MORPHOLOGY AND PATHOMORPHOLOGY

Paneth Cells of the Eastern Gray Squirrel (*Sciurus carolinensis*) and Red-Cheeked Suslik (*Citellus erythrogenys* Brandt)

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It is shown that the structure of Paneth cells in duodenum of the eastern gray squirrel and red-cheeked suslik is similar to that in other mammals. Seasonal differences in Paneth cell structure are not found in squirrels, while in susliks they are marked.

Key Words: *squirrel; suslik; hibernation; duodenum; Paneth cells*

In spite of numerous data on Paneth cells, one of the most interesting populations of enterocytes of the small intestine, [7-11], some aspects of their functioning remain unclear. It is known that granules of these cells contain heavy metals, and digestive and lysosomal enzymes; the cells can phagocytize bacteria and release antibacterial factor [1].

Paneth cells in the eastern gray squirrel (*Sciurus carolinensis*) and red-cheeked suslik (*Citellus erythrogenys* Brandt) are the least studied.

Both species are representatives of the same family (*Sciuridae*); however, squirrels are active throughout the year while susliks hibernate through the winter (7-8 months), during which they do not eat because they do not store food.

The aim of the present study was to perform a comparative investigation of Paneth cell morphology in the duodenum from the eastern gray squirrel and red-cheeked suslik in different seasons.

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MATERIALS AND METHODS

Samples of duodenum from 9 the eastern gray squirrels inhabiting Minnesota and 10 red-cheeked susliks caught in the southern part of West Siberia were used for the study. Material obtained in different seasons was fixed in 3% glutaraldehyde on phosphate buffer, pH 7.4, postfixed in 1% osmium tetroxide, and, after dehydration embedded in a mixture of epoxy resins. Sections were prepared with a Tesla-BS 490A ultratome. Semithin sections were stained with methylene blue; ultrathin sections were contrasted with uranyl acetate and lead citrate. Examination and photography of sections were performed with a JEM-100C electron microscope.

RESULTS

Duodenal Paneth cells of the squirrel and suslik are located only at the bottom of crypts (Fig. 1). Paneth cells begin and end their life cycle within the crypt

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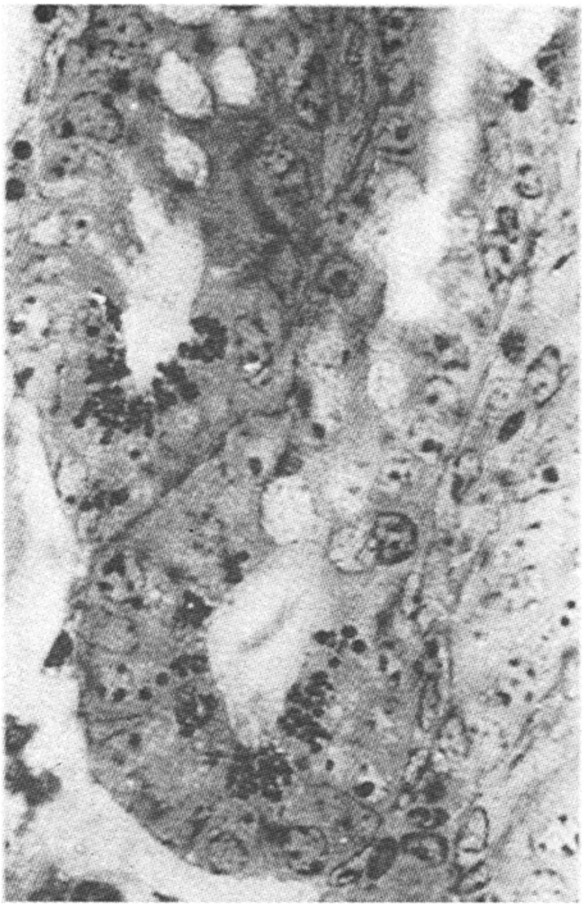

Fig. 1. Paneth cells at the bottom of duodenal crypts in the suslik. Semithin section, methylene blue staining. ×1250.

[3,5], and therefore young cells of small size occur side by side with differentiated cells at different stages of secretory cycle. Their base lies on the basal membrane, whereas the apical part with microvilli faced the intestinal lumen. The large nucleus is situated basally and has a round or oval shape with 1-2 nucleoli. The karyoplasm shows a fine granular structure; heterochromatin forms small marginal conglomerates of differing density.

The protein-synthesizing apparatus is well developed in Paneth cells. It is represented by a developed granular endoplasmic reticulum (GER), which is the form of long cisternae, widened in places, that are situated in the basal and lateral regions of the cells (Fig. 2, *a*). Individual GER elements are found above the nucleus among secretory granules. In some squirrel cells the GER forms ringlike structures.

The Golgi apparatus is located above the nucleus. The extent of its development is depended on the level of cellular secretory activity. In some cells it consists of flattened cisternae and accumulations of vesicles and forming granules, whereas in other cells, probably those more active in secretion, its elements are more widened. In longitudinal sections of Paneth cells as many as 5-6 groups of cisternae of the Golgi apparatus are found in susliks, while in squirrels this organelle is not so numerous. The region of the Golgi apparatus is the site of intensive granule production (Fig. 2, *b*), where secretory material collects as fine granules in the cisternae. An electron-transparent space of various size is seen between the membrane and the granular substance. As the granule grows and separates from the Golgi apparatus, the light submembrane zone thins out and disappears, whereas electron-dense material fills nearly the entire granule. In susliks some matured granules have a dense core surrounded by a lighter halo, in which case a few of them contain several such condensations. In squirrels the boundary membrane of matured secretory granules is thinned and usually closely adherent to the granular substance, while in susliks the membrane is twisted, may be interrupted, and may even be separate from its contents. The bulk of the granule is filled with uniformly electron-dense material, while in squirrels there are granules with light eccentric zones where destructive changes may be evident (Fig. 3, *a*). The size of matured secretory granules situated in the supranuclear zone of the cell varies from 0.43 μ to 3.14 μ. The electron-dense material of the granule is of glycoprotein nature [4,10]. The number of granules in Paneth cells is known to depend on specific features of the diet and may be related to developing pathological processes, a zinc deficiency, for example [3,6]. The granular contents are released by exocytosis.

Mitochondria of different size, oval or elongate, are evenly distributed through the whole cytoplasm. A centriole was not found in this cells. Sometimes small polymorphous heterogeneous lysosomes, multivesicular bodies, and myelin figures are found in the Golgi apparatus zone (Fig. 3, *a*).

Seasonal variations in Paneth cell structure were not found in the squirrels, whereas in the hibernating suslik pronounced seasonal changes were revealed in these cells [2]. In the cytoplasm of Paneth cells in hibernating susliks the density of free ribosomes increases, the number of polysomes decreases, and the GER is fragmented, its channels markedly narrowed in some cells and widened in others. The Golgi apparatus is represented by a group of very expanded (sometimes even round) cisternae of various size (Fig. 3, *b*). Maturing granules are rare, and mature granules are less abundant than in summer and sometimes appear more electron-transparent. The number of lysosomes increases and some of them are large. Destructively altered mitochondria are commonly found.

From this study it may be concluded that specific features of the ecology of these animals are

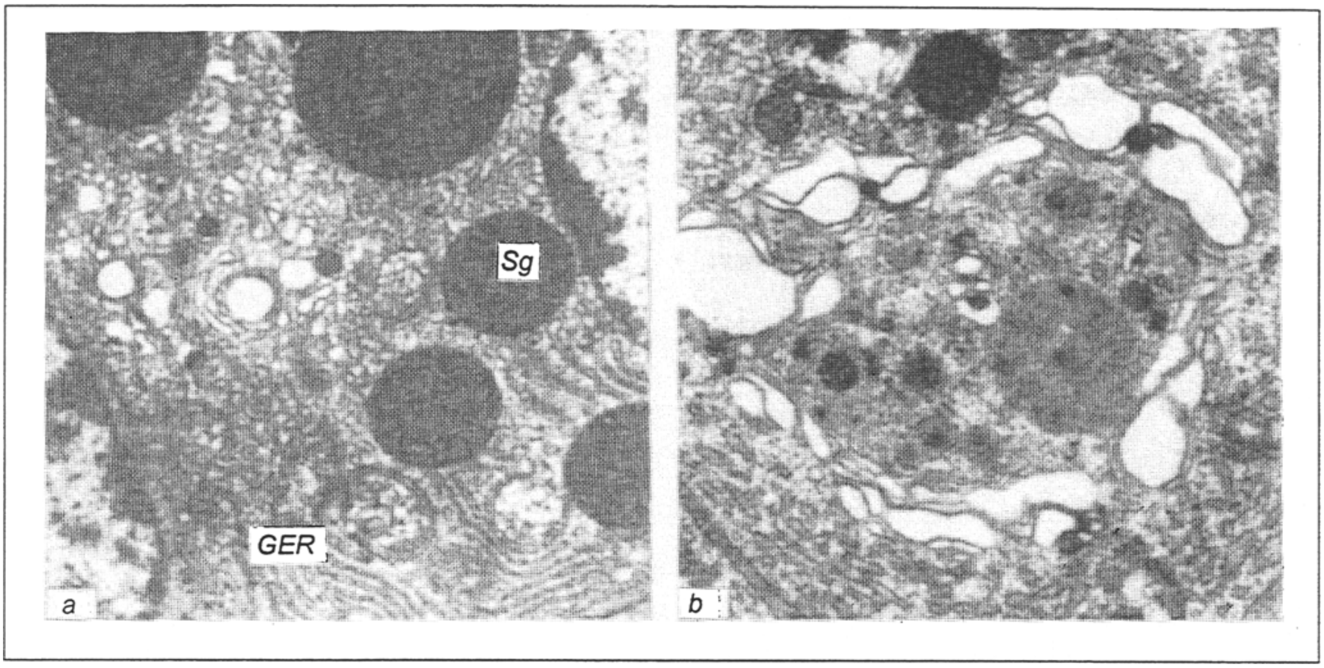

Fig. 2. Fragments of Paneth cells of *S. carolinensis* (*a*) and *C. erythrogenys* (*b*); the Golgi apparatus is situated in the supranuclear zone in the cross section of the cell. *Sg* - secretory granules; *GER* - granular endoplasmic reticulum. Magnification: *a*) 7200; *b*) 10,000.

reflected not only in behavior and function of organs and systems, but also in all levels of their organization, including the structure of cellular elements such as Paneth cells.

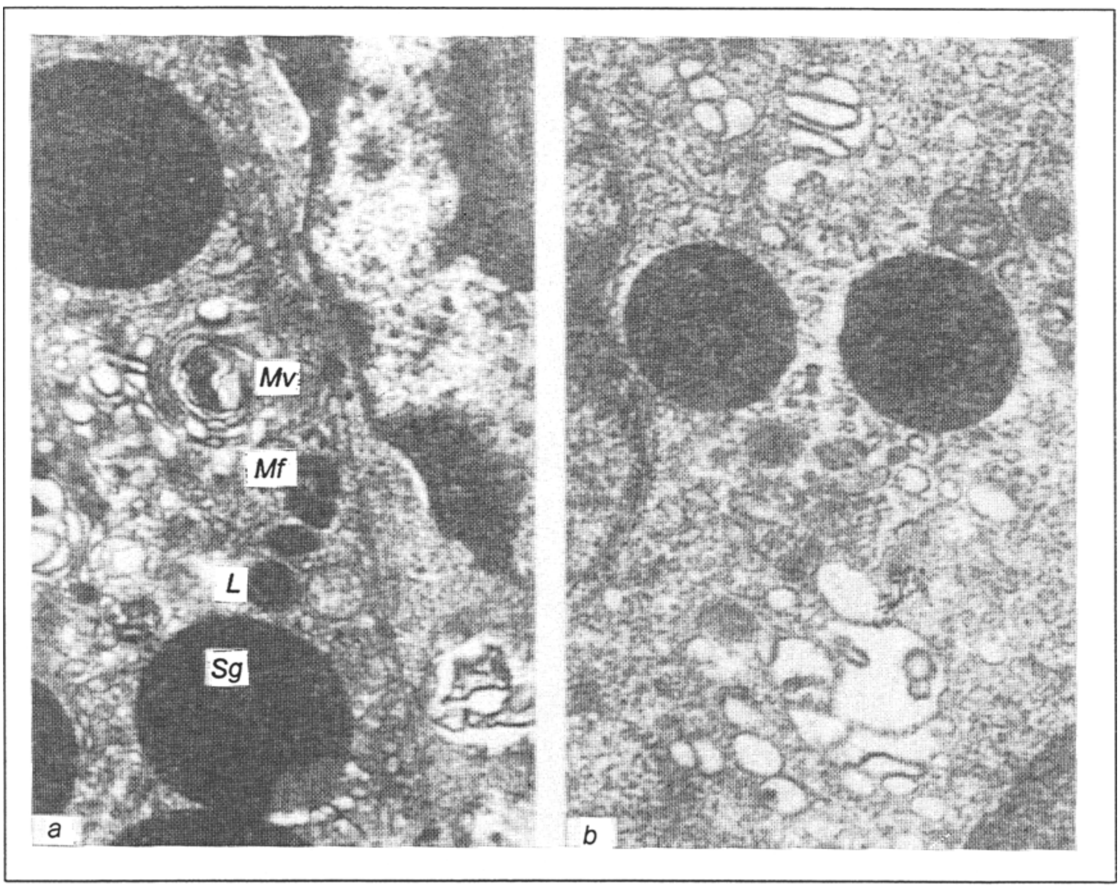

Fig. 3. Fragments of Paneth cells of *S. carolinensis* (*a*): biphase secretory granule with the light zone partially destroyed and a myelin figure. *Mv* - multivesicular body; *Mf* - microfilaments; *L* - lysosome, *Sg* - secretory granules. ×10,000; *b*) Golgi apparatus with expanded cisternae in hibernating *C. erythrogenys*. ×11,000.

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Alterations in Peritoneum Exposed to High-Energy Laser Radiation

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The effect of carbon dioxide (CO_2) and Nd-YAG high-energy lasers on the formation of peritoneal adhesions was studied using light, scanning, and transmission electron microscopy in albino rats. Both types of lasers initiate the development of peritoneal adhesions similar in structure. The intensity of adhesion formation is markedly lower in the case of Nd-YAG laser as compared to the action of CO_2 laser of the same power.

Key Words: *peritoneum; high-energy laser; adhesions*

Laser scalpels based on high-energy radiation sources rank among the finest surgical tools. They offer advantages over the usual scalpels due to their hemostatic, aseptic, and other properties, and hence have made it possible to improve or even change the techniques of surgical treatment [2,5,7,8,10,11].

Morphological studies of reparative processes in parenchymatous organs after laser treatment have showen that healing of the incisions made by these instruments occurs more rapidly and with fewer complications, such as suppuration, tearing of sutures, etc. [1,3]. However, such complications as the formation of adhesions and the development of so-called adhesion disease [4,6,10,12] have not discouraged the use of laser scalpels in abdominal surgery. Initiation of adhesion development may above all occur due to alteration of the serous membranes, particularly destruction of mesothelium integrity. However, the changes occurring in serous membranes and especially their mesothelial lining exposed to high-energy lasers have not been studied.

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The goal of the present investigation was to study the alterations of serous membranes from different intestinal regions following the use of CO_2 and Nd-YAG lasers.

MATERIALS AND METHODS

Albino rats under Nembutal anesthesia were subjected to median laparotomy and superficial laser wounds were inflicted on intestinal loops and parietal peritoneum. The animals were sacrificed 3, 7, and 14 day after the operation. Pieces of peritoneum from the adhesion region were examined morphologically with light, transmission (TEM), and scanning (SEM) electron microscopy.

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