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Parental Presence during Induction of Anesthesia Improves Compliance of the Child and Reduces Emergence Delirium

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Abstract

Introduction Preoperative stress and anxiety in pediatric patients are associated with poor compliance during induction of anesthesia and a higher incidence of postoperative maladaptive behaviors. The aim of our study was to determine which preoperative preparation strategy improves compliance of the child during induction and decreases the incidence and intensity of emergence delirium (ED) in children undergoing ambulatory pediatric surgery.

Materials and Methods This prospective observational study included 638 pediatric American Society of Anesthesiologists I–II patients who underwent ambulatory pediatric surgery, grouped into four preoperative preparation groups: NADA (not premedicated), MDZ (premedicated with midazolam), PPIA (parental presence during induction of anesthesia), and PPIA + MDZ. The results were subsequently analyzed in four age subgroups: Group 1 (0–12 months), Group 2 (13–60 months), Group 3 (61–96 months), and Group 4 (> 96 months). Preoperative anxiety (modified Yale Preoperative Anxiety Scale [m-YPAS]), compliance of the child during induction (Induction Compliance Checklist [ICC]), and ED (Pediatric Anesthesia Emergence Delirium scale) were analyzed in each group.

Results Eighty-one percent of patients in the PPIA + MDZ preparation group presented a perfect compliance during the induction of anesthesia (ICC = 0), less preoperative anxiety (mean score m-YPAS = 26), less probability of ED (odds ratio: 10, 5 [3–37.5]; $p < 0.05$), and less ED intensity compared with the NADA group (1.2 vs. 5.8; $p = 0.001$).

Conclusion PPIA associated with midazolam premedication improves compliance during induction and decreases the incidence and intensity of ED.

Keywords
- emergence delirium
- preoperative anxiety
- induction of anesthesia

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Introduction

Children, especially younger ones, suffer variable degrees of stress and anxiety when entering the operating room, displaying poor collaboration and escape intentions, increasing the need for active immobilization with subsequent crying, polypnea, tachycardia, and high blood pressure responses.[1] All this can influence compliance and safety, increasing the risks during this period and favoring aspiration and the appearance of laryngospasm, bronchospasm, arrhythmias, and pulmonary arterial hypertension crises.[2] Preoperative anxiety has also been associated with a higher incidence of emergence delirium (ED),[3] consisting of an altered state of consciousness upon emergence from general anesthesia with crying, excitement, and involuntary movements. ED can have negative repercussions on patient safety since it can cause self-injury with important consequences, such as injury to the surgical site, tearing of drains or dressings, or accidental withdrawal of a venous access that can even delay hospital discharge.

The aim of the study was to determine which preoperative preparation strategy improves compliance of the child during induction of anesthesia and reduces the incidence and intensity of ED in children undergoing ambulatory pediatric surgery.

Materials and Methods

After approval by the local Ethics and Research Committee, we conducted a prospective observational study that included 638 children who were classified as American Society of Anesthesiologists physical status 1 or 2 and elective for ambulatory pediatric surgery.

Over a 2-year period, we analyzed different preoperative strategies to reduce preoperative anxiety of children implemented at four different time-points (of 6 months duration each). Whether a child was allocated to one strategy or another was exclusively based on the time of surgery. Each 6-month stage included a different strategy:

- Stage 1: children went into the operation room without any preparation (not premedicated [NADA] group).
- Stage 2: children were premedicated with 0.3 mg/kg intranasal midazolam up to a maximum of 10 mg at least 30 minutes before entering the operating room (premedicated with midazolam [MDZ] group).
- Stage 3: children were accompanied by a parent during induction of anesthesia (parental presence during induction of anesthesia [PPIA] group).
- Stage 4: children were premedicated with 0.3 mg/kg intranasal midazolam up to a maximum of 10 mg and were accompanied by a parent during induction of anesthesia (PPIA + MDZ group).

The surgical interventions and the administration of anesthesia were always performed by the same professionals (two surgeons and an anesthetist). In all patients, an inhalation anesthesia induction was performed at tidal volume, with sevoflurane, gradually from 2 vols.% to a maximum of 6 vols.%, in a 50% mixture of air and oxygen. Next, a peripheral venous line was placed in all patients, a total dose of 1 to 3 µg/kg of fentanyl was administered intravenously and additionally a regional nerve block was performed according to the type of surgery (penile, ilioinguinal, or incisional), with bupivacaine 0.5%, without exceeding 2 mg/kg.

In the groups where the presence of the parents was required for the induction of anesthesia, parents were previously briefed on their role in the operating room and after obtaining their consent; they were provided with appropriate clothing and were allowed to accompany the child to the operating room and be present during the inhalation induction of anesthesia. Once the child was anesthetized, and before proceeding with the placement of the venous line, they were guided by an assistant to leave the operating room. In all groups, and once the patient was monitored, the immediate presence of one of the parents was allowed in the recovery room.

The degree of preoperative anxiety was assessed with the m-YPAS scale[4] (the modified Yale Preoperative Anxiety Scale) upon admission to the operating room; m-YPAS scale contains 22 items in five categories: activity, emotional expressivity, state of arousal, vocalization, and use of parents. Each category consists of a list of interrelated behaviors; the most representative observed in each of the five categories is the score for that category (score ranges from 23.4 to 100). We considered preoperative anxiety of children when m-YPAS > 30. According to the child's behavior when placing the face mask, their compliance during induction was classified as poor (Induction Compliance Checklist [ICC] > 4), moderate (ICC $= 1$–4), or perfect (ICC $= 0$), as reported by the ICC scale.[4] The anesthetist assessed both scales.

The nursing staff in the recovery room recorded the incidence of ED after 15 minutes of stay in the recovery room applying the Pediatric Anesthesia Emergence Delirium (PAED) scale.[5] ED was defined for PAED scores ≥ 10. The PAED scale was also used to measure the intensity of ED, where 0 stands for no ED, and 20 is the maximum intensity of ED.

Statistical Analysis

Quantitative variables are described by the mean and standard deviation or by the median and the 25th and 75th percentiles in the case of variables that do not follow a normal distribution. Categorical variables are described as absolute values with their corresponding relative frequencies. In any statistical test, the level of significance used is $\alpha = 0.05$. The comparison of the main target variables was done by the chi-squared test and analysis of variance as appropriate.

The analysis of preoperative anxiety measured by the m-YPAS scale was compared in the different age groups by means of "*a posteriori*" contrast using the corresponding α risk correction test.

To verify the effects of preoperative preparation on the compliance of the child during induction of anesthesia and the incidence of ED, a logistic regression analysis adjusted for the corresponding confounding variables was performed.

Results

Six-hundred and thirty-eight pediatric patients undergoing ambulatory pediatric surgery were recruited; demographic variables, study groups, and type of surgeries are depicted in ►Table 1.

Table 1 Demographic variables

Group	Variables	N/N total (%)
Age	Group 1: 0–12 mo	82 (12.9)
	Group 2: 13–60 mo	342 (53.6)
	Group 3: 61–96 mo	115 (18)
	Group 4: > 96 mo	99 (15.5)
Gender	Male	474 (74.3)
	Female	164 (25.7)
Preoperative preparation	NADA	180 (28.2)
	MDZ	128 (20.1)
	PPIA	162 (25.4)
	PPIA + MDZ	168 (26.3)
Type of surgery	Phimosis, meatotomy, cystoscopy	260 (40.8)
	Inguinal, umbilical, epigastric hernia, cryptorchidism	174 (27.3)
	Soft tissue pathology (eyebrow tail cyst, pilomatrixomas, nevus, molluscum, pyogenic granuloma, papillomas, ingrown nail, polyotia, polydactyly)	142 (22.2)
	Sublingual bristles, lipstick, mucocele	62 (9.7)

Abbreviations: MDZ, premedicated with midazolam; NADA, not premedicated; PPIA, parental presence during induction of anesthesia; PPIA + MDZ, parental presence during induction of anesthesia and premedicated with midazolam.

Table 2 Mean m-YPAS score by preoperative preparation and age group

m-YPAS	NADA ($n = 180$)	MDZ ($n = 128$)	PPIA ($n = 162$)	PPIA + MDZ ($n = 168$)
0–12 mo[a] ($n = 82$)	48.8 (39–58) ($n = 29$)	51.2 (28–74) ($n = 7$)	24.1 (22–25) ($n = 35$)	31.9 (23–40) ($n = 11$)
13–60 mo[b] ($n = 342$)	55.6 (50–60) ($n = 79$)	39.1 (35–43) ($n = 91$)	30.3 (27–33) ($n = 72$)	26.3 (24–28) ($n = 100$)
61–96 mo[c] ($n = 115$)	34 (28–39) ($n = 35$)	29.9 (24–35) ($n = 22$)	30 (24–35) ($n = 26$)	24.4 (23–25) ($n = 32$)
> 96 mo ($n = 99$)	28.9 (24–33) ($n = 37$)	31.2 (22–39) ($n = 8$)	23.1 (22–23,7) ($n = 29$)	24.1(22–25) ($n = 25$)

Abbreviations: MDZ, premedicated with midazolam; NADA, not premedicated; m-YPAS, Modified Yale Preoperative Anxiety Scale; PPIA, Parental presence during induction of anesthesia; PPIA + MDZ, Parental presence during induction of anesthesia and premedicated with midazolam.
[a]Age 0–12 months. Posthoc (Scheffé test): $p < 0.05$ for PPIA vs. NADA and MDZ.
[b]Age 13–60 months. Posthoc (Scheffé test): $p < 0.05$ for PPIA vs. NADA and MDZ; $p < 0.05$ for PPIA + MDZ vs. NADA and MDZ.
[c]Age 61–96 months. Posthoc (Scheffé test): $p < 0.05$ for PPIA + MDZ vs. NADA.

Preoperative Anxiety

Overall, younger patients presented higher degrees of preoperative anxiety (►Table 2). The age groups most influenced by the presence of parents (PPIA and PPIA + MDZ) regarding the reduction in preoperative anxiety are the 0 to 12-month group and the 13 to 60-month group (►Table 2).

Compliance of the Child during Induction of Anesthesia

The PPIA + MDZ group presented higher percentages of perfect anesthetic induction: 54.5% in the 0 to 12-month group and 81% in the 13 to 60-month group, compared with the NADA group: 6.9 and 19%, respectively (►Table 3). The PPIA + MDZ group was 7.5 times more likely to have a perfect/moderate induction compared with the NADA group (odds ratio [OR] 7.54 [2.65–21.4]; $p = 0.001$) compared with the MDZ group that was 2.6 times more likely to have a perfect/moderate induction compared with the NADA group (OR 2.67 [1.33–5.35]; $p = 0.001$).

Emergence Delirium

The analysis of the incidence of ED by age groups revealed that the 0 to 12-month and the 13 to 60-month groups were those with the highest incidence of ED (►Table 4). The group with the lowest incidence of ED was the PPIA + MDZ group (1.8%), followed by the PPIA group (10.50%), the MDZ group (14.1%), and the NADA group (23.2%) ($p = 0.001$). Furthermore, using the mean score of the PAED scale—in which 0 stands for no ED and 20 for maximum intensity ED—we

Table 3 Compliance of the child during induction of anesthesia as reported by the ICC scale

Group	Age (mo)	Poor induction (ICC > 4; %)	Moderate induction (ICC = 1–4; %)	Perfect induction (ICC = 0; %)
NADA	0–12[a]	69	24.1	6.9
	13–60[b]	48.1	32.9	19
	61–96	17.1	8.6	74.3
	> 96	13.5	5.4	81.1
MDZ	0–12[a]	42.9	57.1	0%
	13–60[b]	20.9	28.6	50.5
	61–96	0	13.6	86.4
	> 96	0	12.5	87.5
PPIA	0–12[a]	20	31.4	48.6
	13–60[b]	27.8	36.1	36.1
	61–96	11.5	7.7	80.8
	> 96	6.9	3.4	89.7
PPIA + MDZ	0–12[a]	18.2	27.3	54.5
	13–60[b]	2	17	81
	61–96	3.1	9.4	87.5
	> 96	0	4	96

Abbreviations: ICC, Induction Compliance Checklist; MDZ, premedicated with midazolam; NADA, not premedicated; PPIA, parental presence during induction of anesthesia; PPIA + MDZ, parental presence during induction of anesthesia and premedicated with midazolam.
[a]$p < 0.001$ for 0–12 months group and type of preoperative preparation.
[b]$p < 0.001$ for 13–60 months group and type of preoperative preparation.

Table 4 Incidence of emergence delirium by preoperative preparation and age group as defined by the PAED scale

PAED	NADA (%)	MDZ (%)	PPIA (%)	PPIA + MDZ (%)	*p*-Value
0–12 mo ($n = 82$)	37.9	28.6	11.4	9.1	< 0.05
13–60 mo ($n = 342$)	27.8	15.4	15.3	1	0.001
61–96 mo ($n = 115$)	14.3	9.1	3.8	3.1	0.3
> 96 mo ($n = 99$)	10.8	0	3.4	0	0.2

Abbreviations: MDZ, premedicated with midazolam; NADA, not premedicated; PPIA, parental presence during induction of anesthesia; PPIA + MDZ, parental presence during induction of anesthesia and premedicated with midazolam; PAED, Pediatric Anesthesia Emergence Delirium.

observed that the group with the lowest intensity of ED was the PPIA + MDZ group (1.2), followed by the PPIA group (3.7), the MDZ group (4.6), and the NADA group (5.8; ►Fig. 1).

Once adjusted for age, preoperative anxiety, and sex, we observed that the NADA group was 10 times more likely to have postoperative agitation than the PPIA + MDZ group; the 0 to 12-month group was four times more likely to have postoperative agitation than the > 96-month group, and patients who presented preoperative anxiety (m-YPAS > 30) were 1.2 times more likely to present postoperative agitation than those who did not present preoperative anxiety (m-YPAS < 30; ►Table 5).

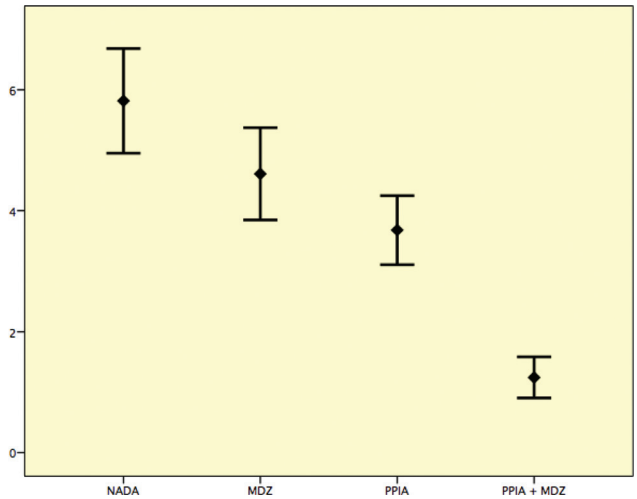

Fig. 1 95% confidence interval for the mean emergence delirium intensity measured by the Pediatric Anesthesia Emergence Delirium (PAED) scale, according to the preoperative preparation group. MDZ, premedicated with midazolam; NADA, not premedicated; PPIA, parental presence during induction of anesthesia; PPIA + MDZ, parental presence during the induction of anesthesia and premedicated with midazolam. Posthoc (Scheffé test): $p < 0.05$ for PPIA + MDZ vs. NADA, MDZ, PPIA.

Discussion

The results of our study prove that the preoperative preparation approach "parental presence during induction of anesthesia associated with midazolam premedication (PPIA + MDZ)" achieves the best degree of optimal or desirable induction conditions, with a probability of doing so up to 7.5 times higher compared with the NADA group and with a more significant benefit in children < 60-month. Our results are in line with those described in other studies.[6,7] However, in the study by Arai et al,[8] they determined that the presence of parents did not improve compliance during the induction of anesthesia, from which it is assumed that beforehand preparation of parents is necessary for it to become an effective tool. It is interesting to highlight that PPIA alone as a preoperative preparation approach is equivalent in efficacy to pharmacological premedication (MDZ) with a very similar perfect induction rate (55.6 vs. 56.2%), which means that PPIA could be an alternative to premedication in cases where sedatives cannot be administered or are not indicated due to shortage of time, in very young children or with associated pathologies that relatively contraindicate pharmacological premedication: prematurity, sleep apnea syndrome, etc. Achieving optimal compliance conditions during induction of anesthesia is the aspiration of every anesthesiologist in clinical practice, since poor compliance inductions, with agitated children and the need for immobilization, entail important risks during this critical period (hypoxemic crises, laryngospasm, bronchospasm, pulmonary hypertension crises) besides leading to greater

Table 5 Multivariate logistic regression analysis of the incidence of emergence delirium by preoperative preparation adjusted for age and preoperative anxiety

Variable	Group	OR	95% CI	*p*-Value
	NADA vs. PPIA + MDZ	10.5	(3–37.4)	< 0.05
Preoperative preparation	MDZ vs. PPIA + MDZ	6.3	(1.7–24)	< 0.05
	PPIA vs. PPIA + MDZ	5.8	(1.6–21.5)	< 0.05
Age	0–12 mo vs. > 96 mo	4	(1.3–11.4)	< 0.05
	13–60 mo vs. > 96 mo	2.5	(0.9–6.9)	
	61–96 mo vs. > 96 mo	1.5	(0.4–4.7)	
Anxiety	m-YPAS > 30 vs. m-YPAS < 30	1.2	(1.009–1.03)	< 0.05

Abbreviations: CI, confidence interval; MDZ, premedicated with midazolam; m-YPAS, the modified Yale Preoperative Anxiety Scale), m-YPAS > 30 (preoperative anxiety); NADA, not premedicated; OR, odds ratio; PPIA, parental presence during induction of anesthesia; PPIA + MDZ, parental presence during induction of anesthesia and premedicated with midazolam.

anesthetic requirements as a result of associated tachycardia and polypnea.[2]

We have found that preoperative preparation, age, and preoperative anxiety of children significantly influence the incidence of ED. The preoperative preparation based on PPIA + MDZ has a protective effect especially in the 0 to 12-month and 13 to 60-month groups. These results keep up with the study by Arai et al,[8] where the PPIA + MDZ group presented a lower degree of postoperative agitation than the MDZ group (mean score of 3 and 4, respectively). However, in the study by Sánchez et al,[6] although the PPIA group had better induction quality compared with the NADA group, they found no significant differences in postoperative maladaptive behaviors according to the State Trait Anxiety Inventory scale. Our results follow the line of the study by Aono et al,[9] where they concluded that children between 3 and 5 years of age are more prone to postoperative agitation compared with older children.

It is unquestionable that the presence of ED is an undesirable adverse effect, with diverse incidence rates according to different studies (18–25%)[10,11] and it involves risks for the patient due to self-injury, falls, and the removal of fluid therapy lines, drains, drainage tubes, monitoring devices, dressings, etc. It is often necessary for auxiliary staff to immobilize the patient and to use sedative medications (propofol, midazolam, dexmedetomidine, etc.) to control the clinical state. In our work, we have observed that the preparation based on PPIA + MDZ not only reduces the incidence of ED but also decreases its intensity, so this preoperative preparation approach could reduce the aforementioned risks.

We have established, like Kain et al,[3] that preoperative anxiety of children is a risk factor for ED, and this mainly depends on the type of preoperative preparation and age. The group with the lowest mean score (m-YPAS) was the PPIA + MDZ group and the most vulnerable age groups were those under 60 months (5 years). Yet, in the study by Rasti-Emad et al,[12] they detected no differences in children's anxiety when parents came along with them into the operating room compared with children who entered without their parents. This may be due to, as the authors acknowledge, the lack of psychological preparation of parents entering the operating room. The presence of anxious parents in the operating room does not have any beneficial effect on the child; indeed, it could even increase their anxiety.[13] Efforts should be made to provide effective information on all the steps that take place from the moment it is decided that the child is going to be operated on until the recovery period. We must make parents aware that their children's anxiety largely depends on their attitude. In addition to verbal information, there are passive modeling techniques, with informative videos showing how a child and his parents correctly face all the stages of hospitalization, and active modelling techniques, where in addition to viewing the video, parents and/or their children are asked to imitate these practices.[14]

There are other measures used in clinical practice that have proven useful in reducing preoperative anxiety: clowns, music therapy, and video games. Golan et al[15] showed a reduction in preoperative anxiety children who were accompanied by clowns in the preoperative room and in the operating room until the completion of induction, similar to what we obtained with MDZ (m-YPAS = 37.3 vs. m-YPAS = 37.7). Mariana et al[16] analyzed the effect of music therapy on preoperative anxiety in children and found a very significant reduction (m-YPAS = 28.6) higher than that obtained in the MDZ group (m-YPAS = 37.7) and the PPIA group (m-YPAS = 27.6) but lower than our PPIA + MDZ group (m-YPAS = 26). While preoperative anxiety measurements in this study were taken after 15 minutes of listening to music in the outpatient care room and not at the entrance of the operating theater as we did in our study. While it is not as effective as the PPIA + MDZ approach, music therapy has great anxiolytic efficacy and could complement other preoperative preparation measures. In the study by Patel et al,[17] they concluded that children who watched videos plus PPIA had less preoperative anxiety at the time of induction than the PPIA group and the PPIA + MDZ group (m-YPAS = 41.7 vs. m-YPAS = 51.5 vs. m-YPAS = 53.9); the higher levels of preoperative anxiety compared with our study are due to the fact that the measurement of preoperative anxiety was made at the time of anesthetic induction and not at the entrance of the operating theater.

PPIA, in addition to being an "anxiolytic" measure, could be another safety tool, as parents could be involved in the checklist or surgical checklist of the patient in the operating theater by recalling undescribed allergies, verifying the exact surgical site and somehow mitigating the errors that may occur due to latent conditions or playing a more direct role in avoiding active failures. Along these lines, although we have not analyzed any safety variable in the study, PPIA could become a safeguard to avoid potential errors during this period. Future research lines could include the impact of parental presence in the operating room regarding the safety of pediatric patients.

We consider that some methodological aspects of our study require specific comment. First, it is a prospective observational study that has a temporality bias, so the experience of the anesthetic-surgical team during the study, along with the presence of parents in the operating room, may modify the usual behavior of the anesthesiologist (e.g., being more careful) and may therefore have an impact on the variables studied. Second, although the PAED scale has proven to be very useful and reliable,[5] it has certain limitations; the main one lies in the difficulty in distinguishing between ED and postoperative pain. However, there is consensus that the use of the PAED scale is useful in improving the methodology of research in this field, once pain is controlled.[18] As previously mentioned, we have included highly homogeneous outpatient surgeries and in all pertinent procedures, peripheral nerve blocks and/or incisional blocks were performed so that patients at the time of analysis for ED had their pain under control (data not shown).

In conclusion, in our work and in the population studied, we have observed that preoperative preparation and patient age influence the compliance of anesthetic induction and the incidence of postoperative agitation. PPIA associated with MDZ is a very effective strategy in reducing preoperative anxiety, obtaining perfect compliance of anesthetic induction (ICC = 0) and achieving lower incidence rates and intensity of ED. These benefits are more significant in patients under 5 years of age.

Conflict of Interest

None declared.

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