

EXPERIENCE OF USING AN EXCIMER LAMP EQUIPPED WITH UVB DOSE CONTROL SYSTEM IN DERMATOLOGY

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Abstract

Intermediate ultraviolet (UVB) therapy is considered a relatively safe method of treating skin diseases with an autoimmune component in development compared to medical drug methods, including PUVA therapy. This is due to the small depth of penetration of the rays of this wavelength range into skin, which provides a purely local effect on the human body. Excimer lamps are an alternative to the expensive excimer laser for phototherapy of psoriasis or vitiligo. However, for effective phototherapy using UVB lamps, the distance from an emitter to a patient's skin must be considered. In this paper, we report on treatment of patients using an excimer lamp, the control unit of which is equipped with an optical system for controlling of ultraviolet radiation dose, which allows automatically calculating the time for a set UVB dose. The article describes the results of phototherapy using an excimer lamp of several cases of psoriasis, vitiligo and other forms of dermatitis with a good therapeutic and cosmetic effect. When using an excimer lamp, not a single case of exacerbation of dermatological diseases was established.

Keywords: psoriasis, vitiligo, atopic dermatitis, phototherapy, UVB, excimer lamp, UV dose

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ОПЫТ ПРИМЕНЕНИЯ ЭКСИМЕРНОЙ ЛАМПЫ, ОСНАЩЁННОЙ СИСТЕМОЙ КОНТРОЛЯ UVB ДОЗЫ, В ДЕРМАТОЛОГИИ

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Резюме

UVB терапия считается относительно безопасным способом лечения кожных заболеваний с аутоиммунным компонентом в развитии в сравнении с медикаментозными методами, включая PUVA терапию. Это обусловлено малой глубиной проникновения лучей данного диапазона длин волн в кожный покров, что обеспечивает сугубо локальное воздействие на организм человека. Эксимерные лампы являются альтернативой дорогостоящему эксимерному лазеру при фототерапии псориаза и витилиго. Однако для эффективной фототерапии с использованием UVB ламп необходимо учитывать расстояние от излучателя до кожи пациента. В данной работе сообщается о лечении больных с использованием эксимерной лампы, блок управления которой снабжён оптической системой контроля дозы ультрафиолетового излучения, что позволяет автоматически производить расчёт времени сеанса для заданной UVB дозы. В статье приведено описание результатов фотолечения с использованием эксимерной лампы нескольких случаев псориаза, витилиго и других форм дерматитов с хорошим терапевтическим и косметическим эффектом. При использовании эксимерной лампы не установлено ни одного случая обострения дерматологических заболеваний.

Ключевые слова: псориаз, витилиго, атопический дерматит, фототерапия, UVB, эксимерная лампа, доза ультрафиолетового излучения

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Introduction

In modern medicine, drug-based immunocorrection drugs are traditionally used for the complex treatment of immune system-related dermatological diseases and for the prevention of their recurrence. The chronic persistent nature of dermatoses with an immune component in pathogenesis requires long-term use of this group of drugs. However, taking into account the need for their lifelong use, there is a high risk of developing a wide range of side effects, as well as the tolerance syndrome to the drug [1], so today UV physiotherapy of skin diseases is considered the safest and most popular method of treating various forms of psoriasis [2], vitiligo [3] and other forms of dermatoses.

Experimental studies conducted in the early 80's of the last century showed high efficiency of phototherapy with the use of UVB irradiation (280-315 nm range) [4]. It has been proved that rays with a wavelength of more than 315 nm (UVA) are ineffective in the treatment of psoriasis, and short-wave radiation of the UVC range causes mutations and is carcinogenic, since it is within the absorption bands of DNA and RNA [5]. UVB therapy is a relatively safe treatment method due to the minimal impact of radiation on the human body. The rays of this wavelength range are completely dispersed in the epidermis [6], initiating photobiological reactions that contribute to the improvement of the skin [7].

Along with the spectral composition of the ultraviolet radiation, an important parameter in the process of phototherapy, which has a significant impact on the effectiveness of treatment, is the level of the ultraviolet dose when irradiating the patient's skin [8]. It is believed that the optimal effectiveness and safety of phototherapy in the treatment of psoriasis and/or vitiligo is achieved with the value of the minimum erythema dose (MED), which reflects the level of the patient's skin sensitivity to UVB radiation. A well-known technique for the determination of a patient's MED is used, which was described by P. Asawanonda et al. [8]. With a UVB dose below MED, phototherapy may be ineffective, and irradiation of the skin with a dose higher than MED will lead to a burn of the patient's skin, which may provoke an exacerbation of the disease [9].

Excimer lasers, which can generate coherent and directed radiation at a wavelength of 308 nm, are often used as a source of UVB radiation. Laser radiation produced by the decomposition of an exciplex XeCl* molecule has stable spectral and energy characteristics and is easily dosed, which makes excimer lasers a traditional choice for dermatological applications [10]. The disadvantages of the XeCl laser include the large size and weight of the device, the small area of the radiating surface, the need for maintenance, and the high cost of installation; in addition, the gas mixture used in the laser contains a hazardous dose of chlorine.

Phototherapy of large areas affected with dermal diseases is often provided with low-pressure fluorescent

mercury lamps, which emit narrow-band ultraviolet with a band peak of about 311 nm. The configuration of UVB emitters based on such lamps is diverse: from portable lamps for home use to UV booths. However, mercury UVB lamps are characterized by a strong dependence of the radiation intensity on the temperature of the walls of the quartz envelope and a significant decrease in the radiation power over their relatively short service life (no more than 1,500 hours) [11], which significantly affects the accuracy of calculating the UVB dose with the use of these lamps.

The gas mixture of excimer lamps does not contain metal vapors, so the temperature of the flask walls of such lamps has little effect on their radiation power [12], and the use of an electrodeless system [13] of an excimer lamp can provide a service life of more than 8,000 hours [14]. Thus, excimer lamps do not need warming up before use and provide highly stable ultraviolet radiation.

Unfortunately, the use of semiconductor LEDs developed for UVB phototherapy (UVB LED) is not widespread, because there are problems with a rapid decline of the power of such LEDs, which reduces the efficiency of the semiconductor device [15].

Unlike lasers, all lamps developed for UVB therapy are characterized by a significant decrease in the intensity of radiation when the distance from the emitter to the irradiated surface increases, and for the calculation of the UVB dose received by the patient during a phototherapy session, it is necessary to take into account the distance to the patient's skin. It is obvious that the accuracy of distance measurement and the constancy of the distance will determine the actual UVB dose and the effectiveness of treatment in general.

Materials and methods

91 patients with the winter form of vulgar (plaque) psoriasis were treated, including 24 patients with I - III Fitzpatrick skin phototypes, 55 with vitiligo, and 12 with atopic dermatitis. Before the treatment, informed consent was obtained from the patients.

All patients were treated with an excimer lamp [16] developed in the Optical Radiation Laboratory of Immanuel Kant Baltic Federal University, where two XeCl emitters based on a barrier discharge were used as a source of UVB rays [17]. A distinctive feature of this device is the possibility of complete automatic no-touch control of the level of UV radiation dose received by the patient.

Results

The results of treatment of patients with psoriasis

The group of patients with psoriasis included 24 patients: 13 (54.2%) men and 11 (44.8%) women. The average age of patients was 34 (ranging from 21 to 48 years).

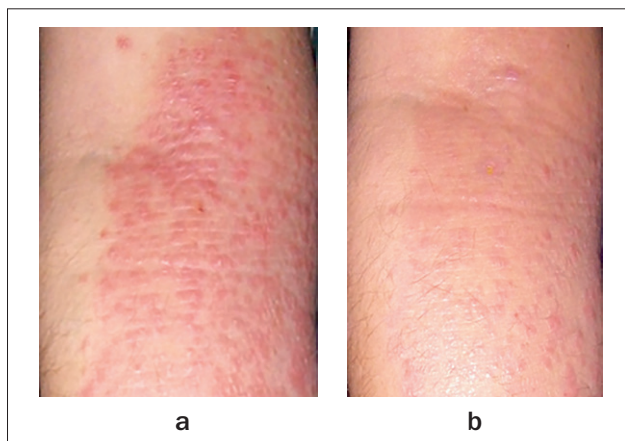


Рис. 1. Очаг псориаза на правой сгибательной внутренней поверхности верхней конечности:

а – до лечения;

б – после 6-го сеанса фототерапии

Fig. 1. Right bending inner surface of an upper limb:

а – before the treatment;

б – after the 6th session of phototherapy

The duration of psoriasis from its onset was from 1 to 19 years. All patients were treated on an outpatient basis in accordance with the described method. The initial UVB dose was from 0.1 to 0.3 J/cm². The course of treatment included 12 sessions held at regular intervals 3 times a week: Monday, Wednesday, Friday or Tuesday, Thursday, Saturday. Each subsequent dose of the therapy session was increased by 0.1J/cm², which brought the final radiation dose within the range of 1.2-1.4 J/cm². Positive results in the form of plaques flattening and decreased inflammation activity were observed from the 6th session of the therapy. A persistent effect, expressed in maintaining the institutional stage of psoriasis, was persistent in

all patients over the 8 months of the follow-up after the completion of therapy.

Clinical observation # 1. Male, 54 y. o. Diagnosis: plaque psoriasis. The PASI value before the start of therapy was 18 (Fig. 1a). After the final session of excimer lamp therapy, the patient had a clinical decrease in erythema, the plaques flattened, and the peeling on their surface was resolved (Fig. 1b). The PASI index was found to be 8. Observation of the patient for the next 6 months showed no signs of relapsing psoriasis: slight dyschromia persisted in the former areas of rash.

Clinical observation # 2. Male, 48 y. o. Diagnosis: plaque psoriasis, extensive, advanced stage. Disease history: he has been suffering from psoriasis for 20 years, and for a long time, he was treated with narrow-band phototherapy on a UV 1000 KL unit (Herbert Waldmann GmbH & Co, Germany) at a wavelength of 311 nm, which gave a temporary effect. He received treatment with Apremilast for 1 year, without any improvement. Clinical findings: the process is widespread, the skin of the lower extremities and the lower leg area features multiple flat papular elements of pinkish-red color, ranging in size from a pinhead to a small coin, infiltrated, dense, rising above the level of healthy skin, prone to coalescence and peripheral growth, grouped in plaques (Fig. 2a). Papules are covered with abundant easily separated scales of silvery-white color. The isomorphic reaction and the triad of psoriatic clinical signs are positive.

After the final series of excimer lamp therapy sessions, the patient had significantly flatter plaques, and the peeling on their surface was resolved (Fig. 2b).

Fig. 3 shows the results of the ultrasound examination of the patient's psoriatic plaque before treatment and 1 month after its start. The studies were performed with



Рис. 2. Очаг псориаза на левой наружной поверхности верхней конечности:

а – до лечения;

б – после 12-го сеанса фототерапии

Fig. 2. Left outer surface of the upper limb:

а – before the treatment;

б – after the 12th session of phototherapy

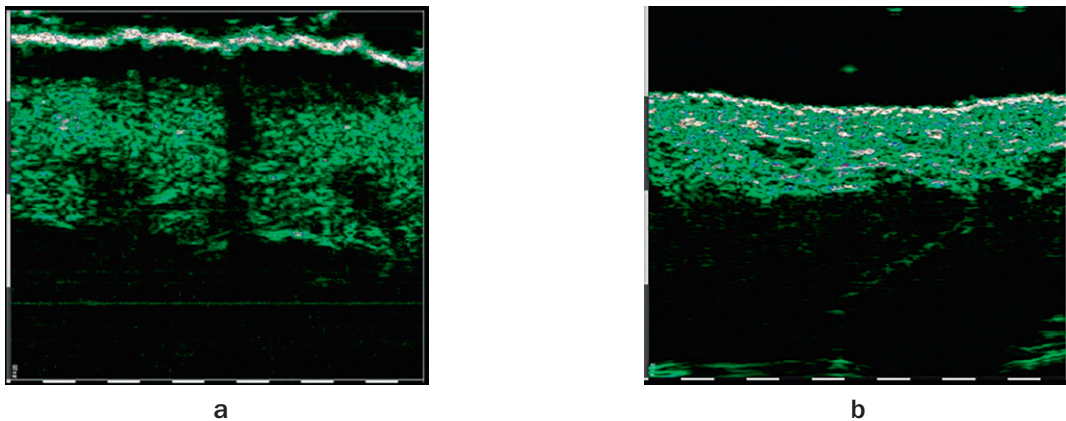


Рис. 3. Данные ультразвукового исследования псориатической бляшки:

a – до лечения;
b – спустя 1 мес после начала лечения

Fig. 3. Left outer surface of the upper limb:

a – before the treatment;
b – a month after the start of the treatment

DUB SkinScanner unit (Taberna pro medicum GmbH, Germany).

The results of treatment of patients with vitiligo

The second group of patients included in the study was represented by 55 patients with vitiligo, including 28 (51%) men and 27 (49%) women. The average age of patients was 33 (ranging from 14 to 62). The duration of the disease was from 8 months to 12 years. All patients received treatment on an outpatient basis. Sessions were held 3 times a week with a minimum, individually set irradiation exposure. The initial UVB dose was 0.2 to 0.5 J/cm². The dose of each subsequent therapy session was increased by 0.1 J/cm², so that the dose of the final irradiation session was within the range of 1.7-2.0 J/cm². The total number of sessions was individual and did not exceed 16. The sessions were held at regular intervals 3 times a week: Monday, Wednesday, Friday or Tuesday, Thursday, Saturday. In the majority of the patients, active repigmentation of vitiligo foci began from the 4th session. Further monitoring of patients with vitiligo showed a persistent positive effect that remained for 12 months.

Clinical observation # 3. Woman, 45 y. o. Diagnosis: vitiligo. Disease history: the patient has had it for 20 years. She did not receive any treatment. Clinical findings: on the skin of the upper and lower extremities; on the forearms and shins, there are multiple milky-white depigmented spots of irregular shape with clear borders, prone to peripheral growth and coalescence.

After the completion of the series of UVB therapy sessions with an excimer lamp, the patient had a significant clinical repigmentation of the lesions.

The results of treatment of patients with atopic dermatitis

The third follow-up group consisted of 12 patients with atopic dermatitis, including 5 (42%) men and 7 (58%) women. The average age of the patients was 17 years old (ranging from 12 to 26). The duration of the disease ranged from 1 year to 26 years. The initial UVB dose for patients with atopic dermatitis was from 0.1 to 0.2 J/cm². Patients received 10 therapy sessions, which were conducted at equal intervals 3 times a week: Monday, Wednesday, Friday or Tuesday, Thursday, Saturday. Each subsequent dose of therapy was increased by 0.1 J/cm², so that the dose of the last session of irradiation was at a dose of 1.0 - 1.1 J/cm². A positive effect in the form of smoothing of lichenized foci was observed from the fourth or fifth irradiation sessions. The follow-up of the patients for a year after the completion of therapy did not reveal episodes of exacerbation of dermatosis.

Clinical observation # 4. Girl, 13 y. o. Diagnosis: atopic dermatitis in the exacerbation phase. History of the disease: atopic dermatitis from early childhood, exacerbations twice a year in autumn and spring. The last exacerbation was within 1.5 months. Clinical findings: the process is widespread, involving the skin of the face, neck, upper and lower extremities, and the corpus, there are multiple erythematous and erythematous/papular foci of red color with fuzzy borders, symmetrical, prone to coalescence. Against the background of erythema, there are erosions covered with serous crusts (Fig. 5a). There are pronounced manifestations of lichenification (the skin is rough to the touch, thickened, flaky, the skin pattern is exaggerated). Multiple excoriations are observed. The dermatographism in the foci is white.

The result of treatment: the inflammatory process

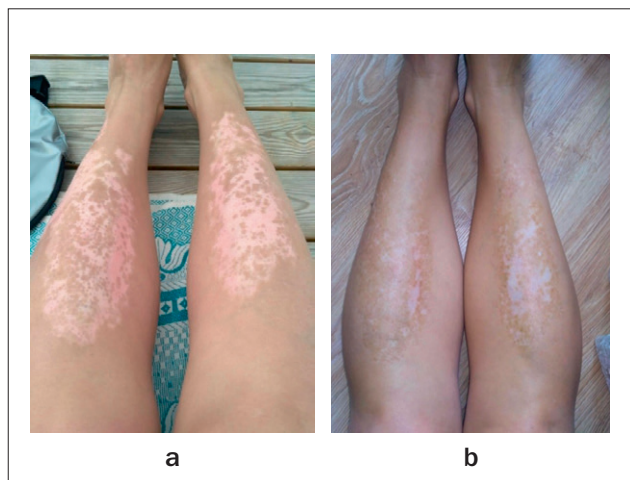


Рис. 4. Очаги витилиго на голенях:

а – до лечения;

б – после 15-го сеанса фототерапии

Fig. 4. Lower legs of a patient:

а – before the treatment;

б – after the 15th session of phototherapy

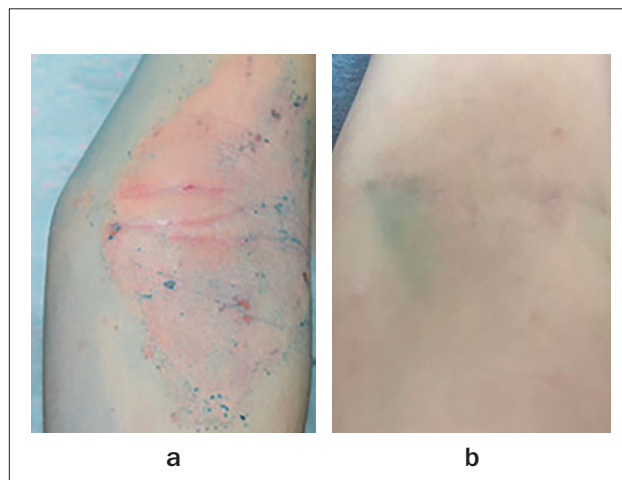


Рис. 5. Атопический дерматит на сгибательной стороне локтевого сустава:

а – до лечения;

б – после 10-го сеанса фототерапии

Fig. 5. Bending side of an elbow joint:

а – before the treatment;

б – after the 10th session of phototherapy

stopped, reducing peeling, itching, dryness of the skin (Fig. 5b).

Conclusion

The use of a device that automatically monitors the level of UV radiation dose received by the patient makes UVB therapy of patients with autoimmune skin diseases safe and effective. We have not found any cases of exac-

erbation of dermatological diseases after the use of the method.

The short interval of the procedure (from 10 seconds to several minutes) allows the device to be actively used in outpatient settings on a large number of patients, and makes the use of an excimer lamp equipped with a UVB dose control system a highly cost-effective method, taking into account the cost of the procedure.

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