

Reaction of the Popliteal Lymph Node to Transcutaneous Irradiation with Helium-Neon Laser

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Prolonged transcutaneous irradiation with helium-neon laser light decreases the transport ability of the popliteal and iliac lymph nodes. Laser radiation stimulates lymphocytes, predominantly T cells.

Key Words: *lymph nodes; laser radiation*

Low-energy laser radiation exerts various effects at the tissue and organ levels which are associated with direct and mediated influences of electromagnetic waves. Even local laser irradiation induces a complex homeostatic reaction of the organism [2,5] due to "transmission" of the laser effect via biological fluids and photoregulating systems. In this connection, photoactivation of the microcirculatory bed seems very important, since it provides prolonged improvement of trophic processes. Recently, it has been demonstrated that even a single irradiation with a helium-neon laser modifies the structure of the lymph node (LN) [1].

MATERIALS AND METHODS

Experiments were performed on adult male Wistar rats. The animals were divided into two groups. Group 1 (intact rats) served as the control. In group 2 rats, the area of the popliteal LN projection on the skin was irradiated with a continuous helium-neon laser: $\lambda=0.63 \mu$, 25 mW/cm, one 10-min session, 7 days. Lymph nodes were excised 24 h after the last session. The calf muscle and the iliac LN were dehydrated in an IR-2M apparatus, and the water content was then determined by weighing.

RESULTS

Prolonged irradiation with a helium-neon laser induced structural and functional modifications in the

popliteal and iliac lymph nodes. On the basis of histological evidence, LN were classified [3,4] as follows: fragmented (type I), compact (type II), and intermediate (type III). In type I LN, the cortex was divided into 1-3 segments and exhibited the maximum transport activity. The cortex/medulla (CM) index was <0.9 . This index is employed for structural characterization of a lymph node and is calculated as the ratio between the cortex and medulla, the amount of the medulla being assumed as 1.

In type II LN, the cortex looked like a homogenous layer; medullary sinuses were narrow, and the transport activity was the lowest. The CM index was >1.4 . The structure of type III LN was intermediate between that of type I and type II LN.

After laser irradiation, the structure of both popliteal and iliac LN changed from type III (control) to type II. The CM index in the popliteal LN increased to 2.43 (vs. 0.9 in intact animals). The proportion of secondary LN increased more than 2.5-fold compared with the control (Fig. 1). The relative proportion of medullary cords and sinuses decreased by 66.6 and 27.2%, respectively, compared with the control.

The number of cells per unit area increased both in the cortex and medulla of the popliteal LN. This tendency was particularly pronounced in the paracortical zone and medullary sinuses, where cell content increased by 31 and 33%, respectively. The number of small lymphocytes in the paracortical zone, medullary cords, and medullary sinuses increased by 35, 28, and 30%, respectively, compared with the control. Bearing in mind the small changes in the

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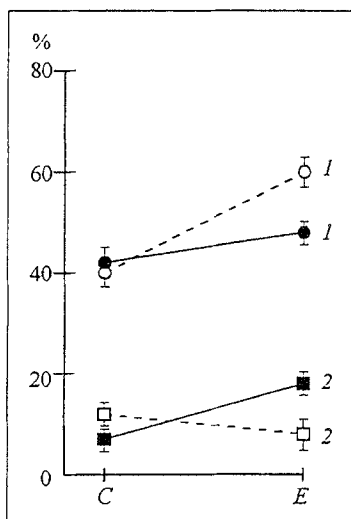


Fig. 1. Changes in the proportion of paracortical zone (1) and secondary lymph nodules (2) in the iliac (broken line) and popliteal (solid line) lymph nodes induced by helium-neon laser irradiation of skin projection of the popliteal lymph node. Here and in Fig. 2: control (C) and experimental (E) groups.

absolute amount of large and medium lymphocytes, we have suggested that the increase in the number of small lymphocytes in the popliteal and iliac LN results from recirculation (Fig. 2). The number of macrophages in the germinal centers increased. The rise in the relative proportion of mature plasma cells in the medullary cords was due to accelerated differentiation of immature cells, as evidenced by a decrease in the absolute number of plasmablasts and immature plasma cells 3.9- and 2.1-fold, respectively, while the number of mature plasma cells increased by 86%. The emergence of plasma cells in medullary sinuses and an increase in the number of mast cells were observed.

After laser irradiation, the CM index in the iliac LN was 4.29 (3.3-fold greater than in the control). The proportion of the paracortical zone increased 1.5-fold, while the relative area of secondary LN decreased by 42% (Fig. 1). A pronounced plethora of all microvessels was observed in the deep layers of the medulla. The relative areas of medullary cords and sinuses decreased 73.4 and 38.4%, respectively, compared with the control.

The modifications of cellular composition in the iliac LN were similar to those observed in the popliteal LN, although several specific features were noted. The increase in the cell number per unit area of the paracortical zone was less pronounced (18% compared with the control), while in the medullary sinuses this parameter increased 2.55-fold. Cell content of germinal centers and medullary cords decreased by 13 and 27%, respectively. Similarly to the popliteal LN, the absolute amount of small lymphocytes in the paracortical zone and medullary cords and sinuses decreased by 22%, 43%, and 3.14-fold, respectively, compared with the control.

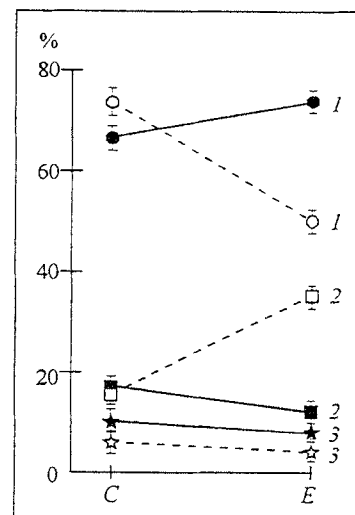


Fig. 2. Changes in the proportion of cells in germinal center of iliac (broken line) and popliteal (solid line) lymph node induced by helium-neon laser irradiation of skin projection of the popliteal lymph node. Small (1), medium (2), and large (3) lymphocytes.

In the medullary cords, the number of these cells increased, while the absolute number of immature and mature plasma cells decreased, respectively, 91 and 35%, and their relative numbers decreased, respectively, by 86 and 11%. Mast cells and processed (dendritic) cells appeared in the medullary sinuses.

Changes in the type of LN induced by laser radiation were reflected by the LN function. According to classification [3], type II LN (compact) has the lowest transport activity compared with that of type I and type III LN. This was confirmed by the measurements of the water content in the lateral area of the calf muscle from which lymph flows to the iliac LN. It was found that after laser irradiation the water content in this muscle increased by 48% compared with the control group.

In the iliac LN (its lymphodynamics is related to that in the popliteal LN), water content decreased 3-fold.

It can be suggested that prolonged helium-neon laser irradiation of the popliteal LN inhibits the transport (drainage) function both of popliteal LN and iliac LN due to considerable stimulation of lymphoid cells.

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