Indian Journal of Clinical Anaesthesia 2024;11(3):348–353

Content available at: https://www.ipinnovative.com/open-access-journals

Indian Journal of Clinical Anaesthesia

Journal homepage: www.ijca.in

Original Research Article

Optimum clear liquid quantification using point of care gastric sonography after ingestion of measured volumes of clear liquid in adult patients posted for elective surgeries: A randomized controlled study

Ramesh Koppal[1], **Dinesh Naik**[1], **Tanuja K S**[2], **Sangamesh Nainegali**[1]*, **Mahindra B Kalashetty**[1], **Anusha S R**[1], **Harshitha Gopal**[1]

[1]*Dept. of Anaesthesiology, S N Medical College, Bagalkote, Karnataka, India*
[2]*Medanta- The Medicity, Gurugram, Haryana, India*

ARTICLE INFO

Article history:
Received 12-07-2024
Accepted 13-08-2024
Available online 30-08-2024

Keywords:
Ultrasonography
Gastric
Anaesthesia
Right lateral decubitus

ABSTRACT

Background and Aim: High mortality and morbidity as a result of gastric content aspiration in the perioperative period is common. Therefore, nature and volume of gastric content can be obtained quantitatively and qualitatively by using ultrasonography. In this study we assessed the quantity and quality of gastric content after giving measured volumes of clear liquid orally depending on the body weight, 2 hours before anaesthesia.

Materials and Methods: 132 patients were randomly assigned into four groups. Patients in group A received 0 mL kg-1, group B received 5 mL kg-1, group C received 8 mL kg-1 and group D received 10 mL kg-1 of clear liquid orally 2 hours prior to anaesthesia. Residual volume and content in the gastric antrum were observed by using ultrasonography after 2 hours in both supine and right lateral decubitus position.

Results: In our study, 100% of patients in group A, 97% of patients in group B, 81.8% of patients in group C and 69.7% of patients in group D revealed grade 0 antrum (empty stomach) with P value <0.05. Remaining patients showed grade 1 (empty only in supine) and grade 2 antrum (not empty in both supine and right lateral decubitus) with liquid as their main gastric content respectively.

Conclusion: Majority of patients showed empty stomach after administration of clear fluids given orally upto 5 mL kg-1 2 hours prior to anaesthesia.

1. Introduction

Aspiration of gastric content in the perioperative period is a major risk for morbidity and mortality in patients undergoing surgery.[1,2] Patients who have full stomach are at higher risk of aspiration during anaesthesia which may lead to ARDS, respiratory infection, generalized sepsis, prolonged hospital stay and financial burden on patients. Antral ultrasonography (USG) is becoming an important, non-invasive tool to assess the gastric content and avoid perioperative complications of aspiration.[3,4]

Nature of the gastric content can be qualitatively assessed by antral sonography and also quantitative assessment of total gastric fluid can be calculated by cross-sectional area (CSA) of the antrum.[5–8] As per present American Society of Anesthesiologist (ASA) guidelines, fasting period for clear liquids given orally is 2 hours. Recent studies have shown that shortened fasting time may improve the perioperative outcome for patients with a low risk of aspiration and less discomfort as a result of prolonged fasting.[9] Shorter fluid

* *Corresponding author*.
E-mail address: ndrsangamesh@gmail.com (S. Nainegali).

https://doi.org/10.18231/j.ijca.2024.066

fasting might be a strategy to improve the patient comfort but has not been investigated yetwidely.[10–15]

Many observational studies have demonstrated the safe duration of fasting to avoid perioperative aspiration, but paucity in the literature regarding quantity of fluid that can be given to the patient depending on body weight still persists. Hence, based on our pilot study we hypothesized that by giving lesser than or equal to 5 mL kg^{-1} of clear fluid orally, 2 hours before anaesthesia would reduce the risk of pulmonary aspiration in adults.

2. Objectives

Primary objective of our research is to identify the optimum quantity of clear liquid that can be given orally prior to anaesthesia the ASA I and II fasting guidelines.

Secondary objective is to qualitative analysis of gastric contents.

3. Materials and Methods

After obtaining the institutional principal committee certificate a clinical based prospective randomized double blinded study was conducted for a period of 18 months. The current trial has been listed with "Clinical Trial Registry of India" (CTRI/2020/06/026244). Written informed consent was taken from 132 patients of ASA grade I and II, aged 18 to 65 years undergoing elective surgeries with (Body Mass Index) BMI ≤30 kg m^{-2}. Patient refusal to give consent, patients having delayed gastric emptying time (Eg; chronic kidney disease, diabetes), pediatric patients and pregnancy were eliminated from the study.

Patients participating in the study were randomly grouped into A, B, C, D. Random allocation of patients into these groups was done by computer generated numbers. Group A is taken as control group which received 0 mL$kg^{-1}$of clear liquid orally. Group B, C and D received 5 mL kg^{-1}, 8 mL $kg^{-1}$and 10mL kg^{-1} respectively. It is a double blinded randomized controlled study. Here person performing the USG and interpreter were blinded for the quantity of fluid given. An independent investigator prepares all the fluid volumes to be given to the patient pre-operatively. USG was performed on all the patients by the same person.

The USG machine (GE Logiq e, GE Healthcare, Wisconsin, United States) a curved array, low frequency probe (1-5MHZ) was used. Imaging was done in supine with mild head up and right lateral decubitus (RLD) position in sagittal plane immediately below the xiphisternum. Maneuvers of transducer like rotation and heel-to-toe movement was done to observe the gastric antrum in the short axis at the level of aorta. Mean while other structures like long axis of abdominal aorta, head/neck of pancreas, inferior margin of left lobe of liver was observed by moving the transducer from left costal margin.

Positioning the patient in supine makes easy to observe the content in gastric antrum where as in RLD, contents in dependent antrum which gets drained due to gravity from the fundus were observed easily. The antrum is identified in cross-section at the level of the abdominal aorta in the supine and RLD. Three readings of antral CSA were taken which correlates with the fluid in antrum. Mean of all the three readings of CSA was calculated. By applying the Perlas formula (27+14.68xCSA –1.28x age) to the obtained values we calculated gastric volume.[11]

Stomach Volume (mL) =27+14.68xCSA (cm^2)-1.28xage (in years).

CSA = (CCxAPx3.14)/4

CSA = Cross sectional area. (Antral CSA is measured using the free-tracing tool of the ultrasound equipment and including the full thickness of the gastric wall from serosa to serosa).

CC = Craniocaudal diameter

AP = Anteroposterior diameter

Both CC and AP diameters were taken from still image of the antrum.

After gastric antral volume was assessed by using curvilinear probe of USG, grading was done as follows.

Grade 0 antrum-empty in both supine and RLD shows Bull's eye appearance (Figure 1 a)

Grade 1 antrum- hypoechoic,clear fluid with distended antrum visible only RLD but empty in supine (Figure 1 b).

Grade **2 antrum**- clear fluid was visible both in RLD and supine (Figure 1c).

Solid material appeared as 'frosted glass' appearance (Figure 1 d).

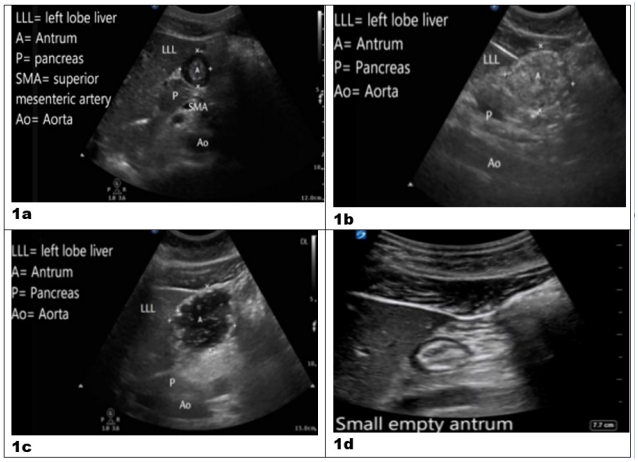

Figure 1: a): Empty gastric antrum (Grade 0) looks like 'Bull's-eye' appearance; **b)**: antrum containingclear fluid looks like hypoechoic, distended antrum(Grade 1 antrum) in which fluid visible in RLD only, empty in supine; **c):** Clear fluid visible in both supine and RLD (Grade 2 antrum); **d)**: Antrum with solid material 'frosted glass' appearance

3.1. Statistical analysis

Estimation of sample size was done by using Med calc software version 2.3.1 at95% confidence level, 80% power of the study. As there were no reference articles, a pilot study was conducted taking 36 samples with 0 mL kg^{-1} (Control group), 5 $mLkg^{-1}$, 8 $mLkg^{-1}$ and 10$mLkg^{-1}$ of clear fluid supplementation and residual volume was recorded using USG after 2 hours. Based on the optimum fluid to be given orally in order to achieve the expected residual volume in stomach, the Receiver operating characteristic (ROC) curve analysis was done. It was found that the optimum fluid to be given orally is less than or equal to 5 $mLkg^{-1}$with 73.9% sensitivity and 71.4% specificity and area under the curve = 0.78. The sample size is 32≈ 35 in each group.

Data was entered in Microsoft Excel & later analyzed statistically by using IBM SPSS statistics for windows, version 19 (IBM Corp., Armonk, N.Y., USA). Mean & Standard Deviation was calculated for quantitative data. Kolmogorov-Smirnov (K-S) test was applied to check the normality of distribution. Percentage & Proportion were used for qualitative data. Chi-Square test and Student 't-test for qualitative and quantitative data respectively were applied. Other appropriate statistical tests were applied for data. $p<0.05$ was considered significant.

4. Results

A total of 132 patients undergoing elective surgeries conforming to ASA I and II were enrolled in this study (Diagram 1). The demographic variables in terms of age, gender, weight, height, BMI in all the four groups were comparable (Table 1).

According to the three point grading system used as per volume in antrum, 100% of patients in group A, 97% in group B, 82% in group C, 73% in group D revealed grade 0 antrum (empty stomach) with p value<0.05 which was statistically significant. 0% of patients in group A, 3% in group B, 12% in group C, 6% in group D showed grade 1 antrum.0% of patients in group A and B showed grade 2 antrum, 6% in group C, 21% in group D showed grade 2 antrum.(Table 2)

And as per contents in antrum 100% of patients in group A showed empty stomach. In group B, 97% of patients showed empty stomach and 3% of patients showed liquid as their gastric content. In group C, 82% of patients showed empty stomach and 18% of patients showed liquid as their gastric content. In group D, 73% of patients showed empty stomach, 24% of patients showed liquid and 3% of patients showed solid or liquid mixed with air as their gastric content.(Table 3)

5. Discussion

According to our observation, majority of patients (97%) showed grade 1 antrum and empty stomach after administration of clear fluids orally upto 5$mLkg^{-1}$given 2 hours prior to anaesthesia. 81.8% and 69.7% of patients revealed empty stomach after administration of fluids upto 8 $mLkg^{-1}$and 10 $mLkg^{-1}$respectively, which conveyed a higher risk of pulmonary aspiration. Risk stratification is done depending on the clear volume content in gastric antrum. The average stomach antrum value in fasted patients is 1.5 $mLkg^{-1}$.

Mortality after aspiration pneumonia can be as high as 5% and it accounts for up to 9% of all anaesthesia related deaths due to aspiration of gastric contents in the perioperative period.[11] Preoperative fasting guidelines are designed to reduce the risk of complications related to the perioperative aspiration. As per previous studies, carbohydrate-rich fluids up to 2 hours before elective surgery improves the subjective well-being and also reduces thirst and hunger.[16]

Presently due to paucity of the devices to assess stomach content reliably, USG which has easy accessibility and noninvasive nature is used in determining the gastric contents and to prevent risk of pulmonary aspiration at bed side.[16] Hence, we conducted randomized controlled study at our hospital to quantify the safe amount of clear liquid according to body weight which can be given preoperatively as per ASA guidelines.

The role of USG in assessing the gastric volume ad content have been revealed positively in some previous studies. According to the study conducted by Anahi Perlas et al, the gastric antrum provided the most reliable quantitative and qualitative information for gastric volume. The antral CSA correlated with the volumes upto 300 mL in a close-to-linear fashion after giving measured volumes of clear liquid, and also provided qualitative information about gastric content and its nature.[11]

According to the study conducted by I.-K.song et al, carbohydrate fluids ingested 2 hours before surgery reduced the gastric volume and did not cause any serious complications in pediatric patients and also parents were satisfied with the preoperative carbohydrate drink.[16]

As per the observations of Bolondi, sequential measurements of antral CSA after a standardized oral intake have been used to measure gastric emptying time correlating well with scintigraphy evaluation.[17]

Presently very few studies have been published pertaining to preoperative ingestion of clear liquids given orally without taking patients body weight into consideration. The strength of our present research is that we have tried to quantify the safe amount of liquids which can be given orally according to body weight preoperatively. Limitations of our experiment are, our study included only ASA I and II patients, conducted only in elective cases and

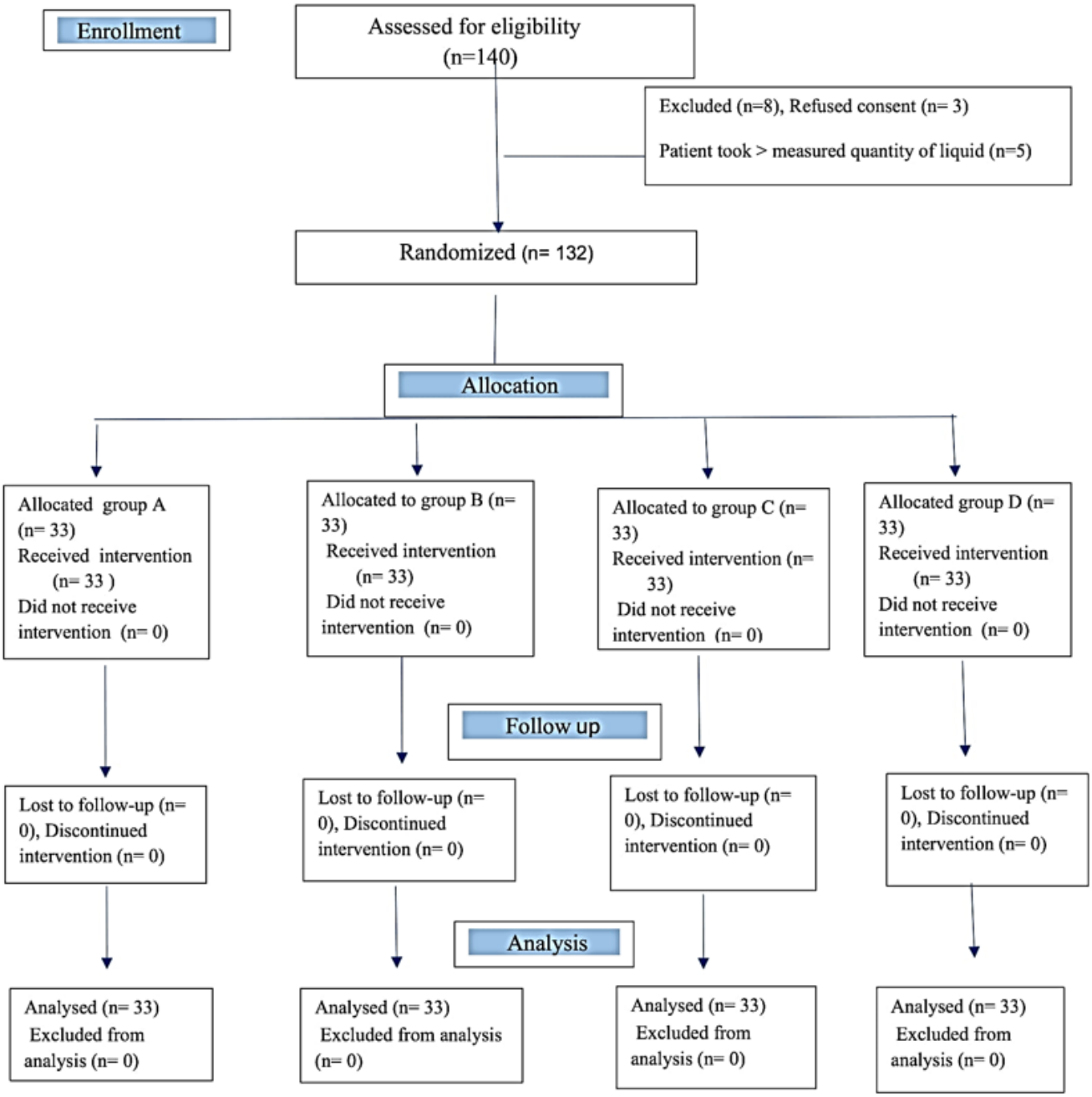

Diagram 1: Consort flow diagram of the study

Table 1: Comparison of four groups with respect to demographic data

Variables	Group A (n-33)	Group B (n-33)	Group C (n-33)	Group D (n-33)	p - Value
Age (years)	43.36±13.01	39.12± 14.45	39.30±12.83	43.58±13.75	0.355
Weight (kg)	62.27±9.59	63.17±9.03	66.73±7.99	64.79±6.41	0.147
Gender (male/female)	23/10	22/11	22/11	23/10	0.987
Height(cms)	162.00±8.05	163.35±8.50	164.32±5.01	163.97±6.20	0.261
Body mass index	23.70±2.96	23.61±2.52	23.79±2.22	23.26±2.23	0.839

* kg – kilogram, †cms – centimeter

Table 2: Comparison of gastric volume in different groups in terms of grades

Volume Grade	Groups				Total
	A	B	C	D	
0	33 (100%)	32 (97%)	27 (82%)	24 (73%)	116
1	0	1 (3%)	4 (12%)	2 (6%)	15
2	0	0	2 (6%)	7 (21%)	1
Total	33	33	33	33	132

Chi square test P< 0.006, highly significant

Table 3: Comparison of gastric contents in different groups

Gastric contents	Groups				Total
	A	B	C	D	
empty	33 (100%)	32 (97%)	27 (82%)	24 (73%)	116
Liquid	0	1 (3%)	6 (18%)	8 (24%)	15
solid	0	0	0	0	0
liquid/solid with air	0	0	0	1 (3%)	1
Total	33	33	33	33	132

Chi square test P< 0.01, significant

only in small group of population. In future many studies have to be conducted in broader group and different type of studies.

6. Conclusion

According to our study, Majority of patients (97%) showed Grade 1 antrum and empty stomach after administration of clear fluids upto 5ml/kg, 2hours prior to anaesthesia. 81.8% and 69.7% of patients showed empty stomach after administration of fluids upto 8ml/kg and 10ml/kg respectively, which showed higher risk of aspiration.

In conclusion our study revealed a safe allowable quantity of clear fluid that can be given orally to the patient 2 hours before anaesthesia is upto 5mLkg^{-1}in comparison with higher volumes.

7. Sources of Funding

None.

8. Conflict of Interest

None.

References

1. Warner MA, Warner ME, Weber JG. Clinical significance of pulmonary aspiration during the perioperative period. *Anesthesiology*. 1993;78(1):56–62.
2. Engelhardt T, Webster NR. Pulmonary aspiration of gastric contents in anaesthesia. *Br J Anaesth*. 1999;83(3):453–60.
3. Moser JJ, Walker AM, Spencer AO. Point-of-care paediatric gastric sonography: can antral cut-off values be used to diagnose an empty stomach? *Br J Anaesth*. 2017;119(5):943–7.
4. Putte PVD, Vernieuwe L, Jerjir A, Verschueren L, Tacken M, Perlas A. When fasted is not empty: a retrospective cohort study of gastric content in fasted surgical patients†. *Br J Anaesth*. 2017;118(3):363–71.
5. El-Boghdadly K, Wojcikiewicz T, Perlas A. Perioperative point-of-care gastric ultrasound. *BJA Educ*. 2019;19(7):219–26.
6. Gagey AC, Siqueira MDQ, Monard C, Combet S, Cogniat B, Desgranges F, et al. The effect of pre-operative gastric ultrasound examination on the choice of general anaesthetic induction technique for non-elective paediatric surgery. A prospective cohort study. *Anaesthesia*. 2018;73(3):304–12.
7. Kaydu A, Gokcek E. Sonographic gastric content evaluation in patients undergoing cataract surgery. *Niger J Clin Pract*. 2019;22(11):1483–8.
8. Cho EA, Huh J, Lee SH, Ryu KH, Shim JG, Cha YB, et al. Gastric Ultrasound Assessing Gastric Emptying of Preoperative Carbohydrate Drinks: A Randomized Controlled Noninferiority Study. *Anesth Analg*. 2021;133(3):690–7.
9. Andersson H, Zarén B, Frykholm P. Low incidence of pulmonary aspiration in children allowed intake of clear fluids until called to the operating suite. *Paediatr Anaesth*. 2015;25(8):770–7.
10. Schmidt AR, Buehler P, Seglias L, Stark T, Brotsch B, Renner T, et al. Gastric pH and residual volume after 1 and 2 h fasting time for clear fluids in children. *Br J Anaesth*. 2015;114(3):477–82.
11. Perlas A, Chan VW, Lupu CM, Mitsakakis N, Hanbidge A. Ultrasound assessment of gastric content and volume. *Anesthesiology*. 2009;111(1):82–9.
12. Perlas A, Mitsakakis N, Liu L, Cino M, Haldipur N, Davis L, et al. Validation of a mathematical model for ultrasound assessment of gastric volume by gastroscopic examination. *Anesth Analg*. 2013;116(2):357–63.
13. Cubillos J, Tse C, Chan VW, Perlas A. Bedside ultrasound assessment of gastric content: an observational study. *Can J Anaesth*. 2012;59(4):416–23.
14. Arzola C, Cubillos J, Perlas A, Downey K, Carvalho JCA. Interrater reliability of qualitative ultrasound assessment of gastric content in the third trimester of pregnancy. *Br J Anaesth*. 2014;113(6):1018–23.
15. Jeong JY, Ahn JH, Shim JG, Lee SH, Ryu KH, Lee SH, et al. Gastric emptying of preoperative carbohydrate in elderly assessed using gastric ultrasonography: A randomized controlled study. *Medicine (Baltimore)*. 2021;100(37):e27242.
16. Song IK, Kim HJ, Lee JH, Kim EH, Kim JT, Kim HS. Ultrasound assessment of gastric volume in children after drinking carbohydrate-containing fluids. *Br J Anaesth*. 2016;116(4):513–7.
17. Bolondi L, Borolouti M, Santi V, Calletti T, Gaini S, Labo G. Measurement of gastric emptying time by real-time ultrasonography. *Gastroenterology*. 1985;89(4):752–9.

Author biography

Ramesh Koppal, Professor https://orcid.org/0000-0002-4943-1675

Dinesh Naik, Associate Professor https://orcid.org/0000-0003-1587-458X

Tanuja K S, Senior Resident https://orcid.org/0000-0002-4794-1989

Sangamesh Nainegali, Professor https://orcid.org/0000-0002-2709-4065

Mahindra B Kalashetty, Professor https://orcid.org/0000-0002-7143-9059

Anusha S R, Post Graduate Student https://orcid.org/0009-0000-8498-7559

Harshitha Gopal, Post Graduate Student https://orcid.org/0009-0004-7359-3107

Cite this article: Koppal R, Naik D, Tanuja K S, Nainegali S, Kalashetty MB, Anusha S R, Gopal H. Optimum clear liquid quantification using point of care gastric sonography after ingestion of measured volumes of clear liquid in adult patients posted for elective surgeries: A randomized controlled study. *Indian J Clin Anaesth* 2024;11(3):348-353.