

# THE MOTOR FUNCTION OF THE INTESTINE WHEN THE STOMACH IS EMPTY

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The first attempt to demonstrate various types of digestive tract activity and to relate their origin to the influence of prolonged dietary regimens was made in I. P. Pavlov's laboratories [11].

V. N. Boldyrev [2] was the first to discover that, when not engaged in digestion, the periodic activity of the stomach could be lastingly replaced by continuous activity. I. A. Edel'man [12] distinguished two types of movement of the empty stomach: periodic and "acidic." The final concept of the types of motor activity of the fasting stomach was given by S. V. Anichkov [1] who described periodic contractions (type A), strong continuous "acidic" contractions (type B), and weak continuous contractions with increased gastric tone (type C).

It was later shown [1, 7, 13] that type A was characteristic for adult dogs, while continuous "acidic" contractions of the stomach were observed predominantly in pups and young monkeys.

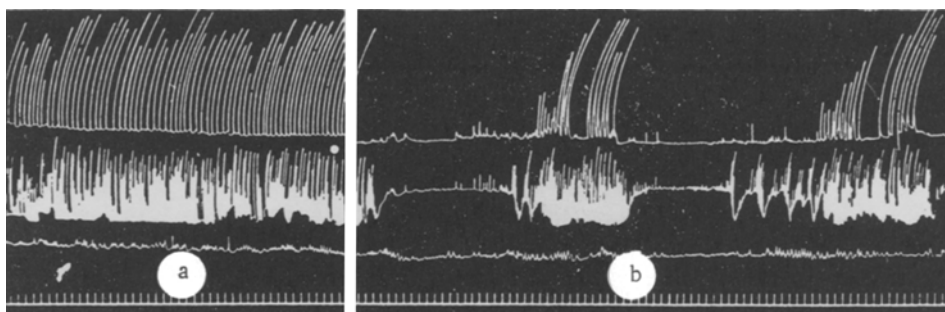


Fig. 1. Continuous and periodic motor activity of the digestive tract when not engaged in digestion (dog Mal'chik).

a) Continuous activity; third type of motor function of the duodenum; b) periodic activity; first type of motor function of the duodenum.

Records from above down: gastric motor activity; duodenal motor activity; sigmoid motor activity; time marker (3 minutes 20 seconds).

Various types of periodic and continuous intestinal activity, in particular duodenal, have also been described [4, 10, 3, 6, 8].

A number of authors explain the absence of periodic motor activity of the duodenum by the mechanical effect of the balloon introduced into its lumen. At the same time periodic motor activity can be clearly observed by on-cographic means on an intestinal loop externalized under the skin [5]. Since it is reasonable to assume that the various types of motor activity pertaining to the stomach when not engaged in digestion must to some extent reflect the state of the whole digestive system, we supposed that the upper portion of the small intestine would probably also reflect various functional states of its motor activity. The present work was undertaken to test this hypothesis.



Fig. 2. Periodic motor activity of the stomach and intestine. Second type of duodenal motor activity (dog Butuz).  
Records from above down: gastric motor activity; duodenal motor activity; time marker (3 minutes 20 seconds).

## EXPERIMENTAL METHOD

Experiments were carried out on four dogs with gastric and duodenal fistulas. The experiments were performed 18-20 hours after a meal. In order to check the effect of qualitatively different diet on the motor function of the intestine, the dogs were sometimes kept on a predominantly milk diet, sometimes on a meat diet. The duration of the experiments was from 5 to 24 hours. The intestinal movements were recorded by the Boldyrev method on a kymograph with a slowly rotating drum. The volume of the balloon used for recording the duodenal contractions was in all cases the same (8-10 cm<sup>3</sup>). The motor activity of the stomach and the duodenum was recorded simultaneously. A total of 55 experiments was performed, 15 of these covering a period of 24 hours each.

## EXPERIMENTAL RESULTS

When the stomach and the upper part of the small intestine were free of food, three main types of motor activity could be noted in the duodenum and the upper portion of the intestine.

The first type, is definite periodic activity, and is characterized by an almost complete absence of duodenal contraction during the "resting period". The periods of contraction are considerably shorter than the corresponding resting periods of the stomach and continue for an average of 30-40 minutes. 10-30 minutes prior to the beginning of gastric activity fluctuations in intestinal tone and intestinal contractions usually appear. The frequency of intestinal contractions is 14-18 per minute. The wave-like movements occur in 1-3 minute periods, at first infrequent, then merging together. They constitute the period of duodenal "activity"; its duration is 50-80 minutes. As a rule, the intestinal contractions end 5-10 minutes later than the gastric activity. The intestinal tone is somewhat raised during the contractions, but in a number of experiments diminution of tone was noted (Fig. 1, b). It is this particular type of periodic motor activity of the duodenum which has been described in the literature [9, 10]. We observed it only in one of the four experimental dogs. It is accompanied by strictly periodic secretions by the pancreas and intestine and output of bile during the motor activity of the duodenum [9].

The second type of periodic motor activity of the duodenum, which may be called intermediate, is expressed mainly in prolonged changes of tone.

Throughout the experiment, the duodenum contracts continuously at a rate of 12-16 contractions per minute. The contractions are grouped together (in lots of 15-30) into waves with a periodicity of 1-3 minutes, which follow one another continuously. During each such wave there is first an increase in tone and some enhancement of contraction, then diminution of tone and weakening of contractions. Gradual increase of intestinal tone and marked enhancement of contraction correspond to each period of gastric activity. However, in some experiments, no change in the strength of intestinal contraction was noted. The lowest intestinal tone and the weakest contractions are observed 10-30 minutes after termination of gastric activity. On the contrary, when the stomach is undergoing periodic contractions the intestinal tone is at its highest. It must be stressed that despite the continuous character of contraction of this type, the secretion of pancreatic juice, intestinal juice and bile occur strictly periodically. Secretion of the juice by the duodenum begins before the start of periodic gastric contractions and ends a few minutes after the latter's termination. Evidently there is an interconnection between the periodic secretion of duodenal juice, periodic gastric contractions and periodic increases in duodenal tone, which is demonstrable in the presence of continuous movements of the duodenum. The second type of duodenal contraction corresponds to that described earlier [3]. We observed it in three of our experimental dogs (Fig. 2).

The third type of duodenal motor activity is expressed by continuous contractions of great force over a period of 6-10 hours without consistent fluctuations in tone. The rhythm of these contractions is slower (4-8 per minute) than that observed during periodic activity of the duodenum (Fig. 1, a). The duodenal contractions are accompanied by continuous contractions of the stomach, copious secretion of gastric juice, and very weak but prolonged secretion by the duodenum.

The first and second types of duodenal motor activity are evidently a consequence of individual peculiarities of different animals, since over a period of many months we hardly observed replacement of one type by the other. The duration of the experiments was without significance in this respect; nor did prolonged uniform diet or change of dietary regimen lead to a change in the type of activity.

The third type of activity was observed in all the four dogs and replaced the first or second types. Evidently, it depends not on the individual peculiarities of the animal, but on the functional state of the digestive tract. This is supported by the presence of transition from periodic duodenal contractions to continuous ones in the course of

the same experiment. Such transitions could be observed only in experiments lasting 24 hours; there was no strict correlation with the time of day, although continuous contractions were more often observed during the night and in the morning.

It seems to us that our material indicates caution with regard to erroneous conclusions concerning the existence of only periodic or continuous motor activity of the duodenum. The recording method used by us and other authors permits the demonstration of both types of duodenal motor activity. The first and third types of activity are clearly defined, but the second type is more blurred. We refer it to periodic activity only provisionally.

In favor of delineating this type as a special form of periodic duodenal activity is the presence of accompanying manifestations which are associated with continuous motor activity of the duodenum: continuous gastric contractions, continuous secretion of acid gastric juice, weak and continuous secretion by the duodenum.

Our experiments thus confirm the close functional interconnection which exists between gastric and duodenal activity when not engaged in digestion.

#### SUMMARY

Three types of motor function of duodenum were revealed in chronic experiments on 4 dogs with gastric and duodenal fistulas. The first two types pertain to periodic function, while the third is a continuous intestinal motor function. In prolonged experiments the periodic duodenal motor function of the first and second type is changed into continuous contraction of the third type, which demonstrates the changes in the functional condition of the digestive tract. The first two types of motor function reflect the individual peculiarities of the digestive tract of various animals since one is not changed into another. An interrelationship was established between different forms of gastric and duodenal motor functions.

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