

Operative fasting guidelines and postoperative feeding in paediatric anaesthesia-current concepts

Address for correspondence:

Dr. Ekta Rai,
Department of Anesthesia,
Christian Medical College,
Vellore, Tamil Nadu, India.
E-mail: drektarai@yahoo.com

Ann Sumin Toms, Ekta Rai

Department of Anesthesia, Christian Medical College, Vellore, Tamil Nadu, India

ABSTRACT

Preoperative fasting period is the prescribed time prior to any procedure done either under general anaesthesia, regional anaesthesia or sedation, when oral intake of liquids or solids are not allowed. This mandatory fasting is a safety precaution that helps to protect from pulmonary aspiration of gastric contents which may occur any time during anaesthesia. We searched PUBMED for English language articles using keywords including child, paediatric, anaesthesia, fasting, preoperative, gastric emptying. We also hand searched references from relevant review articles and major society guidelines. Association of Paediatric Anaesthesiologists of Great Britain and Ireland (APAGBI), the French Language Society of Paediatric Anaesthesiologists and the European Society of Paediatric Anesthetists recommends clear fluid intake upto one hour prior to elective surgery unless specific contraindications exists. Current guidelines recommend fasting duration of 4 hours for breastmilk, 6 hours for milk and light meals and 8 hours for fatty meals. The European Society for Clinical Nutrition and Metabolism (ESPEN) guidelines recommend that oral intake can be initiated within hours of surgery in most patients. While fluids can be started almost immediately, the introduction of solids should be done more cautiously.

Key words: Anaesthesia, children, clear fluids, fasting guidelines, milk, preoperative, solids

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INTRODUCTION

Preoperative fasting period is the prescribed time prior to any procedure done either under general anaesthesia, regional anaesthesia or sedation, when oral intake of liquids or solids are not allowed.^[1] This mandatory fasting is a safety precaution that helps to protect from pulmonary aspiration of gastric contents which may occur any time during anaesthesia (either at induction, during a procedure, at recovery or in the immediate postoperative period). This occurs as a result of loss of protective airway reflexes and regurgitation. Fasting guidelines have therefore been proposed to minimise the risk of pulmonary aspiration and its complications and thus help provide safe anaesthesia. It also helps in preventing prolonged fasting and its side effects namely hypoglycaemia, dehydration and electrolyte imbalance, thereby decreasing perioperative morbidity and thus improving patient satisfaction and outcome. We searched PUBMED for English language articles using keywords including child, paediatric, anaesthesia, fasting, preoperative, gastric emptying. We also hand searched references from relevant

review articles and major society guidelines. These guidelines, which include a specified time period of preoperative fasting, have been discussed in detail.

Gastric emptying

Understanding the physiology of gastric emptying has led to improvement in the preoperative fasting regimen. It has been found that while emptying of solids follow zero order kinetics, liquids follow first order kinetics.^[2] The factors influencing gastric emptying of fluids include the pressure gradient between the stomach and duodenum, and the density, volume, osmolality and pH of the gastric fluid. Gastric emptying of water and other clear fluids

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follows an exponential curve with a mean half-time of 10 minutes. In contrast, glucose containing fluids have an initial slower emptying, albeit the difference being negligible after 90 minutes. For solids, the major factors that delay emptying are increasing meal density and quantity with minor factors being old age and female sex. In abnormal scenario gastric emptying for solids start approximately 1 hour after a meal with 50% of the ingested solid food being passed on to the duodenum within 2 hours. In mature neonates and infants, gastric emptying of human milk is in between 2 and 3 hours. While prematurity and cow's milk have shown to slacken the rate of gastric emptying, emptying of infant formula feed is greatly affected by the content in it.^[3]

Delayed gastric emptying can occur in various situations, and may be divided aetiologically into physiological alterations, disease alterations, and intake of drugs. Severe pain and anxiety are well known reasons for delayed gastric emptying. Systemic diseases like diabetes mellitus are known to reduce gastric emptying much more for solids than for liquids, with gastrointestinal stasis due to either tumour or obstruction also having the same effect. Late pregnancy also causes delayed gastric emptying. Delayed gastric emptying times for solids and a small but statistically significant increase in gastric fluid volumes when compared with non-smokers, has been forwarded as reasons for avoiding smoking immediately before anaesthesia. Recreational abuse of cannabinoids, high doses of alcohol and usage of opioids has also shown to inhibit gastric emptying.

GUIDELINES

Pre-operative assessment

A thorough preoperative evaluation is necessary in order to identify the patients who are at increased risk of aspiration. The preoperative evaluation should include patient history and clinical examination which in turn should include the patient's age, sex, American Society of Anesthesiologists (ASA) status, any difficult airway, gastro-oesophageal reflux disease, diabetes or any other factors which may increase the risk of pulmonary aspiration. It is imperative that the patients are educated on the need and importance of preoperative fasting.

Clear fluids

The fasting period especially for clear fluids have literally come down over the past 50 years.

Randomised trials comparing the gastric volume and pH in two groups who were given clear fluids either till 2 to 4 hours or more than 4 hours prior to surgery showed lower gastric pH in the second group whereas equivocal findings regarding gastric volume.^[1] This was further corroborated by a study done by Maltby *et al.*, which showed that clear fluids can safely be taken till 2 hours prior to surgery.^[4] Also another study by Song *et al.* where ultrasonic assessment of gastric volume in children were done, showed that clear fluids up to 10 to 15ml/kg when given 2 hours prior to induction resulted in a decrease in antral volume rather than increasing it.^[5]

The guidelines published by the European and American organisations encourage drinking clear fluids till 2 hours prior to an elective surgery.^[1,6] The updated guidelines by European Society of Paediatric Anaesthesiologists (ESPA) encourage drinking clear fluids till 1 hour prior to surgery. ESPA updated guidelines regarding clear fluids has also been endorsed by Society for Paediatric Anaesthesia of Australia and New Zealand. Clear fluids include fruit juice without pulp, water, and coffee or tea without milk; but do not include alcohol. Milk is not included under clear fluids because it coagulates in the acidic environment of stomach and delays gastric emptying. Though some studies define a small amount of milk added to tea or coffee as clear fluids, there is insufficient data to suggest the volume of milk that can be safely added.

Until recently, most guidelines would suggest a fasting period of 2 hours for clear fluids.^[7] Nonetheless recent studies have shown that the risk of pulmonary aspiration is less in children and this has led to many centres now moving on to a 1 hour fasting time for clear fluids in children.^[8] The APRICOT study– ‘The Anesthesia Practice in Children Observational Trial’, which is a pan European multicentric study reported that there has not been a single documented admission to intensive care or incidence of prolonged intubation following aspiration in children.^[2,9] A study by Andersson H *et al.* reported that liberalising the fasting period in children for clear fluids did not alter the incidence of pulmonary aspiration.^[10] APAGBI, the French Language Society of Paediatric Anaesthesiologists and the ESPA also recommends clear fluid intake upto 1 hour prior to elective surgery unless specific contraindications exists. It is now an official guideline of ESPA that clear fluids can be allowed till 1 hour prior to surgery.^[11] A recent study

of 16000 children from the United States also showed the safety of 1 hour NPO for clear fluids.^[12]

Hence, it can be summarised that while the traditional 2 hours fasting regime for clear fluids may still be practiced for adults, it can be reduced upto 1 hour for children prior to an elective surgery unless specific contraindications exist. The decrease in fasting time results in reduced anxiety, irritability, hunger and thirst in the perioperative period which in turn contributes to the comfort and well-being of children.

Breast milk

Studies have suggested that breast milk empties faster than formula feeds but required more than 2 hours and upto 3 hours to ensure complete emptying. So the current guidelines recommend a fasting period of 4 hours for breast milk before an elective procedure requiring any form of anaesthesia.^[2,6]

Infant formula feeds

There is inadequate data to evaluate the safe period of fasting for formula feeds. This is due to the fact that gastric emptying for formula feed varies with the content of the formula. Also, rather large variations have been noticed in the composition of formula food between different regions/countries. For this reason, ASA has set a fasting period of 6 hours for infant formula before any elective procedures requiring anaesthesia.^[1]

Solids and non-human milk

Robert *et al.* on their study on rhesus monkey suggested that clinically significant aspiration occurs when the gastric volume is more than 25ml (0.4ml/kg) and the pH is 2.5 or less.^[13] Van de Putte *et al.* on their study on the gastric volume using bed side ultrasound however suggested a higher critical volume of 1.5 ml/kg for clinically significant aspiration.^[14] A randomised control trial by Miller *et al.* showed no significant difference between patients who fasted overnight and patients who had light breakfast 2 to 4 hours prior to surgery in terms of gastric volume and pH.^[15] Further non randomised studies by Thomas *et al.* showed that incidence of hypoglycaemia was more in the group that fasted for 8 hours or more as compared to the group that had milk 4 hours prior to surgery.^[16] Also non-randomised trials by Power *et al.* reported enhanced comfort in patients with fasting period of 2 hours for fluids and 6 hours for solids with no increase in the risk of pulmonary aspiration.^[17]

It is recommended that non-human milk or a light meal can be taken till 6 hours prior to elective surgery requiring any form of anaesthesia whereas a heavy meal or meal with fried and fatty items require a longer fasting period of 8 hours or more as the gastric emptying may be delayed in such cases. Not only the type of food, but also the amount is important in determining the fasting period.^[1]

Carbohydrate loading

Recognition of the physiology of stress response to surgery and anaesthesia led to the adoption of various measures to decrease it.^[18] It has been recognised that prolonged preoperative fasting leads to increased stress response to surgery. Major surgeries result in a lot of metabolic responses which includes insulin resistance and hyperglycaemia. Preoperative carbohydrate loading enhances recovery by modifying insulin resistance, minimising protein losses and thus improving postoperative muscle function. It has also been reported that preoperative loading of carbohydrate does not increase the incidence of pulmonary aspiration; however, its role in diabetics has not been well established.^[19] Carbohydrate loading has also been found to be an important independent predictor for improved post-operative outcome and in the reduction of post-operative wound dehiscence.^[20] Fluids with 50 grams of carbohydrate can be safely given till 2–3 hours prior to surgery.^[21] However, all carbohydrates may not be equally safe, with evidence being based primarily on products with predominantly maltodextrins.^[6]

Chewing gum

The 2011 European fasting guidelines do not put any restriction on chewing gum. A randomised controlled trial by Dubin *et al.* suggested that surgery need not be cancelled if the patient arrives chewing sugarless gum prior to induction. It has also been established that no significant relationship exists between chewing sugarless gum, gastric volume and pH.^[22] A randomised controlled trial in children aged between 5 and 17 years reported that children who chewed gum with or without sugar prior to anaesthesia had higher gastric volume and pH.^[23] A meta-analysis of four studies on the effects of chewing gum in the perioperative period reported a slight increase in gastric volume without a change in gastric pH. This increase in gastric volume was found to be insufficient for causing pulmonary aspiration. Therefore, it has been suggested that surgery need not be cancelled in healthy individuals who chew gum in the preoperative

period.^[24] There is also evidence suggesting that gum chewing can enhance gastric mobility and emptying. However, chewing gum should not be allowed after administration of sedatives and any residual chewing gum should be removed from the mouth prior to induction.^[25] As the significance of increase in gastric volume by gum chewing is unclear, some studies have suggested restricting it in the immediate preoperative period.^[3] In view of the conflicting reports regarding gum chewing in the preoperative period, further studies may be required to determine the exact relationship between gum chewing and pulmonary aspiration.

Special situations

While assessing the fasting status of a trauma victim it must be remembered that the gastric volume is not related to the hours of fasting but to the nature of trauma and the time interval between last food intake and trauma.^[26] Thus all trauma victims are considered to be full stomach.^[6] Severe pain and administration of opioids can cause a delay in gastric emptying.^[27,28] Various systemic diseases can also cause delay in gastric emptying, the commonest example being diabetes mellitus.^[29] It has been found that there is no significant change in gastric acid secretion in pregnancy.^[6,30] While early labour does not significantly affect gastric emptying, advanced labour can result in delay of the same.^[31] Conditions causing gastro esophageal reflux as in hiatus hernia and bowel obstruction can increase the risk of pulmonary aspiration during anaesthesia. Patients with difficult airway are also at high risk for aspiration. So the anaesthetic management has to be modified in such situations.

CURRENT CONCEPTS

Role of education

Education to all medical staff regarding the importance of correct duration of fasting will help in the practical application of the existing guidelines. Newton *et al.* documented that introduction of standard protocols and education of nurses and doctors can reduce unnecessary preoperative fasting duration by three times.^[32]

Role of ultrasound in fasting

There is growing evidence for role of ultrasound in qualitative and quantitative assessment of gastric content which in turn will guide us more into starvation guidelines.^[33]

Post-operative feeding

It has been reported that early oral feeding is safe and well tolerated even after elective colorectal surgery, which questions the traditional belief of fasting till bowel function returns.^[34] The European society for clinical nutrition and metabolism (ESPEN) guidelines recommend that oral intake can be initiated within hours of surgery in most of the patients.^[35] Delaying oral intake following surgery gives no added advantage. Few studies challenged the concept of early feeding as they documented increased incidence of nausea and vomiting after early but forced feeding.^[36] But none of the recent studies support this issue. Early oral intake in the postoperative period does not affect wound healing and can result in decreased hospital stay following surgery.^[35,37-39] There has been various observational studies, meta-analysis and multicentric trials that support early oral intake after surgery.^[38] Based on the various studies it can be concluded that early but on demand oral feeding can be started in the post-operative period even before the return of bowel function in otherwise healthy individuals. While fluids can be started almost immediately, the introduction of solids should be done more cautiously.

SUMMARY

There is considerable inter individual variability in gastric emptying. It is also affected by a lot of factors like anxiety, pain, diabetes, trauma, reflux disease and intestinal obstruction to name a few. Various randomised control trials, multicentric trials, meta-analysis and observational studies on healthy individuals have led to the development of the 8-6-4-2 fasting regimen which states a fasting period of 8 hours for fatty meals, 6 hours for light meals, milk and infant formula, 4 hours for breast milk and 2 hours for clear fluids before an elective surgery requiring anaesthesia. The 2-hour fasting period for clear fluids is liberalised to 1 hour in children. This is based on various studies which showed very minimal risk of aspiration, decreased incidence of dehydration and improved child satisfaction. Maltodextrin based carbohydrate drinks may be given till 2 hours, preoperatively. Gum chewing prior to surgery is not an indication for delaying the procedure provided it is only chewed, not swallowed. The ward staff should be educated and encouraged always to find whether oral intake can be continued incase of unanticipated prolongation of the period of fasting. Also, post-operative oral feeding should be initiated at the earliest and only on demand in otherwise healthy individuals who are not sedated

Table 1: Summary of fasting guidelines

Types of Feeds	Hours of Fasting -Existing Guidelines	Explanation
Clear Fluid Max vol=3 ml/kg water, clear (non-opaque) fruit juice or squash/ cordial, ready diluted drinks, and nonfizzy sports drinks. Non-thickened, non-carbonated Carbohydrate rich drink	1 2	Rare instances of aspiration (0.07-0.1%) and if aspiration occurs, it is not severe and long lasting. Mostly, fasting durations are prolonged. Clear fluid calms the child down especially in hot weather Improves insulin sensitivity. Better metabolic profile. Early Discharge after surgery.
Breast Milk	4	High whey to casein ratio content of breast makes it follow water like emptying. Due to high lipid content than water needs more time
Milk	6	Cow's milk+Gastric acidic juices converts into solid and liquid (curd) Emptying follows biphasic with rapid initial liquid phase followed by zero order solid phase Follows zero order kinetics.
Solids Non Fatty Meal Fatty Meal	6 8	
Postoperative resumption of fluids	As early as possible, on demand	

unless contraindicated. Table 1 summarizes the fasting guidelines for children and also updates on the current concepts of post operative feeding.

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Conflicts of interest

There are no conflicts of interest.

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