

# EFFECT OF ELECTRICAL STIMULATION OF THE HYPOTHALAMUS ON THE GASTRIC SECRETION

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Translated from *Byulleten' Éksperimental'noi Biologii i Meditsiny*, Vol. 56, No. 9,  
pp. 21-24, September, 1963  
Original article submitted December 4, 1962

The effect of electrical stimulation of various parts of the hypothalamus on the gastric secretory function outside the period of digestion has been studied in chronic experimental conditions [2,3,4]. It has been found that stimulation of areas of the hypothalamus situated at the level of the anterior and lateral borders of the infundibulum of the hypophysis cause the secretion of a large volume of gastric juice with high acidity and digestive power. Stimulation of an area of the hypothalamus situated at the level of the posterior border of the infundibulum causes a very slight increase in the secretion of gastric juice not containing free hydrochloric acid.

Until recently there was no evidence in the literature of the participation of the hypothalamus in the regulation of the secretory activity of the stomach in response to food stimuli. This is apparently because most investigations, principally conducted outside the Soviet Union, were carried out in acute experimental conditions, and it is impossible to study the secretory activity of the stomach in response to food stimuli in acute experiments. Recent researches, however, have demonstrated that the anterior portion of the hypothalamus is concerned in the regulation of the secretory activity of the stomach in response to food stimuli.

Experiments on dogs with gastric pouches isolated by Pavlov's method, and with bipolar silver electrodes implanted in different parts of the hypothalamus have shown [5] that stimulation of one area of the anterior hypothalamus caused a noticeable reduction in the volume of gastric juice and in its free and total acidity and digestive power, especially during the first hour. The reduction in the secretion of gastric juice also continued during the 3 h immediately following the end of stimulation. The anterior hypothalamus was stimulated with a sinusoidal current (50 cps, 1.5 V) for 1 h after eating a standard meal. After stimulation of the anterior hypothalamus daily for several days, the volume of gastric juice secreted on the following days was reduced. If another part of the anterior hypothalamus was stimulated, however, an increase in the volume of secretion and in the acidity of the gastric juice was recorded, without any change in its digestive power.

The role of the hypothalamus in the gastric secretion in response to food stimuli has not been studied. The elucidation of this problem is of considerable interest, for it will clarify the role of the higher centers of the autonomic nervous system in the regulation of the secretory activity of the stomach.

The object of the present investigation was to study the secretory activity of the stomach in response to food stimuli during electrical stimulation of various parts of the hypothalamus.

## EXPERIMENTAL METHOD

Investigations were carried out on 3 dogs with a Pavlov gastric pouch. The gastric secretion was stimulated in these animals by feeding them with 200 g raw meat. The secreted gastric juice was collected every hour throughout the experiment lasting 6 h. The free hydrochloric acid and total acidity were determined in the hourly samples of gastric juice, and the digestive power in a period of 24 h was estimated by Mett's method. The free hydrochloric acid concentration and the total acidity were determined by titration with 0.1 N NaOH solution, using dimethylaminoazobenzene (0.5% alcoholic solution) and phenolphthalein (1% alcoholic solution) as indicators. From 1 to 10 ml of gastric juice was collected. The acidity of the gastric juice was expressed as the number of milliliters of alkali required to neutralize 100 ml of gastric juice.

After the secretory activity of the stomach in response to feeding with 200 g of meat had been carefully investigated, tetrapolar electrodes were implanted into the hypothalamic region of the animals by our previously developed method [1]. The dogs took part in the experiments on the 7th-10th day after insertion of the electrodes into the hypothalamus. During the experiment lasting 6 h, the hypothalamus was stimulated every 15 min with an electric current for 3 min. The electric current was supplied by a type ZG-10 tone generator with a frequency of 60 cps and a strength of 0.5 mA.

#### EXPERIMENTAL RESULTS

The secretion of the isolated gastric pouch was investigated in three stages: during feeding with 200 g raw meat, after implantation of the electrodes without stimulation, and during stimulation of different parts of the hypothalamus.

During stimulation of the hypothalamic region, a visible change took place in the secretion of the isolated gastric pouch during meat feeding. Before implantation of the electrodes in the hypothalamus of the dog Chernyi, during the experiment lasting 6 h an average volume of 25.8 ml of gastric juice was secreted, and after the operation an average volume of 24.7 ml was secreted in the same time. During stimulation of the hypothalamus with an electric current from the anterior electrodes (middle part of the hypothalamus), 24.1 ml of gastric juice was secreted during the experiment, and during stimulation from the posterior electrodes, situated at the level of the posterior border of the infundibulum of the hypophysis 45 ml was secreted.

The pattern of secretion of gastric juice during the 6-h period of the experiment varied before and after application of the electrodes to the hypothalamus and during stimulation of its different parts. Before the operation the largest volume of gastric juice was secreted during the 1st hour of the experiment. During the next 3 h the intensity of the secretion of gastric juice fell, and at the 5th and 6th hours of the experiment the volume of gastric juice secreted was insignificant.

After implantation of the electrodes in the hypothalamus, no change took place in the pattern of secretion of the gastric juice, but an increase in the secretion was observed during the 1st hour of the experiment.

When the middle portion of the hypothalamus was stimulated (from the anterior electrodes) the largest volume of gastric juice—on the average 6.4 ml—was secreted during the 1st hour of the experiment. The secretion of gastric juice was reduced in the 2nd, 3rd, and 4th hours of the experiment, the corresponding average volumes being 3.1, 3.2, and 3.5 ml. In the 5th and 6th hours, however, 3.8 and 4.1 ml of gastric juice respectively were secreted.

When the posterior part of the hypothalamus was stimulated, behind the infundibulum of the hypophysis, on the average 6.6 ml of gastric juice was secreted during the 1st hour, and the maximal secretion of 8.3 ml took place during the 2nd hour. The secretion was subsequently maintained at a high level, and diminished slightly towards the end of the experiment, although remaining more intensive than during the 1st hour.

Besides the changes in the magnitude and dynamics of secretion of gastric juice during stimulation of the hypothalamus, changes also took place in the acidity of the juice. The free hydrochloric acid content of the juice during meat feeding before implantation of the electrodes was 75, and the total acidity 100. After operation the acidity rose slightly: the free hydrochloric acid to 78-81 and the total acidity to 100-104.

When stimulation was applied from the anterior electrodes, the free hydrochloric acid content rose (83-87) and the total acidity varied between 105 and 106. Stimulation of the posterior part of the hypothalamus caused an even greater increase in the acidity. The free hydrochloric acid content rose to 92-94 and the total acidity to 113-115.

The digestive power of the gastric juice showed no significant change during stimulation of the various parts of the hypothalamus. In the dog Chernyi it remained between 4 and 5 mm at all stages of the investigations.

In the dog Enot the anterior electrodes were situated in the anterior portion of the hypothalamus in the region of the supraoptic nuclei, and the posterior electrodes at the level of the posterior border of the infundibulum of the hypophysis. The changes in the secretion of gastric juice during stimulation of the hypothalamus in this dog were somewhat different in character, on account of the change in the position of the electrodes. An increase in the secretion of gastric juice was observed after the operation of implantation of the electrodes and during stimulation of the various parts of the hypothalamus. The largest increase in secretion was observed during stimulation of the posterior portion of the hypothalamus.

Before implantation of the electrodes, in the course of an experiment on the dog Enot lasting 6 h, 39 ml of gastric juice was secreted, compared with 48 ml after the operation. During stimulation of the anterior portion of the hypothalamus the secretion was 49 ml, and during stimulation of the posterior part—53 ml.

The general pattern of the changes in the hourly secretion of gastric juice was the same in all the experiments. During the 1st hour the largest volume of gastric juice was secreted during stimulation of the anterior portion of the hypothalamus. So far as the acidity of the gastric juice is concerned, in Enot after implantation of the electrodes and during stimulation of the various parts of the hypothalamus a very slight increase in the content of free hydrochloric acid and in the total acidity was observed. Before implantation of the electrodes the free hydrochloric acid was 73.3 and the total acidity 100, while after the operation the corresponding values were 79.1 and 116.6. After stimulation of the anterior portion of the hypothalamus the free hydrochloric acid and total acidity were 77.5 and 106.6, and after stimulation of the posterior part, 76.6 and 106.6 respectively. No significant changes occurred in the digestive power of the gastric juice.

Hence, during stimulation of the posterior portion of the hypothalamus, in all cases the secretion of gastric juice was increased in the first phase, and especially in the second phase of gastric activity, when humoral mechanisms of regulation of secretion are usually brought into play. The question of the mechanism responsible for this increase in the second phase of gastric activity during stimulation of the hypothalamus is a complicated one and calls for special investigations.

#### LITERATURE CITED

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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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