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EFFECT OF PROPER VAPOR LASER RADIATION ON MICRORELIEF AND ULTRASTRUCTURE OF GLANDULOCYTES OF THE GASTRIC MUCOSA

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KEY WORDS: laser irradiation, stomach, microrelief, ultrastructure.

The stimulating effect of low-intensity laser radiation (LILR) has accounted for the widespread use of different types of lasers in medicine. The helium-neon laser (HNL) has achieved the most widespread popularity [5, 7]. A series of investigations has shown that the structural basis of the stimulating effect of HNL is an increase in the rate of proliferation of cells combined with an increase in the rate of their differentiation [2-4]. LILR induces characteristic changes in intracellular structures, reflecting the intensification of intracellular processes. This is manifested as an increase in the volume of profiles of the endoplasmic reticulum, an increase in the number and size of the mitochondria, etc. [1, 6].

At the present time, to stimulate repair processes and, in particular, to accelerate the healing of gastric and duodenal ulcers, copper vapor lasers (CVL) are used. However, many of the structural aspects of the effect of LILR of CVL on the gastric mucosa remain unstudied.

EXPERIMENTAL METHOD

The microrelief and ultrastructure of cells of the fundal glands of 28 Wistar albino rats were studied. The power of the radiation at the object level was 8 mW, the diameter of the zone of irradiation 3 mm, the duration of the procedure 1, 3, and 5 min, and the doses 6.78, 20.34, and 33.909 J/cm^2, respectively. The animals were killed by instant decapitation 5-10 min and 1 h after irradiation. In the control group, similar manipulations were carried out with the animals, but without irradiation. Tissue samples, fixed with glutaraldehyde and postfixed with osmic acid, were dehydrated for scanning electron microscopy in alcohol and acetone, dried by the critical point method, and sprayed with gold (HCP-2 and IB-3 instruments, "Hitachi," Japan). For transmission electron microscopy, Epon-Araldite sections were subjected to double staining and examined in the "Hitachi" H-600 microscope. Semithin sections were stained with methylene blue and fuchsine.

EXPERIMENTAL RESULTS

Examination of semithin sections after intragastric irradiation of the gastric mucosa for 1 min revealed congestion of the microvessels of the gastric mucosa, and an increase in size of the cells of the fundal glands, especially the chief cells (Fig. 1a). Changes were observed in the surface of the gastric mucosa, with variation in the context of mucoid in the surface and pit cells (Fig. 1b, c). Changes in microrelief were seen particularly clearly during scanning electron microscopy. The ridges surrounding

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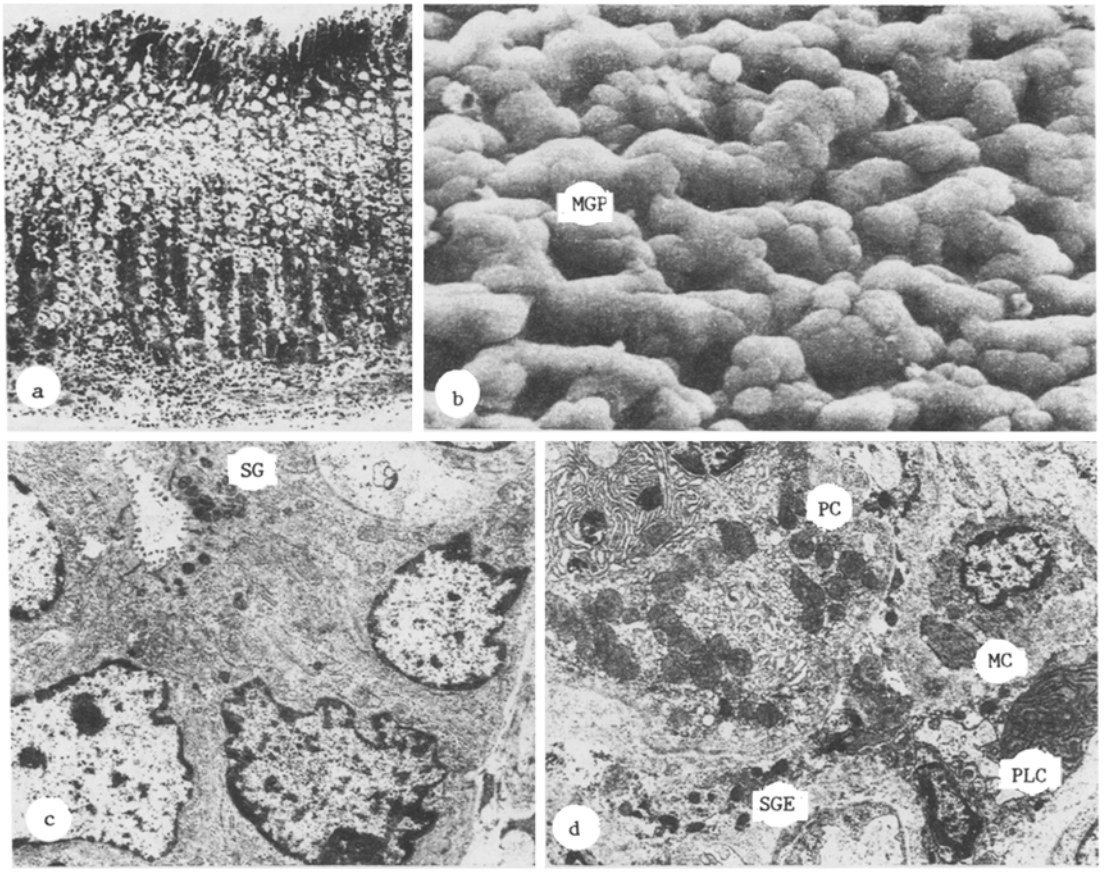

Fig. 1. Changes in epitheliocytes of gastric mucosa after endogastric laser irradiation for 1 min (dose 6.78 J/cm^2). a) Enlargement of cells of fundal glands. Semithin section. Stained with methylene blue and fuchsine. 400×; b) Dilatation of mouths of gastric pits. 1000×; c) Mucocytes of gastric pits contain a few secretory granules and developed intracellular structures. 3000×; d) Increase in number of tubulovesicles and microvilli of intracellular secretory tubules of parietal cells, secretory granules of eosinophilic cells in intercellular space of connective tissue, degranulation of mast cells and fragment of plasma cell. 3000×.

the mouths of the gastric pits were in contact with each other and projected into the lumen. The mouths of the pits were significantly dilated as a result of the uneven swelling of the cells lining the ridges, and the microrelief became irregular. Migrating blood cells were often found on the surface. However, even if a distinct picture of changes and some irregularity of the microrelief were present, no damage could be seen to the luminal surface of the epitheliocytes (Fig. 1b).

Transmission electron microscopy showed changes in the intracellular structures, evidence of intensification of the specific functions of the secretory cells. There was an increase in the number of profiles of the rough endoplasmic reticulum (RER) and Golgi complex (GC), enlargement of its vacuoles, swelling of mitochondria, and enlargement and an increase in the number of secretory granules. In the parietal cells the lumen of the intracellular secretory tubules was dilated, and the number of microvilli and tubulovesicles was increased (Fig. 1d). In the cells lining the gastric pits, besides an increase in the number of profiles of GC and the number of its vacuoles, unequal numbers of secretory granules were present in different cells. Some cells were empty (Fig. 1c) whereas others contained many granules of secretion. The number of free eosinophils and mast cells was increased in the connective stroma of the glands (Fig. 1d).

Irradiation of the gastric mucosa for 3 min in a total dose of 20.34 J/cm^2 caused intensification of the ultrastructural changes, evidence of intensification of the specific functions of the secreting cells. Besides the more marked changes characteristic of irradiation for 1 min, an increase in size of the secretory granules and dilatation of the profiles of the RER were observed (Fig. 2a). Migration of connective-tissue cells into the stroma of the glands and into the epithelium was increased. The state of the microrelief indicated inequality of swelling of the pit surface cells into the lumen on account of differences in the amount of secretion in their cytoplasm. The lumen of the pits was widened and a large part of them contained homogeneous floccules of

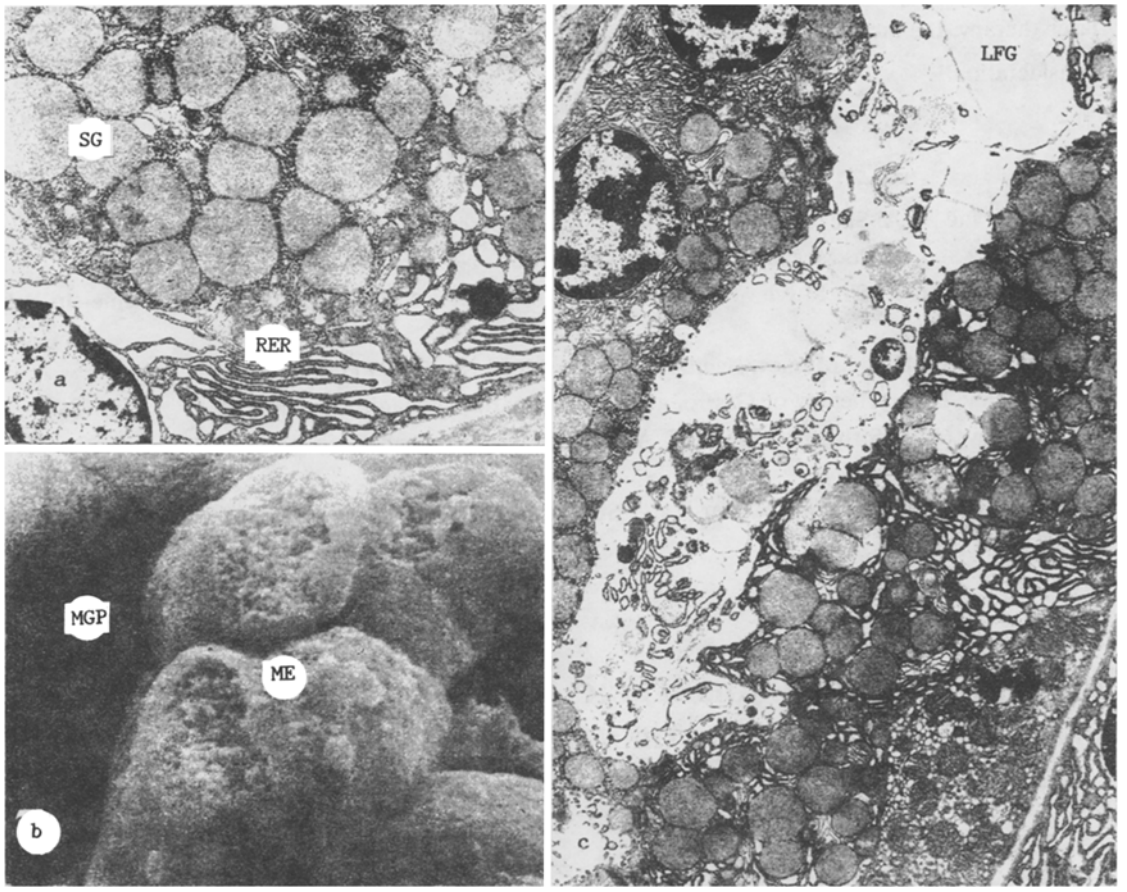

Fig. 2. Changes in epitheliocytes of gastric mucosa after endogastric irradiation by copper vapor laser for 3 and 5 min (doses 20.34 and 33.90 J/cm^2). a) Dilatation of profiles of rough endoplasmic reticulum and enlargement of secretory granules of chief cells after irradiation for 3 min. 4000×; b) Appearance of microerosions on apical surface of epitheliocytes after irradiation for 5 min. 5000×; c) Fragments of cytoplasmic structures in lumen of fundal glands after irradiation for 5 min. 3000×. SG) Secretory granules; MGP) mouths of gastric pits; ME) microerosions; LFG) lumen of fundal glands; PC) parietal cell; MC) mast cell; PLC) plasma cell; SGE) secretory granules of eosinophils.

secretion. The apical surface of the overwhelming majority of epitheliocytes lining the surface of the gastric mucosa and forming its microrelief showed no visible signs of injury. In individual cells, however, there was some degree of disturbance of the integrity of the surface. Irradiation of the gastric mucosa for 5 min caused a marked increase in the number of cells of the pits and ridges with an injured surface, or in some cases with deep erosions on the apical luminal parts of the cytoplasmic membrane (Fig. 2b).

Transmission electron microscopy, used to investigate cells of the fundal glands, revealed alternative changes in intracellular structures. They consisted of considerable varcuolation of the RER, the appearance of myelin bodies in the cytoplasm and mitochondria, intrusions in the nuclei, and perinuclear edema. Mucocytes in the necks of the fundal glands and the pit surface cells mainly contained empty cytoplasm. Disturbance of the integrity of the cytoplasmic membranes of the glandulocytes was very frequently observed. Fragments of intracellular structures of the epitheliocytes were discovered in the lumen of the fundal glands (Fig. 2c).

Thus, the investigations showed that after laser irradiation of the gastric mucosa changes in the ultrastructure of the glandulocytes and microrelief of the surface, reflecting stimulation of specific secretory function, were observed when doses of 6.78 to 20.34 J/cm^2 were used, and the duration of irradiation was 1 and 3 min, respectively. During irradiation for 5 min, with a dose of 33.90 J/cm^2, changes of an irreversible type appeared. Stimulating doses of irradiation with LILR from a CVL were comparable with those obtained during irradiation of the gastric mucosa by HNL [2-4]. When gastric and duodenal ulcers are

treated by laser therapy, the fact that irreversible changes follow the use of doses of irradiation exceeding 20.34 J/cm2 must be taken into consideration.

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HISTOCHEMICAL STUDY OF CHOLINERGIC STRUCTURES OF THE FROG TONGUE DURING CHRONIC ETHANOL ADMINISTRATION

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Investigators studying the effect of ethanol on cholinergic structures of the gastrointestinal tract have concentrated their attention mainly on organs such as the stomach and small and large intestine [8]. Meanwhile, the proximal part of the gastrointestinal tract, namely the mouth and tongue, have not yet been studied from this standpoint. Yet histochemical studies have shown that the tongue in man and various vertebrates has a rich cholinergic innercation [1-4, 7] which, in the opinion of the authors cited, plays an important role in the regulation of vascular tone, of gland function, and of activity of the taste receptor system, and which evidently is involved in the perception and transmission of tactile stimuli [1]. It has also been shown that cholinergic fibers maintain nervous connections between unimodal (gustatory) and heteromodal (gustatory and tactile) receptors of the tongue, and combine them into receptive fields [1].

The aim of this investigation was to study the chronic effect of ethanol on cholinergic structures of the frog tongue.

EXPERIMENTAL METHOD

Experiments were carried out on frogs (*Rana temporaria*), kept under laboratory conditions at 10°C. Ethanol was administered to the frogs through the skin, i.e., by the natural way in which fluids enter these animals [5]. In this way the direct damaging action of ethanol on the tongue was excluded. The experimental animals (48 frogs) were kept away from water for 14-90 days, but were kept for 2 h daily in a crystallizing tank with 3% ethanol solution. Animals of the control group (20 frogs) were kept in water for the same time.

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