PREOPERATIVE FASTING GUIDELINES

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Clinically significant pulmonary aspiration during general anaesthesia is rare in healthy patients having elective surgery. The largest study reports an incidence of 1 in approximately 10,000 patients, with no deaths in more than 200,000.[1] The majority of serious cases of pulmonary aspiration occur in emergency cases, particularly trauma, obstetrics and abdominal surgery in which delayed gastric emptying may be further prolonged by administration of opioid narcotic analgesics. If, in addition, tracheal intubation is difficult, anaesthesia is allowed to lighten and suxamethonium (succinylcholine) to wear off, repeated attempts at laryngoscopy may precipitate gagging, vomiting and aspiration. [1]

Fasting guidelines

The purpose of fasting guidelines for healthy patients undergoing elective surgery is to minimize the volume of gastric contents while avoiding unnecessary thirst and dehydration. Dehydration is particularly important in hot countries. Guidelines should be based on clinical studies in surgical patients or, when this evidence is not available, on the physiology of digestion and gastric emptying. Although the earliest books on anaesthesia did not mention fasting, in 1883 the famous surgeon Lister [2] recommended that there should be no solid matter in the stomach, but that patients should drink clear liquid about 2 hours before surgery. For the next 80 years until the 1960s most textbooks recommended a 6-hour fast for solids and 2-3 hours for clear liquids.

During the 1960s in North America the preoperative order 'nothing by mouth after midnight' was applied to solids as well as liquids. The change was widely accepted although the reasons for it have been lost in the mists of time. Pulmonary aspiration was known to be one of the leading causes of anaesthetic related mortality. Concern about the risk of pulmonary aspiration was fuelled by Roberts and Shirley's 1974 statement[3] that patients with 0.4ml/kg (25ml in adults) of gastric contents, with pH <2.5 are at high risk of pulmonary aspiration. However, Roberts and Shirley did not establish a relationship between volume in the stomach and volume aspirated into the lungs.[4,5] They later revealed that that they had drawn their conclusion after instilling 0.4ml/kg acid into the right mainstem bronchus in one experiment in one monkey.

The myth of 25ml in the stomach being a surrogate marker for high risk of aspiration is now discredited. [6] Clinical studies show that 40-80% of fasting patients fall into that category, [7] yet the incidence of pulmonary aspiration is 1 in 10,000. Raidoo et al[8] have demonstrated that 0.8ml/kg in the trachea of monkeys (equivalent to >50ml in adult humans) is required to produce pneumonitis. For this volume to reach the lungs, the volume in the stomach must be greater, even if the lower and upper oesophageal sphincters are incompetent.

Gastric pressure

The human stomach is a very dispensable organ and can accommodate up to 1000ml before intragastric pressure increases.[9] In cats, whose lower oesophageal sphincter mechanism is similar to that in humans, the minimum volume of gastric fluid required to overcome the sphincter varies from 8ml/kg to >20ml/kg.[10] In humans, the lower figure is equivalent to approximately 500ml and the higher one 1200ml. The volume of gastric contents after an overnight (> 8 hours) fast averages 20 to 30ml, and varies from 0 to >100ml (Table 1). Therefore, unless the patient has an incompetent sphincter, reflux of gastric contents does not occur with the normal range of fasting gastric volumes. If we know how long the stomach takes to return to the fasting state, we can formulate appropriate fasting guidelines for elective surgery.

Gastric emptying

Modern physiological studies use a dual isotope technique in which solids and liquids are tagged with different radioactive isotopes.[11] Clear liquids empty exponentially, 90% within 1 hour and virtually all within 2 hours. They do not contain particles >2mm and therefore pass immediately through the pylorus. The pylorus prevents passage of particles >2mm, so digestible solids (bread, lean meat, boiled potatoes) must be broken down to particles <2mm before they can pass into the small bowel. Total emptying of a meal normally takes 3-5 hours. Large particles of indigestible food, especially cellulose-containing vegetables, empty by a different mechanism, after the stomach has emptied liquid and digestible food, that may take 6-12 hours.

Gastric physiology therefore suggested that 'nothing by

Table 1. Preoperative oral fluid: Residual gastric fluid volume (RGFV) and pH

			Drink on day of surgery		Nothing by mouth from midnight	
Year	Author	Oral Intake	Mean Fast	RGFV (ml)	Mean Fast	RGFV (ml)
1983	Miller et al (UK)	toast and tea/coffee	3¼h	11 (0-43)	9h	9 (0-42)
1986	Maltby et al (Canada)	water 150ml	2½h	18 (0-56)	16½h	27 (0-80)
1987	Sutherland et al (Canada)	water 150ml	2½h	21 (0-50)	13½h	30 (2-75)
1988	Hutchinson et al (Canada)	coffee/juice 150ml	2½h	24 (0-96)	14½h	23 (0-75)
1988	McGrady et al (UK)	water 100ml	2h	17 (4-52)	12h	35 (0-58)
1989	Agarwal et al (India)	water 150ml	2½h	21 (0-50)	12h	30(0-75)
1989	Scarr et al (Canada)	coffee/juice 150ml	2-3h	25 (0-90)	>8h	26(0-120)
1991	Maltby et al (Canada)	coffee/juice no limit	2-3h	22 (3-70)	>8h	25(0-107)
1991	Ross et al (USA)	water 225ml	½h	21±18	>8h	30 ± 2
1991	Mahiou et al (France)	Clear liquid 1000ml	2h	38±18	11h	35 ± 15
1993	Lam et al (Hong Kong)	water 150ml	2-3h	26 (3-66)	11½h	22 (1-78)
1993	Phillips et al (UK)	clear liquid, no limit	2¼h	21 (0-80)	13h	19(0-63)
1993	Søreide et al (Norway)	water 300-450ml	1½h	23±20	13h	31 ± 30

Values are mean (range) or mean ± SD

mouth after midnight' is logical for solid food but that patients could safely drink clear liquids on the day of surgery. Nevertheless, entrenched beliefs, those built on false premises, are difficult to dislodge. Double blind, randomized clinical trials in surgical patients were required.

Clinical Studies

In 1983, Miller et al reported no difference in gastric fluid volume or pH in patients who were 'nothing by mouth' after midnight' and those who had tea and toast 2-4 hours before surgery.[12] Since then clinical studies with clear liquids in adults (Table 1) and children[13,14] have confirmed those findings. Fasting guidelines at Foothills Medical Centre in Calgary were changed in 1988. Since then, 'nothing by mouth after midnight' has applied only to solids, and clear liquids are encouraged until 3 hours before the *scheduled* time of surgery, or 2 hours before the *actual* time of surgery. Follow-up studies in more than 400 patients showed no difference in gastric fluid or pH at induction of anaesthesia between those who drank and those who fasted from midnight, nor did the volume ingested (50-1200ml) influence the residual volume in the stomach. This is not surprising because clear liquids empty within 2 hours. Gastric contents after that time consist of gastric secretions and swallowed saliva, as in patients who fast from midnight.

'Clear liquids' include water, apple juice, carbonated beverages, clear tea and black coffee. Sugar may be added to tea or coffee, and 10ml (two teaspoons) of milk. Milk, or tea or coffee made with milk, is treated as a solid because, with gastric juice, it forms a thick

flocculate that takes up to 5 hours to empty forms the stomach. Although chewing gum stimulates salivation; it does not significantly increase gastric fluid volume or acidity,[15] but the gum must be removed from the patient's mouth before induction of anesthesia! Apart from Miller et al no investigators have allowed solid food on the day of surgery. When patients do eat solid food, the time of surgery should be decided according to the type of food ingested.

Delayed Gastric Emptying

Disorders of gastric motility, pyloric obstruction, gastroesophageal reflux and diabetic gastroparesis delay gastric emptying. Indigestible solids are the first to be affected, followed by digestible solids and finally liquids. Because the rate of gastric emptying of clear fluids is not affected until these conditions are far advanced, most patients may still be allowed to drink on the morning of surgery. Different investigators have found obese patients to have either a larger[16] or smaller[17] residual fasting gastric fluid volume than non-obese patients. These comments only apply to patients scheduled for elective surgery. All emergency cases, especially those involving trauma and women in labour, should always be assumed to have delayed gastric emptying.

Gastric emptying is normal in all three trimesters of pregnancy and beyond 18 hours post-partum, but is delayed in the first 2 hours post-partum.[18] Labour causes an unpredictable delay in gastric emptying that is markedly potentiated by opioids.[19] Nevertheless, there is a move towards less rigid fasting guidelines during labour, especially in women who are not expected to require operative intervention.[20]

Development of American Society of Anesthesiologists (ASA) fasting guidelines

The ASA formed a Task Force in 1996 to review relevant clinical human research studies published 1966 to 1996. Over 1100 citations were initially identified, of which 232 articles contained relationships between preoperative fasting and pharmacological prophylaxis of pulmonary aspiration. Expert opinion was also obtained from international anaesthesia and gastroenterologist consultants in preparing clinical guidelines for preoperative fasting (Table 2) and pharmacological prophylaxis in healthy patients undergoing elective (elective) surgery. These were approved by the House of Delegates at the 1998 ASA Annual Meeting and were published in the March 1999 issue of Anesthesiology.[21] The Canadian Anesthesio-logists' Society has published similar guidelines.[22]

Implementation of new fasting guidelines

Cooperation of anaesthesia colleagues, surgeons and nurses are essential for implementation. In our hospital, we presented the evidence at a meeting of the anaesthesia department, then to a joint meeting of surgeons and

Table 2. American Society of Anesthesiologists fasting guidelines

Ingested material	Minimum fast[a]
Clear liquids[b]	2 hours
Breast milk	4 hours
Infant formula	6 hours
Non-human milk	6 hours
Light meal[c]	6 hours

a Fasting times apply to all ages.

b Examples: water, fruit juice without pulp, carbonated beverages, clear tea, black coffee.

c Example: dry toast and clear liquid. Fried or fatty foods may prolong gastric emptying time. Both amount and type of food must be considered.

The guidelines recommend no routine use of gastrointestinal stimulants, gastric acid secretion blockers or oral antacids.

anaesthetists, and also to a meeting of head nurses of our surgical wards. The clinical heads of anaesthesia and surgery then sent a joint letter to all consultant and trainee surgeons and anaesthetists, with copies to the head nurses to provide details of the revised guidelines. The nursing staff then used the guidelines to revise the fasting instructions in the hospital's nursing policy manual

Conclusion

The order 'nothing by mouth after midnight' should apply only to solids for patients scheduled for surgery in the morning. An early light breakfast of easily digested toast or similar food with clear liquid is permissible for afternoon cases. Clear liquids should be allowed until 3 hours before the scheduled time of surgery so that a change in the surgical schedule can be made and still allows 2 hours before the actual time of surgery. For patients with true gastroesophageal reflux, whether or not they drink, an H_2-receptor blocker (ranitidine) or proton pump inhibitor (omeprazole) may be advisable to minimize gastric acid secretion.

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