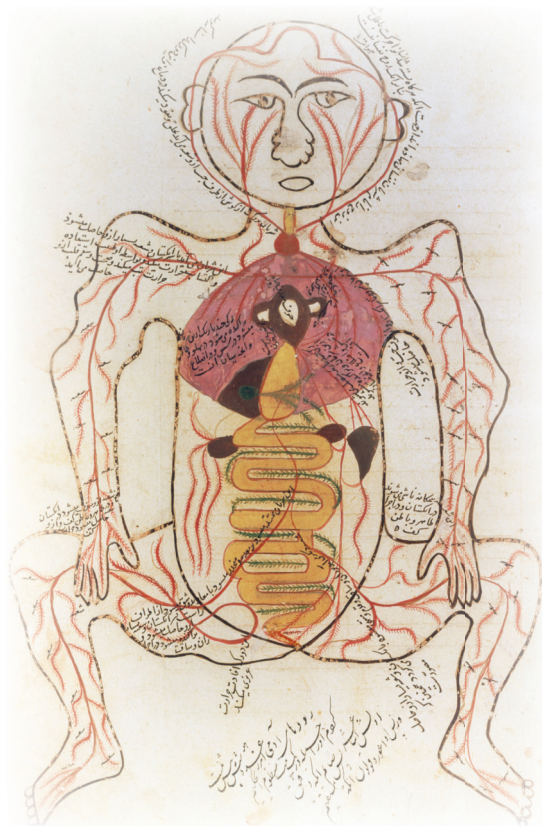


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Preoperative Fasting: Will the Evidence Ever Be Put into Practice?

In 1999, the American Society of Anesthesiologists called for less restrictive preoperative fasting, yet clinicians continue to prescribe NPO after midnight.



Overview: Decades of research support the safety and health benefits of consuming clear liquids, including those that are carbohydrate rich, until a few hours before elective surgery or other procedures requiring sedation or anesthesia. Still, U.S. clinicians routinely instruct patients to fast for excessively long preoperative periods. Evidence-based guidelines, published over the past 25 years in the United States, Canada, and throughout Europe, recommend liberalizing preoperative fasting policies. To improve patient safety and health care quality, it's essential that health care professionals abandon outdated preoperative fasting policies and allow available evidence to guide preanesthetic practices.

Keywords: aspiration, fasting, gastric fluid volume, pneumonia, preoperative care, preprocedural fasting, preoperative carbohydrate loading

Imagine two patients diagnosed with colon cancer, both scheduled for colectomy tomorrow morning: Susan Moore, who lives in New York City, and Paul Shaw, who lives in London. In all likelihood, Ms. Moore will be instructed to stop eating and drinking at midnight, whereas Mr. Shaw will probably be advised to drink a carbohydrate-rich clear liquid this evening as well as tomorrow morning and continue drinking clear liquids until two hours before surgery. Why the disparity? Preoperative fasting practices in the United States often disregard both the guidelines of the American Society of Anesthesiologists (ASA)^{1,2} and the most current available evidence on the subject. The ASA recommends that healthy patients consume clear

show a progressive decline in aspiration incidence, from 0.15% in 1946¹³ to 0.006% in 2002.¹⁴ As for stomach contents at the time of surgery, rates of gastric emptying vary widely, depending on the type of liquid or food consumed.^{3,5} Clear liquids leave the stomach almost immediately, while full liquids and solids remain for significantly longer periods. It's long been established that patients who drink clear liquids a few hours before surgery have significantly lower gastric volumes and similar or higher pH values compared with those who fast overnight, suggesting that drinking clear liquids may stimulate gastric emptying and dilute acidic gastric secretions, thereby lowering the risk of pulmonary aspiration and increasing patient safety.¹⁵⁻¹⁷

Fasting instructions for healthy presurgical patients should be based on the known differences in gastric transit times of clear liquids, full liquids, and other foods.

liquids up to two hours before elective surgery or conscious sedation but cautions that their guidelines aren't intended for women in labor and may need to be modified for patients with conditions that affect gastric emptying or fluid volume and those in whom airway management may be difficult.^{3,5} Evidence gathered throughout the world over the past 25 years not only supports the ASA guidelines, but establishes the health benefits of preoperative carbohydrate loading (through the consumption of carbohydrate-rich clear liquids) the evening before and the morning of surgery.^{6,7} So why does the practice of prescribing NPO (*non per os*, or nothing by mouth) from midnight preceding a scheduled surgery persist—and how can clinicians promote a change?

A PRACTICE BASED ON MYTH

The U.S. practice of requiring an extended fast before scheduled anesthesia or sedation is based primarily on the following three myths⁸⁻¹²:

- **Myth:** Overnight fasting from all solids and liquids is the optimal approach to reduce the risk of pulmonary aspiration during anesthesia.
- **Myth:** Gastric emptying time is the same for clear liquids as for full liquids (those that are not transparent, such as milk, creamed soup, and nonstrained fruit juice) and solids.
- **Myth:** Clear liquids ingested up to two hours before surgery increase the risk of vomiting and pulmonary aspiration.

In fact, increased awareness of risk factors for aspiration, together with modern anesthetic practices¹⁰ and improved anesthetic agents, has dramatically reduced the risk of pulmonary aspiration. Large studies

The custom of preoperative fasting was introduced in the mid-1800s to minimize vomiting associated with the anesthetic chloroform.⁹ Although physicians of that era recognized that a recent meal increased the risk of chloroform-associated vomiting, they encouraged patients to drink clear liquids until a few hours before surgery. In fact, the 19th-century British surgeon Joseph Lister, who founded antiseptic medicine and wrote what may be the first published preoperative fasting guidelines, clearly distinguished between the effects of solids and liquids on chloroform-anesthetized patients. He advised surgeons, "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."⁹

By the end of the 19th century, Lister's advice was being followed and patients were commonly permitted a cup of "beef tea" (beef bouillon) a few hours before surgery.¹² This practice of differentiating liquids from solids in preoperative instruction prevailed until after World War II, when Mendelson documented an asthma-like syndrome of expiratory wheezing, dyspnea, cyanosis, and pulmonary lesions following the aspiration of stomach contents by obstetric and laboring patients who were under general anesthesia and not intubated.^{9,13} Soon after, the standard of care for surgical patients was to prescribe NPO after midnight.^{9,10,12,18}

RESISTANCE TO REVISED GUIDELINES

Over the past 25 years, professional organizations of anesthesiologists and anesthesiologists in Canada, the United States, and Europe revised their guidelines on preoperative fasting in light of a growing body of evidence that healthy patients who consume clear liquids until

a few hours before anesthesia or sedation are as safe as and more comfortable than patients who fast for six to eight hours beforehand.^{3,5,19-21} In 2003, a systematic review of 22 randomized controlled trials found that patients who drank clear liquids up to 90 minutes before surgery were at no greater risk of vomiting, aspiration, or related morbidity during anesthesia or sedation than were fasting patients, regardless of the volume of clear liquids they consumed.²⁰ In 2009, the American College of Gastroenterology revised its guidelines for colorectal cancer screening, emphasizing the importance of “aggressive hydration before and during” colonoscopy preparation and referencing ASA guidelines that support clear liquids until two hours before procedures requiring sedation.^{4,22}

Unfortunately, the publication of new evidence and revised practice guidelines doesn’t ensure their dissemination and implementation. Colleagues at hospitals throughout the United States have indicated that “NPO after midnight” is commonly prescribed for presurgical patients. A study of 155 adults at one U.S. medical center who underwent surgery between November 1999 and May 2000—eight to 14 months after publication

of the ASA guidelines—found that the majority of patients (91%) were instructed to remain NPO after midnight.¹ On average, patients fasted 12 hours from liquids and over 14 hours from solids, but some fasted for up to 20 hours from liquids. A follow-up quality improvement study involving 275 surgical patients was conducted at the same institution between June and October 2004—two years after a liberalized preoperative fasting policy had been put into effect and introduced through an intensive education program.² Findings revealed little improvement in practice. Again, most patients (85%) were instructed to remain NPO after midnight, and fasting times were similar to those in the 2000 study: patients fasted from clear liquids for an average of 11 hours and from solids for an average of over 14 hours.

EMERGING EVIDENCE ON PREOPERATIVE CARBOHYDRATE LOADING

U.S. preoperative fasting instructions for healthy patients should be based on the known differences in gastric transit times of clear liquids, full liquids, and other foods (see Table 1).³⁻⁵ Instructions should at first focus on liberalizing clear liquid policies because it’s here that we see the greatest difference between routine preoperative instructions (NPO after midnight) and evidence-based guidelines.^{1,2} But that’s not enough. Updated guidelines, based on current literature, clinical data, and expert opinion, show that having a light meal, such as toast and a clear liquid, up to six hours before surgery poses no greater risk of aspiration for healthy presurgical patients than remaining NPO after midnight.³⁻⁵ Moreover, studies have shown that prolonged fasting is not benign.

In addition to discomforts such as thirst, hunger, anxiety, drowsiness, and dizziness, excessive preoperative fasting may have adverse physiologic effects, including dehydration, insulin resistance, postoperative hyperglycemia, muscle wasting, and a weakened immune response.^{18,23-25} Clear liquids, taken alone, may be insufficient to ward off such effects. Emerging evidence suggests that, in addition to offering clear liquids up until two hours before anesthesia or sedation, the best way to avert the harmful consequences of preoperative fasting is to prescribe a carbohydrate-rich clear beverage to be consumed two to three hours before the scheduled procedure (see *The Benefits of Preoperative Carbohydrate Loading*^{6,23,24,26-29}). This type of preoperative preparation has been shown to reduce postoperative insulin resistance,^{24,30-34} nausea and vomiting,³⁵ and loss of muscle strength.^{29,36} It’s also associated with a shorter hospital length of stay.²⁴ Based on evidence from the past decade that strongly supports the benefits of preoperative carbohydrate loading, the European Society for Clinical Nutrition and Metabolism,⁶ the British Association for Parenteral and Enteral Nutrition, the Association for Clinical Biochemistry, the Association of Surgeons of Great Britain and Ireland,

Table 1. Summary of the American Society of Anesthesiologists Preoperative Fasting Guidelines for Healthy Patients of All Ages^a

Ingested Material	Minimum Fasting Period (hr)
Clear liquids ^b	2
Breast milk	4
Infant formula	6
Nonhuman milk ^c	6
Light meal ^d	6
Regular meal	8

^a The guidelines are intended only for healthy patients who are undergoing elective procedures with anesthesia (general or regional), sedation, or analgesia. They are not intended for women in labor and may need to be modified for patients in whom airway management may be difficult and for patients with reduced gastric emptying or conditions that affect fluid volume (such as pregnancy, obesity, diabetes, hiatal hernia, gastroesophageal reflux disease, and ileus or bowel obstruction).³⁵

^b Clear liquids include water, fruit juices without pulp, carbonated beverages, clear tea, and black coffee.

^c Since nonhuman milk is similar to solids in gastric emptying time, the amount ingested must be considered when determining an appropriate fasting period.

^d A light meal might consist of clear liquids and toast.

Source: Practice guidelines for preoperative fasting and the use of pharmacologic agents to reduce the risk of pulmonary aspiration: application to healthy patients undergoing elective procedures: an updated report by the American Society of Anesthesiologists Committee on Standards and Practice Parameters. *Anesthesiology* 2011;114(3):495-511.

The benefits of preoperative carbohydrate loading

Some of the science behind the practice.

While U.S. surgeons have described preoperative carbohydrate loading as “promising” but preliminary,²⁶ the European Society for Clinical Nutrition and Metabolism recommends oral preoperative carbohydrate loading for most patients.⁶ Here’s how it can mitigate some of the more dangerous consequences of preoperative fasting.

Insulin resistance. Even after brief periods of fasting, metabolism slows to forestall starvation, dramatically reducing insulin sensitivity.^{24, 27} The trauma of surgery also produces insulin resistance, but unlike fasting, surgery speeds the metabolic rate, accelerating catabolism. Insulin levels rise in compensation, but because cells are resistant to it, blood glucose levels rise as well, lowering the ratio of insulin to glucagon and intensifying gluconeogenesis. By reducing insulin sensitivity, prolonged preoperative fasting exacerbates the metabolic stress of surgery, both during the procedure and—depending on the scale of the surgery and the recovery period—for up to several weeks thereafter. The resultant hyperglycemia is associated with increased morbidity and hospital length of stay.

Providing the patient with a carbohydrate-rich beverage two to three hours before surgery ameliorates the metabolic response to the fasting state. In a series of randomized studies, patients were given either a glucose infusion or a 400 mL drink containing 50 g of glucose two to three hours before surgery.²⁴ Gastric emptying occurred within two hours of consumption; two to three hours afterward, insulin was measured at normal postprandial levels with insulin action having increased by 50%.

A double-blind, randomized controlled trial of 252 Swedish patients scheduled for abdominal surgery examined plasma glucose and serum insulin levels, preoperative discomfort, residual gastric volume, and gastric acidity in those who fasted from midnight and those who consumed either flavored water (placebo) or a carbohydrate-rich clear liquid the evening before surgery (800 mL) and at the hospital about two hours before anesthesia induction (400 mL).²⁸ Glucose and insulin levels were measured in all three groups before the beverages were consumed, 40 and 90 minutes afterward, and following induction, when stomach contents were aspirated and analyzed.

The researchers found no significant differences in gastric volumes or pH between the groups and

reported no adverse outcomes from consuming the beverages. After drinking the carbohydrate beverage, patients reported thirst, hunger, and anxiety that was significantly less than the thirst, hunger, and anxiety reported by the water and control groups. Before morning beverages were consumed, glucose and insulin levels didn’t differ between the groups. As expected, 40 and 90 minutes after consumption of the carbohydrate beverage, glucose and insulin levels were significantly higher in the carbohydrate group than in the other two groups. At induction, however, the carbohydrate group had significantly lower glucose levels than the others, although their insulin levels remained significantly higher.

Immune function. The stress response to surgery substantially weakens a patient’s immune system. To explore the effects of preoperative carbohydrate-rich beverages on the immune response to surgery, Dutch researchers measured human leukocyte antigen (HLA)-DR expression on monocytes in blood samples collected from 30 healthy patients the day before and the day after they underwent elective orthopedic surgery.²³ Patients had been randomly assigned to fast overnight or to consume one of two carbohydrate-rich beverages with equivalent carbohydrate content. After surgery, the HLA-DR expression on monocytes had decreased significantly in the fasting group, but there was no drop in the two carbohydrate groups, suggesting that the carbohydrate-rich beverages preserved immune function.

Muscle wasting. Because fasting depletes glycogen stores, requiring the body to generate glucose from noncarbohydrate sources, it may contribute to postoperative muscle wasting, a clear risk to frail patients and a potential impediment to rehabilitation in all patients.²⁹ A group of Scottish researchers studied whether providing usable energy in the form of preoperative carbohydrate-rich beverages could protect against postoperative muscle loss.²⁹ Investigators randomly assigned 65 patients, who’d been admitted for major elective abdominal surgery, to receive 800 mL of either a placebo drink (n = 34) or a carbohydrate-rich drink (n = 31) 12 hours before surgery and an additional 400 mL of the assigned beverage two to three hours before anesthesia induction. Loss of muscle mass, indicated by reduced arm muscle circumference, was significantly greater in the placebo group than in the carbohydrate group.

the Society of Academic and Research Surgery, the Renal Association, the Intensive Care Society,³⁷ and the Scandinavian Society of Anaesthesiology and Intensive Care Medicine¹¹ have all endorsed guidelines that recommend providing a carbohydrate-rich clear beverage two to three hours before surgery, in addition to other clear liquids.

REASONS FOR RESISTANCE

Restrictive preoperative fasting instructions are slow to change for a number of reasons. Some U.S. health care providers may be unaware of the ASA guidelines and the numerous studies supporting liberalized preoperative guidelines.³⁸ Others may have an unwarranted fear of pulmonary aspiration risk in healthy patients undergoing elective procedures and false perceptions that fasting from midnight is safer than not and that intravenous fluids sufficiently compensate for prolonged fasting.^{8,10,20} Some clinicians believe that patients would be confused by instructions specifying different fasting durations for solids, liquids, and clear liquids,³⁹ or that implementing individualized instructions would require more time and personnel than relying on the single instruction, “NPO after midnight.”⁴⁰ Lengthy preoperative fasts are also commonly perceived as offering greater flexibility in surgical scheduling (the rationale being that if a cancellation occurs, a patient who’s been fasting for a longer period can be safely moved to an earlier spot on the surgery schedule).^{12,40} The likelihood of schedule variation, however, tends to be exaggerated.⁴¹ Two studies found that fewer than 10% of surgeries moved to an earlier time slot, starting an average of 33 minutes early in one¹ and 56 minutes early in the other.² In a prospective study of 5,420 consecutive patients scheduled for surgery 15 weeks before or 15 weeks after liberalized fasting instructions were implemented, there were no surgery cancellations and there was no difference in the incidence of surgical delays because of nonadherence to fasting instructions.³⁹

CAMPAIGN FOR CHANGE

Education alone cannot overcome the complex and multifactorial barriers to implementing evidence-based guidelines. Liberalizing preoperative fasting practices requires nothing short of a campaign by nurses, surgeons, anesthesiologists, and other health care professionals to inform colleagues and patients about the current guidelines; to encourage colleagues and patients to discuss the guidelines and supporting clinical data; and, ultimately, to help their facilities revise protocols and procedures in accordance with current evidence.

Such revisions require clinicians to

- develop preoperative order sets that include the option of “clear liquids until _____” and “consume _____ ounces of the carbohydrate-rich clear liquid beverage _____ at the following time: _____.”

- establish benchmarks to increase the number of patients instructed to have clear liquids until two hours before surgery.
- use the electronic health record as a tracking tool.
- employ decision support tools to remind clinicians of evidence-based fasting guidelines and help them identify the patients to whom they apply.
- provide patients with both verbal and written preoperative fasting instructions, specifying the scheduled time of surgery and the times to stop consuming solids, full liquids (describe and give examples), and clear liquids (describe and give examples).
- confirm that patients understand preoperative instructions by asking them to repeat them back.

Efforts must be ongoing and evaluated for effectiveness. Quality improvement projects that track patients’ preoperative fasting instructions and actual fasting durations can be used to identify health care providers whose instructions aren’t evidence based. Focus quality improvement efforts on patients scheduled for late morning or early afternoon surgery, ensuring that they’re told to have clear liquids or a light breakfast on the morning of their surgery or procedure. These patients are at greatest risk for discomfort and the adverse effects of prolonged fasting. If a surgery or procedure is delayed, offer the patient clear liquids.

RECOMMENDATIONS FOR RESEARCH

Current preoperative fasting guidelines are recommended only for healthy patients undergoing elective procedures involving anesthesia (general or regional), sedation, or analgesia.³⁻⁵ More research is needed to determine optimal practices for other patient populations, such as those undergoing gastrointestinal surgery and overweight or obese patients.¹¹ Studies conducted outside the United States have found that patients having elective gastrointestinal surgery, including colorectal surgery, are at no greater risk for aspiration than are other patients^{28,29,36} and that gastric emptying of clear liquids is not delayed in obese patients.⁴²⁻⁴⁴ Other potential areas of investigation include the safety and efficacy of clear liquids for presurgical patients with diabetes or gastroesophageal reflux disease; the effects of clear liquids on intraoperative and postoperative fluid balance; and the effects of carbohydrate-rich clear liquids on preoperative care and postoperative recovery.¹¹ ▼

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