

REVIEW ARTICLE

Preoperative fasting guidelines

A narrative review

Maud De Meyer, Carolina S. Romero and Marc Van de Velde

Preoperative fasting has long been a cornerstone of perioperative care, primarily aimed at minimising the risk of pulmonary aspiration during anaesthesia. The historical 'nil per os from midnight' policy, once universally adopted, has undergone considerable re-evaluation in recent decades. Growing evidence supporting the safety of shorter fasting intervals, particularly for clear liquids, have led to the revision of fasting guidelines worldwide. Despite these updated recommendations, prolonged preoperative fasting remains common in clinical practice. Contributing factors include outdated protocols, miscommunication, logistical constraints, operating room scheduling, too low priority and variability in guideline implementation. Such practices not only diminish patient

comfort but may also lead to metabolic disturbances, with children being especially susceptible.

This narrative review explores the rationale, evolution, and current guidelines surrounding preoperative fasting. Both pharmacological and non-pharmacological strategies, such as the use of gastric ultrasound, rapid sequence induction, and gastric tubes, are discussed. The emerging impact of glucagon-like peptide-1 receptor agonists (GLP-1RAs) is also highlighted. By synthesising current evidence, this review aims to provide clinicians with a practical, evidence-based framework for optimising fasting practices and improving perioperative outcomes.

KEY POINTS

- Preoperative fasting guidelines are only applicable to healthy patients undergoing elective surgery.
- The rate of gastric emptying for both liquids and solids is influenced not only by factors such as ingested volume, osmolality, composition, and caloric density, but also by patient comorbidities.
- Due to persistently poor clinical adherence to updated guidelines, unnecessarily prolonged preoperative fasting diminishes patient comfort and significantly elevates the risk of dehydration, metabolic disturbance, and potential hypoglycaemia, particularly in children.
- The increasing use of glucagon-like peptide-1 receptor agonists poses a new challenge, as these

drugs delay gastric emptying and may necessitate cautious preoperative management.

- Gastric ultrasound and techniques like rapid sequence induction play a key role in objectively assessing and managing aspiration risk.

Introduction

Preoperative fasting is a fundamental component of perioperative care to minimise the risk of pulmonary aspiration during anaesthesia. The traditional 'nil per os from midnight' policy, which imposed fasting from solids and liquids after midnight regardless of surgery timing, was introduced in the 1960s.¹ However, this approach has been increasingly challenged by evidence showing that prolonged fasting does not necessarily reduce gastric volume² and may instead contribute to

From the Department of Anaesthesiology, UZ Leuven, Leuven, Belgium (MDM), Anaesthesia and Critical Care Department, Consorcio Hospital General Universitario de Valencia, and Faculty of Health Sciences, Universidad Europea de Valencia, Valencia, Spain; Outcomes Research Consortium, Houston, Texas, United States of America (CsR) and the Department of Anaesthesiology and the Department of Cardiovascular Sciences, UZ Leuven and KU Leuven, Leuven, Belgium (MvdV)

Correspondence to Maud De Meyer, MD, Department of Anaesthesiology, UZ Leuven, Herestraat 49, 3000 Leuven, Belgium.
Tel: +32 497124220; e-mail: maud.demeyer@uzleuven.be

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patient discomfort, dehydration, metabolic disturbances, and perioperative complications.^{3–5} Almost four decades ago, new guidelines from major anaesthesiology societies included shorter fasting periods tailored to the type of intake, clear liquids vs. solids.^{6–8} Despite these updates, adherence remains suboptimal due to persistent misconceptions, logistical challenges, and variability in institutional protocols.^{9–12} This narrative review provides a comprehensive overview of gastric physiology, guideline evolution, clinical consequences of non-adherence, and strategies to improve preoperative fasting practices.

Methods

Search strategy

The primary PubMed search was limited to ‘preoperative fasting guidelines’. To expand the scope of this article, two additional PubMed searches were conducted, one on ‘GLP-1 receptor agonists’ combined with ‘preoperative guideline’, ‘preoperative management’ or ‘perioperative management’, and another on ‘gastric tubes’ and ‘airway management’. Although only one relevant article was initially retrieved from the latter search, further exploration through the ‘cited by’ section provided additional useful information. Relevant articles, their references, and, when valuable, references of those references were reviewed (snowballing technique). Occasionally, general theoretical background was supplemented using clinically-orientated resources such as StatPearls. The full search yield is summarised in the Supplemental Digital Content 1, <http://links.lww.com/EJAIC/A181>.

Physiology of stomach emptying

Anatomical divisions of the stomach

The stomach is anatomically divided into several regions, each with a distinct role in digestion. The fundus, corpus, antrum, and pyloric canal coordinate to facilitate the digestive process.

The fundus serves as a temporary reservoir for ingested food, gradually releasing it into the corpus for further digestion. It expands to accommodate varying amounts of food and liquid, ensuring efficient mixing and processing. Along with the corpus, it contains gastric glands that secrete hydrochloric acid (HCl).^{13,14} This acidic environment activates pepsinogen, converting it into pepsin, which is essential for protein digestion.¹³

The corpus, the stomach’s central region, plays a key role in gastric secretion. It produces gastric juices containing HCl, pepsinogen, water, mucus and intrinsic factor that aid in food breakdown, particularly proteins.¹³ Muscular contractions in the corpus mix food with gastric secretions, forming chyme, a semi-liquid substance with particle sizes smaller than 1 to 2 mm.^{15,16} This process further breaks down food and facilitates digestion.

The antrum, the stomach’s lower portion, is characterised by strong muscular contractions. These peristaltic waves

grind food into smaller particles and thoroughly mix it with gastric secretions.¹⁷

The pyloric canal contains the pyloric sphincter, which regulates gastric emptying by allowing only small amounts of chyme to pass into the small intestine at a controlled rate. This precise release ensures optimal digestion and nutrient absorption.¹⁷

Each gastric region plays a distinct role in the digestive process, including storage, gastric juice secretion, mechanical digestion, mixing and grinding of food, and regulation of gastric emptying. Together, these processes break down ingested food into essential nutrients for absorption.

Control of gastric emptying

The stomach plays a central role in the breakdown of food, alternating between digestive and inter-digestive phases to transport ingested food to the small intestine.

Digestive phase

During digestion, the stomach churns and mixes food with gastric acid to form chyme. In addition to this mechanical breakdown, digestive enzymes such as pepsins break down macromolecules into smaller components.¹⁷

The stomach regulates the rate at which nutrients enter the small intestine to optimise digestion and absorption. The composition of ingested food influences gastric emptying. For example, fatty foods slow gastric emptying due to the complexity of lipid digestion, whereas carbohydrates and proteins can accelerate it.¹⁶ Water, in contrast, exits the stomach rapidly.¹⁷

Inter-digestive phase

The inter-digestive phase is essential for clearing indigestible residues. This process is controlled by the migrating motor complex, which consists of distinct phases: an initial period of quiescence, followed by gradually increasing activity, culminating in intense contractions. Throughout these phases, the pylorus and duodenum remain relaxed to facilitate residue passage.¹⁷

Neuronal and hormonal regulation

Gastric emptying is regulated by a complex interplay of neuronal and hormonal signals. These mechanisms ensure digestion and absorption proceed at an optimal pace. Gastric motility and emptying are primarily governed by the vagus nerve and enteric nervous system.

Hormonal control further fine-tunes this process. Gastrin and ghrelin stimulate gastric emptying, whereas cholecystokinin, released by duodenal cells in response to fat and protein, slows gastric emptying to allow thorough digestion and absorption. The delicate balance between stimulatory and inhibitory factors ensures the controlled

movement of food from the stomach to the small intestine.¹⁸

Rate of gastric emptying

The rate of gastric emptying is primarily governed by ingested volume, osmolality, composition, and caloric density, with the stomach typically emptying at a controlled rate of 1 to 4 kcal min⁻¹.^{17,19,20} While plain water empties most rapidly, exhibiting a half-time ($t_{1/2}$) of approximately 10 min^{3,17,19,21} and complete clearance within approximately 45 min,^{3,21} the introduction of energy content alters this timeline. Consequently, carbohydrate-containing drinks may require up to 90 min for full gastric emptying.^{22,23}

This physiological delay occurs regardless of whether the carbohydrates are simple (monosaccharides and disaccharides like glucose, fructose, and sucrose) or complex (polysaccharides such as maltodextrin). Since carbohydrates consistently deliver 4 kcal g⁻¹,²² the gastric emptying of table sugar added to water follows a predictable caloric curve. Notably, while substituting simple carbohydrates for complex ones can reduce a drink's osmolality, this only results in a slight increase in gastric emptying speed. This is because caloric density exerts a far more dominant regulatory effect on the stomach than osmolality alone.²⁴

In clinical practice, these timelines ensure that carbohydrate-rich clear fluids remain within safety margins for preoperative intake. However, persistence of gastric contents beyond these windows, specifically the retention of more than 10% of food after 4 h, may be indicative of pathological delayed gastric emptying.²⁵

Pathophysiology: patients with delayed gastric emptying

Numerous factors can potentially delay gastric emptying, including obesity, gastro-oesophageal reflux disease, hiatus hernia, ileus, bowel obstruction, diabetes mellitus, labour, hypothyroidism, shock, trauma and opioid use.^{3,7}

Specifically regarding pregnancy, basal gastric secretion and acidity remain unchanged. However, there is a delay in gastric emptying during the first trimester of pregnancy, and also during labour. Epidural analgesia has been shown to increase gastric emptying, but not to levels observed in non-pregnant women.²⁶

When any of these factors apply, gastric emptying times may be prolonged and harder to predict. Preoperative fasting guidelines are generally only applicable to healthy patients in elective surgery.

Pulmonary aspiration, aspiration pneumonia and death

Pulmonary aspiration of gastric contents is a rare but potentially life-threatening complication that can result in pneumonitis, pneumonia, and airway obstruction.

Mendelson was the first to report fatalities following the aspiration of gastric contents during general anaesthesia.¹ The estimated incidence of pulmonary aspiration varies between studies, ranging from approximately 1 in 2000 to 1 in 10 000 in elective adult cases.^{27,28} Although less frequent in elective procedures than in emergency cases, aspiration carries a significant risk, with mortality reported between 1.5% and 6.6%.³ Several factors are associated with an increased risk of aspiration, including higher American Society of Anesthesiologists (ASA) status and emergency procedures in non-fasted patients.

^{27–29} The severity of pulmonary aspiration is largely determined by the volume and pH of the gastric contents. Early animal studies suggested a significantly increased risk of pneumonia when more than 0.4 ml kg⁻¹ of gastric contents with a pH below 2.5 were aspirated.¹ More recent human data propose a cut-off value of 1.5 ml kg⁻¹ for residual gastric volume to distinguish between normal and elevated volumes, thereby helping to assess the risk of regurgitation.³⁰ However, the threshold for gastric pH has remained consistent over time.^{31,32}

Effect of anaesthesia

Once anaesthesia is induced, patients experience a depression of protective airway reflexes, including the gag, cough, and swallowing reflexes. Both the upper and lower oesophageal sphincters play a critical role in preventing the regurgitation of gastric contents and thereby reducing the risk of pulmonary aspiration. However, anaesthetic agents can impair the function of both sphincters.

The upper oesophageal sphincter, which is under voluntary control, permits the passage of food during swallowing.³³ It is primarily composed of skeletal muscle, with the cricopharyngeus muscle serving as its main component.³⁴ Consequently, muscle relaxants significantly reduce upper oesophageal sphincter tone, thereby increasing the risk of regurgitation.³⁵ Even in the absence of neuromuscular blockers, upper oesophageal sphincter pressure can be reduced by various anaesthetic agents, including propofol,³³ opioids,³⁶ benzodiazepines,^{36,37} and inhalation agents – with the exception of nitrous oxide³⁸ and ketamine.³⁹

In contrast, the lower oesophageal sphincter is composed of smooth muscle and serves to prevent passive reflux of gastric contents.³³ Normal lower oesophageal sphincter resting pressure ranges from 15 to 25 mmHg.²⁶ This physiology changes markedly during pregnancy: intra-gastric pressure increases, while the lower oesophageal sphincter pressure progressively decreases, reaching a nadir of around 2.5 mmHg by 36 weeks of gestation.²⁶ Muscle relaxants do not affect the lower oesophageal sphincter tone.³⁵ Low doses of propofol have minimal impact on the lower oesophageal sphincter, while the effect of higher doses remains controversial, with studies reporting both increases³³ and decreases⁴⁰ in lower oesophageal sphincter pressure. Opioids, benzodiazepines,

and inhalational anaesthetics, however, tend to relax smooth muscle, thereby reducing lower oesophageal sphincter tone and potentially increasing the risk of aspiration.⁴¹

Evolution of preoperative fasting guidelines

Historical perspective

William Beaumont, a U.S. Army surgeon, was the first to explore gastric physiology in detail. Over nearly a decade, he conducted groundbreaking experiments on a patient who had sustained a gunshot wound to the abdomen, resulting in a gastric fistula. Through direct observation of the stomach's contents through this fistula, Beaumont noted distinct differences in gastric emptying times between solids and liquids. Solids remained in the stomach for up to 5 h, while liquids emptied almost immediately.⁴²

Maltby has provided a comprehensive overview of the history of preoperative fasting practices from 1847 to 1983.¹ Early on, preoperative fasting was believed to minimise postoperative nausea and vomiting. In 1858, John Snow was the first to describe the unpleasant experience of vomiting in relation to anaesthesia.⁴³ Over time, the primary rationale for preoperative fasting shifted toward reducing the risk of pulmonary aspiration. As early as 1883, Joseph Lister proposed that fasting could lower this risk.⁹ He also pioneered the distinction between solid food and clear liquids in the context of preoperative preparation.¹

Clear liquids are defined as water, pulp-free juices, black tea, black coffee, and carbohydrate-rich beverages.^{4,44} In contrast, liquids containing particles, soluble fibre, milk-based drinks, and jellies are classified as solids. However, small amounts of milk, up to approximately one-fifth of the total volume, added to tea or coffee are still considered acceptable within the definition of clear liquids in Europe (Table 1).⁴⁴ Hillyard *et al.* demonstrated that adding 50 ml of milk to a hot drink does not significantly delay gastric emptying.⁴⁵

Despite early evidence highlighting the differences in gastric emptying between solids and clear liquids, the strict 'nil per os from midnight' policy became widespread in the 1960s.¹ It was not until the 1990s that this practice began to be re-evaluated. Gradually, anaesthesiology societies around the world revised their fasting guidelines in light of emerging evidence, leading to the more evidence based recommendations we see today (Table 2).

Anaesthesiological societies and their current guidelines

In 1993, the Norwegian Society of Anaesthesiologists (NAF) was the first national body to introduce preoperative fasting guidelines that allowed for reduced fasting times for clear fluids.⁴⁷ These guidelines are almost

Table 1 Classification of clear and non-clear liquids

Clear liquids
• Water
• Pulp-free juices
• Black tea
• Black coffee
• Carbohydrate-rich beverages
Non-clear liquids / solids
• Liquids containing particles or soluble fibre
• Milk-based drinks
• Jellies
Exceptions
• In Europe (ESA 2011) ⁴⁴ small amounts of milk (up to ~20% of total volume) in tea or coffee are considered acceptable
• In the US (ASA 2017, 2023) ^{4,7} , in Australia and New Zealand (ANZCA 2024) ¹ and NICE (2020) [‡] , no milk is allowed

[†] <https://www.anzca.edu.au/getContentAsset/d4eb4cab-69e6-4228-8568-bbc911c6c505/80feb437-d24d-46b8-a858-4a2a28b9b970/PG07-Pre-anaesthesia-consultation-2024.pdf?language=en>. [‡] <https://www.nice.org.uk/guidance/ng180/chapter/recommendations#intraoperative-care>.

entirely similar to today's guidelines. The Scandinavian Society of Anaesthesiology and Intensive Care Medicine (SSAI) also adheres to a 2-h fasting policy for clear liquids but allows premedication to be taken with clear fluids up to 1 h before anaesthesia. Their guidelines permit adults to consume up to 150 ml and children up to 75 ml of water.⁵⁰

Currently, fasting times for clear liquids still differ between adults and children. Adults are permitted to consume clear fluids up to 2 h before anaesthesia, while children may do so up to 1 h beforehand. In 2020, Morrison *et al.* were the first to propose reducing the fasting time for clear liquids in adults to 1 h, aligning with the paediatric recommendation.⁵⁴ Some centres have gone further by endorsing a 'sip-til-send' approach, where patients are encouraged to continue sipping small amounts of clear fluids until they are called to the operating theatre.^{55–57} However, safety data supporting this practice are limited to children, with little evidence in adults.^{55–57} Marshman *et al.* conducted a quality-improvement study in adults but noted that their study was underpowered to draw definitive conclusions regarding the safety of the liberal fasting protocol in terms of regurgitation and pulmonary aspiration.⁵⁵ Harnett *et al.*, however, concluded that a 'sip-til-send' approach was non-inferior in non-labouring pregnant women before elective caesarean delivery.⁵⁸

In contrast to other societies, the Australian and New Zealand College of Anaesthetists (ANZCA) has provided age-specific fasting recommendations for children since 2017. The 2017 guideline distinguished between infants younger and older than 6 months.⁵¹ In the 2024 update, this threshold was revised, with recommendations now differentiating between children under and over 12 months of age (<https://www.anzca.edu.au/getContentAsset/d4eb4cab-69e6-4228-8568-bbc911c6c505/80feb437-d24d-46b8-a858-4a2a28b9b970/PG07-Pre-anaesthesia-consultation-2024.pdf?language=en>). Younger infants are

Table 2 Overview of the preoperative fasting recommendations of different national societies and their adjustments over time

Year	Society	Applies to adult/child	Clear liquids	Breast milk	Infant formula and non-human milk	Solids
1987	CAS ⁴⁶	Both	5 h	5 h	5 h	5 h
1993	NAF ⁴⁷	Both	2 h	4 h		6 h
1999	ASA ⁴⁸	Both	2 h	4 h	6 h	6 h light meal 8 h meat, fried foods, or fatty foods
2000	CAS ⁴⁹	Both	2 h	4 h	6 h	6 h light meal 8 h meat, fried foods, or fatty foods
2005	SSAI ⁵⁰	Both	2 h	4 h	4 h infant formula 6 h non-human milk	6 h
2008	ANZCA ⁹	Both	2 h	6 h	6 h	6 h
2010	AAGBI APAGBI [*]	Both	2 h	4 h	6 h	6 h
2011	ESA ⁴⁴	Both	2 h	4 h		6 h
2017	ASA ⁷	Both	2 h	4 h	6 h	6 h light meal 8 h meat, fried foods, or fatty foods
2017	ANZCA ⁵¹	Adult Child < 6 months > 6 months	2 h 2 h			6 h light meal
2018	ADARPEF APAGBI ESPA ⁵²	Child	1 h	4 h	6 h	6 h
2020	CAS ⁵³	Adult Child	2 h 1 h	4 h	6 h	6 h light meal 8 h large meal, meat, fatty foods
2022	ESAIC ⁶	Child	1 h	3 h	4 h	6 h solids
2023	ASA ⁴	Both	2 h	4 h	6 h	6 h light meal >6 h meat, fried foods, or fatty foods
2023	CAS ⁸	Adult Child	2 h 1 h	4 h	6 h	6 h any meal
2023	ANZCA [†]	Adult Child < 6 months > 6 months	2 h 1 h			6 h light meal
2024	ANZCA [‡]	Adult Child < 12 months > 12 months	2 h 1 h	3 h 3 h	4 h 6 h	6 h light meal

The adjustment of a guideline compared with a previous guideline of an association is shown in bold. Due to CAS's annual updates, only those guidelines that contain a change are shown. AAGBI, Association of Anaesthetists of Great Britain and Ireland; ADARPEF, French Language Society of Paediatric Anaesthesiologists; ANZCA, Australian and New Zealand College of Anaesthetists; APAGBI, Association of Paediatric Anaesthetists of Great Britain and Ireland; ASA, American Society of Anesthesiologists; CAS, Canadian Anesthesiologists' Society; ESA, European Society of Anaesthesiologists; ESAIC, European Society of Anaesthesiology and Intensive Care; ESPA, European Society of Paediatric Anaesthetists; NAF, Norsk anestesilogisk forening/Norwegian Society of Anaesthesiologists; SSAI, Scandinavian Society of Anaesthesiology and Intensive Care Medicine. *AAGBI safety guideline: Preoperative Assessment and Patient Preparation – The role of the Anaesthetist (2010). The Association of Anaesthetists of Great Britain and Ireland. https://rcoa.ac.uk/sites/default/files/documents/2019-09/Guideline_preoperative_assessment_patient_preparation_anaesthetist_2010_final.pdf. †[https://web.archive.org/web/20231104083045/https://www.anzca.edu.au/getattachment/d2c8053c-7e76-410e-93ce-3f9a56ffd881/PG07\(A\)-Guideline-on-pre-anaesthesia-consultation-and-patient-preparation-2023](https://web.archive.org/web/20231104083045/https://www.anzca.edu.au/getattachment/d2c8053c-7e76-410e-93ce-3f9a56ffd881/PG07(A)-Guideline-on-pre-anaesthesia-consultation-and-patient-preparation-2023). ‡<https://www.anzca.edu.au/getContentAsset/d4eb4cab-69e6-4228-8568-bbc911c6c505/80feb437-d24d-46b8-a858-4a2a28b9b970/PG07-Pre-anaesthesia-consultation-2024.pdf?language=en>.

allowed shorter fasting intervals, given their increased susceptibility to the adverse effects of prolonged fasting.⁵¹ ANZCA recommends that healthy children may consume clear liquids up to 3 ml kg⁻¹ h⁻¹ until 1 h before anaesthesia, a practice shown to be safe, with gastric volumes returning to baseline within an hour of ingestion.⁵⁹ Moreover, since their 2023 update, ANZCA defines a sip as 30 ml of water that may be taken alongside premedication.

In 2022, the European Society of Anaesthesiology and Intensive Care (ESAIC) updated its guidelines, relaxing preoperative fluid fasting requirements for children. Similar to ANZCA, they reduced fasting times to 3 h for breast milk and 4 h for infant formula or non-human milk, though they did not differentiate by age. ESAIC also noted that several centres have already adopted a 4-h fasting policy for non-clear liquids or a light breakfast, but emphasised that this practice is supported by weaker evidence.⁶

The ASA remains unique in applying the same fasting guidelines to both adults and children, continuing to follow the traditional 2–4–6 rule (2 h for clear fluids, 4 h for breast milk, 6 h for solids). In their 2023 update, they no longer specifically recommend an 8-h fast for meat, fried or fatty foods. Instead, they state that a minimum fasting period of over 6 h should be respected.⁴

The Canadian Anesthesiologists' Society (CAS), which updates its guidelines annually, currently advises a uniform 6-h fast for all meals, without distinction between light meals and meat, fried or fatty foods.⁸

Additional recommendations

Beyond the primary professional societies in anaesthesia, other national health bodies provide evidence-based frameworks for perioperative care. The National Institute for Health and Care Excellence (NICE), for

instance, provides evidence-based guidance on health and care in the United Kingdom. They recommend a preoperative fasting period of 2 h for clear fluids in adults (<https://www.nice.org.uk/guidance/ng180/chapter/recommendations#intraoperative-care>). Consistent with the ASA and ANZCA guidelines, NICE explicitly excludes milk from the 'clear liquid' category.

Building on this regulatory framework, clinical research has sought to define the specific physiological triggers of gastric delay. Several studies indicate that the caloric content of a drink, rather than volume alone, is a significant determining factor influencing gastric emptying time.^{60–62} Specifically, Okabe *et al.* suggest that beverages containing up to 220 kcal and 500 ml in volume, such as pulpless orange juice (with relatively high osmolality and viscosity) or diluted milk (with relatively high viscosity), can be safely consumed up to 2 h before anaesthesia. However, they caution that these findings should not be extrapolated to drinks with extremely high osmolality, viscosity, or both, since these may significantly delay gastric emptying regardless of caloric density.⁶⁰

This pragmatic approach to preoperative intake extends to the use of chewing gum. The consensus among major anaesthesia bodies including the ASA, ESAIC, and ANZCA, is that elective surgery should not be delayed or cancelled due to preoperative gum chewing.^{4,6,44} While the gum must be discarded before induction to avoid physical airway obstruction, these organisations recognise that any resulting increase in gastric fluid volume is clinically insignificant and does not alter gastric pH or aspiration risk.⁶³ Far from being a clinical hazard, permitting gum chewing can actually enhance the patient experience by mitigating preoperative anxiety and thirst, while also offering recovery benefits such as the potential reduction of postoperative ileus.⁶⁴

Adherence to preoperative fasting regimes

Despite the clarity of current guidelines and the widespread abandonment of the 'nil per os from midnight' policy, adherence remains a challenge. Although fasting recommendations have remained relatively consistent since the 1990s, multiple studies continue to report unnecessarily prolonged preoperative fasting times in both adults and children.^{10–12} For example, the BIG-FAST study reported a median fasting duration of 12 h for adults, well beyond current recommendations.¹⁰ Similarly, in children, Brunet-Wood *et al.* found a median fasting time of 11 h,¹¹ while Aroonpruksakul *et al.* observed fasting durations of 11–14 h for solids and 2–12 h for clear liquids.¹²

Several factors contribute to this persistent over-fasting:

- (1) Tradition and habits: one of the primary reasons for prolonged fasting is the continued adherence to outdated protocols by healthcare providers.⁹

Merchant *et al.* reported that approximately 50.4% of surveyed anaesthetists in Canada, Australia and New Zealand, and Europe still follow a 'nil per os from midnight' approach, despite updated guidelines.⁹ A Brazilian study also concluded that many of their hospitals were not following current guidelines.¹⁰ This practice is often justified by the desire for scheduling flexibility, allowing patients to be easily moved forward in the surgical line-up if necessary.

- (2) Miscommunication and patient compliance: another major contributing factor is the incorrect interpretation or recall of fasting instructions by patients, or by parents for children. Özhan *et al.* found that low educational levels, age, decreased cognitive function and high anxiety are key factors that cause many patients to forget important verbal instructions.⁶⁵ A letter with the most important information can significantly improve patient understanding and adherence.
- (3) Practical limitations for early-morning procedures: patients scheduled for early-morning procedures often experience prolonged fasting simply due to the timing of their surgery. Because they are unlikely to wake up during the night to eat, their fasting duration for solids typically matches or exceeds the length of their sleep, leading to fasting periods that significantly surpass guideline recommendations.

Consequences of non-adherence to fasting guidelines

Failure to follow appropriate preoperative fasting guidelines can lead to significant clinical consequences at both ends of the spectrum. On one hand, consuming food or liquids too close to the time of induction of anaesthesia increases the risk of pulmonary aspiration due to elevated gastric volume and diminished protective airway reflexes.^{33,35–37,40,41} Although several guidelines support the safety of consuming clear liquids up to 1–2 h before anaesthesia, given their rapid gastric emptying^{3,17,19,21} ingestion of solids or non-clear liquids too close to induction remains a risk factor. On the other hand, excessive fasting beyond the recommended time frames also poses risks that are often underestimated.

He *et al.* reported that patients who consumed a carbohydrate drink 2–3 h before anaesthesia experienced significantly less hunger, thirst, and anxiety compared with patients who fasted for 8–12 h before surgery.⁶⁶ Beyond discomfort, extended fasting may trigger notable physiological and metabolic changes. Inadequate fluid intake can lead to dehydration and hypotension at the time of induction.^{3,4,67} Moreover, prolonged fasting can activate catabolic processes such as gluconeogenesis, lipolysis, and proteolysis, ultimately contributing to perioperative insulin resistance.¹⁰

Infants and young children are particularly vulnerable to the effects of extended fasting.^{5,67,68} They are at higher

risk of dehydration and hypoglycaemia due to their limited glycogen stores, immature gluconeogenic pathways, and inadequate ketogenic responses.⁶⁸ In very young children, these physiological limitations can result in significant metabolic instability during the perioperative period.

Pharmacological considerations in preoperative fasting

High gastric acidity and large gastric volume are significant contributors to the harmful effects of aspiration. Therefore, pharmacological interventions aimed at reducing gastric acidity and accelerating gastric emptying may theoretically help prevent these conditions. Additionally, emesis should be avoided. To achieve these effects, H₂-receptor antagonists (H₂RAs), proton pump inhibitors (PPIs), antacids, prokinetics, and antiemetics, may prove beneficial.

H₂RAs, such as ranitidine and cimetidine, bind to H₂-receptors on the parietal cells of the stomach, inhibiting the stimulatory effects of histamine and thus reducing acid production. When administered intravenously, they begin to take effect within 30 min, but for maximum effect, H₂RAs should be given 1–2 h before anaesthesia.⁴⁴ Their duration of action typically ranges from 4 to 10 h.⁶⁹ H₂RAs are less potent than PPIs at inhibiting acid production.^{70–72}

PPIs, such as omeprazole and pantoprazole, act by inhibiting proton pumps on parietal cells, thereby blocking the stimulatory effects of histamine, gastrin and acetylcholine.^{44,73} As prodrugs, PPIs require activation in an acidic environment, meaning they may take several days to achieve maximum effect.^{70,71,73} However, intravenous formulations offer immediate acid suppression.^{70,71}

Antacids, such as sodium citrate and magnesium trisilicate, begin neutralising stomach acid within seconds to minutes, leading to a rapid increase in gastric pH when administered immediately before surgery.^{74,75} Their effect typically lasts up to 2 h.⁷⁵

Prokinetic drugs, such as metoclopramide and domperidone, promote gastric emptying mainly by stimulating gastrointestinal muscular contraction. For optimal effectiveness, they should be taken 30–60 min in advance.⁷⁶

Antiemetics encompass various types of medications that generally reduce nausea and vomiting.⁷⁷ However, their effects on gastric emptying differ. Dopamine antagonists, such as the aforementioned prokinetic drugs, stimulate gastric emptying. In contrast, serotonin antagonists, like ondansetron, have no impact on gastric emptying, while anticholinergics, such as atropine and glycopyrrolate, can even slow it down.^{76,78}

European and American guidelines agree that prophylactic administration of the above-mentioned drugs is not recommended for patients without an increased

aspiration risk. However, in cases of elevated pulmonary aspiration risk, these pharmacological interventions may be routinely used preoperatively.^{7,44}

Glucagon-like peptide-1 receptor agonists

GLP-1RAs are currently a trending topic. Initially developed for diabetes treatment, they have gained attention in recent years for their, in some cases off-label, use in managing obesity.^{79–81} These drugs are recognisable by their generic names ending in ‘-tide’, such as dulaglutide, liraglutide, and semaglutide. However, two new drugs, orforglipron and danuglipron, are currently in clinical trial phase. Like the semaglutide Rybelsus, they are designed for oral administration.²⁰ Their side effect profile is similar to other GLP-1RAs, being primarily gastrointestinal and dose-dependent.^{82,83}

GLP-1 is a hormone that, upon binding to its receptor, stimulates insulin release from the pancreas while inhibiting glucagon secretion, leading to lower blood glucose levels.^{79–81} Endogenous GLP-1 can be enzymatically degraded by dipeptidyl peptidase 4 (DPP-4), but synthetic GLP-1 agonists are designed to resist this degradation.^{79,80,84} Additionally, GLP-1 and its synthetic analogues delay gastric emptying,^{79–81,84,85} an effect that is most pronounced during the early stages of treatment and dose escalation.⁸⁶ This side effect is more commonly associated with short-acting GLP-1RAs,^{84,86} but tends to diminish due to tachyphylaxis after 4–12 weeks of use.^{80,84,87}

Some consensus documents and safety bulletins have been published, all advising anaesthetists to proceed with caution. They recommend confirming gastric content via gastric ultrasound.^{84,88–91} Indeed, a recent 2026 prospective matched-control study found that 49% (21/43) of patients on semaglutide had a ‘full stomach’ on ultrasound compared to only 18% (8/44) of controls, despite standard fasting.⁹² Based on the ultrasound findings and the urgency of the procedure, consensus documents suggest proceeding as usual, implementing ‘full stomach’ precautions, or postponing anaesthesia.^{88,90,91,93}

Multisociety consensus, including the ASA, suggests that patients without specific risk factors may continue GLP-1RA therapy perioperatively, as bridging therapy is generally not feasible. For those at increased risk, a 24-h liquid diet can facilitate continuation.⁹⁰ However, if an unacceptable safety profile exists, the decision to withhold therapy must be balanced against the risk of inducing metabolic instability, such as hyperglycaemia, which could complicate postprocedure care.⁹⁰ In such cases, the ASA recommends withholding daily-dosed GLP-1RAs on the day of elective surgery and weekly-dosed GLP-1RAs for one week before the procedure.^{89,90}

In contrast, the ESAIC adopts a more nuanced approach: while they also advise a one-week pause for patients with diabetes, they recommend withholding weekly doses for

at least two weeks when used specifically for obesity management. Critically, whereas the ASA suggests dietary modification only for higher-risk cases, the ESAIC and ANZCA recommend a 24-h clear liquid diet before surgery for all patients on these medications, regardless of their individual risk profile.^{91,94} ANZCA even considers the use of erythromycin to accelerate gastric emptying.⁹¹

It should be emphasised that complete drug clearance requires 4 to 5 half-lives, and studies on the full recovery of gastric motility after GLP-1RA discontinuation are lacking.^{80,88} Nonetheless, guidance documents often adopt a conservative approach to mitigate risks and avoid potential harm.

In conclusion, further research is needed to optimise the perioperative management of GLP-1RAs to reduce the risk of perioperative aspiration. The high prevalence of residual gastric content recently reported in semaglutide users, nearly 50%,⁹² underscores the urgent need for larger, multicentre trials to determine if current withholding guidelines are sufficient to ensure patient safety. Conversely, cessation may lead to hyperglycaemia, which increases the risk of surgical site infections and may paradoxically slow gastric emptying, potentially negating the benefits of withholding the drug.^{95,96} Furthermore, patients who omit doses are susceptible to tachyphylaxis-related effects. Those on high-dose regimens or who previously experienced severe symptoms during initial titration may encounter significantly more potent gastrointestinal side effects upon restarting the medication than they were previously accustomed to.^{95,97}

Non-pharmacological interventions in preoperative fasting

Gastric ultrasound

Gastric ultrasound is a non-invasive tool that quickly and objectively assesses gastric contents and the associated risk of aspiration in real time. The gastric antrum is of paramount importance because of its consistent location in humans and because it is an ideal ultrasound window for all kinds of stomach content.⁹⁸ To ensure that the antrum is visible, the left lobe of the liver and the aorta must be captured in the same image. The patient is first scanned in the supine position and then in right lateral decubitus (RLD) for a more accurate estimation of gastric contents, especially at low volumes.⁹⁸ In case of a 'frost-ed-glass' pattern (Fig. 1a), indicating recent food ingestion, or solid hyperechoic content (Fig. 1b) a supine ultrasound is sufficient. If the stomach appears empty, indicated by a bull's eye appearance (Fig. 1c), or if clear fluids (Fig. 1d, e) are seen, the patient should have a gastric ultrasound image in RLD.^{99,100} In this position, a cross-section of the gastric antrum is again obtained, and the cross-sectional area is measured. Depending on the age of the patient and the measured cross-sectional area, a corresponding estimate of the gastric volume is obtained. Using this predefined table, we can quickly see whether

the patient's gastric volume indicates a fasting/low risk state (up to 1.5 ml kg⁻¹) or a non-fasting/high risk state (more than 1.5 ml kg⁻¹).^{30,99} When the stomach contains solids or too much fluid, the procedure should be postponed unless it is urgent. In that case, rapid sequence induction and intubation (RSII) can be used.

However, the introduction of this approach comes with challenges. Gastric ultrasound findings may be inaccurate if there is abnormal underlying gastric anatomy, particularly in patients who have undergone gastric surgery, such as gastric sleeve/banding/bypass, and patients with a hiatus hernia.¹⁰⁰ In addition, a high level of expertise is needed for the correct assessment of gastric ultrasound and interpretation of the results. Therefore, healthcare facilities should invest in proper training of their personnel.

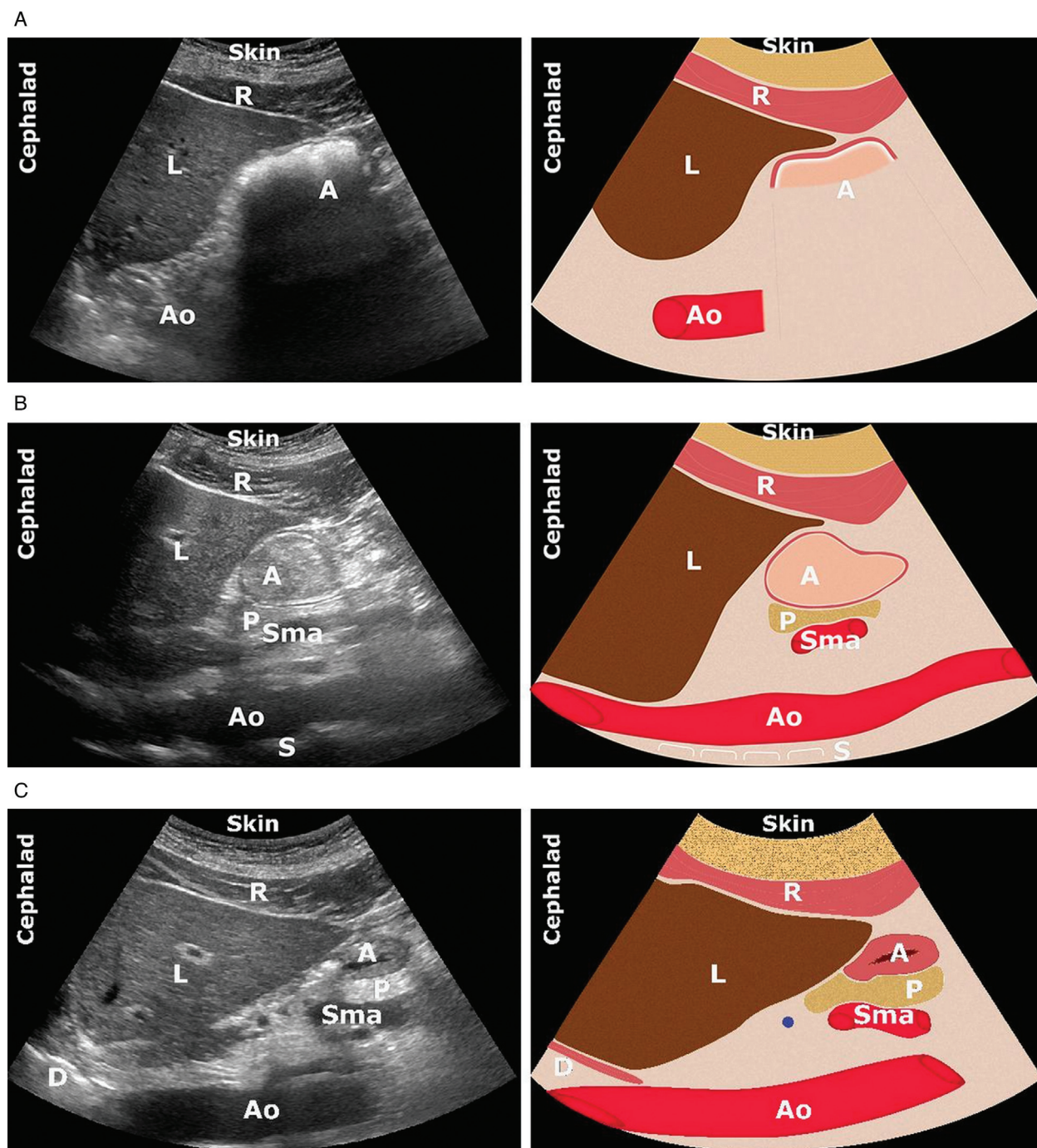
Rapid sequence induction and intubation

In patients at high risk of aspiration, RSII or awake fibre-optic intubation is the induction of choice. The latter is preferred in case of suspected difficult airway conditions. RSII involves the administration of a rapid-acting induction agent and neuromuscular blocker to facilitate quick airway protection using an endotracheal tube. It is designed to minimise the chance of pulmonary aspiration caused by passive or active regurgitation.¹⁰¹ It is used in emergency situations where delayed gastric emptying is common or in patients with unconfirmed history of fasting, and can be performed with or without cricoid pressure (CP) or left paratracheal pressure (LPP).

Cricoid pressure

In 1961, Sellick introduced CP to prevent regurgitation of gastric or oesophageal contents and to prevent gastric inflation in mask-ventilated patients.¹⁰² Sellick's manoeuvre has since been adopted and remains common practice. In practice, a force of about 30 N (10 N $\approx$ 1 kg) is given to press the cricoid cartilage against the 5th cervical vertebra occluding the oesophageal lumen.¹⁰³ However, there is controversy over the effectiveness of this technique. Opponents of this technique point to the lack of evidence in favour of CP and list several disadvantages: difficult visualisation of laryngeal structures during laryngoscopy, longer intubation time, higher Cormack and Lehane scores, decreased lower oesophageal sphincter tone, lateral oesophageal deviation with incomplete occlusion, possible oesophageal rupture if active vomiting occurs, and no reduction in aspiration risk.^{104–109} Some of these claims are met with resistance from CP supporters. For example, they dispute the claim that lateral oesophageal deviation leads to incomplete occlusion. They consider the cricoid cartilage and the hypopharynx as one entity. Thus, during CP, lateral displacement of this entity occurs simultaneously, leading to compression of the oesophageal lumen.¹¹⁰ Furthermore, a 30 N cricoid force is more than sufficient to prevent regurgitation, despite lateral displacement of the

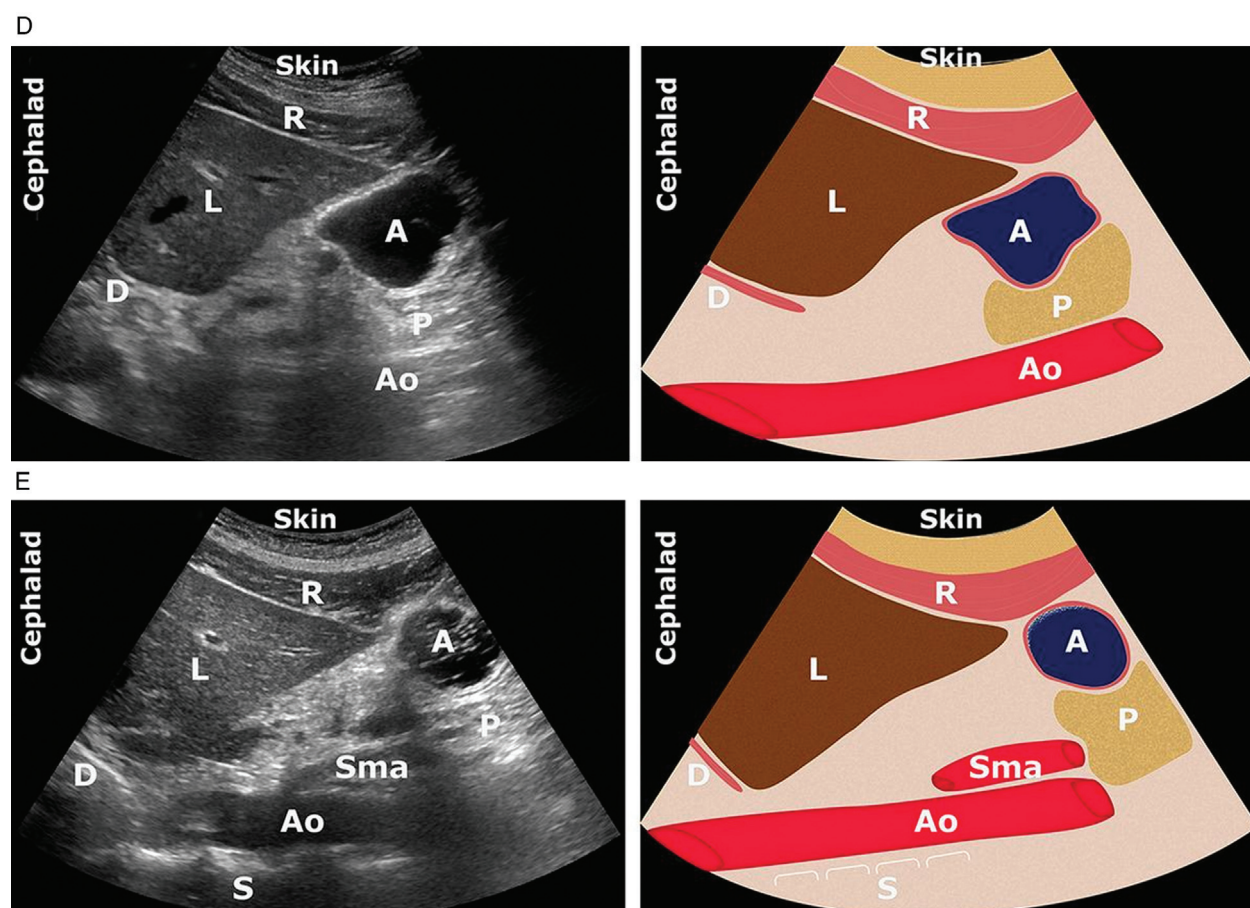
Fig. 1 Type of gastric content. (a) Solid early stage. (b) Solid late stage. (c) Empty stomach. (d) Clear fluid. (e) Clear fluid with air bubbles. A: antrum; Ao: aorta; D: diaphragm; L: liver; P: pancreas; R: rectus abdominis muscle; S: spine; Sma: superior mesenteric artery. Used with permission from gastricultrasound.org.



oesophagus, because intragastric pressure rarely exceeds 25 mmHg.¹⁰⁷ Regarding the possibility of oesophageal rupture, only one report described this phenomenon after RSII using CP. However, analysis of this incident showed no causal relationship with CP.¹⁰⁷

Mishra *et al.* developed a CP sensor device providing real-time feedback that significantly improved oesophageal occlusion in their study, suggesting that monitoring the applied force may enhance the efficacy of Sellick's manoeuvre.¹¹¹ CP is contraindicated in suspected airway

Fig. 1 Continued.



obstruction, retropharyngeal abscess, cervical spine injury, tracheomalacia, laryngeal trauma, or difficult airway anatomy. In these situations head-up tilt may be used instead.^{107,112}

Because there is a lack of high-quality evidence on this topic and varying guidelines exist, if any, each clinician continues to follow their own best practice.^{110,113} In conclusion, more research is needed to establish clear guidelines.

Left paratracheal pressure

LPP is being proposed as an alternative to Sellick's manoeuvre. The technique involves applying lateral pressure to the left border of the trachea, a few centimetres superior to the clavicle, with the aim of occluding the oesophagus.¹¹⁴ Javillier *et al.* found no significant difference in the applied force required for LPP between men and women.¹¹⁴ Won *et al.* concluded that mask ventilation, if required, is easier to achieve using LPP. However, their findings showed that the glottic view

during direct laryngoscopy and the overall intubating conditions did not significantly differ when comparing CP and LPP.¹¹⁵

Gastric tubes

Gastric tubes (GT) can be preoperatively inserted through the mouth (OGT) or the nose (NGT) and are typically used to decompress the stomach in cases of intestinal obstruction or ileus and to remove any food and fluid present. Currently, there are no guidelines as to who should receive a preoperative GT. As with CP, each clinician continues their own best practice. However, some guidelines regarding difficult airway management briefly mention the consideration of mechanical gastric drainage using NGT, without going into detail about the intended target group.^{116,117} The Canadian Airway Focus Group (CAFG) recommends suctioning on the nasogastric tube before and during induction if there is a suspicion of a difficult airway and an increased risk of aspiration. They also suggest placing an NGT if one is not already present.¹¹⁷

Sellick initially proposed removing the NGT after a final aspiration, just before induction of anaesthesia, because both oesophageal sphincters were affected by this NGT, increasing the risk of regurgitation.¹⁰² After gaining new insights, he rejected these earlier thoughts and stated that CP was safe in the presence of a NGT.¹¹² Two later cadaveric studies supported the effectiveness of CP in closing the oesophagus around the NGT.^{118,119} Vanner and Pryle also found that the lateral movement of the NGT within the oesophageal lumen enhanced the efficacy of CP. They observed that during CP, the pressure behind the cricoid cartilage is unevenly distributed, with the NGT occupying the portion of the oesophageal lumen that is relatively less compressed.¹²⁰

In the last decades, only two articles have extensively discussed the use of the NGT. Salem *et al.* proposed an airway management algorithm for patients with oesophageal lesions, gastro-oesophageal reflux and gastric dilation.¹¹² Eichelsbacher *et al.* described the advantages and drawbacks of gastric tubes, and provided several recommendations.⁷⁷

Medicolegal implications of fasting guidelines

Personalised medicine and adherence to clinical practice guidelines are not mutually exclusive. However, clinical practice guidelines are not suitable for all patients; a case-by-case assessment discussing patient preferences and values is preferable.¹²¹ Nonetheless, in a dataset of closed claims, the secondary cause of anaesthesia claims was intubation (29%).¹²² In a more recent analysis, aspiration accounted for 5% (115/2496) of closed claims; death was reported in 57% (66/115) of these cases, and a total of 14% (16/115) of patients experienced permanent severe injury.¹²³

Conclusion and future research directions

Preoperative fasting guidelines have evolved from an old-fashioned and traditional 'nil per os from midnight' approach to evidence-based, patient-centred recommendations that differentiate between clear liquids and solids. These guidelines apply to low-risk patients undergoing elective surgery. In these circumstances, recommended fasting times are 2 h for clear liquids in adults, 1 h for children (except the ASA guideline), and 6 h for solids. High-risk groups on the other hand, such as patients with bowel obstruction, gastro-oesophageal reflux disease, or women in labour, may require tailored fasting times. The definition of clear liquids varies among societies. However, the most widely used definition is 'tea or coffee without milk and juices without pulp'. Further research is required to appropriately categorise these characteristics. Despite the advances of shorter fasting periods, adherence remains inconsistent, often leading to unnecessarily prolonged fasting that can contribute to patient

discomfort, metabolic disturbances, and increased perioperative complications.

Gastric ultrasound has emerged as a valuable tool for assessing aspiration risk by directly visualising gastric contents, particularly in high-risk patients or those on medications that delay gastric emptying, such as GLP-1 receptor agonists. However, its widespread implementation requires further training and standardisation. Pharmacological interventions, including PPIs and prokinetics, may play a role in selected cases but are not routinely recommended for low-risk patients.

In conclusion, future research and randomised controlled trials on different fasting regimes are needed. Moreover, there is a need for studies specifically addressing high-risk patient groups to optimise safety and outcomes.

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