3. L. F. Panchenko, T. N. Alyab'eva, V. V. Malinovskaya, et al., Byull. Éksp. Bio. Med., 104, No. 7, 87 (1987).
4. Ya. E. Khesin, A. M. Amchenkova, A. N. Narovlyanskii, et al., Vest. Akad. Med. Nauk SSSR, No. 1, 80 (1984).
5. J. E. Blalock and E. M. Smith, Biochem. Biophys. Res. Commun., 101, 472 (1981).
6. N. Dafny, Neuropharmacology, 22, 647 (1983).
7. C. Reyes-Vazquez, N. Weisbrodt, and N. Dafny, Life Sci., 35, 1015 (1984).
8. R. Simantov, S. R. Childers, and S. H. Snyder, Eur. J. Pharmacol., 47, 319 (1978).
9. E. M. Smith and J. E. Blalock, Proc. Natl. Acad. Sci. USA, 78, 7530 (1981).

EFFECT OF A HELIUM-NEON LASER ON PIAL MICROCIRCULATION IN RATS

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Lasers, which have a photodynamic and biostimulating action on tissues, are being increasingly used to study the morphological and functional changes in organs and tissues [2, 5, 8]. The use of lasers in microcirculatory research has made it possible to apply precise conditions of stimulation to different parts of the microcirculatory bed [6] and also a means of assessing the microcirculation of the blood in vivo [7]. The use of low-energy lasers, inducing a biostimulating effect, is promising as a means of studying the effect of outside influences on vessels of the microcirculatory bed [1, 3]. Among these lasers, the helium-neon laser (HNL) has achieved the most widespread popularity.

The aim of this investigation was to study the effect of HNL on the microcirculatory bed of the pia mater and the microcirculation in rats in order to discover the sensitivity of arteriolar and venular microvessels to this agent at different ages of postnatal development.

EXPERIMENTAL METHOD

Experiments were carried out on albino rats aged 7, 30, 45, 60 and 90 days. Preparation of the animal and biomicroscopy of the pial microvessels were carried out by the method described previously [4]. The MBB-1 contact microscope, through the optical system of which the radiation of an HNL (the LGN-104) with a wavelength of 0.63 μ and a power of 40 mW was passed, was used. The duration of irradiation of the microvessels was 1, 3, 6, 12, 18, and 30 min. The diameter of the laser beam in the focal plane of the microscope was 10-20 μ, so that it was possible to subject the wall of arterioles, precortical arterioles, capillaries, postcortical venules, larger venules, and arteriolo-arteriolar anastomoses to the action of the laser beam.

EXPERIMENTAL RESULTS

High-precision application of HNL to the pial microvessels induces local changes in the microcirculation. In the zone of action of the laser on the wall of an arteriole dilatation develops, with the result that a zone of local dilatation is formed. Above and below the zone of dilatation, constriction of the microvessel is observed (Fig. 1). The amount of dilatation is directly proportional to the duration of exposure, and inversely proportional

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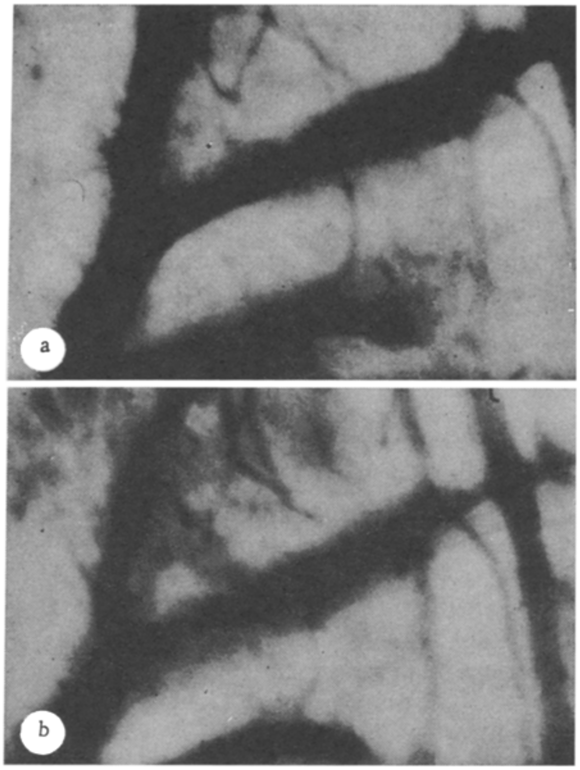

Fig. 1. Reaction of arterioles (diameter 30-35 μ) of pia mater of 90-day-old rat at 18th minute of exposure to laser. Here and in Fig. 2: a) before exposure, b) after exposure to laser; biophotomicrograph. 70 ×.

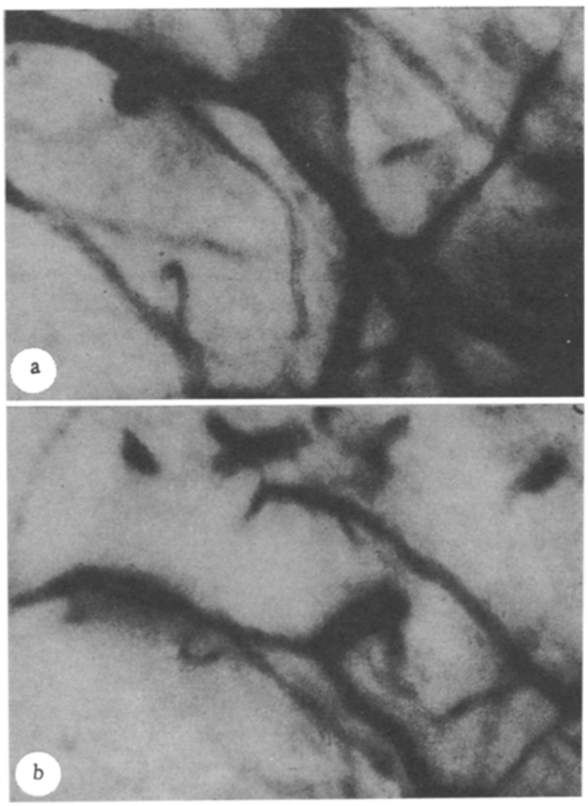

Fig. 2. Dilatation of precortical arteriole of pia mater of 30-day-old rat after laser irradiation.

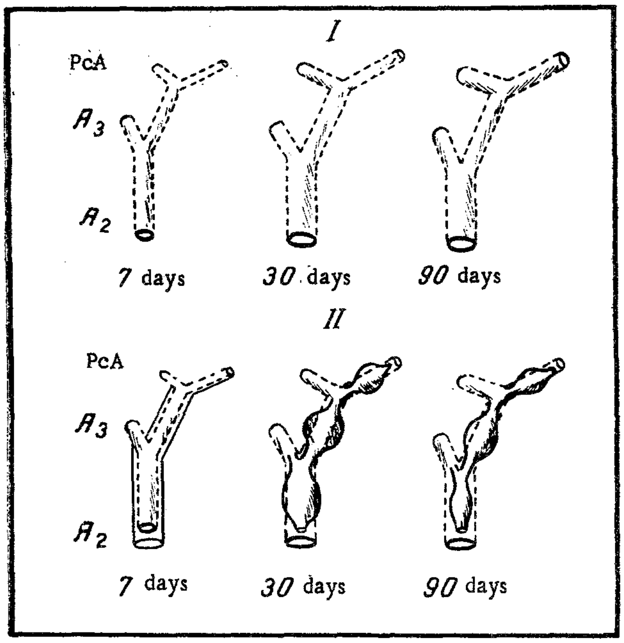

Fig. 3. Changes in character of reaction of arteriolar vessels in different parts of microcirculatory bed with an increase in the animals' age, in response to laser irradiation. I) Before, II) after irradiation. PcA) Precortical arterioles.

to the original diameter of the microvessel. For instance, in 2nd-order arterioles (diameter 40-50 μ) at the 6th minute of exposure the increase in diameter was 3% of the original value, whereas in 3rd-order arterioles (diameter 25-30 μ) the increase was 27% ($p < 0.05$). The most distal arterioles called precortical (diameter 15-20 μ) possess marked reactivity. At the 6th minute of exposure to the laser beam the degree of their dilatation was 35% of the initial level ($p < 0.05$; Fig. 2).

With an increase in the duration of exposure to the laser the size of the zone of local dilatation of the microvessel increased. After irradiation for 18 min the diameter of the 3rd-order arterioles and precortical arterioles was approximately doubled compared with that at the 6th minute of exposure.

The reaction to irradiation of the wall of the venular microvessels by the laser was weaker, but similar in character to the response of the arterioles. Following exposure to the laser for 30 min the collecting venules (diameter 60-80 μ) increased their diameter by 9%, whereas dilatation of the postcortical venules (diameter 30-45 μ) amounted to 29% ($p < 0.05$).

Biomicroscopy clearly revealed that laser irradiation causes changes in the microcirculation, which are manifested mainly as an increase in the velocity of the blood flow in arterioles and venules. This causes the granularity of the blood flow to disappear, and the intermittent flow is replaced by continuous. Meanwhile the dynamic hematocrit index rises, as is indirectly shown by an increase in optical density of the blood flow in the irradiated vessel.

During postnatal development the intensity of the reaction of the microvessels to laser irradiation changes. A characteristic feature of the microvessels of 7-day-old rats is general dilatation, with the result that the diameter of the irradiated microvessel is increased uniformly throughout its length (Fig. 3). Precortical arterioles 10-15 μ in diameter, which in 7-day-old animals did not react to laser irradiation, are the exception. This is evidently due to immaturity of their smooth muscle cells.

More adult animals are characterized by the change from general dilatation of the microvessels to local dilatation at the site of irradiation, and simultaneous constriction above and below the irradiated segment. With age the intensity of the reaction of local dilatation of the arterioles falls, but the degree of their constriction, on the other hand, increases. For instance, in 30-day-old rats, toward the 18th minute of laser irradiation, the diameter of the 3rd-order arterioles at the site of irradiation was increased by 59%

($p < 0.001$), whereas in 90-day-old rats the increase was only 16% ($p < 0.05$). Constriction of the microvessels was minimal in 30-day-old rats at 5%, whereas in 90-day-old animals it was 30% ($p < 0.05$).

To give a general estimate of the age changes in sensitivity of the wall of the pial microvessels to laser irradiation, it can be said that their reactivity diminishes with age.

Local changes in the pial microcirculation were thus demonstrated in response to laser irradiation. The vessels of the microcirculatory bed differ in their sensitivity to laser irradiation. The intensity of the reaction depends on the duration of exposure, the diameter of the microvessel, and the animal's age. With age both the degree of magnitude of the response of the microvessels and its latent period change.

LITERATURE CITED

1. M. T. Aleksandrov, Z. T. Antipova, S. S. Aleksandrova, et al., Resources and Methods of Quantum Electronics in Medicine [in Russian], Saratov (1976). pp. 135-136.
2. N. F. Gamaleya, Lasers in Experimental and Clinical Medicine [in Russian], Moscow (1972).
3. A. A. Gulyaev, M. M. Averbakh, and V. V. Dobkin, Resources and Methods of Quantum Electronics in Medicine [in Russian], Saratov (1976), pp. 75-78.
4. V. I. Kozlov and F. B. Litvin, Fiziol. Zh. (Kiev), No. 9, 1189 (1986).
5. Yu. G. Parkhomenko, O. K. Skobelkin, and E. I. Brekhov, Arkh. Patol., No. 3, 30 (1979).
6. A. M. Chernukh, V. S. Shinkarenko, L. S. Ivanov, et al., Byull. Éksp. Biol. Med., No. 1, 16 (1976).
7. M. D. Stern, Nature, 254, 56 (1975).
8. M. P. Wiedemen, Microvasc. Res., 8, 132 (1974).

EFFECT OF 5,7-DIHYDROXYTRYPTAMINE ON NOCICEPTIVE SENSITIVITY AND ON THE ANALGESIC EFFECT OF MORPHINE

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The role of serotoninergic brain mechanisms in the regulation of nociceptive sensation and the analgesic action of opiates remains the subject of vigorous discussion. Ideas on the importance of serotoninergic brain structures in the integration of nociceptive responses of different modalities and on correlation between the morphological state of the serotoninergic systems and changes in opiate analgesia are contradictory [5, 6, 13]. The participation of this neurotransmitter system in the formation of the hemodynamic manifestations of pain and their resistance to the action of morphine-like analgesics is virtually unstudied.

We therefore decided to study changes in nociceptive sensation, in pressor nociceptive responses of the arterial blood pressure (BP) and the analgesic effect of morphine in nociceptive tests with different levels of integration in the brain, after selective pharmacological destruction of serotoninergic systems.

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