

Minimal erythema response (MED) to solar simulated irradiation in normal Indian skin

Vandana Mehta Rai, S. D. Shenoi, C. Balachandran, Sathish Pai

Department of Skin & STD, Kasturba Medical College, Manipal, Karnataka, India.

Address for correspondence: Dr. S. D. Shenoi, Prof and Head, Dept of Skin & STD, Kasturba Medical College, Manipal - 576104, India.
E-mail: shru12@yahoo.com

ABSTRACT

Background: Phototesting is an essential tool in the investigation of photodermatoses. **Aims:** The main aim was to study the cutaneous response to UVR in terms of minimal erythema dose (MED) to both UVA and UVB in normal Indian subjects with a solar simulator and to study the relationship of skin type to MED. **Methods:** One hundred healthy volunteers not on any medication and without any history of photodermatoses were phototested using a solar simulator with whole spectrum irradiation (UVA, UVB and visible light) and only visible and UVA radiation. The tested areas were marked with gentian violet and readings were taken after 24 hrs. **Results:** Of the 100 volunteers, 48% were males and 52% were females, with a mean age of 36.6 ± 11.6 yrs. The most common skin type among Indians was type 5 (46%) followed by type 4 (41%). The mean MED for UVB was 61.5 ± 17.25 J/cm². The MED for UVA could not be determined as none of the patients showed any erythema after irradiation for 45 minutes. **Conclusions:** As the MED is found to be low in idiopathic acquired photodermatoses, the MED in the normal population could serve as a baseline data in the investigation.

KEY WORDS: Phototesting, Minimal erythema dose, MED, Solar simulator

INTRODUCTION

Assessment of the cutaneous response to ultraviolet radiation is important in the assessment of patients with photodermatitis, in planning phototherapy, in understanding photobiology, and in the epidemiological investigation of skin cancers.

In various idiopathic photodermatoses like polymorphic light eruption, hydroa vacciniforme, solar urticaria, and actinic prurigo, the MED to UVA and UVB has been found to be reduced. In parthenium

dermatitis, where photosensitivity is a common feature, the MED to UVB is also lowered. Phototesting is a useful procedure to detect the abnormal sensitivity to light by determination of the minimal erythema dose (MED), which is the minimal dose of UVR required to produce a clearly marginated erythema at the irradiated skin site. The purpose of phototesting is three fold. Firstly, it establishes the presence of a photosensitivity disorder. Secondly, it determines the action spectrum, and thirdly, it reproduces the lesions by provocative light test. The aim of the study was to determine the MED to both UVA and UVB in normal Indian subjects

How to cite this article: Rai VM, Shenoi SD, Balachandran C, Pai S. Minimal erythema response (MED) to solar simulated irradiation in normal Indian skin. *Indian J Dermatol Venereol Leprol* 2004;70:277-9.

Received: June, 2004. **Accepted:** July, 2004. **Source of Support:** Nil.

using a solar simulator and to study the relationship of skin type to MED.

METHODS

One hundred healthy volunteers who were not on any medication and with no past or present history of photodermatitis were included in the study. The subjects were mostly indoor workers but a few outdoor workers were also present. For each patient, the skin type and response to UV radiation was determined. To classify the skin type, Fitzpatrick’s classification of skin photo type was used. The skin type was determined mainly on the basis of the skin color of the covered back as none of our patients gave a history of sunburn. All were phototested using a solar simulator assembled by the Biophysics Department, Ninewells Hospital, Dundee, Scotland. Phototesting was performed on the back. Two filters were used: a 305 filter, which delivered whole spectrum radiation (i.e. UVA, UVB and visible light) in a graded dose of 20–100 J/cm² for a period of about 5 minutes, and a 345 filter, which delivered UVA and visible light in doses of 400-700 J/cm² for a maximum period of 45 minutes after determining the thermopile output and the time for delivery. The infrared radiation was excluded using a liquid filter of 0.1% CuSO₄. The areas irradiated were of 2x2 cm each and were marked using gentian violet and the readings taken after 24 hours. The presence or absence of erythema at each tested site was looked for and the minimal erythema dose (MED) was recorded, the MED being defined as the minimal dose of UVR required to produce just perceptible erythema. Results were analyzed using SPSS software and the *P Value* was determined by using the chi square test

RESULTS

Out of 100 healthy volunteers, 48% were males and 52% were females. Their age ranged from 17 years to 69 years with a mean of 36.6 ± 11.6 years. All the participants recruited were Indians. (Table 1 and 2).

When skin types IV, V, and VI were compared for MEDs, there was a significant difference between type IV and type V skin (p < 0.0001; very highly significant), and

Table 1: Distribution of subjects according to the Fitzpatrick skin type

	Number	Percentage
III	1	1.0
IV	41	41.0
V	46	46.0
VI	12	12.0
Total	100	100.0

The most common skin type was type 5 (46%) followed by type 4 (41%).

Table 2: The mean MED for each skin type was as shown below

	Mean	Std. deviation	Minimum	Maximum
Skin type	3	40.00	-	40.00
	4	51.22	11.88	40.00
	5	68.29	16.11	40.00
	6	78.00	14.76	60.00
Total	61.51	17.25	40.00	100.00

The mean MED ± SD for solar simulated irradiation, including UVB, for the 100 subjects was 61.5 ± 17.25 J/cm².

between type IV and type VI (p = 0.0001; very highly significant). However, no significant difference was found between the MEDs of type V and type VI skin (p = 0.072). Skin type III was excluded because there was only one patient. MED for UVA using the 345 filter could not be determined as none of the volunteers showed any erythema even after irradiation for 45 minutes (700 J/cm²) to the UVA. Because of the impracticability of the exposure times, MED determination for UVA above 700 J/cm² was not done in our patients. The MED for UVA on Indian skin is probably greater than 700 J/cm².

DISCUSSION

Cutaneous responses to UVR among normal subjects provide useful baseline data for the study of photodermatology. The normal ranges vary among different populations and each centre needs to establish its own reference values. The minimal erythema dose, which is the threshold dose for burning reactions (with reference to white skin), is a simple and useful measure of in vivo sensitivity to UVR. Skin photo typing is a simple screening method used to predict skin reactions to ultraviolet radiation. The original concept of skin typing was proposed by Fitzpatrick in 1975 on the basis of reported susceptibilities to burning and tanning to UVR. However, this concept was based on reports on white skin. There are few reports on brown skin. At first, brown skin was grouped simply as skin type V, in addition to the skin types I through IV of white skin by

Pathak and Fitzpatrick.¹ Later, brown skin was divided into three groups: type IV for light brown skin, type V for brown skin, and type VI for dark brown skin.

In a study performed in brown skinned Koreans, the most common skin type was type III, with the mean MED for that type being 66.2 ± 14.7 . The average MED as a whole for Korean brown skin was 70.4 ± 16.5 using Waldmann UV-800 lamps.¹ In case of Japanese skin, which is genetically more capable of tanning than Caucasian skin, there was a positive correlation of the skin type with the MED.² In case of Chinese and Asian skin the skin types correlated fairly well with the MED to UVA and UVB. The skin color measurements are more objective than skin type assessment and could be better markers of photosensitivity. The most common skin type reported in Chinese and Asians was type II, with a mean of 79 ± 27 using 7 fluorescent bulbs.³ No MED was found to be typical of black skin, MED of which was 5-33 times more than that of Caucasians. The greater resistance of progressively darker skin to the effect of UVR is probably due to the presence of a greater number of larger and deeply pigmented melanosomes. The reason for the MED being higher in black skin could also be attributed to differences in epidermal optics and UVR penetration.⁴

In various idiopathic photodermatoses like PLE, hydroa vacciniforme, solar urticaria, and actinic prurigo, the MED to UVA and UVB has been found to be abnormal. Even in parthenium dermatitis the MED to UVB is low.

In this study we have established the normal MEDs for Indian skin. The most common skin type found was type V (46%). Its mean MED was 68.2 ± 16.1 . The average MED \pm SD for Indian skin was found to be 61.5 ± 17.2 . Our results show that there is a step wise increase in the average MED from skin types III to VI. Although the skin types and MED were correlated, there is a wide range of MEDs within each skin type and a substantial

degree of overlap in the MED range among different skin types. The MED of patients with skin type VI was higher than that of patients with skin type V and type IV. Our values of MED are slightly higher than those reported from the West⁵ and this could be due to variations in instrumentation, methods of measurement and the genetic differences of different populations. The MED was lower in fair skinned individuals and higher in darker skinned individuals. For an average person (type IV), a MED of 40J would be considered as normal. However, for dark skinned people (type V and VI), a MED of 60J and above would be considered as normal. Our observations confirm the findings of Sayre, et al⁶ that the mean MED values of various skin types are significantly different, but contradict the work of Wilson, et al who found a remarkable homogeneity among skin types I through IV.⁷

REFERENCES

1. Youn JI, Oh JK, Kim BK, Suh DH, Chung JH, Oh SJ, et al. Relationship between skin photo type and MED in Korean brown skin. *Photodermatol Photoimmunol Photomed* 1997;13:208-11.
2. Kawada A, Hiruma M, Noda T, Kukita A. Skin typing, sun exposure and sunscreen use in a population of Japanese. *J Dermatology* 1989;16:187-90.
3. Wee LK, Chong TK, Quee DK. Assessment of skin types, skin colours and cutaneous responses to ultraviolet radiation in an Asian population. *Photodermatol Photoimmunol Photomed* 1997;13:169-72.
4. Diffey BL, Robson J. The influence of pigmentation and illumination on the perception of erythema. *Photodermatol Photoimmunol Photomed* 1992;9:45-7.
5. Westerhof W, Estevez-Uscanga O, Meens J, Kammeyer A, Durocq M, Cario I. The relationship between constitutional skin color and photosensitivity estimated from UV induced erythema and pigmentation dose response curves. *J Invest Dermatol* 1990;94:812-6.
6. Sayre RM, Desrochers DL, Wilson CJ, Marlowe E. Skin type, minimal erythema dose (MED) and sunlight acclimatization. *J. Am Acad Dermatol* 1981;5:439-43.
7. Wilson DD, Kaidbry KH. Ultraviolet light sensitivity and prolonged UVR erythema. *J Investigative Dermatol* 1981;77:434-6.