



Nulla Per Os (NPO) guidelines: time to revisit?

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Purpose of review

Preoperative fasting guidelines are generalized to elective procedures and usually do not distinguish between the ambulatory and inpatient setting. Prevalence of aspiration is low while prolonged preoperative fasting is common clinical reality. Recently, changes in preoperative fasting guidelines have been widely discussed.

Recent findings

Rates of prolonged clear fluid fasting (>4 h) prior to surgery are reported in up to 80% of patients with mean fasting duration of up to 16 h and beyond. Prolonged fasting may result in adverse effects such as intraoperative hemodynamic instability, postoperative delirium, patient discomfort, and extended hospital length of stay. Liberal approaches allowing clear fluids up to 1 h prior to anesthesia or until premedication/call to the operating room have shown no increase in adverse events among children. Various anesthesia societies now encourage clear fluid intake up to 1 h prior to pediatric elective anesthesia. Similar reports in the adult cohort are scarce.

Summary

Allowing sips of water until call to the operating room may help reducing prolonged preoperative fasting and improving patient comfort while keeping a flexibility in operating room schedule. The feasibility and safety of a liberal clear fluid fasting regimen among adults undergoing elective anesthesia needs to be evaluated in future studies.

Keywords

aspiration of gastric content, aspiration pneumonia, clear fluid fasting, elective anesthesia, NPO guidelines, patient satisfaction, perioperative period, prolonged fasting

INTRODUCTION

To avoid aspiration events in patients undergoing nonemergent procedures, preoperative fasting practice originated as 'Nulla per os' (NPO), also known as 'nil-by-mouth from midnight'. This practice has since then developed to current recommendations across the globe ranging from allowing clear fluid intake for up to 2, and milk and solids for up to 6 h preoperatively [1,2³,3,4]. However, actual preoperative fasting times often exceed these recommendations and prolonged fasting is a common clinical reality [5–8⁴]. This is the case even in highly planned settings because of the fear that when a sip of fluid is ingested and the procedure is moved to an earlier time the attending anesthesiologist would eventually delay or even cancel the surgical procedure.

Prevalence of perioperative pulmonary aspiration is low [9⁵,10⁶,11⁷] and there is a lack of direct evidence if current guidelines actually help to reduce adverse outcomes. Gastric volume and gastric pH determined by techniques such as gastric ultrasound are often used as surrogate endpoints [12].

Recently, alterations of preoperative fasting guidelines have been widely discussed seeking to avoid prolonged preoperative fasting duration and potentially liberate preoperative clear fluid intake up to 1 h, especially in the pediatric population [13,14⁸,15–17].

Procedures performed in an outpatient setting continue to be on the rise [18]. The evidence of preoperative fasting practice and its effects in the ambulatory surgical population is low [19,20]. Also, current preoperative fasting guidelines rarely distinguish between different elective procedure settings such as ambulatory versus inpatient, individual patient characteristics or the anticipated anesthesia

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KEY POINTS

- Preoperative fasting guidelines do not discriminate between the outpatient and inpatient setting, but are tailored to elective procedures in general.
- Prevalence of aspiration is low while prolonged preoperative fasting is common clinical reality, which may adversely affect hemodynamic stability during anesthesia, postoperative delirium, perioperative patient discomfort, and length of stay.
- Various anesthesia societies have recently changed their guidelines encouraging clear fluid intake up to 1 h prior to elective anesthesia for children.
- Multiple studies in the pediatric cohort demonstrate no increase in perioperative pulmonary aspiration with liberal clear fluid fasting regimens for elective anesthesia. Similar evidence among adults is scarce.
- Some evidence suggests that allowing sips of clear fluids until called to the OR may be the way to go in elective surgery to prevent prolonged fasting periods.

plan such as general anesthesia versus regional anesthesia versus monitored anesthesia care (Fig. 1). Taking into account these factors, which may influence risk of aspiration, may allow to develop a risk-adapted algorithm for preoperative fasting practice.

One approach could be to allow for patients at low risk of aspiration to take sips of clear liquids until being called to the operating room (OR). This may help to avoid prolonged fasting, improve

patient comfort, and decrease anxiety as well as reduce preoperative dehydration and subsequent cardiovascular instability especially in the elderly [21]. Although the type of procedures performed in the ambulatory setting may vary internationally and even across different healthcare facilities, patients qualifying for outpatient procedures are characterized by being healthy or having well controlled comorbidities and being at low risk of perioperative complications in order to ensure safe same-day discharge [22–24]. Therefore, patients undergoing ambulatory surgery may benefit from adaptations in NPO guidelines that ensure hydration and reduce adverse sequelae of prolonged fasting [7,19].

PREOPERATIVE FASTING: CURRENT GUIDELINES VERSUS CLINICAL REALITY

Internationally recommended preoperative fasting times range from 2 h for clear liquids to 6 h for milk and solids [1,2³,3] and even up to 8 h for meals including meat, fatty, or fried food [4]. Although clinicians debate liberating recommended preoperative clear fluid limitation [13,14²²,15–17], prolonged preoperative fasting is common clinical reality with reported mean fasting times of clear liquids ranging between 5 and 16 h in adults [5,6,25] and between 3 and 12 h in children [7,8²⁶,27²⁸] and reported rates of prolonged clear fluid fasting (>4 h) in up to 80% of patients.

Recommending and even encouraging clear fluid intake up to 1 h before anesthesia for elective

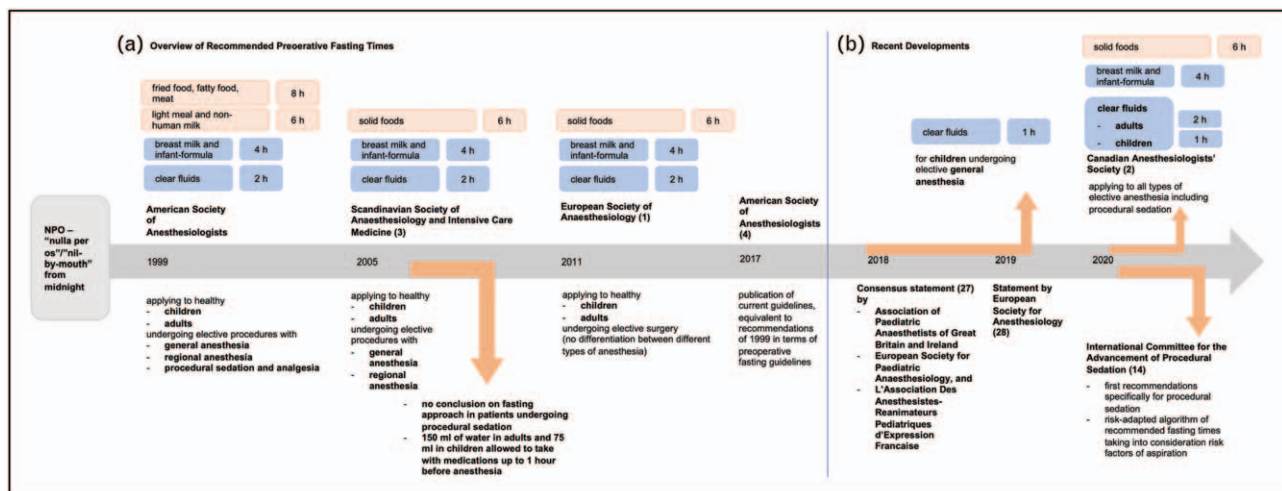


FIGURE 1. Overview of current international preoperative fasting guidelines and recent developments. (a) An overview of current international preoperative fasting guidelines on a rough timeline with a special focus on recommended preoperative fasting time by oral intake and specifications made in regards to children versus adults and type of anesthesia. (b) Focuses on recent developments published through updated guidelines and consensus statements within the past 3 years. Novel developments since 2018 include allowance of clear fluid intake in children up to 1 h prior to surgery and a risk-adapted algorithm for the setting of procedural sedation. Number in parentheses indicate citations as detailed in the reference section.

pediatric cases has been widely debated and recently statements endorsing this recommendation have been published by the Association of Paediatric Anaesthetists of Great Britain and Ireland, the European Society for Anaesthesiology, and l'Association des Anesthésistes-Réanimateurs Pédiatriques d'Expression Française and the Canadian Pediatric Anesthesia Society [29[■],30,31[■]] (Fig. 1). Such recommendations are in line with recommendations of the ERAS mindset to interact as little as possible with normal homeostasis [22].

But what about rethinking clear fluid intake in adults prior to elective anesthesia and would growing numbers of ambulatory anesthesia cases qualify as a setting for special considerations in preoperative fasting guidelines? Or should preoperative fasting times be tailored in a more detailed algorithm considering different factors such as planned anesthetic approach, type of procedure and patient characteristics which may increase aspiration risk similar to what has been proposed recently for the setting of procedural sedation [14[■]]?

In the pediatric population, there have been quality improvement efforts successful in reducing duration of clear fluid fasting before anesthesia [7,8[■],27[■]] and studies reporting liberalization of clear fluid intake until called to the operating room [28,32,33], without noting a difference in aspiration events or cancellation/postponement of procedures [9[■]]. Unfortunately, the evidence of similar published reports in the adult population is scarce [6] and yields opportunity for future research efforts.

ADVERSE EFFECTS OF PROLONGED FASTING

Excessive preoperative fasting with patients going up to 16 h and longer without a drink is clinical reality [6], which is accompanied by various adverse effects.

It may be intuitive that preoperative dehydration caused by excessive fluid fasting may contribute to hypotension after anesthesia induction. A recent study by Simpao *et al.* [34[■]] of 15 543 children demonstrated an association of duration of fluid fasting prior to surgery with higher odds of low systolic blood pressure following inhalational anesthesia induction in multivariable analysis. A randomized controlled trial of 219 patients undergoing minor surgery under general anesthesia found that an additional bolus of intravenous fluids of 8 ml/kg prior to the induction of anesthesia resulted in significantly decreased hemodynamic instability during induction [35]. Prolonged preoperative fluid fasting has previously been identified as an independent predictor of early postoperative delirium [5]

and shown to be associated with patient discomfort including hunger, thirst, experiences of anxiety, sadness, and even pain and nausea [19,25,36] and extended hospital length of stay [37].

In order to avoid these adverse effects, it is important to understand the underlying mechanisms leading to preoperative fasting way beyond the recommended NPO times such as all aspects of communication of preoperative fasting recommendations to the patient (e.g. clarity, form of communication – written/verbal, body language from clinicians and nurses), individual patient factors (personality traits, living situation, support system, and so on) and factors relating to preoperative care on the day of surgery [38,39]. Some of these have been successfully addressed by counter measures in recent quality improvement efforts to reduce preoperative fasting duration in the pediatric cohort [7,8[■],27[■]].

In addition, variability and short notice changes of the OR schedule are common and may largely contribute to prolonged fasting times by both procedures being postponed and clinicians prescribing prolonged fasting times in the first place in order to keep a certain flexibility in procedure scheduling: e.g. the international fasting recommendations may allow for intake of clear fluids up to 2 h prior to surgery, but patients may start being called to the OR at 7 am; consequently clinicians may allow patients to drink until 5 am on the morning of surgery; as the patient may still be sleeping at this time, they end up taking the last drink the night before surgery resulting in prolonged fasting.

Keeping a flexibility in procedure scheduling is also a reason why clinicians remain hesitant towards suggestion of liberating preoperative clear fluid intake further. Allowing patients to take sips of water until being called to the OR would help reduce duration of fluid fasting, avoid dehydration, and ameliorate patient comfort without causing delay in the OR schedule [19,28,32,33]. It may even be speculated that small amounts of liquids being allowed until transfer to OR might result in smaller overall volume of preoperative fluid ingestion as opposed to quickly drinking a large amount at once when faced with a strict deadline after which fluid intake is forbidden all together.

GASTRIC EMPTYING PHYSIOLOGY AND RESIDUAL GASTRIC VOLUME

The goal of preoperative fasting is to reduce the risk of gastrointestinal regurgitation by reducing gastric content. The main focus of this goal is on the reduction of gastric volume and on elevating gastric pH. Gastric emptying physiology is complex and in

absence of pathologies delaying gastric emptying the time for oral intake to be emptied from the stomach differs by ingested volume, composition, and caloric content [40]. Although water clears from the stomach with a $t_{1/2}$ (i.e. 50% remaining in the stomach) of 10 min and being fully cleared after around 40 min, the gastric emptying time of other liquids depends on their caloric content and ranges from 1 to 2 h with an average rate of 1–4 kcal/min [40–42].

Gastric volume has been shown to be around 0.2–1.7 ml/kg in fasted patients undergoing elective cholecystectomy [43[■]], which is in line with previously established residual volume in healthy fasted individuals [44]. Gastric ultrasound has become a useful tool with established methodology to evaluate gastric content and volume [45,46[■]] and has been trialed in various scenarios to guide in estimation of aspiration risk and help in individual clinical decision making [43[■],47,48]. A residual gastric volume > 1.5 ml/kg for fluid content has been suggested to signal an increased risk of gastrointestinal regurgitation and pulmonary aspiration [44] and this cut-off value has been utilized in various studies [43[■],49]. This would translate to a residual volume of 105 ml for an adult of 70 kg. But there is a lack of direct evidence in research studies demonstrating which residual gastric volume may be safe with certainty.

A randomized controlled trial of 138 children between the ages of 1–16 years old with an ASA status of I or II undergoing general anesthesia found no significant difference in gastric pH or gastric volume after endotracheal intubation as determined through sampling with an orogastric tube between a group allowed clear fluids until premedication (median fasting duration: 48 min [interquartile range, 18.5–77.5]) compared to those allowed clear fluids until 2 h preoperatively as per guidelines [28]. Even adhering to current preoperative fasting recommendations does not guarantee an empty stomach as demonstrated in a recent study by Chang *et al.* [43[■]] utilizing gastric ultrasound to examine gastric content of fasted patients prior to anesthesia induction for elective laparoscopic cholecystectomy. This study found absence of an empty stomach in 18 of 138 patients (13%), which was defined as either solid gastric content (9%) or fluid content > 1.5 ml/kg (4%). These findings are in line with data of a retrospective cohort study examining the gastric content of 538 fasted patients [49].

A study in healthy volunteers identified sip volume for thin liquids to be 10–14 ml [50]. So allowing sips of water until being called to the operating room is unlikely to contribute to an increased risk of perioperative pulmonary aspiration

in healthy patients undergoing elective surgery not otherwise at an increased risk of aspiration, considering a gastric clearance time of 40 min for water and a residual gastric volume of 105 ml in an adult of 70 kg not increasing risk of gastrointestinal regurgitation.

Of note, guidelines published by the Scandinavian Society of Anaesthesiology and Intensive Care Medicine in 2005 allow for a volume of 150 ml of water for adults and 75 ml for children to take their medication with up to 1 h prior to anesthesia [3]. Extent of damage to the lung tissue and subsequent manifestation of disease after pulmonary aspiration depend on chemical properties and volume of the aspirate [51]. Which amount of clear fluid may actually cause harm is a matter of debate. However, it should be noted that during bronchoalveolar lavage, a procedure performed routinely in various lung diseases, the instillation and suctioning of physiological saline in three to five sequential repetitive volumes of 100–300 ml each are recommended per subsegment of lung tissue [52].

PERIOPERATIVE PULMONARY ASPIRATION

NPO guidelines seek to reduce the risk of gastrointestinal regurgitation and pulmonary aspiration. Prevalence of periprocedural aspiration is low with recently reported rates of 0.014–0.021% in adults undergoing procedural sedation [53] and 0.01% in adults undergoing general anesthesia [11[■]] with 0.5–0.6% in high-risk cases undergoing rapid sequence induction [54]. Similarly, in the pediatric population perioperative pulmonary aspiration has recently been reported to occur in only 0.01–0.12% of patients undergoing general anesthesia [9[■],10[■],26[■]]. Sequelae of aspiration events range from ICU admission and increased length of stay to a reported mortality rate of 1.5–6.6% [10[■],11[■]].

One factor consistently shown to be associated with an increased risk of aspiration is emergency procedure [9[■],10[■],11[■]]. Other factors named to characterize an increased risk of aspiration are listed in Table 1. No aspirations have been reported in nonfasted patients or those with shortened fasting status undergoing ambulatory cataract surgery [20] or procedures other than endoscopy performed with procedural sedation [53]. But because of the very low rate of perioperative aspiration events, a poor degree of evidence remains.

CONCLUSION

In summary, there are no specific guidelines on preoperative fasting for the ambulatory setting.

Table 1. Risk factors for perioperative gastrointestinal regurgitation and pulmonary aspiration

Category	Examples
Procedure type or circumstantial setting	Upper endoscopy, bronchoscopy [11 [■] , 14 [■] , 53] Emergency procedure/nonfasted patient [1–4, 9 [■] , 10 [■] , 11 [■]] Women in labor [1–4]
Relating to the airway	Anticipated difficult airway management [4, 14 [■]] Airway abnormalities [14 [■]]
Relating to gastrointestinal system	Gastro-esophageal reflux [3, 4, 30] Hiatal hernia [3, 4, 14 [■]] Hyperemesis [3, 14 [■]] Functional dyspepsia [3] Bowel obstruction including ileus, tumor, stricture and esophageal disorders including achalasia [3, 4, 14 [■] , 30]
Other factors delaying gastric emptying	Gastroparesis through systemic disease such as diabetes mellitus [3, 4, 30] Pain [3] Use of opioids [3] Severe obesity [4, 14 [■]]

This table lists factors named in context with an increased risk of pulmonary aspiration. Numbers in brackets represent according references.

Although perioperative pulmonary aspiration can be a detrimental event, recently reported aspiration rates in elective surgery are low and subsequent aspiration-related mortality even lower. Prolonged fluid fasting of up to 16 h and longer is common and may in turn cause the patient harm and discomfort. A residual gastric volume of 105 ml in an adult of 70 kg is deemed safe for induction of anesthesia. And considering a typical sip volume of up to 15 ml and gastric clearance of water after around 40 min, allowing patients to drink water in sips until call to the operating room would be a reasonable clinical practice that can help to reduce preoperative fluid fasting time while keeping a certain flexibility in the OR schedule.

This has been trialed on multiple occasions in children undergoing anesthesia and there is no reason this should not be extended to adults undergoing elective surgery. Various healthcare professionals are involved in realization of recommended fasting times. Straight-forward and universally applicable recommendations are more likely to be put into practice, which would help avoiding prolonged fasting.

Please consider, these suggestions should by no means imply that appropriate measures mitigating aspiration risk should not be applied in cohorts of patients in which elective planning of a surgical procedure may not be ensured, e.g. in the obstetric setting.

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Conflicts of interest

There are no conflicts of interest.

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- of special interest
- of outstanding interest

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