

Preoperative Anxiety and Postoperative Nausea and Vomiting in Children: Is There an Association?

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We performed a cross-sectional study to explore a potential association between preoperative anxiety and postoperative nausea and vomiting (PONV). The study enrolled 51 unpremedicated children 5–16 yr old undergoing outpatient surgery and standardized general anesthesia. Anxiety of children was assessed in the preoperative holding area and during the induction of anesthesia. The incidence of nausea and vomiting was documented in the postanesthesia care unit (PACU) and 24 h postoperatively (POD#1). In addition to univariate analysis, we used multivariate logistic regression models, wherein the dependent variable was the presence or absence of PONV and the independent variables included potential confounders such as age, sex, and perioperative opioid consumption. Univariate analysis showed that children who experienced nausea (32 ± 5 vs 31 ± 4 , $P = ns$) or vomiting (32 ± 4 vs 32 ± 5 ,

$P = ns$) in the PACU did not differ significantly in their anxiety before surgery. A multivariate model, in which the dependent variable was the presence or absence of vomiting at POD#1 and the independent variables included preoperative anxiety, age, sex, and opioid consumption, indicated that preoperative anxiety does *not* predict the occurrence of nausea and vomiting ($P = ns$). We conclude that children's anxiety in the preoperative holding area has *no* predictive value for the occurrence of PONV in the PACU or POD#1. **Implications:** This study was performed to explore a possible association between children's anxiety before surgery and postoperative nausea and vomiting. We found that controlling for confounding variables, anxiety in the preoperative holding area has *no predictive value* for the occurrence of postoperative nausea and vomiting.

(Anesth Analg 2000;90:571–5)

Postoperative nausea and vomiting (PONV) is a common problem in patients undergoing general anesthesia and surgery (1–4). Despite dramatic changes in anesthesia practice, the incidence of PONV has remained constant for the past 30 yr (5). PONV not only delays patient discharge from ambulatory surgical centers, it is also the leading cause for unanticipated hospital admissions (6). Thus, it is important to identify patients who are at increased risk of developing PONV to modify anesthetic management in the hope that we can decrease the incidence of this side effect.

Several risk factors have been previously identified as contributing to an increased risk of developing

PONV (7,8). These risk factors include age, sex, obesity, surgical procedure, and history of motion sickness and PONV (7,8). One study, however, demonstrated that the overall impact of these factors did not serve as a good predictor for identifying patients at high risk of developing PONV, and that the positive predictive value of the previously mentioned variables is only 61.7% (9). Thus, it appears there must be additional important risk factors to be identified.

Several review articles appearing in the American and British literature indicate that increased anxiety before undergoing anesthesia and surgery is a risk factor for the development of PONV (1,3,4,10–13). However, there are, at present, *no* scientific data correlating preoperative anxiety with PONV in children or adults. Furthermore, several scientific reports indicate *no* association between preoperative anxiety in children and adults and the amount of gastric residual volume (14–16). That is, the gastric residual volume of children who are anxious preoperatively is *not* higher when compared with the gastric residual volume of children who are calm preoperatively. Thus, one might *not* expect a higher incidence of PONV in highly anxious children, because their gastric residual volume is not reported to be significantly higher.

Supported in part by the National Institute for Child Health Disease (NICHD) (R01HD3007-01) and the Patrick and Catherine Weldon Donaghue Medical Research Foundation.

Presented in part at the annual meeting of the Society for Pediatric Anesthesia, February 18, 1999, Las Vegas, NV.

Accepted for publication November 9, 1999.

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Considering the lack of scientific evidence to support or disprove the relationship between PONV and anxiety, we decided to examine whether there is an association between preoperative anxiety level and the incidence of PONV in children undergoing anesthesia and surgery.

Methods

This cross-sectional cohort study was conducted at Yale-New Haven Children's Hospital. The study population consisted of 51 children, 5–16 yr old, nonobese, ASA physical status I and II, who were scheduled to undergo general anesthesia for elective lower abdominal surgery. To avoid potential confounding variables, any history of chronic illness, developmental delay, prematurity, motion sickness, or previous PONV excluded subjects from participation in this study. All anesthetic inductions were performed by a group of four attending anesthesiologists. The protocol was approved by our institutional review board, and the parents of all subjects provided informed, written consent.

The State-Trait Anxiety Inventory for Children (STAI) (17) is a self-reported anxiety instrument used with children >5 yr old and is considered the gold standard for anxiety evaluation. It contains two separate 20-item subscales that measure *trait* (baseline) and *state* (situational) anxiety. The STAI-*state* scale is designed to measure transitory anxiety *states*, i.e., subjective feelings of apprehension, tension, and worry varying in intensity and fluctuating over time. The STAI-*trait* scale measures relatively stable individual differences in anxiety proneness, that is, the tendency to experience anxiety *states*.

The visual analog scale (VAS) (18) is widely used as a self-report measure of nausea and pain. The VAS rating system consists of a 100-mm line that pictorially represents two extremes at either end of the continuum. To measure nausea, the scale ranged from *not nauseated* (score of 0) to *extremely nauseated* (score of 100). To measure pain, the scale ranged from *no pain* (score of 0) to *extreme pain* (score of 100). All subjects were instructed how to use the VAS scale on recruitment to the study and on arrival to the postanesthesia care unit (PACU).

The Modified Yale Preoperative Anxiety Scale (mYPAS) (19,20), an observational measure of anxiety, consists of 27 items in five categories of behavior indicating anxiety in young children (activity, emotional expressivity, state of arousal, vocalization and use of parents). The mYPAS total score ranges from 0 to 100 with higher scores indicating greater anxiety.

Baseline demographic data, including age, sex, and history of surgery and hospitalization, were obtained from all parents. *State* and *trait* anxiety were assessed

in all subjects by using self-report behavioral instruments (STAI for Children). The instruments were administered by a trained psychologist in the holding area on the day of surgery. No preoperative sedative medication *or* parental presence during the induction of anesthesia were offered to children who participated in this study. Parental presence was used, however, as rescue therapy on separation to the operating rooms. That is, when a child exhibited *extreme* anxiety and distress on separation (as determined solely by the attending anesthesiologist managing the case), parental presence was used as a rescue therapy.

Anesthesia was induced in all subjects by using a scented mask with O₂/N₂O in a ratio of 3/7 L flow. Sevoflurane was started with a concentration of 1%, then, increased every three breaths to a maximum of 6%. Once the subject became unconscious, an IV cannula was inserted and 0.1 mg/kg of vecuronium, as well as 2–4 μg/kg of fentanyl, were administered to facilitate tracheal intubation. Oral gastric suctioning was done after securing the airway; the oral gastric tube was left in place throughout the procedure and removed at the time of skin closure. Intraoperative anesthesia was maintained with O₂/N₂O in a ratio of 1:2 and isoflurane titrated to effect. At the conclusion of surgery, the surgeons locally infiltrated the wound with 0.25% bupivacaine. No caudal anesthesia was performed on any of the subjects. All patients received 50 μg/kg of neostigmine and 10 μg/kg of glycopyrrolate to reverse the residual effect of muscle relaxant. Subjects were extubated in the operating room after they met the standard extubation criteria and were transported to the PACU. All parents were present throughout the entire PACU period.

In the PACU, subjects were monitored every 15 min for levels of pain or episodes of retching/vomiting or nausea. Severity of nausea and pain was assessed by self-reported VAS, and the incidence of retching/vomiting was recorded by the PACU nursing staff who were blinded to the subject's preanesthetic behavioral testing results. Protocols for postoperative management of nausea/vomiting and pain were developed at the onset of the study. It was decided *a priori* that when vomiting occurred, *or* the nausea VAS score was greater than 15, subjects would be treated with IV ondansetron (0.1 mg/kg up to 4 mg). Similarly, when the pain VAS score was greater than 15, an IV dose of 0.3–0.5 μg/kg fentanyl was given.

Twenty-four hours after surgery, parents were contacted by telephone and asked whether their child had any episodes of nausea or retching/vomiting after discharge from the hospital, including the car ride home. Parents were specifically instructed to directly question their children whether such episodes occurred and *not* to rely on spontaneous complaints from their children. Parental response was structured as a yes/no answer for each of the questions. This

differed from the methodology used in the PACU. Parents were also asked whether these episodes were associated with pain or consumption of pain medications. The phone interview lasted no more than 5 min.

All data were analyzed with SPSS version 6.1.1 (SPSS Inc., Chicago, IL). We compared children who experienced nausea and vomiting with those who did not. Student's *t*-test was used for analysis of continuous variables and a χ^2 test was used for the analysis of categorical variables (statistical significance, $P \leq 0.05$). Person Correlation Coefficient (*r*) was calculated to estimate the association between severity of nausea and anxiety. To control for potential confounding variables, the association between PONV and anxiety was examined by using multivariate logistic regression models. This was done only when the univariate analysis was significant. The potential confounding variables selected were based on previously published literature (1,4,21). Thus, the dependent variable in the multivariate models was the presence or absence of PONV and independent variables were *state* anxiety of the child (continuous), age of the child (continuous), the administration of opioids to the child (categorical), and sex (categorical). Because a significant association has also been found between ondansetron administration in the PACU and the frequency of vomiting on 24 h postoperatively (POD#1), we considered including this variable in the logistic regression model as well. We opted not to do so, however, because a very high correlation was found between ondansetron administration and fentanyl administration.

Results

We recruited 51 children for this study ($n = 51$); 41 (80%) were boys and 10 (20%) were girls. All girls were prepubescent. Surgical procedures included herniorrhaphy (80%), hydrocelectomy (14%), and orchiopexy (6%). The baseline characteristics are summarized in Table 1. Rescue therapy in the form of parental presence during the induction of anesthesia was used for 15 children (29%). Observed anxiety during the induction of anesthesia was not different between children who were accompanied by a parent and children who were not accompanied by a parent (mYPAS, 42.5 ± 25 vs 42.2 ± 27 , $P = \text{NS}$).

Thirty-three children (65%) reported nausea and 21 children (41%) developed vomiting in the PACU. No differences were found in characteristics such as age, sex, weight, *trait* anxiety, *state* anxiety, and pain scores between children who vomited and those who did not (Table 2). Similarly, there were no differences in *state* anxiety (32 ± 5 vs 31 ± 4 , $P = \text{ns}$) or *trait* anxiety (37 ± 6 vs 36 ± 8 , $P = \text{ns}$) scores between the children who were nauseated in the PACU and those who were not. In addition, there was little correlation between *state*

Table 1. Baseline and Demographic Data

Characteristics	$n = 51$
Age (yr)	
Range	5-16
Mean \pm SD	8.4 ± 2.9
Weight (kg)	
Range	15-76
Mean \pm SD	32.1 ± 13.9
Sex	
Boys (%)	80
Girls (%)	20
Surgical procedure	
Herniorrhaphy (%)	80
Hydrocelectomy (%)	14
Orchiopexy (%)	6

($r = 0.02$) and *trait* ($r = 0.06$) anxiety and the severity of nausea as assessed by a VAS. Further, the incidence of vomiting in the PACU was not different between children who required parental presence during the induction of anesthesia and children who did not require parental presence (35% vs 42%, $P = \text{ns}$). Finally, children who were highly anxious during the induction of anesthesia (upper 25% mYPAS) were not more nauseated (61% vs 51%, $P = \text{ns}$) and did not vomit more frequently (46% vs 53%, $P = \text{ns}$) as compared with children who were calm during the induction of anesthesia (lower 25% mYPAS).

Thirty-eight children (74%) received IV fentanyl in the PACU. Eighty percent of the children who vomited and 71% of the children who did not received fentanyl in the PACU ($P = \text{ns}$). When analyzed as continuous data, children who vomited in the PACU received a similar amount of fentanyl throughout the PACU and perioperative periods as compared with children who did not vomit (Table 2). Also, children who developed nausea were *not* given more fentanyl throughout the perioperative period (3.5 ± 1.3 vs 3.4 ± 1.0 $\mu\text{g}/\text{kg}$, $P = 0.74$) and throughout the PACU period (0.86 ± 0.8 vs 0.54 ± 0.7 $\mu\text{g}/\text{kg}$, $P = 0.2$) as compared with children who did not develop nausea. When analyzed as categorical data, the incidence of nausea (63% vs 38%, $P = 0.12$) and vomiting (45% vs 31%, $P = 0.37$) was higher among children who received fentanyl in the PACU, although this did not reach statistical significance.

Finally, the incidence of reported nausea (80% vs 51%, $P = 0.09$) and vomiting (60% vs 36%, $P = 0.17$) was higher among girls than boys, although this was not statistically significant. Severity of nausea, as assessed by VAS, was not significantly different between girls and boys (53 ± 46 vs 52 ± 41 , $P = \text{ns}$). Similarly, *state* anxiety (33 ± 6 vs 32 ± 5 , $P = 0.6$) and *trait* anxiety (39 ± 7 vs 35 ± 7 , $P = 0.2$) were not different in girls as compared with boys.

On POD#1, 21 children (41%) developed nausea and 17 children (33%) developed vomiting in the first 24 h

Table 2. Characteristics of Subjects as a Function of Postoperative Vomiting in the Postanesthesia Care Unit

Characteristic	Vomit (n = 21)	No vomit (n = 30)
Age (yr)	7.7 ± 3.0	8.8 ± 2.8
Weight (kg)	28.7 ± 14.1	34.5 ± 13.4
Sex		
Boys (%)	37	63
Girls (%)	60	40
Pain score ^{a,b}	13 ± 5	13 ± 5
STAIC-S ^{a,c}	32 ± 4	32 ± 5
STAIC-T ^{a,d}	37 ± 7	36 ± 7
mYPAS induction ^{e,f}	32 (22-100)	29 (22-100)
Perioperative fentanyl (μg/kg) ^g	3.3 ± 0.9	3.6 ± 1.4
PACU fentanyl (μg/kg) ^g	0.62 ± 0.5	0.79 ± 0.9

Data are mean ± SD, n, or median (range).

Pain Score = visual analog scale, scores range from 0 to 100, STAIC-S = State Trait Anxiety Inventory for Children, *State* score, STAIC-T = State Trait Anxiety Inventory for Children, *Trait* score, Modified Yale Preoperative Anxiety Scale, Perioperative fentanyl = intraoperative fentanyl + postanesthesia care unit (PACU) fentanyl.

after surgery. The incidence of nausea (50% vs 39%, $P = 0.52$) and vomiting (34% vs 30%, $P = 0.85$) was similar between girls and boys. Thirty-six children (71%) received ondansetron in the PACU before they were discharged. Of the children who received ondansetron, 25% vomited on POD#1 as compared with 50% of the children who did not receive ondansetron and who vomited on POD#1 ($P = 0.051$).

Univariate analysis demonstrated that *state* anxiety (32 ± 5 vs 32 ± 5 , $P = \text{ns}$) and *trait* anxiety (34 ± 5 vs 37 ± 7 , $P = 0.12$) of the children who developed nausea were not different as compared with children who did not. In contrast, children who vomited on POD#1 were less anxious in the preoperative holding area on the day of surgery (30 ± 3 vs 33 ± 5 , $P = 0.02$), and had lower *trait* anxiety scores (33 ± 5 vs 38 ± 7 , $P = 0.04$) as compared with children who did not vomit. When other characteristics were compared between the two groups, it was found that the group who vomited was also older (9.5 ± 3.2 vs 7.8 ± 2.6 yr, $P = 0.04$). In contrast, pain scores (3.9 ± 2.4 vs 3.8 ± 2.2 , $P = \text{ns}$), weight (35 ± 13 vs 31 ± 14 , $P = \text{ns}$), and anxiety during the induction of anesthesia (29 [22-100] vs 32 [22-100], $P = \text{ns}$) did not differ between the two groups.

A multivariate backward conditional logistic regression model was constructed, in which the dependent variable was the presence or absence of vomiting on POD#1, and the independent variables included *state* anxiety of the child, age, and sex of the child, and the administration of opioids to the child in the PACU. The overall model was *not* significant ($P = 0.29$), and *none* of the independent variables remained in the equation of the model. Thus, controlling for age, sex, and opioids administration, *state* anxiety was *not* a predictor for vomiting on POD#1. A similar model, in

which the dependent variable was the presence or absence of vomiting on POD#1 and the independent variables included *trait* anxiety of the child, age and sex of the child, and the administration of opioids in the PACU, revealed that the overall model is *not* significant ($P = 0.33$) and that controlling for other variables, *trait* anxiety is not a predictor for vomiting on POD#1.

Discussion

This study suggests that children's anxiety in the preoperative holding area has *no* predictive value for the occurrence of PONV in the PACU and on POD#1. These findings are in contrast to previous literature suggesting that increased anxiety during the *preoperative* period is associated with increased incidence of PONV (1-4). We must again emphasize, however, that the existing literature consists mostly of review articles and is not data driven. The only data to date that support the suggested association between preoperative anxiety and increased incidence of PONV come from a survey conducted by Quinn et al. (22) who questioned patients about their experience during the first 24 hours after anesthesia and surgery. Among the 21 questions asked, four were relevant to the issue of PONV. The investigators concluded that preoperative anxiety was associated with an increased incidence of nausea, not vomiting (22). This study, however, had multiple methodological flaws, including the absence of a valid tool to measure anxiety and no standardization of the anesthetic technique or the surgical procedure. Interestingly, Eger (23) suggested that excessive air swallowing in the anxious patient could increase vomiting. In our study, children who exhibited extreme anxiety during the induction of anesthesia (which presumably will result in excessive air swallowing) did not manifest increased incidence of PONV.

We found the incidence of PONV higher when compared with previous reports (1-2), which can be attributed to several factors. First, we queried all children every 15 minutes about nausea and vomiting symptoms. This is in contrast to other studies that did not directly ask subjects at regular time intervals about symptoms and relied on spontaneous information. A previous study by Selby et al. (24) indicates the need to carefully assess symptoms of PONV in young children, rather than to rely merely on spontaneous information. That study reported a 35% incidence of postoperative vomiting, which is similar to the rate of vomiting we reported (41%). Also, caudal anesthesia was not part of our study protocol, and thus, pain was managed solely with IV opioids. This may have resulted in higher opioid use and less-than-optimal pain control, leading to an increased incidence of PONV.

The etiology of PONV is complex and has many contributory factors. Thus, to establish an association between preoperative anxiety and PONV, it is essential to try to isolate preoperative anxiety from other etiologic factors. We controlled for both the surgical procedure and anesthetic management throughout the perioperative period. We did not, however, control for the issue of opioid administration. That is, because opioid administration is associated with an increased incidence of PONV, ideally opioids should not have been part of the anesthetic protocol for this study. To correct for this issue, we used a multivariate logistic regression model to control for the potential confounding effects of age, sex, and opioid administration. Other potential confounding variables include the child's age and sex. Because we did not limit our study population in regard to age or sex, these variables may have affected our results; thus, we included them in our logistic regression model.

In conclusion, we found that preoperative anxiety has no predictive value for PONV in the PACU and on POD#1. These findings are in contrast to previously published medical literature.

The authors would like to thank Paul G. Barash, MD for his critical review of this manuscript.

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