

INFLUENCE OF THE PROPERTIES OF THE CHYME  
ON THE SECRETORY AND MOTOR FUNCTION  
OF THE ALIMENTARY TRACT

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Our previous investigations of the secretory and motor-evacuatory activity of the gastro-intestinal tract after extensive resection of the proximal portion of the small intestine [3, 12] showed that important factors in adaptation to the new conditions of digestion are an increase in the intensity of gastric secretion and a slowing of the evacuation of food from the stomach.

The neuro-humoral connections between the individual parts of the digestive system, and especially between the various portions of the intestine and the stomach, are known to be of great importance to the activity of the system as a whole. Changes in the secretory and motor functions of the stomach as a result of mechanical and chemical stimulation of the intestine have been reported by several investigators [1, 2, 4-10, 13-15].

The object of the present investigation was to study the effects of afferent impulses from various portions of the small intestine on the gastric secretion and motor activity, during the action of chyme of different qualities and products of digestion of food on these portions of bowel.

#### EXPERIMENTAL METHOD

Investigations were carried out on 2 dogs with a Basow gastric fistula and fistulas of the middle portion of the jejunum and the terminal portion of the ileum (50 cm proximal to the ileocolic valve).

The method of study of the gastric secretion has been fully described earlier [12]. The normal level of secretion was established in response to sham feeding with meat for 2 min. Samples of gastric juice were taken every 15 min into a flask placed in melting ice, in which they were kept until the time of determination. The free and total acidity of the gastric juice was determined by a titration method, and the pepsin content by Hunt's colorimetric method [11], modified by one of the authors. The total secretion of free hydrochloric acid in milligrams was calculated by multiplying the content of free acid in 1 ml of gastric juice by the volume of juice obtained during the experiment [16]. The total amount of pepsin secreted was determined in a similar way.

After establishment of the background pattern of gastric secretion in response to sham feeding with meat, the effect of introduction of certain products of protein hydrolysis into the middle portion of the jejunum and the terminal portion of the ileum on the process of secretion was investigated. For this purpose, immediately after sham feeding 20 ml of 5% peptone solution, chyme from the jejunum or ileum (10 ml) obtained immediately before the experiment, or "artificial chyme" (10 ml), consisting of the products of enzymic hydrolysis of meat proteins with gastric juice or with gastric and pancreatic juices in succession, was injected slowly (over a period of 5 min) through the intestinal fistula.

The "artificial chyme" was prepared as follows. On the day before the experiment 50 ml of gastric juice obtained from a certain dog (the "donor") was added to 25 g of minced meat, and the mixture was incubated at 38° for

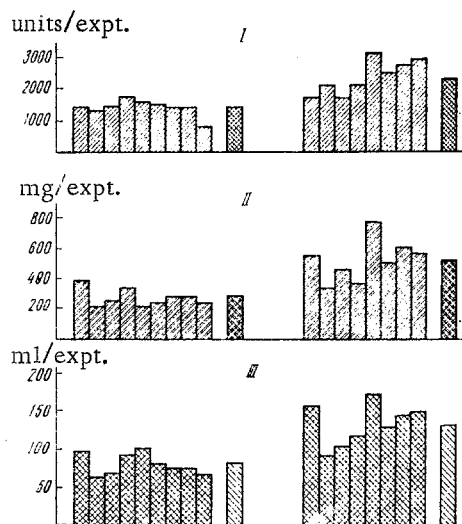


Fig. 1. Secretion of gastric juice (III), or free hydrochloric acid (II) and of pepsin (I) in response to sham feeding with meat followed by injection of 20 ml of 5% peptone solution through an intestinal fistula into the dog Lata, with a fistula of the stomach and of the terminal portion of the ileum. On the left—control experiments with sham feeding, on the right—experiments in which peptone was subsequently injected. The individual columns in the right half of each diagram represent mean values.

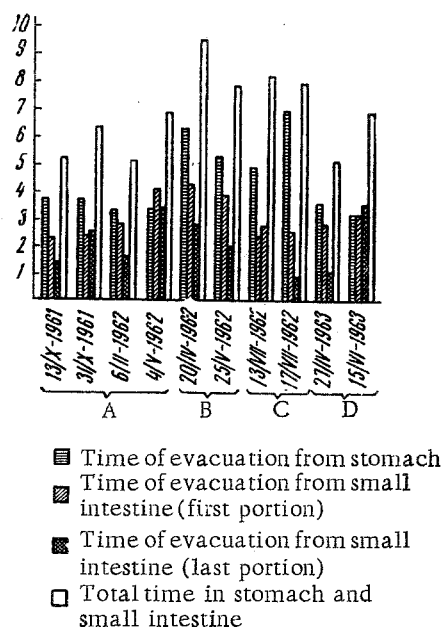


Fig. 2. Evacuatory function of the stomach and small intestine of the dog Lata in control experiments (A) and after injection of peptone 6 times (B), "artificial chyme" 5-6 times (C), and chyme obtained from the ileocecal region (D) through the fistula into the ileocecal region. Food stimulus—milk.

2 h. To prepare products of meat protein hydrolysis by gastric and pancreatic juices in succession, after incubation of the meat with gastric juice, to 50 ml of mixture was added the same or twice the volume of pancreatic juice, and the whole was incubated for a further 2 h. The incubated material was filtered and kept in the cold. Before being introduced into the intestine the solution was warmed on a water bath to 37°; the pH of the artificial chyme after hydrolysis with gastric and pancreatic juices was about 6-7.

The motor function was investigated by a roentgenological method. As food stimuli the dogs received milk (150 ml) or minced meat (100 g) mixed with 50 g barium sulfate. After administration of the food stimulus, 5% peptone solution or products of protein hydrolysis (10-20 ml) was injected through the intestinal fistula once or 5-6 times during the experiment.

## EXPERIMENTAL RESULTS

Injection of peptone and products of protein hydrolysis into the middle portion of the jejunum and the terminal ileum caused various changes from the background pattern of gastric secretion as determined in response to sham feeding with meat. In the dog Lata, injection of peptone into the terminal ileum caused a large increase in gastric secretion. The secretion of free hydrochloric acid and pepsin also showed a marked increase (Fig. 1). Injection (unknown to the dog) of 20 ml of 5% peptone solution into the intestinal fistula without preliminary sham feeding did not cause secretion of gastric juice; the pH of the gastric mucous membrane did not fall below 5 during the 4-5 h of the experiment.

Investigation of the motor-evacuatory function of the stomach in the dog Lata gave the following result: 1) injection of peptone into the terminal ileum caused a delay in the beginning of evacuation from the stomach; 2) repeated injection of peptone or "artificial chyme" caused a delay in complete evacuation from the stomach, whereas a single injection had no effect on the duration of evacuation of the contrast material from the stomach; 3) injection (for control purposes) of the same volume of chyme obtained from the terminal ileum of the same dog, whether

Volume of Gastric Secretion, and Secretion of Free Hydrochloric Acid and Pepsin in Response to Sham Feeding with Meat for 2 min Followed by Injection of Peptone Solution or Natural or "Artificial Chyme" through the Intestinal Fistula into the Dog Lata, with Fistulas of the Stomach and Terminal Ileum (mean experimental results)

Type of stimulus of gastric secretion	Vol. of gastric juice secreted (in ml/expt.)	Secretion of free hydrochloric acid (in mg/expt.)	Secretion of pepsin (in units/expt.)
Sham feeding	80	281	2890
Sham feeding followed by injection of peptone solution into intestinal fistula	133	534	4639
Sham feeding followed by injection of chyme from jejunum of "donor" dog into intestinal fistula	134	654	4838
Sham feeding followed by injection of products of hydrolysis of meat proteins with gastric juice into intestinal fistula	157	664	6421
Sham feeding followed by injection of products of hydrolysis of meat proteins with gastric and pancreatic juices into intestinal fistula	103	487	4666

only once or several times during the experiment, did not cause delay in evacuation from the stomach (Fig. 2). After injection of peptone solution into the ileocecal region an increase was also observed in the time taken for the "first" food portions to pass along the small intestine, i.e., in the time from the beginning of evacuation from the stomach to the beginning of the passage of food into the large intestine (Fig. 2).

In the dog Pestryanka, injection of peptone or "artificial chyme" into the fistula of the middle portion of the jejunum caused no significant increase in gastric secretion, or in the secretion of hydrochloric acid and pepsin, and no change in the motor-evacuatory function of the stomach.

The degree of hydrolysis of the proteins acting on the receptors of the terminal ileum had a definite effect on the gastric secretion and the duration of evacuation from the stomach, causing a reflex increase in the secretion of gastric juice, hydrochloric acid, and pepsin, and delaying the evacuation of food from the stomach. The increase in gastric secretion and the delay in evacuation from the stomach were, to some extent, inversely proportional to the degree of chymic digestion of the proteins. In other words, the lower the degree of digestion of the proteins, the greater the reflex increase in gastric secretion and delay in evacuation from the stomach which it caused. Data illustrating the stimulant action of products of protein hydrolysis on the interoceptors of the terminal ileum, and hence, on gastric secretion, are shown in the table, while the delaying action on evacuation of the stomach may be seen in Fig. 2.

It may be concluded from these investigations that the chemoreceptors of the mucous membrane of the terminal portion of the small intestine possess differential sensitivity in relation to the composition and properties of the chyme reaching this part of the intestine. The increase in gastric secretion and delay in evacuation of the stomach are dependent on the degree of digestion of the food substances.

It may be postulated that after extensive resection of the proximal portion of the small intestine, an increase in gastric secretion and delay in emptying of the stomach may take place as a result of stimulation of the terminal ileum with products of protein hydrolysis, for such products reach the terminal ileum relatively quickly after resection of a considerable segment of the small intestine.

#### SUMMARY

Experiments were carried out on 2 dogs with fistulae of the stomach and small intestine. A study was made of the effect produced by the administration of the products of protein hydrolysis, chyme, and peptone into the middle and terminal portion of the small intestine on the gastric secretion and the motor-evacuatory function of the stomach and the small intestine.

It was shown experimentally that administration of peptone, as well as of meat protein hydrolyzed by the gastric and pancreatic juices, into the end portion of the small intestine distinctly intensified the secretion of gastric juice, free hydrochloric acid, and pepsin and also delayed the evacuation of the stomach.

The experimental results show that mucosal chemoceptors in the terminal portion of the small intestine show differential sensitivity to the composition and properties of the chyme supplied to this portion of the intestine.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.

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