ISA Guidelines

Perioperative fasting and feeding in adults, obstetric, paediatric and bariatric population: Practice Guidelines from the Indian Society of Anaesthesiologists

PREAMBLE

Preoperative fasting involves being nil by mouth before surgical procedures requiring sedation or anaesthesia.[1] In the postoperative period, complete avoidance of oral dietary intake is practiced, till recovery of bowel function for abdominal surgeries.[2] Impairment or abolition of airway reflexes following deep sedation or anaesthesia can lead to pulmonary aspiration of gastric contents.[3] The ideal condition for minimising the risk of regurgitation and aspiration is an empty stomach before deep sedation or anaesthesia, which may be impossible to achieve due to the continuous gastric secretory activity along with impaired physiology due to various aetiologies encountered in the preoperative period.

Traditional cut off points of gastric aspirate volumes of >25 mL with pH <2.5 have long been quoted to correlate with significant pulmonary aspiration leading to respiratory failure.[4,5] This critical pH and volume was obtained by Roberts and Shirley on a Rhesus monkey and were extrapolated to humans.[6] Although pH and gastric volume have been traditionally measured using aspiration techniques, the modern research modalities utilising pharmacokinetic properties of orally administered water-soluble substances such as paracetamol, magnetic resonance imaging (MRI) and scintigraphy have provided better insights into the physiology of gastric emptying. Newer modalities such as gastric ultrasonography (GUS) have been increasingly used to study the gastric volumes and emptying.

Pradeep A Dongare, S Bala Bhaskar[1], S S Harsoor[2], Rakesh Garg[3], Sudheesh Kannan[4], Umesh Goneppanavar[5], Zulfiqar Ali[6], Ramachandran Gopinath[7], Jayashree Sood[8], Kalaivani Mani[9], Pradeep Bhatia[10], Priyanka Rohatgi[11], Rekha Das[12], Santu Ghosh[13], Subramanyam S Mahankali[14], Sukhminder Jit Singh Bajwa[15], Sunanda Gupta[16], Sunil T Pandya[17], Venkatesh H Keshavan[18], Muralidhar Joshi[19], Naveen Malhotra[20]

Assistant Professor, Department of Anaesthesiology, ESI-PGIMSR, Bengaluru, [1]Department of Anaesthesiology, Vijayanagar Institute of Medical Sciences, Ballari, [2]Professor, Department of Anaesthesiology, Dr BR Ambedkar Medical College and Hospital, Bengaluru, [3]Additional Professor, Department of Onco-Anaesthesia, Pain and Palliative Medicine, DR BRAIRCH, AIIMS, New Delhi, [4]Professor, Department of Anaesthesiology, BMCRI, Bengaluru, [5]Professor, Department of Anaesthesiology, Dharwad Institute of Mental Health and Neurosciences, Dharwad, [6]Associate Professor, Department of Anesthesiology and Critical Care, Sher-I-Kashmir Institute of Medical Sciences, Srinagar, [7]Professor and Head,Department of Anaesthesiology and Intensive Care, ESIC Medical College and Hospital,Hyderabad, [8]Honorary. Joint Secretary, Board of Management, Chairperson, Institute of Anaesthesiology, Pain and Perioperative Medicine, Sir Ganga Ram Hospital, New Delhi, [9]Scientist IV, Department of Biostatistics, AIIMS, New Delhi, [10]Professor and Head, Department of Anaesthesiology and Critical Care, All India Institute of Medical Sciences, Jodhpur, [11]Chief Clinical Dietician, Apollo Hospitals, Bengaluru, [12]Professor and Head, Department Anaesthesiology, Critical care and Pain, Acharya Harihar Post Graduate Institute of Cancer, Cuttack, [13]Assistant Professor, Department of Biostatistics, St John's Medical College, Bengaluru, [14]Senior Consultant Anaesthesiologist, Aster R V Hospital, Bengaluru, [15]Professor and Head, Department of Anaesthesiology and Intensive Care, Gian Sagar Medical College and Hospital, Punjab, [16]Professor and Head, Department of Anaesthesiology, Geetanjali Medical College and Hospital, Udaipur, [17]Chief of Anaesthesia and Surgical ICU, AIG Hospitals, Hyderabad, [18]Senior Consultant and Chief, Department of Neuroanaesthesia and Critical Care, Apollo Hospitals, Bengaluru, [19]Head, Department of Anaesthesia and Pain Medicine, Virinchi Hospitals, Hyderabad, [20]Professor, Department of Anaesthesiology and In Charge Pain Management Centre, Pt BDS PGIMS, Haryana, India

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What is the need for the Indian Society of Anaesthesiologists (ISA) guidelines?

A large number of surgical procedures are conducted daily in India, with diverse health care settings and differing practice standards. The patient population varies in terms of food items consumed, with a variable fat content, caloric content and nutrient composition in different regions and states. The socio-cultural, geographic and economic factors also play a role in the food habits.

The overall culture and eating habits of the population is largely similar in countries of South Asia that includes India, Bhutan, Nepal, Bangladesh, Sri Lanka, Maldives, Afghanistan and Pakistan, but the available guidelines do not apply uniformly across these countries and very few evidences address the problems peculiar to this region. These issues have been taken into consideration during the formulation of 'Practice guidelines on perioperative fasting and feeding' by the ISA.

This document emphasises the concerns related to the safe duration of fasting before and after administration of sedation or anaesthesia for elective, diagnostic or surgical procedures. It addresses the type and quantity of solid and liquid food that can be ingested safely till the fasting is initiated and the feeding is restarted in the postoperative period. It covers the general surgical population, and those undergoing paediatric, obstetric and bariatric procedures. The guidelines are not applicable for subset of patients who have medical or surgical conditions which predispose them to aspiration.

These guidelines are developed based on the current evidence available worldwide and in India as also on the basis of institutional practice patterns across India, gathered from the countrywide survey conducted by the ISA. The guidelines are designed to steer the practice of anaesthesiology based on evidence, and cannot be taken as absolute or standard answers for specific research questions. The recommendations will be updated as and when additional evidence emerges in future.

Focus of the guidelines

These clinical practice guidelines provide recommendations for withholding solid and liquid food before elective diagnostic or surgical procedures performed under deep sedation or anaesthesia (regional or general) and for resumption of oral feeds in the post procedure period. They are aimed to reduce the incidence and severity of aspiration pneumonitis and other complications (such as hypotension during induction of anaesthesia), to prevent delays or cancellations of surgical procedures and also lead to a better patient outcome. The guidelines are addressed to practicing anaesthesiologists, surgeons, other medical and paramedical professionals involved in patient care.

It may also be useful for patients to know the types of food that are considered as clear liquids, non-clear liquids, light meal and heavy meal and to guide them in consumption of food items before presenting for elective diagnostic or surgical procedures. It will identify the shortcomings in the evidence specific to South Asian countries, and allow for the formation of institutional protocols and stimulate research among the colleagues so that evidence is added for the future.

METHODOLOGY

The ISA approved the proposal for preparation of the practice guidelines on perioperative fasting and feeding during the annual general body meeting of ISA in November 2017. The core committee consisted of the President and Secretary of ISA and six members. The expert committee consisted of 12 members, with academic standing and experience in the field of anaesthesiology and respective subspecialties from different institutions of India, along with two expert biostatisticians and one nutrition expert.

The core committee held meetings within the group (3 in-person and 25 online) and with members of the expert committee (2 in-person and 12 online) to discuss the research questions and the evidence available. The core committee formulated and circulated a validated survey questionnaire[7] for each section to institutions across India, to collect additional data regarding institutional fasting and feeding practices from those geographical regions. Surveys pertaining to paediatric, obstetric and bariatric patients were circulated to institutions offering services specifically to such groups. The evidence obtained from the expert committee members and the results from the survey were combined to formulate the draft guideline document. The same was presented at the annual conference of ISA (ISACON) in November 2019 in a special session involving the core committee, expert committee, delegates and ISA governing council members. The updated draft was presented to and approved by the general body of ISA.

Electronic search for full text articles published in English language before January 2020 was conducted, using keywords based on the research questions, in PubMed, Embase, Cochrane Library and Google Scholar databases: meta analyses, systematic reviews, randomised controlled trials (RCTs), observational studies, cohort studies, case series and case reports were included. Manual retrieval of the missing manuscripts from the bibliography of the published articles and guidelines was done. Narrative reviews, editorials and letters to editors or correspondence and other similar items including only abstracts were excluded.

Standard data extraction techniques from retrieved manuscripts were followed for subsequent meta-analysis. Research questions answered by at least 3 RCTs or observational studies fulfilling the Population; Intervention; Comparator; Outcome and Time frame (PICOT) criteria were included for meta-analysis. Additional data were collected for institutional fasting practices for adult population (from 56 institutions), for obstetric population (from 21 institutions), for paediatric population (from 13 institutions) and for bariatric population (from 18 institutions) from India, based on surveys using validated questionnaires.[7] If meta-analysis was not possible for a research question, expert consensus was obtained based on the outcomes of available studies and the survey findings to arrive at a recommendation.

The Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach was used to allot the 'Level of Evidence' (LOE) of the literature included. The GRADE protocol categorises evidence into 'High, Moderate, Low and Very Low'. Based on these levels of evidence, recommendations were framed and graded as either weak or strong.[8]

For the purpose of these guidelines, preoperative fasting is defined as the minimum required fasting duration for oral intake of solids or liquids prior to administration of anaesthesia or sedation necessary to minimise the risk of regurgitation and pulmonary aspiration in patients devoid of risk factors for regurgitation.

An empty stomach is a state when the gastric contents reach the baseline volume after the intake of a solid, semi solid or liquid meal. Baseline volume is defined as the volume of gastric contents of an adult after overnight fasting.

Residual Gastric volume is the volume of gastric contents at the time of examination or evaluation.

A full stomach is the presence of solid content or a state of increased volume of the liquid gastric contents above the baseline volumes after the intake of a solid, semisolid or liquid meal.

Clear liquid is defined as any liquid which takes <2 h to empty from the stomach in human beings.

Non-clear liquid is defined as any liquid which takes between 2 h and 4 h to empty from the stomach in human beings.

Light meal is defined as any food item which takes between 4h to 6h to empty from the stomach in human beings.

Heavy meal is defined as any food item which takes >6 h to empty from the stomach in human beings.

The summary of recommendations is represented as a table [Table 1].

ADULT SECTION

What is the acceptable residual gastric volume?

Roberts *et al.* found that instillation of 25 mL of gastric aspirate into the right bronchus of rhesus monkey produced significant aspiration pneumonitis. Extrapolating this finding to humans, they stated that aspiration of 25 mL would produce pneumonitis and postulated that residual gastric volume of more than 25 mL posed a high risk for aspiration pneumonitis.[6] Many studies tried defining the residual gastric volume, based on values obtained by actual aspiration (during endoscopy or by gastric tube) and by imaging techniques. More recent studies have used GUS to quantify the residual gastric volumes after fasting. The stratifications related to duration of fasting, definition of residual gastric volume and its assessment methods in existing studies have been inconsistent, limiting the attempts for formulation of acceptable definitions for clinical practice.

Perlas *et al.* in a prospective descriptive study using GUS found that 86 of the 200 patients fasted for 8 h for solids and 5 h for liquids had no or minimal residual gastric volume, while seven patients had a high residual gastric volume of 180 ± 83 mL. One among these with gastro-oesophageal reflux disease aspirated the gastric contents during extubation.[9] Van de Putte

et al. performed a retrospective analysis of 512 patients and classified patients as 'empty stomach' (no contents or liquid content <1.5 mL/kg) or 'full stomach' (liquid content >1.5 mL/kg or presence of solid content) based on GUS; they found that despite adhering to the American Society of Anesthesiologists' fasting guidelines, 32 patients had full stomach by this criteria. The mean fasting duration in these patients was 10.8 h and 13.9 h for liquids and solids, respectively. Eight patients had consumed heavy meals out of the nine patients who had solid content while one each of them had gastro-oesophageal reflux disease and Parkinson's disease.[10] Four studies involving pregnant women found residual gastric volumes to be higher than 25 mL.[11-14]

Based on the current evidence, the traditional cutoff point of more than 25 mL residual gastric volume as a risk factor for aspiration pneumonitis may need to be re-examined in adults.

Adequate fasting times – When is the stomach empty?

Twenty one studies describing gastric emptying times of various kinds of foods were identified.[15-35] Of these, 14 were RCTs and 7 were observational studies. These studies used various methods of gastric emptying estimation such as the 'gold standard' scintigraphy, MRI, GUS and carbon dioxide breath analysis. Most studies were performed on healthy volunteers involving small sample sizes. Six studies each were performed on gastric emptying of liquids of varying composition, solids of varying content, and combination of solid with liquid or meals, respectively while one study each consisted of semisolids and comparison of solids versus liquids, respectively. These studies showed significant variations in gastric emptying. A study in the Indian setting published in 1999 concluded that addition of spice (masala) to idli reduced the gastric emptying time.[34]

The inferences drawn from these studies are as follows:

1. The gastric emptying time is different for liquids, solids and semisolids. For solids it depended on the method of cooking, particle size and composition
2. Clear liquids of low caloric value take approximately 2 h to empty
3. Liquids with high caloric value and non-clear liquids may take longer than 2 h to empty
4. Combinations of solids and liquids take anywhere between 4 and 7 h to empty
5. Fried food items of similar composition take longer time to empty
6. Scintigraphy cannot be used to estimate the residual gastric volume
7. GUS estimation of residual gastric volume is computed by mathematical models based on the cross-sectional area of the gastric antrum, where return to baseline values is considered as gastric emptying time.

The categorisation of food items by the survey into heavy meals, light meals and clear liquids was reviewed by an experienced dietician after referring to the available evidence [Appendix 1-3].[20,36-64] The classification was revised by the dietician based on the duration of emptying of the stomach contents as clear liquids, non-clear liquids, light meal and heavy meal [Table 2].

Clear liquid 2 h before induction of anaesthesia *vs* overnight fasting

The stomach always has a basal volume due to continuous gastric secretions. The duration of fasting is considered acceptable if the post prandial gastric volume returns to basal levels. The 20 studies identified by our search regarding clear liquids intake and gastric volumes did not report any event of aspiration or regurgitation.[65-84] The studies were of Low, or Very Low level of evidence. In eight studies, after overnight fasting, one group received water to consume medications and the other, received between 100 and 500 mL water till 2 hours before induction of anaesthesia.[65-72]

Residual gastric volume considerations

The meta-analysis of three studies conducted using studies published between1988 and 2016, comparing consumption of water 2 h prior to induction of anaesthesia and overnight fasting found that the groups who had consumed water 2 h prior had comparable residual gastric volumes with a mean difference of 0.76 mL and 95% CI 0.60 to 1.02 (LOE- Moderate).[64-66]

Studies comparing consumption of other clear liquids such as orange juice, black coffee with overnight fasting were analysed separately (LOE- Very Low to Low). The meta-analysis of six such studies published between 1988 to 2016 showed that the residual gastric volumes were comparable between the two groups of patients with a mean difference of 1.04 mL and 95% CI of 0.90 mL to 1.2 mL) (LOE- Moderate).[68-73]

pH considerations

The meta-analysis of 4 studies conducted between 1988 to 2016 showed a lower gastric pH in patients fasted overnight compared to those allowed water 2 h before the induction of anaesthesia with a mean difference of 1.0 and 95% CI of 1.07 (LOE- Moderate).[65-67,73] The meta-analysis of 5 studies found higher gastric pH after administration of clear liquids other than water 2 h before the induction of anaesthesia compared to overnight fasting with a mean difference of 1.08 and 95% CI of 0.98 to 1.19, while network meta-analysis showed the pH to be higher in groups allowed to consume clear liquids when compared to water (LOE-Moderate).[67-71]

Residual gastric volumes and pH considerations from other studies

Scarr *et al.* conducted an observational study in patients scheduled for ambulatory surgeries and classified 181 patients into 4 groups based on the duration of fasting (<3h, 3-4.9 h, 5-8 h and >8 h) and found similar gastric volumes and pH in all the groups. The participants in the study were asked not to consume solid food from midnight and were asked to consume 150 mL liquid (coffee, tea, water or apple juice) 1 h before leaving home (LOE- Very Low).[74]

A study using Technetium^{99} to assess the emptying of clear liquids showed that the patients receiving carbohydrate containing solutions had gastric volumes comparable with patients receiving water at 90 min and at 120 min (LOE- Very Low).[75] Other studies which compared residual gastric volumes and pH after consumption of different kinds of liquids showed comparable gastric volumes and pH (LOE- Very Low to Low).[76-82] In a study assessing gastric volumes by gastroscopic aspiration after consumption of 200 mL water, the patients fasted for 40 to 75 min had gastric volumes similar to those fasted for 80-150 min (LOE- Moderate).[83] An earlier meta-analysis also concluded that there was no evidence that patients given liquid (including water, coffee, fruit juice, clear liquids and other drinks, e.g., isotonic drink, carbohydrate drink) 2-3 h prior to surgery had increased incidence of aspiration or regurgitation (LOE- High).[3] Newer commercially available carbohydrate containing clear liquids such as maltodextrin preparation (a polysaccharide), have been used as a part of the enhanced recovery after surgery (ERAS) protocol; the residual gastric volumes and gastric content pH have been found to be comparable to those after over-night fasting (LOE- Very Low).[77] Gomes *et al.* compared the residual gastric volumes using gastric ultrasonography after administration of 12.5% maltodextrin and a combination of 12.5% maltodextrin and glutamine. They found that the addition of glutamine did not increase the residual gastric volume 2 h after administration in healthy volunteers (LOE- Very Low).[84]

Volume of clear liquids allowed

An RCT by Soreide *et al.* found comparable gastric volumes after administration of 20 mL, 150 mL and 300-450 mL of water 1-2 h before surgery (LOE- Very Low).[85] Similarly, comparable residual gastric volumes were found between overnight fasting patients and those receiving 100–500 mL clear liquids 2 h before surgery in other studies conducted in patients scheduled for elective surgical procedures (LOE-Very Low to Low).[65-84]

Survey findings

The average fasting times for solids, liquids and clear liquids as per the survey respondents from 56 institutions were 7.43 ± 1.65 h, 5.68 ± 1.90 h and 3.16 ± 2.33 h, respectively.

Recommendations

Clear liquids should be allowed up to 2 h prior to administration of sedation or anaesthesia.

The volume of clear liquid consumed may be restricted to <450 mL, 2 h prior to administration of sedation or anaesthesia.

Non-clear liquids may be allowed up to 4 h prior to administration of sedation or anaesthesia.

Light meals may be allowed up to 6 h prior to administration of sedation or anaesthesia.

If the patient has consumed heavy meals, it may be prudent to wait for at least 10 h prior to administration of sedation or anaesthesia.

Heavy meal consumption is not advisable the night prior to surgery.

Aspiration prophylaxis

Various drugs have been used with the purpose of either increasing the pH, decreasing the volume of gastric contents or both and the studies on these drugs have measured residual gastric volumes by using aspiration from gastric tubes. The commonest

drugs that have been used are H_2 receptor blockers, proton pump inhibitors, non-particulate antacids such as sodium citrate and prokinetic drugs like metoclopramide. This section examines if the routine use of aspiration prophylaxis will benefit the patient.

Residual gastric volume considerations

H_2 receptor blockers

The meta-analysis of 3 studies showed no decrease in the residual gastric volume with the administration of oral H_2 receptor blockers (cimetidine and ranitidine) compared to placebo with a mean difference of 1.51mL and a 95% CI of 1.02 to 2.23 (LOE- Moderate).[86-88] A small sample study by Salempara *et al.* showed a significant decrease in the residual gastric volume after administration of oral cimetidine either 300 mg or 600 mg 2 h before surgery (LOE- Very Low).[89] Morison *et al.* conducted a study involving an intravenous phase and oral phase. There was no difference in the residual gastric volume in the intravenous phase but in the oral phase, lower residual gastric volumes were observed when ranitidine was administered 2 h before the surgery (LOE- Very Low).[90] Similar results were found by Maile *et al.* with intravenous administration of ranitidine 1–2 h before surgery.[91] Three studies found patients with gastric volumes more than 25 mL even after administration of oral H_2 receptor blockers (LOE- Very Low).[92-94] Similar studies conducted with different dosage regimens of H_2 receptor blockers, timing and routes of administration have yielded conflicting results.[95-100] Overall, the evidence does not point to uniform observations of reduction in the residual gastric volume after administration of H2 receptor blockers.

Proton pump inhibitors

The meta-analysis of 3 studies comparing residual gastric volumes after administration of proton pump inhibitors and placebo yielded a mean difference of 3.31 mL with a 95% CI of +2.34 to 4.68 (LOE- Moderate).[101-103] Mehta *et al.* conducted a study comparing three different proton pump inhibitors and found that the residual gastric volumes were comparable among them (LOE- Very Low).[104]

H_2 receptor blockers vs proton pump inhibitors

The meta-analysis of 4 studies comparing residual gastric volumes after the administration of either drug showed a mean difference of 1.68 mL and a 95% CI of 1.44 to 1.95 (LOE- Moderate).[105-108] Nishina *et al.* conducted two studies in 1996 and 2000 comparing different proton pump inhibitors and ranitidine and found least residual gastric volumes (per kg body weight) when ranitidine was administered as a single dose on the morning of surgery (LOE- Very Low).[109,110] Levack *et al.* achieved a gastric volume of <25 ml and pH >2.5, in 84% of patients receiving either ranitidine or omeprazole, when administered the night before and early morning of surgery and 73% of patients who received a single equivalent dose of omeprazole on the morning of surgery (LOE- Low).[111] Dattatraya *et al.* conducted a similar study and none of the ($n = 50$ in each group) patients receiving either ranitidine or proton pump inhibitors (omeprazole, esomeprazole, pantoprazole) had residual gastric volume >25 mL in both the H_2 receptor blocker and the proton pump inhibitor groups (LOE- Very Low).[112]

Two meta-analyses concluded that H_2 receptor blockers were better than proton pump inhibitors to reduce the gastric volume.[113,114] Puig *et al.* in a meta-analysis including 18 publications with different schedules of administration and routes of administration, found that patients receiving H_2 receptor blockers were at lower risk of aspiration (as per criteria laid down by Shirley and Roberts) (LOE- High).[113]) Clark *et al.* in another meta-analysis including 7 RCT's found that the gastric volumes were lower and gastric content pH was higher in groups who received H_2 receptor blockers (LOE- High).[114]

H_2 receptor blockers, Proton pump inhibitors and prokinetic drugs

The meta-analysis of 3 studies showed no significant difference in residual gastric volumes between the placebo group and those who received H_2 receptor blocker with prokinetic drugs with a mean difference of 2.15 mL and 95% CI of 1.63 to 2.97 (LOE- Moderate).[115-117] Manchikanti *et al.* conducted two studies which showed that there was a significant reduction in the residual gastric volume after administration of H_2 receptor blocker with prokinetic drugs in comparison to either of the drugs administered alone (LOE-Very Low).[118,119] Dimich *et al.* conducted a study in patients coming for ambulatory surgeries and found that there were significantly higher residual gastric volumes in patients who received H_2 receptor blockers compared to those who received H_2 receptor

blockers with prokinetic drugs (LOE- Low).[120] Gombar *et al.* in a study on 80 patients coming for surgery, found reduced gastric residual volumes on administration of a combination of proton pump inhibitors and prokinetic drugs when compared to H_2 receptor blockers and proton pump inhibitors administered alone (LOE- Very Low).[121]

Non-particulate antacids and H_2 receptor blockers

Six studies showed that the gastric volumes were higher when non-particulate antacids (sodium citrate) were administered when compared with controls or H_2 receptor blockers (LOE- Very Low to Low).[122-127]

Anticholinergic drugs

Anticholinergics are the other group of drugs postulated to reduce the residual gastric volume by decreasing the gastric secretion. Three studies using atropine or glycopyrrolate administered alone did not show much difference in the residual gastric volumes (LOE-Very Low to Low).[128-130]

pH considerations

H_2 receptor blockers

The meta-analysis of three studies (with oral cimetidine and ranitidine) showed that the pH was slightly higher in patients receiving H_2 receptor blockers compared to placebo with a mean difference of 0.41 with 95% CI of 0.33 to 0.50 (LOE- Moderate).[86-88] Other studies which compared H_2 receptor blockers in varying doses or dosage regimen found similar increase in the pH of residual gastric contents (LOE- Very Low to Low).[89-95,97-100]

Proton pump inhibitors

The meta-analysis of 3 studies showed an increased gastric pH in patients receiving proton pump inhibitors with a mean difference of 0.94 and a 95% CI of 0.11 to 1.77 (LOE- Moderate).[101-103] Mehta *et al.* compared three proton pump inhibitors and found a raised gastric pH with all three groups (LOE- Very Low).[104]

H_2 receptor blockers vs proton pump inhibitors

The meta-analysis of 4 studies showed the pH of gastric contents to be higher with proton pump inhibitors with a mean difference of 0.6 and a 95% CI of -0.08 to +1.28 (LOE- High).[105-108] The studies involving more than two groups (comparing different drugs or dosages or dosage regimen) also showed similar results (LOE- Very Low to Low).[109-114,131]

Prokinetic drugs

Seven studies showed that prokinetic drugs when used alone did not have any effect on the pH of gastric contents (LOE- Very Low to Low).[115-121]

Non-particulate antacids and H_2 receptor blockers

The gastric pH was raised in all patients receiving non-particulate antacids and was comparable to H_2 receptor blockers.(LOE- Very Low to Low)[122-127,132] Foulkes *et al.* compared gastric content pH after administering no drug, oral cimetidine 300 mg and 0.3 M sodium citrate 30 mL (n = 15 in each group) and found that all patients had a pH of more than 2.5 after receiving sodium citrate (LOE- Very Low to Low).[124]

Anticholinergic drugs

Use of anticholinergics was not found to cause any significant change in the pH of gastric contents (LOE- Very Low).[128-130]

Survey findings

Most of the respondent institutions advised aspiration prophylaxis for all patients scheduled for surgery (44.64%). Further, 42.86% of institutions advised aspiration prophylaxis for at risk patients and 10.71%, for emergencies only. The remaining 1.79% of institutions did not use any prophylaxis. Seventy one percent of the respondents used H_2 receptor blockers as aspiration 18 prophylaxis, 70% prokinetic drugs, 57% proton pump inhibitors, 54% 5HT3 receptor antagonist, 9% sodium citrate (0.3 M) and 5% used others. Those who chose the option 'others' mentioned dexamethasone, additional prokinetic drugs and multiple drugs.

Recommendations

Routine use of aspiration prophylaxis in adequately fasted patients is not advised prior to administration of sedation or anaesthesia.

Aspiration prophylaxis is advised in high-risk patients as identified by the anaesthesiologist.

H_2 receptor blockers, proton pump inhibitors and prokinetic drugs may be used as prophylaxis in high-risk patients.

Postoperative oral feeding in Adult patients

The research into the postoperative feeding in general adult surgical population revealed association of multiple factors (LOE- Very Low).[133] The wide variability in the surgical procedures performed and the techniques involved influences the decision on

resumption of postoperative feeding. Systematic reviews and meta-analysis have been performed for specific surgeries like colorectal surgeries or lower abdominal surgeries.[134,135]

Survey findings

The respondents felt that the mean time for allowing clear liquids postoperatively was 4.0 ± 2.3 h and for solids was 8.6 ± 7.0 h.

In view of lack of quality evidence and variability in the time of resumption of oral feed as per our survey no recommendations can be made in the general adult surgical population.

Miscellaneous

Chewing gum, alcohol consumption and smoking have been explored with regards to their effect on gastric emptying and residual gastric volume in the perioperative fasting period. A meta-analysis of 4 studies, RCTs and observational studies showed that there is no difference in the residual gastric volume or gastric emptying whether patients had chewed gum or not in the preoperative period (LOE- Very Low to Low).[136-140] However, in an analysis of incidents in the webAIRs Australian incident reporting system, chewing gum was found in the mouth of 5 patients during induction of anaesthesia. It may be important to ensure that patients spit out chewing gum before the administration of anaesthesia or sedation (LOE- Low).[141] Chewing gum in the postoperative period is not common practice in India. A Cochrane review and 1 other meta-analysis have found early return of bowel function with chewing gum in the postoperative period (LOE- Low).[142,143] Another meta-analysis of 12 studies and other RCTs have found the results to be equivocal (LOE- Low to Moderate).[144-147]

Studies conducted on the effect of alcohol (6% vs 10%, 3 units vs 6 units, beer, wine, 50% ethanol) on gastric emptying have been equivocal. Studies on varying concentrations of alcohol have found that overall alcohol consumption may delay the gastric emptying of solid food (LOE- Very Low to Low).[148-151]

Effect of smoking, chewing nicotine gum and nicotine patch on gastric emptying and residual gastric volume have been studied. Acute cigarette smoking has been found to delay the gastric emptying of solid and liquid food (LOE- Low).[152,153] However, a study on the effect of nicotine patch on the gastric emptying of solids and liquids did not find any delay (LOE- Very Low).[154] A study using ultrasonography did not find any difference in the residual gastric volumes after acute cigarette smoking (LOE- Very Low).[155]

OBSTETRIC SECTION

Is the incidence of aspiration higher in pregnant women scheduled for elective procedures?

Studies performed in various settings (patients scheduled for cervical encirclage, caesarean sections, manual removal of placenta, medical termination of pregnancy, under general anaesthesia) were included. The level of evidence of most of these studies was low. The meta-analysis of 5 studies yielded a combined incidence of aspiration of 29/1,00,000 (95% CI was 7/1,00,000 to 120/1,00,000) (LOE- High).[156-160] In a case series published by Dureja *et al.*, two cases of aspiration were identified. Of these two one was in a patient who had presented to the emergency with history of trauma and bleeding per vagina. Pulmonary aspiration was suspected when intra-operatively the patient developed increased resistance to ventilation under general anaesthesia (LOE- Very Low).[161]

Survey findings

The responses from 21 institutions, dedicated to obstetric anaesthesia services showed that only 42.7% institutions considered pregnant women to be at higher risk for aspiration in the perioperative period.

Recommendations

Women in early or late pregnancy when administered sedation or general anaesthesia may be considered to be at high risk for aspiration.

Appropriate fasting times in pregnant women.

Seven comparative trials[162-168] related to gastric emptying and 2 RCT's[169,170] related to residual gastric volume or comparison of gastric antral areas in pregnant women were accessed. The methods of assessment of gastric emptying included phenol red dye method, potential tomography, GUS and breath analysis after lactulose and paracetamol absorption. The studies used varying quantities of meal; most of the studies were done with clear liquids and some with light meal consumption. The meta-analysis of 5 studies estimating gastric emptying of liquids in pregnant women compared to non-pregnant women showed that liquids took longer time to empty from the stomach in non-pregnant women with a mean difference of 2.06 min and 95% CI of -1.28

to +5.40 (LOE- High).[162-166] Wald *et al.* found prolonged oro-caecal transit times in pregnant patients (LOE- Very Low).[167] Cholioro *et al.* found prolonged half emptying times for liquids in first trimester and term pregnancy compared to 4–6 months after delivery (LOE- Very Low).[168] Wong *et al.* conducted two studies in 2002 and 2007, both comparing consumption of 300 mL and 50 mL water with pregnant women in one study and obese pregnant women in another. They found reduced half times with consumption of 300 mL water in both studies (LOE- Low).[169-170] Three observational studies based on ultrasonographic estimation of the cross-sectional area found comparable outcomes between pregnant women scheduled for caesarean section and non-pregnant women (LOE- Low to Moderate).[11,13,14]

One observational study showed a residual gastric volume >1.5 mL/kg in 23–52% pregnant women with more than 36 weeks of gestation. (LOE- Very Low).[12] There were no studies comparing the gastric emptying of solid food.

Hong *et al.* in a randomised control trial including 200 patients compared the residual gastric volume and pH between term pregnant women coming for Caesarean sections and women coming for gynaecological surgeries and found that the mean gastric volume was higher (0.49 ± 0.4 mL/kg vs 0.24 ± 0.2 mL/kg) and mean gastric content pH was lower (2.4 ± 1.4 vs 3.0 ± 1.9) in pregnant women in comparison to non- pregnant women (LOE- Low).[171]

Survey findings

The participant obstetric anaesthesia units across India advocate similar fasting times for both pregnant and non-pregnant women.

Thus, in pregnant women, the duration of preoperative fasting for different kinds of foods is the same as in non-pregnant women

Recommendations

Clear liquids may be allowed up to 2 h prior to administration of sedation or anaesthesia in pregnant women.

Non-clear liquids may be allowed up to 4 h prior to administration of sedation or anaesthesia in pregnant women.

Light meals may be allowed up to 6 h prior to administration of sedation or anaesthesia in pregnant women.

If the pregnant woman has consumed a heavy meal, it may be prudent to wait for at least 10 h prior to administration of sedation or anaesthesia.

Heavy meal consumption is not advisable the night prior to surgery in pregnant women.

Routine aspiration prophylaxis in pregnant women

Residual gastric volume considerations

We identified 12 comparative trials (including one from India),[172-183] 2 systematic reviews[184,185] and 3 surveys[186-188] on aspiration prophylaxis in obstetric units. The studies had low level of evidence due to small sample sizes and varied drugs employed for prophylaxis. The studies examined usage of sodium citrate, H_2 receptor blockers, prokinetic drugs and proton pump inhibitors alone or in combinations. Qvist *et al.* found that the administration of H_2 receptor blocker in pregnant women resulted in a marginal decrease in the residual gastric volume compared to those who did not receive the drug (LOE- Very Low).[172] Dewan *et al.* compared sodium citrate administered <60 min before versus >60 min before induction of anaesthesia and they found that patients administered sodium citrate >60 min before induction had a lower gastric content pH. The residual gastric volumes were comparable between the groups (LOE- Low).[173] Sullivan *et al.* found that the residual gastric volume was reduced in pregnant women receiving ranitidine and metoclopramide compared to those receiving ranitidine, metoclopramide or magnesium trisilicate alone (LOE- Very Low).[174] Studies comparing the use of sodium citrate and H_2 receptor blockers, particulate antacids and use in elective vs emergency surgeries, have found that they increased the pH of gastric content but the residual gastric volumes are also increased (LOE-Very Low to Low).[175-180] Studies comparing the effect of proton pump inhibitors and H_2 receptor blockers on residual gastric volume found that the volumes were lower when H_2 receptor blockers and proton pump inhibitors were administered the night before and morning of surgery than when administered only on the morning of surgery (LOE- Very Low to Low).[181-183]

pH considerations

Different methods of assessment of pH in pregnant patients were used in the studies included in our

search. Among the drugs, sodium citrate, particulate antacids, H_2 receptor blockers and proton pump inhibitors were found to raise the pH of gastric contents. Addition of metoclopramide to ranitidine had no effect on the pH. The pH levels were comparable when H_2 receptor blockers or proton pump inhibitors were used. (LOE-Very Low to Low).[172-183]

Two systematic reviews[184,185] (LOE- Moderate) found no benefit of routine prophylaxis with any of these drugs. But, a systematic review by Paranjothy *et al.*[185] on interventions to prevent aspiration pneumonitis in 2658 patients undergoing caesarean sections under general anaesthesia found that the combination of antacids and H_2 receptor blockers was more effective than no intervention, and superior to antacids alone in preventing low gastric pH. Most of the surveys done across the United Kingdom and Australia between 1987 and 1994 found that routine aspiration prophylaxis was preferred (LOE- Very Low).[186-188]

Survey findings

All respondent obstetric units in the survey except one, administered aspiration prophylaxis in pregnant women (both for emergency and elective indications) scheduled for caesarean section. Only one institution did not provide aspiration prophylaxis for women undergoing caesarean section under regional anaesthesia. Ten units administered routine prophylaxis out of 18 units for women receiving labour analgesia. The commonest drugs administered were ranitidine and metoclopramide.

Recommendations

Pregnant women requiring sedation or anaesthesia should be administered aspiration prophylaxis.

H_2 receptor blockers, proton pump inhibitors either alone or in combination with prokinetic drugs can be administered for aspiration prophylaxis.

Post-operative oral feeding in patients after caesarean section

The 20 studies[189-208] were heterogeneous with respect to anaesthetic techniques used (regional anaesthesia, general anaesthesia or both) and the timing of surgery (emergency or elective). Sips of water or liquid diet was used for resumption of oral feed in majority of the studies.[189,190,192,194-199,201,203] Few of the studies targeted resumption of normal diet or solid food.[193,200,202] Studies have used various parameters and outcomes such as time to appearance of bowel sounds, time to passage of flatus and incidence of ileus among others while discussing about resumption of oral feeds postoperatively. The time to initiation of early oral feed varied from 30 min to 8 h after surgery. The delayed feeding was based either on the appearance of bowel sounds or a fixed time frame postoperatively.

Time of post-operative oral feed and time to appearance of bowel sounds

The meta-analysis of 5 studies (including patients who had undergone caesarean section under spinal anaesthesia or general anaesthesia) showed that the mean difference in the appearance of bowel sounds was 7.93 hours longer with a 95% CI of 2.20 to 13.65 in the conventionally (12–24 h) fed group than in the early (6–8 h) fed group (LOE- Moderate)[189-192,200] Teoh *et al.* found bowel sounds immediately postoperatively in 95.9% patients at 30 min in the early feed group and in 90.8% patients at 30 min in the control group. The occurrence of bowel sounds was not an outcome measure in this study (LOE- Very Low).[198] But, Mawson *et al.* found 87% of the patients to have bowel sounds the morning after surgery in the early feeding group (sips of water 6–8 h after caesarean section) and in 44.8% patients in the conventional feeding group (sips of water 12 h after caesarean section) (LOE-Low).[197]

Time of post-operative oral feed and time to passage of first flatus

Twelve studies estimated the time to passage of flatus in post caesarean section patients after administration of different kinds of intake.[189-200] The meta-analysis of 4 studies in post caesarean section patients showed consumption of sips of water 6–8 h after surgery resulted in shorter time to passage of flatus with a mean difference of 9.91 h and a 95% CI of 3.57 to 16.25 compared to those allowed sips of water 12–24 h after surgery (LOE- Moderate).[189-192] Other studies where the time to passage of flatus after solid food or food given earlier than 6 h showed similar results.[193-200]

Incidence of ileus and other factors

The meta-analysis of 8 studies combining the incidence of ileus at 24 h showed a relative risk of 1.08 with a 95% CI of 0.81 to 1.45. There was no significant difference in the incidence of ileus between patients who had been given oral feed between 6 and 8 h and those who received feed at 12–24 h (LOE- High).[190-192,198,199,201-203] The incidence of nausea, vomiting, abdominal distension, length of hospitalisation, maternal

satisfaction, etc., were comparable between groups of patients who had early initiation of feed to delayed initiation of feed across most of the studies. Meta-analysis and systematic reviews by other authors also yielded similar results (LOE-High)[204-208]

Evidence pertaining to oral consumption of liquids after obstetric interventions other than caesarean section are sparse and no meaningful conclusions can be drawn about the same. Studies of very low level of evidence have even advocated postoperative feeding as early as 2 h. Experts were of the opinion that oral feed can be allowed at a shorter duration than 8 h. This allows for further scope for research.

Survey findings

The time to initiation of oral feeds in the postoperative period by respondent obstetric units was 6.1 ± 7.7h for liquids after central neuraxial block, 6.0 ± 6.6 h for liquids after general anaesthesia, 12.7 ± 14.2 h for solids after central neuraxial block and 13.3 ± 14.2 h for solids in patients who had undergone caesarean section under general anaesthesia.

Recommendations

Clear liquids can be allowed orally 8 h after caesarean section under regional/general anaesthesia.

Gastric emptying in immediate postpartum period

Women in the postpartum period (from delivery to 12 weeks) may present for procedures (e.g., sterilisation). Whitehead *et al.* in a study comparing gastric emptying times using paracetamol absorption technique found that there was no difference in pregnant women and women on the 1st, 2nd or 5th day postpartum (LOE- Very Low).[166] Gin *et al.* in a study on 8 women in the postpartum period found that the gastric emptying was rapid on the first and third postpartum day and comparable to gastric emptying in 6 women who came for follow-up after 6 weeks (LOE- Very Low).[209] Lam *et al.* compared residual gastric volume and gastric content pH in non-pregnant women (n = 50), women in the postpartum period who had fasted overnight (n = 50) and women in the postpartum period who had consumed clear liquids 2 h prior (n = 50). They found that the median residual gastric volumes and pH were comparable among all three groups (LOE- Very Low).[210]

Women in post-partum period may not be any different from general adult population with regard to gastric emptying times and pH.

Miscellaneous

Studies found that women who chewed gum in the immediate postoperative period after caesarean sections had shorter times to passage of flatus, return of bowel sounds (LOE- Very Low to Low).[211-218]

PAEDIATRIC SECTION

Factors predisposing children for regurgitation and aspiration

Seven studies evaluated the factors predisposing children for regurgitation and aspiration.[219-225] A meta-analysis of 49 studies involving 1457 children (28 weeks of gestation to adulthood) reinforced the significance of food type in modulating gastric emptying and found that aqueous solutions had faster gastric emptying compared to solids (45 min vs 98 min) (LOE - High).[219] Children aged 3–17 years maybe at a higher risk of aspiration as their gastric residual volume was >0.4 mL/kg. All except one child had gastric content pH <2.5 (LOE-Very Low).[220] Children (6 months to 18 years) were found to have greater risk for acid aspiration than adults (18–64 years) and geriatric (>64 years) population as children have a greater gastric residual volume and lower gastric content pH.[221]

The prevalence of reflux regurgitation was highest at 2 months of age (86.9%) which decreased to 7.6% by 1 year of age in Thai children.[222] A study on 1000 consecutive day care surgery children (2–12 years) found that preoperative acetaminophen and midazolam increased gastric fluid volume (GFV) while lower GFV was associated with ASA physical status III, male gender, gastroesophageal reflux disease, and proton pump inhibitor administration. All had GFV >0.4 mL/kg despite standard fasting protocols. (LOE–Low).[223]

Incidence of aspiration in children

The meta-analysis of 8 studies published between 1998 and 2019 with a total sample size of 4,26,594 patients yielded an incidence of 49/1,00,000 aspirations in children with a 95% CI of 30/1,00,000 to 81/1,00,000 (LOE–High).[224-231] The Anaesthetic Incident Monitoring Study reported 133 cases of aspiration in children <14 years out of the total 240 incidents of aspiration. Only 17 of these children were inadequately fasted (LOE – Very Low). The main reasons attributed to aspiration included emergency surgery, medications, inadequate anaesthesia.[232] A case series involving three children showed one

child developing aspiration despite adequate fasting (LOE–Very Low).[233]

Survey findings

A total of 10 units that exclusively catered for paediatric anaesthesia and one department that catered to obstetric and child population participated. They reported 72 cases of regurgitation, 31 cases of regurgitation with aspiration and eight cases of aspiration pneumonitis perioperatively in children undergoing elective surgeries. Similarly, 91 cases of regurgitation, 34 cases of regurgitation with aspiration and 14 cases of aspiration pneumonitis were reported in children undergoing emergency surgeries. Most children recovered with oxygen therapy. There were three deaths in children scheduled for emergency surgery attributed to regurgitation and aspiration.

Gastric emptying time in children

GUS evaluation showed that the emptying time in 48 healthy volunteers (8–14 years) for apple juice, 2% milk and Ensure® Clear was 3-3.5 h (LOE- Low).[234] Expressed breast milk emptied twice as fast as formula milk in preterm infants in a GUS study (LOE- Low).[235] An MRI study in children found gastric emptying of clear liquids had a median half-life of <30 min (LOE- Low).[236] Gastric emptying for cow's milk was similar in both healthy children and those with GERD (LOE- Low).[237] Prolongation of liquid gastric emptying half-time was observed with increasing severity of GERD (LOE- Low).[238] The adult normative data for gastric emptying for solids may be inappropriate for children (5–18 years) (LOE- Low).[239] In a serial GUS study on stable preterm infants, breast milk composition was found to influence gastric emptying, with feeds of higher casein content emptying faster while fortified mother's milk emptying much slower than unfortified mother's milk (LOE- Low).[240] Another GUS study on preterm infants fed with fortified, unfortified and pasteurised human milk found reduced percentage of gastric retention with higher casein, whey and lactulose concentrations in the milk. They also found that curdling did not affect emptying (LOE- Low).[55] In a GUS study on children <5 years, it was found that 100 mL milk up to 3% fat and clear liquid 100 mL with 17.5% dextrose can be safely given 3 h and 2 h prior to anaesthesia, respectively (LOE- Low).[241] Children (8.2–12.5 years) consuming 7 mL/kg of raspberry syrup had a gastric emptying half time of 27 min compared to 20 min in those who consumed 3 mL/kg of the same in an MRI based volunteer study (LOE- Low).[242] The average gastric emptying half-time was 49 ± 23 min, 54 ± 29 min and 65 ± 36 min for breast milk, half-fortified breast milk and fully fortified breast milk respectively (LOE- Low).[243] The mean gastric emptying half-time was 107.2 min for 30 g of chocolate crispy cake among children (5–10 years, LOE – Very Low).[244] The calculated mean gastric emptying time was <4 h (236 min) following breakfast in pre-schoolers in a study using serial ultrasonographic measurements (LOE – Very Low).[245]

Consumption of water 1 h prior vs 2 h prior to induction of anaesthesia

Residual gastric volume considerations

The meta-analysis of 3 studies involving 307 children aged 1–16 years, found that the residual gastric volume was comparable between groups consuming water at 1 hour or >2 h prior to the induction of anaesthesia with a mean difference of 1.46 mL and a 95% CI of 0.77 to 2.97 (LOE - High).[242,246,247]

pH Considerations

No difference in gastric pH was found in two studies where children aged 1–16 years were allowed to consume clear liquid at premedication or 1 h prior compared to consumption of water 2 h prior to induction of anaesthesia (LOE – Moderate).[242,247]

Other Clear Liquids (2 h vs >2 h prior to induction of anaesthesia)

Residual gastric volume considerations

The meta-analysis of 5 studies found that the residual gastric volume was lower in children who consumed clear liquids containing calories at 2 h prior to induction of anaesthesia compared to those who consumed at an interval of more than 2 h with a mean difference of 0.77 mL with a 95% CI of 0.47 to 1.27. Two of these studies were performed in infants and one study compared residual gastric volume and pH after consumption of water or breast milk. Three other studies involved infants and children up to 14 years of age (LOE – High).[248-252]

In a study of 120 children (2–18 years) scheduled for gastroscopy, consumption of lemon-flavoured carbohydrate beverage reduced the mean volume of gastric contents compared to water or tea administered 2 h prior to induction of anaesthesia (LOE – High).[253] The residual gastric volume was comparable when 6 or 10 mL/kg apple juice was consumed 2.5 h before

induction of anaesthesia compared to overnight fasting in children aged 5–10 years (LOE – Moderate).[254]

pH Considerations

No significant difference in gastric pH was found in the meta-analysis of five studies (2 in infants and 3 in infants and children aged up to 14 years) comparing pH after clear liquid consumption at 2 h or >2 h before induction of anaesthesia with a mean difference of 0.97 and a 95% CI of 0.85 to 1.09 (LOE – High).[248-252] The gastric pH was comparable in children 2–18 years age both with consumption of lemon-flavoured carbohydrate beverage or non-carbohydrate beverage (water or tea) 2 h prior to the procedure (LOE – Moderate).[253] Comparable pH was found when 6-10 mL/kg apple juice was consumed 2.5 h before induction of anaesthesia compared to overnight fasting in children aged 5–10 years (LOE – Moderate).[254]

Fasting times for formula feeds and solids

Children <9 months of age given formula feeds at 4-6 h Vs 8 h prior to induction of anaesthesia showed comparable residual gastric volume (LOE – Moderate).[252] In a crossover MRI trial, children (6.8–12.2 years) when given a light breakfast consisting of cereal flakes and milk products at 4 h had a higher gastric volume when compared to the same given at 6 h (LOE – Low).[255] Weight corrected gastric residual volumes in 22 children who had fasted <6 h was comparable to 46 children who had fasted >6 h in children (0.3–19.6 years) scheduled for MRI (LOE – Very Low).[256]

The evidence showed a large variability in the age of the subjects studied (neonates - 18 years).

Survey findings

Regarding the appropriate fasting time for different kinds of food items, most of the respondents opined that 2 h was appropriate for clear liquids, 4 h for human milk, 6 h for cow's milk and 6 h for formula feed or solids. Three of the 11 respondents who answered the question on volume of clear liquid allowed in children felt that 3 mL/kg was the appropriate volume. Two others felt that there was no limit. The rest felt that 10 mL/kg, 20 mL, <50 mL and 100 mL were appropriate, and 1 respondent felt that no specific volume was recommended.

Recommendations

Consumption of water, up to 3mL/kg should be allowed until 1 h prior to administration of anaesthesia.

Consumption of clear liquids other than water, up to 3 mL/kg can be allowed until 2 h prior to administration of anaesthesia.

Human milk and fully skimmed non-human milk can be allowed until 4 h prior to administration of anaesthesia.

Non-clear liquids, non-human milk, formula feeds, light breakfast or light meal may be allowed until 6 h prior to administration of anaesthesia.

Aspiration prophylaxis in children

Domperidone reduced gastric emptying in preterm neonates (LOE –Low).[257] Oral ranitidine with or without liquids resulted in a decrease in both volume and acidity of gastric contents (LOE – Moderate).[258] Low dose erythromycin appears to be safe and effective in decreasing gastric emptying in preterm babies born after 34 weeks of gestation in the first two weeks of life (LOE – Moderate).[259] Oral ranitidine hydrochloride 2 mg/kg is effective in increasing the pH of gastric aspirate in children aged one to six years in the majority of patients though one should expect lack of measurable response in some children (LOE – High).[260] Gender, age, gastrointestinal pathology or pH-altering medication does not appear to have an effect on the GFV (LOE – Very Low).[261] Thus, as per the evidence, aspiration prophylaxis may not be uniformly effective in improving the gastric pH and reducing the residual gastric volume in adequately fasted children.

Recommendations

The attending anaesthesiologist can decide for or against the administration of aspiration prophylaxis in adequately fasted children.

Fasting practices in children scheduled for procedural sedation

Out of a total of 149046 sedation procedures evaluated for the incidence of aspiration,[262-266] only one study reported aspiration events (10 instances) (LOE – Low),[262] while other four studies found no instances of aspiration in any of the children despite many children not meeting the standard fasting criteria prior to procedural sedation (LOE – Low).[263-266] Overall, 30,306 children did not meet standard fasting criteria out of 148935 known cases of fasting duration (LOE – Low).[262-266] A survey among Canadian paediatric emergency departments reported that only 53% physicians follow standard fasting guidelines for children undergoing procedural

sedation. The physicians were less likely to perform procedural sedation immediately if a child had a full meal <2 hours ago or liquids <1 hour ago. Those with 6–10 years of experience were more willing to perform immediate procedural sedation in such situations. Physicians who had an institutional fasting policy reported disinclination towards performing immediate procedural sedation (LOE – Very Low). The evidence shows that the fasting guidelines are not strictly followed for procedural sedation in paediatric patients.[267] In low resource settings the decision on the duration of fasting for procedural sedation will be influenced by set up and the level of expertise of the attending anaesthesiologist.

Recommendations

The attending anaesthesiologist can decide on the duration of fasting for procedural sedation within operating room or remote location.

Postoperative oral feeding practices in children

In a study involving children (6 months–4 years), early resumption of oral intake (apple juice 10 mL/kg) in the post anaesthesia care unit after the Face Leg Activity Cry Consolability (FLACC) score was ≥4, following anaesthesia was associated with reduced incidence of postoperative vomiting and a decrease in opioid consumption compared to those kept fasting till return to ward. (LOE – Moderate).[268] The postoperative fasting times were significantly greater in children less than 17 years scheduled for complex surgical procedures than those undergoing non-complex procedures. Most patients received some postoperative fasting time, even when it was not ordered by the physician in the diet order (LOE – Very Low).[269]

Survey findings

Most respondents (of the 10 units) felt that resumption of clear liquid intake can be started at 1–2 h, human milk at 3–4 h, formula feed at 4–6 h, and cow's milk at 4–6 h after surgery.

Recommendations

The oral consumption of clear liquids in the postoperative period should be resumed at the earliest where no medical or surgical contraindications exist.

Effects of prolonged fasting duration in children

Observational studies and surveys found the duration of preoperative fasting is prolonged in 60-70% of the children posted for surgery (LOE – Very Low).[229,270–272] In a study comprising of 1350 children (2-16 years) with a median fasting time of 12.05 hours, 56% were found to be very hungry or starving, while 27% of the children were very thirsty (LOE – Very Low).[273] Children <36 months showed higher concentration of plasma ketone bodies and lower mean arterial pressure immediately after anaesthetic induction following prolonged duration of fasting. But there was no significant difference in the plasma glucose concentrations (LOE – Moderate).[274]

Overnight fasting,[275] breast milk (LOE – Moderate),[276] or infant milk formula NAN (Nestle Australia Ltd.) consumed 3-4 h preoperatively (LOE –Moderate)[277] or administration of lactated Ringer's solution as intraoperative maintenance fluid (without dextrose containing solutions) were not associated with perioperative hypoglycaemia. In a retrospective study on 238 children who had undergone MRI under propofol sedation, the duration of fluid abstinence did not correlate with the decrease in the blood pressure.[278] In an observational study in 100 children aged 2–6 years scheduled for ophthalmic examination under sevoflurane anaesthesia, it was found that the prolonged duration of fasting correlated with emergence delirium scores at 15 and 25 min after the procedure (LOE – Very Low).[279] In a cohort study including 404 children undergoing bone marrow biopsy under general anaesthesia, it was found that the exposed group (those fasted for >3 h) had a higher incidence of postoperative vomiting (LOE – Very Low). But there was no correlation to the incidence of hypoglycaemia.[280] In a prospective interventional study (of approximately 16,000 children), effects of utilising quality improvement methodology to reduce excess fasting times, with a goal of achieving experienced clear liquid fasting times ≤4 h for 60% of patients was studied. Use of active language encouraging drinking; clear liquids allowed up until arrival to operating room (30 min prior to arrival time); providing water or apple juice in preoperative holding area and addition of sports drinks to allowable clear liquids, resulted in an improvement with compliance to fasting duration for clear liquids (LOE – Low).[281]

Survey findings

If the duration of fasting was more prolonged than recommended, 62% of the respondents assessed for hypoglycaemia, 38% felt that they had to look for hypotension. Thirty eight percent also felt that they had to assess for irritability, dry tongue, blood sugar if neonate or administered liquids.

BARIATRIC SECTION

Obese individuals are considered to be at higher risk of aspiration, with a high body mass index (BMI) correlating with acid reflux.[282-287] Increased transient lower oesophageal sphincter relaxation (TLOSR) with acid reflux has been reported in 2-hour postprandial oesophageal manometry in obese and overweight subjects when compared with a non-obese subjects.[288]

The meta-analysis of 3 RCTs comparing the gastric emptying half-time for liquids in obese and non-obese individuals found that the gastric emptying half times were comparable with a mean difference of 4.78 min and a 95% CI of -13.09 to +3.54 (LOE- Low).[289-291] Similar studies comparing gastric emptying time of solids have shown equivocal results with some showing a prolonged overall gastric emptying time (LOE- Very Low).[292-299]

The meta-analysis of 5 RCTs comparing residual gastric volume in obese and non-obese individuals showed that obese individuals have a slightly higher residual gastric volume compared to non-obese individuals with a mean difference of 2.47 and a 95% CI of 0.24 to 4.71(LOE- High).[300-304] The meta-analysis of 4 RCTs comparing gastric content pH showed that obese individuals had lower pH when compared to non-obese individuals with a mean difference of 2.92 and a 95% CI of -5.57 to - 0.31 (LOE- High).[300,302-304]

An RCT including 126 adult obese individuals (excluding those with gastro-oesophageal reflux, hiatus hernia and diabetes mellitus) fasted from midnight found that the residual gastric volume and pH in the control group were comparable to the study group administered 300 mL. liquid (water, apple juice, black coffee, clear tea, carbonated beverages) 2 h before surgery. They concluded that drinking clear liquid as per guidelines may not increase the risk of aspiration in obese patients (LOE- Very Low).[305] Peura *et al.* in a post hoc analysis of patients enrolled in phase 3 studies comparing use of dex-lansoprazole and placebo or lansoprazole found that the symptom severity due to acid reflux increased with BMI and hence, they derive greatest benefit from treatment with proton pump inhibitors (LOE- Low).[286] Lam *et al.* compared the residual gastric volume and gastric content pH in morbid obese patients scheduled for gastric stapling and found that administration of intravenous cimetidine 60–90 min before the procedure reduced the residual gastric volume and increased the gastric content pH (LOE- Low).[306] A similar study compared the effect of cimetidine and ranitidine with or without the administration of metoclopramide on the residual gastric volume and gastric content pH in morbidly obese patients scheduled for gastroplasty and found that the residual gastric volumes and gastric content pH were comparable among all the groups (LOE- Very Low).[307] In a study evaluating the effect of combinations and different doses of ranitidine and metoclopramide, they found that 300 mg of oral ranitidine the night before and morning of surgery combined with metoclopramide 10 mg the morning of surgery reduced the residual gastric volume to the greatest extent. The pH was comparable among the study groups and higher than the control group (LOE- Very Low).[308] Mahajan *et al.* compared the residual gastric volume and gastric content pH in lean and morbidly obese patients with or without the administration of ranitidine and metoclopramide as prophylaxis in patients who had fasted for 8 hours prior to elective surgery. They found that the residual gastric volume was lower in lean individuals and those morbidly obese individuals who had received prophylaxis (LOE- Low).[309]

Survey findings

Our survey found that 66.7% of the respondents administer aspiration prophylaxis to all obese individuals while 16.7% of the respondents administer only in patients with reflux symptoms; 77.8% of the respondents chose H2 receptor blockers as the first choice for administration as prophylaxis.

Recommendations

Obese individuals may be considered to be at higher risk for aspiration in comparison to non-obese individuals when administered sedation or anaesthesia.

In obese individuals, the advice on preoperative fasting practices may be the same as in non-obese individuals prior to the administration of sedation or anaesthesia.

Aspiration prophylaxis may be administered in obese patients prior to the administration of sedation or anaesthesia.

H_2 receptor blockers, proton pump inhibitors either alone or in combination with prokinetic drugs can be administered for aspiration prophylaxis.

Postoperative oral feeding practices in obese patients after bariatric surgery

Matlok *et al.* in an analysis of 170 patients in an observational study (who underwent either laparoscopic Roux en Y procedure or sleeve gastrectomy) found that oral liquid was well tolerated by 128 patients when administered within 5 h of postoperatively. Oral administration of liquid was tolerated by 162 patients within the first 24 h (LOE- Very Low).[310] There is insufficient evidence to formulate a recommendation for the resumption of postoperative feeding in this subset of patients.

Survey findings

The mean time for resumption of oral feed in bariatric patients calculated from the data from the 18 respondents were 12.1 ± 8.9 h for clear liquids for restrictive procedures and 14.7 ± 11.9 h for malabsorption procedures. The mean time for resumption of solid food was 119.8 ± 162 h for restrictive and 123.4 ± 160.2 h for malabsorption procedures, respectively.

ROLE OF GUS AS PREOPERATIVE TOOL FOR ASSESSING GASTRIC CONTENT

Identification and differentiation of stomach contents

Most studies on identification of antral contents with GUS were observational or experimental in nature performed on different subset of patients such as pregnant women, children and in patients undergoing elective/emergency surgery.

Six healthy volunteers (fasting for 8 h) evaluated with GUS on four occasions, after consumption of 200 mL apple juice or 200 mL 2% milk or a standard solid meal (sandwich and apple juice) confirmed the ability of GUS in identifying empty stomach, and in differentiating clear liquid from viscous liquid or solid content (LOE- Low).[311] In 20 healthy volunteers, the post prandial state of the stomach was identified by 2 well-trained emergency medicine residents and 1 attending physician on 73% and 65% occasions with the volunteers in right lateral decubitus (RLD) and supine positions respectively. However, after consumption of 16 ounce of water, the stomach could be visualised 100% of the times. (LOE- Low).[312] The GUS could differentiate fasted from non-fasted (liquids/solids) states with high sensitivity (85% for all) and specificity (93% and above for all) in a volunteer cross over study (LOE- Low).[313] The GUS could easily differentiate the contents of the stomach in pregnant women (LOE- Moderate).[314] A sensitivity as high as 1 and a specificity as high as 0.975 was established in a study with GUS in 40 patients who underwent 80 examinations by experienced sonologists (LOE- Moderate).[315] Similar study found that the mathematical model used by them was reliable in obese patients when volumes of up to 400 mL were administered (LOE- Very Low).[316] Antrum could be identified in 95% and 90% of obese patients in RLD and supine positions respectively. The study also found larger antral areas and basal gastric volume in these patients (LOE-Very Low).[317] The cut off values for empty stomach in children after induction of anaesthesia were found to vary in the supine and RLD positions, with the latter having the highest sensitivity and specificity (LOE- Low).[318]

GUS has been shown to be a valuable tool in influencing the induction/intubation technique with respect to risk of aspiration in infants with pyloric stenosis, children, adults and critically ill patients (LOE- Low).[319-323] A study found that 6/100 patients (4 chronic kidney disease, 1 obese, 1 no co-morbidities) scheduled for elective surgery had 'full stomach' by GUS despite prolonged fasting durations (10–15 h) indicating that 10 h fasting duration does not assure an empty stomach (LOE- Very Low).[324] An observational GUS study on 246 patients with average fasting duration of 7.75 h for elective and 7.345 h for emergency procedures found 69 patients to be at risk of aspiration (solid food or liquid content >1.5 mL/kg). A positive association was found between the risk of aspiration and GERD (LOE- Very Low).[325]

Quantifying liquid content in the stomach

A study concluded that antral cross-sectional area (CSA) of <8 cm^2 might indicate an empty stomach in patients without GERD (LOE- Very Low).[326] Interindividual variability in the gastric volume estimate with GUS after administration of equal amounts of liquid was high with minimal intrasubject variability after a meal (LOE- Very Low).[327] The median fasting antral area was 4.2 cm^2 (range 2–16 cm^2) and volume of aspirated juice varied from 5 to 200 mL with correlation between antral area measurements and aspirated volume (LOE- Very Low).[328] GUS in 24 normal newborns and eight newborns with suspected gastric retention [mean age 10.8 days) showed CSA >1 cm^2 after a nasogastric

feed (milk) of >10 mL (LOE- Very Low).[329] Estimation of gastric volume from antral area correlated better with the actual gastric volume than when estimated from the body or fundus up to 300 mL in the lateral decubitus position (LOE- Very Low).[330] An area of 340 mm^2 coincided with the residual gastric volume of 0.8 mL/kg (considered high risk by the authors) (LOE- Very Low).[331] MRI evaluation of gastric content volumes in children (6.4–12.8 year) found best correlations of antral volumes by GUS in RLD position (LOE- Very Low).[332] The gastric volumes up to 500 mL estimated from antral CSA by GUS measured in RLD position strongly correlated with volumes aspirated by gastroscopy in non-pregnant adults with a BMI <40 kg/m^2 (LOE- Very Low).[333] A gastric CSA >9.6 cm^2 corresponded with a high gastric volume (1.5 mL/kg) in third trimester pregnant women (LOE- Very Low).[334] Song *et al.* in a study in children aged 18 years administered 10–15 mL/kg of carbohydrate containing solution 2 h before anaesthetic induction and were able to identify and measure the contents of the stomach in all 79 individuals. They quantified the stomach in terms of cross-sectional area. They did not correlate with the volume of liquid ingested (LOE- Very Low).[335] Moser *et al.* in a study tried to estimate the cut off values for empty stomach in children after induction of anaesthesia. They found that the cut off point varied in the supine and right lateral decubitus position. The latter had the highest sensitivity and specificity. They quoted the antral cross-sectional area to be 3.07 cm^2 (LOE - Low).[318] In a cohort study including 200 children aged between 1 and 16 years, Bouvet *et al.* found the prevalence of at risk stomach (defined as volume >1.25 mL/kg) to be 1% in adequately fasted children scheduled for elective surgery (LOE- Low).[336] Arzola *et al.* developed a predictive model in term pregnant women scheduled for caesarean section under neuraxial anaesthesia after standard fasting instructions. They found no solid food in the stomach. Total of 53 women were in grade 0, 49 in grade 1 and 1 had grade 2 as per Perlas grading. Ninety-five per cent of the women presented with an antral area of <9.6 cm^2 (corresponding to an estimated volume of <1.5 mL/kg) (LOE- Low).[11] In a similar study Amaral *et al.* found that the median for the gastric antral cross-sectional area was 4 cm^2 in 85 pregnant women. The 95th percentile was 10.3 cm^2. The gastric antral area correlated well with the body weight and the BMI (LOE- Very Low).[337] Zieleskiewicz *et al.* conducted a study on parturients after administration of 0.4 mL/kg, 0.8 mL/kg and 1.5 mL/kg of water and tried to find the gastric antral area correlating best with the volume consumed. They found that the cut off value for detecting gastric fluid of >0.4 mL/kg, >1.5 mL/kg was 387 mm^2 and 608 mm^2 respectively in the supine position (LOE- Low).[338] Roukhomovsky *et al.* conducted a similar study in 35 pregnant women and found that the cut off point of 505 mm^2 and the qualitative Perlas grading of grade 1 stomach combined predicted gastric volumes of >1.5 mL/kg better than either of these parameters used alone (LOE- Low).[339]

Reliability of GUS compared to other methods of estimation of residual gastric volume

Reliability of GUS to assess gastric emptying and the residual gastric volume has been studied. The studies which describe the gastric emptying half time have used scintigraphy or serial ultrasonographic measurements. Scintigraphy measures the gastric emptying half time using residual radioactivity with time, whereas serial ultrasonographic measurements determine the reduction in the estimated gastric volume with time. Holt *et al.* found that the graphs for gastric volumes assessed serially were comparable between scintigraphy and ultrasonographic measurements (LOE- Low).[340] Liu *et al.* found that trans-abdominal ultrasonography is similar in accuracy to scintigraphy in this regard (LOE- Low).[26] Hveem *et al.* showed a comparable sensitivity to scintigraphy in quantifying emptying of both low and high nutrient liquids (LOE- Very Low).[341] Darwiche *et al.* found good correlation in gastric emptying measured by ultrasonography and scintigraphy in diabetic patients (LOE- Very Low).[342]

In another study by Sharma V *et al.* the volumes estimated by ultrasonography correlated well with aspirated gastric content volumes in 19 patients admitted to the Intensive Care Units (LOE- Very Low).[343] Schmitz *et al.* found that the gastric antral CSA in RLD position with GUS were comparable with MRI in 18 volunteer children (LOE- Very Low).[344] The aspirated gastric volume by gastroscopy was comparable for up to 500 mL of ingested volumes in non-pregnant patients with a BMI <40 kg/m2 and the reliability of antral area assessments assessed by repeated estimations showed a coefficient of variation of 5.8%.[328,333]

Survey findings

Of the 56 respondents only one routinely assessed the gastric volume preoperatively. Nine respondents

Table 1: Summary of recommendations

Sl No.	Recommendations	Level of recommendation (GRADE)
Adult Section		
1	Clear liquids should be allowed up to 2 h prior to administration of sedation or anaesthesia.	Strong
2	The volume of clear liquid consumed may be restricted to <450 mL, 2 h prior to administration of sedation or anaesthesia.	Weak
3	Non-clear liquids may be allowed up to 4 h prior to administration of sedation or anaesthesia.	Weak
4	Light meals may be allowed up to 6 h prior to administration of sedation or anaesthesia.	Weak
5	If the patient has consumed heavy meals, it may be prudent to wait for at least 10 h prior to administration of sedation or anaesthesia.	Weak
6	Heavy meal consumption is not advisable the night prior to surgery.	Strong
7	Routine use of aspiration prophylaxis in adequately fasted patients is not advised prior to administration of sedation or anaesthesia.	Strong
8	Aspiration prophylaxis is advised in high-risk patients as identified by the anaesthesiologist.	Weak
9	H_2 receptor blockers, proton pump inhibitors and prokinetic drugs may be used as prophylaxis in high-risk patients.	Weak
Obstetric Section		
1	Women in early or late pregnancy when administered sedation or anaesthesia may be considered to be at highrisk for aspiration.	Weak
2	Clear liquids may be allowed up to 2 h prior to administration of sedation or anaesthesia in pregnant women.	Weak
3	Non-clear liquids may be allowed up to 4 h prior to administration of sedation or anaesthesia in pregnant women.	Weak
4	Light meals may be allowed up to 6 h prior to administration of sedation or anaesthesia in pregnant women.	Weak
5	If the pregnant woman has consumed a heavy meal, it may be prudent to wait for at least 10 h prior to administration of sedation or anaesthesia.	Weak
6	Heavy meal consumption is not advisable the night prior to surgery in pregnant women.	Strong
7	Pregnant women requiring sedation or anaesthesia should be administered aspiration prophylaxis.	Strong
8	H_2 receptor blockers, proton pump inhibitors either alone or in combination with prokinetic drugs can be administered for aspiration prophylaxis.	Weak
9	Clear liquids can be allowed orally 8 h after caesarean section under regional/ general anaesthesia.	Strong
Paediatric Section		
1	Consumption of water, up to 3mL/kg should be allowed until 1 h prior to administration of anaesthesia. Consumption of water, up to 3 mL/kg should be allowed until 1 h prior to administration of anaesthesia.	Strong
2	Consumption of clear liquids other than water, up to 3 mL/kg can be allowed until 2 h prior to administration of anaesthesia.	Weak
3	Human milk and fully skimmed non-human milk can be allowed until 4 h prior to administration of anaesthesia.	Weak
4	Non-clear liquids, non-human milk, formula feeds, light breakfast or light meal may be allowed until 6 h prior to administration of anaesthesia.	Weak
5	The attending anaesthesiologist can decide for or against the administration of aspiration prophylaxis in adequately fasted children.	Weak
6	The attending anaesthesiologist can decide on the duration of fasting for procedural sedation within operating room or at remote location.	Weak
7	The oral consumption of clear liquids in the postoperative period should be resumed at the earliest where no medical or surgical contraindications exist.	Strong
Bariatric Section		
1	Obese individuals may be considered to be at higher risk for aspirationin comparison to non-obese individuals when administered sedation/ general anaesthesia.	Weak
2	In obese individuals, the advice on preoperative fasting practices may be the same as in non-obese individuals prior to the administration of sedation or anaesthesia.	Weak
3	Aspiration prophylaxis may be administered in obese patients prior to the administration of sedation or anaesthesia.	Weak
4	H_2 receptor blockers, proton pump inhibitors either alone or in combination with prokinetic drugs can be administered for aspiration prophylaxis.	Weak
Gastric Ultrasonography Section		
1	Gastric ultrasonography may be used as a bedside tool for assessing the quality and quantity of gastric contents in the preoperative period.	Weak
2	The quality and quantity of gastric contents should be assessed in the right lateral decubitus position.	Strong

Table 2: Classification of food items into clear liquids, non-clear liquids, light meal, heavy meal

Type of food	Name of the food	Approximate time of gastric emptying
Clear Liquids (Juices without pulp)	Coconut water (400 ml), Black tea (200 ml), Black coffee (200 ml), 25% dextrose, Watermelon juice, Pineapple juice, Apple juice, Sandalwood sharbat, Rooh afzha, Khus sharbat, Aerated cold drink, Tetra pack juice, Rice ganji (also called kanji or congee, strained), Clear soup broths, Dal water, Green tea, Maltodextrin preparations	<2 h
Non-Clear Liquids	Rava porridge (200 ml), Ragi malt (200 ml), Sattu drink (200 ml), Milk (200ml), Buttermilk (300 ml), Milk shake (200 ml), Fruit yoghurt (150 ml), Cold coffee (200 ml), Tea (200 ml), Filter coffee (200 ml), Smoothie (200 ml)	2- 4h
Light Meal	Bread slice (1 no.), Cream of soups, Curd rice (150 g), Dal rice (150 g),Poha (100 g), Phulka with vegetable (1 with 4 spoons of vegetable), Curd (200 ml), Milk shake with fruit (200 ml), Milk and corn flakes (1 cup), Idli with sambhar (1 no.), Poha / Avalakki soaked in water and eaten (30 g), Puffed rice (150 g), Marie biscuits (4 no.) with milk 150 mL, Glucose biscuit (4 no.) with milk 150 mL.	4- 6 h
Heavy Meal	Thali (chapathi+ rice+ dal + veg + curd), Noodles with curry (250 gms), Pongal with curd (2 bowls), Khichdi with curd and papad (2 bowls), Pessarattu/Dosa with chutney and sambhar (3 in no.), Thali Rice+ poriyal+sambhar+curd +pickle, Parantha (stuffed)with dahi and pickle (2 no.), Chicken curry and rice (1 bowl), Kebabs with chutney and french fries (4 in no.), Pizza (2 triangles) with coke, Burger (veg/non-veg) 1 no.	> 6 h

Note: 1. All volumes mentioned in brackets are with respect to adult patients only. 2. Volumes of clear liquid are taken as <450 mL unless specifically mentioned

(16.07%) assessed the gastric volume preoperatively in patients they considered at risk. Forty-six respondents (82.14%) did not routinely assess the gastric volume. Of these only 5 respondents used ultrasonography to measure the gastric volume.

Recommendations

Gastric ultrasonography may be used as a bedside tool for assessing the quality and quantity of gastric contents in the preoperative period.

The quality and quantity of gastric contents should be assessed in the right lateral decubitus position.

Summary

The guidelines formulated are based on evidence and are applicable in their respective patient population. The summary of the guidelines are represented in Table 1. Overall, the guidelines suggest optimal time for consumption of food prior to the administration of anaesthesia. These guidelines will be updated as and when new evidence arises.

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Conflicts of interest

There are no conflicts of interest.

Address for correspondence:
Dr. Pradeep A Dongare,
ESI-PGIMSR, Rajajinagar, Bengaluru, Karnataka, India.
E-mail: pradeep.dongare@gmail.com

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Appendix 1: Survey responses for clear liquids		
Type of fluid	**Sub entries**	**No of entries**
Water	Plain	43
	Glucose/ Sugar	9
	Honey	1
Juice	Orange/ Clear Juice	16
	Lemonade	11
	Appy	2
	Frooti	1
	Soft drinks	1
	Apple juice	1
Fluids		1
Coconut Water		25
Clear Soup		1
Black Tea/ Coffee		7
Buttermilk		2

Appendix 2: Survey responses for light meal	
Type of food	**No. of entries**
Idli 1-3	28
Poha	11
Paratha/ Roti/ Chapathi/ Jowar Roti with/ without curry	16
Upma	14
Bread toast/ Sandwich/ with or without omelette or milk	15
Rava Idli	3
Appam/ Dosa	8
Ragi items	1
Oats with milk	1
Cows milk	1
Biscuits 2-4/ with or without cream	4
Vada	5
Poori (1-3)	2
Cornflakes 1 bowl	1
Kanji	1
Salad	1
Halwa	1
Dry fruit	1
Fruit Juice	1
Veg soup	1
Rice rasam with curd/ sambar/rasam	4
Coffee and tea	1
Ganthia	1
Pongal	1
Misal	1

Appendix 3: Survey responses for heavy meals	
Type of food	**No. of entries**
Chapathi/ Paratha/ Poori/ Roti/ Jowar Roti/ Bajra Roti with curry/ mentioned without curry	43
Rice with Dal/ Curd/ Rasam/ Sambar/ Veg Curry/ Non-Veg curry	43
Non-Vegetarian (Chicken/ Mutton/ Pork)	25
Dosa/ Akki roti/ Idli	6
Fried Vegetarian Preparation	10
Sweets	7
Full Meals	11
Ragi Balls	1
Sandwiches	1