

Preoperative Oral Fluids: Is a Five-hour Fast Justified Prior to Elective Surgery?

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MALTBY JR, SUTHERLAND AD, SALE JP, SHAFFER EA. Preoperative oral fluids: is a five-hour fast justified prior to elective surgery? *Anesth Analg* 1986;65:1112-6.

The effects of preoperative oral administration of 150 ml fluid were studied prospectively in 140 unmedicated, ambulatory outpatients presenting for first trimester therapeutic abortion. Intraoperative gastric fluid volume, pH, and rate of gastric emptying were measured in the four groups to which patients were randomly assigned. At an average time of 2½ hr preoperatively all patients received either oral ranitidine, 150 mg, or a placebo tablet, with the nonabsorbable marker dye bromosulphthalein (BSP), 50 mg in 10 ml water, followed by either 150 ml water or no further fluid. The effect of volume ingested was assessed by comparing the volume of gastric contents obtained by gastric tube suctioning at the completion of surgery in the two groups given placebos. The gastric volume was significantly

less in patients given 150 ml water (17.6 ± 14.5) than in those given only BSP (26.7 ± 18.9) (P < 0.02), and was further significantly decreased in the two groups given ranitidine (8.3 ± 7.3, 9.5 ± 7.7 ml) (P < 0.001). Mean pH values were significantly higher in the two ranitidine groups (5.52 ± 1.79, 5.03 ± 1.79) than in the two placebo groups (1.75 ± 0.94, 1.92 ± 1.27). The combination of a residual volume of 25 ml and pH less than 2.5 was found in 46% of patients given only BSP with placebo, in 23% of those given 150 ml water with placebo, and in no patient given ranitidine. There was no correlation between the gastric volume or pH values with the ingestion-surgery interval in patients given 150 ml water.

Key Words: GASTROINTESTINAL TRACT—gastric emptying. HISTAMINE—ranitidine. ANESTHESIA—outpatient.

"While a complete emptying of the stomach can never be guaranteed, a minimum of five hours (preoperative starvation) in the absence of pain, trauma, apprehension, narcotics, gastrointestinal disorders, or premedications is suggested except under emergency conditions" (1). Such guidelines have been followed in most hospitals for many years. Foods pass through the stomach at variable and somewhat unpredictable rates, sometimes taking up to 12 hr (2,3). In contrast, water and crystalloid-containing fluids have a 50% emptying time of only 12 min (4). It therefore appears illogical to have a single guideline for both preoperative solids and liquids.

Prolonged preoperative starvation causes patient discomfort, yet more than one third of fasting patients have a gastric volume greater than 25 ml, and in 90% the gastric fluid pH is less than 2.5 (5). Previous

studies have shown that H₂ receptor antagonists favorably alter preoperative gastric volume and pH (5-7).

In view of the difference in physiologic handling of liquids and solids by the gastrointestinal tract, it was decided to assess the safety and effects of ingesting 150 ml water. This amount of fluid was ingested 120-180 min before induction of anesthesia, together with either oral ranitidine or placebo, in outpatients presenting for first trimester abortion. This group of patients may be at higher risk of acid aspiration because of the purported association of pregnancy with delayed gastric emptying (8).

Methods

After approval of the study protocol by the University of Calgary Joint Ethics Committee and with informed consent, 140 ambulatory patients presenting for first trimester therapeutic abortion were studied. Details of the patients' age, weight, gestation, smoking history, fasting interval, and history of recent vomiting or symptoms of reflux were recorded on admission to the daycare holding area. Hunger and thirst were

Received from the Departments of Anaesthesia and Medicine, Foothills Hospital at the University of Calgary, Calgary, Alberta, Canada. Accepted for publication June 2, 1986.

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Table 1. Patient Characteristics (mean \pm SD)

	<i>n</i>	Age (yr)	Weight (kg)	Gestation (weeks)	Duration of fasting (hr)	Ingestion-surgery interval (min)
Group 1 (P + 150 ml)	35	24.5 \pm 4.4	58.8 \pm 9.2	8.9 \pm 1.5	14.4 \pm 2.1	144 \pm 17
Group 2 (R + 150 ml)	35	24.4 \pm 4.3	61.5 \pm 8.7	9.3 \pm 2.0	13.9 \pm 2.3	145 \pm 19
Group 3 (P)	35	24.9 \pm 5.1	58.9 \pm 8.5	9.4 \pm 1.7	14.1 \pm 1.6	150 \pm 19
Group 4 (R)	35	24.9 \pm 4.1	59.3 \pm 8.9	9.4 \pm 1.5	14.0 \pm 1.4	145 \pm 16

P, Placebo; R, Ranitidine.

Table 2. Gastric Volume and pH and Percentage of Dye Recovered

	Volume ^a	pH ^a	% Dye recovered ^a
Group 1 (150 ml water + placebo) (<i>n</i> = 35)	17.6 \pm 14.5 ^b (0-56)	1.75 \pm 0.94 (0.75-6.5) <i>n</i> = 33	0
Group 2 (150 ml water + ranitidine) (<i>n</i> = 35)	8.3 \pm 7.3 ^c (0-24)	5.52 \pm 1.79 ^c (1.33-7.71) <i>n</i> = 28	0.008 \pm 0.019 (0-0.080)
Group 3 (10 ml water + placebo) (<i>n</i> = 35)	26.7 \pm 18.9 (0-80)	1.92 \pm 1.27 (0.91-6.44) <i>n</i> = 33	0.002 \pm 0.019 (0-0.05)
Group 4 (10 ml water + ranitidine) (<i>n</i> = 35)	9.5 \pm 7.7 ^c (0-35)	5.03 \pm 1.79 ^c (1.64-7.51) <i>n</i> = 31	0.004 \pm 0.015 (0-0.09)

The differences between numbers in which pH was measured and numbers per group represents patients with no gastric aspirate.

^aMean \pm SD (Range)

^b*P* < 0.02 vs group 3.

^c*P* < 0.01 vs groups 1 and 3.

graded—nil, mild, moderate, extreme—on admission and again on arrival in the operating room. All patients had fasted for at least 10 hr from midnight until arrival at the hospital. Those receiving any medication known to affect gastric secretion were excluded. No sedative or narcotic drug premedication was given. Between 120 and 180 min preoperatively, all patients were given bromosulphthalein (BSP), 50 mg in 10 ml water as a nontoxic, nonabsorbable marker dye (9). Patients were randomly assigned to one of four groups: Group 1 (*n* = 35) received BSP, 50 mg + 150 ml water + placebo. Group 2 (*n* = 35) received BSP, 50 mg + 150 ml water + ranitidine, 150 mg. Group 3 (*n* = 35) received BSP, 50 mg + placebo. Group 4 (*n* = 35) received BSP, 50 mg + ranitidine, 150 mg.

General anesthesia was induced in all patients using intravenous thiopental, followed by nitrous oxide and oxygen supplemented with fentanyl. No other drugs were administered. At the end of surgery, which lasted an average of 10 min, an orogastric Salem sump-tube was passed and gastric contents aspirated with the patient in three different positions to facilitate maximal aspiration—lithotomy in the Trendelenburg position, horizontal supine, and left lateral positions. The pH of the aspirate was measured using a calibrated Radiometer PHM 82 pH meter and the BSP concentration using a Beckman spectrophotometer (9).

The percentage of ingested BSP remaining in the stomach was calculated by multiplying the measured concentration by the aspirated volume and expressing this as a percentage of the original 50 mg.

Results are given as mean \pm SD, and ranges where appropriate. Data were analyzed using one-way analysis of variance and Student's *t*-test. The χ^2 -analysis was used for comparisons between groups and to compare the proportions of patients in the four groups with pH less than 2.5, volume greater than 25 ml, or a combination of both risk factors. Correlation between patient characteristics and measured gastric volumes and acidity was sought using linear regression analysis. Differences were considered statistically significant when *P* was less than 0.05.

Results

There were no significant differences among the four groups with regard to age, weight, gestation, fasting interval, or the ingestion-surgery interval (Table 1). There was also no difference in the history of smoking, heartburn, or dyspepsia among the groups.

The volume, pH, and percentage BSP recovered in gastric contents are shown in Table 2. Patients who had 150 ml water with placebo (group 1) had significantly less residual gastric volume than did those

Table 3. Incidence of Patients in each Group with High Risk Factors^a

	Volume > 25 ml		pH < 2.5		Volume > 25 ml and pH < 2.5	
	Number	%	Number	%	Number	%
Group 1. (150 ml water + placebo)	8/35	23	31/31	100	8/35	23
Group 2. (150 ml water + ranitidine)	0/35	0	2/28	7	0/35	0
Group 3. (placebo)	18/35	51	16/33	48	16/35	46
Group 4. (ranitidine)	1/35	0	4/31	13	0/35	0

^aResidual gastric volume greater than 25 ml and pH less than 2.5

who had only BSP (group 3) whereas pH remained unchanged. Premedication with ranitidine (groups 2 and 4) significantly decreased both gastric volume and acidity compared with placebo (groups 1 and 3). Patients who drank 150 ml water with ranitidine (group 2) had significantly lower residual volumes and significantly higher pH levels than patients who had only BSP and placebo (group 3).

Virtually no BSP could be detected in the gastric fluid samples. The calculated percentage of dye remaining was extremely low in all patients, the maximum value being 0.09%, indicating that virtually all of the preoperative oral fluid had passed through the stomach by the time of surgery. No patient in group 1 had any dye detected in the gastric fluid, indicating complete gastric emptying of the oral fluid administered (Table 2).

The volume of gastric fluid in groups 1 and 2 (150 ml water) could not be correlated with the premedication interval, nor was there any correlation with duration of fast, patient's weight, smoking history, period of gestation, or history of heartburn or vomiting.

The incidence of patients with the combined high-risk factors of residual gastric volume greater than 25 ml and pH less than 2.5 is shown in Table 3. The drinking of 150 ml water significantly decreased this incidence, even in the placebo groups (group 2 vs 3). No patient premedicated with ranitidine (groups 2 and 4) fell into this high-risk category.

The severity of thirst on arrival in the operating room was significantly less than on admission in patients given 150 ml water (Fig. 1). Severity of hunger was unaltered.

Discussion

Pulmonary aspiration of gastric contents during anesthesia is a small but significant cause of anesthesia-related deaths, especially in obstetrics (10,11). Although precise numbers are not known, it is probable that many patients suffer nonfatal aspiration with significant morbidity. The severity of pulmonary damage

is related both to the volume and pH of the inhaled fluid, a combination of more than 25 ml with pH less than 2.5 being considered potentially lethal (12). Any safe treatment or management that reduces this hazard is desirable.

Several studies have demonstrated that the minimum fasting period of 5 hr in patients undergoing elective surgery does not predictably produce a safe gastric volume and pH (13,14). A more prolonged fast of up to 17 hr does not help, as more than one-third of patients still have the high-risk combination of a large gastric volume and low pH (5).

William Beaumont, in his studies on the fistulous stomach of Alexis St. Martin in 1825-1826, observed that fluids emptied rapidly in less than 1 hr (15). During the early years of anesthesia, patients were encouraged to take oral fluids, but not food, on the morning of surgery (16,17). In the 1920s, in Britain, clear fluids in the form of China tea, hot glucose water, or beef tea were given 3 hr before surgery (18,19). Since that time, the period of fasting for clear liquids as well as solids has been extended empirically so that it is now 5 or 6 hr (1,20) or simply nothing by mouth after midnight on the night before surgery (21).

The scientific basis for these changes is not clear. Both saline and glucose-water, unless very concentrated, empty rapidly (4). More than 90% of a 750-ml bolus of isotonic saline empties within 30 min in most patients (22). Furthermore, Miller et al. have shown that, in elective inpatients not receiving a narcotic premedication, tea and toast taken 2-4 hr preoperatively does not adversely affect the volume of gastric contents at the time of surgery (23). The opiates are potent antagonists of gastric emptying, and their role in elective premedication needs further evaluation in this context.

Ranitidine is a selective antagonist of histamine at gastric H₂ receptor sites. Maximum response to oral administration of the drug is achieved with a dose of 150 mg. It is rapidly absorbed after oral administration and inhibits both basal gastric secretions and gastric acid secretion induced by secretagogues. Peak plasma

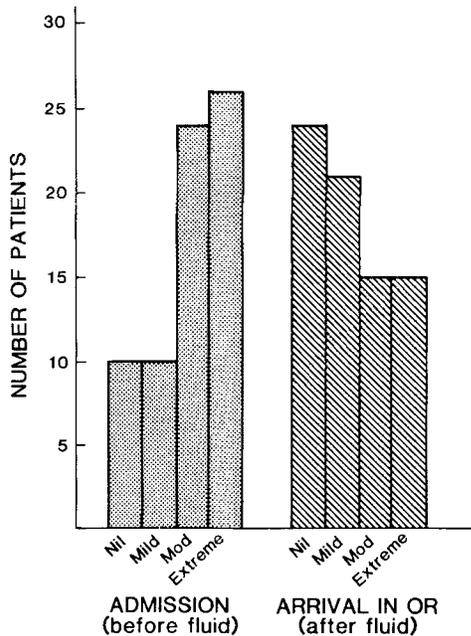


Figure 1. The effect of 150 ml water on the incidence and severity of thirst after 10 hr of fasting.

concentrations are achieved within 2-3 hr, and effective plasma concentrations persist for 8-12 hr (24).

The present study was undertaken to determine whether a 5-hr fast of fluids is necessary or even desirable. Because clear fluids are rapidly emptied from the stomach, it seemed possible that gastric volume and pH might be no worse after 150 ml water than after the traditional prolonged fast. Furthermore, because ranitidine reduces both the volume and acidity of gastric secretion, its use as premedication was expected to produce further improvement.

Our results support these hypotheses. In the patients studied, 150 ml water, even without ranitidine, significantly reduced gastric volume and pH. A possible explanation is that the ingested fluid increased the pressure gradient between the stomach and duodenum, stimulating gastric peristalsis and therefore gastric emptying (25). All our patients were ambulatory in the interval between receiving the dye and arrival in the operating room, so that it may be assumed that the dye was evenly mixed with stomach contents. The extremely low residual concentrations of dye remaining in the stomach at the time of surgery indicates that the gastric volume measured represents not just the fluid ingested with the dye but the gastric secretions produced after most of the dye had passed beyond the stomach. A further benefit of fluid administration found in this study was the significant reduction in preoperative thirst.

Gastric emptying is delayed in late pregnancy (26). However, in this study of first trimester patients, gastric emptying of fluid was rapid. The tone of the lower esophageal sphincter is known to be reduced, and the rate of emptying of the gallbladder decreases progressively during pregnancy (26,27). It is therefore possible that gastric hypomotility is also progressive during pregnancy, even though the volume and acidity of gastric secretions are not altered (14,26).

We conclude that the prolonged withholding of oral fluid does not improve the gastric volume and pH and may indeed worsen them. In this study, 150 ml water reduced residual gastric volume and increased patient comfort by decreasing thirst. Hunger was not altered. Gastric emptying of fluids is rapid in elective female outpatients, who remain ambulatory and who are not given narcotic premedication. It appears safe for such patients to drink up to 150 ml water, preferably with oral ranitidine 150 mg, 2-3 hr preoperatively.

The authors thank the daycare nursing staff and anesthesia colleagues for their cooperation; Mr. D.R. Kirk, gastrointestinal unit faculty technician, for laboratory analyses; and Mrs. C. Harris for secretarial assistance.

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