difficult at present to explain this fact and to link it with differences in the course of the two forms of myopathy. It can only be suggested that the fundamentally different character of the changes in the myoid cells may affect in different ways the ability of the thymocytes to react with muscle tissue antigens, and in turn, this could evidently be one of the many factors responsible for differences in the pathological process in the two forms of muscular dystrophy.

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HEALING OF ACUTE GASTRIC BLEEDING POINTS COAGULATED BY LASER RADIATION

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KEY WORDS: acute ulcer; bleeding; lasers; productive inflammation; regeneration.

Lasers, used as a "light scalpel," are nowadays being employed on an ever-increasing scale during surgical operations [3, 4, 6-8]. The laser incision is characterized by the formation of a narrow layer of coagulation tissue necrosis along the line of section, which ensures complete hemostasis [5]. A peculiarity of the healing of laser wounds, as several workers have found [1-3], is the absence of leukocytic inflammatory infiltration in tissues bordering on those which have been injured. Galankin and Botsmanov [2], who have studied the healing of several organs resected by CO_2 laser beam, concluded that this phenomenon is linked with the character of tissue necrosis induced by the laser beam and is not tissue-specific.

Reports have also been published on the successful arresting of acute gastroduodenal hemorrhages through an endoscope by means of laser radiation without the need to perform an emergency operation at the height of bleeding [9-12]. This widens the opportunities for solution of the problem of arresting acute hemorrhages from the proximal part of the gastrointestinal tract.

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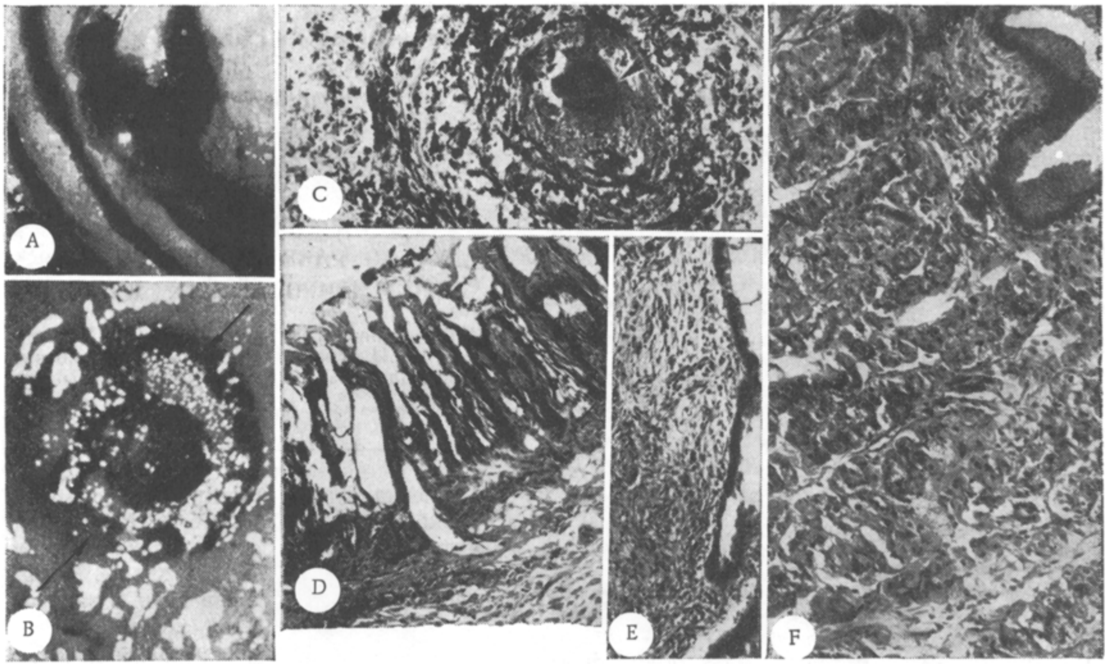

Fig. 1. Healing of gastric ulcers after laser hemostatis. A) Acute bleeding ulcer, endoscopy; B) coagulation hemostatic scab in region of floor of ulcer after photocoagulation of bleeding point by argon laser radiation. Characteristic halo of hyperemia (arrows) visible outside ulcer defect; C) laser coagulation thrombus; newly formed granulation tissue. 120 ×; D) bleeding ulcer coagulated by CO_2 laser radiation. Layer of coagulation necrosis is without leukocytic infiltration (3rd day after photocoagulation). 70 ×; E) epithelization of floor of ulcer on 7th day after photocoagulation by argon laser radiation. 120 ×; F) regenerated mucosa 6 months after photocoagulation by AYG laser radiation. Differentiation of cells of fundal glands into chief and parietal. 250 ×. Hematoxylin and eosin.

The object of this investigation was to study the mechanism of the hemostatic action of different types of continuous laser radiation and the particular features of healing of sources of acute gastric bleeding coagulated by laser radiation under experimental conditions.

EXPERIMENTAL METHOD

Stereotyped injuries to the mucosa and submucosa of the stomach 8.0 mm in diameter and 1.4 mm in depth, formed by a modified Wood's capsule for aspiration biopsy, were used as model of acute gastric bleeding (Fig. 1A). In 60 dogs under general anesthesia six bleeding ulcers were produced after gastrotomy and were coagulated by a focused laser beam. Two ulcers served as the control of spontaneous healing. Continuous radiation of a CO_2 laser (power 30 W, wavelength 10.6 μ), an argon laser (power 6 W, wavelength 0.488-0.514 μ), and a neodymium laser on ytttrium-aluminum garnet (YAG laser), with a power of 50 A (wavelength 1.06 μ, power density at the focus 4, 2.9, and 50 W/mm^2 respectively), was used. Complete hemostasis was produced by the CO_2 laser in 16.0 ± 1.2 sec, the argon laser (through an endoscope) in 24.8 ± 2.3 sec, and the AYG laser in 8.2 ± 0.6 sec. For histological investigation the animals were killed 0, 1, 3, 7, 14, 21, 30, and 45 days and 6 and 12 months after the experiment. Material was fixed in 10% neutral formalin solution and embedded in paraffin wax. Sections were prepared by a combination of histological, histochemical, and impregnation methods.

EXPERIMENTAL RESULTS

The principal mechanism of the hemostatic action of the lasers studied is thermal. As a result of transformation of the light energy of the radiation into heat and its absorption by the bleeding ulcers, a hemostatic scab quickly forms; the scab consists of fibrin, blood cells, and the tissues of the floor and walls of the coagulated ulcers, which undergo coagulation necrosis (Fig. 1B). Superficial coagulation of their contents and of the components of the vascular wall takes place in the lumen of the blood vessels that act as the source of bleeding, with the resulting formation of a thrombus of hyaline type, characteristic of laser coagulation, which occludes the "leaking" vessel and stops bleeding (Fig. 1C). The formation of coagulation necrosis is accompanied by instantaneous evaporation of inter- and intracellular fluid and by condensation and coagulation of tissues, fibrin, and blood cells. The width and structure of the necrotic layer differed following the action of different lasers. The coagulation scab was densest in the case of hemostatis produced by the CO_2 laser - its widths were 36.5 ± 13.9 µ. It was accompanied by superficial charring of the tissues. This leads to absorption of radiation energy by the scab and explains the superficial action of this laser.

Radiation of the argon and, to a greater degree, the AYG laser is not completely absorbed by the necrotic layer of coagulated tissues but is scattered in the deeper layers of the stomach wall, not only along the track of the beam, but also into surrounding tissues, leading to increased vascular permeability outside the zone of the ulcer, with the formation of a characteristic halo of hyperemia on the boundary with intact tissues (Fig. 1B). Because the spectrum of radiation from an argon laser is close to the absorption spectrum of hemoglobin, the maximum of the radiation is intensively absorbed by the blood in the region of the floor of ulcers, and this explains the formation of a necrotic layer 11.3 ± 1.4 µ in depth.

The greatest hemostatic effect was obtained with the AYG laser, by means of which arterial bleeding from vessels up to 1.5 mm in diameter could be quickly coagulated. Radiation from this laser is not completely absorbed by the coagulation scab, but spreads to the outer muscle layer of the stomach and led in 50% of cases to injury to that layer, observed on histological examination 1-3 days after photocoagulation. However, complete perforation required an exposure 7 times longer than the optimal for hemostasis. Nevertheless, it is evident that additional measures reducing the risk of perforation will have to be worked out.

A special feature of the healing of bleeding ulcers coagulated by laser radiation is the absence of demarcating leukocytic infiltration on the boundary of the necrotic layer with intact tissue (Fig. 1D) and activation of macrophages and fibroblasts. On the 3rd day the coagulation scab is shed, exposing the floor of the ulcers, consisting of definitive granulation tissue with many newly formed capillaries and proliferating connective tissue cells. After the 7th day a simple cubical tegumentary epithelium begins to "creep" from the margins of the ulcer (Fig. 1E) and by its invagination into the granulation tissue it forms depressions resembling gastric pits. After 2 weeks the ulcers have a primitive mucous membrane with a few short tubular undifferentiated mucoid glands. Recanalization of the coagulation laser thrombi begins during this same period, with restoration of the blood flow by the 21st-30th days. After 1 month regeneration of the muscular layer of the newly formed mucous membrane takes place in ulcers coagulated by radiation from argon and CO_2 lasers. Because of the injury to the structure of the outer muscle coat of the stomach by the AYG laser, this phenomenon is not observed, and a delicate reticular scar is formed within the submucosal and outer muscular layers. Complete restoration of the structure of the mucosa with differentiation of cells of the fundal glands into chief and parietal occurred 6-12 months after photocoagulation (Fig. 1F).

A characteristic feature distinguishing the healing of acute sources of gastric bleeding coagulated by various types of laser radiation is thus the development of productive aseptic inflammation with absence of leukocytic infiltration of the tissues affected by coagulation necrosis. This phenomenon is also observed during healing of laser wounds following operations on organs of the gastrointestinal tract and it is universal in character.

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CYTOLOGICAL ANALYSIS OF SYMPATHETIC NUERONS OF NORMALLY DEVELOPING AND PARTIALLY DESYMPATHIZED RATS AGED 1 AND 5 MONTHS

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When administered to animals for several days after birth guanethidine induces a marked decrease in the number of sympathetic nerve cells [5]. Depending on the program of its administration, desympathatization in the rats may be partial or virtually complete [2]. Since the physical development of partially desympathized animals is affected only a little, they are convenient objects with which to study the development of sympathetic neurons when the volume of innervated tissues is increased.

In the investigation described below neurons of the cranial cervical sympathetic ganglion of sexually immature and young mature rats were studied during normal development and after partial chemical desympathization by guanethidine at an early age.

EXPERIMENTAL METHOD

Desympathization was induced by subcutaneous injection of guanethidine (Izobarin, from Pliva, Zagreb, Yugoslavia) subcutaneously from the 1st through the 14th day after birth in a dose of 15 mg/kg daily. When the rats of the experimental and control groups had reached the age of 1 month (immature) or 5 months (young mature; Zapadnyuk's classification [3]), their cranial cervical sympathetic ganglia were incubated *in situ* for 30 min in a solution of ^{3}H-leucine (specific activity 40 Ci/mmole). The animals were killed 1 h after the end of incubation and the cranial cervical sympathetic ganglia were fixed in Carnoy's fluid and embedded in paraffin wax. Sections 7 μ thick were coated with type M nuclear emulsion, exposed for 1 month at 4°C, and stained with methylene blue. Autoradiographs were analyzed by counting grains of silver per unit area of cytoplasm of the nerve cells. The number of neurons with a well outlined nucleus was counted in every 5th section in serial sections through the cranial cervical sympathetic ganglion of the experimental and control animals. Summation of the values for all the 5th sections served as an index of the number of cells in the ganglion. The volume of the perikarya was determined by regarding them as approximately an ellipsoid of rotation, by the formula $V = (\pi/6)AB^2$ where A is the major and B the minor diameter of sections of the perikaryon containing the nucleus with nucleolus, measured by means of a screw ocular micrometer.

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