THE RELATIONSHIP BETWEEN THE MOTOR REACTION OF THE PYLORIC PORTION OF THE STOMACH AND ITS FUNCTIONAL STATE

S. D. Groisman

From the Division of the Physiology of Digestion and the Circulation (Head — Docent P. F. Bogach) of the Institute of Physiology (Director — Docent P. F. Bogach) of the T. G. Shevchenko Kiev State University

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Indications have recently appeared in the literature of the great importance of the functional state of the gastrointestinal tract in the performance of its motor reactions, and that the functional state of the gastrointestinal tract is connected with the period of work or rest. P. F. Bogach [1] was the first to establish that the strength and duration of the motor reactions of the small intestine vary in relation to its functional state. An increase in the excitation of the fundal portion of the stomach at the end of a period of rest was observed by E. M. Matrosova [6].

In view of the fact that the motor activity of the pyloric region differs from that of both the fundus of the stomach and the small intestine, we decided to investigate how the excitation of the pyloric section changes at different moments of a period of rest. Such an investigation is also of interest because the motor function of the pylorus has by no means received sufficient study.

EXPERIMENTAL METHOD

Experiments were carried out on 2 dogs 16-18 hours after feeding. In the dogs, Basov-Pavlov fistulas had been made in the fundal portion of the stomach. Through the fistulas and into the stomach were passed 2 rubber balloons, attached to nipple tubes. One balloon, 5 cm long, was attached to a short tube (2-3 cm), the other — with a length 2 or 5 cm depending on the aim of the investigation — was attached to a nipple tube 10-12 cm long. The small balloon (2 cm long) on the long nipple tube was used for registration of the basal motor activity of the pylorus, and the large balloon (5 cm long) for stimulation of the pylorus and at the same time for registering its motor activity. Increase in the length of the balloon, and consequently in its volume, allowed reduction of that part of the pressure inside the balloon which resulted from the elastic tension of the walls of the balloon. The large balloon (5 cm long) on the short nipple was used for recording the motor activity of the fundal portion of the stomach. In some experiments, in order to fix the balloon in the pyloric region, we inserted a third balloon into the stomach, on a nipple tube 20-25 cm long. This balloon passed through into the duodenum. The base of the pyloric balloon was attached to the nipple tube of the duodenal balloon; the balloons were passed into the stomach one after the other. A special investigation showed that inflation of the duodenal balloon with 3-4 ml of air did not essentially modify the motor activity of the pylorus. In order to record the basal motor activity, 20-30 ml of air was introduced into the balloon in the fundus and 3-4 ml of air into the balloon in the pylorus.

For stimulation, from 15 to 60 ml of air was introduced into the balloon in the pylorus. The balloons were inflated with air by means of a special apparatus which permitted not only the introduction of a definite volume of air, but also a constant watch to be kept on the pressure inside the balloons. The motor activity of the pyloric and fundal portions of the stomach were recorded on the drum of a kymograph by means of water — air or air transmission and a Marey’s capsule.
EXPERIMENTAL RESULTS

In all the experiments we observed periodicity of the motor activity of the pylorus, which coincided in time with the periodicity of the motor activity of the fundal portion of the stomach. Under these circumstances typical rest periods took place in the pylorus. These findings confirm the accuracy of I. A. Edel'man's [8] point of view of the presence of periodic motor activity in the pyloric segment. American workers [12], formerly supporting the opposite view, have lately been obliged to change their minds [9]. Thus, at the present time, thanks to the work of a number of authors [4, 7, 9, 10], the presence of periodic motor activity and typical rest periods in the pyloric portion of the stomach can be considered to be firmly established.

In the middle and end part of the working period, the amplitude of the pyloric contractions underwent a number of regular changes associated with the contractions of the fundal portion of the stomach. The amplitude of the pyloric contractions was least from 15-30 seconds after completion of the fundal wave; it then gradually increased and reached its maximum at the moment of development of the next fundal wave, or slightly afterwards. The next 1 or 2 pyloric contractions remained at the maximum amplitude, after which their amplitude sharply diminished and the whole cycle of changes in the amplitude started afresh (Fig. 1). In the initial part of the period of work, when the fundal waves had not quite reached their normal size, these regularities were less clearly seen. At the end of the period of work, the variations in amplitude became particularly large.

![Fig. 1. Period of work in the fundal and pyloric portions of the stomach. (At the beginning of the period of work the pyloric balloon several times slipped through into the duodenum). Significance of the curves (from above downwards): motor activity of the fundus, motor activity of the pylorus, stimulation marker, time marker (17 seconds).](image)

On inflation of the balloon in the pyloric segment of the stomach to 20 ml during a period of work, the amplitude of the pyloric contractions was considerable increased, although the character of the variations in amplitude remained unchanged (Fig. 2, first half). On increasing the stimulating volume to 30 ml, the amplitude of the less powerful contractions continued to grow. The contractions of the pyloric segment became more even, but right at the end of the period of work the variations in the amplitude were restored.

Further distension of the stimulating balloon with air to 50-60 ml led to a diminution of the amplitude of the pyloric contractions (see Fig. 2, second half). For example, if the pyloric balloon contained 15-20 ml of air, the pressure inside the balloon during maximum contraction reached 80-90 mm of mercury, then after introduction of a further 40 ml of air it did not rise during these contractions higher than 50-60 mm of mercury. In spite of the fact that this volume was evidently excessive, when the stimulus was applied we observed no restlessness on the part of the dog. Gradual escape of air from the pyloric balloon enabled all the above-mentioned phenomena to be observed in the opposite order. The depressing influence of a strong mechanical stimulus on the motor activity of the pylorus during experiments of short duration on dogs was pointed out by McCrea and McSwiney [11].

During inflation of the pyloric balloon with 20-40 ml of air in the course of a period of rest, the appearance