

Parental Presence during Induction of Anesthesia

Physiological Effects on Parents

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Background: The authors conducted a randomized controlled trial to determine whether parental presence during induction of anesthesia (PPIA) is associated with parental physiologic and behavioral manifestations of stress.

Methods: Children and their parents (N = 80) were randomly assigned to one of three groups: (1) PPIA; (2) PPIA plus 0.5 mg/kg oral midazolam; and (3) control (no PPIA or midazolam). The effect of the group assignment on parental heart rate (HR), parental blood pressure, and parental skin conductance level (SCL) were assessed. Both parental HR and parental SCL were monitored continually. Anxiety of the parent and child was also assessed.

Results: Parental HR increased from baseline until the induction of anesthesia ($P = 0.001$). A group-by-time effect ($P = 0.005$) was also found. That is, throughout the induction period there were several time points at which parents in the two PPIA groups had a significantly higher HR than did parents in the control group ($P < 0.05$). Similarly, SCL was found to increase in all parents from baseline until induction of anesthesia ($P = 0.001$). Significant group differences in SCL changes over time were found as well ($P = 0.009$). State anxiety and blood pressure following induction of anesthesia did not differ significantly between groups ($P = \text{nonsignificant}$). Examination of parental Holter data revealed no rhythm abnormalities and no electrocardiogram changes indicating ischemia.

Conclusions: The authors found that PPIA is associated with increased parental HR and SCL. However, no increased incidence of electrocardiogram abnormalities were found in parents present during induction of anesthesia.

PARENTAL presence during induction of anesthesia is currently one method used to treat preoperative anxiety in young children.¹ While recent randomized controlled trials do not support the routine use of this intervention,^{2–4} the overwhelming majority of parents strongly favor this practice.^{5,6} Indeed, previous studies have confirmed that close to 90% of parents questioned indicate

that they would like to be present during their child's induction of anesthesia.^{6,7}

Parental presence during induction of anesthesia has been associated with increased parental satisfaction regarding not only the separation process from the child, but extending also to increased satisfaction with the overall functioning of the hospital.⁸ Nonetheless, a majority of parents report being upset while present during the induction process.⁹ Isolated reports of disturbances in the operating room^{10,11} and parental syncopal episodes¹² have been documented in the medical literature. A recent editorial by Lerman¹³ also raised the possibility of cardiac rhythm abnormalities and myocardial ischemia among parents while they are present in operating rooms.

The purpose of this randomized controlled trial was to examine the impact of parental presence during induction of anesthesia on the physiologic and behavioral stress response of the parents. We examined parental heart rate (HR), electrocardiogram rhythm anomalies, blood pressure (BP), skin conductance levels (SCLs), and self-reported anxiety.

Materials and Methods

The population of this randomized controlled trial consisted of parents and children who were American Society of Anesthesiologists physical status I–II and who were undergoing general anesthesia and elective outpatient surgery at Yale–New Haven Children's Hospital. Parents whose children had a history of chronic illness, prematurity, or developmental delay were excluded from this study. Yale University's Institutional Review Board approved the experimental protocol, and all participants provided written informed consent for this study.

Experimental Interventions

Based on a random number table, parents were assigned to one of the following three experimental groups: (1) parental presence during induction of anesthesia (PPIA) group; (2) control group, wherein parents were separated from their child at the entrance to the operating room (OR) and were not present during induction of anesthesia; and (3) PPIA and midazolam group, wherein children were given oral midazolam (0.5 mg/kg) approximately 30 min before induction of anesthesia and parents were present during induction of anesthesia.

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Behavioral and Physiologic Instruments

Detailed psychometric data regarding the instruments below were presented in previous publications by our study group.¹⁴ All instruments were administered under the direct supervision of a trained psychologist.

- State Trait Anxiety Inventory (STAI). This self-report anxiety behavioral instrument consists of two separate 20-item subscales that measure baseline and situational anxiety.¹⁵ The STAI shows good validity and reliability and has been used to date in more than 1,000 scientific publications.
- Monitor Blunter Style Scale (MBSS). This standardized self-report instrument assesses coping style in adults through four scenarios of stressful situations.¹⁶ The instrument was developed specifically for patients undergoing medical procedures and identifies information-seeking ("monitoring") and information-avoiding ("blunting") coping styles. The instrument has good reliability data.
- Modified Yale Preoperative Anxiety Scale. This observational state anxiety measure for young children contains 27 items in five categories (Activity, Emotional Expressivity, State of Arousal, Vocalization, and Use of Parents).¹⁷ This scale has good-to-excellent reliability and validity for measuring children's anxiety in the preoperative holding area and during induction of anesthesia.
- Visual Analog Scale of Previous Medical Experience. This visual analog scale measures the extent to which parents judge their children have favorably handled previous medical experiences in the pediatrician's office or hospital settings. The rating system consists of a 100-mm line that represents two behavioral extremes at either end of a continuum, *i.e.*, "very poorly" (score of 0) and "very well" (score of 100).
- Biolog[®] (UFI, Morro Bay, CA) is an ambulatory physiologic data recorder (Holter). This data recorder continuously records electrocardiogram and SCL. SCL is a measure of skin conductance resulting from sweat gland activity, which is modulated by the level of emotional stress experienced at that moment.¹⁸ SCL recording was performed using two Ag-AgCl electrodes filled with BioGel electropotential medium and connected to the volar surface of the second and third fingers of the nondominant hand. All recorded electrocardiogram and SCL data are stored on a PCMCIA memory card. When recording is complete, the card is removed from the Biolog[®], inserted into a card reader, and connected to the host personal computer through a serial port. The Downloading and Plotting Software operating on a host personal computer (win31/9x) is used to download and plot the data, after which it can be viewed, printed, or converted into channel-specific ASCII data files.

Study Protocol

Parents and their children were recruited 2–7 days before the child's surgery while undergoing a voluntary behavioral preoperative preparation program, or the night before surgery if they did not participate in this preparation program. The program provides information to children and parents through an orientation tour of the OR and *via* interviews by a nurse and an anesthesiologist. Modeling using dolls by child-life specialists is a major part of the program.

Preoperative Holding Area

On the day of surgery upon arrival at the hospital, parents completed baseline measures of their anxiety (STAI) and coping style (MBSS). The child's anxiety was also assessed at this time (Modified Yale Preoperative Anxiety Scale). Next, systolic and diastolic BPs (Omron Healthcare Inc., Vernon Hills, IL) were measured for each parent participant. Once BP measurement was completed, parents were fitted with the Biolog[®], electrocardiogram electrodes were attached to the chest, and electrodes were attached to the first two fingers of the nondominant hand to measure SCLs. About 30 min before separation to the OR, participants in the PPIA + midazolam group received 0.5 mg/kg of oral midazolam.

Separation Process

Parents in the PPIA group and PPIA + midazolam group accompanied their child into the OR for induction of anesthesia. Parents in the control group accompanied their child to the OR doors and then returned to the waiting area. Anxiety of children in the control group was evaluated upon separation to the OR (Modified Yale Preoperative Anxiety Scale). If a child in the control group exhibited extreme anxiety upon separation (as determined solely by the attending anesthesiologist), PPIA was offered as rescue therapy. Following separation, all parents completed a second measure of their state anxiety (STAI), and their BP was measured. At this point, the Biolog[®] was then removed, and data were downloaded into a computer.

Induction Period

Anesthesia was induced *via* a scented mask using a standardized oxygen-nitrous oxide-sevoflurane technique. Anxiety of children was evaluated upon entrance to the OR and upon introduction of the anesthesia mask. As soon as anesthesia was induced, a research assistant then escorted parents in the two PPIA groups from the OR to the waiting area. These parents then completed a second measure of their anxiety (STAI), and their BP was measured. At this point, the Biolog[®] was then removed, and data were downloaded into a computer.

Postanesthesia Care Unit

After surgery was completed, incidence of adverse effects (*i.e.*, emergence delirium) and time to discharge

Table 1. Baseline Characteristics of Parents and Children

	PPIA (n = 29)	Control (n = 24)	PPIA + Midazolam (n = 27)	P
Parents				
Age, yr	37 ± 7	34 ± 4	36 ± 8	0.67
Sex, % female:male	70:30	75:25	70:30	0.92
Baseline heart rate, beats/min	85 ± 21	82 ± 11	83 ± 14	0.83
Baseline skin conductance level (μΩ)	11 ± 5	11 ± 4	10 ± 5	0.74
Baseline systolic blood pressure, mmHg	121 ± 22	124 ± 18	123 ± 19	0.8
Baseline diastolic blood pressure, mmHg	82 ± 13	81 ± 15	82 ± 29	0.95
Trait anxiety (STAI)	38 ± 8	36 ± 6	39 ± 9	0.4
State anxiety, holding area (STAI)	44 ± 13	45 ± 12	45 ± 11	0.96
Miller behavioral style scale	5 ± 5	4 ± 4	4 ± 4	0.8
Children				
Age, yr	5.5 ± 3	4.8 ± 3	4.8 ± 2	0.61
Sex, % female:male	38:62	29:71	46:54	0.49
State Anxiety, holding area (mYPAS)	35 ± 17	42 ± 20	43 ± 18	0.24
Previous medical experiences (VAS)	73 ± 33	82 ± 16	80 ± 16	0.41
Voluntary Preparation Program, % yes:no	58:42	52:48	50:50	0.86

Data are mean ± SD.

mYPAS = modified Yale preoperative anxiety scale; PPIA = parental presence during induction of anesthesia; STAI = Spielberger State-Trait Anxiety Inventory; VAS = visual analog scale measuring how well child handled previous medical visits.

for each child were recorded in the postanesthesia care unit.

Statistic and Analytic Approaches

Sample Size. The primary endpoint of this study was the change in parental HR from the preoperative holding area to induction of anesthesia. Sample size was computed *a priori* for the three groups using analysis of variance (ANOVA) estimates.[#] Data obtained in a previous investigation⁴ indicated that parental HR in the preoperative holding area is about 79 ± 8 beats/min. Given a moderate-to-large effect size of 0.4 and an α of 0.05 (two-tailed), 25 participants in each of the three groups would yield power of about 0.85, sufficient to identify group differences.

Analysis of Biolog[®] Data (Heart Rate and Skin Conductance Levels). After downloading continuous data from each participant, HR and SCL data were averaged for the following specific time increments for each participant: the first 5 min of recording in all participants were allowed for accommodation to the Biolog[®]. Baseline measurement of HR and SCL consisted of the average HR and SCL during the second 5-min interval that each participant wore the Biolog[®]. In both PPIA groups, HR and SCL data were then averaged for 1-min intervals beginning 5 min before the parent and child entered the OR. Upon entrance to the OR, HR and SCL data were averaged for each 1-min interval during the child's induction of anesthesia (a total of 2–3 min for all participants) and for an additional three 1-min intervals after anesthesia was induced and the parent left the OR. In the control group, HR and SCL data were similarly averaged

for 1-min intervals beginning 5 min before the child separated from the parent and entered the OR. HR and SCL data were then averaged in 1-min increments for the following 7–8 min while parents in the control group returned to the waiting room. This method resulted in one baseline measurement and 12 sequential 1-min increment measures of average HR and SCL for all participants.

Overall Statistics. Descriptive statistics demonstrate relations between parent variables and anxiety levels. Data are presented as mean ± SD. SCL data were transformed as a percentage of their baseline value for each participant. Differences between groups were examined using inferential statistics, including *t* tests and one-way ANOVA. Anxiety levels and HR and SCL data were compared using two-way repeated-measures ANOVA. We localized differences in HR and SCL that were identified by the repeated-measures ANOVA by performing a planned (*a priori*) contrast that compared the combination of both PPIA group means to the control group using the full sample to estimate error variance. *P* values < 0.05 were considered statistically significant.

Results

The final sample consisted of 80 parents whose children were undergoing routine, elective outpatient surgery. Parents enrolled in this study were 36 ± 7 yr old and were mostly female (71%). The three groups of participants did not differ in regard to age, distribution of gender, coping style, proportion of participants that attended the voluntary preoperative preparation program, baseline measures of BP, HR, and SCL, or anxiety (table 1). Children of these parents were also similar in regard to baseline measures of age, gender, and comfort-com-

[#] Borenstein M, Cohen J. Statistical power analysis: A computer program (ANOVA module). Mahwah, NJ, Lawrence Erlbaum Associates Inc., 1988.

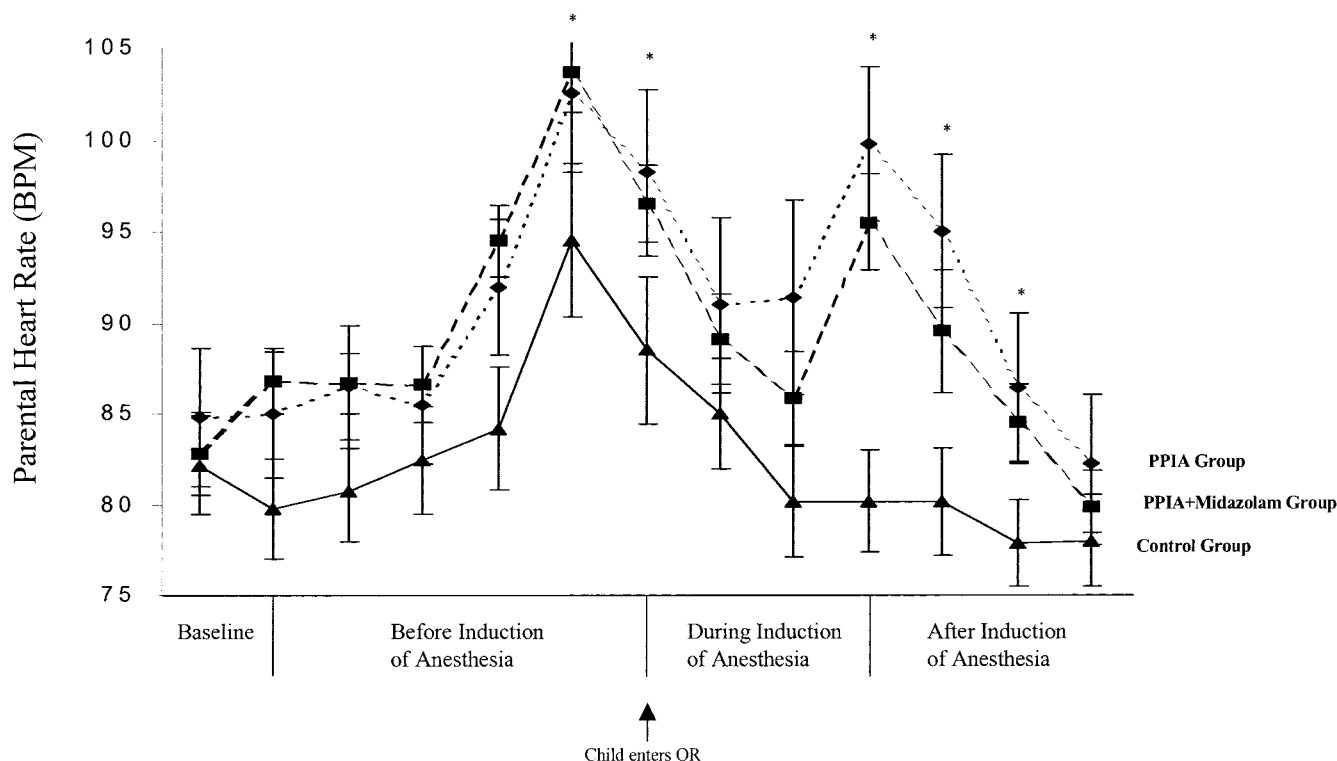


Fig. 1. Changes in parental heart rate from baseline measurement until after induction of anesthesia. Data are reported as mean \pm SE. *Time points at which differences between groups are statistically significant ($P < 0.05$). BPM = beats/min; OR = operating room; PPIA = parental presence during induction of anesthesia.

pliance during previous medical experiences (table 1). Procedures underwent included PE tubes (9%), tonsillectomy and adenoidectomy (20%), minor general surgery and urologic surgery (e.g., inguinal hernia, orchioplexy; 23%), circumcision (9%), and other minor procedures (39%). One of the children in the control group needed rescue therapy in the form of PPIA ($n = 1$).

Overall, anxiety of children increased significantly during the perioperative process based on group assignment ($F_{4,146} = 3.2$; $P = 0.015$). That is, across time, children in the PPIA + midazolam group showed significantly lower levels of anxiety as compared with children in the control group or PPIA group ($P = 0.023$).

A repeated-measure ANOVA demonstrated that HR in all parents increased from baseline until the child entered the OR for induction of anesthesia ($P = 0.001$; fig. 1). Results also showed a group-by-time effect ($P = 0.005$). A planned contrast showed that throughout the induction period there were several time points at which parents in the two PPIA groups had a significantly higher HR as compared with parents in the control group ($P < 0.05$). These points included: at 1 min before the child entered the OR, which is approximately the time that the parent and child were notified that surgery was about to begin and began walking the short distance to the OR; at the time of the child's entrance to the OR; immediately after induction of anesthesia, when parents in the PPIA groups left the OR, separating from their

child; and for the 2 min following that separation. There were no significant differences at any point between the parental HR of the PPIA + midazolam group and the parental HR of the PPIA-alone group ($P = \text{nonsignificant}$).

A similar increase in parental SCL from baseline until the child entered the OR for induction of anesthesia was found ($F_{12,35} = 5.7$; $P = 0.001$). Results also showed a group-by-time effect ($P = 0.009$). That is, SCL increased in all parents until the child entered the OR, at which point SCL remained elevated in parents who were in the two PPIA groups until induction was over. Skin conductance levels, however, decreased in parents who were in the control group (fig. 2). Planned contrasts confirmed that after the induction was over, as well as for the following 3 min, the SCL of parents in both PPIA groups remained significantly higher than the SCL of parents in the control group ($P < 0.05$). Again, as with HR, there were no differences between parental SCL in the PPIA + midazolam group and parental SCL in the PPIA-alone group ($P = \text{nonsignificant}$).

Baseline systolic and diastolic BPs did not differ by group and are reported in table 1. Results showed that systolic BP increased significantly from baseline to after induction of anesthesia ($P = 0.01$). However, there were no group differences in systolic BP after induction of anesthesia (PPIA, 123 ± 21 ; PPIA + midazolam, 128 ± 16 ; control, 126 ± 19 ; $P = 0.59$). Diastolic BP did not significantly increase from baseline ($P = 0.62$), and there

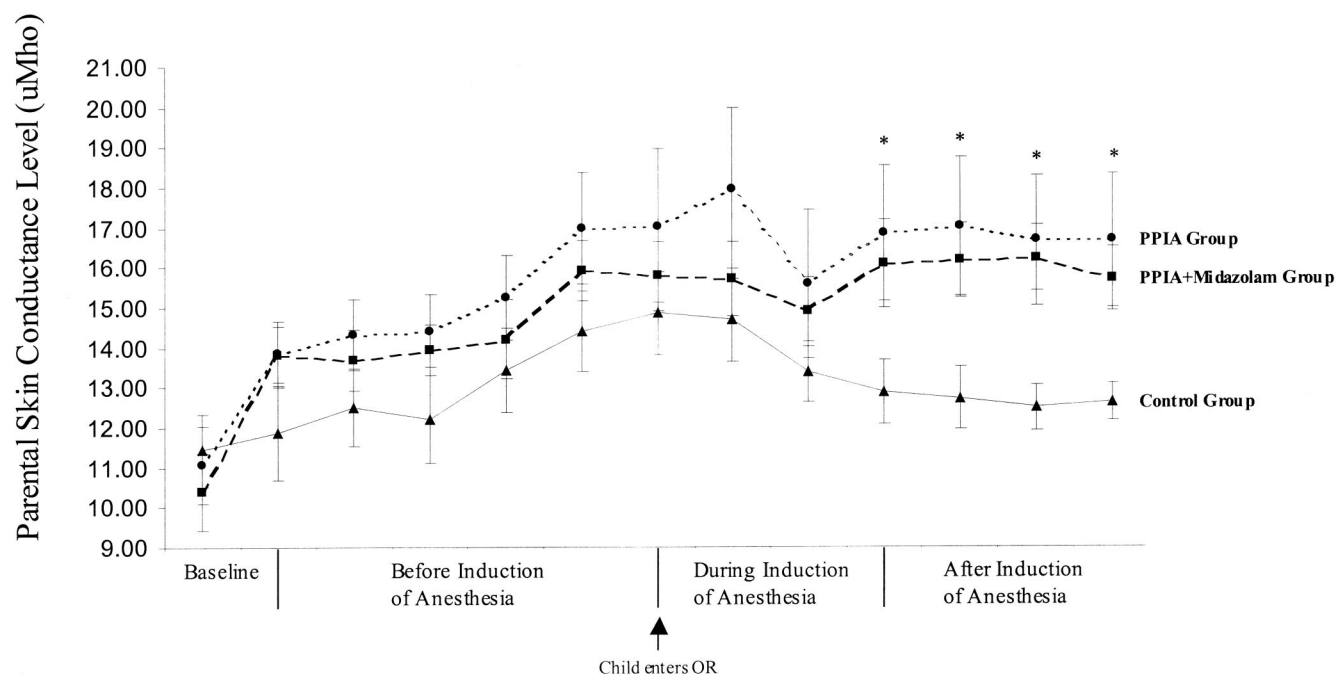


Fig. 2. Changes in parental skin conductance level from baseline measurement until after induction of anesthesia. Data are reported as mean \pm SE. *Time points at which differences between groups are statistically significant ($P < 0.05$). OR = operating room; PPIA = parental presence during induction of anesthesia.

were no group differences in diastolic BP after induction of anesthesia (PPIA, 82 ± 14 ; PPIA + midazolam, 85 ± 13 ; control, 81 ± 15 ; $P = 0.88$).

Parental HR data revealed that about 10% of parents in the PPIA group had isolated ventricular ectopy as compared with 11% of parents in the PPIA + midazolam group and 13% of parents in the control group ($P = 0.94$). All ventricular ectopy activity consisted of single beats. Single premature atrial contractions were seen in 7% of parents in the PPIA group, 7% of parents in the PPIA + midazolam group, and 13% of the control group ($P = 0.69$). There was no association between the time of atrial and ventricular ectopy events and the period of induction of anesthesia. Analysis of all parental electrocardiogram data revealed no ST segment depression.

Although parental self-reported anxiety (STAI) increased in all groups from the baseline measurement in the holding area to separation ($F_{1,74} = 26.14$; $P = 0.0001$), there were no group differences in self-reported anxiety at the time of separation ($P = \text{non-significant}$). Finally, men reported significantly lower anxiety levels as compared with women, both in the holding area (40 ± 10 vs. 47 ± 12 ; $P = 0.007$) and after separation from their child (42 ± 13 vs. 56 ± 13 ; $P = 0.001$). However, no gender differences were found in the holding area or at separation in HR or SCL ($P = \text{non-significant}$).

Interestingly, parental coping style (MBSS) was found to affect the changes observed in parental HR. High-monitoring parents (1 SD over the mean MBSS score) in both PPIA groups reported lower anxiety both in the holding area and after separation as compared with high-

monitoring parents in the control group (49 ± 13 vs. 61 ± 6 , $P = 0.021$; 54 ± 14 vs. 66 ± 5 , $P = 0.03$). When physiologic indicators of anxiety were examined, however, these high-monitoring PPIA group parents had a significantly higher HR upon their child's entrance into the OR than did high-monitoring parents in the control group (106 ± 18 vs. 89 ± 10 , $P = 0.043$). There were no difference in SCLs at baseline ($P = 0.78$) or upon the child's entrance to the OR between high-monitoring parents in the control group and high-monitoring parents in the PPIA groups ($P = 0.98$).

We also found a significant correlation between children's anxiety levels during induction of anesthesia and the HR of parents who were present during induction of anesthesia. That is, at 1 min before entrance to the OR, the correlation coefficient was 0.422 ($P < 0.05$). Upon entrance to the OR, the correlation coefficient was 0.492 ($P < 0.05$), and as the parent exited the OR after induction, the correlation coefficient was 0.38 ($P < 0.05$).

Finally, no group differences were found between the three groups in postoperative variables such as the incidence of postoperative emergence delirium ($P = 0.99$) or discharge time ($P = 0.35$).

Discussion

Under the conditions of this study, parents who were present during the induction of anesthesia of their child exhibited increased HR and SCLs. Self-reported anxiety levels of these parents following the induction process,

however, did not differ as compared with self-reported anxiety levels of parents who were not present during the induction process. Analysis of the parental electrocardiogram data did not reveal any significant rhythm abnormalities or ST changes.

A recent editorial in *ANESTHESIOLOGY* underscored the importance of evaluating both the potential benefits and the potential drawbacks and risks of parental presence during induction of anesthesia.¹³ Accordingly, the current investigation evaluated the parental behavioral and physiologic response to induction of anesthesia. Previous prospective cohort investigations indicated that many parents report increased anxiety when present during induction of anesthesia.^{7,9} In the current investigation, however, we found that the level of self-reported parental anxiety immediately after induction of anesthesia in both PPIA groups did not differ significantly from the level of self-reported anxiety of parents in the control group immediately after separation. This finding is in agreement with previous randomized controlled trials that have examined this issue.^{2,4} Interestingly, we also found that parental self-reported anxiety in the PPIA + midazolam group did not differ significantly from parental self-reported anxiety in the PPIA group. A previous investigation by our study group found that parents whose children were premedicated with oral midazolam were less anxious as compared with parents who were present during induction of anesthesia.³ Thus, in the current study, one might have expected a significant impact of premedication with oral midazolam on parental anxiety. That is, one could hypothesize that administering midazolam to children will result in lower anxiety in the child during induction of anesthesia and, in turn, lower parental anxiety levels. Clearly this did not occur in this current investigation. Also of interest is an investigation published recently by Bauchner *et al.*¹⁹ In a randomized controlled trial, the investigators followed a group of young children undergoing venipuncture. The investigators found that parents who were present during the venipuncture reported to be less anxious as compared with parents who were not present during the procedure. Clearly, this area of investigation is complex and needs to be further explored.

The increase in parental HR and SCL observed in this investigation is a reflection of the stress the parents undergo during induction of anesthesia of their child. Inspection of the parental electrocardiogram data revealed minimal significant rhythm abnormalities or ST changes. The frequency of parental cardiac rhythm abnormalities found in the current investigation is comparable to that found in cardiac Holter studies involving healthy volunteers.^{20,21} It should be noted, however, that 71% of all parents involved in the current study were women and that the children participating in this study were all healthy children undergoing outpatient procedures. Thus, the results of our study may be limited

to this particular study population. Future studies are needed to evaluate the impact of this practice on older fathers who are present during the induction of anesthesia process. It is possible that the combination of older fathers who are present during the induction of anesthesia of sicker children undergoing major inpatient procedures would result in electrocardiograph abnormalities.

Vessey *et al.*⁹ reported that the most upsetting thing for parents who are present during induction of anesthesia is separation from their child after the induction of anesthesia. This previous finding can be confirmed by inspection of the HR data presented in figure 1. Parental HR throughout the induction process peaked at two points: the first was just before induction and the second was immediately as the parents left the OR, separating from their child.

In this study, fathers self-reported lower anxiety levels than mothers both at baseline and after separation from their child. However, there were no gender differences in HR or SCL at baseline or after separation. This lack of differences in HR or SCL may be related to the small number of fathers participating in the study. Previous studies have established that women report higher pre-operative anxiety as compared with men.²² In parents, mothers of children with cancer report higher levels of state anxiety than do fathers.²³ In a study of gender differences in response to social stress, women were described as more reactive to the stressor, resulting in increased STAI scores; this study also found no gender differences in HR or SCL responses.²⁴ In addition, a study of parents who were present during induction of anesthesia also noted that mothers reported a significantly larger degree of upset than did fathers.⁹ Thus, our findings of gender differences in anxiety are consistent with previous studies.

Monitoring is a type of coping style in which people who score high in this trait (high monitors) seek out much more information about medical experiences.¹⁶ High monitors also undergo sustained high anxiety and physical arousal during medical experiences.^{16,25} They tend to express more concern about procedural details,²⁶ experience more frequent negative thoughts about medical treatment, and are less able to control such thoughts.²⁷ High monitors also perceive potentially stressful situations as more threatening than low monitors.²⁸ We hypothesized that the high-monitoring parents in the control group would be more anxious during induction of anesthesia than the high-monitoring parents in the PPIA groups. That is, since coping style suggests that more information is preferred by a high-monitoring parent, a parent with access to more information about what is happening to their child (*i.e.*, a parent in one of the PPIA groups who was present during induction of anesthesia) will likely feel more comfortable than a parent without access to such information (*i.e.*, a parent in the control group). Our data showed that at separation,

high-monitoring parents' self-reported anxiety was indeed significantly higher in the control group as compared with self-reported anxiety of parents in the PPIA groups. However, in contrast to parents' self-reported anxiety levels, physiologic measures of stress showed that at separation, high-monitoring parents in the control group had a lower HR as compared with high-monitoring parents in the PPIA groups. Therefore, high monitoring parents in the control group demonstrated an apparent incongruence between subjective and physiologic indicators of stress. Clearly, this area needs to be investigated further.

Several design issues related to this study should be noted. First, we obviously could not blind the participants (parents) and observers to treatment conditions. This may not be of significance, however, as the parental outcome measures we used included objective physiologic and self-report data rather than observational ratings, thus the risk of bias is minimal. Second, the parental follow-up period of this study was limited to the preoperative period. One might possibly critique this investigation, indicating that we should have followed parental HR, BP, SCLs, and anxiety levels throughout the surgical procedure. While we agree, we thought it more important to instead constrain the follow-up period so as to limit the potential confounding effect of other perioperative events on the outcome measures assessed.

In conclusion, under the conditions of this study, we found that parental presence during induction of anesthesia is associated with increased parental HR and parental SCLs. We did not find, however, an increased incidence of rhythm abnormalities or electrocardiogram changes in parents present during induction of anesthesia.

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