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ORIGINAL ARTICLE

Prospective Study

Enhanced recovery after surgery strategy to shorten perioperative fasting in children undergoing non-gastrointestinal surgery: A prospective study

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Abstract

BACKGROUND

Enhanced recovery after surgery strategies are increasingly implemented to improve the management of surgical patients.

AIM

To evaluate the effects of new perioperative fasting protocols in children ≥ 3 mo of age undergoing non-gastrointestinal surgery.

METHODS

This prospective pilot study included children ≥ 3 mo of age undergoing non-gastrointestinal surgery at the Children's Hospital (Zhejiang University School of Medicine) from January 2020 to June 2020. The children were divided into either a conventional group or an ERAS group according to whether they had been enrolled before or after the implementation of the new perioperative fasting strategy. The children in the conventional group were fasted using conventional strategies, while those in the ERAS group were given individualized fasting protocols preoperatively (6-h fasting for infant formula/non-human milk/solids, 4-h fasting for breast milk, and clear fluids allowed within 2 h of surgery) and postoperatively (food permitted from 1 h after surgery). Pre-operative and postoperative fasting times, pre-operative blood glucose, the incidence of postoperative thirst and hunger, the incidence of perioperative vomiting and aspiration, and the degree of satisfaction were evaluated.

RESULTS

The study included 303 patients (151 in the conventional group and 152 in the ERAS group). Compared with the conventional group, the ERAS group had a shorter pre-operative food fasting time [11.92 (4.00, 19.33) *vs* 13.00 (6.00, 20.28) h, *P* < 0.001), shorter preoperative liquid fasting time [3.00 (2.00, 7.50) *vs* 12.00 (3.00, 20.28) h, $P < 0.001$], higher preoperative blood glucose level [5.6 (4.2, 8.2) *vs* 5.1 (4.0, 7.4) mmol/L, $P < 0.001$], lower incidence of thirst (74.5% *vs* 15.3%, $P < 0.001$), shorter time to postoperative feeding [1.17 (0.33, 6.83) *vs* 6.00 (5.40, 9.20), $P < 0.001$], and greater satisfaction [7 (0, 10) *vs* 8 (5, 10), $P < 0.001$]. No children experienced perioperative aspiration. The incidences of hunger, perioperative vomiting, and fever were not significantly different between the two groups.

CONCLUSION

Optimizing fasting and clear fluid drinking before non-gastrointestinal surgery in children ≥ 3 mo of age is possible. It is safe and feasible to start early eating after evaluating the recovery from anesthesia and the swallowing function.

Key Words: Enhanced recovery after surgery; Fasting; Water deprivation; Pre-operative period; Postoperative period; Intraoperative complications; Postoperative complications

Core Tip: This study aimed to evaluate the effects of new perioperative fasting protocols in children > 3 mo of age undergoing non-gastrointestinal surgery. Through multi-disciplinary collaboration and information transformation, it is possible to optimize the fasting and clear fluid drinking process before non-gastrointestinal surgery in children > 3 mo of age. For children with non-gastrointestinal surgery, it is also safe and feasible to start early eating after evaluating the recovery from anesthesia and the swallowing function.

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INTRODUCTION

Enhanced recovery after surgery[1] is an evidence-based, interdisciplinary approach for the care of surgical patients, and it was first proposed by Henrik Kehlet and colleagues more than 20 years ago[2,3]. The aim of ERAS is to optimize perioperative management strategies in order to improve prognosis, shorten perioperative hospital stay, and reduce complications, readmissions, and overall treatment costs [3]. The implementation of ERAS requires a multidisciplinary team that includes surgeons, anesthetists, and nursing staff[3]. ERAS has provided numerous recommendations to improve perioperative management of the patient, such as shortening the period of perioperative fasting, the use of minimally-invasive surgical techniques, the careful maintenance of fluid balance, early oral feeding after surgery, minimal use of drains/tubes, and early mobilization[3,4].

Shortening the pre-operative fasting time is one of the focuses of ERAS. Traditionally, fasting from midnight before an operation has been recommended to minimize the risk of aspiration[5]. Nevertheless, fasting from midnight increases insulin resistance and is not comfortable for the patient [6]. Furthermore, complete gastric emptying occurs within 90 min[7], and the consumption of 300 mL of clear fluid 2 h before surgery does not affect gastric volume or pH[8]. Notably, meta-analyses of randomized controlled trials have found that shortening the pre-operative fluid fasting duration does not increase the risk of adverse outcomes such as aspiration or regurgitation in adults[9] and children [10]. Guidelines from the American Society of Anesthesiologists[11,12] and the European Society of Anaesthesiology[13] recommend that children undergoing surgery should fast from the intake of solid food, non-human milk, and infant formula for ≥ 6 h, breast milk for ≥ 4 h, and clear fluids for ≥ 2 h. The guidelines issued by the Chinese Society of Anesthesiologists are very similar, except that children can be given ≤ 5 mL/kg of clear fluids, up to a maximum volume of 300 mL, within the 2-h period before surgery. Importantly, several studies have indicated that the implementation of these guidelines is suboptimal, with many pediatric patients being fasted for longer time periods than those recommended. For example, a study of children in the United States described pre-operative fasting times of 14.1 ± 6.3 h for food, 9.3 ± 6.6 h for breast milk, and 12.6 ± 5.9 h for clear liquids[14], and comparable results have been reported by studies in Europe[15], Australia[16], and Africa[17]. Importantly, implementing specific strategies to reduce pre-operative fasting times can improve adherence to the current guidelines [18,19].

Another important focus of ERAS is the early introduction of oral nutrition postoperatively. The European Society of Anaesthesiology recommends restoring liquid intake within 3 h after surgery[13], and a recent consensus statement encourages the early oral intake of fluids and solids after abdominal surgery[20]. Indeed, allowing adult patients to eat normal food on the day of surgery has been reported to shorten the time to resumption of bowel function, reduce the length of hospital stay, and decrease the incidence of postoperative complications[21-24]. Postoperative fasting can induce discomfort and anxiety in children due to thirst and hunger. Furthermore, early postoperative feeding in children has been reported to reduce the levels of hunger, thirst, and pain, shorten the time to first flatus/stool, and decrease infection rates, without increasing the incidence of vomiting[25-27]. Nevertheless, most hospitals still abide by the strategy of restricting food intake until ≥ 6 h after surgery. Moreover, data are very limited regarding the potential benefits and safety of early postoperative feeding in children in China.

Recently, the General Surgery Department of our hospital has cooperated with other departments, including the Anesthesia Department, Operating Room, and Information Department, to implement a series of strategies to align our pre-operative and postoperative fasting protocols with the ERAS recommendations. The aim of this prospective pilot study of children ≥ 3 mo of age undergoing non-gastrointestinal surgery was to evaluate the effects of the new perioperative fasting protocols on pre-operative and postoperative fasting times and the incidences of thirst, hunger, vomiting, aspiration, and postoperative fever. It is anticipated that the procedures and findings described in this study would facilitate the optimization of perioperative fasting strategies in other surgical departments, especially in China.

MATERIALS AND METHODS

Study design and patients

This prospective pilot study included children undergoing non-gastrointestinal surgery at the General Surgery Department/Surgical Endoscopic Center of the Children's Hospital (Zhejiang University School of Medicine) between January 2020 and June 2020. The inclusion criteria were: (1) Age ≥ 3 mo of age; (2) Children undergoing elective non-gastrointestinal surgery; and (3) ASA grade I-II[28]. The exclusion criteria were: (1) Gastrointestinal dysfunction (such as gastroesophageal reflux or gastrointestinal tract obstruction); (2) Obesity; (3) Difficult airway; (4) Cerebral injury; (5) Intracranial hypertension; (6) Coma; (7) Anesthesia time > 3 h, which would result in drug accumulation that would require a longer period of postoperative food and water fasting; or (8) Cardiac or renal dysfunction. The study was approved by the Ethics Committee of the Children's Hospital, Zhejiang University School of Medicine. All children and their guardians provided informed consent for the study.

Patient grouping

The study participants were divided into two groups according to whether they had been enrolled before or after the implementation of the new perioperative fasting strategy. Children who underwent surgery between January 8, 2020 and April 5, 2020 were managed using a conventional fasting protocol (see below) and allocated to a conventional group. Children who underwent surgery between April 6, 2020 and June 20, 2020 were managed using a fasting protocol based on ERAS recommendations (see below) and allocated to an ERAS group. The study aimed to have at least 150 patients in each group.

Perioperative fasting protocols

In the conventional control group, the traditional perioperative fasting plan was used. In order to meet the requirements of 8 h without food and 4 h without water before the operation, a "batch fasting" was implemented. The responsible doctor arranged the banned food/water at 00:00, 2:00, and 4:00 in batches according to the operating room planning. After the operation, food and water were prohibited for 6 h in accordance with the current nursing routine requirements, and anesthesia recovery and swallowing function were not routinely evaluated. After 6 h, small amounts of rice soup, porridge, and other soft foods were allowed, and the patients were gradually shifted to a normal diet.

For children in the ERAS group, pre-operative fasting was based on the current guidelines in the United States, Europe, and China: ≤ 5 mL/kg of clear fluids, up to a maximum volume of 300 mL, were permitted within the 2 h before surgery; fasting period of 4 h for breast milk; fasting period of 6 h for formula milk, non-human milk, and starchy solids; and fasting period of 8 h for solids such as fat and meat. In order to implement an individualized pre-operative fasting protocol, the estimated start time of the operation for each patient was calculated on the day before surgery according to the order of the surgical list (which was decided by the surgical team) and the mean duration of each type of operation (which had been calculated from data obtained from the surgical anesthesia system). The nurse on the night shift re-assessed any risk factors that might influence the timing or lead to the cancellation of the operation. On the day of surgery, the progress of the surgical list was continuously monitored from the information system by the chief nurse or another staff member, and any delays in surgery were reported to the appropriate nursing staff and patient/parents so that the fasting times could be adjusted accordingly. Postoperatively, the children in the ERAS group were allowed to have food intake from 1 h after surgery, provided that they passed a safety assessment requiring a Steward recovery score > 4[29] and a water swallow test score of 1-2, *i.e.*, able to drink 2-5 mL (children aged < 1 year) or 5-10 mL (children aged ≥ 1 year) of water in one or two attempts within 5 s. Liquid food was provided initially, and semi-liquid food (such as porridge) was provided 15 min later. The volume of the initial diet was half the regular feeding volume. A return to a normal diet was made gradually.

The implementation of the individualized fasting protocol for children in the ERAS group involved the training of medical staff at departmental meetings, which was led by the investigators in charge of reviewing the available literature and creating the new strategy. A slide deck was prepared to facilitate the training sessions. The patients and their parents were also informed about the fasting protocol, and the advantages of drinking clear liquids within the 2 h before surgery were emphasized. A simplified slide deck was used to help convey the relevant information to the patients and parents.

Data collection

All data were collected by trained investigators from our department through face-to-face questioning, reviewing medical records, and observation. The pre-operative food fasting time (the time from the last intake of food to transfer to the theatre) and liquid fasting time (the time from the last intake of clear liquids to transfer to the theatre) were recorded by the nurse who transferred the child to the operating room through inquiry of the parents. A venous blood sample for the measurement of pre-operative blood glucose levels was obtained before the initiation of intravenous infusions at 9:00 on the day of surgery. Postoperative food fasting time (time from transfer to the ward to the first intake of liquid) was recorded by a nurse at the bedside. Postoperative thirst reported before the first intake of food by children aged ≥ 2 years was recorded by the nurse in charge. Intraoperative vomiting and aspiration were recorded by a trained data collector after reviewing the records on the day after surgery. Postoperative vomiting and postoperative fever (≥ 37.5°C) before discharge from the hospital were recorded by the data collector after review of the medical records and consultation with the parents. On the morning after surgery, the children and parents were asked to rate their satisfaction with the pre-operative fasting protocol using a visual analog scale, where 0 indicated non-satisfaction and 10 indicated great satisfaction.

Statistical analysis

SPSS 23.0 (IBM Corp., Armonk, NY, United States) was used for statistical analyses. Categorical data are described as frequencies and percentages and were compared between groups using the chi-squared test or Fisher's exact test. Continuous data are described as the mean ± SD or median (range) according to normal distribution or not. Normally-distributed continuous data were compared between two groups using the independent-samples t-test. Non-normally-distributed continuous data were compared using the rank-sum test. $P < 0.05$ was considered statistically significant.

RESULTS

Baseline data

A total of 303 children were included in this study. Among the 151 children in the conventional group (median [range]: 2.2 [0.3, 13.1] years), 81 had an indirect inguinal hernia, 8 had a thyroglossal cyst, 10 had a branchial fistula, 32 had a local mass, and 20 had other disorders (lymphangioma, hydrocele of the tunica vaginalis, *etc.*). Among the 152 children in the ERAS group (median [range]: 2.3 [0.3, 14.7] years), 88 had an indirect inguinal hernia, 6 had a thyroglossal cyst, 12 had a branchial fistula, 24 had a local mass, and 22 had other disorders (lymphangioma, hydrocele of the tunica vaginalis, *etc.*). Age, gender, body mass index, anesthesia time, anesthesia method, and operation time did not differ significantly between the two groups (Table 1).

Pre-operative clinical data

The ERAS group had a significantly shorter food fasting time [11.92 (4.00, 19.33) *vs* 13.00 (6.00, 20.28) h, $P < 0.001$] and liquid fasting time [3.00 (2.00, 7.50) *vs* 12.00 (3.00, 20.28) h, $P < 0.001$] than the conventional group (Table 2). The preoperative blood glucose level was significantly higher in the ERAS group than in the conventional group [5.6 (4.2, 8.2) *vs* 5.1 (4.0, 7.4) mmol/L, $P < 0.001$; Table 2].

Postoperative clinical data

The time to postoperative feeding was significantly shorter in the ERAS group than in the conventional group [1.17 (0.33, 6.83) *vs* 6.00 (5.40, 9.20), $P < 0.001$]. Among children aged ≥ 2 years, the incidence of thirst was significantly higher in the conventional group than in the ERAS group (74.5% *vs* 15.3%, $P < 0.001$), whereas the incidence of hunger was not significantly different between the conventional group (26.3%) and ERAS group (21.5%). No children in either group experienced intraoperative or postoperative aspiration, and the incidences of perioperative vomiting and fever were also not

Table 1 Comparison of general clinical data between the two groups

	Conventional group (n = 151)	ERAS group (n = 152)	P value
Gender, n (%)			0.447
Male	93 (61.6)	100 (65.8)	
Female	58 (38.4)	52 (34.2)	
Age (yr), median (range)	2.2 (0.3,13.1)	2.3 (0.3,14.7)	0.791
Body weight (kg), median (range)	13.0 (4.5,60.0)	13.0 (5.1,57.0)	0.559
Anesthesia time (h), median (range)	0.65 (0.10,2.43)	0.68 (0.12,1.56)	0.173
Operation time (h), median (range)	0.33 (0.05,1.83)	0.37 (0.05,1.21)	0.061
Anesthesia method, n (%)			0.291
Tracheal intubation and general anesthesia	99 (65.6)	106 (69.7)	
General anesthesia with caudal block	18 (11.9)	22 (14.5)	
General anesthesia	22 (14.6)	19 (12.5)	
General anesthesia with local anesthesia	12 (7.9)	5 (3.3)	

ERAS: Enhanced recovery after surgery.

Table 2 Comparison of preoperative food and liquid fasting times, preoperative blood glucose level, postoperative complications, and degree of satisfaction between the two groups

	Conventional group (n = 151)	ERAS group (n = 152)	P value
Preoperative liquid fasting time (h), median (range)	12.00 (3.00, 20.28)	3.00 (2.00, 7.50)	< 0.001
Preoperative food fasting time (h), median (range)	13.00 (6.00, 20.28)	11.92 (4.00, 19.33)	< 0.001
Preoperative blood glucose (mmol/L), median (range)	5.1 (4.0, 7.4)	5.6 (4.2, 8.2)	< 0.001
Time to postoperative feeding (h), median (range)	6.00 (5.40, 9.20)	1.17 (0.33, 6.83)	< 0.001
Postoperative vomiting, n (%)	4 (2.6)	3 (2.0)	0.993
Postoperative fever, n (%)	7 (4.6)	6 (3.9)	0.767
Satisfaction (points)	7 (0, 10)	8 (5, 10)	< 0.001

ERAS: Enhanced recovery after surgery; SD: Standard deviation.

significantly different between groups (Table 2). Satisfaction with the fasting protocol was significantly higher for the ERAS group than for the conventional group [7 (0, 10) *vs* 8 (5, 10), P < 0.001].

DISCUSSION

In view of the current discrepancy between preoperative fasting guidelines and clinical practice, we carried out this study and hoped to enrich the research data on early postoperative feeding for non-gastrointestinal surgery, offer scientific and accurate medical care for children, and improve the satisfaction of the children and their families. The main finding of this pilot study is that children ≥ 3 mo of age in the ERAS group had a shorter pre-operative food fasting time, shorter pre-operative liquid fasting time, higher pre-operative blood glucose level, lower incidence of thirst, shorter time to postoperative feeding, and greater satisfaction with the fasting strategy than the conventional group. Notably, no children experienced perioperative aspiration, and the incidences of perioperative vomiting and fever were not significantly different between groups. Taken together, our findings show that the implementation of ERAS-based fasting protocols can safely shorten perioperative fasting times and improve the comfort of children undergoing non-gastrointestinal surgery.

Conventional opinions suggest that the laryngeal reflex is suppressed under anesthesia and that this increases the risk of aspiration. Therefore, it was generally recommended that patients abstain from food and liquids from midnight to ensure complete gastric emptying and safe anesthesia. However, gastric emptying occurs within 90 min[7], and consumption of a small amount of clear fluid 2 h before surgery has little effect on gastric volume or pH[8], suggesting that prolonged fasting for food and liquids before surgery is unnecessary. In the present study, the mean pre-operative liquid fasting time was 12.15 h in the conventional group but only 3.17 h in the ERAS group. Despite the large difference in pre-operative liquid fasting time, the incidence of intraoperative and postoperative vomiting was not significantly different between the two groups, and no children experienced aspiration. Our findings agree with previously published data that shortening the duration of pre-operative fasting is safe and does not lead to an increase in the incidence of aspiration or vomiting in children[10,30,31] or adults[9,11].

Since fasting from midnight increases insulin resistance and is uncomfortable for the patients[6], shortening the pre-operative fasting time has several potential benefits. The intake of carbohydrate-containing liquids could help patients to maintain energy levels before they are exposed to surgical trauma, potentially improving clinical outcomes. This study found that the blood glucose level before surgery was significantly higher in the ERAS group than in the conventional group, suggesting that shortening the pre-operative fasting time could help maintain the blood glucose levels near the upper limit of the normal range. Interestingly, the pre-operative consumption of a carbohydrate drink has been reported to decrease not only postoperative insulin resistance[32] but also postoperative nausea[33].

In adult patients, the consumption of normal food on the day of surgery was found to quicken the resumption of bowel function, decrease hospital stay, and reduce the incidence of postoperative complications[21-24]. Furthermore, a study in children reported that early postoperative oral intake of fluid was associated with reductions in postoperative vomiting incidence and opioid use[34]. In the present study, postoperative feeding for patients in the ERAS group was initiated at 1 h after surgery, following a safety evaluation based on the Steward recovery score and water swallow test. In the ERAS group, the water swallow test score was 1-2 in 148 of the 152 patients, with only two children scoring 4 due to the appearance of an irritating cough. Thus, the vast majority of children were able to begin eating semi-liquid food at 1 h after surgery, and the diet was then gradually switched to a normal diet. Notably, the incidence of vomiting did not differ between the two groups, indicating that shortening the duration of postoperative fasting does not increase the risk of nausea and vomiting.

Prolonged fasting is uncomfortable for the patient[6] and can lead to discomfort and anxiety in children because of thirst and hunger. The present study found that shortening the duration of perioperative fasting reduced patient discomfort since the ERAS group reported a lower incidence of thirst than the conventional group (among patients aged ≥ 2 years). Furthermore, satisfaction with the fasting protocol was greater for the ERAS group than for the conventional group. Other published studies have also reported benefits of a shorter duration of perioperative fasting on patient comfort[25-27].

The conventional group had a pre-operative food fasting time of 13.25 ± 2.73 h and a pre-operative liquid fasting time of 12.15 ± 3.02 h, consistent with previous investigations[14-17]. A notable observation in the present study was that although the ERAS group had a shorter pre-operative food fasting time (11.67 ± 3.41 h) and pre-operative liquid fasting time (3.17 ± 0.93 h) than the conventional group, the fasting durations were still longer than the those aimed for by the new strategy. Similar data have been reported by several previous studies describing the implementation of new protocols to shorten perioperative fasting times[18,19,35]. Our multidisciplinary approach to implementation of the new fasting protocols involved an extensive literature review in establishing an evidence-based strategy, training of all relevant staff members, close cooperation between several departments, and a clear explanation of the new protocol and its potential benefits to patients and their parents. A key aspect of this strategy was to estimate the start time of each operation as accurately as possible, as this allowed individualization of the pre-operative fasting protocol for each patient. Although the order of the surgical list did not change in this study, the duration of the individual operations inevitably varied from the estimated values, particularly for surgery that was performed at a different department. Furthermore, the cancellation of operation also had a knock-on effect on the other scheduled operations. These factors inevitably introduced a degree of error that hampered the achievement of optimal fasting times, despite the coordinated efforts of staff members to make appropriate adjustments. Another factor that may have affected pre-operative fasting times is that some children scheduled for morning surgery did not feed at around 6 h before surgery, as advised, because they were asleep.

This study has some limitations. Although this was a prospective study, we used a method of grouping based on the date of admission rather than randomization in order to avoid interaction between different groups of children in the same ward. Therefore, the findings may be prone to selection bias. Furthermore, the generalizability of the results is not known because the study was conducted at a single hospital, and the sample size was relatively small. Many of the children underwent laparoscopic surgery with CO_2 insufflation, but the association of abdominal distension with nausea and vomiting was not assessed as a possible confounding factor. In addition, outcomes such as duration of hospital stay and postoperative complications were not evaluated. Large-scale, multicenter studies are needed to verify our findings.

Although the amount of data collected in this study was small, there are actually many original studies on clear beverages 2 h before surgery and early postoperative eating, and they all support that clear beverages 2 h before surgery are safe and beneficial, and that early eating is safe as long as the patients have recovered from anesthesia and swallowing function evaluation is done[1,36-41]. This study is characterized by the pre-operative personalized fasting and drinking protocol and postoperative innovative use of the water swallow test to assess the swallowing function, which can better solve the problem of uncertain clinical surgery time. In addition, the water swallow test does not increase the workload of the nurses.

CONCLUSION

Through multi-disciplinary collaboration and information transformation, it is possible to optimize the fasting and clear fluid drinking process before non-gastrointestinal surgery in children ≥ 3 mo of age. Individualized fasting programs are worthy of clinical promotion. For children with non-gastrointestinal surgery, it is also safe and feasible to start early eating after evaluating the recovery from anesthesia and the swallowing function. The water swallow test can be used for postoperative swallowing function evaluation, which is simple, practical, and operable, and has good clinical promotion value.

ARTICLE HIGHLIGHTS

Research background

Shortening the pre-operative fasting time and early introduction of postoperative oral nutrition are two important foci of ERAS. However, there exists a discrepancy between preoperative fasting guidelines and clinical practice. And postoperative oral nutrition lacks guidelines. In the current study, we shortened the pre- and post-operative fasting time, and improved the children' comfort.

Research motivation

The topic of our study was to set out perioperative fasting schedule which is suitable for clinical situations. We tried to estimate the start time of each operation as accurately as possible and provide a safe and feasible criterion to start early eating. The procedures and findings could facilitate the optimization of perioperative fasting strategies in other surgical departments, especially in China.

Research objectives

Our main objectives were to set out perioperative fasting schedule which is suitable for clinical situations. Through multi-disciplinary collaboration and information transformation, we optimized the fasting and clear fluid drinking process before non-gastrointestinal surgery in children ≥ 3 mo of age and applied the water swallow test to evaluate the postoperative swallowing function after recovery from anesthesia. We enriched the research data on perioperative fasting schedule.

Research methods

The ERAS group adopted an individualized pre-operative fasting protocol, and the estimated start time of the operation for each patient was calculated on the day before surgery according to the order of the surgical list (which was decided by the surgical team). Meanwhile, according to the information system, the progress of the surgical list was continuously monitored by the chief nurse or another staff member, so that the fasting times could be adjusted timely.

Research results

Our individualized fasting protocols help the ERAS group realize a shorter preoperative food fasting time, shorter time to postoperative feeding, and greater satisfaction. No children experienced perioperative aspiration. Although the order of the surgical list did not change in this study, the duration of the individual operations inevitably varied from the estimated values, particularly for surgery that was performed at a different department. Thus, we hope to establish a warning system to predict risk factors which may result in the suspension of surgery in the whole hospital.

Research conclusions

We innovatively proposed the water swallow test to evaluate the postoperative swallowing function after recovery from anesthesia.

Research perspectives

We hope to further increase the preoperative intake of clear fluid drinking and set out the most optimal cutoff in the future.

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FOOTNOTES

Author contributions: Ying Y and Xu HZ were responsible for the manuscript conceptualization, methodology, resources, software, and supervision; Ying Y and Han ML took charge of data curation, investigation, and project administration; Ying Y was responsible for funding acquisition and manuscript writing, reviewing, and editing; Han ML was responsible for formal analysis, validation, and visualization.

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