

Effect of transcranial laser infrared irradiation of the mouse brain on analgesic defense-reflex reactions

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ABSTRACT

An investigation of reflectory analgesic reactions was made on the brain of white mice when it was exposed to transcranial laser radiation with the wavelength of 0.89 μm and the energy density of 3.12 J cm^{-2} . These reactions were evaluated with the aid of 'tail flick'⁵ and 'hot plate' tests. It was found that antinociceptive reactions did not change during the experiment. However, laser radiation might produce a protective antistress effect.

Key words: laser radiation, CNS, reflex, antinociperception

I. INTRODUCTION

Low-intensity laser radiation finds broad application in treating acute and chronic pains. The therapeutic treatment of such pathologies includes laser photostimulation of biologically active (acupuncture) loci and laser influence on myofascial zones that trigger pain. In the first case, therapeutic effects are possibly governed by the mechanisms typical of acupuncture, whereas, in the second case, they can be ascribed to the inactivation of myofascial trigger zones. It is known that laser infrared radiation penetrates soft tissues at a depth of 5 to 6 cm, with bone tissues being "transparent" for laser infrared radiation. Therefore, when middle and paravertebral biologically active or trigger zones are exposed to laser radiation, cerebral structures are also irradiated. To treat "cervicogenous" and exertion head pains, we expose the articular, ligamental, and muscular trigger zones of the craniocervical region to laser infrared radiation.¹ In this case, laser radiation produces an influence on the low part of the brain stem structures.

The aim of our investigation is to study and estimate the 'unplanned' influence of laser radiation on the brain. It is of interest to evaluate the effect produced by laser radiation on the functional state of the central nervous system, in particular, on the defense reflex reactions.

2. MATERIALS AND METHODS

In our experiment, we used 40 breedless white mice weighing between 20 and 25 g (20 mice constituted an experimental group and 20 mice constituted a control group). Hair was removed on the skullcap and on the base of the skull. All the exposed mice were fixed with the aid of special forceps by necks without affecting their respiration and blood circulation. This fixation enabled us to provide similar experimental conditions. The irradiation was performed with the aid of a 'Mustang' apparatus (Russia) based on a semiconductor laser. Laser radiation was incident on the base of the skull. The losing head of the apparatus was in contact with the mouse skin during the irradiation. The parameters of laser radiation were as follows: $\lambda = 0.89 \mu\text{m}$, the pulse repetition frequency was 1,500 Hz, and the pulse power was 3.4 W. The exposure time and the energy density were, respectively, 20 min and 3.12 J cm^{-2} . Defense reflex reactions were estimated with the 'tail flick' test by using a Hugo Sach Electronic anaigesimeter (Germany) and with the 'hot plate' test at a temperature of 55°C . In these tests, we determined the background latent time of defensive reactions. Corresponding measurements were made 30 min, 45 min, 60 min, and 24 hours after the beginning of laser irradiation of experimental mice or after the fixation of control mice. The results obtained were then treated with the Student *t* test.

3. RESULTS AND DISCUSSION

When the control mice were fixed for 60 min in the 'tail flick' test, it was found that the latent time of the animals' defensive reactions increased by 29% ($p < 0.05$) as compared with the background values (Fig. 1). At this stage, difference in the latent time between the mice of the control and experimental groups was also significant ($p < 0.05$). It is possible that the increased latent time in the control group was caused by the immobilization stress. The fact that the latent time regained its initial values within 24 hours provided evidence for our suggestion. The latent time in the experimental mice did not show an increase, which might be evidence of a protective and normalizing effect of laser radiation.

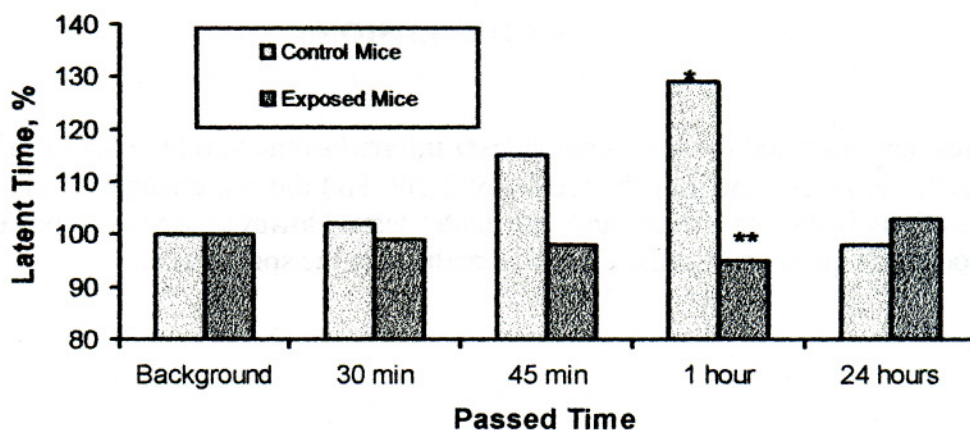


Figure 1. Effect of transcranial laser infrared irradiation of the mouse brain on their reflexory reactions in the "tail flick" test. **Note:** * means that statistical significance of differences is not less than $p < 0.05$ with respect to the background values of a corresponding group; ** denotes that statistical significance of differences is not less than $p < 0.05$ with respect to the background values of two groups at a given stage.

The 'hot plate' test did not reveal significant difference in the latent time between the control and experimental groups (Fig. 2).

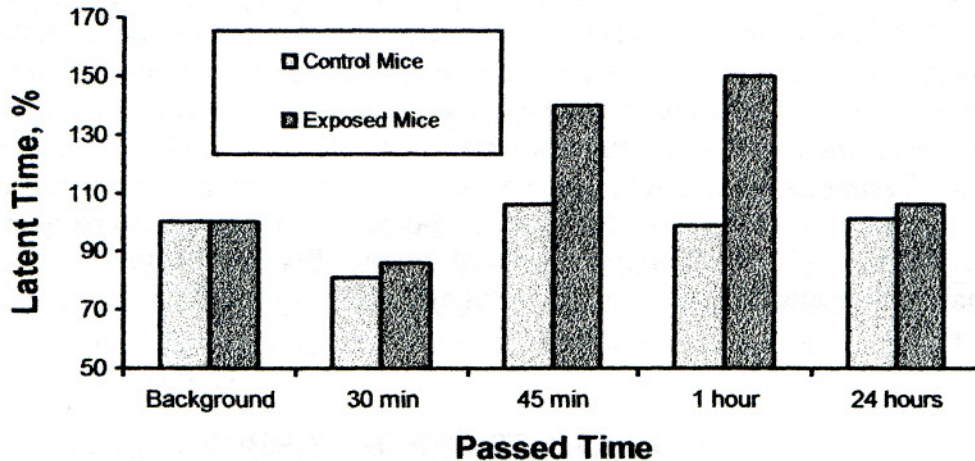


Figure 2. Effect of transcranial laser infrared irradiation of the mouse brain on their reflexory reactions in the 'hot plate' test. **Note:** There are no statistically significant changes.

It is known that the 'tail flick' test, in which animals jerk back their tail, activates the reflexory analgesic reaction. This reaction is predominantly realized at the level of the spinal cord.² The 'hot plate' test, in which animals lick their pads, is known to activate supraspinal mechanisms. The results obtained therefore provide evidence for the fact that laser radiation did not change the character of reflexory analgesic reactions occurring at the spinal and supraspinal levels. However, laser radiation might produce a protective antistress effect realized at the spinal level.

4. CONCLUSIONS

We thus demonstrated that transcranial laser infrared irradiation ($\lambda = 0.89 \mu\text{m}$, the energy density of 3.12 J cm^{-2} , the pulse repetition frequency of 1,500 Hz) did not change the character of reflexory analgesic reactions in the 'tail flick' and 'hot plate' tests. However, one may postulate that this laser radiation produced a protective antistress effect realized at the spinal level.

REFERENCES

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