THE EFFECT OF LOCAL GASTRIC HEATING ON ACID SECRETION IN THE DOG

A Preliminary Report

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MANY forms of treatment have been directed toward the stomach in an attempt to alter its acid secretion. Of the nonoperative technics, irradiation and hypothermia have become popular, each giving various degrees of success. Because of the similar effects of irradiation and of heat on animal tissues,[1, 2] an experimental study was undertaken early in 1963 to evaluate the histologic and secretory changes secondary to local heating of the gastric mucosa. A report of the study follows.

Material and Method

Twelve mongrel dogs whose weights ranged from 14 to 22 kg. were studied. Local gastric heating was achieved by circulating hot water through a stomach-shaped latex balloon that was inserted orally under light Nembutal anesthesia and was inflated to volumes of from 600 to 800 ml. A recirculating pump and water bath maintained a constant volume and temperature. The test group was heated at 50 C. (122 F.). Heating was maintained for an arbitrary period of 45 minutes in each animal.

In order to determine the maximum heating temperature that a dog could tolerate for the 45-minute test period, each of six dogs was subjected to gastric heating at 45, 48, 50, 52, 53, and 55 C. (113, 118.4, 122, 125.6, 127.4, and 131 F., respectively). Laparotomy was performed simultaneously so that gastric biopsy specimens could be obtained and the temperature of the mucosa and adjacent organs recorded.

The test group comprised six dogs each of which underwent gastrostomy before the gastric heating. A tube was placed in the dependent portion of the stomach for the collection of gastric secretion, which was obtained by gravity drainage with the dog standing. After a 24-hr. fast, gastric juice was collected for one hour. Twenty-five milligrams of betazole hydrochloride† was then injected intramuscularly, and gastric juice was collected for the following one hour. A routine gastric analysis for free and total acid was performed on each of the two specimens. Any specimen containing bile was discarded. The quantitative gastric determinations were made after the dogs were allowed to recover from surgery for one week; at least three baseline gastric analyses were performed.

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†*Histalog, Eli Lilly and Company.*

Results

Of the dogs used to establish tolerance, those that underwent gastric heating at more than 50 C. (122 F.) died in from 6 to 12 hours. Autopsy revealed a severe mucosal burn in each animal, but no evidence of gastric perforation; the biopsy sites were intact. All dogs with gastric heating at 50 C. (122 F.), or less, tolerated the procedure well and recovered normally from the laparotomy with no delay in healing. Pathologic changes were limited to the stomach, with a moderate amount of mucosal edema and focal hemorrhage, evident as long as one week after heating. A temperature of 50 C. (122 F.) was therefore selected to be used for gastric heating in the test group.

Test group. Five of the six dogs underwent gastric heating at 50 C. (122 F.).* *Figure 1* shows the changes in concentration of free hydrochloric acid for the individual dogs. All dogs became essentially achlorhydric during the first post-heating week. The most consistent, and perhaps significant, change was the decrease in the fasting, unstimulated acid secretion. Virtual achlorhydria persisted in most of the dogs, although it did not seem to be correlative with the response to Histalog. After the initial suppression, the response to Histalog stimulation became variable. Three dogs (A, B, and C) were killed when it became apparent that their gastric acid output had returned to normal or varied greatly. Microscopic examination of the stomachs and adjacent organs showed no significant changes, and parietal cells were abundant in the gastric mucosa. Dogs D and E are still alive and healthy, but demonstrate a persistent suppression of free acid after almost one year.

The amount of inorganic acid secretion closely paralleled that of free acid, as did the change in the volume of gastric secretions.

Comment. The mechanism responsible for these changes is not apparent from the present data. Further studies are in progress to elucidate these problems and to evaluate other variations in thermal treatment.

Conclusion

Local gastric hyperthermia has a definite, suppressive effect on gastric acid secretion in dogs. This effect has continued in two dogs for almost one year, with the amounts of free hydrochloric acid reduced approximately 50 percent from base line values before gastric heating.

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**The sixth dog underwent heating twice at 45 C. (113 F.). There was no suppression of gastric acid at this latter temperature; in fact, a slight increase in acid concentration was noted after each of the two heating treatments. These data are not included in this report.*

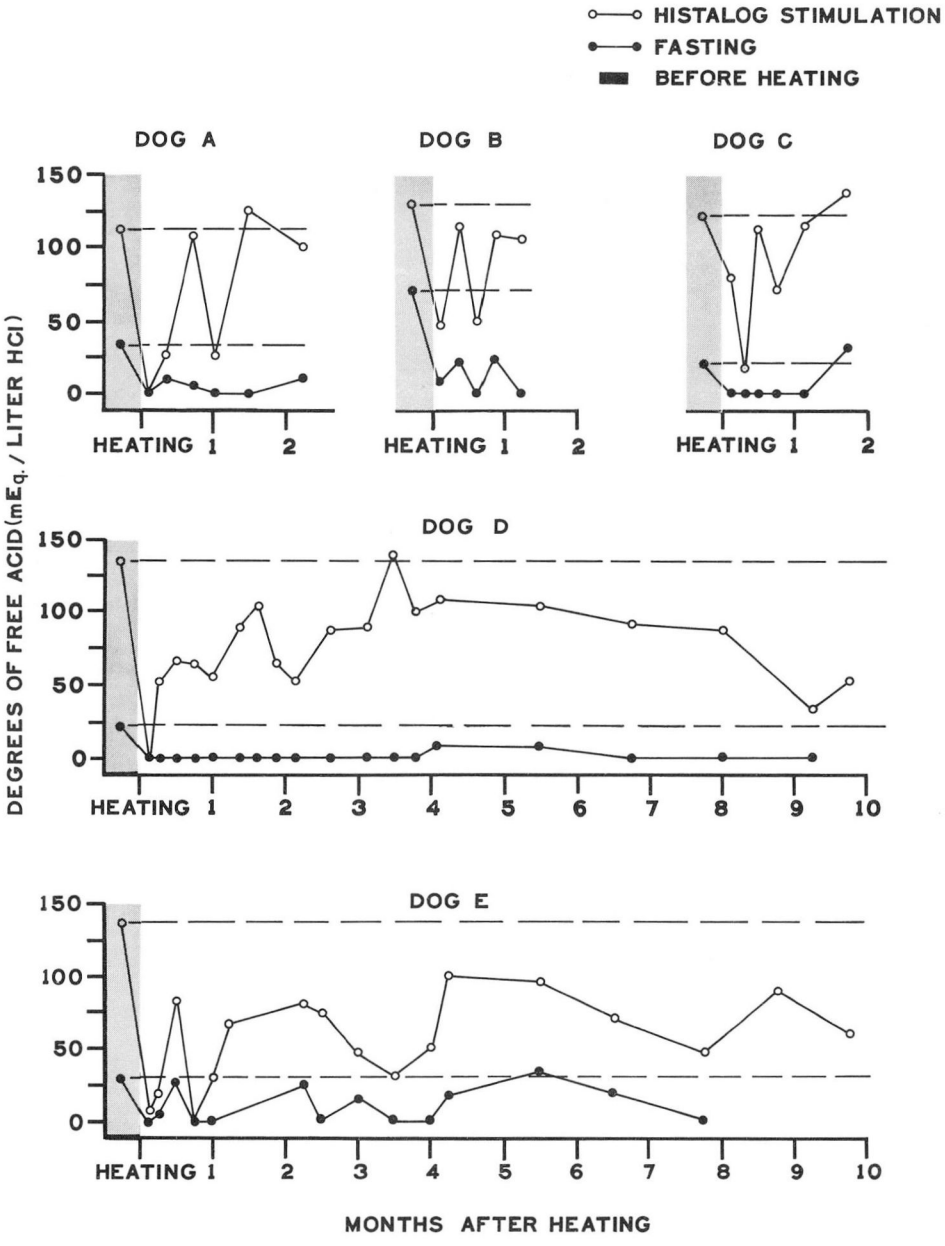

Fig. 1. Graphs showing changes in concentration of free acid after local gastric heating at 50 C. (122 F.) for 45 minutes in five dogs.

Addendum

Since the inception of this project, Rosswick, Economou, and Beattie[3] have reported a similar study of hyperthermic effects on gastric secretion over a 10-week period.

References

1. Crile, G., Jr.: Selective destruction of cancers after exposure to heat. Ann. Surg. **156**: 404-407, 1962.
2. Warren, S. L.: Preliminary study of effect of artificial fever upon hopeless tumor cases. Am. J. Roentgenol. **33**: 75-87, 1935.
3. Rosswick, R. P.; Economou, S., and Beattie, E. J.: Effects of gastric hyperthermia on gastric acid secretion in dog. Surgery **55**: 559-563, 1964.