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A Retrospective Cohort Study of Predictors and Interventions that Influence Cooperation with Mask Induction in Children

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What is already known:

- Uncooperative anesthesia inductions are associated with increased patient anxiety and potential postoperative behavioral complications.

What this article adds:

- Of the patient characteristics we studied, only patient age was associated with an increased probability of cooperation with mask induction.
- The presence of Child Life Specialists was associated with increased cooperation with mask induction while parental/guardian presence at induction was associated with a decrease in cooperation.

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Abstract

Background

Uncooperative pediatric mask induction is linked to perioperative anxiety. Although some risk factors for uncooperative inductions have been reported, there are no large cohort studies that identify intrinsic patient characteristics associated with cooperation.

Aim

The primary aim was to identify patient characteristics associated with cooperative mask inductions. The secondary aim was to determine whether preoperative interventions were associated with increased cooperation.

Methods

This retrospective cohort study included patients 2 -11 years old and ASA class I-IV who underwent mask induction. Our primary outcome of interest was cooperation with mask induction, which was correlated against the Induction Compliance Checklist. The variables analyzed for association with cooperation were age, sex, ASA class, class of surgery, preferred language, and race. Interventions examined for association with induction cooperation included premedication with midazolam, exposure to distraction technology, parental presence, and the presence of a Child Life Specialist. Multivariate mixed effects logistic regression was used to assess the relationship between patient characteristics and cooperation. A separate multivariate mixed effects logistic regression was used to examine the association between preoperative interventions and cooperation.

Results

9,692 patients underwent 23,474 procedures during the study period. 3,372 patients undergoing 5,980 procedures met inclusion criteria. The only patient characteristic associated with increased cooperation was age (OR 1.20, p-value 0.03). Involvement of Child Life Specialists was associated with increased cooperation (OR 4.44, p-value = 0.048) while parental/guardian presence was associated with decreased cooperation (OR 0.38, p-value = 0.002).

Conclusion

In this cohort, increasing age was the only patient characteristic found to be associated with increased cooperation with mask induction. Preoperative intervention by a Child Life Specialists was the sole intervention associated with improved cooperation.

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Introduction

Lack of cooperation during pediatric anesthesia induction is stressful for patients and parents. Uncooperative behavior, which can range from tearful to combative, is closely linked to perioperative anxiety.[1] Experienced by up to 75% of patients, this anxiety has been associated with a variety of negative outcomes, including increased pain and sleep that in some cases can persist for up to 6 months after the procedure.[2-4] Although some risk factors for uncooperative inductions have been identified, including attention deficit hyperactivity disorders, younger age, and shorter preoperative preparation time, the majority of pediatric previous work has focused on preoperative anxiety rather than identification of children who are at risk for uncooperative inductions.[5-10]

Preoperative anxiety may influence cooperation with anesthesia induction.[1, 10] Risk factors for preoperative anxiety are well-characterized, including younger age, previous medical visits, quality of the parent-child relationship, developmental delay, temperament, and parental anxiety.[5] Educational materials, parent-present induction, premedication, the use of Child Life Specialists, and the use of distracting technology have been developed to reduce preoperative anxiety, but their targeted use often

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relies on clinical judgement.[9, 11-13] Despite a hypothesized relationship between preoperative anxiety and induction cooperation, factors influencing cooperation remain relatively poorly understood.

We sought to better characterize factors influencing the likelihood of cooperation during pediatric mask induction. The primary aim was to report the association between patient characteristics and patient cooperation. The secondary aim was to examine associations between a variety of preoperative pharmacological and non-pharmacological interventions and patient cooperation.

Methods

Setting

All procedures occurred at a free-standing, academic children's hospital in Northern California with 311 beds. The hospital has 7 operating rooms and 12 non-operating room settings, such as ambulatory procedure rooms and interventional suites. The anesthesia and surgical providers included academic faculty, fellows, residents, nurse practitioners, and physician assistants. As a quaternary care trauma center with neonatal, pediatric, and cardiovascular intensive care units, the surgical population included a diverse group of patients, from complex neonates to ambulatory procedures on healthy children.

Prior to anesthesia, patients' caregivers received an in-person or telephone encounter, during which the patients' preoperative anxiety was informally assessed by an anesthesia advanced practice provider or physician. The potential for preoperative administration of anxiolytics was discussed with the families and recommendations included in the preoperative evaluation. On the day of procedure, final decisions for preoperative anxiolytics were confirmed through collaborative discussions between the anesthesiologists and families. The option of involving a Child Life Specialist during the perioperative period was presented to the families by the preoperative nurses and anesthesiologist on the day of the surgery. Uncooperative behavior during attainment of preoperative vital signs, lack of eye contact, clinging to a caregiver, or crying triggered by healthcare professionals were signs that reinforced need for a Child Life Specialist consultation. At our institution, two to three Child Life Specialists are present in the preoperative area during the daytime hours. If requested, Child Life Specialists provide their services over 90% of the time within 15 minutes. A Child Life Specialist may not be available if all are occupied with other patients, fewer are available due to sick leave, or at times outside of regular business hours.

Design

Using data obtained from our institution's electronic medical record (EMR), we conducted a retrospective cohort study of patients undergoing procedures between January 1, 2016 and July 1, 2017. Inclusion criteria included: age between 2-11 years, ASA class I-IV, and the use of mask induction.

Outcome

Patient information was obtained through a customized report created by the EMR, and the outcome was cooperation with mask induction. Cooperation was defined as whether the patient willingly proceeded with mask induction as determined by the attending anesthesiologist at the time of the

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procedure, which was recorded in the induction note of the anesthesia record as a binary variable (cooperative during induction? Yes or No).

Measures

Induction Compliance Scale and Anesthesiologist Assigned Cooperativity

In order to assess the ability of anesthesiologists to reliably indicate whether patients were cooperative with induction, 52 video-recorded inductions from the same study investigation period were scored by two trained research assistants with the Induction Compliance Checklist (ICC). The ICC is a validated, 10-item, observer-rated checklist of behaviors that interfere with induction of anesthesia.[14] Higher scores equate to poorer induction compliance. These ICC scores were compared to the charted assessment of the attending anesthesiologist who determined whether they thought patients were "cooperative" or "non-cooperative." Correlation between ICC and anesthesiologist-assigned cooperativity was confirmed using a Point-Biserial correlation. The correlation coefficient was 0.77 ($p < .001$).

Aims

The primary aim was to identify demographic variables associated with mask induction cooperation. The following variables were collected from the EMR and analyzed for associations: age; sex; ASA class (I-IV); class of surgery (Otolaryngology, Urology, Orthopedics, General, Ophthalmology, Neurosurgery, Plastics, Gastroenterology, Cardiovascular, and Other); self/guardian identified preferred language (English, Spanish or other); and self/guardian identified race (Caucasian, Asian, African-American, other). No guidance was provided to patients when identifying their race.

The secondary aim was to explore the association between common interventions used to reduce preoperative anxiety and cooperation with mask induction. Interventions examined for association with induction cooperation included midazolam premedication, distraction entertainment technology (smartphone, tablet, video projector, virtual reality), other sedative premedication (dexmedetomidine, ketamine), parental/guardian presence at induction, and Child Life Specialist involvement.

Analysis

In the univariate analysis, Chi-Square test (categorical data) and t-test (continuous data) were used to investigate associations between cooperation and patient characteristics (primary aim) and associations between cooperation and interventions to reduce anxiety (secondary aim).

In the multivariate analysis, for the primary aim, multiple mixed effects logistic regression analysis was performed using the backward stepwise conditional method with removal criterion of p-value equal to or greater than 0.05. The dependent variable was patient cooperation and the independent variables were patient characteristics (age, sex, ASA class, class of surgery, preferred language, and race). For the secondary aim, an unadjusted mixed effect logistic regression analysis was performed with cooperation as the dependent variable and interventions (use of midazolam premedication, distraction entertainment technology, other sedative premedication, parental/guardian presence at induction, and Child Life Specialist involvement) as the independent variable. Interventions are not mutually exclusive, and more than one intervention could be used for each patient. An adjusted mixed effects logistic regression

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analysis was also conducted that included adjusting for patient characteristics that were statistically significant from the first aim.

All statistical analysis was performed using R (v3.6.1, Vienna, Austria).

Results

Overall

9,692 patients underwent 23,474 procedures during the study period. 3,372 patients undergoing 5,980 procedures met inclusion criteria (Figure 1). Overall in this study, the mean age was 5.5 years (standard deviation [SD] 2.73 years) (Table 1). 41.9% of all patients were female (Table 1). English was the most common preferred language (80.3%) followed by Spanish (16.1%) and Other (3.6%) (Table 1). The most commonly reported races were White (39.6%), Other/Unknown (39.6%), and Asian (18.7%) (Table 1). 25.4% of patients were classified as ASA I, 38.3% were ASA II, 30.1% were ASA III, and 6.3% were classified as ASA IV (Table 1). Surgeries were classified into ten distinct categories. The most commonly performed surgery type was otolaryngology (24.7%), followed by Other (17.7%), Cardiovascular (12.7%), Urology (10.4%), Orthopedics (9.8%), General Surgery (7.5%), Ophthalmology (6.9%), Neurosurgery (3.7%), Plastic Surgery (3.6%), and Gastroenterology (3.0%).

Primary Aim: Characteristics Associated with Cooperation

All univariate patient characteristics stratified by cooperativity are presented in Table 2. Cooperative patients were older (mean age 5.65 (SD 2.7) vs 4.62 years (SD 2.7), p < 0.001). Cooperative patients also had a higher proportion of females (42.5% versus 36.5%, p = 0.012). The proportion of ASA classifications significantly differed between the two groups (p < 0.001, Table 2), as did the proportion of different surgeries types that were performed (p < 0.001, Table 2). Language and race did not differ significantly between cooperative and non-cooperative groups.

After adjusting for repeated patient procedures and adjusting for co-existing patient characteristics using the mixed effects multivariate logistic regression model, only age remained associated with cooperation (OR 1.21, p = 0.03), (Table 3).

Secondary Aim: Interventions Associated with Cooperation

Univariate analysis of interventions stratified by cooperativity demonstrated that cooperative patients had statistically significant lower use of midazolam premedication (55% vs 72%), lower parental presence during induction (21% vs 28%), and lesser involvement of Child Life Specialists (2.2% vs 4.4%) (Table 4).

Using the mixed effects logistic model, interventions were analyzed (Table 5, unadjusted model). This model was then adjusted by including significant patient characteristics from Aim 1, which included only age (Table 5, adjusted model). Midazolam premedication (OR = 0.71, p = 0.26), the use of distraction entertainment technology (OR = 0.66, p = 0.19), and other sedative premedication (OR = 0.76, p =0.71) were not associated with a significant change in induction cooperation after controlling for age. The presence of a parent or guardian (OR = 0.38, p = 0.002) was associated with reduced cooperation,

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while the use of Child Life Specialist services (OR = 4.44, p = 0.048) was associated with increased cooperation in the adjusted model.

Discussion

In this retrospective cohort analysis, the only patient characteristic associated with increased cooperation was age. Parental/guardian presence at induction was associated with decreased cooperation with mask induction and Children Life Specialist services were associated with increased cooperation.

Regarding characteristics associated with cooperation during mask induction, the reported findings align with some previous studies and contrast with others. The observed associations between age and cooperation are consistent with reports that patients of younger ages experience more preoperative anxiety and are less likely to comply with mask induction.[10, 14] The lack of association between cooperation and gender or race is also consistent with a previous study that controlled for different variables.[10] However, the lack of association between preferred language and induction cooperation is in contrast to a previous report of higher levels of preoperative anxiety in children between the ages of 1 and 6 who have Spanish-speaking parents, a difference which may be attributable to the wider age range of patients sampled in this study.[6] The lack of association between ASA status and increased cooperation is also contrasted with prior reports of critically ill children being more cooperative with mask induction.[15]

The retrospective and non-randomized design of this study makes it difficult to interpret the effects of the interventions. Since these interventions are generally offered to patients who are uncooperative, it may even be expected that the interventions would be associated with lower cooperation due to a selection bias. The significant association between parental presence and lower patient cooperation may reflect an institutional strategy to involve parents whose children are uncooperative, thus systematically biasing the results. Although unable to control for these biases, it is encouraging to note the association between Child Life Specialists and patient cooperation. Child Life Specialists are trained in methods of pediatric education and anxiolysis and are specifically consulted for patients who are at risk of being uncooperative. The positive association between Child Life Specialists and cooperation suggests that the use of child life specialists is an especially effective strategy to improve patient cooperation. Our findings are supported by a randomized controlled study that evaluated use of Child Life Specialists in 137 children undergoing imaging procedures.[16] Use of Child Life Specialists in this study increased cooperation and decreased pain and distress.[16] Similarly, a double-blind, alternate-assignment intervention study found that children undergoing elective otolaryngology surgery who worked with Child Life Specialists had lower anxiety scores compared to those who were not seen by Child Life Specialists.[17] Additional large, randomized studies with diverse types of surgery are needed to confirm the findings of the current study.

The present study has several limitations. First, as a retrospective study, it is impossible to determine causality from the associations as discussed in the previous paragraph. Second, we did not

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account for patients having multiple procedures, and studies have demonstrated that previous anesthetic experiences in pediatric patients may affect subsequent cooperation.[10, 18] Additional patient information such as procedure type and patient medical history beyond ASA class may have identified additional associations or confounders. Third, as a single-center study, the generalizability of the findings is limited. Fourth, there was no formal decision algorithm for anxiolytic interventions. Instead, the type of anxiolytic offered to patients were decided based on patient and anesthesiologist preferences after collaborative discourse. The lack of a formal offering structure may have biased the results. Fifth, patients who undergo mask inductions may have fundamentally different characteristics than those who elect intravenous inductions. Future research may explore these potential differences, which would provide additional characteristics to control for when examining cooperation with induction. Sixth, the lack of association between cooperation and race may have been influenced by the 40% of patients in the cohort who did not identify their race. Finally, cooperation was self-reported using an unvalidated measure by the attending anesthesiologists on the day of the procedure and open to observer bias. Good correlation between unbiased observer ICC scores and anesthesiologist-assigned cooperation scores through 52 video recorded inductions helps interpret the degree of this potential bias. Further, as a retrospective study, it is unlikely that reported answers were modified for study purposes as the data was included as a standard section of the induction note. Although validated scales are available to measure cooperation, it would be difficult to use those tools during routine charting across thousands of patients in a busy academic center, particularly when examining a large sample as used in this study. Utilizing of a research assistant to provide a third person assessment of every induction was outside the scope of this study, as is common in large retrospective cohort studies.

Conclusion

Although factors that are associated with improved mask induction compliance have been prospectively examined in relatively small, but well-designed studies, this study substantially contributes to the literature by reviewing thousands of patients using multivariate analyses. Even though the retrospective design reduces the ability to determine causality, the large number of included patients provide sampling power. Out of several patient characteristics examined, the only associated with a higher probability of cooperation with mask induction was age. Of the several preoperative anxiolytic interventions, the only associated with an increased probability of cooperation with mask induction was the presence of a Child Life Specialist. A Child Life Specialist uses age appropriate techniques and coping strategies to foster trust and understanding, leading to cooperation. Although no causality can be drawn from the associations presented in this retrospective review, settings with limited access to Child Life Specialists may consider targeting young children to increase cooperation with mask induction. The impact of cooperative mask induction on patient anxiety, future perioperative experiences, and postoperative behavioral outcomes warrants further study.

Disclosures

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Stanford IRB approved this waiver for this retrospective review. No funding was used for this study. The authors have no conflicts of interest to disclose.

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Tables

Table 1: Characteristics of Patients Included in Review

Age	**Mean (Standard Deviation)**
	5.5 (2.73)
Sex	**N (%)**
Male	3473 (58.1)
Female	2507 (41.9)
ASA Class	
Class I	1519 (25.4)
Class II	2289 (38.3)
Class III	1797 (30.1)
Class IV	375 (6.3)
Preferred Language	
English	4803 (80.3)
Spanish	963 (16.1)
Other	214 (3.6)
Race	
White	2385 (39.6)
Asian	1120 (18.7)
Black or African-American	126 (2.1)
Other/unknown	2366 (39.6)
Type of Surgery	
Cardiovascular	761 (12.7)
Gastroenterology	182 (3.0)

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General	447 (7.5)
Neurosurgery	219 (3.7)
Ophthalmology	415 (6.9)
Orthopedics	583 (9.7)
Other	1060 (17.7)
Otolaryngology	1478 (24.7)
Plastics	212 (3.5)
Urology	623 (10.4)

Table 2: Characteristics by Cooperative versus Non-Cooperative Patients

	Non-Cooperative (N = 702)	**Cooperative** (N = 5278)	p-value
	Mean (Standard Deviation)	**Mean (Standard Deviation)**	
Age	4.62 (2.68)	5.65 (2.72)	<.001
Sex	**N (%)**	**N (%)**	0.012
Male	439 (62.5)	3034 (57.5)	
Female	263 (36.5)	2244 (42.5)	
ASA Class			<.001
Class I	153 (21.8)	1366 (25.9)	
Class II	288 (41.0)	2001 (37.9)	
Class III	238 (33.9)	1559 (29.5)	
Class IV	23 (3.3)	352 (6.7)	
Preferred Language			0.90
English	565 (80.5)	4238 (80.3)	
Spanish	114 (16.2)	849 (16.1)	
Other	23 (3.3)	191 (3.6)	
Race			0.09
White	266 (37.9)	2101 (39.8)	
Asian	148 (21.1)	972 (18.4)	

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Black	8 (1.1)	118 (2.2)	
Other/unknown	280 (39.9)	2086 (39.5)	
Type of Surgery			<.001
Cardiovascular	56 (8.0)	705 (13.4)	
Gastroenterology	12 (1.7)	170 (3.2)	
General	53 (7.5)	394 (7.5)	
Neurosurgery	29 (4.1)	190 (3.6)	
Ophthalmology	92 (13.1)	323 (6.1)	
Orthopedics	58 (8.3)	525 (9.9)	
Other	150 (21.4)	910 (17.2)	
Otolaryngology	168 (23.9)	1310 (24.8)	
Plastics	16 (2.3)	196 (3.7)	
Urology	68 (9.7)	555 (10.5)	

Table 3: Multivariate Mixed Effects Logistic Regression of Patient Characteristics Associated with Cooperative Behavior

	Odds Ratio Full Model	**p-value**	**Odds Ratio Final Model**	**p-value**
Age	1.21**	0.03	1.20 **	0.03
Sex				
Male	0.91	0.83		
Female	--			
ASA Class				
Class I	--			
Class II	0.44	0.06		
Class III	0.46	0.15		
Class IV	0.94	0.94		
Preferred Language				
English	--			
Spanish	0.99	0.98		
Other	0.59	0.62		

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Race		
White	--	
Asian	0.81	0.72
Black	1.54	0.81
Other/unknown	0.96	0.93
Type of Surgery		
Cardiovascular	--	
Gastroenterology	2.02	0.69
General	1.94	0.52
Neurosurgery	0.75	0.80
Ophthalmology	0.23	0.16
Orthopedics	0.42	0.36
Other	0.93	0.93
Otolaryngology	0.29	0.12
Plastics	1.02	0.99
Urology	0.44	0.39

** indicates statistically significant at p-value < 0.05
Full model includes Age, Sex, ASA Class, Preferred Language, Race, and Type of Surgery
Final model was determined using the backward stepwise conditional method with removal criterion of p-value equal to or greater than 0.05

Table 4: Interventions used by Cooperative versus Non-Cooperative Patients

	Non-Cooperative (N = 702)	**Cooperative** (N = 5278)	p-value
	N (%)	**N (%)**	
Midazolam			<.007
No	275 (39.2)	2358 (44.7)	
Yes	427 (71.9)	2920 (55.3)	
Other IV Anxiolytics			0.50
No	699 (99.6)	5242 (99.3)	
Yes	3 (0.4)	36 (0.7)	
Parents			<.001
No	505 (71.9)	4177 (79.1)	
Yes	197 (28.1)	1101 (20.9)	
Technology			0.44

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No	563 (80.2)	4162 (78.9)	
Yes	139 (19.8)	1116 (21.1)	
Child Life			0.001
No	671 (95.6)	5163 (97.8)	
Yes	31 (4.4)	115 (2.2)	

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Table 5: Multivariate Mixed Effects Logistic Regression of Patient Characteristics Associated with Cooperative Behavior

	Unadjusted Model	**p-value**	**Adjusted Model[$]**	**p-value**
Midazolam	0.71	0.26	0.77	0.39
Other IV Anxiolytics	0.76	0.82	0.64	0.71
Parents	0.38	0.002**	0.38	0.002**
Technology	0.66	0.21	0.65	0.19
Child Life	4.44	0.04**	4.17	0.048**

$ adjusted for age

** indicates statistically significant at p-value < 0.05

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Figure Legend

Figure 1: Patient Exclusion Flowchart

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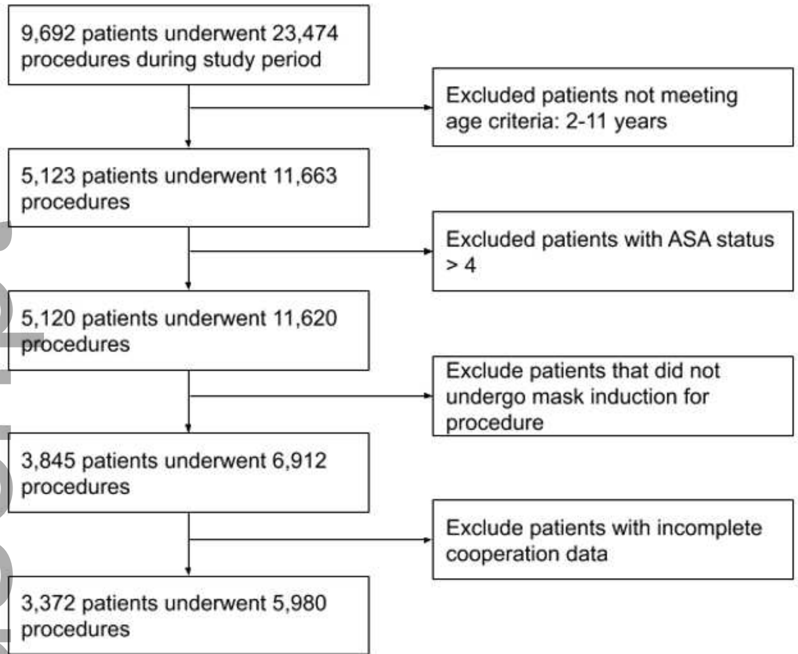

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