

EFFECT OF ULTRAVIOLET RADIATION ON DEVELOPMENT OF A CONDITIONED DEFENSIVE ACTIVE AVOIDANCE REFLEX

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The effect of long-wave ultraviolet radiation on higher nervous activity was studied in mice. Irradiation with suberythema doses was found to have a beneficial effect on the rate of formation of a conditioned defensive active avoidance reflex. Of two schemes of irradiation tested – with constant and with gradually increasing doses – the latter proved to be more effective.

KEY WORDS: ultraviolet radiation; conditioned reflexes; active avoidance.

Long-wave ultraviolet radiation (LUV) by erythema luminescent lamps is widely used at the present time for prophylactic, therapeutic, and hygienic purposes for the correction of avitaminosis D, for increasing immunologic reactivity, and for reducing the incidence of respiratory and suppurative diseases [4–6, 9, 12]. However, the literature on the effect of UV rays on higher nervous activity in man and animals is not extensive and it is devoted to the action of single [1, 13] or repeated exposures to radiation either to the integral UV emission from mercury–quartz lamps [2, 3] or to short-wave radiation from bactericidal lamps [15].

It is therefore desirable to study the effect of LUV radiation on higher nervous activity.

EXPERIMENTAL

Experiments were carried out on male BALB/c mice weighing 16–18 g. The animals were divided into 3 groups: 1) control, 2) animals receiving 0.75 of an erythema dose, and 3) mice receiving 6 erythema doses. In each experimental group 40 sessions of irradiation were given in the course of 10 weeks. Six weeks after the end of irradiation a conditioned defensive active avoidance reflex was formed in the mice in a T-shaped maze, and its stability was tested 24 h later. To produce the conditioned reflex, the mouse was placed in the first part of the main corridor of the maze and either the right or the left passage was illuminated at the same time. After 5 sec an electric current was applied to the floor of the maze, which the mouse could avoid by running into the illuminated passage. After a certain number of manipulations, during which the right and left passages were illuminated at random, a conditioned active avoidance reflex consisting of running into the illuminated passage was formed in the animals. Training to produce the reflexes was carried out until five correct avoidance reflexes were exhibited in succession. The stability of the reflex was tested by repeating the procedure of training using the original criterion. The intervals between combinations were 30 sec.

RESULTS AND DISCUSSION

In the first stage the remote action of different doses of LUV radiation on the formation of a conditioned active avoidance reflex was investigated (Table 1). In animals receiving suberythema doses the rate of formation of the conditioned active avoidance reflex was almost 5 times higher than in the control. In the mice receiving six erythema doses no statistically significant difference from the control was discovered in this respect. The stability of the reflex was sufficiently high in all groups.

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TABLE 1. Remote Effect of Different Doses of LUV Irradiation on Formation and Stability of the Conditioned Active Avoidance Reflex

Number of combinations to the 5 out of 5 criteria	Control		0.75 of erythema dose			6 erythema doses		
	n	M±m	n	M±m	P	n	M±m	P
Formation of conditioned active avoidance reflex	10	14,9±2,4	12	3,1±0,9	<0,01	13	15,5±1,2	>0,2
Testing stability of the reflex	10	2,5±0,5	12	2,1±0,4	>0,2	13	1,5±0,4	>0,2

TABLE 2. Direct Effect of Different Schemes of LUV Irradiation on Formation and Stability of a Conditioned Active Avoidance Reflex

Number of combinations to the 4 out of 5 criteria	Control		Constant doses			Gradually increasing doses		
	n	M±m	n	M±m	P	n	M±m	P
Formation of active avoidance reflex: running into the illumination passage (training)	14	2,6±0,6	25	2,3±0,3	>0,2	27	1,0±0,4	<0,05
Testing the stability of the reflex	13	0,8±0,5	24	0,9±0,2	>0,2	27	0,5±0,3	>0,2
Formation of active avoidance reflex – running into unilluminated passage (retraining)	11	15,9±1,3	24	12,2±1,1	<0,05	23	11,1±1,1	<0,01
Testing the stability of the reflex	11	1,0±0,3	23	1,7±0,3	<0,2	23	0,8±0,2	>0,2

Suberythema doses of LUV radiation thus have the optimal remote action on conditioned-reflex activity.

Various systems of prophylactic UV irradiation are used: either constant doses or gradually increasing doses. The method of irradiation with gradually increasing suberythema doses is regarded by some workers as more physiological, for the photosensitivity of the skin varies during adaption of the body to UV radiation. This method is recommended for use as a "hardening" procedure [8, 10–12].

In this connection a comparative study was made of the effect of different schemes of LUV irradiation on the conditioned-reflex activity of the mice. Three groups of animals were studied: 1) control, 2) animals irradiated with constant doses (0.75 of an erythema dose), and 3) irradiated with gradually increasing doses (0.25, 0.5, 0.75, 1.0, and 1.25 erythema doses). In each experimental group 20 sessions of irradiation were given in the course of 5 weeks. The total dose received by the animals in the two experimental groups was the same, 15 erythema doses. The conditioned active avoidance reflex was formed immediately after the end of the course of irradiation by the same method as in the first part of the investigation. In addition, 15 days later all the animals were retrained, i.e., a new conditioned active avoidance reflex, consisting of running into the unilluminated passage, was formed. The stability of this reflex was tested after 24 h. In each case the training to form the reflex continued until a correct avoidance reflex was obtained 4 times out of 5.

The results showing the direct effect of the different schemes of LUV irradiation on the formation and stability of the conditioned active avoidance reflex are given in Table 2. They demonstrate improvement of the conditioned-reflex activity in the animals immediately after the course of LUV irradiation, especially in mice receiving gradually increasing doses: the conditioned active avoidance reflex was formed (training) significantly quicker in them than in the control mice. During retraining (the formation of a new conditioned reflex) the beneficial effect of irradiation was observed in both experimental groups but it was somewhat greater in the animals receiving gradually increasing doses. This is evidence of improvement of the mobility of the nervous processes under the influence of LUV radiation. The degree of stability of the reflex in all cases remained at about the same, sufficiently high, level.

These investigations thus showed the beneficial action, both direct and remote, of suberythema doses of LUV radiation on the higher nervous activity of mice, as manifested by the more rapid formation of a

conditioned active avoidance reflex. Hypererythema doses had no marked action on the conditioned-reflex activity of the mice. This state of affairs is in harmony with the generally accepted view that suberythema doses have a beneficial, stimulant effect, but hypererythema doses have an unfavorable effect on the functional state of the body and on its reactivity and its resistance to the harmful action of external environmental factors [7, 14].

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