Safety and feasibility of early water consumption after general anesthesia recovery in patients undergoing daytime surgery

Yixing Lu  
Maternal and Child Health Hospital of Guangxi Zhuang Autonomous Region

Siyan Liu  
Reproductive Hospital of Guangxi Zhuang Autonomous Region

Shunzhong Jing  
Maternal and Child Health Hospital of Guangxi Zhuang Autonomous Region

Xuefeng Zhao  
the First People's Hospital of Yulin

Jiamei Liang  
the First Affiliated Hospital of Guangxi Medical University

Xiaoqiang Sun  
the First Affiliated Hospital of Guangxi Medical University

Yunan Lin  
277464077@qq.com  
the First Affiliated Hospital of Guangxi Medical University

Article

Keywords: General anesthesia, Early drinking water, Pre-drinking water assessment, Nausea and vomiting, Antral motility index

Posted Date: January 9th, 2024

DOI: https://doi.org/10.21203/rs.3.rs-3829411/v1

License: ☑️ ☐ This work is licensed under a Creative Commons Attribution 4.0 International License. Read Full License

Additional Declarations: No competing interests reported.
Abstract

Following general anesthesia, many patients experience dry lips, throat discomfort, intense thirst, and a strong desire to drink water in the postanesthesia care unit (PACU). However, the safety of drinking water is often raised. In this prospective observational study we aimed to assess the safety and feasibility of allowing patients to drink water shortly after recovering from general anesthesia, particularly in the context of daytime surgery. Postoperative patients were given water intake in the PACU according to a standard assessment protocol. A total of 216 patients undergoing non-gastrointestinal surgery. For the per-protocol analysis, sixteen patients were excluded. They were divided into four groups based on the amount of water they consumed: group A (<1 mL kg\(^{-1}\)), group B (1–2 mL kg\(^{-1}\)), group C (>2 mL kg\(^{-1}\)), and group D (no drinking). The incidence of post-drinking nausea and vomiting was only 0.67%\(\times\)1/150\(\times\), with no differences in comparisons between groups \((P=0.289)\). Drinking water resulted in a significant decrease in thirst, oropharyngeal discomfort, and pain scores, while significantly increasing the antral motility index (MI). This difference was statistically significant when compared to the pre-drinking values \((P< 0.001)\). Notably, the more water patients consumed, the more pronounced their gastrointestinal peristalsis. A significant difference in antral MI was observed between groups B, C, and A \((P< 0.001)\). Non-gastrointestinal surgical patients who pass a pre-drinking water assessment after resuscitation from general anesthesia can safely consume moderate amounts of water in the PACU. Early water intake is both safe and feasible to promote postoperative recovery.


Introduction

According to the standard requirements of daily surgical anesthesia management, patients who have undergone general anesthesia are conventionally subjected to preoperative fasting and prohibited from drinking water. These patients who have not been drinking water for a long time have lost body fluids. Therefore, most patients have dry lips and parched mucous membranes upon awakening from general anesthesia. After surgery, they experience considerable thirst, throat discomfort, emotional instability, and other similar discomforts, which significantly heightens their desire for water consumption.

Postoperative dietary management is one of the core components of enhanced recovery after surgery (ERAS) management\(^1\). Clinical research has provided evidence on the advantages and safety of reintroducing oral fluids after patients undergo general anesthesia. The early resumption of oral food and fluid intake postoperatively can facilitate the recovery of intestinal motor function, and accelerate the overall postoperative recovery of the body\(^2\).

However, there is a notable scarcity of clinical studies focusing on early postoperative water intake. Notable discrepancies exist in terms of the timing of water consumption, the quantity of water intake, and the method of drinking water\(^3,4\). Existing evidence suggests that patients in the early stages of recovery from general anesthesia can consume an appropriate amount of water. Both children and
adults have reported the ability to drink water shortly after general anesthesia recovery\textsuperscript{5,6}. Nevertheless, there is a considerable dearth of substantial research addressing the quantity and timing of water consumption after surgery. The criteria for evaluation before permitting water intake and its impact on quality verification remain unresolved. There is a clear need for multi-center, large-sample, and randomized controlled studies. Thus, we have conducted a prospective randomized controlled study to explore the safety and feasibility of early PACU water consumption for patients recovering from general anesthesia and to provide practical insights for accelerating the clinical progress of rehabilitation surgery.

**Materials and methods**

**Study design**

This study was approved by the Ethics Committee of the First Affiliated Hospital of Guangxi Medical University in Nanning, China (Chair Songqing He, 26 August 2022; file number 2022-KY-(087)). It was registered at chictr.org.cn (6 September 2022; identification number: ChiCTR2200063418) before the start of the trial and patient enrolment. Written informed consent was obtained from all patients.

A total of 258 patients of either sex, aged \( \geq 18 \) years, with ASA I-II, who underwent non-gastrointestinal surgery, were included in the study during the period from September 1, 2022 to May 1, 2023. The CONSORT flowchart for the study is presented in Fig. 1. Exclusion criteria were pregnancy with difficult intubation, anesthetic complications, and unwillingness to participate in the study for any reason.

**Randomization and intervention**

Postoperative patient awakening, anesthesiologists surveyed to gauge the patient's willingness to consume water. Patients who expressed reluctance to drink water were excluded. After meeting the evaluation criteria, patients were randomly assigned using a mobile phone software designated “random number.” Numbers 1-150 were included in the study group, each patient was provided with a disposable cup containing 150 mL of warm boiled water for a single intake. Drinking as much or as little water as they felt comfortable. They were divided into three groups based on the amount of water consumed, group A (\(<\ 1\ \text{mL} \ \text{kg}^{-1}\)), group B (1–2 mL kg\(^{-1}\)), and group C (\(>\ 2\ \text{mL} \ \text{kg}^{-1}\)). Numbers 151 to 200 were entered into the control group (group D, no drinking).

**Standard assessment protocol**

The evaluation process followed a step-by-step progression:

- This evaluation included the patient’s intention, level of knowledge, airway protection (coughing and swallowing), nausea and vomiting, and head and limb movement\textsuperscript{7,8}.
- We evaluated the patients’ circulation, blood oxygen saturation, postoperative nausea, vomiting, and any bleeding or discharge at the surgical site following general anesthesia recovery\textsuperscript{8,9}.
Finally, if the patient has recovered well, the 3-ounce water swallow test\textsuperscript{10} was conducted to evaluate the patient’s swallowing and drinking capabilities after resolving any swallowing difficulties.

Data collection

The primary outcome was the incidence of nausea and vomiting with drinking water at different times. The secondary outcome parameters were patient experiences before and after drinking, including facial expression, thirst, oropharyngeal discomfort, and postoperative pain. Scores are expressed on a 0–10 numerical scale, with higher values indicating worse conditions. A modified B-ultrasound technique\textsuperscript{11} was employed to measure the antral MI for scanning (Fig. 2).

Statistical analysis

The presentation of categorical data is in the form of frequency percentages (n %) and analyzed through the Chi-squared ($\chi^2$) test. For normally distributed continuous data, it is expressed as the mean ± standard deviation ($\pm s$). Intra-group comparisons were performed using a paired sample t-test, whereas multi-group comparisons employed nonparametric tests. For non-normally distributed continuous data, the presentation was in the form of median and interquartile range, with statistical significance determined at $P < 0.05$.

Results

A total of 258 patients who met the criteria for water consumption were initially screened before their operations. Following anesthesia and recovery, a reassessment of the patient’s willingness to drink water was conducted, with 216 patients expressing their desire to consume water, while 16 were excluded due to their unavailability for follow-up.

Baseline characteristics

No significant differences were observed in the baseline characteristics of the patients, duration of prohibition from drinking, anesthesia duration, intraoperative infusion volume, and type of surgery (Table 1).
Table 1
Patient characteristics and anesthesia management

<table>
<thead>
<tr>
<th></th>
<th>Group A (n = 48)</th>
<th>Group B (n = 50)</th>
<th>Group C (n = 52)</th>
<th>Group D (n = 50)</th>
<th>(P)-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male/female</td>
<td>22/26</td>
<td>29/21</td>
<td>32/20</td>
<td>27/23</td>
<td>0.437</td>
</tr>
<tr>
<td>Age (years)</td>
<td>34.73 ± 9.97</td>
<td>36.48 ± 11.99</td>
<td>34.29 ± 10.51</td>
<td>35.32 ± 9.57</td>
<td>0.772</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>164.67 ± 8.58</td>
<td>165.62 ± 8.55</td>
<td>167.06 ± 9.39</td>
<td>166.08 ± 8.14</td>
<td>0.563</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>60.51 ± 12.35</td>
<td>64.22 ± 12.59</td>
<td>63.90 ± 14.19</td>
<td>63.96 ± 12.44</td>
<td>0.396</td>
</tr>
<tr>
<td>BMI (kg (m^{-2}))</td>
<td>22.11 ± 2.81</td>
<td>23.33 ± 3.75</td>
<td>22.69 ± 3.52</td>
<td>23.05 ± 3.23</td>
<td>0.511</td>
</tr>
<tr>
<td>Prohibition duration (h)</td>
<td>11.64 ± 3.53</td>
<td>11.58 ± 3.78</td>
<td>11.45 ± 2.51</td>
<td>11.63 ± 1.58</td>
<td>0.972</td>
</tr>
<tr>
<td>Anesthesia duration (min)</td>
<td>125.63 ± 38.54</td>
<td>124.84 ± 41.25</td>
<td>128.04 ± 44.99</td>
<td>128.68 ± 26.00</td>
<td>0.646</td>
</tr>
<tr>
<td>Intraoperative infusion Volume (ml)</td>
<td>315.21 ± 115.21</td>
<td>328.00 ± 118.30</td>
<td>325.00 ± 132.66</td>
<td>316.50 ± 85.70</td>
<td>0.956</td>
</tr>
<tr>
<td>Surgical type</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arthroscopic surgery n(%)</td>
<td>12 (25.0)</td>
<td>15 (30.0)</td>
<td>18 (34.6)</td>
<td>15 (30.0)</td>
<td>0.879</td>
</tr>
<tr>
<td>Thyroid surgery n(%)</td>
<td>23 (47.9)</td>
<td>16 (32.0)</td>
<td>11 (21.2)</td>
<td>20 (40.0)</td>
<td></td>
</tr>
<tr>
<td>Laparoscopic surgery n(%)</td>
<td>4 (8.3)</td>
<td>6 (12.0)</td>
<td>6 (11.5)</td>
<td>4 (8.0)</td>
<td></td>
</tr>
<tr>
<td>Internal Fixation Removal n(%)</td>
<td>5 (10.4)</td>
<td>4 (8.0)</td>
<td>6 (11.5)</td>
<td>4 (8.0)</td>
<td></td>
</tr>
<tr>
<td>Superficial lumppectomy n(%)</td>
<td>0 (0.0)</td>
<td>4 (8.0)</td>
<td>3 (5.8)</td>
<td>3 (6.0)</td>
<td></td>
</tr>
<tr>
<td>Others n(%)</td>
<td>4 (8.3)</td>
<td>5 (10.0)</td>
<td>8 (15.4)</td>
<td>4 (8.0)</td>
<td></td>
</tr>
</tbody>
</table>

Results in the PACU

The incidence of nausea and vomiting among the four patient groups was not statistically significant (\(p = 0.289\); Table 2). The scores of each index were lower after drinking water compared to before, facial expressions (1 [IQR 1–2] vs. 4 [3–5]; \(p < 0.001\)), thirst (0 [IQR 0–0] vs. 6 [5–8]; \(p < 0.001\)), oropharyngeal discomfort (2 [IQR 1–2] vs. 3 [3–5]; \(p < 0.001\)), and pain (2 [IQR 1–2] vs. 3 [2–3]; \(p < 0.001\); Fig. 3). Meanwhile, the antral MI significantly improved after water consumption (1.61 [IQR 0-3.66] vs. 0 [0-0.05];
Furthermore, the greater the amount of water consumed, the more pronounced the improvement in the antral MI ($p < 0.001$; Fig. 4).

### Table 2
Incidence of adverse events after water consumption [n (%)].

<table>
<thead>
<tr>
<th>Adverse event</th>
<th>Group A (n = 48)</th>
<th>Group B (n = 50)</th>
<th>Group C (n = 52)</th>
<th>Group D (n = 50)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Immediate nausea and vomiting</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>1.000</td>
</tr>
<tr>
<td>Ward nausea and vomiting</td>
<td>1 (2.1)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>2 (4.0)</td>
<td>0.289</td>
</tr>
<tr>
<td>Abnormal exhaust/defecation</td>
<td>0 (0.0)</td>
<td>1 (2.0)</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>0.392</td>
</tr>
<tr>
<td>Poor appetite</td>
<td>3 (6.3)</td>
<td>1 (2.0)</td>
<td>2 (3.8)</td>
<td>1 (2.0)</td>
<td>0.626</td>
</tr>
</tbody>
</table>

### Discussion

Accelerated surgery rehabilitation recommends the oral intake of clear fluids up to ≤ 400 mL 2 h before surgery\textsuperscript{12}. Clinicians prioritize safety and may not always adhere to this preoperative fluid intake recommendation. Our study revealed that the majority of patients refrained from drinking water from the evening before the surgery until the day after. Some patients consumed 400 mL of clear fluids at 06:00 a.m. on the day of the operation. On average, patients included in the study abstained from drinking for approximately 11.57 ± 2.95 h.

The ERAS management concept recommends goal-oriented or restricted fluid infusion during surgery, which significantly reduces the total intraoperative fluid volume in patients\textsuperscript{13,14}. In our collected cases, the average duration of anesthesia was 126.82 ± 38.18 min, with an intraoperative infusion volume of 321.28 ± 113.71mL. Despite these anesthesia management strategies, they may not fully meet the fluid needs of patients who have refrained from consuming water for a long time. As a result, patients in the day surgery center frequently presented with dry throats and a strong desire to drink water upon entering the PACU after anesthesia recovery.

In this study, the time elapsed from the recovery of general anesthesia to the commencement of water intake averaged 31.77 ± 11.44 min. Various studies have reported different recommendations regarding the timing of water intake. Mercan proposed that children could be allowed to drink water 1 h after surgery\textsuperscript{5}, whereas Yin’s study reported a first water intake time of 0.29 ± 0.14 h\textsuperscript{15}, which was similar to our results.

However, we believe that the exact timing of initiating water intake is not the primary concern. Different surgical procedures or individual patients may warrant varying timeframes for commencing water intake. The key lies in the pre-water assessment. Nascimento developed a Safety Protocol for Thirst Management(SPTM) to relieve thirst\textsuperscript{8}. SPTM establishes specific safety criteria, including a good
recovery of consciousness, recovery of airway protection mechanisms (cough and swallowing), and the absence of postoperative nausea and vomiting. This assessment method is also applicable to children. This particular study focused on patients undergoing day surgery, with their length of stay controlled within 24–48 hours. The assessment plan for this study not only incorporates the safety criteria from SPTM but also establishes an assessment methodology and procedure in combination with the post-anesthetic exit scoring system designed by Chung. This plan evaluates the patient’s recovery, emphasizing the evaluation of throat reflexes and swallowing function, and also takes into consideration postoperative bleeding at the surgical site, the potential airway risks following surgery, and the secondary surgical risk assessment. By conducting research within the parameters of ensuring patient safety, this study also provides a valuable reference for future clinical applications.

This study did not impose strict limitations on the amount of water patients consumed. The patients were encouraged to drink water according to their personal preferences and established drinking habits. They had the flexibility to sip small amounts of water or adjust their intake based on their individual needs. In the study group, the volume of water consumed averaged 1.72 mL per kg of body weight, and the duration required to complete water intake averaged 15.5 s. The maximum volume of water consumed reached 750mL. The amount of water consumed in this study significantly exceeded that reported in other clinical studies.

The volume and speed of water consumption are closely linked to the surgical site and the gender of the patients. Patients undergoing thyroid surgery tended to consume less water at a relatively slower pace, as swallowing could cause discomfort or pain at the surgical site. In contrast, those undergoing superficial or limb surgeries demonstrated a preference for larger quantities and a quicker pace of water intake. Furthermore, male patients consistently expressed stronger demands for water than female patients, leading to larger water intake volumes. The amount of water consumed was also closely related to the patient’s past drinking habits. Patients who habitually consumed higher daily water volumes also exhibited a greater desire and capacity for post-surgery water consumption.

For the sake of clinical safety and rationality, it is still recommended to set a maximum drinking water volume. This not only alleviates the concerns of medical staff but also meets the patients' need for drinking water while achieving the same therapeutic effects. A reasonable drinking water volume is suggested to be ≤ 3 mL per kg of body weight or to keep the total amount within 200 mL.

Most clinical studies have not explicitly described the drinking position of patients. Proper posture adjustments can enhance patient comfort, reduce tension, and effectively minimize the occurrence of nausea and vomiting. The positioning of the head is by physiological habits, relieving the strain on soft tissues like neck muscle ligaments. This reduction in muscle tension and neck traction pain, in turn, minimizes vertebral artery compression and distortion, thereby preventing cerebral ischemia, reducing intracranial pressure, and decreasing the likelihood of experiencing headaches, nausea, and vomiting. Therefore, we gradually adjust the height of the head of the bed to achieve a comfortable position for the patient before they begin drinking. In this study, the head of the bed was elevated at 19°. The elevation of
the head of the bed is also affected by the surgical site. For example, when dealing with thyroid surgical wounds in the neck, raising the head of the bed too high may exert pressure on the wound, leading to discomfort and pain. On the other hand, patients undergoing surgeries on body surface tumors or limbs might prefer to drink water in a slightly reclined position. Consequently, whether or not the head of the bed is raised and the degree of elevation should be adjusted according to the patient’s comfort level.

Studies have reported concerns regarding the complications such as vomiting and accidental inhalation following early water consumption. Most studies recommend the restriction of water supply in the PACU. In this study, patients were divided into four groups based on the amount of water they consumed. There were no differences in comparisons between groups \( (p = 0.289) \). Patients did not experience an increased risk of complications, such as choking, coughing, nausea, or vomiting, as a result of excessive water consumption.

There was no direct correlation between the amount of water consumed and the incidence of nausea and vomiting. While larger water intake exerted greater pressure on the gastric wall, resulting in a positive feedback effect that accelerated gastrointestinal peristalsis and promoted gastric contents emptying, it did not lead to an increased incidence of adverse events such as vomiting reflux aspiration. During the PACU observation period following drinking water, there were no cases of nausea and vomiting. Only one patient experienced vomiting after returning to the ward, resulting in a total incidence rate of 0.67%, which is far lower than other studies\(^{18,19}\). Two patients who delayed consuming water vomited in the ward, with an incidence of 4.0%. All three patients underwent goiter resection. The primary reason for vomiting is the throat stimulation associated and swallowing pain with this type of surgery.

It was observed that early drinking water had a positive effect on several aspects of patient well-being, including stabilizing the patient’s mood, alleviating postoperative tension and anxiety, effectively relieving their thirst, improving the dryness and discomfort in their throats, and reducing postoperative wound pain. Notably, there was no linear correlation between the reduction in other scores and the volume of water consumed, and no significant differences were found among groups with varying water intake amounts \( (p > 0.05) \). Even a small amount of warm water given orally was equally effective in achieving the desired therapeutic effect. In essence, different patients consumed varying quantities of water, but the treatment goal remained consistent. Drinking water stimulated gland secretion effectively alleviated dry throat discomfort, and left postoperative patients satisfied with the early drinking water treatment strategy.

This study employed ultrasound to monitor the movement of the gastric antrum both before and after drinking water. These changes in gastric antrum movement serve as an indicator of gastrointestinal function recovery. Research has demonstrated that there exists a complex bidirectional relationship between the brain and the gut. Negative emotions, such as anxiety or fear, can have adverse effects on intestinal function\(^{23,24}\). Patients recovering from general anesthesia experience uncertain surgical outcomes, unfamiliar surroundings, pain, thirst, hunger, and other discomforts, which can lead to negative emotions. These emotions directly affect gastrointestinal motility. We observed that most
patients had relatively static stomachs before drinking water, with a median gastric antrum MI of 0.00(0, 0.05). However, after drinking water patients’ moods stabilized, and they felt happier and more at ease. Drinking water also directly stimulates the gastric wall, promoting gastric peristalsis and gastric secretion under this dual effect. The ultrasound revealed a significant increase in gastric antrum movement, with the median gastric antrum MI after drinking water increasing to 1.61(0,3.66).

The study revealed a positive correlation between antral motility and water intake (Fig. 4). The more water patients consumed, the more active their gastrointestinal peristalsis became. The median antral MI of patients who consumed water of 1–2 mL kg\(^{-1}\) was 1.78(0.45–4.18). The median antral MI of patients who consumed water of > 2 mL kg\(^{-1}\) was 2.35(0.59–3.77), which was significantly higher than patients who consumed < 1 mL kg\(^{-1}\). The presence of a linear correlation between water intake and the antral MI, as well as any potential capping effect, is an aspect that has not been addressed in the existing literature, thus warranting further research.

**Conclusion**

Patients undergoing non-gastrointestinal surgery can consume a suitable amount of water according to their desire, provided they meet the criteria for post-general anesthesia recovery. Early water consumption is safe, feasible, and well-tolerated. This can address the psychological demands of patients, stabilize their emotions, facilitate gastrointestinal function recovery, and improve overall medical treatment satisfaction.

**Declarations**

**Human and animal rights**

The authors declare that the work described has been carried out in accordance with the Declaration of Helsinki of the World Medical Association revised in 2013 for experiments involving humans as well as in accordance with the EU Directive 2010/63/EU for animal experiments.

**Informed consent and patient details**

The authors declare that this report does not contain any personal information that could lead to the identification of the patient(s).

The authors declare that they obtained written informed consent from the patients and/or volunteers included in the article. The authors also confirm that the personal details of the patients and/or volunteers have been removed.

**Acknowledgments**
This work was supported by the First Affiliated Hospital of Guangxi Medical University, China. The authors would like to thank the patients participating in this study.

**Author contributions**

All authors conceptualized and designed the study. Y.X.L. wrote the first draft of the article. X.F.Z., J.M.L. and X.Q.S. were involved in sample collection. S.Y.L. and S.Z.J. were involved in Statistical Analysis and prepared figures. Y.N.L. revised and contributed to the intellectual content of the article. All authors reviewed the manuscript.

**Data availability**

The data that support the findings of this study are available on request from the corresponding author.

**Competing interests**

The authors declare that they have no conflicts of interest.

**References**


Figures
Figure 1

CONSORT flow diagram of patients’ distribution.
Figure 2

Diastolic and systolic ultrasound images of the gastric antrum after drinking.

L: liver; A: gastric antrum; P: pancreas; SMA: superior mesenteric artery; Ao: abdominal aorta
Figure 3
Scores of evaluation indices before and after drinking.

Figure 4
Antral MI before and after drinking.