MOVEMENTS OF THE SMALL INTESTINE DURING STIMULATION OF DUODENAL RECEPTORS

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Stimulation of duodenal mechanoreceptors and chemoreceptors increases motor activity of the large intestine.

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The mechanisms controlling complex physiological relationships between organs of the digestive system have received little study. This applies particularly to the relationship between movements of the large intestine and distant segments of the gastro-intestinal tract.

EXPERIMENTAL METHOD

Chronic experiments were carried out on 4 dogs with fistulas of the duodenum and large intestine.

Duodenal mechanoreceptors were stimulated for 1-2 min by inflating a thin-walled rubber balloon inserted through the fistula into the duodenum with air up to a volume of 30-50 ml.

The chemoreceptors were stimulated by injecting food stimuli (10-20% peptone solution, 2% soap solution, 5-10-20% sugar solution) into the duodenum through an insufflation tube. To prevent stimulation of the mechanoreceptors, not more than 10 ml of solution was injected into the duodenum. Movements of the large intestine were recorded by a graphic method using a balloon.

The experiments were performed on fasting animals 18-20 h after the last meal.

EXPERIMENTAL RESULTS

Transient stimulation of the duodenal mechanoreceptors (pressure in balloon 16-20 mm Hg) when the large intestine was in resting state increased the tone of the large intestine and produced contractions of types I and II (Fig. 1a). The latent period of the intestinal motor response was 30-100 sec. After mechanical stimulation for 1-2 min the duration of the response of excitation of contractions ranged from 3-5 to 8-9 min.

If the balloon in the duodenum was inflated during weak intestinal contractions, the movements of the large intestine were considerably increased. This increase was characterized by an increase in tone and in amplitude of the contractions (Fig. 1b). The latent period of the motor responses of the large intestine to stimulation of the duodenal mechanoreceptors varied from 0.5 to 2.5 min, but in most cases it was between 1.0 and 1.5 min.

Stimulation of the duodenal chemoreceptors by peptone solution with a background of the large intestine in a resting state produced distinct and prolonged excitation of contraction of the large intestine. The latent period of this response was 10-120 sec. The developing movements consisted of peristaltic and tonic waves (Fig. 2). Some contractions of the small intestine were observed for 8-15 min, whereafter they slowly weakened and the intestine returned to its resting state.

Injection of peptone solution into the duodenum at a time of weak motor activity of the large intestine produced an increase in tone and strengthening of contraction of the large intestine.

The same pattern was observed in experiments when 5-10-20% sucrose solution were introduced into the duodenum, the only difference being that sugar solutions were less effective in their action on motor

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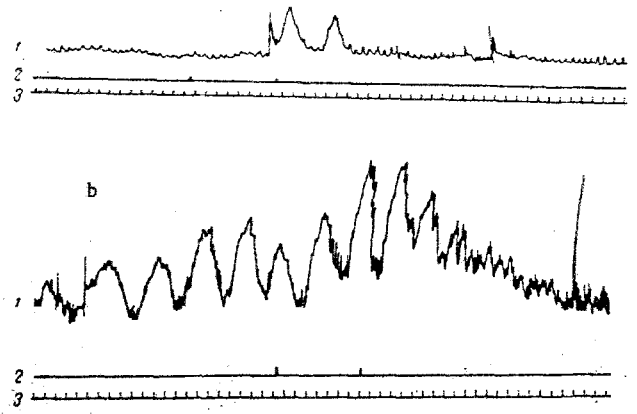

Fig. 1. Effect of mechanical stimulation of duodenal receptors on movements of large intestine. a) background of intestine in a resting state; b) background of weak intestinal contractions. From top to bottom: 1) movements of large intestine; 2) marker of stimulation (inflation of duodenum with balloon up to 50 ml air); 3) time marker 15 sec.

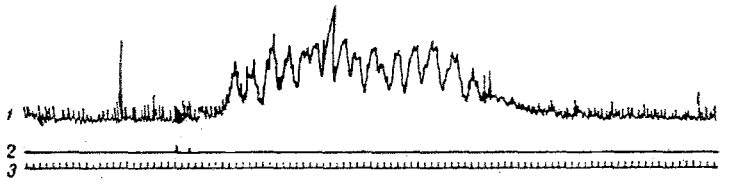

Fig. 2. Effect of injection of 10% peptone solution into duodenum on motor activity of large intestine. Significance of curves as in Fig. 1.

activity of the large intestines. For instance when 5, 10, or 20% solutions of sugar were injected into the duodenum with the large intestine in a resting state, contractions of the latter were produced in only 15 of the 24 experiments.

Injection of 20% soap solution (sodium salt of fatty acids of sunflower oil) into the duodenum while the large intestine was in a resting state led to the appearance of intestinal contractions. If soap solutions were injected into the duodenum during weak contractions of the large intestine, these contractions were strengthened. The tone and the amplitude of the intestinal contractions were increased considerably. This response continued for 5-16 min, depending on the physiological state of the intestine. If the duodenal mucosa was irrigated with soap solution at the end of a resting period of the intestine, the intestinal motor response was much stronger than when this stimulus was applied at the beginning or in the middle of the resting period. A similar relationship was observed in experiments when the duodenal mucosa was irrigated with peptone solution.

The results of these investigations indicate that adequate stimulation of the mechanoreceptors and chemoreceptors of the duodenum excites and stimulates motor activity of the large intestine. However, the large intestine responds more strongly to chemical than to mechanical stimulation of the duodenum. Evidence of this is given by the duration of the latent period and magnitude of the reflex response of the large intestine.

It can be concluded from the results of these experiments that excitatory influences from duodenal receptors act on motor function of the large intestine.