Preoperative Anxiety and Volume and Acidity of Gastric Fluid in Paediatric Patients undergoing Ambulatory Surgery

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Abstract

Aims: To examine the relationship between preoperative anxiety, age, gastric fluid volume (GFVw) and pH among paediatric outpatients undergoing ambulatory surgery.

Methods: An observational study was conducted on patients aged 1-12 years. Preoperative anxiety was evaluated by modified Yale Preoperative Anxiety Scale on admission (mYPAS-ad) and on entry to operating rooms (mYPAS-or). Gastric content was aspirated under general anaesthesia.

Results: Complete data was collected from 119 patients. Mean mYPAS-ad was 36.36, mean mYPAS-or was higher, 48.35. Mean GFVw (ml/kg) was 0.404, pH was 1.55. Patients with higher mYPAS-or had significantly larger GFVw. mYPAS-ad and GFVw were not related. Older children had significantly larger GFVw and lower pH.

Conclusions: Paediatric patients with higher mYPAS-or had larger GFVw in this study.

Keywords: Anxiety, Gastric Fluid, pH, Paediatric, Outpatient, Ambulatory Surgery

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Introduction

Aspiration pneumonia is a serious complication of general anaesthesia. To reduce this risk, guidelines on two-hour clear fluid fasting were established and later updated by the American Society of Anesthesiology in 2017 (1). These guidelines are used as standard in Japan. There are several reports on preoperative anxiety and gastric contents in adult patients (2,3) and in paediatric inpatient settings (4). Relationships between preoperative anxiety and volume and pH of gastric fluid in paediatric outpatients undergoing surgery, however, have not been widely examined. Ambulatory surgery is especially beneficial for paediatric patients in reduction of distress and anxiety because they can be in a familiar environment until just before surgery. We studied the relationship between preoperative anxiety and gastric fluid volume and studied anxiety and pH in paediatric outpatients undergoing general anaesthesia by supraglottic airway device. We hypothesized that any distress from longer waiting time in hospital may affect patient anxiety, gastric fluid and pH.

Methods

This was a prospective, monocentric, observational study conducted in a private hospital (No. 2017-15). As there is no intervention in our study protocol differing from our daily practice, the Takatsuki General Hospital Ethics Committee concluded that there was no need to obtain written consent. Oral informed consent was obtained from patient's parents.

We enrolled paediatric patients aged between one and twelve years, with ASA physical status 1 or 2, scheduled for ambulatory minor surgeries using supraglottic airway device between August 2017 and September 2018. We excluded patients with past history of any kind of surgery within six months, multiple surgeries, gastrointestinal surgery or mental disorder.

Preoperative instruction

All patients could eat until the night before administration. Clear fluid oral intake was without limit between waking time and 07:30 for morning cases, or 11:00 for afternoon cases. Formula milk or breast milk was allowed to be taken until 03:30/ 05:30 for morning cases, or 07:00/ 09:00 for afternoon cases, respectively. In our institution the first morning ambulatory surgery starts at 09:30, the first in the afternoon begins at 13:00.

Anxiety evaluation

Child anxiety was measured by attending anesthesiologists at two time points, using the Modified Yale Preoperative Anxiety Scale (mYPAS) which was developed in 1995 (5) and modified in 1997 (6). Immediately after patient's arrival in hospital around 08:30, an attending anesthesiologist interviewed and assessed their condition in a holding area, and anxiety was measured (mYPAS-ad). After vital signs were taken by a nurse, patients were escorted to a general ward and waited there for surgery with their parents. Upon entry to the operating rooms (OR), anxiety was measured again (mYPAS-or). During patient check-in by OR nurses, the patient's favorite DVDs were played in the OR holding area. The same anesthesiologist took each mYPAS score. Premedication is not usually administered for ambulatory patients in our institution.

Anaesthesia method

After inhalational induction of anaesthesia, a peripheral intravenous cannula was inserted. Airway was secured by laryngeal mask airway (LMA) ProSeal (Teleflex Medical, NC. USA), according to patient's age and weight. A multi-orificed gastric sump tube (Argyle, St. Louis, MO) was inserted without lubricant; 8 Fr for LMA ProSeal sizes 1.5 and 2 and 10 Fr or 12 Fr for LMA ProSeal sizes 2.5 and 3. With the patient in supine position, the gastric tube position was confirmed by stomach auscultation. Gastric content was gently aspirated by syringe in a right lateral decubitus position and in a supine position while gently massaging the hypogastric area. In each position, the gastric tube was moved back and forth several times. Collected gastric fluid was measured by syringe and acidity was measured by colorimetric paper (7) (No. 1-1254-03, AS ONE, Osaka, Japan) by five people independently. Patient gastric pH was defined as mean of the five values.

Primary outcome is any relationship between patient anxiety and gastric fluid volume divided by body weight (GFVw) and gastric pH. Secondary outcome is any relationship between waiting time in hospital and GFVw and gastric pH.

Statistical analysis

Background factors are summarized in Table 1 (near here). Outcomes were GFVw (Table 2)and pH (Table 3), influential factors were age, mYPAS-ad, mYPAS-or and waiting time. Multiple linear regression analysis with backward stepwise algorithm was used to calculate a predictive model. A probability of < 0.05 was considered to be significant. Spearmen rank correlation was performed between waiting time and change in anxiety level. All statistical calculations were made using EZR version 1.36 software package [8] (Jichi Medical University, Saitama, Japan).

Table 1 Patient characteristics and results. Data are presented as mean (standard deviation, S.D.) [range].

Patients No.	119 (Male 71/ Female 48)
Age (yr)	4.54 (2.92) [1.0-12.75]
Height (cm)	100.7 (19.9) [70.4-155]
Weight (kg)	16.7 (7.0) [8.5-44]
mYPAS-ad	36.36 (15.43) [23.33-100.0]
mYPAS-or	48.35 (20.03) [23.33-100.0]
GFVw (ml/kg)	0.404 (0.337) [0.0158-1.816]
pH	1.55 (0.48) [0.70-3.60]

mYPAS-ad: modified Yale Preoperative Anxiety Score on admission.
mYPAS-or: modified Yale Preoperative Anxiety Score on entry to operating rooms.
GFVw: gastric fluid volume divided by body weight.
mYPAS consists of five elements (activity, vocalization, emotional expressivity, state of arousal and use of parents), ranges between 23.33 and 100, with higher score indicating higher anxiety.

Results

During this period, 131 patients underwent ambulatory surgery. Complete data were collected from 119 patients, and 12 patients were excluded because of technical errors in fluid collection, lack of mYPAS evaluation because the patients were asleep during interview on admission and/or on entry to OR, or due to parental decision. None of the patients took any kind of medication. Patient characteristics and results are shown in Table 1. mYPAS-ad and mYPAS-or were 36.36 (15.43) and 48.35 (20.03) [mean (SD)], respectively. GFVw (ml/kg) was 0.404 (0.337) and pH was 1.55 (0.48) [mean (SD)]. Multiple linear regression analysis revealed that older age and higher score of mYPAS-or were independent risk factors for greater GFVw (coefficient 4.14, 95% confidence interval (C.I.) 2.07-6.22, $p< 0.001$, coefficient 3.96, 95% C.I. 0.94-6.98, $p=0.011$), respectively (Table 2).

There was no correlation between mYPAS-ad and GFVw, and no correlation between waiting time and GFVw. Multiple linear regression analysis showed that older age was an independent risk factor for lower gastric pH value (coefficient -3.96, 95% C.I. -6.89-1.03, $p=0.008$) (Table 3). Gastric acidity was not affected by mYPAS-ad, mYPAS-or or waiting time. According to two multiple linear regression analyses, older children showed significantly greater volume of gastric fluid and lower value of pH. From Spearman's correlation analysis, there was no correlation between waiting time and difference obtained by subtracting mYPAS-or from mYPAS-ad (coefficient -0.139, $p=0.131$) (Fig.1)

Statistically, older children showed lower anxiety level on entry to OR. Patients with high mYPAS-or value had larger GFVw, but high mYPAS-ad value did not mean larger GFVw. This means higher anxiety level on entry to OR, is related to higher gastric fluid volume, not anxiety level on admission. Acidity of gastric fluid was not related to anxiety level on admission or entry to OR. Waiting time did not increase GFVw, did not decrease pH, and did not elevate mYPAS-or.

Table 2 Multiple linear regression analysis for GFVw (independent variables were age, mYPAS-ad, mYPAS-or and waiting time).

	Multivariate analysis		**Stepwise (BIC)**	
	coefficient [95%C.I.]	p-value	coefficient [95%C.I.]	p-value
Age $\times 10^{-2}$ (yr)	4.27 [2.18, 6.37]	< 0.001	4.14 [2.07, 6.22]	< 0.001
mYPAS-ad$\times 10^{-3}$	-0.32 [-4.65, 4.01]	0.884	----------	----------
mYPAS-or$\times 10^{-3}$	3.87 [0.39, 7.36]	0.030	3.96 [0.94, 6.98]	0.011
Waiting time$\times 10^{-3}$ (min)	-0.62 [-1.72, 0.47]	0.263	----------	----------

Older patients had significantly greater GFVw ($p< 0.001$). Patients with higher score of mYPAS-or had significantly greater GFVw ($p=0.011$). However, there were no associations between mYPAS-ad, waiting time and GFVw.

Table 3 Multiple linear regression analysis for pH (independent variables were age, mYPAS-ad, mYPAS-or and waiting time).

	Multivariate analysis		**Stepwise (BIC)**	
	coefficient [95%C.I.]	p-value	coefficient [95%C.I.]	p-value
Age $\times 10^{-2}$ (yr)	-3.82 [-6.94, -0.69]	0.017	-3.96 [-6.89, 1.03]	0.008
mYPAS-ad$\times 10^{-3}$	0.77 [-5.66, 7.21]	0.812	----------	----------
mYPAS-or$\times 10^{-3}$	0.30[-4.88, 5.47]	0.910	----------	----------
Waiting time$\times 10^{-3}$ (min)	-0.07 [-1.71, 1.57]	0.933	----------	----------

Older patients had significantly lower pH of gastric fluid ($p=0.008$).

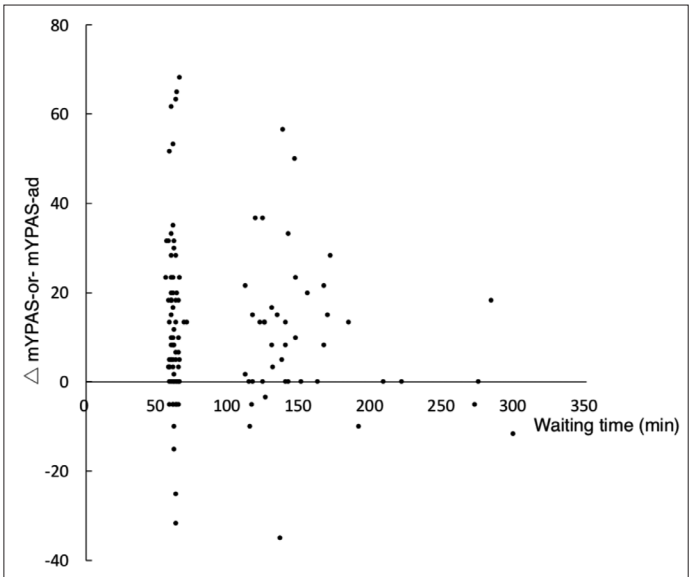

Figure 1 Spearman rank correlation between waiting time in hospital and difference obtained by subtracting mYPAS-or from mYPAS-ad. Waiting time in hospital did not increase patient anxiety (coefficient -0.139, p=0.131).

Older paediatric patients showed significantly higher GFVw and lower pH, and significantly lower anxiety level on entry to OR.

Discussion

Patient anxiety on admission was not associated with changes to GFVw or pH in this study. Contrarily, higher anxiety level on entry to OR was associated with greater GFVw. Distress after arrival in hospital may contribute to increase in GFVw. We hypothesized that distress from longer waiting time in hospital may affect patient anxiety, GFVw and pH, but in this study the hypothesis was incorrect. Factors other than waiting time must therefore be involved in increase in anxiety. At our institution, ambulatory surgeries are scheduled in order of patient age, meaning older patients have to wait longer for surgery in hospital. After receiving age-appropriate preoperative preparation by anesthesiologist upon arrival at hospital, older patients may have less anxiety (9,10). Short waiting time in hospital is not necessarily stressful, and may actually be useful for psychological preparation in school-age children.

Kawana et al (4) reported that a high-anxiety group of inpatients aged between three and six years undergoing surgery showed significantly lower gastric volume than lower anxiety inpatients, but there was no difference in pH. For this reason, they assumed that the cephalic phase of gastric secretion was being suppressed in the high-anxiety group and the increased sympathetic tone disturbed gastric secretion. Regarding gastric volume, our result was completely opposite to their result. There are two major differences between our studies. First, our study is of outpatients, whereas the patients in the previous study patients stayed overnight in hospital before the day of surgery, which might be a source of stress. In their study, the mean GFVw in the low anxiety group was 0.47 (0.26), which is similar to in our study. A second difference between the studies is that our patients were allowed to take clear liquid between waking time and up to two hours before the surgery, whereas oral intake was prohibited after sleep in the previous study, which could also cause hunger, thirst and discomfort. Unnecessary fluid restriction should be avoided since there was no difference in GFVw between the two studies as long as patient anxiety is low.

In this study, we found that two patients presented a full stomach (defined as fluid volume over 1.5 ml/kg) (11). One patient with GFVw 1.51 ml/kg and pH 0.90 was a 12 year-old girl (149.5 cm in height, 37.1 kg in weight), who took 200 ml of isotonic water three hours before induction of anaesthesia, and mYPAS-ad/ mYPAS-or were 36.67/ 31.67 respectively. The other patient, with GFVw 1.81 ml/kg and pH 2.10, was a 5 year-old girl (116.0 cm in height, 20.1 kg in weight), who took 50 ml of isotonic water two hours before induction of anaesthesia and mYPAS-ad / mYPAS-or were 50.00/ 73.33 respectively. There seems to be no common factor for the relatively large residual volume of gastric fluid in these two patients. Recently, it has been recommended to shorten the liquid fasting time to one hour (12) and several clinical studies support this up-to-date clear fluid policy (13,14). Thomas and colleagues (2018) suggest 3 ml/kg as an appropriate volume of clear fluid (15). Despite following conventional ASA clear fluid fasting guidelines and recent consensus statements, two of our patients (1.7%) showed residual gastric fluid, but the percentage is low compared to the 6.2% of patients with a full stomach in a previous report (11). For minor ambulatory surgeries, paediatric patients are usually induced by inhalational anaesthesia and supraglottic device is chosen to secure the airway. If the stomach is inflated by manual mask ventilation, it is safer to aspirate gastric fluid and air because the patient may vomit from distension of the stomach.

There are some limitations to our study, the first is the method of gastric fluid suction. Blind aspiration through multi-orificed catheter in three consecutive patient positions (supine, left lateral and right lateral position) could allow to aspiration up to 96-97% of GFV (16,17). However, we positioned patients in two positions, right lateral decubitus and then supine position. According to ultrasound assessment, most of the gastric content moves from the fundus and body toward the antrum in right decubitus position (18). Underestimation of fluid volume could be minimized by slow and gentle suction if there was sufficient time. Secondly, we used 8 Fr gastric catheter for patients weighing between 8.5 kg and 18.8 kg, 10 Fr for patients weighing between 9.9 kg and 34 kg, and 12 Fr for patients weighing 36 and 37 kg. GFV was low and dead space of a tube was fixed for an 8.5 kg-patient and an 18.8 kg-patient. GFV was corrected by body weight, so dead space may also cause underestimation of collected gastric fluid.

Higher mYPAS-or was associated with greater GFVw. Waiting time in hospital did not affect anxiety level. Other factors could not be clarified from the results of this research, but reduction of patient anxiety should always be considered separate from aspiration risk.

Conclusions

In paediatric outpatients undergoing ambulatory surgery, patients with higher score of mYPAS-or had greater volume of gastric fluid. pH was not affected by either mYPAS-ad or mYPAS-or. Waiting time in hospital did not influence patient anxiety and had no effect on gastric fluid volume or acidity.

Disclosure

The Takatsuki General Hospital Ethics Committee approved the protocol for this study (No. 2017-15). The study was entirely funded by departmental resources. The authors declare that there are no conflicts of interest.

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