EXPERIMENTAL METHODS FOR CLINICAL PRACTICE

Blood and Lymph Circulation in Peribronchial Lymph Nodes under Conditions of Bronchial Inflammation Treated with Laser Therapy

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Ultrastructure of vascular endothelium and sinuses of regional lymph nodes was studied under conditions of infectious-destructive lung disease. Inflammation caused significant damage to these cells, while endobronchial laser therapy produced considerable plastic changes in the bronchi.

Key Words: *lymph node; pulmonary abscess; ultrastructure; laser therapy*

Lymph capillaries, the initial elements of the lymphatic system in the mucosa of the major bronchi and pulmonary tissue, play a key role in the development of inflammatory reaction [4,5]. Our aim was to study responsiveness of regional peribronchial lymph nodes (LN) in infectious destructive inflammation in the lungs and changes in their structure in response to chosen therapeutic strategy.

MATERIALS AND METHODS

Regional LN were obtained from 13 patients with nonspecific inflammatory processes in the lungs (acute and gangrenous abscesses). Group 1 comprised LN of 7 patients receiving conventional therapy; group 2 consisted of LN of 6 patients receiving complex therapy including endobronchial laser therapy. The parameters and scheme of the endobronchial laser therapy were described elsewhere [4]. The therapeutic setup was based on an LG-111 He-Ne laser.

Regional LN biopsy specimens were used to prepare paraffin sections, which were then stained with azure II, or embedded in epoxy resins to make ultrathin sections that were double contrasted with uranyl acetate and lead citrate.

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RESULTS

Macroscopically, group 1 LN were enlarged, had relatively dense consistence and dull dark surface. Light microscopy revealed typical morphological signs of acute lymphadenitis.

Capillaries of the connective tissue trabeculae had the signs of active function and enhanced permeability. Endotheliocytes (ET) of these capillaries had developed vesicular apparatus, large vacuoles in the cytoplasm, a great number of cytoplasmic projections and mitochondria (Fig. 1, *a*).

Arterial capillaries formed a dense network and had the signs of active function (Fig. 1, *b*). Most capillaries corresponded to the phenotype of young and new vessels formed in response to node enlargement. The structure of ET was disturbed in the majority of capillaries. Some capillaries were destroyed and did not supply blood (Fig. 1, *c*).

Venous capillaries were more labile, but as a whole maintained their structure (Fig. 1, *d*). Postcapillary venules had wide lumen and were lined by cubical ET. Blood elements including neutrophilic leukocytes were

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seen in the lumen of most venules (Fig. 1, *e*). In some venules endothelial lining was thinned and considerably damaged (Fig. 1, *f*). The rare signs of transendothelial lymphocyte migration were casual findings rather than the indication of functional activity.

Lymph sinuses had various structural and functional states. The marginal sinuses had wide lumens with damaged cells in the lining epithelium and local disturbances in its integrity (Fig. 2, *a*). Lymphocytes, macrophages, and neutrophils were seen in the lumen. The cells with signs of active phagocytosis prevailed among the macrophages. The neutrophils probably were carried by the lymph from the inflammatory foci. The lymphoid cells were considerably damaged.

The cortical and intermediate cortical sinuses were often compressed by hyperplastic lymphoid tissue, ET

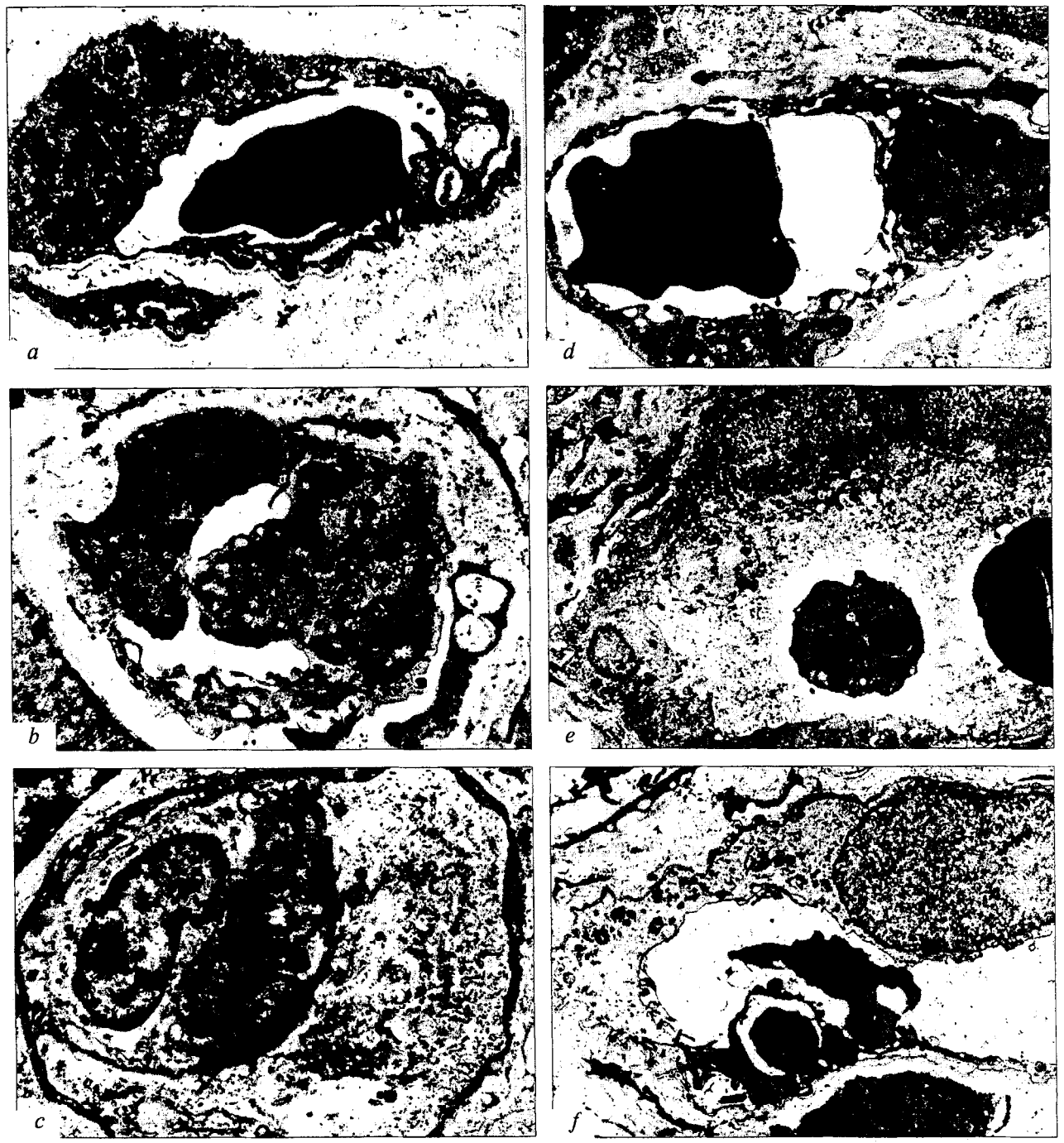

Fig. 1. Blood capillary (*a-c*), venous capillaries (*d*), and a postcapillary venule (*e,f*) of a connective tissue trabecula in Group 1 lymph node. Hyperplasia of vesicular apparatus and deep invaginations of the nuclear membranes of endotheliocytes (*b*), considerable structural disturbances in a capillary (*c*), heterogeneity of endotheliocyte structure (*f*). ×4,000 (*a*), ×3,000 (*b-d*, *f*), and ×2,000 (*e*).

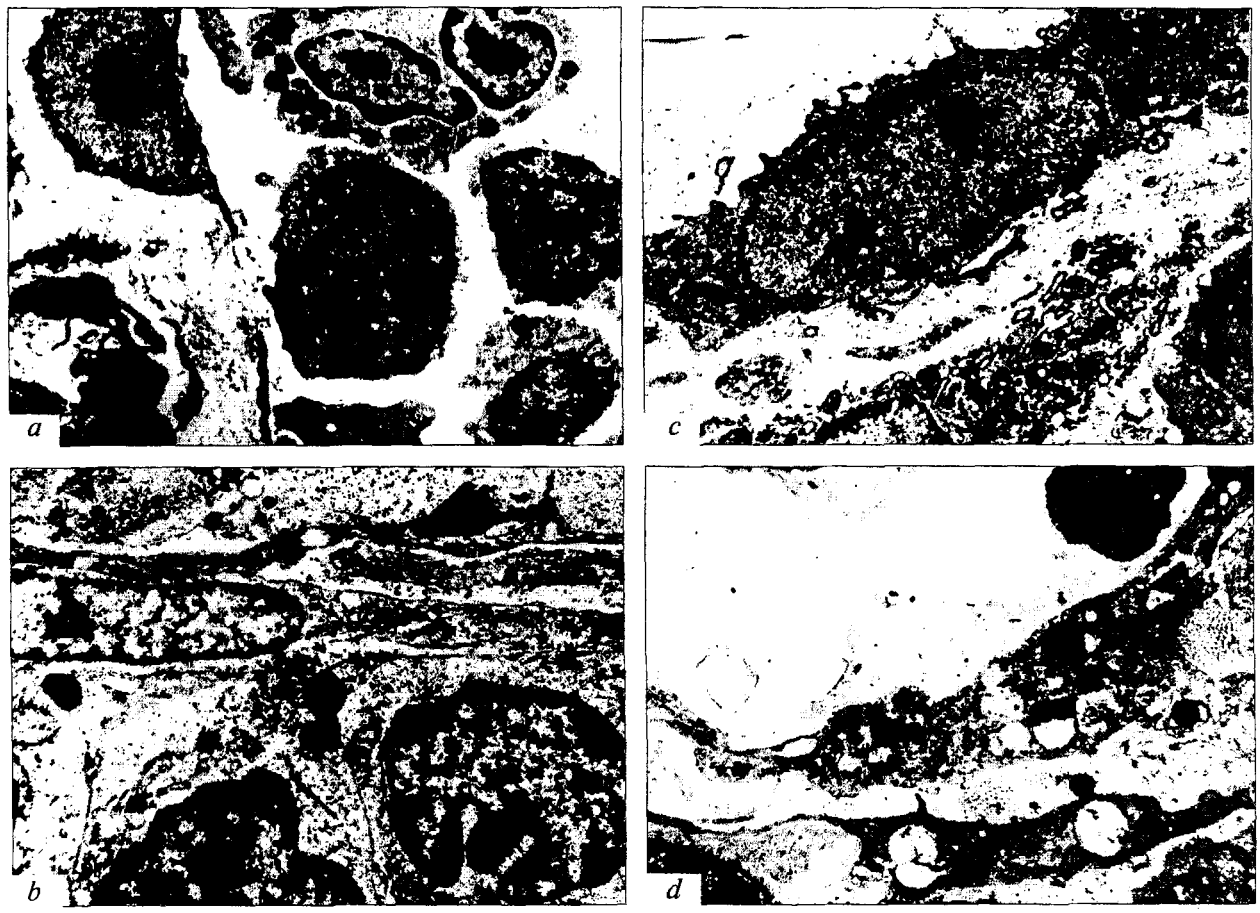

Fig. 2. Marginal (*a*), cortical (*b*), and medullar (*c, d*) sinuses of Group 1 lymph nodes. *a*) rupture of the endothelial lining, ×3,000; *b*) compression of the lumen, ×3,000; *c*) endotheliocyte hypertrophy, ×3,000; *d*) lysosome-like granules in the apical cytoplasm of endotheliocyte, ×6,000.

in such sinuses had various ultrastructural damages (Fig 2, *b*). Only few sinuses had wide lumens with numerous lymphocytes and macrophages and different structural alterations in the lithoral cells.

Medullar sinuses were lined with hypertrophied ET (Fig. 2, *c*). The apical cytoplasm of ET enriched with cell organelles contained lysosome-like granules (Fig. 2, *d*). Activated lymphocytes were seen in the lumen of medullar sinuses. The majority of macrophages had developed ultrastructure and signs of phagocytosis.

Group 2 lymph nodes were smaller than in group 1, had moderate consistence and dark dull wet surface on sections. Histological examination revealed the connective tissue capsule, follicles against the background of cortical plateau, medullary cords, trabeculae, and sinuses penetrating the nodal parenchyma.

The ultrastructural examination showed that major characteristic feature of LN in this group was the absence of damages.

Arterial capillary network was moderately developed. Most capillaries had structural signs of active ET function. ET had cytoplasmic projections, dense cytoplasmic matrix, clusters of mitochondria in the perinuclear region, and deep invaginations of the nuclear membrane (Fig. 3, *a*). Venous capillaries were plethoric, and the structure of ET was heterogeneous (Fig. 3, *b*).

Most postcapillary venules had free lumens, developed mitochondrial apparatus, different thickness of the ET barrier and ruptures of the basal layer in the area of ET contacts. ET nuclei greatly varied in shape. (Fig. 3, *c*).

Sinuses had functionally active structure. ET of most sinuses (from marginal to medullar) had typical structure (Fig. 3, *d*). The sinus lumens contained numerous lymphocytes with developed ultrastructure and macrophages, most of them had signs of active phagocytosis, developed mitochondrial and lysosome apparatuses, dense cytoplasmic network, and numerous projections.

Most diseases are accompanied by secondary damages to the lymphatic system [2,3]. Traffic of toxic lymph from the lung involved in infectious destructive inflammation in patients treated by conventional methods [4] induces considerable changes in the structure of regional LN. Heterogeneity of damages in the

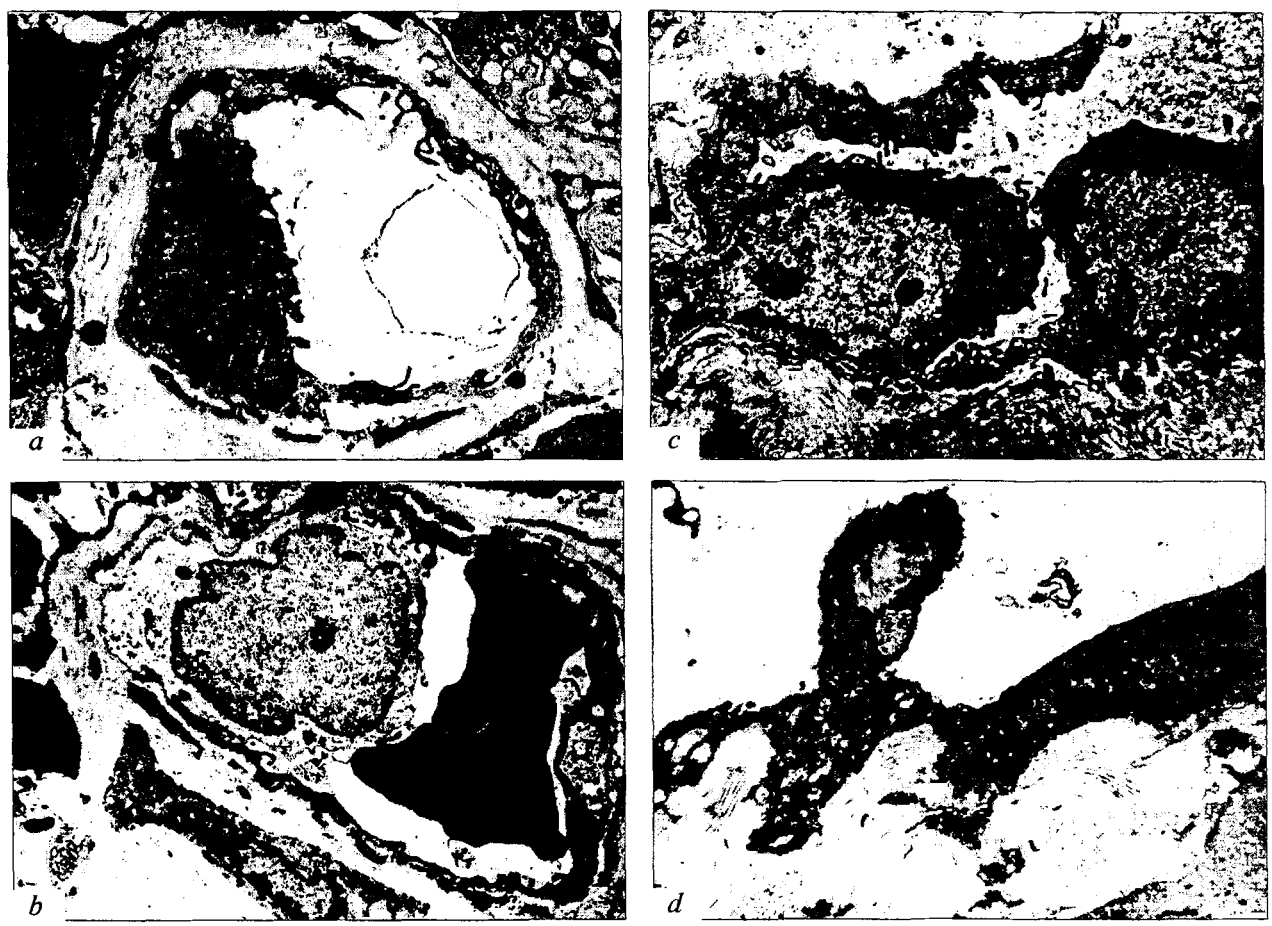

Fig. 3. Arterial (*a*) and venous (*b*) blood capillaries, postcapillary venule (*c*) and endotheliocytes of marginal sinus (*d*) of group 2 lymph nodes, ×3,000.

LN compartments and their moderation along the lymph flow suggest that the barrier and filter functions are relatively preserved. This observation is confirmed by a vast number of actively phagocytizing macrophages, specificity of phagocytized matter in various compartments, and different degree of damages to lithoral and blood cells in sinuses. At the same time, marked abnormalities are seen in blood vessels, in particular in the cortical and pericortical areas. There were no signs of active transendothelial lymphocyte migration in postcapillary venules.

Compression of cortical and intermediate cortical sinuses by modified hyperplastic lymphoid tissue was accompanied by local disturbances in lymph circulation. Under these conditions this may have a positive effect due to limitation of toxic influences from abscess via the lymphatic pathways.

Endobronchial laser therapy promotes recovery of the bronchial drainage and clearing of the abscesses from purulent masses and tissue debris, as well as moderates the peripheral inflammatory reaction [4]. Elimination of abscess-produced toxic effects is accompanied by restoration of structural organization of the regional LN with adequate blood and lymph circulation.

As a whole, LN should be considered as important homeostatic organs of internal medium of the organism. Morphofunctional changes in LN in response to external influences are the signs of adaptation, they correlate with the degree and limits of adaptive processes. This substantiates the approach to the "drained organ — regional LN" axis as to an integral system, in which LN plays the role of a marker of the environmental stress [1].

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