Iced Saline Lavage Does Not Slow Bleeding from Experimental Canine Gastric Ulcers

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The efficacy and safety of iced saline lavage for upper gastrointestinal bleeding is unproven. In this study, canine stomachs were lavaged in vivo to determine whether iced saline staunched bleeding from mechanically induced acute gastric ulcers. Each animal served as its own control. Bleeding rates were measured during an initial period of saline lavage at 37°C. Saline at 4°C, with or without added norepinephrine, was no more effective than saline at 37°C in decreasing the rate of gastric hemorrhage. These data do not support the clinical practice of lavaging with iced saline or norepinephrine-containing solutions in human gastric hemorrhage.

Traditional nonsurgical measures for the control of upper gastrointestinal bleeding include lavage, neutralization or reduction of gastric acidity, intravascular pitressin infusion, therapeutic angiography, and, in the case of varices, balloon tamponade (1, 2). The therapeutic efficacy of most techniques remains unproven by properly controlled clinical trials. Anecdotal reports have suggested each measure is associated with successful hemostasis, but such reports are difficult to interpret because 80–90% of patients with upper gastrointestinal hemorrhage stop bleeding spontaneously (3).

Gastric lavage with iced saline via large-bore tube has long been a common initial treatment in bleeding patients (4–6). The rationale for its use was supported by the demonstration in dogs of reduced acid and pepsin output as well as decreased gastric blood flow when gastric cooling was achieved using a 2–5°C solution (7, 8). Subsequently the lowering of gastric temperature using gastric hypothermia machines in patients with upper gastrointestinal bleeding was advocated by several centers (9–12). However, complications of this therapy, such as mucosal thermal damage and pneumonia, led to a rapid decline in its popularity.

In our institution we have observed several patients in whom the use of iced lavage solutions resulted in marked discomfort or obtundation. In addition, the potential for untoward cardiovascular and other systemic responses to hypothermia has concerned us (13–15). Accordingly, the current study was designed to examine whether bleeding from experimental canine gastric ulcers is slowed significantly more by iced as compared with warm lavage solutions. In addition, we investigated whether the clinical practice of adding norepinephrine to the lavage solution further enhanced hemostasis in this model.

METHODS AND MATERIALS

Mongrel dogs, 20–25 kg, were premedicated with acepromazine and anesthetized with pentobarbital. Through a midline abdominal incision, the pylorus was clamped
and a calibrated thermistor probe was sewn to the anterior or gastric wall. The “ulcer maker,” an enlarged, modified suction biopsy capsule, was passed by mouth and was used to make 2–5 standard-sized ulcers along the greater curvature of the stomach (16). Because the dog has an extremely efficient clotting mechanism, spontaneous cessation of bleeding in this model often occurs within 40 min; this can be prevented by prior anticoagulation of the animal. Accordingly, sodium heparin was given intravenously (200 USP units/kg) immediately before creation of the ulcers. An Ewald lavage tube (32 French) was then inserted through the mouth into the stomach, the abdominal incision was covered with towels, and gastric lavage was initiated with saline at 37°C. Lavage was conducted with a hand-held 100-ml syringe connected to the Ewald tube so that 100 ml of saline could be instilled into and withdrawn from the stomach every minute. Gastric lavage effluent obtained during the first 2 min was discarded. Thereafter, effluent was saved and was pooled in separate containers every 2 min. After eight such specimens of gastric effluent were obtained (control period = 16 min), the lavage fluid was changed, and another eight specimens of gastric effluent were collected (test period = 16 min). For each specimen, the time of collection, volume, and hemoglobin concentration were measured. Saline (0.9 g of NaCl/100 ml) at 37°C was always used during the control period; saline at 37°C, or saline at 4°C, or a solution of norepinephrine bitartrate (Sigma Chemical Co., St. Louis, Missouri), 32 mg/1000 ml of saline (17) at 4°C, was used during subsequent test periods. Hemoglobin was quantified as cyanomethemoglobin at 540 nm in a Beckman model B spectrophotometer. One ml of gastric effluent was mixed with 2 ml of a concentrated cyanomethemoglobin reagent (Hycel Inc., Houston, Texas); the mixture was treated with ultrasound for 20 sec to lyse red blood cells. A standard of 11.8 g of hemoglobin per 100 ml (Hycel Inc.) was used as the basis for calculating the amount (ml) of blood in each specimen of gastric effluent. The bleeding rate (ml of blood lost per minute) was calculated by linear regression analysis of time and cumulative blood loss over the period of observation. Significance between rates of blood loss during control and test periods in an experiment was assessed by paired t test. The unpaired t test was used in comparing blood loss among different experiments.

RESULTS

Lavage with Saline at 37°C. The mean bleeding rate during the first 16 min (0.87 ± 0.38 SD ml/min) was not significantly different from that during the final 16 min (0.62 ± 0.37 SD ml/min; paired t = 2.25; P > 0.05 for 8 df) when warm saline was infused throughout control and test periods (Table 1). The average temperature of the anterior gastric wall did not change from the beginning (36.9°C) to the end (36.8°C) of the test period.

Lavage with Saline at 4°C. The mean bleeding rate of 0.88 ± 0.62 SD ml/min during the control period was unaffected by lavage with saline at 4°C (0.68 ± 0.73 SD ml/min; t = 0.85; P > 0.1), although the temperature of the anterior gastric wall fell from 36.3°C to 31.8°C (P > 0.01) during the test period.

The mean bleeding rate of 1.00 ± 0.65 SD ml/min during the control period was similarly unaffected by lavage with norepinephrine in saline at 4°C (0.84 ± 0.86 SD ml/min; t = 0.63; P > 0.1). When data were pooled for control periods versus all test periods using iced saline, no significant difference emerged (P > 0.1).

Overall, no significant differences (P > 0.1) were noted among bleeding rates during the three control periods or among the three test periods. In addition, the decrease of mean bleeding rate from control to test periods was not significantly different in the warm versus iced saline-treated dogs (P > 0.1).

DISCUSSION

Gastric lavage in patients with upper intestinal bleeding achieves several purposes other than hemostasis. Blood in the lavage fluid confirms that the bleeding site is most probably proximal to the ligament of Treitz (18). The volume and color of aspirated blood gives information about the activity and rate of hemorrhage. Lavage may also facilitate subsequent endoscopy by removing blood and clots. Does cooling the lavage fluid confer any therapeutic benefit?

Experimental observations in animals raise doubts about the hemostatic efficacy of iced saline lavage. Although several reports document a decrease in gastric blood flow upon lowering the temperature of normal canine stomach (8, 19–21), a marked increase in left gastric artery flow during