percentages test has been considered.

4. RESULTS

The MED ranged from 350 to 600 mJ/cm^2. The average and standard deviation was (448.1± 87.6mJ/cm^2) (table:1, figure:3).

There were no statistically significant differences (p- value: 0.709788457) between males (457.5 ± 119.133mJ/ cm^2) and females (442.307± 66.351mJ/ cm^2) and between patients with psoriasis (430± 84.616 mJ/ cm^2) and patients with vitiligo (455.333± 90.54 mJ/cm^2) (p-value:0.562717918). Also there were no significant differences (p-value:0.958068696) between patients with skin type III and IV (447 ± 89.697mJ/ cm^2), (449.09 ± 89.939 mJ/ cm^2) respectively.

The MED for each patient, with the diagnosis, skin type, age and gender is shown in (table:2).

5. Discussion

MED is a valuable tool used to set dose regimens in treating skin diseases with NBUVB. It is not time consuming and easy to perform. The same device used to deliver NBUVB as a treatment can be used to determine the MED. The present study showed wide variations in MED among our patients 350 to 600 mJ/ cm^2. However there were no significant differences between patients with psoriasis and patients with vitiligo. Gender did not have a significant effect on MED, and patients with skin types III and IV did not differ significantly.

The selection of the forearm for UV exposure and determination of the minimum cutaneous erythema (MED) in Iraqi patients is based on several scientific and clinical considerations. It is well known that the MED value varies between body regions due to differences in skin thickness, melanin content, and natural sun exposure. Areas such as the face and hands tend to be more sensitive than other areas such

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as the back or forearm [14]. The forearm is a standard and commonly used site in clinical studies for determining the MED because it is easily accessible, allows for accurate dosing, facilitates monitoring of skin reactions, and is moderately exposed to the sun, reflecting a suitable average sensitivity for studies.

Skin sensitivity may vary in Iraqi patients due to ethnic and environmental factors. However, using the forearm provides a standardized site from which results can be compared locally and internationally, with the possibility of adjusting doses based on individual response [14]. The results of the study, showed Fitzpatrick types III and IV, the most common types in the Middle East, provide accurate indications for these categories. However, it noted the presence of other skin types (I, II, V, and VI) that require physical differences between these types. I and II are considered to be more UV-sensitive, and therefore may have a lower minimum erythema (MED) than III and IV. This means that the doses used in the study may have been high for these types, increasing the risk of burns or contributing to them.

Skin types V and VI are characterized by a higher percentage of melanin compared to other types, providing greater natural protection and leading to a higher MED, and therefore may require higher doses to optimize therapeutic effect.

Tejasvi, et al. was successfully determined the minimal erythema dose for narrowband ultraviolet B radiation in North Indian patients by comparing visual assessments with derma spectrometer measurements. The assessment of the managements effects no important difference in MED designed by visual and derma spectrometer analyses. The skin with darker kinds have no low MED but particular patients with lighter skin category showed lesser MED [15]

Su-Young et al. conducted a study measuring the Minimal Erythema Dose (MED) using spectrophotometric analysis following Narrowband Ultraviolet B phototesting, examining the clinical implications of these spectrophotometric values in phototherapy. Among the L*a*b* color space parameters, only the b* values showed a statistically significant difference between skin type III and IV groups ($p = 0.003$). A positive correlation was observed solely between MEDs and b* values ($p < 0.05$). Moreover, the mean b*/L* ratio was significantly higher in the type IV group compared to the type III group ($p < 0.05$). [16].

Conclusion

The assessment of the minimal erythema dose (MED) is a valuable tool utilized for customizing narrowband ultraviolet-B (NBUVB) phototherapy in patients with vitiligo and psoriasis. By tailoring treatment doses according to individual skin sensitivity, healthcare providers can optimize therapeutic outcomes while minimizing adverse effects. This approach supports the safe application of NBUVB, enhancing patient compliance and treatment efficacy. Future studies with larger cohorts are recommended to further refine dosing protocols and assess long-term benefits across diverse patient populations.

Ethics information

This research was carried out following the ethical guidelines specified in the Declaration of Helsinki. Informed consent was obtained from all participants before their involvement in the study. The rights, confidentiality, and privacy of all participants were strictly protected throughout the research process. This research adhered to internationally accepted ethical standards for studies involving human subjects.

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