GASTRIC SECRETION AND ACUTE GASTRODUODENAL LESIONS FOLLOWING HYPOTHALAMIC AND PREOPTIC STIMULATION

AN EXPERIMENTAL STUDY IN CATS*

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CONSIDERABLE clinical and experimental evidence attests to the importance of the central nervous system and particularly the hypothalamus in regulating gastrointestinal functions. Clinical examples of acute gastrointestinal lesions in association with brain tumors, cerebrovascular damage, injury and other pathology are well documented. Stimulation of the hypothalamus in experimental animals has been reported to alter gastric secretion, and lesions induced in this region have been related to acute gastrointestinal erosions and haemorrhages.

In order to elucidate which brain structures could be responsible for the production of these gastrointestinal neurogenic lesions, acute stimulation experiments with stereotaxically oriented electrodes have been performed in cats. These experiments have shown that short stimulation of certain points in the anterior hypothalamus and the preoptic area can produce in a considerable number of the experimental animals acute gastric and duodenal erosions and haemorrhages.

Because acute neurogenic gastrointestinal lesions generally have been related to changes in gastric secretions, the purpose of the present study was to investigate the possible correlation between the production of the experimentally induced lesions in the gastric mucosa and quantitative alterations in volume, acidity and peptic activity of the gastric juice, following the stimulation of different regions in the hypothalamus and the preoptic area.

MATERIALS AND METHODS

Ninety cats weighing between 3 and 4.5 kg. were used. The animals were fasted for 24 hours before the experiment. Venesection was performed under ether anesthesia and 50 mg. per kg. of body weight of alpha-chloralose were injected intravenously. This maintained a satisfactory state of anesthesia for the duration of the experiment. Throughout the experiments the animals received an intravenous infusion of normal saline at the rate of 8 drops per min.

The experimental animals were divided into the three following groups: (1) Thirty-one control animals. In 20 cats the pylorus was ligated and in 7 of these animals a Levine gastric tube was introduced. In 8 of these animals an electrode was inserted into the hypothalamus or the preoptic region for 6 hours, but no stimulation was performed. In the remaining 3 cats no gastric or brain surgery was done. Quantities of gastric juice adequate for study were obtained in 13 out of the 20 ligated animals. (2) Thirty-eight animals in which the anterior hypothalamus or the preoptic area were stimulated. In 33 of these animals the pylorus was ligated and in 8 of these animals a Levine gastric tube was introduced. In 8 of these animals an electrode was inserted into the hypothalamus or the preoptic region for 6 hours, but no stimulation was performed. In the remaining 3 cats no gastric or brain surgery was done. Quantities of gastric juice adequate for study were obtained in 13 of the 20 ligated animals. (3) Twenty-one animals in which the posterior hypothalamus was stimulated. In all of these animals the pylorus was ligated and in 8 of these animals a Levine gastric tube was introduced. Adequate amounts of gastric juice were obtained in 26 of the 33 ligated cats. (3) Twenty-one animals in which the posterior hypothalamus was stimulated. In all of these cats the pylorus was ligated and in 8 of them a Levine gastric tube was introduced. In this group adequate amounts of gastric juice for study were obtained in 14 animals.

The peptic activity in the gastric juice was

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determined in 10 control and in 28 stimulated animals.

The hypothalamus and the preoptic region were stimulated with a S4 Grass stimulator through bipolar concentric electrodes which were introduced with the aid of a stereotaxic instrument through small burr holes in the skull. The peripheral ends of the bipolar electrodes were separated by a vertical distance of 0.5–1.0 mm. The parameters of stimulation were of 3 to 4 volts, 10 msec. in duration and at a frequency of 50 per sec. The stimulus lasted 4 min. and in some experiments it was performed in two or three adjacent points 1 mm. apart, in the same frontal plane.

In those animals in which a gastric tube was introduced gastric secretion was collected by gentle manual suction from the ligated stomach before, immediately after, and at hourly intervals following stimulation. In other animals the gastric juice was collected from the resected stomach at the end of the experiment, which lasted between 6 and 8 hours. Volume was measured and free and total acidity were determined by titration with 0.05N NaOH with the use of the Toepfer reagent and phenolphthalein as indicator. Peptic activity was determined by the method of West as modified by Hollander.21

At the end of the experiments the brains in which the electrodes in those animals in which gastroduodenal lesions had developed were situated mainly in the lateral region of the anterior hypothalamus and the preoptic area, corresponding to frontal planes 12 to 15 of the stereotaxic atlas of the cat.22 A few points were situated more medially in the same planes.

In contrast to the results obtained following anterior hypothalamic or preoptic stimulation, the gastroduodenal lesions developed only rarely following the stimulation of the posterior hypothalamus. Out of the 21 animals stimulated in 40 different points, at the level of the mammillary bodies in the frontal planes 8 and 9 of the stereotaxic atlas, in only 2 animals was a small gastric erosion observed. Fig. 3 demonstrates the numerous points in the posterior hypothalamus, the stimulation of which failed to produce gastrointestinal lesions.

No pathological changes were found in the gastric and duodenal mucosa of the control animals.

RESULTS

In 20 out of the 38 animals in which the anterior hypothalamus or the preoptic region was stimulated acute gastroduodenal lesions appeared within a few hours following the stimulation. In 7 animals only erosions were found, in another 8 only haemorrhages, while in the remaining 5 cats both erosions and haemorrhages were found. The largest erosions and haemorrhages measured 4 and 6 mm. respectively. Between 1 and 12 lesions occurred in the different animals. Detailed description of these lesions has been reported elsewhere13 and they will be described here only briefly. The haemorrhages were either intramucosal or submucosal and were accompanied by capillary congestion with some extravasation of erythrocytes. The erosions involved the mucosa and usually did not reach the muscularis mucosae (Figs. 1 and 2). Only occasionally fresh haemorrhages were found around the erosions. There was no inflammatory reaction around the erosions, as only a short period had elapsed since their formation.4

The histological examination of the brains indicated that the electrodes in the lateral region of the anterior hypothalamus and the preoptic area, corresponding to frontal planes 12 to 15 of the stereotaxic atlas of the cat,22 2. A few points were situated more medially in the same planes.

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