The Effect of Localized Gastric Hypothermia on Gastric Secretion in Dogs

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REPORTS by Wangensteen and his associates,1-4 describing a reduction in gastric acidity after freezing, prompted us to evaluate the acid secretory responses of intact stomachs and gastric pouches in dogs following gastric "freezing."

MATERIALS AND METHODS

Adult mongrel dogs weighing between 9 and 20 kg. were prepared either with gastrostomies or with vagally innervated or denervated gastric pouches. In 11 dogs, thermistors that had been embedded in Teflon patches were sutured into the wall of the intact stomach or gastric pouch. The thermistors were allowed to heal in place and were used later to determine gastric temperatures. In 3 dogs with gastric fistulas, 6 thermistors were inserted between the mucosa and the submucosa of the stomach: No. 1 at the cardia, No. 2, 3, and 4 across the middle of the anterior wall, No. 5 on the posterior surface, and No. 6 in the antrum. Three thermistors were sewn equidistant along the long axis of the pouch in 8 dogs. The thermistors were calibrated to a scale of -10° to +40° C. Their electrical leads were attached to a junction socket embedded in a modified Thomas cannula that was placed in the body wall. In these animals, gastric temperatures were measured during gastric freezing without opening the abdomen, by connecting the junction socket to an electric thermometer previously calibrated in degrees Centigrade.

After at least 4 weeks had been allowed for recovery from operation, pre-freezing acid secretory studies were performed. In dogs with vagally innervated gastric pouches, secretion was stimulated by histamine, insulin-induced hypoglycemia, ground lean meat, and gastrin. Histamine was given subcutaneously in doses of 0.05 mg. base per kilogram, and gastric juice was collected for 2 hr. One unit of insulin per kilogram of body weight was given intravenously, and gastric juice was collected for 1 hr. Twenty grams of meat was given every

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15 min. for 1 hr. and then every 30 min. during the remainder of the 4-hr. test. Gastrin extract equivalent to 20 gm. of original hog antral mucosa in 20 ml. of normal saline solution was given intravenously over a 4-hr. period. Gastrin was prepared by extracting hog antral mucosa by the use of Stage 1 of the method described in detail by Gregory and Tracy. Histamine, gastrin, and meat feedings were used in dogs with vagally denervated pouches. Dogs with gastric fistulas were given histamine and insulin.

In all tests, the volume of secretion was measured and the titratable acidity to pH 3.5 was determined by titration with 0.1 N sodium hydroxide solution, Töpfer's reagent (dimethylaminoazobenzene) being used as an indicator. The output of acid was calculated as milliequivalents of HCl per unit of time.

Concentration of histamine was determined in the gastric mucosa of some dogs before and after gastric hypothermia, by a modification of the Barsoum-Gaddum procedure.

Following completion of secretory tests, the stomachs in 10 dogs with gastrostomies were frozen according to the technic described by Peter et al. A Swenko gastric hypothermia machine was used. A stomach-shaped balloon was inserted into the stomach and filled with 600-800 ml. of precooled ethyl alcohol. Perfusion of the balloon was carried out for a period of 1 hr. with inflow temperature between $-16.5^\circ$ and $-19.6^\circ$ C. and outflow temperature between $-4.3^\circ$ and $-13^\circ$ C. The flow rates were between 1250 and 1562 ml./min.

In 8 dogs with gastric pouches, only the pouch was subjected to gastric freezing. A condom was inserted into the pouch and filled with 100-125 ml. of coolant. Because the lumens in the cannulas were reduced in size, tubing of smaller diameter was used between balloon and machine. This modification reduced the flow rate more than 50%.

Gastric secretory tests were repeated at varying intervals of time following gastric freezing.

Five dogs with gastrostomies were subjected to gastric freezing at weekly intervals for 6 weeks. The responses to insulin hypoglycemia and histamine were measured before and after each procedure. In these animals, the duration of the hypothermia procedure was shortened to 15 min., and the volume of alcohol in the balloon was 1200 ml.

RESULTS

In Dogs With Vagally Innervated Gastric Pouches

Although the mean temperature of coolant entering the balloon was between $-18.2^\circ$ and $-21.9^\circ$ C., temperatures of the walls of the Pavlov pouches remained above 0° C. during the time gastric freezing was performed. Mean

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