EFFECT OF LOW INTENSITY INFRARED SHORT-RANGE LASER RADIATION ON METABOLIC FUNCTION OF THE ISOLATED RAT MYOCARDIUM IN HYPOXIA

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Low-energy infrared semiconductor lasers, operating in the near infrared region, possess high biological activity and have deep penetrating powers into the tissues. With their appearance, new prospects have been opened up for the practice of medical physiotherapy. They have been shown to be highly effective in various branches of internal medicine, the surgery of infection, traumatology, neurology, etc. There have been isolated publications on the beneficial use of infrared laser radiation (IRLR) in cardiology, especially under conditions of coronary insufficiency [1, 2, 5, 6]. The use of IRLR also is promising because of the extreme simplicity of its use. However, the mechanism of its biological and therapeutic action has not yet been adequately studied. The targets for IRLR have not yet been explained: whether it acts at the molecular, subcellular, or cellular levels. These problems are best studied on relatively simple models of metabolic functions, which would allow direct and indirect effects of IRLR to be separated and the sites of their application in the general regulatory system of the body located. In view of the positive cardiotrophic effect of IRLR in clinical practice, the study of its action on the ischemic myocardium is of particular scientific interest. Accordingly the aim of the investigation described below was to study the action of IRLR on parameters of metabolic function of the isolated contracting heart under conditions of acute oxygen deficiency. With the aid of this model it is possible to detect rapid quantitative changes in the specific contractile function of the cardiomyocytes under the influence of any external stimulating factor.

EXPERIMENTAL METHOD

Experiments were carried out on noninbred male albino rats weighing 150-200 g, subdivided beforehand into animals with low (LR) and high (HR) resistance to hypoxia [4]. To obtain the isolated heart, the rats were anesthetized with ether, the thorax quickly opened the inferior vena cava cannulated, and the superior vena cava ligated, after which the heart was washed out for 10-20 sec with heparin solution (1000 U heparin to 1 liter physiological saline). The heart was then separated from the incoming blood vessels, removed, and placed in physiological saline with heparin on ice, after which it was suspended. The isolated heart was perfused by Langendorff's retrograde method in our own modification [3] with oxygenated Krebs–Henseleit solution (95% O₂ + 5% CO₂, pH 7.4, 37°C) containing glucose (11.0 mM). The optimal pressure of perfusion fluid in the aorta was 80-100 cm water. Acute hypoxia was induced by lowering the oxygen concentration in the perfusion fluid to 20% and replacing it with nitrogen (model of acute hypoxia — H₂O₂). After a period of stabilization of the contractile function of the heart for 30-40 min, the test parameters were recorded (20 min), after which H₂O₂ was produced (20 min). The perfusion fluid was then again replaced by the original solution (95% O₂ + 5% CO₂). Restoration of parameters of metabolic function of the myocardium were recorded in the posthypoxic reoxygenation period for 20-30 min. When the action of IRLR was studied, it coincided in

*Deceased.

time with the action of $H_{20}$ (20 min). Irradiation was carried out with the AML T 01 design of semiconductor infrared laser with $\lambda = 0.89 \mu$, pulse power 3 W, pulse following frequency 400 Hz, and exposure 20 min.

The mechanical contractility of the heart was measured under isometric gauge conditions by means of a strain gauge transducer. Optimal stretching of the myocardium (by 1.5 times) was achieved with the aid of a vernier device. The rate (CR) and force (FCC) of the cardiac contractions were recorded. The rate of oxygen consumption (respiration rate $V_r$) was determined.