MORPHOLOGY AND PATHOMORPHOLOGY

Ultrastructure and Proliferation of Gastric Epitheliocytes During Exposure to Ultraviolet Laser

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Local exposure to ultraviolet laser in a dose of at least 4 J/cm^2 decreases the epitheliocyte labeled nuclei index in the fundal portion of the stomach, the decrease being the greatest for actively proliferating cervical cells. It involves a decrease in the amount of parietal microorganisms and alteration of epitheliocytes. The latter phenomenon was most expressed after a dose of 6 J/cm^2. Changes caused by UV laser were observed 24 h after exposure.

Key Words: *laser; gastric epitheliocytes; microorganisms; proliferation; ultrastructure*

Ultraviolet lasers (UVL, nitrous laser) are less often used in medicine than helium-neon or infrared arsenide-gallium lasers. A specific feature of UVL exposure of cells and tissues is a manifest alterating effect of this low-intensity laser at relatively low doses [4,5].

The ability of UVL to inhibit connective tissue cell proliferation and suppress adhesive activity of the peritoneum play an important role in prevention of adhesions in the peritoneum.

UVL exerts an antibacterial effect [1,4]. This effect can be used for decreasing bacterial contamination of mucosal surfaces, specifically, for eradicating *Helicobacter pylori* from the gastroduodenal mucosa, which is important in the therapy of peptic ulcer [6,7].

Effect of UVL on the ultrastructure and proliferation of gastric mucosa and on microorganisms on the surface of epitheliocytes (parietal microorganisms) is not well studied [2,5].

MATERIALS AND METHODS

Local exposure of gastric mucosa in the fundal portion of the stomach was carried out in Wistar rats weighing 120-140 g (n=103) endogastrally with a light guide connected to radiation source. An LGI-21 nitrous laser with a wavelength 337 nm was used, radiation power at the light guide outlet 2.5 mWt, diameter of exposed zone 3 mm, duration of exposure 1, 2, and 3 min, and doses 2, 4, and 6 J/cm^2, respectively. In control groups, the corresponding portions of the stomach were exposed to white light or noncoherent exposure at a similar wavelength and power.

For radioautographic study, ^{3}H-thymidine in a dose of 18.5 kBq/g was intraperitoneally injected 10 min before exposure at 10:00 after an overnight fast. Paraffin sections were coated with M emulsion and after a 30-day exposure developed in amidol developer. The labeled nuclei index was determined by counting at least 1000 nuclei for each type of cells of the fundal gastric mucosa.

All painful procedures were performed under ether narcosis. Animals were sacrificed by decapitation 5 min, 1, 8, 24, and 48 h after a single exposure.

Specimens of gastric mucosa and small intestine were fixed in 2.5% glutar aldehyde in phosphate buffer, dehydrated, and embedded in Epon-Araldite. Ultrathin sections after double contrast staining were examined under a Hitachi-H600 electron microscope. Parietal microorganisms were counted in semithin slices stained with methylene blue-fuscnin by

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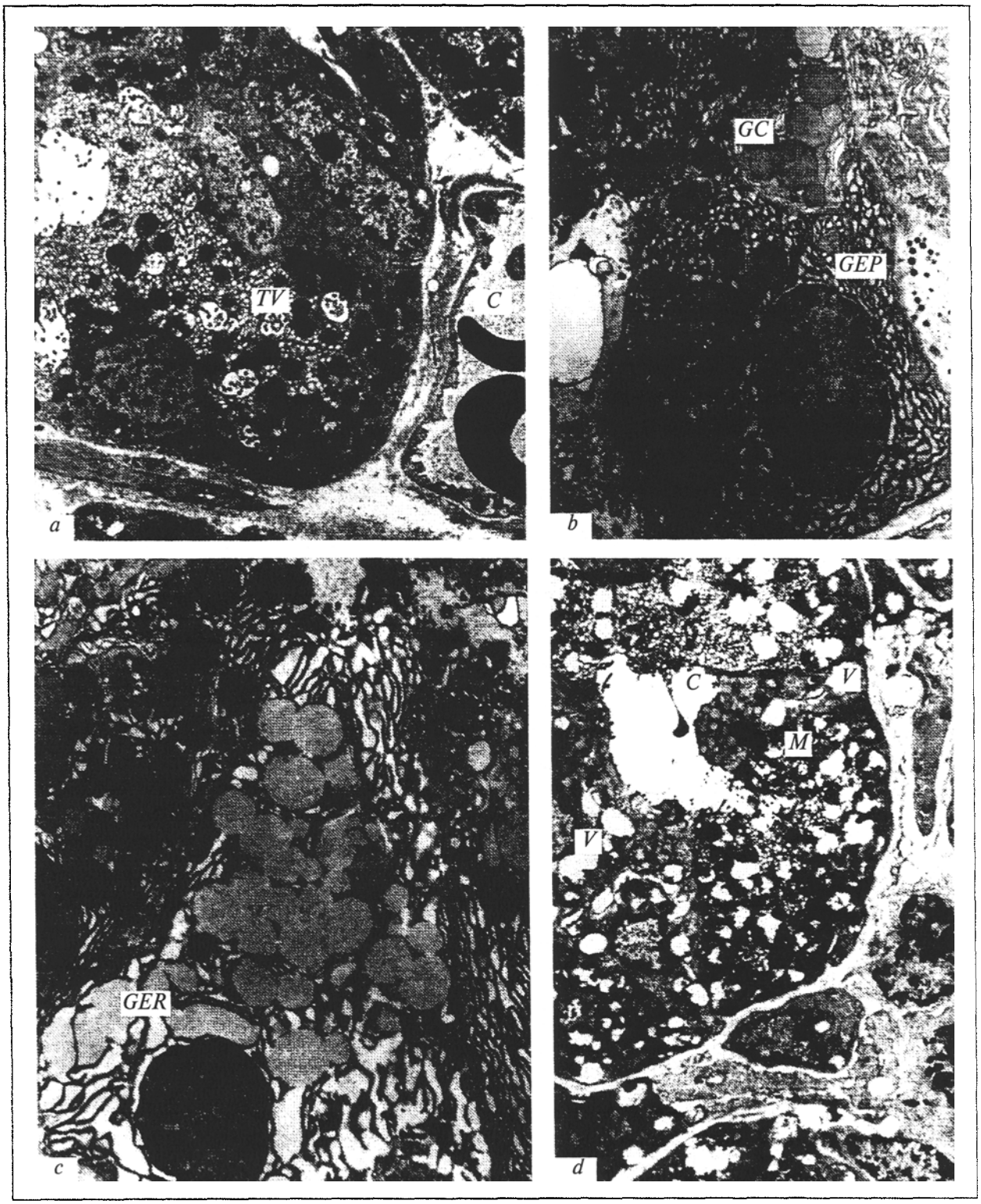

Fig. 2. Ultrastructural changes in fundal glandular cells after exposure to ultraviolet laser. Transmission electron microscopy. *a*) dilatation of capillaries (*C*), increased number of trabeculovesicles (*TV*) in parietal cells 1 h after 1-min exposure, ×3700; *b*) enlarged Golgi complex (*GC*) and extended profiles of granular endoplasmatic reticulum (*GER*) 8 h after 1-min exposure, ×4500; *c*) extended profiles of granular endoplasmatic reticulum (*GER*) and fusion of secretory granules of accessory reticulum 1 h after 2-min exposure, ×4500; *d*) swelling and clarification of mitochondrial (*M*) matrix, vacuolization (*V*) and clasmatosis (*C*) of parietal cells 24 h after 3-min exposure, ×3700.

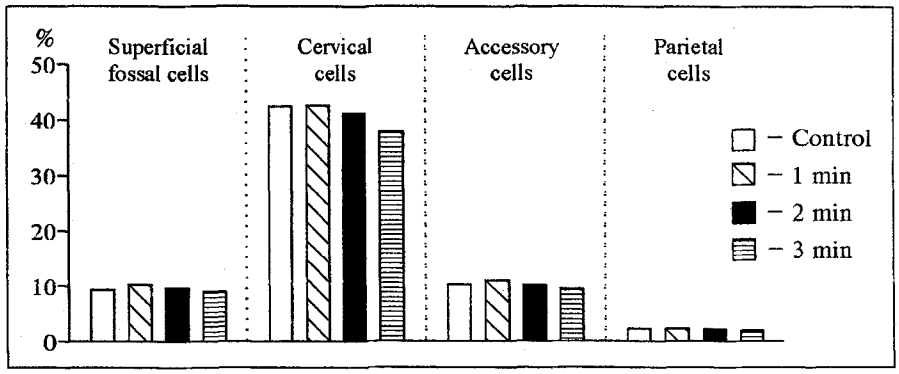

Fig. 1. Labeled nuclei index in the gastric mucosa cells after exposure to ultraviolet laser.

stereomorphometry at a distance of up to 40 μm from the apical surface of cells [2].

RESULTS

Radioautography showed than 1-min UVL exposure of gastric mucosa caused a slight increase in the proliferative activity of its epitheliocytes. A 2-3-min exposure significantly decreased the labeled nuclei index in all types of epitheliocytes. The greatest decrease of the parameter was observed in the most actively proliferating cervical cells of the fundal glands (Fig. 1).

UVL exposure of gastric mucosa notably decreased the relative volume of parietal microorganisms. This decrease was most pronounced 8 h after 1- and 2-min exposure. Later the number of parietal microorganisms increased, but did not reach the initial level even 48 h after exposure (Table 1).

UVL-modified proliferative activity of gastric mucosal cells and the decrease in the number of parietal microorganisms were associated with rearrangement of epitheliocyte ultrastructure, predominantly of the chief and parietal cells.

One-minute exposure of the gastric mucosa stimulated the microcirculation and specific functions of the chief and parietal cells. Capillaries were dilated and their relative volume increased. In the chief cells, Golgi complex and the granular endoplasmatic reticulum were enlarged. In the parietal cells, the number of tubulovesicles increased and intracellular secretory canaliculi were dilated. Similar changes were observed in accessory cells from the very beginning of observation (Fig. 2, *a, b*). These changes were observed later, after 8 and 24 h (Fig. 2, *c*) and were associated with increased relative volume proportion of these cells.

More expressed alteration of cells, resulting in their abnormalities, was observed 5 and 1 h after 2- and 3-min exposure. Besides swelling and clarification of mitochondria, numerous vacuoles appeared in the cytoplasm of the chief and parietal cells and signs of clasmatosis were observed. These early changes persisted at later periods (24 h after exposure, Fig. 2, *d*) and disappeared only 48 after exposure.

One-minute UVL exposure of the gastric mucosa stimulated cellular proliferative activity and decreased the number of parietal microorganisms without modifying epitheliocytes. Doses of 4 J/cm^2 and higher reduced the number of parietal microorganisms, but involved a decrease in the labeled nuclei index of the cells and their alteration. Cell changes persisted for 24 h after exposure.

UVL exposure of the gastric mucosa can be used for decreasing bacterial contamination, including that with *Helicobacter pylori*. Doses higher than 2 J/cm^2 and repeated exposure earlier than after 24 h are not recommended.

Table 1. Relative Volume (%) of Parietal Microflora of the Fundal Part of Gastric Mucosa Exposed to UVL

Time after exposure	Duration of exposure, min	
	1	2
Control	5.1±0.1	5.1±0.1
5 min	4.8±0.2	4.6±0.1
1 h	3.4±0.1	3.1±0.09
8 h	0.8±0.09*	0.7±0.09*
24 h	1.3±0.08*	1.1±0.08*
48 h	3.5±0.9	3.2±0.07

Note. *$p<0.05$ *vs.* the control.

REFERENCES

1. L. G. Bazhenov, R. A. Sadykov, and S. R. Pulatov, *Med. Zh. Uzb*, No. 7, 26-28 (1991).
2. I. M. Baibekov, R. Sh. Mavlyan-Khodzhaev, and E. Sh. Musaev, *Byull. Eksp. Biol. Med.*, **107**, No. 1, 106-108.
3. I. M. Baibekov, V. A. Khoroshaev, Yu. I. Kalish, *et al., Functional Morphology of the Peritoneum in Health, Peritonitis, and Laser Exposure* [in Russian], Tashkent (1996).
4. I. M. Baibekov and F. G. Nazyrov, eds., *Morphological Aspects of Laser Exposures of Chronic Ulcers and Liver* [in Russian], Tashkent (1996).
5. V. I. Kozlov and I. M. Baibekov, eds., *Morphological Basis of Low-Intensity Laser Therapy* [in Russian], Tashkent (1991).
6. N. Hudson, W. G. Brydon, M. A. Eastwood, and A. Ferguson, *Alim. Pharmacol. Ther.*, **9**, No. 1, 45-49 (1995).
7. L. A. Noach, M. A. Bertola, M. P. Schwarts, *et al., Eur. J. Gastroenterol. Hepatol.*, No. 6, 585-591 (1994).