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Pediatrics 2006;118;651

DOI: 10.1542/peds.2005-2920

ARTICLE

Preoperative Anxiety, Postoperative Pain, and Behavioral Recovery in Young Children Undergoing Surgery

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The authors have indicated they have no financial relationships relevant to this article to disclose.

ABSTRACT

OBJECTIVE. Findings from published studies suggest that the postoperative recovery process is more painful, slower, and more complicated in adult patients who had high levels of preoperative anxiety. To date, no similar investigation has ever been conducted in young children.

METHODS. We recruited 241 children aged 5 to 12 years scheduled to undergo elective outpatient tonsillectomy and adenoidectomy. Before surgery, we assessed child and parental situational anxiety and temperament. After surgery, all subjects were admitted to a research unit in which postoperative pain and analgesic consumption were assessed every 3 hours. After 24 hours in the hospital, children were discharged and followed up at home for the next 14 days. Pain management at home was standardized.

RESULTS. Parental assessment of pain in their child showed that anxious children experienced significantly more pain both during the hospital stay and over the first 3 days at home. During home recovery, anxious children also consumed, on average, significantly more codeine and acetaminophen compared with the children who were not anxious. Anxious children also had a higher incidence of emergence delirium compared with the children who were not anxious (9.7% vs 1.5%) and had a higher incidence of postoperative anxiety and sleep problems.

CONCLUSIONS. Preoperative anxiety in young children undergoing surgery is associated with a more painful postoperative recovery and a higher incidence of sleep and other problems.

www.pediatrics.org/cgi/doi/10.1542/peds.2005-2920

doi:10.1542/peds.2005-2920

Key Words
anxiety, surgery, child behavior, pain, psychological impact

Abbreviations
T/A—tonsillectomy and adenoidectomy
PPMP—Postoperative Pain Measure for Parents
PHBQ—Post Hospitalization Behavioral Questionnaire
STAI—State Trait Anxiety Inventory
MBSS—Miller Behavioral Style Scale
mYPAS—modified Yale Preoperative Anxiety Scale
PACU—postanesthesia care unit
POD—postoperative day

Accepted for publication Mar 20, 2006

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MORE THAN 5 million children undergo surgery in the United States every year, and it is reported that up to 50% of these children develop significant behavioral stress and anxiety before their surgery.[1] Although these behavioral manifestations cause significant hardship to children and parents, perhaps of even higher significance is the impact of these preoperative behaviors on postoperative recovery.[2] In adults, several cohort studies have been conducted to explore the relationship between preoperative anxiety and postoperative outcomes such as pain, analgesic use, and return to normal activities. Although inconsistent and marked by many methodologic problems, collected findings from published studies suggest that the postoperative recovery process is more painful, slower, and more complicated in patients with high levels of preoperative anxiety.[3–8] To date, no similar investigation has been conducted in young children undergoing anesthesia and surgery.

Thus, we designed a large-scale study to test the hypothesis that increased preoperative anxiety in children predicts a slower and more painful postoperative recovery. At the onset of this study, we noted that multiple methodologic issues have hindered much of the previous research that examined the effects of preoperative anxiety on postoperative outcomes in adult patients. That is, patient populations were not homogenous in terms of surgical procedures, and anesthetic-management protocols were not standardized. Some previous studies used nonvalidated outcome-measurement scales and subjective, rather than objective, outcome variables or assessed the outcomes at only one time point rather than adopting repeated outcome assessments to better understand the progression of recovery. The study presented here was designed to address all the above-mentioned methodologic concerns.

METHODS

This study was conducted at Yale-New Haven Children's Hospital between July 1998 and January 2004. Consecutive outpatient children aged 5 to 12 years, American Society of Anesthesiology (ASA) physical status I-II, scheduled to undergo general anesthesia and elective outpatient tonsillectomy and adenoidectomy (T/A) were considered for enrollment. Exclusion criteria included ASA physical status higher than II, developmental delay, a history of affective disorder, psychotropic medication use, and prematurity (<36 weeks' gestation). Children who had a positive sleep study, were scheduled to be admitted after surgery, or had a BMI >25 were excluded from participation. Preoperative sedatives such as midazolam were not permitted in this study, and parental presence during induction of anesthesia was used only as a "rescue treatment" (see "Study Protocol"). In this study, we followed children and their parents from 5 days before surgery until 14 days after surgery. An institutional review board approved the study, all parents provided informed written consent, and all children 7 years or older provided written assent.

Primary Outcome Measures

The primary end point of this controlled cohort study was the child's postoperative pain as assessed by pain-assessment instruments and analgesic consumption.

Parental Report: Postoperative Pain Measure for Parents

The 15-item Postoperative Pain Measure for Parents (PPMP) behavioral measure was developed to help parents more reliably assess their child's postoperative pain.[9] We administered the PPMP 24 hours after surgery (before discharge from the hospital), on the following 2 days at home (days 2 and 3 after surgery), and at days 7 and 14 after surgery.

Child Report: Bieri Faces Scale

This is a widely used self-report measure of pain that consists of 7 drawn faces that are rank-ordered in equal intervals for their expression of pain. Test-retest reliability is very good (.82), and face validity, content validity, and construct validity are supported.[10] In this study, the Bieri faces scale was administered to each child, approximately every 4 to 6 hours, before he or she was given medication in the hospital and at home.

Analgesic Consumption

As described below in "Study Protocol," during the first 24 hours in the hospital the subjects were followed by the pediatric pain service and received acetaminophen (Tylenol) 10 mg/kg + codeine 1 mg/kg every 3 hours if they were in pain (Bieri faces scale score of ≥3). After 24 hours in the hospital, all the subjects were discharged from the hospital. For the next 3 days at home, subjects received acetaminophen 10 mg/kg + codeine 1 mg/kg every 3 hours if they were in pain. Nurses telephoned the parents daily and recorded all amounts of medications consumed. Total amounts of Tylenol and codeine received were summed separately for each child, yielding the following variables: total amount of codeine given at the hospital, total amount of codeine given at home, total amount of Tylenol given at the hospital, and total amount of Tylenol given at home.

Secondary Outcome Measures

The secondary end points of this prospective study included the child's postoperative behavioral recovery as assessed by nurses and parents.

Parent Report: Post Hospitalization Behavioral Questionnaire

The Post Hospitalization Behavioral Questionnaire (PHBQ) self-report questionnaire for parents is widely used in the psychological literature and is designed to evaluate maladaptive behavioral responses and developmental regression in children.[11] The PHBQ consists of 27 items in 6 domains of anxiety, including general anxiety, separation anxiety, sleep anxiety, eating disturbances, aggression against authority, and apathy/withdrawal. This instrument has been shown to demonstrate acceptable test-retest reliability, good agreement with interviews with parents ($r = 0.47$), and to predict changes as a function of preoperative interventions.[11] Parents completed the PHBQ at home on postoperative days (PODs) 1, 2, 3, 7, and 14. Scores can show improvements in behavioral domains or increases in maladaptive behavior.

Emergence-Status Measure

Emergence-delirium status was determined by using an observer measure that behaviorally assesses symptoms of emergence delirium and yields a score of 1, 2, or 3 (1, no symptoms; 2, mild symptoms [eg, occasional movement or crying, no need for restraint]; 3, marked symptoms [eg, thrashing and/or needs restraint and/or constant crying]).[12]

Other Measures

Parental

State-Trait Anxiety Inventory (Parent)

This is a widely used self-report anxiety-assessment instrument. To date, >1000 studies using the State-Trait Anxiety Inventory (STAI) and the STAI have been published in peer-reviewed literature.[13,14] Test-retest correlations for the STAI are high and range from .73 to .86.

Miller Behavioral Style Scale (Parent)

The Miller Behavioral Style Scale (MBSS) assesses parental coping style through 4 scenarios of stressful situations. This standardized tool was developed for patients undergoing medical procedures and has excellent reliability and validity.[15]

Child

Modified Yale Preoperative Anxiety Scale

The modified Yale Preoperative Anxiety Scale (mYPAS) structured observational measure of preoperative anxiety in children was developed and validated previously by our study group. The mYPAS consists of 27 items in 5 domains of behavior indicating anxiety in young children (activity, emotional expressivity, state of arousal, vocalization, and use of parents). Using κ statistics, the mYPAS domains have good to excellent interobserver and intraobserver reliability and were validated against other global behavioral measures of anxiety.[16,17]

EASI Instrument of Child Temperament

The EASI standardized tool assesses the various aspects of temperament in children and is used widely in the literature.[18] The instrument has good validity when compared against other measures of temperament for preschool children, and test-retest reliability of the EASI temperament tool was high when mothers were rating their preschool children on adjacent months.[19]

Study Protocol

A team of research assistants functioned as the assessors and administered the various observational tools. Assessors were blind to the study hypotheses. These members were trained to achieve interrater and intrarater reliability of >.90 on the mYPAS. Training sessions and assessment using videotapes were conducted every 3 months. Nurses on the research unit were trained with the use of the Bieri faces scale and other instruments used for the study; regular review sessions were held for nurses on the research unit as well.

Recruitment

All subjects were recruited 7 to 10 days before surgery while undergoing a preparation program visit in which the children and their parents participated in a tour of the operating room and the hospital. Parental trait anxiety (STAI), parental coping style (MBSS), and temperament of the child (EASI) were assessed.

Day of Surgery, Preoperative Holding Area

Anxiety of the child was rated by a trained observer (mYPAS). If the child exhibited extreme anxiety after separation (as defined only by the anesthesiologist managing the case), parental presence was applied as "rescue therapy." Parents completed a measure of their state anxiety (STAI).

Day of Surgery, Operating Room

Anesthesia was induced by using O_2/N_2O and sevoflurane administered via a scented mask. Maintenance of anesthesia was accomplished with isoflurane/N_2O/O_2, 0.1 mg/kg of vecuronium, and 0.1 mg/kg of morphine sulfate. Also, ondansetron 0.1 mg/kg was administrated to all patients. All subjects received a 10 mL/kg fluid bolus on insertion of the intravenous cannula followed by appropriate replacement for blood loss. Adverse effects such as laryngospasm were noted and managed appropriately. Next, the T/A was performed. It should be noted that no steroids were administered to the subjects, and no local anesthetics were injected into the tonsillar bed. All procedures were conducted by using this technique.

Day of Surgery, Postanesthesia Care Unit

Incidence of adverse effects and amount of analgesics administered were noted. Management of pain was standardized, and the child's pain was assessed. If a child scored ≥3 on the nurse-administered Bieri faces scale, they received up to 0.1 mg/kg of morphine sulfate. The amount of morphine given was converted to codeine units and then included in the sum of total amount of codeine given at the hospital. Children remained in the postanesthesia care unit (PACU) for an average of 2 hours.

First 24 Hours After Surgery

All subjects were admitted to the Yale Children's General Clinical Research Center for a period of 24 hours for observation. Self-report pain was assessed by using the Bieri faces scale every 4 hours. If a score of ≥3 was reported, the child received acetaminophen 10 mg/kg + codeine 1 mg/kg, and his or her pain was assessed again after 1 hour. At 6-hour intervals throughout the hospital stay, nurses categorized (yes versus no) whether each subject had trouble falling asleep or staying asleep and whether the child woke up crying over the past 6 hours.

Next 2 Days at Home

After 24 hours, all subjects were discharged from the hospital. For the next 2 days at home, subjects received acetaminophen 10 mg/kg + codeine 1 mg/kg every 4 to 6 hours if they scored ≥3 on the Bieri faces scale. If analgesics were administered, the child's pain was assessed again after 1 hour. Parents also completed a pain visual analog scale daily to indicate the amount of pain the child suffered. Subjects were contacted daily by Children's General Clinical Research Center nurses, who recorded parental assessments of analgesic requirements, parental visual analog scale scores, behavioral recovery as assessed by the PHBQ, and parental notation of child report of pain as assessed by the Bieri faces scale. We also inquired if the child had any problems getting to sleep and staying asleep.

Days 7 and 14 After the Operation

Parents were contacted by telephone, and behavior (PHBQ) was assessed. Pain management was continued throughout these 14 days as on the first 2 days at home.

Analytic and Statistical Approaches

After completion of the study, we divided children in this study into 2 groups on the basis of their preoperative state anxiety as measured by the mYPAS in the preoperative holding area. Using construct validity analysis, we determined that children who showed positive signs of high clinical anxiety as measured by the mYPAS in the preoperative holding area (ie, crying or whimpering, frightened and/or sad facial expressions, or vigilance or panic) were included in the high-anxiety group. Children without these signs of extremely high anxiety were included in the low-anxiety group. Indeed, the mean mYPAS score of those in the high-anxiety group was significantly higher than that of those in the low-anxiety group (60 ± 14 vs 30 ± 8; $P = .01$).

Because the primary focus of our investigation was pain after surgery, we used PPMP items that were shown to be reliably and distinctly related to pain in our population. Thus, we performed a principal-components factor analysis with varimax rotation on the PPMP items for each of the postoperative measurements (eg, PODs 1, 2, 3, 7, 14). Three factors that explained 54% to 72% of the variance emerged in all days. Individual factor scores were used in subsequent analyses and identified as activity, pain expressivity, and protective behavior. We used repeated-measures analysis of variance, independent sample t tests, χ^2 analysis, and correlation coefficients to examine and report the data. The amounts of acetaminophen and codeine received by each child were normalized by weight (kg). Data are reported as mean ± SD and were analyzed by using SPSS 13.0 (SPSS Inc, Chicago, IL). P was accepted as significant at $<.05$.

RESULTS

We enrolled a total of 241 children who were undergoing elective T/A surgery, and their parents, in this controlled cohort study. Baseline characteristics of children and parents in the high-anxiety ($n = 44$) and low-anxiety ($n = 197$) groups are shown in Table 1. Aside from levels of anxiety in the preoperative holding area, there were no significant differences in demographic or personality characteristics between these 2 groups of children. Parents of children in the high-anxiety group reported, on average, ~1 year less education than did parents of children in the low-anxiety group ($P = .002$).

Postoperative Pain

Observer Ratings

Parental assessment of child's pain (PPMP pain factor 24 hours postoperatively) also showed a significant difference between the high-anxiety and low-anxiety groups over the 24 hours in the hospital (−0.09 ± 1.0 vs 0.33 ± 0.83, respectively; $P = .026$). This observer report of slower pain recovery continued after the children were discharged from the hospital and returned home. Repeated-measures analysis of variance showed a significant between-subjects effect when the parent's overall ratings of the child's pain (PPMP) were examined over the first 3 PODs ($F_{1,156} = 3.9$; $P = .050$). Inspection of Fig 1 shows that children in the high-anxiety group showed higher pain scores and a slower decline compared with children in the low-anxiety group. There were no significant group differences at the POD-7 and -14 time points.

Self-Report Ratings

Children rated their pain before and 1 hour after receiving each dose of medication. Average pain scores did not differ before receiving medication in the hospital or at home (P = not significant); however, ratings made 1 hour after receiving medication showed that children in the high-anxiety group self-reported consistently higher levels of pain; these differences reached statistical signif-

TABLE 1 **Baseline Characteristics**

Children	Low-Anxiety Group (n = 197)	High-Anxiety Group (n = 44)	P
Age, mean ± SD, y	6.3 ± 2.3	5.9 ± 2.7	.45
Gender, % male/% female	49:51	54:46	.35
Ethnicity, % white	85	79	.27
Previous surgery, %	24	20	.33
Child attended hospital preparation program, %	67	68	.56
State anxiety, mean score ± SD			
Holding area	29.7 ± 8.5	60.1 ± 13.9	<.001
Induction	42.8 ± 21.6	67.2 ± 26.1	<.001
Temperament (EASI), mean score ± SD			
Emotionality	11.6 ± 4.4	12.2 ± 4.2	.44
Activity	15.2 ± 4.1	14.8 ± 3.7	.54
Sociability	18.3 ± 3.0	17.6 ± 2.6	.18
Impulsivity	12.4 ± 3.9	12.2 ± 3.7	.76
Parents, mean score ± SD			
Education, y	15 ± 2.6	13.7 ± 2.6	.002
Coping style (MBSS monitoring)	4.7 ± 3.3	5.4 ± 3.5	.29
Personal stress questionnaire	22.5 ± 7.4	24.1 ± 6.9	.24
Trait anxiety (STAI)	40.1 ± 6.7	39.3 ± 6.0	.49
State anxiety (STAI)	43.6 ± 11	44.8 ± 11	.54

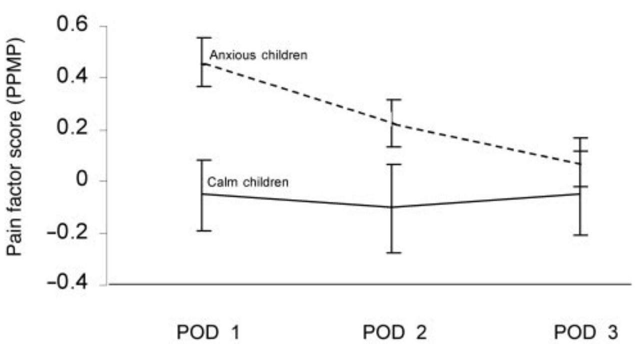

FIGURE 1
Parental assessment of the children's postoperative pain.

icance at several time points both in the hospital and at home (see Fig 2).

Analgesic Consumption
We found that analgesic consumption while in the hospital and as administered by nursing staff did not differ by group (for the low-anxiety and high-anxiety groups, respectively; codeine: 5.2 ± 2.9 vs 4.5 ± 1.9 mg/kg, P = .35; acetaminophen: 40.2 ± 21.5 vs 38.9 ± 19.1 mg/kg, P = .78). However, during their home recovery (that is, the first 14 days), children in the high-anxiety group consumed, on average, significantly more codeine (1.75 ± 2.4 vs 3.2 ± 3.3 mg/kg; P = .027) and acetaminophen (25.6 ± 30.5 vs 42.5 ± 37.6 mg/kg; P = .023) compared with children in the low-anxiety group.

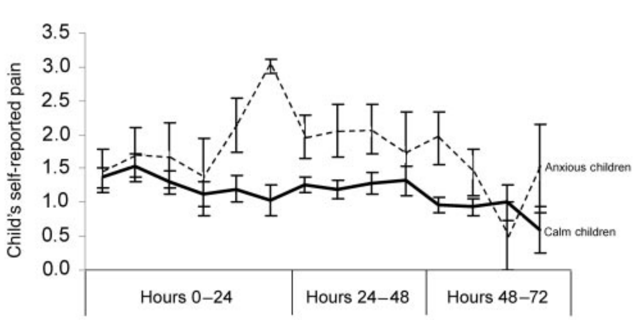

FIGURE 2
Children's self-reported postoperative pain.

Immediate and Delayed Behavioral Recovery

Emergence Delirium
We found that the emergence status of children in the PACU differed on the basis of their anxiety in the preoperative holding area. That is, a significantly higher proportion of children in the high-anxiety group was assessed as agitated, crying, and/or thrashing in the PACU as compared with patients in the low-anxiety group (9.7% vs 1.5%; χ^2 = 6.2; P = .048).

Separation and General Anxiety
Children in the high-anxiety group scored significantly higher on the separation-anxiety subscale of the PHBQ over the first 3 PODs as compared with children in the low-anxiety group ($F_{1,160}$ = 5.121; P = .025). Children in the high-anxiety group also scored significantly higher on the generalized-anxiety subscale (PHBQ) on the first 2 PODs as compared with children in the low-anxiety group (P = .043); however, this difference in generalized anxiety did not continue over time ($F_{2,160}$ = 1.4; P = .27).

Eating Difficulties/Improvement
We found that children who were more anxious also showed a different pattern of recovery in eating habits as

measured by these items on the PHBQ. Although we found that the incidences of increased postoperative difficulty in eating were no different between the 2 groups (*P* = not significant), there were significant differences in the incidences of improved postoperative eating between the groups. That is, on PODs 1 and 2, significantly more children in the low-anxiety group exhibited improved eating behavior compared with children from the high-anxiety group (POD 1: 10% vs 1%, $P = .02$; POD 2: 6% vs 0%, $P = .02$) (Fig 3).

Postoperative Sleep

During the hospital stay, children in the high-anxiety group had more problems falling asleep, staying asleep, and waking up crying as compared with children in the low-anxiety group 24 hours after admission to the research unit (see Fig 4). At home, children in the high-anxiety group had increased trouble getting to sleep and staying asleep on POD 3 (4% vs 12%; $P = .04$). No other differences were found between the high-anxiety and low-anxiety groups on other postoperative behavioral domains (as measured by the PHBQ).

DISCUSSION

In the first study of its kind, we found that increased anxiety before surgery in children is associated with increased postoperative pain, analgesic consumption, general anxiety, and sleeping problems and decreased postoperative eating improvement. It should be noted, however, that most of these outcomes did not extend beyond the first 3 days after surgery.

The findings of this carefully conducted pediatric controlled cohort study should be considered within the larger conceptual framework of preoperative and postoperative anxiety in adult patients. Five decades ago, Janis[20] proposed that moderate levels of preoperative anxiety in adult patients are associated with good postoperative behavioral recovery, whereas low and high levels of preoperative anxiety are associated with poor behavioral recovery. Although Janis' theory is intriguing, his studies were based on descriptive data from nonrandom, limited samples and retrospective reports of questionable validity. Subsequent studies have been critical of Janis' methodology and have reported a linear rather than a curvilinear relationship.[3–7] That is, low levels of preoperative anxiety are associated with good postoperative behavioral recovery, whereas moderate and high levels of preoperative anxiety are associated with poor postoperative behavioral recovery.

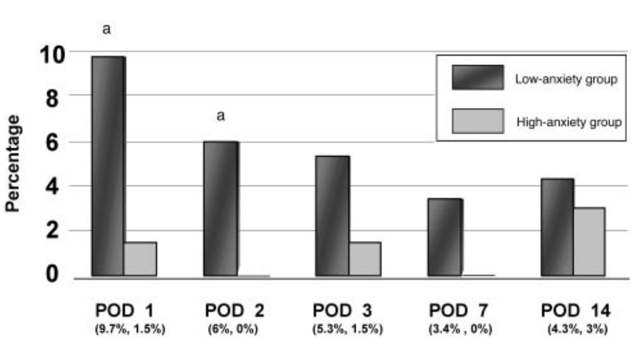

FIGURE 3
Amount of postoperative eating improvement in the children. [a] Statistically significant differences.

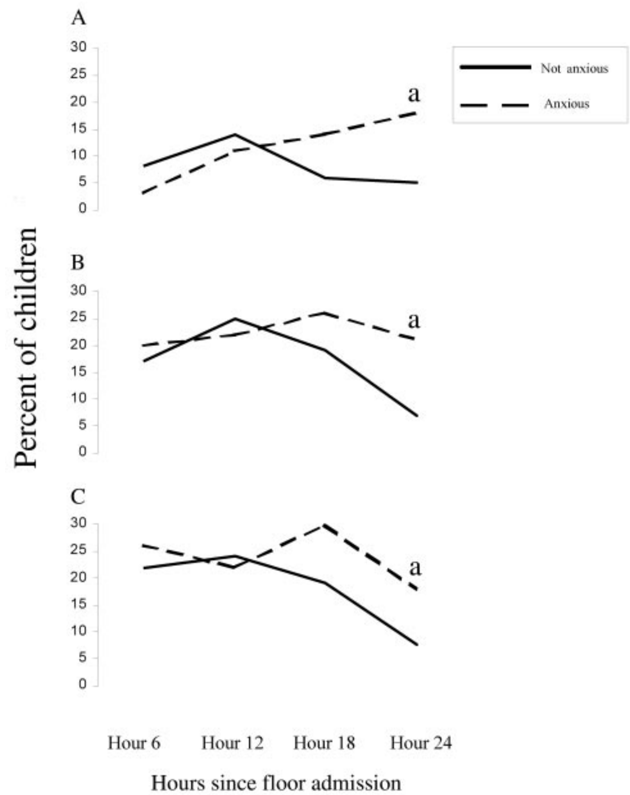

FIGURE 4
Nurse assessment of the children's postoperative sleep difficulties. A, The child had trouble falling asleep; B, the child had trouble staying asleep; C, the child woke up crying. [a] Statistically significant differences.

In adults, the assumption that low preoperative anxiety is predictive of good postoperative outcomes underlies many interventions in which the aim is to reduce preoperative anxiety. To date, preoperative-preparation studies in adult patients have used diverse postoperative outcome measures including pain, analgesic requirements, length of hospital stay, patient satisfaction, cortisol levels, blood pressure, heart rate, and behavioral indices of recovery.[3,7,8,21–23] Many reviews of this research have appeared, which, although critical of the methodology of a large number of studies, have concluded that psychologically prepared adult patients have improved postoperative recovery.[3,4,24–27]

On the basis of the results of our study, as well as the above-mentioned adult studies, it can be hypothesized that decreasing the anxiety of children preoperatively will result in improved postoperative recovery. Indeed, a recent randomized, controlled study found that children who are sedated with midazolam before surgery (and consequently with lower preoperative anxiety levels) showed a significantly lower incidence of maladaptive behavioral changes.[28] Future randomized, controlled trials are needed to establish if preoperative anxiety reduction will also result in improved pain recovery. Indeed, at the current time, our laboratory is executing such a study funded by the National Institutes of Health.

One should note that in the 1980s, >70% of all pediatric hospitals in the United States offered some type of psychological or pharmacologic (sedative drugs) intervention to reduce the anxiety of children undergoing surgery.[29] Unfortunately, with the changes in the medical-economic environment, multiple hospitals have terminated these preoperative interventions.[30,31] A possible reason may be that, although there is a consensus in the literature about the effectiveness of these preoperative interventions in reducing preoperative anxiety,[32] there is a paucity of outcome studies that evaluate the effects of these preoperative interventions on postoperative outcomes. It is our opinion that only through carefully conducted investigations that demonstrate the impact of preoperative anxiety on postoperative outcomes such as pain will this trend reverse.

Several methodologic issues related to the design of this study have to be discussed. First, this is the first pediatric study in this area that carefully controlled all possible confounding variables such as surgical procedure, surgical technique, patient population, anesthetic management, and postoperative pain management. Indeed, execution of this study proved to be quite difficult logistically and quite expensive. Second, although the largest of its kind, the study was not powered to examine pain differences across age groups. That is, we presumed a priori that the association between preoperative anxiety and postoperative pain and behavioral changes are not age dependent.

Finally, although no previous studies have addressed the association between preoperative anxiety and pain in children, 2 recent studies have looked into the association between preoperative pain expectations and postsurgical pain levels.[33,34] Clearly, pain expectations and anxiety, although not the same thing, are related to one another. This is a potentially important point, because pain expectations that are associated with that anxiety could be treated within the perioperative settings. A future study that includes measurement of both constructs over time would be particularly informative.

CONCLUSIONS

We found that increased anxiety before surgery is associated with increased postoperative pain, analgesic consumption, general anxiety, and sleeping problems and decreased postoperative eating improvement. Ongoing randomized, controlled trials will determine if this finding is an association or cause-and-effect. That is, these investigations will determine if reducing levels of preoperative anxiety will lead to decreased preoperative anxiety and lesser postoperative analgesic requirements.

ACKNOWLEDGMENTS

This work was supported by National Institutes of Child Health and Human Development (Bethesda, MD) grant R01HD37007-01.

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DOCTORS' AVERAGE PAY FELL 7% IN 8 YEARS

"A report planned for release today indicates that the average physician's net income declined 7 percent from 1995 to 2003, after adjusting for inflation, while incomes of lawyers and other professionals rose by 7 percent during the period. The researchers who prepared the report say the decline in doctors' inflation-adjusted incomes appears to be affecting the types of medicine they choose to practice and the way they practice it, resulting in fewer primary care doctors and a tendency to order more revenue-generating diagnostic tests and procedures. Primary care doctors, who are already among the lowest-paid physicians, had the steepest decline in their inflation-adjusted earnings—a 10 percent drop—according to the report by the Center for Studying Health System Change, a nonprofit research group in Washington. The average reported net income for a primary care physician in 2003 was $146,405, according to the study, after expenses like malpractice insurance but before taxes. The highest-paid doctors were surgeons who specialize in areas like orthopedics, who had an average net income of $271,652, nearly double what the primary care doctors said they earned. The report was based on a national telephone survey of roughly 6,600 physicians in 2004 and 2005 and earlier surveys by the research center."

Abelson R. *New York Times*. June 22, 2006
Noted by JFL, MD

Preoperative Anxiety, Postoperative Pain, and Behavioral Recovery in Young Children Undergoing Surgery

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Pediatrics 2006;118;651
DOI: 10.1542/peds.2005-2920