2023 American Society of Anesthesiologists Practice Guidelines for Preoperative Fasting: Carbohydrate-containing Clear Liquids with or without Protein, Chewing Gum, and Pediatric Fasting Duration—A Modular Update of the 2017 American Society of Anesthesiologists Practice Guidelines for Preoperative Fasting*

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ABSTRACT

These practice guidelines are a modular update of the "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." The guidance focuses on topics not addressed in the previous guideline: ingestion of carbohydrate-containing clear liquids with or without protein, chewing gum, and pediatric fasting duration.

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HIGHLIGHTS BOX

- The task force reaffirms the previous recommendations for clear liquids until 2 h preoperatively. Simple or complex carbohydrate–containing clear liquids appear to reduce hunger compared with noncaloric clear liquids. The addition of protein to preoperative carbohydrate-containing clear liquids did not seem to either benefit or harm healthy patients. We further suggest not to delay surgery in healthy adults after confirming the removal of chewing gum.
- Fasting duration is often substantially longer than recommended and prolonged fasting has well described adverse consequences. Therefore, to avoid prolonged fasting in children, efforts should be made to allow clear liquids in healthy children as close to 2 h before procedures as possible.
- The task force recommends a robust local effort at each facility disseminating and discussing information shared in this document, providing necessary education to all patient care teams, including but not limited to all members of the anesthesiology and surgical teams, preoperative clinic personnel, preoperative nurses, and hospital floor nurses. Furthermore, it would be necessary to update related policies, printed literature, and wall posters/charts to ensure that patients are receiving consistent messages and instructions from all medical personnel.

Practice guidelines are systematically developed recommendations that assist the practitioner and patient in making decisions about health care. These recommendations may be adopted, modified, or rejected according to clinical needs and constraints and are not intended to replace local institutional policies. In addition, practice guidelines developed by the American Society of Anesthesiologists (ASA) are not intended as standards or absolute requirements, and their use cannot guarantee any specific outcome. Practice guidelines are subject to revision as warranted by the evolution of medical knowledge, technology, and practice. They provide basic recommendations for anesthesia care that are supported by synthesis and analysis of the current literature, expert and practitioner opinion, public comment, and clinical feasibility data. Practice guidelines aim to improve patient care and patient outcomes by providing up-to-date information for patient care.

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The intended population for this update is the same as for the 2017 ASA guideline, limited to healthy patients undergoing elective procedures.[1] Healthy patients are those without coexisting diseases or conditions that may increase the risk for aspiration, including esophageal disorders such as significant uncontrolled reflux disease, hiatal hernia, Zenker's diverticulum, achalasia, stricture; previous gastric surgery (for example, gastric bypass); gastroparesis; diabetes mellitus; opioid use; gastrointestinal obstruction or acute intraabdominal processes; pregnancy; obesity; and emergency procedures.[2–4] Anesthesiologists should recognize that these conditions can increase the likelihood of regurgitation and pulmonary aspiration and should modify these guidelines based upon clinical judgment.

Recommendations

Recommendation	Strength of Recommendation	Strength of Evidence
1. We recommend healthy adults* drink carbohydrate-containing clear liquids† until 2 h before elective procedures requiring general anesthesia, regional anesthesia, or procedural sedation. The carbohydrates may be simple or complex.	Strong	Moderate
2. There is insufficient evidence to recommend protein-containing clear liquids preferentially over other clear liquids before elective procedures requiring general anesthesia, regional anesthesia, or procedural sedation (no recommendation).	Not applicable	Very low
3. We suggest not delaying elective procedures requiring general anesthesia, regional anesthesia, or procedural sedation in healthy adults* who are chewing gum.‡	Conditional	Very low
4. There is insufficient evidence concerning benefits and harms to recommend pediatric patients drink clear liquids until 1 h *versus* 2 h before procedures with general anesthesia, regional anesthesia, or procedural sedation (no recommendation).	Not applicable	Very low
5. To avoid prolonged fasting in children, efforts should be made to allow clear liquids in children at low risk of aspiration as close to 2 h before procedures as possible. In children with shorter clear liquid fasting duration, exercise clinical judgment.	Best practice statement	Not applicable

*Individuals without coexisting diseases or conditions that may increase the risk for aspiration, including esophageal disorders such as significant uncontrolled reflux disease, hiatal hernia, Zenker's diverticulum, achalasia, stricture, previous gastric surgery (for example, gastric bypass), gastroparesis, diabetes mellitus, opioid use, gastrointestinal obstruction or acute intraabdominal processes, pregnancy, obesity, and emergency procedures. Exercise clinical judgment with this patient population. †Up to 400 mL of clear liquids is considered an appropriate volume. Trial participants ingested a median of 400 mL of carbohydrate-containing clear liquids (interquartile range, 300 to 400 mL) up to 2 h before anesthesia administration. ‡Chewing gum should be removed before any sedative/anesthetic is administered.

Purpose

This is a modular update of the "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 ASA task force on preoperative fasting and use of pharmacologic agents to reduce the risk of pulmonary aspiration," which was adopted by the ASA in 2016 and published in 2017.[1] The 2017 guideline did not address whether one type of clear liquid, such as water or carbohydrate-containing clear liquids (with and without protein), is more beneficial. The 2017 guideline also did not address chewing gum or whether a shorter duration of fasting from clear liquids would be more beneficial than the current recommendation of 2 h of fasting for pediatric patients. The purpose of this modular update is to evaluate the current evidence on preoperative fasting, focusing on these interventions. All other recommendations from the 2017 guideline still apply. The outcomes of interest for this update include the adverse consequences of fasting (hunger, thirst, and preoperative nausea and vomiting) and pulmonary aspiration.

Background

Pulmonary aspiration of gastric contents is a rare but potentially life-threatening complication. Although aspiration is uncommon in healthy ASA Physical Status I or II patients (estimated 1.1/10,000 adults and 1.3/10,000 children),[2–4] it may lead to pneumonitis, pneumonia, and airway obstruction.[5,6] Of the aspiration events described in the 2021 ASA Closed Claims analysis of aspiration of gastric contents events, 57% of aspiration incidents resulted in death, and another 15% resulted in permanent severe injury.[4] The rationale for preoperative fasting is to minimize gastric content, thereby lowering the risk of regurgitation and subsequent pulmonary aspiration.

Although the relationship between gastric volume and gastric emptying time with aspiration risk has not been demonstrated in adequately powered studies,[7] most published studies have used these measures as intermediate outcomes. Assuming a 1.1/10,000 baseline incidence of aspiration, to detect a 2-fold increase would require 214,000 participants per arm in a two-arm study (power, 80%; α, 0.05).

Previous ASA guidelines recommend that clear liquids such as water, black coffee, black tea, and juice without pulp are safe to drink until 2 h before general anesthesia, regional anesthesia, or procedural sedation for elective procedures.[1]

For patients undergoing elective procedures, this update addresses:

- Carbohydrate-containing clear liquids (simple or complex)
- Protein-containing clear liquids

- Chewing gum
- Clear liquid fasting duration (1 h *vs.* 2 h) for children

Methodology

The guideline task force included anesthesiologists, epidemiology-trained methodologists, and a patient representative, who was chosen from contacts of the task force and who had experience as a patient. The members disclosed relevant relationships (industry and other entities) that might pose a conflict of interest. The task force was responsible for developing key questions; the relevant patient populations, interventions, comparators, and outcomes; and the study inclusion/exclusion criteria to guide the systematic review (see Systematic Review Protocol in the Supplemental Digital Content, http://links.lww.com/ALN/C930).

- Population: patients undergoing general anesthesia, regional anesthesia, or procedural sedation for elective procedures
- Interventions: drinking carbohydrate-containing clear liquids (simple or complex) until 2 h before general anesthesia, regional anesthesia, or procedural sedation for elective procedures; drinking protein-containing clear liquids (all studied included carbohydrates) until 2 h before general anesthesia, regional anesthesia, or procedural sedation for elective procedures; gum chewing before surgery/procedure; and a shortened duration for clear liquid fasting in children of 1 h
- Comparators: fasting or drinking noncaloric clear liquids (*e.g.*, water, placebo, broth, black tea, black coffee); no gum chewing; and clear liquid fasting duration of 2 h in pediatric patients
- Outcomes: adverse effects of fasting (preoperative hunger, thirst, and nausea) and pulmonary aspiration. Due to the rarity of aspiration, regurgitation, gastric volume, and gastric pH were included as intermediate outcomes.

The anesthesiologist and patient representative task force members rated the importance of each outcome for decision-making on a scale of 1 to 9 (1 to 3, of limited importance; 4 to 6, important; 7 to 9, critical).[8] The evidence synthesis focused on the outcomes rated important or critical.

Literature Search

Comprehensive bibliographic database searches were conducted by a medical librarian using PubMed, EMBASE, and SCOPUS in July 2020 and updated in December 2021. Studies examining carbohydrate- and protein-containing clear liquids published in January 2000 or later were eligible for inclusion. Because gum chewing and 1-h fasting in pediatric patients were new in this guideline, studies published beginning in January 1990 were eligible. In addition, the Cochrane Central Register of Controlled Trials was queried; task force members provided potentially relevant studies; references from systematic reviews and meta-analyses were hand-searched; and trial registries were searched. The PRISMA flow diagram (http://links.lww.com/ALN/C931) and Literature Search Strategy (http://links.lww.com/ALN/C932) are available as Supplemental Digital Content.

Study Screening and Selection

Titles with abstracts and full-text screening were performed using systematic review software (DistillerSR,[9] Evidence Partners, Ottawa, Canada). Screening was performed independently by two methodologists. Conflicts were discussed and, when necessary, included a third methodologist to achieve consensus. All discrepancies were resolved. Potential inclusion–exclusion discrepancies were also examined with an artificial intelligence tool, a component of the systematic review software. Eligible studies included randomized and nonrandomized trials, quasiexperimental, cohort (prospective and retrospective), and case-control designs. Case reports and case series, conference abstracts, letters not considered research reports, non-English publications, and animal studies were excluded. Excluded studies with reasoning are shown in the Supplemental Digital Content (http://links.lww.com/ALN/C933). Studies with multicomponent interventions (for example, enhanced recovery after surgery protocols) were excluded if the effect of fasting on outcomes could not be independently ascertained. Clear liquids with carbohydrates were categorized as simple or complex. Simple carbohydrates included clear fruit juices or water with glucose or fructose added. The complex carbohydrate used in the carbohydrate-loading interventions was maltodextrin. Clear liquids containing less than 10 gm/ml carbohydrate were not considered carbohydrate-containing. Oral rehydration solutions were classified as simple carbohydrates. All protein-containing clear liquids also contained carbohydrates. Trial comparator liquids such as water, placebo, broth, black tea, and black coffee are referred to as "noncaloric clear liquids."

Data Extraction and Management

The study results were extracted into DistillerSR by a single methodologist and reviewed by a second methodologist for quality control. Conflicts were resolved by consensus. When the relevant data were not reported in the published work, attempts were made to contact the authors. The figures were digitized as necessary to obtain quantitative results for synthesis.

Evidence Synthesis

The body of evidence was first described according to study characteristics and treatment arms. The results were then summarized in tabular form by outcome. When relevant, decision-informative, and practicable, pairwise and network random-effects meta-analyses of randomized controlled trials were conducted.[10,11] Nonrandomized studies were considered in the assessment of harms when there was infrequent reporting of harms in randomized controlled trials. Small study

Table 1. GRADE Strength of Evidence Definitions

GRADE	Interpretation
High	We are very confident that the true effect lies close to the estimate of the effect.
Moderate	We are moderately confident in the effect estimate. The true effect is likely to be close to the estimate of the effect, but there is a possibility that it is substantially different.
Low	Our confidence in the effect estimate is limited. The true effect may be substantially different from the estimate of the effect.
Very low	We have very little confidence in the effect estimate. The true effect is likely to be substantially different from the estimate of effect.

GRADE, Grading of Recommendations, Assessment, Development, and Evaluation framework.

effects and the potential for publication bias were evaluated using funnel plots and regression-based tests.[12] Analyses were conducted in R (R Foundation for Statistical Computing, Vienna, Austria).[13–15] (See the methods supplement for further details, http://links.lww.com/ALN/C962.)

Risk of Bias Assessment

The risk of bias for individual studies was evaluated using tools according to study design: for randomized controlled trials, the Cochrane risk of bias tool,[16] and for nonrandomized studies, the Risk Of Bias In Non-Randomised Studies of Interventions tool.[17] The risk of bias appraisals for only randomized controlled trials were used to support all strength-of-evidence ratings (supplemental figs. 1 through 14, http://links.lww.com/ALN/C935).

Strength of Evidence

The strength of evidence was rated by outcome using the Grading of Recommendations, Assessment, Development, and Evaluation framework (table 1). In this framework, randomized control trials start as high strength of evidence, and nonrandomized studies start as low. The strength may be downgraded based on summary study-level risk of bias, inconsistency, indirectness, imprecision, and publication bias. The strength may be upgraded if the effect is large, if a dose-response is present, or if unaccounted residual confounding would likely have increased the effect.[18] For the comparisons of simple and complex carbohydrate–containing clear liquids (residual gastric volume and hunger, and thirst), the strength of evidence was assessed with the Confidence in Network Meta-Analysis tool.[19] This tool includes considerations specific to network meta-analyses.

Strength of Recommendations

For each key question, the evidence synthesis and summary tables of benefits and harms were presented to the task force. The methodologists also reviewed the strength of the evidence for each outcome by key question with the task force.

The categories of recommendations in the Grading of Recommendations, Assessment, Development, and Evaluation approach include strong in favor, conditional in favor, conditional against, and strong against an intervention. Strong recommendations reflect the task force believing all or almost all clinicians would choose the specific action or approach. Conditional recommendations are those where most, but not all, would choose the action or approach.[20,21] When the task force judged the body of evidence inappropriate to rate the strength of evidence but judged a recommendation important, a best practice statement was considered.[22]

Carbohydrate-containing Clear Liquids

Key Question

For adults undergoing elective procedures with general anesthesia, regional anesthesia, or procedural sedation, what are the benefits and harms of carbohydrate-containing clear liquids ingested until 2 h before the procedure compared with fasting and noncaloric clear liquids?

Recommendation

We recommend healthy adults drink carbohydrate-containing clear liquids until 2 h before elective procedures requiring general anesthesia, regional anesthesia, or procedural sedation. The carbohydrates may be simple or complex.

- Strength of recommendation: Strong
- Strength of evidence: Moderate

Up to 400 ml of clear liquids is considered an appropriate volume. Trial participants ingested a median of 400 ml of carbohydrate-containing clear liquids (interquartile range, 300 to 400 ml) up to 2 h before anesthesia administration.

Summary of Evidence

Most patients in the studies were ASA Physical Status I or II with mean or median body mass index of 25 kg/m^2 (range, 21 to 33 kg/m^2; see Appendix). Patients drinking carbohydrate-containing clear liquids until 2 h before their procedures experienced less hunger and thirst compared to fasting (table 2) and less hunger compared to drinking noncaloric clear liquids (table 3). There was no incidence of aspiration or regurgitation in any groups. Tables 2 and 3 summarize the evidence for clinically important outcomes. Supplemental tables 1 to 4 (http://links.lww.com/ALN/C934) detail the strength-of-evidence ratings.

Carbohydrate-containing Clear Liquids *versus* Fasting

Patient-reported Outcomes. Participants drinking carbohydrate-containing clear liquids had lower patient-rated hunger

Table 2. Benefits, Harms, and Strength of Evidence for Carbohydrate-containing Clear Liquids *versus* Fasting

Nonrandomized Studies	Randomized Controlled Trials	Patients	Outcomes	Strength of Evidence GRADE	Effect	Estimate (95% CI)
	5	496	Less hunger*	Moderate	Risk ratio	0.55 (0.43 to 0.71)
	19	1,439	Lower patient-rated hunger	Moderate	Standardized mean difference	−0.62 (−0.84 to −0.40)
					Mean difference†	−16.7 (−22.6 to −10.9)
	6	673	Less thirst*	Moderate	Risk ratio	0.43 (0.24 to 0.74)
	19	1,437	Lower patient-rated thirst	Moderate	Standardized mean difference	−1.0 (−1.4 to −0.63)
					Mean difference†	−24.0 (−33.0 to −15.0)
	5	290	Less nausea*	Low	Risk ratio	0.76 (0.40 to 1.44)
	8	659	Lower patient-rated nausea	Low	Standardized mean difference	−0.03 (−0.48 to 0.43)
					Mean difference†	−0.2 (−4.0 to 3.5)
	2	108	More satisfaction	Low		Discordant trial results
3	31	2,688	Aspiration	Not rated		No aspiration reported
	5	402	Regurgitation	Very low		Differences not detected in any trial
	5	518	Vomiting	Low		Differences not detected in any trial
	14	1,103	Residual gastric volume	Moderate	Mean difference	−2.1 mL (−5.5 to 1.3)
	5	564	Gastric pH	Moderate	Mean difference	0.17‡ (−0.40 to 0.74)

*Incidence proportion. †Reexpressed from standardized mean difference based on mean weighted standard deviation from studies reporting results on a 0 to 100 visual analogue scale. ‡Mean pH in fasted arms 3.1 (95% CI, 1.4 to 4.7). Patients with long-term use of histamine 2 receptor antagonists were excluded from the studies, although one study administered histamine 2 receptor antagonists to the patients in both arms of the study the night before surgery.

GRADE, Grading of Recommendations, Assessment, Development, and Evaluation framework.

Table 3. Benefits, Harms, and Strength of Evidence for Carbohydrate-containing Clear Liquids *versus* Noncaloric Clear Liquids

Nonrandomized Studies	Randomized Controlled Trials	Patients	Outcomes	Strength of Evidence GRADE	Effect	Estimate (95% CI)
	9	939	Lower patient-rated hunger	Moderate	Standardized mean difference	−0.52 (−0.83 to −0.21)
					Mean difference†	−12.8 (−20.9 to −5.2)
	1	40	Less thirst*	Very low	Risk ratio	0.14 (0.01 to 2.6)
	10	850	Lower patient-rated thirst	Low	Standardized mean difference	−0.3 (−0.73 to 0.13)
					Mean difference†	−5.6 (−13.4 to 2.3)
	4	823	Less nausea*	Very low		Discordant trial results
	4	338	Lower patient-rated nausea	Low		Differences not detected in any trial
	2	132	More satisfaction	Low		Higher with carbohydrate liquids
	17	1,823	Aspiration	Not Rated		No aspiration reported
	3	115	Regurgitation	Not Rated		No regurgitation reported
	4	823	Vomiting	Very low		Differences not detected in any trial
	6	955	Residual gastric volume	Low	Mean difference	0.1 mL (−3.8 to 4.0)
1	1	105	Gastric pH	Very low		Differences not detected in any trial

*Incidence proportion. †Reexpressed from standardized mean difference based on mean weighted standard deviation from studies reporting results on a 0 to 100 visual analogue scale.

GRADE, Grading of Recommendations, Assessment, Development, and Evaluation framework.

(supplemental figs. 15 to 16, http://links.lww.com/ALN/C935) and thirst[23–42] compared with fasting patients (moderate strength of evidence). Differences were not detected in rates of nausea[36,39,43–45] (low strength of evidence) or patient-rated nausea (low strength of evidence). Patient satisfaction[31,46] was reported in only two trials, and a difference could not be assessed (low strength of evidence).

Clinical Outcomes. No aspiration was reported after either the fasting or carbohydrate-containing clear liquids groups in 31 randomized controlled trials,[23–26,29,30,32,33,36,37,39,42–44,47–64] 2 nonrandomized trials,[65,66] and 1 case-control study[67] (strength of evidence not rated due to lack of events). Differences were not detected in regurgitation[43,49,55,66,68,69] (very low strength of evidence) or preoperative vomiting[39,50–52,62] (low strength of evidence). Meaningful differences were not apparent for either residual gastric volume[34,38,41,44,46,48–51,62,68–71] (supplemental fig. 17, http://links.lww.com/ALN/C935) or gastric pH[46,50,51,69,71] after fasting or drinking carbohydrate-containing clear liquids (moderate strength of evidence).

Carbohydrate-containing Clear Liquids *versus* Noncaloric Clear Liquids

Patient-reported Outcomes. Drinking carbohydrate-containing clear liquids resulted in lower hunger ratings than did noncaloric clear liquids (moderate strength of evidence).[23,24,26,39,41,72–75] Differences were not evident for patient ratings of thirst[23,24,26,39,41,72,73,75–77] (low strength of evidence) and nausea[23,24,26,73] (low strength of evidence) or in rates of preoperative thirst[78] and nausea[23,24,26,39,73,79] (both very low strength of evidence). Patient satisfaction[46,80] was reported in two trials, with higher satisfaction in patients drinking carbohydrate-containing clear liquids (low strength of evidence).

Clinical Outcomes. No aspiration after carbohydrate-containing clear or noncaloric clear liquids was reported in 17 randomized controlled trials.[23,24,26,39,55,57,59,63,74,75,77,78,80–84] (strength of evidence not rated due to lack of events). Regurgitation[49,55,77] or preoperative vomiting[39,75,82,85] did not differ in randomized controlled trials (very low strength of evidence). Differences in either residual gastric volume[41,46,68,77,82,86] (low strength of evidence) or gastric pH[46,87] (very low strength of evidence) could not be determined.

Comment

Healthy adult patients should be encouraged to drink up to 400 ml of carbohydrate-containing clear liquids until 2 h before an elective procedure to minimize potential harms of prolonged fasting, including hunger and thirst. Trials provided participants with a median of 400 ml (interquartile range, 300 to 400 ml) of clear liquids 2 h before anesthesia administration without adverse consequences. Although differences were not detected in thirst, preoperative nausea, or patient satisfaction, the body of evidence is consistent with lower patient ratings of hunger with carbohydrate-containing clear liquids over noncaloric ones. Aspiration of gastric contents was not evident in the studies.

The overall assessment of aspiration risk may not rely on ASA Physical Status alone, as many of the comorbidities that qualify patients for a higher ASA Physical Status score may be unrelated to delayed gastric emptying or aspiration risk (for example, poorly controlled hypertension). Important consideration should be given to comorbidities that may affect gastric emptying and/or aspiration risk, regardless of ASA Physical Status. Decision-making is complicated by emerging data suggesting that some of the conditions traditionally considered to have an impact on gastric emptying may have little or no effect on gastric emptying. Consistent with the 2017 ASA guideline intended population,[1] healthy individuals are defined as those without coexisting diseases or conditions that may increase the risk for aspiration, including esophageal disorders such as significant uncontrolled reflux disease, hiatal hernia, Zenker's diverticulum, achalasia, stricture; previous gastric surgery (for example, gastric bypass); gastroparesis; diabetes mellitus[88,89]; opioid use; gastrointestinal obstruction or acute intraabdominal processes; pregnancy; obesity; and emergency procedures.[2–4] Anesthesiologists should recognize that these conditions can increase the likelihood of regurgitation and pulmonary aspiration and should modify these guidelines based upon their clinical judgment.

Mixed treatment comparisons did not support the superiority of complex carbohydrates over simple carbohydrates with respect to residual gastric volume or hunger (network meta-analysis; supplemental figs. 18 to 20, http://links.lww.com/ALN/C935, and supplemental tables 5 and 6, http://links.lww.com/ALN/C934).

Carbohydrate-containing liquids may have an impact on blood glucose levels in patients with diabetes, especially patients who skip or reduce their usual hypoglycemics before surgery. Home glucometer readings may help guide the patient's choice of a carbohydrate or a noncaloric clear liquid.

In summary, the evidence showed that for patients with low risk of aspiration, carbohydrate-containing clear liquids until 2 h preoperatively was superior to absolute fasting with respect to beneficial outcomes, without evidence of increased risks. Both simple and complex carbohydrate–containing clear liquids were slightly more advantageous compared with noncaloric clear liquids in patient satisfaction.

Protein-containing Clear Liquids

Key Question

For adults undergoing elective procedures with general anesthesia, regional anesthesia, or procedural sedation, what are the benefits and harms of protein-containing clear liquids 2 h before the procedure compared with fasting and other clear liquids?

Recommendation

There is insufficient evidence to recommend protein-containing clear liquids preferentially over other clear liquids 2 h

Table 4. Benefits, Harms, and Strength of Evidence for Protein-containing Clear Liquids *versus* Fasting

Nonrandomized Studies	Randomized Controlled Trials	Patients	Outcomes	Strength of Evidence GRADE	Effect	Estimate (95% CI)
	1	98	Less hunger*	Very low	Risk ratio	0.66 (0.46 to 0.96)
	1	113	Lower patient-rated hunger	Very low		Median 10 *vs.* 18†, NS
	1	98	Less thirst*	Very low	Risk ratio	0.85 (0.57 to 1.76)
	1	113	Lower patient-rated thirst	Very low		Median 22 *vs.* 40†, NS
	1	98	Less nausea*	Very low	Risk ratio	1.15 (0.38 to 3.53)
	1	113	Less patient-rated nausea	Very low		Median 0 *vs.* 0†, NS
No studies	No studies		Greater satisfaction			
1	8	629	Aspiration	Not Rated		No aspiration reported
	4	150	Regurgitation	Very low		Differences not detected
	1	22	Vomiting	Very low		No vomiting reported
	3	68	Residual gastric volume	Low	Mean difference	-2.5 mL (-8.6 to 3.7)
No studies	No studies		Gastric pH			

*Incidence proportion. †0 to 100 visual analogue scale.
GRADE, Grading of Recommendations, Assessment, Development, and Evaluation framework; NS, not significant.

Table 5. Benefits, Harms, and Strength of Evidence for Protein-containing Clear Liquids *versus* Noncaloric Clear Liquids

Nonrandomized Studies	Randomized Controlled Trials	Patients	Outcomes	Strength of Evidence GRADE	Effect Estimate
	1	24	Lower patient-rated hunger	Very low	Median 13 *vs.* 43†, $p = 0.001$
	2	55	Lower patient-rated thirst	Low	1 randomized controlled trial median 12 *vs.* 2†, $p = 0.01$ 1 randomized controlled trial difference not detected
	2	86	Less nausea*	Low	Differences not detected
	1	24	Less patient-rated nausea	Very low	Difference not detected
	1	74	Greater satisfaction	Very low	Mean 8.7 *vs.* 6.9‡, $p = 0.01$
	5	270	Aspiration	Not Rated	No aspiration reported
	2	34	Regurgitation	Very low	No regurgitation reported
	1	17	Vomiting	Very low	No vomiting reported
No studies	No studies		Residual gastric volume		
No studies	No studies		Gastric pH		

*Incidence proportion. †0 to 100 visual analogue scale. ‡0 to 10 visual analogue scale.
GRADE, Grading of Recommendations, Assessment, Development, and Evaluation framework.

before elective procedures requiring general anesthesia, regional anesthesia, or procedural sedation (no recommendation).

- Strength of evidence: Very low

Summary of Evidence

All protein-containing clear liquids also contained carbohydrates. Patients drinking protein-containing clear liquids until 2 h before their procedures experienced less hunger compared to fasting (table 4) and less hunger and thirst compared to drinking other clear liquids (table 5). There was no incidence of aspiration in any group. No differences in the occurrence of regurgitation were detected. Tables 4 and 5 summarize the evidence for clinically important outcomes, and supplemental tables 7 to 10 (http://links.lww.com/ALN/C934) detail the strength-of-evidence ratings.

Protein-containing Clear Liquids *versus* Fasting

Patient-reported Outcomes. The evidence comparing fasting with protein-containing clear liquids in adults was limited to single trials for each patient-reported outcome (table 4). Differences were not detected in patient-rated or rates of hunger,[32,43] thirst,[32,43] or preoperative nausea[32,43] (all very low strength of evidence).

Clinical Outcomes. Aspiration was not reported in any of the included studies (randomized controlled trials[32,43,49,52–55,64] or nonrandomized designs[90]). Differences in regurgitation[43,49,55,68] or preoperative vomiting[52] were unobserved

in randomized controlled trials (very low strength of evidence). A meta-analysis of three trials found a difference of -2.5 ml (95% CI, -8.6 to 3.7) in residual gastric volume for protein-containing clear liquids *versus* fasting.[49,68,91]

Protein-containing Liquids *versus* Noncaloric Clear Liquids

Patient-reported Outcomes. The evidence in adults comparing noncaloric clear liquids with those containing protein was limited, with one to two studies reporting each outcome of interest (table 5). Single trials reported less hunger[73] and greater satisfaction[80] among patients drinking protein-containing clear liquids compared with patients drinking other clear liquids (very low strength of evidence). Evidence was inconsistent for thirst,[73,76] and differences in nausea[85] were not observed.

Clinical Outcomes. Aspiration,[49,53,55,57,80] regurgitation,[55,68] and preoperative vomiting[85] were not reported in any studies comparing protein-containing clear liquids with noncaloric clear liquids.

Comment

All protein-containing clear liquids in the trials included carbohydrates, precluding assessment of liquids containing only protein. There was inconclusive evidence concerning residual gastric volume in nonsurgical studies that included comparisons of protein-containing clear liquids compared with carbohydrate-containing clear liquids alone (supplemental tables 11 and 12, http://links.lww.com/ALN/C934). Therefore, there is insufficient evidence to recommend protein-containing over other carbohydrate-containing or noncaloric clear liquids.

Chewing Gum

Key Question

For healthy adults undergoing elective procedures with general anesthesia, regional anesthesia, or procedural sedation, what are the effects of chewing gum on residual gastric volume, gastric pH, and pulmonary aspiration before anesthesia induction?

Recommendation

We suggest not delaying elective procedures requiring general anesthesia, regional anesthesia, or procedural sedation in healthy adults who are chewing gum.

- Strength of evidence: Very low

Chewing gum should be removed before any sedative/anesthetic is administered.

Summary of Evidence

Patients chewing gum had a minimally increased residual gastric volume at anesthesia induction compared with fasting (table 6). A difference was not detected in gastric pH between the groups. Table 6 summarizes the evidence for clinically important outcomes. Supplemental tables 13 and 14 (http://links.lww.com/ALN/C934) detail the strength-of-evidence ratings.

Patient-reported Outcomes. In adults, evidence comparing fasting with chewing gum was inconsistent with respect to patient-rated hunger[92] or thirst[92,93] (very low strength of evidence). A study of smokers[92] reported less thirst than those chewing gum (very low strength of evidence).

Clinical Outcomes. There is no clinically relevant increase in residual gastric volume after chewing gum[92,94–97] (low strength of evidence, supplemental fig. 21, http://links.lww.com/ALN/C935, and supplemental table 15, http://links.lww.com/ALN/C934). A difference was not detected in gastric pH[92,94–97] (low strength of evidence, supplemental table 16, http://links.lww.com/ALN/C934). Aspiration was not reported (strength of evidence not rated due to lack of events). Compared with water, residual gastric volume increased in patients chewing gum (very low strength of evidence) in one crossover study.[98]

Table 6. Benefits, Harms, and Strength of Evidence for Chewing Gum *versus* Fasting

Nonrandomized Studies	Randomized Controlled Trials	Patients	Outcomes	Strength of Evidence GRADE	Effect	Estimate (95% CI)
	1	104	Less patient-rated hunger	Very low		Differences not detected in smokers or nonsmokers
	2	162	Less patient-rated thirst	Very low		Inconsistent results nonsmokers
	1	44	Less patient-rated thirst	Very low		Less thirst smokers
No studies	No studies		Less nausea			
No studies	No studies		Greater satisfaction			
No studies	No studies		Aspiration			
No studies	No studies		Regurgitation			
No studies	No studies		Vomiting			
	5	550	Residual gastric volume	Low	Mean difference	7.6 mL (3.0 to 12.2)
	5	550	Gastric pH	Low	Mean difference	-0.1 (-0.4 to 0.2)

GRADE, Grading of Recommendations, Assessment, Development, and Evaluation framework.

Comment

Although the task force does not recommend delaying surgery in healthy adults who have chewed gum during the fasting period, we urge clinicians to confirm the gum has been removed before anesthetic administration. The evidence suggests there is not a clinically meaningful increase in gastric volume after chewing gum. Any benefits of gum chewing are inconsistent and insufficiently studied to encourage gum chewing before surgery.

In conclusion, we do not recommend chewing gum before surgery due to absence of demonstrable benefits. However, if a patient chews gum for personal comfort or preference, we recommend not delaying the scheduled elective procedure, due to inconclusive evidence of harm.

One-hour Clear Liquid Fasting in Pediatric Patients

Key Question

For pediatric patients undergoing elective procedures with general anesthesia, regional anesthesia, or procedural sedation, what are the benefits and harms of 1-h *versus* 2-h clear liquid fasting?

Recommendation

There is insufficient evidence concerning benefits and harms to recommend pediatric patients drink clear liquids until 1 h *versus* 2 h before procedures with general anesthesia, regional anesthesia, or procedural sedation (no recommendation).

- Strength of evidence: Very low

Best Practice Statement

To avoid prolonged fasting in children, efforts should be made to allow clear liquids in children at low risk of aspiration as close to 2 h before procedures as possible. In children with shorter clear liquid fasting duration, exercise clinical judgment.

Summary of Evidence

Differences were not detected in patient-reported hunger or thirst, incidence of aspiration or regurgitation, and gastric pH among pediatric patients fasting for 1 h compared with 2 h (table 7). Inconsistent results were reported for residual gastric volume. Table 7 summarizes the evidence for clinically important outcomes. Supplemental tables 17 through 19 (http://links.lww.com/ALN/C934) detail the strength-of-evidence ratings.

Patient-reported Outcomes. Evidence concerning patient-reported outcomes comparing 1- to 2-h clear liquid fasting in children was limited to one or two studies per outcome. Differences were not detected in preoperative hunger[99] (very low strength of evidence), preoperative thirst[99,100] (very low strength of evidence), or preoperative nausea[99] (very low strength of evidence). A single randomized controlled trial reported higher satisfaction in parents of children with a 1-h clear liquid fast compared with parents of children with a 2-h clear liquid fast[99] (very low strength of evidence).

Clinical Outcomes. Two randomized controlled trials and one large prospective cohort study reported on aspiration and regurgitation.[99–101] One trial reported no aspiration in either group.[99] The other trial included children undergoing surgery for cyanotic congenital heart disease and did not detect a difference in aspiration; however, incidence was high in this population (1.8 and 1.7% in the 1- and 2-h arms respectively).[100] A large prospective cohort study that included subgroups of children fasting less than 1 h (n = 1,709) and 1 to 2 h (n = 2,897) reported higher rates of aspiration and regurgitation in the less than 1-h fasting group (very low strength of evidence) but also noninferiority for regurgitation or pulmonary aspiration (not worse than 1 per 1,000) for a 1- to 2-h clear liquid fast compared with longer times.[101]

Table 7. Benefits, Harms, and Strength of Evidence for 1-h *versus* 2-h Clear Liquid Fasting in Children

Nonrandomized Studies	Randomized Controlled Trials	Patients	Outcomes	Strength of Evidence GRADE	Effect	Estimate (95% CI)
	1	131	Lower patient-rated hunger	Very low		Difference not detected
	1	131	Lower patient-rated thirst	Very low		Difference not detected
	1	344	Less thirst (incidence proportion)	Very low	Risk ratio	0.62 (0.43 to 0.89)
	1	131	Less nausea (incidence proportion)	Very low	Risk ratio	0.90 (0.03 to 2.2)
	1	131	More parental satisfaction	Very low		Better in 1 of 4 domains
	2	475	Aspiration	Very low		Differences not detected
1		4,606	Aspiration/regurgitation	Very low		Less than 1 h: 0.64% *vs.* 1 to 2 h: 0.24%
	2	475	Vomiting	Low		Differences not detected
6*	2	622	Residual gastric volume	Very low		Inconsistent study results
	1	131	Gastric pH	Very low		Difference not detected

*Includes single-arm results from randomized controlled trials.

GRADE, Grading of Recommendations, Assessment, Development, and Evaluation framework.

Differences were not detected in vomiting[99,100] or gastric pH[99] between children fasted 1 h *versus* 2 h (low and very low strength of evidence, respectively). Discordant results for residual gastric volume were reported in two trials[99,100] randomizing patients to 1- and 2-h fasting. Six additional studies provided data on gastric volume over time.[35,102-106] Three of the studies[102–104] were consistent with a return to baseline gastric volume close to 2 h, while three studies[35,105,106] were consistent with a return at 1 h (very low strength of evidence; supplemental table 20, http://links.lww.com/ALN/C934).

Comment

Fasting duration is often substantially longer than recommended irrespective of a 1- or 2-h clear liquid fasting policy.[107–112] Prolonged fasting influences patient-related outcomes (preoperative thirst, hunger, anxiety, nausea and vomiting, pain, and reduced feeling of well-being) and clinical outcomes (dehydration, electrolyte imbalance, and hypotension at induction of general anesthesia).[113,114] Due to low-quality evidence, the task force was unable to make a recommendation for reducing the clear liquid fasting duration to 1 h in the pediatric population. Several pediatric anesthesia practices in the United States now utilize the 1-h fasting duration for clear liquids. Recent European[115] and Canadian[116] guidelines have recommended reducing clear liquid fasting to 1 h in children. However, studies in children are limited, lack significant power to detect uncommon risks, and clinical controversy exists.[117]

Research Gaps and Major Uncertainties

There is a need for well designed, adequately powered randomized trials or large prospective cohort studies in both adults and children to evaluate uncommon adverse events and patient-reported outcomes including preoperative thirst, hunger, anxiety, and patient satisfaction. Comparisons and questions of interest include

- Carbohydrate-containing clear liquids (simple and complex) compared with fasting and noncaloric clear liquids
- Simple carbohydrate–containing clear liquids compared with complex carbohydrate–containing clear liquids
- Carbohydrate-containing clear liquids (simple and complex) compared with clear protein-containing liquids alone
- Protein-containing clear liquids alone compared with fasting and other clear liquids
- Adding milk or cream to coffee or tea *versus* fasting and other clear liquids
- The impact of carbohydrate-containing clear liquids on glycemic levels in patients with diabetes
- Gum chewing compared with no gum chewing

There is a need for studies evaluating gastric volume, gastric emptying, and aspiration in patients with high risk of regurgitation. Comparators of interest include

- Carbohydrate- and protein-containing clear liquids alone and in combination
- Gum chewing

Rigorous comparisons for equivalence or superiority between 1-h *versus* 2-h fasting durations in pediatric patients are needed.

Moreover, there is a need to study gastric emptying and gastric pH in critically ill patients receiving enteral feeding to determine the shortest safe duration of fasting before surgery in that population to minimize feeding interruptions. In the meantime, the task force wishes to remind clinicians to exercise clinical judgment in minimizing feeding interruptions in critically ill patients whose airways are protected with endotracheal or tracheostomy tubes with properly inflated cuffs undergoing procedures that do not include reintubation or airway manipulations.

Finally, there is a need for education of patients, their caregivers, and healthcare providers regarding avoidance of preoperative fasting beyond the recommended durations and the detrimental effects of prolonged fasting.

Summary

The task force reaffirms the 2017 recommendations for clear liquids until 2 h preoperatively.[1] Simple or complex carbohydrate–containing clear liquids appear to reduce patient hunger when compared with noncaloric clear liquids. The addition of protein to preoperative carbohydrate-containing clear liquids did not appear to either benefit or harm healthy patients. We further suggest not to delay surgery in healthy adults after confirming removal of chewed gum.

Prolonged fasting has well described adverse consequences. Actively encouraging clear liquids in healthy children as close to 2 h before procedures as possible is important to avoid them.

The task force recommends a robust local effort at each facility disseminating and discussing information shared in this document, providing necessary education to all patient care teams, including but not limited to all members of the anesthesiology and surgical teams, preoperative clinic personnel, preoperative nurses, and hospital floor nurses. Furthermore, it would be necessary to update related policies, printed literature, and wall posters/charts to ensure that patients are receiving consistent messages and instructions from all medical personnel.

Appendix: Study and Patient Characteristics

Carbohydrate-containing Clear Liquids

The body of evidence included 139 studies (adult surgical: 99 randomized controlled trials,[23–34,36–64,68–86,91,118–157] 7 nonrandomized trials,[65,66,87,152,158–160] 3 prospective cohort studies,[90,161,162] 2 retrospective cohort studies,[163,164] 1 case-control study,[165] and 2 before–after studies[67,166]; adult nonsurgical: 1

randomized controlled trial,[167] 9 crossover,[168–176] and 2 nonrandomized trials[177,178]; pediatric surgical: 9 randomized controlled trials,[100,113,179–185] 1 prospective cohort[186]; and pediatric nonsurgical: 2 randomized controlled trial,[102,104] 1 crossover,[35] and 1 prospective cohort[103]) comparing carbohydrate-containing clear liquids (simple, complex) with water, placebo, or fasting. In the carbohydrate arms, liquids were allowed an average of 2.25 h before surgery (80% until 2 h).

The characteristics of randomized trials supporting recommendations for adult surgical patients (aspiration was assessed across study designs, but the strength of evidence was unable to be rated) included a mean of 95 participants (range, 15 to 880). Approximately one half (53%) were conducted in low-resource countries (Human Development Index scores less than 0.8). Industry support was reported in 16 trials, and author conflict of interest was reported in 12 (10%) studies.

Almost all adult study participants had an ASA Physical Status I or II (92%). The mean age was 53.1 yr (range, 26 to 81), and 61% were women. Excluding the single trial of gastric bypass patients, the average of either mean or median body mass index was 25.1 kg/m^2 (range, 21 to 33). Nine (9%) trials included diabetic patients (from 2 to 100% of participants).

Protein-containing Clear Liquids

All studied protein-containing clear liquids also contained carbohydrates. The body of evidence included 22 adult surgical studies (20 randomized controlled trials,[32,43,49,52–55,57,64,68,73,76,80,85,91,148–152] 1 nonrandomized trial,[90] and 1 retrospective cohort[165]), 7 adult nonsurgical studies (1 randomized controlled trial[167] and 6 crossover studies[170,171,173–176]), and 1 pediatric nonsurgical study[104] comparing the effects of drinking protein-containing clear liquids with fasting or noncaloric clear liquids.

The characteristics of randomized trials supporting recommendations for adult surgical patients included a median of 46 participants (range, 20 to 150). The mean age of participants was 47 yr, 70% were female, and the average body mass index was 23.9 kg/m^2. Twelve studies (53%) reported enrolling patients rated with ASA Physical Status I or II (2 studies also included ASA Physical Status III, and 9 did not report ASA Physical Status). Four (22%) trials included diabetic patients (from 9 to 31% of participants). Two studies received industry support, and 1 study noted author conflict of interest.

Chewing Gum

The body of evidence included 10 studies (7 randomized controlled trials,[92–97,187] 1 crossover study,[98] 1 single-arm study,[188] and 1 case series[189]) comparing chewing gum (sugar-free or sugared) with fasting, water, or lollipops. Chewing gum was allowed either until induction or 30 min to 1 h before surgery. Studies enrolled a median of 75 participants (range, 9 to 237). The mean age of participants was 43.2 yr, and 64% were female. Three (30%) studies enrolled patients rated with ASA Physical Status I or II, and 1 (10%) study included ASA Physical Status I to III (6 [60%] studies did not report ASA Physical Status). None of the studies received industry support, and 1 study noted author conflict of interest.

One-hour Clear Liquid Fasting in Pediatric Patients

The body of evidence included 9 studies (5 randomized controlled trials,[99,100,102,104,106] 1 crossover study,[35] and 3 prospective cohort studies[101,103,105]) providing data on 1- and 2-h fasting in pediatric patients. Only 2 of the trials randomized participants into 1- and 2-h fasting protocols; the remaining studies were not designed to compare 1- and 2-h fasting; however, they included results from pediatric patients fasted less than 2 h.

Most children were ASA Physical Status I or II, although one trial enrolling patients with cyanotic congenital heart disease were more likely of higher ASA Physical Status (ASA Physical Status not reported). One study included younger children (mean age, 3 yr), 2 included children with mean or median age of 5 yr, and the remaining studies reported median ages ranging from 7 to 11 yr. Five studies were conducted in surgical settings, and 4 were nonsurgical. No studies reported industry funding, and 1 (11%) study reported a conflict of interest.

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Competing Interests

Dr. Joshi is a consultant for Baxter Healthcare (Deerfield, Illinois) and Pacira Pharmaceuticals (Parsippany, New Jersey), Dr. Abdelmalak is a consultant and speaker for Acacia Pharma (Duxford, United Kingdom) and Medtronic USA Inc. (Minneapolis, Minnesota), and Dr. Domino has received a research grant from Edwards Life Science Corporation (Irvine, California). The other authors declare no competing interests.

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Address correspondence to American Society of Anesthesiologists: 1061 American Lane, Schaumburg, Illinois 60173. kdomino@uw.edu. This Practice Guideline, as well as all published ASA Practice Parameters, may be obtained at no cost through the Journal Web site, https://pubs.asahq.org/anesthesiology.

Supplemental Digital Content

Systematic Review Protocol, http://links.lww.com/ALN/C930
PRISMA flowchart, http://links.lww.com/ALN/C931
Search strategy, http://links.lww.com/ALN/C932
Excluded studies bibliography with reasoning, http://links.lww.com/ALN/C933
Supplemental tables, http://links.lww.com/ALN/C934
Supplemental figures, http://links.lww.com/ALN/C935
Methods Supplement, http://links.lww.com/ALN/C962

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