

Gastric fluid volume and pH in elective inpatients. Part II: coffee or orange juice with ranitidine

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In order to assess the effect of preoperative oral fluids, with and without ranitidine, on gastric fluid volume and pH 300 elective surgical inpatients, ASA physical status I and II, were randomly allocated to one of six groups. The three ranitidine groups (Groups 4, 5, and 6) are discussed in this paper (Part II), and the three placebo groups (Groups 1, 2, and 3) in Part I. Between two and three hours before the scheduled time of surgery, patients received 150 ml coffee with oral ranitidine 150 mg (Group 4), 150 ml orange juice with oral ranitidine 150 mg (Group 5), or oral ranitidine alone (Group 6). No opiate or belladonna premedication was given. Immediately following induction of anaesthesia a #18 Salem sump tube was passed and its position in the stomach confirmed by auscultation of insufflated air. The volume of residual gastric fluid, which was aspirated into a 60 ml syringe, was recorded, and its pH was measured. There were no statistically significant differences between groups with respect to volume (Group 4: 14.3 ± 15.4 ; Group 5: 14.8 ± 17.0 ; Group 6: 9.7 ± 12.6 ml). The mean pH in all groups was greater than 5.40 (Group 4: 5.65 ± 2.12 ; Group 5: 5.41 ± 2.12 ; Group 6: 6.21 ± 1.51).

Key words

GASTROINTESTINAL TRACT: gastric pH, gastric volume, gastric emptying; PHARMACOLOGY: ranitidine; ANAESTHESIA: inpatient, preoperative oral fluids.

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The danger of pulmonary aspiration of gastric contents is always of concern to anaesthetists. Results from animal experiments suggest that, in humans, a residual gastric volume of more than 25 ml with pH less than 2.5 is potentially lethal.¹ More recent experiments in rats demonstrated a 90 per cent mortality rate following pulmonary aspiration of 0.3 ml·kg⁻¹ fluid with pH less than 1.0, but only 14 per cent with 1.0–2.0 ml·kg⁻¹ if the pH was greater than 1.8.²

The authors of studies on gastric fluid volume and pH in elective patients emphasise the morbidity and mortality associated with acid-aspiration syndrome, although the sources which they quote usually refer to obstetric and other high risk groups of patients.^{3–6} Using extrapolation from animal experiments mentioned above, the gastric contents of 30 per cent of elective patients are potentially lethal, even when they fast for 8–17 hr.^{3,6} Despite this apparent hazard the incidence of aspiration-related morbidity in healthy, elective patients with no delay in gastric emptying is less than 1:10,000.⁷ Nevertheless, a regime by which gastric volume and acidity are reduced is desirable, especially if it makes patients more comfortable.

It is routine practice in many hospitals for elective surgical patients to fast from midnight, irrespective of their scheduled time of surgery. Although gastric emptying of liquids is rapid,⁸ fasting guidelines have only recently been questioned.^{9,10} In previous studies from this centre patients who took oral ranitidine 150 mg with 150 ml water 2–3 hr preoperatively had lower mean residual gastric volume (RGV) and higher mean pH than those who simply fasted overnight.^{10,11} In the present study patients were allowed to drink a cup of coffee or a glass of orange juice (150 ml) with oral ranitidine 150 mg 2–3 hr preoperatively. Their RGV and pH values were compared with those of patients who received ranitidine alone.

Methods

The study protocol was approved by the University of Calgary Conjoint Ethics Committee. Informed consent

TABLE I Randomised groups

	<i>n</i>	<i>Fluid</i>	<i>Tablet</i>
Group 1*	50	Coffee 150 ml	Placebo
Group 2*	50	Orange juice 150 ml	Placebo
Group 3*	50	—	Placebo
Group 4	50	Coffee 150 ml	Ranitidine 150 mg
Group 5	50	Orange juice 150 ml	Ranitidine 150 mg
Group 6	50	—	Ranitidine 150 mg

*Groups 1, 2, 3 are discussed in Part I of this paper.

was obtained from inpatients of ASA physical status I or II, aged 18–60 yr, who were scheduled for elective surgery at 1000 h or later. Pregnant, emergency, and ambulatory patients were excluded, as were those receiving drugs known to affect gastric secretion or motility, including opiate or belladonna alkaloid premedication.

Three hundred consecutive patients were stratified by sex, and randomised within strata to one of six groups using a table of random sampling numbers.¹² Three of the groups received placebo and were described in Part I.¹³ This paper, Part II, describes Groups 4, 5, 6 who received oral ranitidine (Table I).

Between two and three hours before the scheduled time of surgery, immediately before randomisation, and again on arrival in the operating room, patients graded the severity of their hunger and thirst as nil, slight, moderate, or severe. Their age, sex, weight, fasting interval, smoking habit, history of heartburn and vomiting within the previous two weeks, and the proposed surgery were recorded. They were then observed as they ingested a ranitidine tablet 150 mg with either coffee 150 ml (Group 4), orange juice 150 ml (Group 5), or water 10 ml (Group 6).

Premedication was limited to oral diazepam 5–15 mg with 30 ml water 60–90 minutes preoperatively. This was prescribed at the discretion of the physician assigned to anaesthetise the patient, and not by the investigators. Following induction of anaesthesia, and tracheal intubation when indicated, a #18 FG Salem-sump tube was passed into the stomach and its position confirmed by auscultation of injected air. With the patient in the supine position, and with the sampling tube in several locations in the stomach, gastric fluid was aspirated into a 60 ml syringe. The investigator taking the sample was unaware of the group to which the patient had been assigned. The volume of fluid was recorded, and its pH was measured using a calibrated Corning 150 pH meter.

Results are given as means, standard deviations, ranges, and correlation coefficients (*r*). Between groups, tests of significance were done using analysis of variance, Student's unpaired *t* test, chi square test, and *t* test for zero

TABLE II Patient characteristics (mean ± SD)

	<i>Age (yr)</i>	<i>Weight (kg)</i>	<i>Overnight fast (hr)</i>	<i>Ingestion interval (min)</i>
Group 4	36.4 ± 11.0	73.1 ± 15.2	11.8 ± 2.8	161 ± 34
Group 5	35.0 ± 11.8	70.9 ± 15.2	12.3 ± 2.1	142 ± 37*
Group 6	35.5 ± 11.3	71.3 ± 15.2	12.2 ± 2.9	159 ± 37

**p* < 0.05 Group 2 versus Groups 1 or 3.

correlation. Within each group, forward multilinear stepwise regression analysis was performed to correlate residual gastric volume (RGV) and pH with patients' age, weight, sex, smoking habit, premedication, duration of fast, ingestion–induction interval, and osmolality and pH of the ingested fluid. A *p* value less than 0.05 was considered statistically significant.

Results

The three groups were comparable with respect to age, weight, and duration of fast (Table II). Although ingestion was 120–180 min before the scheduled time of surgery, the actual ingestion–induction interval ranged from 75 to 240 minutes. The mean interval was significantly shorter in Group 5. There was no significant difference in the incidence of smoking, diazepam premedication, or heartburn among the groups. The distribution of types of surgery was also similar.

The volume and pH values of gastric fluid are shown in Table III. The differences in mean RGV among the three groups were not statistically significant (*p* > 0.1). There was a statistically significant difference in pH values only between Groups 5 and 6 (*p* < 0.05). In patients who ingested coffee the RGV showed no correlation with the ingestion–induction interval (*r* = 0.11, *p* > 0.05). In those who ingested orange juice there was a negative correlation (*r* = -0.42, *p* < 0.05). However, when adjusted for regression on interval, mean volumes in the two groups were not significantly different. In Group 4 three patients gave a history of heartburn. Their mean RGV (22.2 ± 8.8 ml) was higher than in the remaining 47 patients (12.9 ± 15.3 ml) but, because of the small

TABLE III Gastric volume and pH

	<i>Volume (ml)</i>		<i>pH</i>	
	<i>Mean ± SD</i>	<i>Range</i>	<i>Mean ± SD</i>	<i>Range</i>
Group 4 (coffee)	14.3 ± 15.4	0–68	5.65 ± 2.12	1.59–9.16
Group 5 (juice)	14.8 ± 17.0	0–75	5.41 ± 2.12*	1.86–8.30
Group 6 (mil)	9.7 ± 12.6	0–62	6.21 ± 1.51	1.78–7.77

**p* < 0.05 Group 2 versus Group 3.

TABLE IV Incidence of patients with risk factors for acid-aspiration syndrome

	<i>Volume > 25 ml</i>	<i>pH < 2.5</i>	<i>Volume > 25 ml and pH < 2.5</i>
Group 4 (coffee)	10/50	5/42*	3/50
Group 5 (juice)	9/50	5/37*	4/50
Group 6 (nil)	5/50	1/40*	0/50

*The difference between numbers in which pH was measured and numbers per group represents patients from whom no gastric fluid was obtained.

number of patients with heartburn, statistical comparisons were not made. There was no correlation of RGV or pH with age, weight, sex, smoking habit, premedication, duration of fast, ingestion-induction interval, or osmolality and pH of the ingested fluid. The incidence of patients with RGV > 25 ml and pH < 2.5 was less than ten per cent in all groups (Table IV).

Approximately half the patients in all groups showed no change in thirst from the time of ingestion to arrival in the operating room (Table V). The number whose thirst decreased was significantly greater in those who ingested coffee or orange juice (Groups 4 and 5) than in those who continued fasting (Group 6). Only 16 per cent of patients who received oral fluid were moderately or severely thirsty on arrival in the operating room, compared with 40 per cent of those who continued fasting. There was no correlation of changes in hunger with ingestion of fluid.

Discussion

The H₂ receptor blockers cimetidine and ranitidine are effective in reducing the volume and raising the pH of gastric fluid in a high percentage of fasting, elective surgical patients.⁴ Most studies have been conducted on patients who fasted for at least eight hours up to a mean of 17 hr.³⁻⁶ In our previous studies^{10,11} in patients who ingested 150 ml water with oral ranitidine 2-3 hr before surgery, mean volume and pH were the same as in those who took ranitidine alone. As far as we are aware, the

present study is the first to investigate the effects of coffee and orange juice with ranitidine on RGV and pH.

The RGV recorded in this study was the volume aspirated through a #18 Salem sump tube. Although this may underestimate the total volume¹⁴ the sampling error should be small, and consistent across all groups. This method also allows for valid comparison of our results with those of other investigators who used a similar method.

Although mean volumes were greater in patients who drank coffee or orange juice than in those who fasted, the difference was neither statistically nor clinically significant. The six to eight per cent incidence of RGV > 25 ml with pH < 2.5 in the fluid groups is much lower than the 48 per cent incidence in our control group (Group 3 in Part I of this paper) who fasted from midnight and did not receive prophylaxis. Other investigators have found that neither ranitidine nor cimetidine raise the pH above 2.5 in every patient, even when given by intramuscular or intravenous injection.^{3,4} Our mean RGV and pH values with coffee and juice are similar to theirs in patients who fasted for at least eight hours.

Guidelines for preoperative fasting^{17,18} are assumed to set a safe standard for volume and pH of gastric contents at induction of anaesthesia. Our findings suggest that prolonging the oral fluid fast does not improve this standard, while many patients suffer from hunger and thirst. Regimens which reduce morbidity without adversely affecting the gastric environment deserve consideration. Approximately 40 per cent of our patients graded their thirst as moderate or severe at the interview on the morning of surgery. This frequency and severity of discomfort would be justified if it were balanced by increased safety. Compared with fasting patients without ranitidine, patients who received coffee or orange juice with oral ranitidine had lower RGV and higher pH with a reduction in the incidence of moderate or severe thirst. However, it should be remembered that our findings apply only to liquids and only to elective, healthy, non-pregnant patients. Emergency and obstetric patients, and those who received a narcotic premedication, were specifically excluded from this study.

The frequently written "NPO after midnight" order, by which all oral fluids are withheld from healthy, elective patients on the day of surgery is convenient for anaesthetists to write and for nurses to follow. It also causes discomfort to patients without apparent benefit. Unless patients scheduled for late morning or afternoon surgery have delayed gastric emptying or receive a narcotic premedication, the ordering of a total fluid fast for 10-16 hr requires justification. Fears that ingestion of oral fluid on the morning of surgery will invariably result in a large

TABLE V Changes in hunger and thirst: effect of oral fluid

	<i>Hunger</i>			<i>Thirst</i>		
	<i>Less</i>	<i>More</i>	<i>No change</i>	<i>Less</i>	<i>More</i>	<i>No change</i>
Group 4	11	9	30	25*	4	21
Group 5	9	14	27	26*	3	21
Group 6	9	12	29	15	10*	25

Hunger and thirst on arrival in operating room compared with 2-3 hr preoperatively.

*p < 0.05 Groups 1 and 2 versus Group 3.

RGV appear to be unfounded. However, the stomach is rarely completely empty and the anaesthetist must always be prepared for regurgitation and pulmonary aspiration.

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Résumé

Afin d'évaluer l'effet de l'ingestion orale en période pré-opératoire de liquide, avec ou sans ranitidine, sur le volume de liquide gastrique ainsi que son pH; 300 patients admis pour chirurgie élektive classe I ASA et II ont été randomisés en six groupes. Les trois groupes ranitidine (groupe 4, 5 et 6) sont discutés dans cet article (partie II, et les trois groupes placebo (groupe 1, 2 et 3 sont discutés) dans la première partie. Entre deux et trois heures avant le temps cédulé pour la chirurgie les patients ont reçu 150 ml de café avec de la ranitidine par voie orale 150 mg (groupe 4), 150 ml de jus d'orange avec de la ranitidine par voie orale 150 mg (groupe 5), ou de la ranitidine seule (groupe 6). Aucune prémédication aux opiacés ou belladone n'a été administrée. Immédiatement après l'induction de l'anesthésie un tube #18 Salem sump a été introduit et sa position dans l'estomac a été confirmée par auscultation après insufflation d'air. Le volume gastrique résiduel aspiré avec une seringue de 60 ml a été enregistré et son pH mesuré. Il n'y avait aucune différence statistiquement significative entre les groupes par rapport au volume (groupe 4: 14.3 ± 15.4; groupe 5: 14.8 ± 17.0; groupe 6: 9.7 ± 12.6 ml). Le pH moyen dans tous les groupes était supérieur à 5.40 (groupe 4: 5.65 ± 2.12; groupe 5: 5.41 ± 2.12; groupe 6: 6.21 ± 1.51).