

ULTRASTRUCTURAL CHANGES IN THE PARIETAL CELLS OF PATIENTS WITH GASTRIC ULCER

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Ultrastructural changes in the parietal cells of the fundal glands were studied by analysis of the phases of secretion after injection of histamine in patients with gastric and duodenal ulcer and with different levels of acidity of the gastric juice. In patients with normal and increased acidity of the gastric juice structural changes reflecting increased functional activity of the cells were discovered in the parietal cells after injection of histamine, although the phasic character of the secretory process still remained. In patients with reduced acidity the phases of the secretory process were illdefined and no ultrastructural changes indicating increased functional activity of the parietal cells could be detected.

KEY WORDS: parietal cells; stimulation by histamine; phasic character of gastric secretion; functional activity

Definite changes in the intracellular structures connected with the phases of their function are observed in the parietal cells of the stomach [2, 3, 5, 6]. In patients with peptic ulcer and increased acidity of the gastric juice the phasic character of the secretory process is sharply defined and intensified, whereas if acidity is reduced there are no sharp differences between the individual phases [1, 4].

It was decided to study whether the increased (hyperchlorhydria) or, conversely, reduced (hypochlorhydria) function of the parietal cells is associated with any particular features of their activity or whether it is determined by common regulatory mechanisms independent of the function of the cell itself. To study this problem, parietal cells from the gastric mucosa were investigated in the different phases of secretion after preliminary histamine stimulation in patients with peptic ulcer with hyper-, normo-, and achlorhydria of the gastric juice.

EXPERIMENTAL METHOD

Six patients with gastric and duodenal ulcer under observation in the surgical clinic (Head, Professor S. M. Agzamkhodzhaev) of Tashkent Medical Institute, were chosen for investigation. Acidity of the gastric juice was normal in 2 patients, increased in 2 patients, and reduced in the other 2 patients.

Biopsy of the gastric fundus was carried out with the Olympus fibergastroscope 30 min after injection of histamine in a dose of 20-24 mg/kg, i.e., in the dose in which it is used to obtain maximal stimulation of the gastric glands. The material was examined with the electron microscope.

EXPERIMENTAL RESULTS

In patients with normal acidity of the gastric juice some degree of synchronization of function of the parietal cells was observed after injection of histamine. This was particularly true of the cells of the same gland. Many of the parietal cells were in the phase of accumulation and discharge of the secretory material, and only a few were in other phases of the secretory cycle. This fact can evidently be explained on the grounds that at the time of injection of histamine the cells were in different secretory phases, and they were therefore not stimulated to the same degree. Cells which differed only slightly in the phase of their secretion formation began to function synchronously under the influence of histamine.

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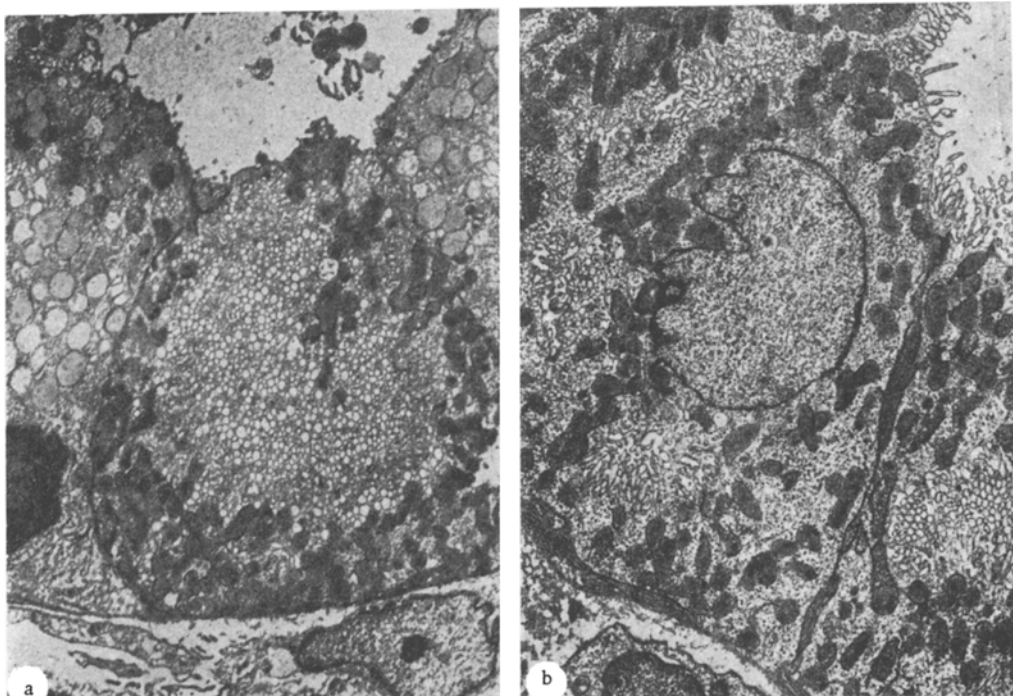


Fig. 1. Parietal cells of patients with peptic ulcer and normal state of gastric secretion after injection of histamine. a) Stage of accumulation of secretory products (6000 \times); b) stage of discharge of secretion (6000 \times).

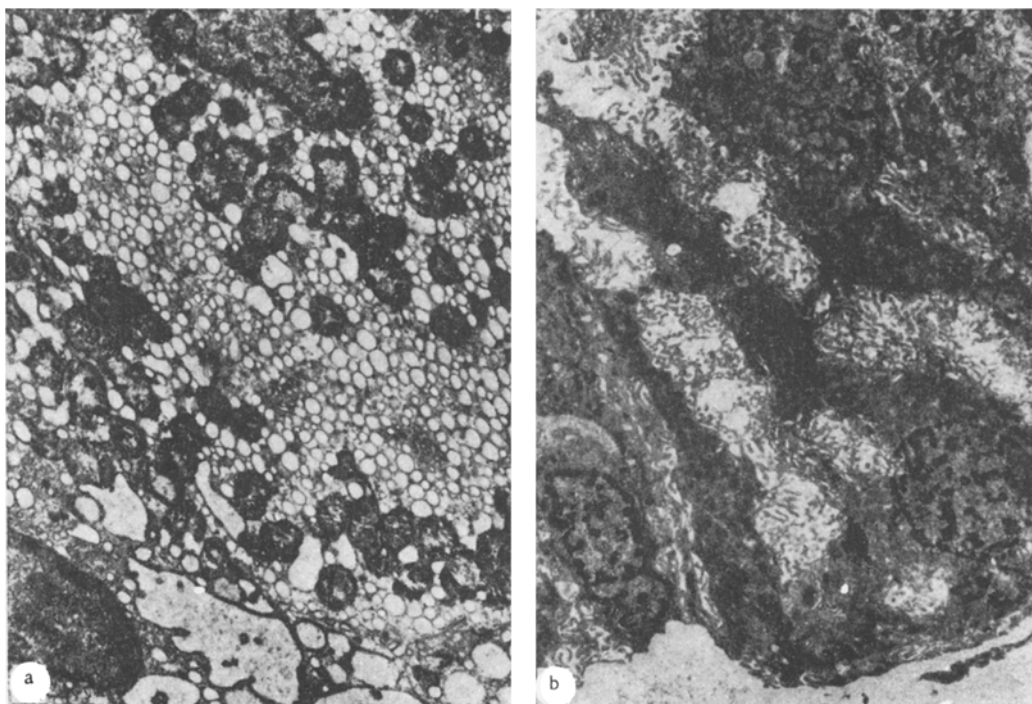


Fig. 2. Parietal cells of peptic ulcer patients with hyperacidity of gastric secretion after injection of histamine. a) Stage of accumulation of secretory products (10,000 \times); b) stage of discharge of secretion.

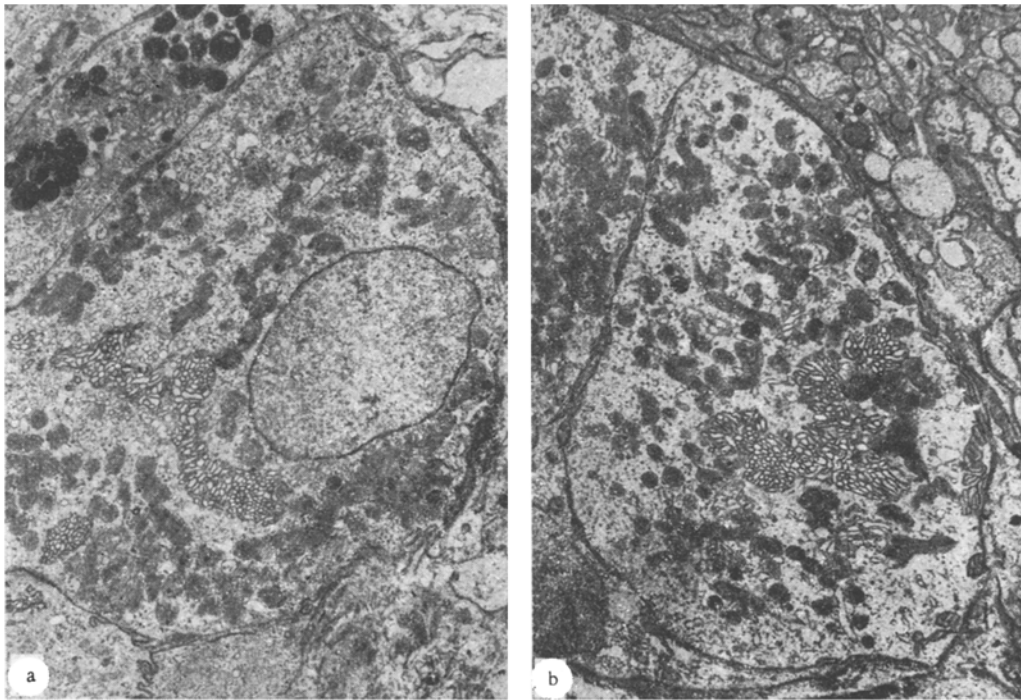


Fig. 3. Parietal cells of peptic ulcer patients with hypoacidity of gastric secretion after injection of histamine. a) Stage of accumulation of secretory products (7000 \times); b) stage of discharge of secretion (6000 \times).

In patients with normal acidity of the gastric juice, after injection of histamine in the phase of accumulation of secretion in the cytoplasm of the parietal cells the number of vesicular structures was greatly increased, they were concentrated around the intracellular secretory tubule (Fig. 1a), but the lumen of the tubule remained collapsed and no microvilli could be detected. This is evidence that discharge of the secretory products had not yet begun at that moment. These cells contained many mitochondria, which had a tendency to become localized in the region of the intracellular tubule.

In the next phase, the phase of discharge of the secretory material, a sharp increase was observed in the lumen of the intracellular secretory tubules, and many microvilli appeared in them. Parallel with this change, the number of vesicular structures in the cytoplasm and around the tubules decreased (Fig. 1b). The mitochondria were very close to the intracellular tubules.

The pattern of intracellular organization (quantitative and qualitative changes in the specialized structures) associated with the phasic character of function of the parietal cells in the patients with a normal acidity of their gastric secretion after histamine stimulation thus very closely resembled that in the hyperacid state without stimulation.

In patients with hyperacidity the ultrastructure of the parietal cells in each phase of the secretory cycle changed considerably after injection of histamine. In the phase of accumulation of secretion there were so many vesicles in the cells that nearly all the cytoplasm was filled with them (Fig. 2a). This points to a very high level of functional activity of the cells. In the phase of discharge of the secretion, many vesicles were discharged at the same time, so that the lumen of the intracellular secretory tubule increased sharply in size and many microvilli were formed. The intracellular tubules occupied a considerable part of the cytoplasm of the cells and very often they opened directly into the lumen of the gland (Fig. 2b). In the cells with increased function vesicles also discharged through the apical plasma membrane, bypassing the intracellular tubules.

A different pattern was observed in the parietal cells of patients with achlorhydria after histamine stimulation. The cells contained very few organoids and the cells themselves were small. Individual phases of the secretory cycle were difficult to distinguish, and even in the stage of maximal accumulation of secretion a few vesicles and collapsed intracellular tubules could be seen (Fig. 3a). Occasionally cells were found with somewhat dilated intracellular tubules, but most frequently, even in the stage of discharge of secretion, they were collapsed and filled with short, thick microvilli (Fig. 3b). Single vesicles were seen around the tubules, some

of them emptied, yet the lumen of the tubule in such cases was not enlarged. This was evidently because the secretory product accumulating from the single emptied vesicles had left the cell via the system of tubules. Consequently, no appreciable ultrastructural changes reflecting an increase in their functional activity could be found in the parietal cells of patients with hypochlorhydria.

The results of this investigation thus show that in normo- and hyperchlorhydria after injection of histamine the phasic character of the secretory process is preserved and the level of functional activity of the parietal cells is raised. In patients with hypochlorhydria the phasic character of the secretory process remained indistinct and no ultrastructural changes indicating an increase in the functional activity of these cells can be observed.

LITERATURE CITED

1. K. A. Zufarov, V. V. Vaisbrot, and K. Khashitov, *Med. Zh. Uzbekistana*, No. 1, 58 (1973).
2. E. A. Zufarov, "Cellular mechanisms of adaptive processes in the stomach and intestine of patients with peptic ulcer before and after resection of the stomach," Public Oration, Tashkent (1974).
3. R. Kh. Niyazova, "Comparative characteristics of the gastric glands of certain vertebrates and ultrastructural features of the secretory process of the gastric glands," Author's Abstract of Candidate's Dissertation, Tashkent (1975).
4. K. I. Rasulev, G. A. Lomonosova, et al., Abstracts of Proceedings of the 10th All-Union Conference on Electron Microscopy [in Russian], Vol. 2, Moscow (1976), pp. 229-231.
5. H. F. Helander, *Gastroenterology*, 56, 35 (1969).
6. N. Ohbayashi, *Jpn. Arch. Int. Med.*, 17, 159 (1970).