

Volume and acidity of residual gastric fluid after oral fluid ingestion before elective ambulatory surgery

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We studied 211 unselected, healthy, adult patients scheduled to undergo elective ambulatory surgery to determine whether the volume or pH of gastric fluid at induction of anesthesia is correlated with the duration of the preoperative fluid fast. Patients were instructed that they must not eat any solid food after midnight but that they were permitted to drink 150 ml of tea, coffee, apple juice or water until 3 hours before their scheduled time of surgery. Patients with gastric disorders and those taking medications that affect gastric motility or secretion were excluded. No premedicant drugs were given. Following induction of general anesthesia the gastric fluid was aspirated through an orogastric tube, its volume recorded and its pH measured with a calibrated pH meter. The patients were retrospectively assigned to one of four groups according to the interval from last fluid ingestion until induction of anesthesia (less than 3 hours, 3 to 4.9 hours, 5 to 8 hours and nothing after midnight). The mean values and extremes for gastric fluid volume and pH were similar in the four groups. We conclude that healthy patients should be allowed to ingest fluid until 3 hours before elective ambulatory surgery.

Nous avons pris au hasard 211 adultes ambulants bien portants sur le point de subir des opérations non urgentes et cherché à savoir s'il existe une corrélation entre le volume et le pH du suc gastrique au moment de l'induction de

l'anesthésie et la durée du jeûne préopératoire. On leur a interdit de manger depuis minuit mais leur a permis de boire 150 ml de thé, de café, de jus de pomme ou d'eau jusqu'à 3 heures avant le moment prévu de l'intervention. On exclut les porteurs de maladies gastriques et les sujets qui prennent des médicaments susceptibles de modifier la motilité ou la sécrétion gastrique. Il n'est donné aucun médicament pré-anesthésique. Une fois l'anesthésie induite, on vide le contenu gastrique par une sonde, en mesure le volume et détermine le pH par un pH-mètre calibré. De façon rétrospective on distribue les sujets en quatre groupes selon que l'intervalle entre leur dernière entrée liquidienne et l'induction de l'anesthésie est de moins de 3 heures, de 3 à 4,9 heures, de 5 à 8 heures, ou qu'aucun liquide n'a été ingéré depuis minuit. Les moyennes et les chiffres extrêmes du volume et du pH sont les mêmes dans les quatre groupes. Nous en concluons que le sujet ambulant bien portant devrait avoir le droit de boire jusqu'à 3 heures avant une intervention non urgente.

The gastric contents at induction of anesthesia consist of swallowed saliva, gastric secretions and any ingested material that remains in the stomach. Fasting patients continue to produce saliva and up to 50 ml per hour of gastric secretions.¹ However, neither ingested fluid, which passes rapidly through the pylorus, nor secretions normally accumulate in the stomach of healthy people. Preoperative fasting causes hunger, thirst and dehydration.^{2,3} Fasting for long periods is justified only if it consistently minimizes the volume of gastric contents that could be regurgitated or vomited during anesthesia. Investigators in several centres have shown that healthy patients who ingest clear fluids 2 to 4 hours before

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surgery do not have larger gastric fluid volumes than those who fast from midnight or longer.³⁻⁸ Our anesthesia department therefore changed its fasting guidelines for patients scheduled to undergo elective ambulatory surgery from "nothing by mouth after midnight" to allow 150 ml of fluid orally up to 3 hours before surgery.

This was a significant change in clinical practice. Because it was the first such change in Canada, and because of concerns expressed by colleagues in other centres, we carried out a follow-up study. Its aims were to determine whether the revised guidelines resulted in indiscriminate eating and drinking by patients on the day of surgery and whether, provided the fluid fast exceeds 2 hours, there is any correlation between this interval and the volume and pH of gastric fluid.

Methods

The study protocol was approved by the University of Calgary's Conjoint Medical Ethics Committee. Informed consent was obtained from 211 consecutive, unpremedicated ambulatory patients with an American Society of Anesthesiologists physical status rating of I or II who were to undergo minor elective orthopedic, gynecologic or otorhinolaryngologic procedures between July and December 1988. They were given written preoperative instructions, including not to eat any solid food after midnight and to drink a cup or glass (150 ml or 6 oz) of coffee, tea, apple juice or water 1 hour before leaving home on the morning of surgery. Patients were requested to register in the ambulatory surgery centre 2 hours before the

scheduled time of surgery. Patients with gastric disorders and those taking medications that affect gastric motility or secretion were excluded from the study. Sex, age, weight, smoking habits, history of heartburn, type of surgery and time of last fluid intake were recorded.

After induction of general anesthesia an orogastric no. 18 Salem sump tube (Medovations Inc, Milwaukee, Wisconsin) was passed and its position in the stomach confirmed by means of auscultation over the epigastrium for insufflated air. With the patient in the supine position the gastric fluid was aspirated into a 60-ml syringe while the tube was manipulated into several positions within the stomach and an assistant massaged the patient's upper abdomen. The volume of fluid was recorded, and its pH was measured with a Corning 150 pH meter (Corning Glass Works, Elmira, New York) calibrated at pH 4 and 7.

The patients were retrospectively assigned to one of four groups according to the interval from last fluid intake until induction of anesthesia: less than 3 hours, 3 to 4.9 hours, 5 to 8 hours and nothing by mouth after midnight.

We performed tests for significant differences in residual gastric fluid volume and pH between groups and between strata (age, sex, weight [less than 80 kg v. 80 kg or more] and smoking status) within groups using analysis of variance. Differences were considered statistically significant when the p value was less than 0.05.

Results

The four groups were comparable with respect to sex, age and weight (Table I). There was a wide

Table I — Demographic features of 211 elective ambulatory surgery patients, by fasting interval

Feature	Fasting interval, h			
	< 3 (n = 39)	3-4.9 (n = 82)	5-8 (n = 33)	> 8* (n = 57)
Sex, no.				
Women	27	56	17	31
Men	12	26	16	26
Mean age (and standard deviation [SD]), yr	33 (12)	35 (10)	34 (13)	31 (10)
Mean weight (and SD), kg	69 (16)	72 (16)	72 (20)	73 (17)

*Nothing by mouth after midnight.

Table II — Mean gastric fluid volume and pH in the four groups

Variable	Fasting interval, h			
	< 3	3-4.9	5-8	> 8
Gastric fluid volume, ml				
Mean (and SD)	25 (21)	24 (20)	31 (24)	26 (22)
Extremes	0, 90	0, 88	1, 90	0, 120
pH				
Mean (and SD)	1.6 (1.0)	1.9 (1.1)	2.2 (1.7)	1.7 (0.7)
Extremes	1.1, 7.2	1.0, 7.3	1.1, 7.9	1.0, 5.9

range of gastric fluid volumes in all groups (Table II), and differences between groups were not statistically significant. Within groups there was no correlation of gastric fluid volume or pH with age, weight or smoking status. The number of patients with a history of heartburn was too small for statistical analysis. The absolute gastric fluid volume but not the volume per kilogram was significantly greater in men than in women. Not all patients who drank fluid adhered strictly to the recommended volume: 25 patients drank less than 150 ml, and 40 patients drank more than 150 ml. There was no correlation between volume of fluid ingested and gastric fluid volume. No patient reported eating solid food on the day of surgery.

Discussion

While it is desirable that there should be no solid matter in the stomach when chloroform is administered, it will be found very salutary to give a cup of tea or beef-tea about two hours previously.

— Lord Lister, 1882⁹

Solid food must be liquefied in the stomach before it enters the small intestine. The length of time required for this to occur depends on the type of food ingested, being shorter for carbohydrates and protein than for fats and cellulose, and the size of the food particles.^{10,11} Complete emptying of solids from the stomach usually takes from 3 to 6 hours but may be prolonged by fear, pain or opioid medication.¹² It is therefore appropriate that no solid food be eaten on the day of surgery.

The routine preoperative order "nothing by mouth after midnight" applies to both liquids and solids and has become engrained in North American anesthetic practice. It takes no account of the rapid gastric emptying of liquids, which usually pass through the stomach within 2 hours, or of the scheduled time of surgery. Patients whose surgery is scheduled in the afternoon commonly fast for 14 hours or more.^{2,3} Nevertheless, many anesthesiologists and surgeons believe they have valid reasons for their adherence to ordering the absolute fast from midnight; others find "nothing by mouth after midnight" a simple order for nurses and patients to understand.

The main concern of anesthesiologists is that shortening the preoperative fast would be at variance with the recommendations in authoritative textbooks^{13,14} and thus with the current standard of practice. Therefore, any complication that might be attributed to deviation from that standard would be medicolegally indefensible. However, clinical studies show that these recommendations are not scientifically valid for liquids.³⁻⁸ Use of a marker dye to assess gastric emptying in elective surgery patients confirms that in almost all patients clear fluids pass through the stomach within 2 hours.^{3,4,15} The Canadian Anaesthetists' Society's

suggestion of a minimum 5-hour fast¹⁶ is under review.

A second concern is that if patients are allowed to drink liquids, some may also eat bacon, eggs, toast or anything else they wish. Our experience in the year since our guidelines were changed is that this fear is unfounded. Approximately 20% of patients volunteered that they drank more than the recommended volume, but all denied that they had eaten any solid food.

A third reason for adhering to the current standard is that if an operation scheduled for early in the day is cancelled at short notice, surgery time may be wasted if patients scheduled for surgery later in the day have been allowed to drink on the morning of surgery. In our experience, delays and cancellations have been less frequent than when patients disobeyed our former "nothing by mouth after midnight" guideline. Many patients drank their fluid 1 hour before leaving home to register at the hospital 2 hours before their scheduled time of surgery, but their actual fasts were often longer than 3 hours because of travelling time or because of delays in the surgical schedule; others chose not to drink.

Passive regurgitation of gastric contents can occur only if the intragastric pressure exceeds the protective tone of the lower esophageal sphincter. For pulmonary aspiration to occur the protective airway reflexes must also be abolished.¹⁷ The severity of pulmonary damage increases as the pH of aspirated fluid falls below 2.5 and, to a lesser extent, as the volume increases above 25 ml.^{18,19} Although the volume of gastric contents obtained by means of aspiration through an orogastric tube underestimates the true residual gastric fluid volume,²⁰ the same technique was used in all patients in our study. The results are therefore valid for comparison among groups and with those from other studies in which this technique was used.²⁻⁸ Use of a dye dilution technique is more complicated but not necessarily more accurate.²¹ The observed differences in gastric fluid volume and pH between the groups in our study were neither clinically nor statistically significant. Therefore, reduction of the fluid fast to 3 hours neither increased nor decreased the risk of regurgitation or aspiration pneumonitis.

We conclude that healthy patients should be allowed to drink clear fluid until 3 hours before their scheduled time of elective ambulatory surgery. This conclusion should not be applied to obstetric cases or to patients who are to undergo emergency surgery. The risk of unexpected regurgitation or vomiting is not altered, and the anesthesiologist must always be prepared to deal with these complications.

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