Original Article

Comparison of Gastric Volume, Gastric pH, and Metabolic Parameters Following Overnight Fasting Versus Clear Fluid Intake Two Hours Before Laparoscopic Abdominal Surgeries: A Prospective Randomized Clinical Study

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Abstract

Background: Aspiration of the gastric contents in the perioperative period is a serious complication of surgery and anaesthesia. Pre-operative fasting aims to reduce gastric volume and increases pH, thereby decreasing the risk of aspiration. This study compared gastric volume measured by ultrasonography, gastric pH, serum glucose, serum electrolytes, and serum lactate (metabolic parameters) in patients after overnight fasting versus after ingestion of 200 ml of clear fluid (water) 2 hours before laparoscopic abdominal surgery. **Material and Methods:** It was a prospective, randomised clinical study conducted at a hospital, in which patients aged ≥18 years undergoing elective surgery under general anaesthesia served as subjects. The subjects were randomised into two groups based on a computer-generated randomisation table: Group A (overnight fasting) and Group B (200 ml of clear water 2 hours before surgery). Gastric volume was evaluated with the help of ultrasonography, and the pH of gastric contents was measured with the help of pH strips after aspirating. Serum glucose, electrolytes, and lactate were examined. **Results:** Our research revealed no significant differences between groups in age, sex, or weight. Ultrasonic measurement of the mean gastric volume was much smaller in Group B (20.2 ± 4.3 ml) than in Group A (28.9 ± 7.9 ml; $p < 0.001$). There was a statistically higher difference between Mean gastric pH in Group B (2.57 ± 0.89) and Group A (1.39 ± 0.7; $p < 0.001$). There was also much less difference in serum potassium and serum lactate levels in group B. **Conclusion:** We concluded that allowing clear fluids during the preoperative period was associated with reduced gastric volume, higher gastric pH and improved metabolic parameters, without evidence of increased aspiration risk. Implementation of evidence-based fasting guidelines may help reduce patient discomfort, dehydration and metabolic stress associated with prolonged fasting.

Keywords: Ultrasonography, Gastric volume, Gastric pH, random blood sugar, Serum electrolytes.

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Introduction

Gastric content aspiration is one of the worst feared complications in the process of anaesthesia as well as the surgical process. Although not common in elective surgery, perioperative pulmonary aspiration is connected with great morbidity, such as aspiration pneumonitis, extended mechanical ventilation, and extended hospitalisation. It is reported to have a mortality of about 5%. Moreover, approximately 9% of anaesthesia-related deaths are explained by pulmonary aspiration, which is why it is of great clinical importance.[1-5]

Preoperative fasting has long been promoted because it decreases the volume and acidic content of gastric contents, thereby minimising the risk and extent of aspiration. But among activities that are not physiologically innocent is prolonged fasting. Surgical stress and prolonged fasting may induce metabolic imbalances, dehydration, electrolyte imbalance, and enhanced insulin resistance, which can worsen the patient's discomfort and, in some instances, lead to poor outcomes in perioperative studies.[6-8] The stomach is not empty even during prolonged fasting, regardless of nil per os practices after midnight.

Several perioperative measures have been implemented to reduce the risk of aspiration, such as the right timing of anaesthesia, regional vs. general anaesthesia, induction, airway control, and enhanced preoperative fasting. Modern fasting principles suggest that preoperative fasting of solids and fluids should continue for no more than 2 hours before an elective operation.[9-11] Although this is the current guideline, extended levity in both liquid and solid fasting is still prevalent in standard clinical practice.

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Previous studies suggest that a gastric volume exceeding approximately 25 ml (or 0.4 ml/kg) may increase the risk of aspiration. However, evidence from systematic reviews, including the Cochrane Database, indicates that avoidance of clear fluids does not significantly increase gastric pH and may paradoxically increase gastric volume due to ongoing gastric secretions during extended fasting periods.[12] Moreover, prolonged fasting is associated with increased thirst, hunger, anxiety, and overall patient dissatisfaction.

Assessment of gastric volume and gastric emptying has traditionally relied on invasive or complex techniques such as nasogastric aspiration, paracetamol absorption tests, electrical impedance tomography, polyethylene glycol dilution, and radionuclide-labeled meals.[13-15] These methods are often impractical for routine perioperative use. In contrast, ultrasonographic assessment of the gastric antrum offers a simple, non-invasive, bedside tool for estimating gastric volume. Measurement of the antral cross-sectional area using two-dimensional ultrasonography has been shown to correlate well with actual gastric volume and is feasible in the majority of patients.[16-18]

The present study was undertaken to compare gastric volume assessed by ultrasonography, gastric pH, and selected metabolic parameters, including serum glucose, electrolytes, and lactate levels, in patients undergoing elective laparoscopic abdominal surgery following overnight fasting versus ingestion of 200 ml of clear fluid (water) two hours before surgery.

Materials and Methods

Study Design and Setting: This hospital-based, prospective, randomised clinical study was conducted after obtaining Institutional Ethics Committee approval. Written informed consent was obtained from all participants before enrolment.

Study Population: Adult patients aged ≥18 years, belonging to the American Society of Anaesthesiologists (ASA) physical status I or II, and scheduled for elective laparoscopic abdominal surgery under general anaesthesia were included in the study.

Exclusion Criteria:

Patients were excluded if they had a history of diabetic autonomic neuropathy, previous gastrointestinal surgery, gastroesophageal reflux disease, continuous preoperative nasogastric drainage, obesity (body mass index >30 kg/m²), pregnancy, or if they had received proton pump inhibitors, H_2 receptor antagonists, or prokinetic agents in the preoperative period.

Randomisation and Group Allocation

Eligible patients were randomised into two groups using a computer-generated randomisation table:

- **Group A (Overnight Fasting Group):** Patients who followed standard overnight fasting.
- **Group B (Clear Fluid Group):** Patients who received 200 ml of clear fluid (water) two hours before induction of anaesthesia.

Preoperative Preparation and Ultrasonographic Assessment: Upon arrival in the preoperative area, an intravenous cannula (18G or 20G) was secured, and intravenous fluids were administered at a rate of 5 mL/kg/h. Patients were positioned in the right lateral decubitus position for ultrasonographic assessment.

Gastric ultrasonography was performed using a low-frequency curvilinear probe (3–5 MHz). The gastric antrum was visualised in the sagittal plane between the left lobe of the liver and the pancreas, appearing as a round to ovoid structure with a characteristic “target” or “bull’s-eye” appearance. Antral cross-sectional area (CSA) was then determined by finding the anteroposterior (AP) and craniocaudal (CC) diameters by using the following formula:

$$CSA = \frac{AP \times CC \times \pi}{4}$$

Gastric volume was estimated using the validated Perlas formula:

$$GV(ml) = 27 + (14.6 \times CSA_{rightlateral}) - (1.28 \times age)$$

Anesthesia Technique and Gastric Aspiration

After transfer to the operating room, routine monitoring, including electrocardiography, pulse oximetry, and noninvasive blood pressure monitoring, was initiated. Vital parameters baseline was taken.

Matz, Glycopyrrolate, and fentanyl were premedicated for patients. Thiopentone and vecuronium were used as anaesthetics, and the trachea was intubated with a different-sized endotracheal tube after three minutes of preoxygenation. Oxygen, nitrous oxide, and vecuronium were used to maintain anaesthesia.

A Ryle tube (16G in men and 14G in women) was then inserted following the induction, and gastric contents were removed with a 20 ml syringe. Epigastric massage was performed with mild force, assisted by an assistant to facilitate aspiration. Gastric fluid volume was noted, and gastric pH was measured using a standard pH indicator strip.

Data Collection: Recordings were done on demographic information (age, sex, weight), type and duration of surgery, thickness of the gastric volume measured using ultrasonography, aspirated gastric volume, gastric pH, serum glucose, serum electrolyte (sodium, potassium, chloride), serum lactate levels, and time interval between ingestion of fluid and surgery.

Statistical Analysis: The data were entered into a Microsoft Excel spreadsheet and regressed using SPSS 21.0. The representation of categorical data was in the form of Frequencies and proportions. The result was taken to be statistically significant with a probability value of less than 0.05, with the understanding that all statistical test rules had to be followed.

Results

80 patients were enrolled in the study, with 40 per group. Group A (overnight fasting) and Group B (clear fluid intake) did not differ statistically in age, sex distribution, or body weight, indicating that the groups were similar at baseline [Table 1].

The mean gastric volume was much smaller in Group B (20.2 ± 4.3 ml) than in Group A (28.9 ± 7.9 ml; p<0.001). There was a statistically higher difference between mean gastric pH in Group B (2.57 ± 0.89) and Group A (1.39 ± 0.7; p<0.001) [Table 2].

There was no statistically significant difference between the two sampled groups for arterial pH, serum sodium, serum chloride, or random blood glucose (p > 0.05). Nonetheless, Group B, compared to Group A, showed a great difference in serum potassium levels and serum lactate levels ($p < 0.05$), meaning that patients in Group A are in better metabolic conditions because they received clear fluids two hours before an operation [Table 2].

Table 1: Demographic characteristics of study participants

Variables		Group A	Group B	P-value
Age		36.5 ± 5.53	39.4 ± 5.34	>0.05
Gender	Male	30 (75%)	32 (80%)	>0.05
	Female	10 (25%)	8 (20%)	
Weight		55.6 ± 4.43	54.8 ± 5.03	>0.05

Table 2: Comparison of gastric parameters and metabolic variables between Group Aand Group B

Variables	Group A	Group B	P Value
Gastric volume (USG ml)	28.9 ± 7.9	20.2 ± 4.3	<0.001*
Gastric pH	1.39 ± 0.7	2.57 ± 0.89	<0.001*
Arterial pH	7.35 ± 0.15	7.32 ± 0.03	>0.05
Serum sodium (mEq/L)	136.62 ± 9.50	140.05 ± 4.16	>0.05
Serum potassium (mEq/L)	4.14 ± 0.53	3.66 ± 0.48	<0.05
Serum chloride (mEq/L)	102.46 ± 8.32	103.24 ± 3.68	>0.05
Random blood glucose	108.74 ± 20.93	110.15 ± 12.76	>0.05
Serum lactate (mmol/L)	2.75 ± 0.62	1.83 ± 0.75	<0.05*

*Statistically significant ($p < 0.05$)

Discussion

Preoperative starvation is an established procedure that has been considered necessary to minimise pulmonary aspiration during anaesthesia by lowering the volume and acidity of gastric material. Although people observe overnight fasting, gastric juice is still secreted by the stomach and may not be empty when anaesthesia induction is commenced. Extensive fasting can, counterintuitively, lead to gastric distension, increased acidity, patient discomfort, dehydration, and metabolic imbalances.[9,10]

The patients who took 200 ml of clear water 2 hours before surgery in the present study showed a significant reduction in gastric volume and a higher gastric pH than those who had overnight fasting. These findings can be used to endorse recent fasting protocols that allow clear fluids through to the time of elective operation and indicate that those protocols do not increase, and may even decrease, factors that can risk aspiration.

Several factors, including volume, characteristics of ingested fluids, and patient-related variables such as obesity and gastrointestinal pathology, affect gastric emptying. Clear fluids, especially water, are also known to leave the stomach rapidly, which explains the low gastric volumes observed in patients with preoperative water intake. This is a likely physiological process that explains why the gastric parameters were better in the clear fluid group in the current study.

Ultrasonographic evaluation of the gastric antrum has developed as a quick, non-invasive bedside technique for determining gastric volume. The gastric antrum can be easily recognised in most patients, and multiple validated mathematical models have been based on antral cross-sectional area, which has been successfully correlated with the real gastric volume. Perlas et al,[18] found a strong linear correlation between ultrasonographically estimated gastric volume and gastroscopically measured gastric volume, with minimal prediction error. This validated technique is employed, which makes the findings in the current study more suspicious.

Demographic characteristics of the two groups were similar, reducing the confounding effects of age, sex, and body weight on gastric emptying and metabolic parameters. Besides the enhancement of both gastric volume and pH, patients in the group with clear fluid intake had very low serum lactate levels, and their serum oxygenation and potassium levels were more stable than in the group with overnight fasting. These results indicate better metabolic homeostasis and decrease physiological stress in patients who can be given free fluid intake before surgery.

The results of previous studies are consistent with our findings.[19,20] Scarr and Maltby,[21] found no significant difference in gastric temperature or acidity between patients receiving clear fluids within several hours of surgery and those who were fasted overnight. Likewise, Hussain et al,[22] showed that long-term fasting did not have an additional effect on decreasing gastric volume or acidity and was associated with greater patient discomfort. These findings, in conjunction with the current study, support the safety and physiological benefits of liberal clear fluid fasting policies.

Despite research testing preoperative carbohydrate-based beverages and demonstrating their advantage in terms of patient comfort and reduced thirst and anxiety, the current research shows that even ordinary water consumption can promote gastric and metabolic health without safety issues. This is more especially true in resource-constrained environments where carb beverages may not be easily accessible.[23,24]

Limitations: There are some limitations to the current study. It was a small-scale study with a small sample, assessed at a single centre. Indirect estimation of gastric volume was performed using ultrasonographic calculations, not the actual volume. Also, the research work was unable to measure clinical outcomes such as actual aspiration incidence or postoperative recovery parameters. The need to include future multi-centre studies with larger samples and measures of clinical outcomes is justified.

Conclusion

This study supports the current fasting guidelines of the American Society of Anesthesiologists (ASA), which permit the intake of clear fluids up to 2 hours before elective surgery. Allowing clear fluids during the preoperative period was associated with reduced gastric volume, higher gastric pH and improved metabolic parameters, without evidence of increased aspiration risk. Implementation of evidence-based fasting guidelines may help reduce patient discomfort, dehydration and metabolic stress associated with prolonged fasting. However, as the risk of regurgitation and aspiration cannot be completely eliminated, anesthesiologists should remain vigilant and prepared to manage such complications in all patients.

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Conflicts of interest

There are no conflicts of interest.

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