

## METHODS

### MULTICHANNEL RECORDING OF HUMAN GASTRIC ELECTRICAL ACTIVITY FROM THE BODY SURFACE

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A method of simultaneous multichannel derivation and recording of gastric potentials from the surface of the anterior abdominal wall is described. By multichannel electrogastrography electrical activity can be recorded selectively in different parts of the stomach from the surface of the anterior abdominal wall. Spatiotemporal and correlation analysis of electrical activity of various parts of the stomach was carried out during digestion.

KEY WORDS: gastric electrical activity; dynamics of peristalsis; correlation analysis.

Single-channel electrogastrography, suggested by one of the writers [13, 14], has become widely adopted in experimental and clinical physiological investigations [1, 3-5, 7, 8, 10-12, 16]. Multichannel simultaneous derivation of potentials from the surface of the anterior abdominal wall would appear to provide the means for toposcopic analysis of the activity of the motor apparatus of the various parts of the stomach.

This paper describes an investigation of this problem.

#### EXPERIMENTAL METHOD

Before the recording of gastric potentials began the subject took a standard test breakfast (150 g bread and 200 ml tea). To amplify and record the gastric potentials the writers used an 8-channel electrogastrograph with symmetrical high-ohmic amplifier inputs, galvanic circuit dividing, and 0.02-, 0.05-, and 0.08-Hz filters. The gastric potentials were recorded as a rule with 0.05-Hz filters [9]. Gastric potentials were recorded by a monopolar technique from all points of the surface of the anterior abdominal wall. Active electrodes were applied to the anterior abdominal wall in the projection of the cardia, fundus, body, and also the antral and pyloric parts of the stomach. The reference electrode was fixed to the lower third of the right leg. The projection of the stomach on the anterior abdominal wall was determined by screening on a trochoscope with the subject in the horizontal position. To determine the mean amplitudes of the gastric potentials the MN-10M analog computer was used. Correlation analysis of gastric electrical activity was carried out with the BÉSM-6 computer. The operation time was 10 min and the minimal time shift between the processes to be correlated was 2 sec.

#### EXPERIMENTAL RESULTS AND DISCUSSION

Altogether 205 tests were carried out on 20 clinically healthy persons aged 20-27 years. The frequency of the potentials recorded from the projection of the pyloro-antral portion was  $3.0 \pm 0.1/\text{min}$ , and that from the body, cardia, and fundus  $2.9 \pm 0.2/\text{min}$ . Correlation functions of potentials from the outlet portion of the stomach differed from those of the other regions by their greater regularity and stability and by their smaller decrement during the operation time (Fig. 1).

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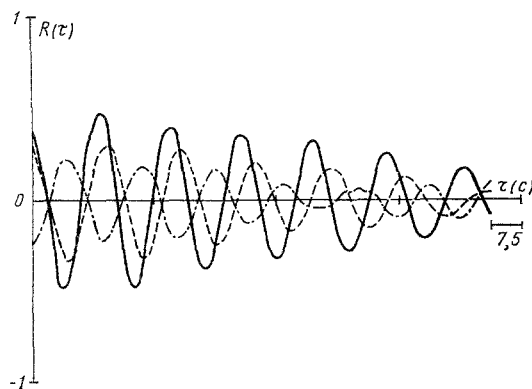


Fig. 1

Fig. 1. Correlation functions of electrical activity in different parts of the stomach. Continuous line) pyloro-antral portion; broken line) body; dot - dash line) cardia.

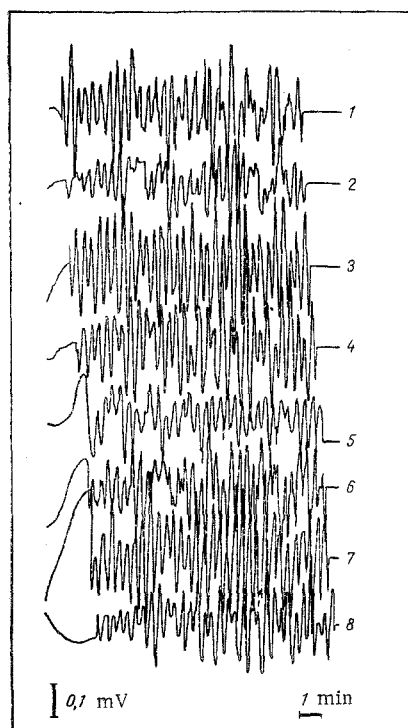


Fig. 2

Fig. 2. Topogram of potentials from different parts of the stomach: 1, 6) body; 2) fundus; 3, 4) antrum; 5) cardia; 7, 8) pylorus.

In the first 10-15 min after the test meal was taken the amplitudes of potentials of the cardia, body, and fundus of the stomach ( $0.26 \pm 0.01$  mV) were higher than in the pyloric and antral portions ( $0.23 \pm 0.02$  mV). Later an increase in the amplitudes of the potentials was found in the pyloro-antral portion (to  $0.28 \pm 0.02$  mV) and a decrease in other parts (in the cardia to  $0.21 \pm 0.01$  mV, in the body to  $0.22 \pm 0.03$  mV, and in the fundus to  $0.19 \pm 0.02$  mV) (Fig. 2). These values of the amplitudes persisted for 120-150 min. During evacuation of the gastric contents the amplitudes of potentials in all parts of the stomach fell considerably and approached their values in the absence of digestion.

A spatial investigation of gastric electric activity showed that different parts of the stomach have different mean amplitudes of their potentials. This indicates that electrical activity of the nearest part of the stomach is recorded selectively from each active electrode.

Correlation analysis of electrical activity of the different parts of the stomach showed a steady state of changes in the pyloro-antral potentials and a quasisteady state of potentials of the cardia, body, and fundus. A high degree of correlation was found between the phasic electrical processes in different parts of the stomach.

The spatiotemporal characteristics of electrical activity in different parts of the stomach indicate that at the beginning of digestion the strength of the peristaltic wave spreading from the cardia toward the pyloric sphincter has a tendency to diminish. In this period the pylorus is closed and motor activity of the outlet part of the stomach is correspondingly low. These results are in agreement with those of chronic experiments on dogs [2, 6, 15], which showed that not every peristaltic wave ends with opening of the pylorus. In the initial period of digestion only the liquid part of the contents is evacuated from the stomach, and no active movements of the outlet part are necessary for this. During evacuation of chyme from the stomach peristalsis of the pyloro-antral part increases, and this is characterized by an increase in its electrical activity.

The shape of the gastric potentials depends substantially on the method of recording, the interelectrode distance, and the lower and upper frequency of the transmission band of the amplifier and recording system, and on other factors. Integral values of the potentials recorded from the surface of the anterior abdominal wall convey objective information about the strength and frequency of the peristaltic waves of the stomach.

Single-channel electrogastrography can be used to study the motor activity of the stomach as a whole. Multichannel electrogastrography also enables motor activity of individual parts of the stomach to be studied. Multichannel electrogastrographic investigations using several single-channel electrogastrographs, carried out on patients with carcinoma of the stomach, have shown that reduced electrical activity in that part of the stomach wall that is affected by the tumor can be detected from the body surface [1, 7]. It can therefore be hoped that the field of usefulness of the suggested method will not be confined to physiological investigations.

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