

Real-Time Assessment of Perioperative Behaviors and Prediction of Perioperative Outcomes

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BACKGROUND AND AIMS: New onset maladaptive behaviors, such as temper tantrums, nightmares, bed-wetting, attention-seeking, and fear of being alone are common in children after outpatient surgery. Preoperative anxiety, fear and distress behaviors of children predict postoperative maladaptive behaviors as well as emergence delirium. Parental anxiety has also been found to influence children's preoperative anxiety. Currently, there is no real-time and feasible tool to effectively measure perioperative behaviors of children and parents. We developed a simple and real-time scale, the Perioperative Adult Child Behavioral Interaction Scale (PACBIS) to assess perioperative child and parent behaviors that might predict postoperative problematic behavior and emergence excitement.

METHODS: We used the PACBIS to evaluate perioperative behaviors during anesthetic induction and recovery in a sample of 89 children undergoing tonsillectomies and adenoidectomies, and their parents. Preoperative anxiety with the modified Yale Preoperative Anxiety Scale, compliance with induction of anesthesia with Induction Compliance Checklist, and incidence of emergence excitement were also recorded.

RESULTS: The PACBIS demonstrated good concurrent validity with modified Yale Preoperative Anxiety Scale and Induction Compliance Checklist and predicted postanesthetic emergence excitement.

DISCUSSION: The PACBIS is the first real-time scoring instrument that evaluates children's and parents' perioperative behavior. The specific behaviors identified by the PACBIS might provide targets for interventions to improve perioperative experiences and postoperative outcomes.

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New onset maladaptive behavior is a common and significant problem in children undergoing outpatient surgery.¹ Preoperative anxiety, poor compliance at anesthetic induction, and other negative behaviors predict emergence delirium and postoperative maladaptive behaviors.² Up to 65% of children develop intense anxiety and fear in the preoperative period, especially during induction of anesthesia.³ Parental anxiety has been shown to influence children's preoperative anxiety.³ Children's anxiety, fear and distress,

as well as some negative parent behaviors (e.g., excessive reassurance, criticism, empathizing and giving inappropriate control to child) may lead to delayed discharge, parental dissatisfaction, and an overall poorer perioperative experience.¹⁻⁴ Postoperative pain is a common and important perioperative distress for pediatric patients. Research suggests that there is discordance between self-report and behavioral pain measures in children, which might reflect the limitations of current behavioral scales of postoperative pain.⁵

At present, there are arguably only two scales available to easily monitor and communicate perioperative behavioral conditions, the Induction Compliance Checklist (ICC)⁶ and the modified Yale Preoperative Anxiety Scale (mYPAS).⁷ Although these real-time scales provide a global assessment of children's anxiety and behavioral compliance during the preoperative period, they are validated only in the preoperative period. Neither the ICC nor the mYPAS identifies coping behaviors of children nor any parental behaviors (Table 1). Assessment of such behaviors is important because these behaviors might be amenable to behavioral interventions to improve overall perioperative outcome.

Three relevant video-based behavior scales include the Child-Adult Medical Procedure Interaction Scale-Short Form (CAMPIS-SF),⁸ the Observational Scale of Behavioral Distress,⁹ and the perioperative CAMPIS (P-CAMPIS).¹⁰ However, these are time-consuming

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Table 1. Comparison of Real-Time Perioperative Behavioral Assessment Instruments

Scale	Assessed perioperative behaviors	Behaviors not assessed by scale
ICC	Child anxiety fear and negative behaviors during induction of anesthesia	Child's coping behaviors, nonanxiety distress behaviors; all adult behaviors
mYPAS	Preoperative child anxiety (activity, emotional expressivity, state of arousal, vocalization, and use of parents)	Nonanxiety behaviors of child; all adult behaviors
PACBIS	Pre and postoperative child and parent, anxiety, coping and distraction behaviors, and adult coping and distress promoting behaviors	

ICC = induction compliance checklist; mYPAS = modified Yale preoperative anxiety scale; PACBIS = perioperative adult child behavioral interaction scale.

Table 2. Original Perioperative Adult Child Behavioral Interaction Scale (PACBIS)

Part A. PACBIS observational					
Parent					
Staff					
Staff					
Child behaviors					
Child coping	1	2	3	4	5
Child distress	1	2	3	4	5
Parent coping promoting	1	2	3	4	5
Parent distress promoting	1	2	3	4	5
Staff coping promoting	1	2	3	4	5
Staff distress promoting	1	2	3	4	5

PACBIS 5-point Likert Rating Scale: 1=None or One.

2-Minimal or few.

3-Moderate or adequate.

4-Substantial or considerable.

5-Maximum or nearly continuous.

PACBIS = perioperative adult child behavioral interaction scale.

and not practical in busy clinical anesthesia settings. Furthermore, given that they are done via videotape, they do not allow for real-time interventions. Thus, there is no effective real-time tool to describe children's and parents' behaviors and guide targeted, real-time interventions to ameliorate perioperative distress. Our study aims were the following: 1) to develop an easy to use scale to assess behaviors of children and parents by anesthesiologists and perioperative nurses with minimal training; and 2) to create a scale that would lead to appropriate behavioral interventions. In this study, we developed a clinically effective real-time tool, the Perioperative Adult Child Behavioral Interaction Scale (PACBIS).

METHODS

This study was approved by the IRB of the Cincinnati Children's Hospital Medical Center. Parental informed consent and children's assent were obtained from all participants. Ninety-five children 3–12-yr-of-age undergoing outpatient tonsillectomy and adenoidectomy, accompanied by at least one parent, were recruited for this study. Two trained research assistants independently coded children's, parents', and staffs' behavior with the PACBIS live in real-time during anesthesia induction and during recovery. During training sessions, a criterion of 80% agreement between the two real-time observers (for PACBIS), and two video-coders (for CAMPIS-SF) was reached.

Once all observers were trained and achieved a good inter-rater reliability, they scored PACBIS and CAMPIS-SF for the validation phase. To avoid interval drift in reliability and accuracy, the authors simultaneously scored PACBIS and CAMPIS-SF measurements of every 15th patient.

The PACBIS was developed based on the CAMPIS-SF, one of the only measures of children's and adults' behaviors during invasive medical procedures. Paralleling the CAMPIS-SF,⁸ the PACBIS uses a 5-point Likert scale for rating perioperative behaviors in real-time on the following six dimensions: Child Coping, Child Distress, Parent Coping Promoting, Parent Distress Promoting, Staff Coping Promoting, and Staff Distress Promoting (Table 2). Coping promoting behaviors include nonprocedural talk to child (e.g., talk about pets, friends, personal interests, school), distraction, praising, encouragement, humor to child, and commands to use coping strategy. Distress-promoting behaviors include excessive reassurance, criticism, apologies, giving inappropriate control to the child and empathic comments. Although many of the codes are similar to those used in the CAMPIS scales, they were substantially modified so that they were relevant for the perioperative setting.

Two different research assistants independently coded the same children, parents, and staff from videotapes with the CAMPIS-SF. In addition, preoperative anxiety was assessed with the mYPAS and

Table 3. Inter-Rater Reliability With PACBIS and CAMPIS-SF

	Weighted kappa	
	CAMPIS-SF (<i>n</i> = 23)	PACBIS (<i>n</i> = 89)
Anesthesia induction related behaviors		
Child coping	0.46	0.60
Child distress	0.70	0.82
Parent's coping promoting	0.51	0.55
Parent's distress promoting	0.71	0.53
Anesthesiologist's coping promoting	0.74	0.57
Anesthesiologist's distress promoting	0.55	0.47
Postoperative behaviors in PACU		
Child-recovery nurse interactions		
Child coping	0.50	0.69
Child distress	0.78	0.71
Recovery nurse's coping promoting	0.72	0.60
Recovery nurse's distress promoting	0.63	0.43
Child-parent interactions		
Child coping	1.0	0.45
Child distress	1.0	0.61
Parent's coping promoting	1.0	81.6% (% agreement)

Inter-rater reliability is expressed as linear weighted kappa coefficients. For Parent's Coping Promoting, we were not able to calculate weighted kappa, so percent agreement between the observers has been reported. If weighted kappa was >0.4, 0.6, and 0.8, inter-rater reliability was considered to be moderate, good and very good, respectively.

CAMPIS-SF = child-adult medical procedure interaction scale-short form; PACBIS = perioperative adult child behavioral interaction scale; PACU = postanesthesia care unit.

compliance with induction of anesthesia was assessed with the ICC. Incidence of emergence excitement was also recorded using an excitement scoring system.¹¹ All statistical tests were two-sided and *P* values <0.05 were considered statistically significant. Inter-rater Reliability between observers were assessed using linear weighted Kappa coefficients. If weighted kappa was 0.41–0.60, 0.61–0.80, and 0.81–1.0, inter-rater reliability was considered to be moderate, good, and very good, respectively. The concurrent validity of the PACBIS with CAMPIS-SF, mYPAS, and ICC as well as the predictive validity of the PACBIS with postsurgical emergency excitement were analyzed using Spearman correlation coefficients.

RESULTS

We recruited 105 patients in this study. For the final analyses, we did not include the first seven patients who were used for training purposes and nine additional patients who had missing postoperative data. The mean age of the remaining 89 study subjects was 7 yr (inter-quartile range 5, 8.6 yr). Boys (49%) and girls (51%) of all races (Caucasians 82%, African Americans 16%, and Asians 1%) were studied. The inter-rater reliability with the PACBIS was moderate to very good across all categories (weighted kappa >0.4) (Table 3). The PACBIS had moderate to strong correlations on assessing child distress during induction when compared with the CAMPIS-SF (Spearman correlation coefficient $r_s = 0.73$), preoperative anxiety assessed by mYPAS ($r_s = 0.40$), and compliance during induction of anesthesia assessed by ICC ($r_s = 0.77$). The PACBIS has good concurrent validity with other scales in assessing perioperative behaviors (Table 4), and it has good predictive validity in predicting postanesthetic emergence excitement in

Table 4. Correlation of PACBIS with CAMPIS-SF, mYPAS, and ICC (Preoperative Behaviors)

Anesthesia induction related behaviors PACBIS (<i>n</i> = 89)	Spearman correlation coefficient		
	CAMPIS-SF (<i>n</i> = 23)	mYPAS (<i>n</i> = 89)	ICC (<i>n</i> = 89)
Child coping	0.36	−0.36*	−0.44*
Child distress	0.73*	0.40*	0.77*
Parent's coping promoting	0.13	−0.09	−0.23†
Parent's distress promoting	0.04	0.14	0.55*
Anesthesiologist's coping promoting	0.57*	−0.05	−0.14
Anesthesiologist's distress promoting	0.19	0.40*	0.59*

CAMPIS-SF = child adult medical procedure interaction scale-short form; ICC = induction compliance checklist; mYPAS = modified Yale preoperative anxiety scale; PACBIS = perioperative adult child behavioral interaction scale.

* *P* < 0.01.

† *P* < 0.05.

children (Table 5). Real-time observers who rated PACBIS, simultaneously rated mYPAS (Intraclass Correlation Coefficients: 0.94 [95% confidence interval 0.91–0.96]) and ICC (Intraclass Correlation Coefficients: 0.96 [95% confidence interval 0.95–0.98]) with excellent inter-rater reliability.

DISCUSSION

Identifying children at high risk for poor postoperative behavioral outcomes will help us target specific interventions and improve the quality of perioperative care. New onset maladaptive behaviors, such as temper tantrums, nightmares, insomnia, and attention-seeking occur in up to 47% of children undergoing outpatient surgery.¹² Previous negative experiences with surgery,¹³

Table 5. Correlation of the Perioperative Adult Child Behavioral Interaction Scale (PACBIS) with Postanesthetic Emergence Excitement Scores in the Recovery Room

PACBIS child behaviors (<i>n</i> = 89)	Spearman correlation coefficient excitement scores (<i>n</i> = 89)
Anesthesia induction child coping	-0.21*
Anesthesia induction child distress	0.44†
Recovery room removal of IV child coping	-0.43†
Recovery room removal of IV child distress	0.60†

* *P* < 0.05.† *P* < 0.0001.

parental anxiety, and poor compliance at induction of anesthesia have been shown to be associated with postoperative maladaptive behaviors in children.² These behavioral complications are associated with poor perioperative outcomes, including delayed hospital discharge and poor parental satisfaction. An effective and practical perioperative behavior scale will help us identify and target child and parent behaviors that might adversely influence perioperative outcomes. The only other perioperative behavioral scale, the P-CAMPIS,¹⁰ has limitations. It is a fine-grained and detailed system requiring coding from videotapes, which is intended to assess behavior during the anesthetic induction period. Although it provides a wealth of information, the P-CAMPIS cannot be used in real-time to assess behaviors or to guide real-time interventions throughout the perioperative period.

In this study, we developed a practical instrument to describe, communicate and manage perioperative behaviors of children and parents in real-time. By identifying children (and parents) at higher risk of perioperative behavioral changes, pain and other poor outcomes before anesthesia induction or during recovery, we hope to make it possible to tailor perioperative behavioral and medical interventions to improve overall perioperative outcomes.

Using the PACBIS behavioral definitions, we are able to identify child and parental behaviors at the time they occur. Thus, perioperative health care providers can immediately intervene (e.g., if the child is anxious and the parent is exhibiting distress-promoting behavior during induction, an anesthesiologist can distract the child and engage the parents in the process of distraction/nonprocedural talk). If the child has excessive anxiety before induction, interventions by child life specialists (e.g., explaining to child and parents what to expect during induction and engaging child in nonprocedural discussions, games, and videos), medical interventions (e.g., midazolam), or teaching parents how to promote coping behaviors in children (e.g., engaging child in nonprocedural discussions and distractions) can be performed to help the child during induction of anesthesia.

Unless we can identify, measure and communicate a behavior, we cannot make any changes. This study is the first step towards their long-term goal of real-time perioperative behavioral interventions, especially in high risk children and parents.

Future work will include additional refinement of the PACBIS to enhance its practicality and further optimize it for the unique perioperative setting, and identification of intervenable important child and parent behaviors. The PACBIS will be further validated if it can be demonstrated to predict other outcomes (e.g., discharge time, postdischarge maladaptive behaviors). The inter-rater reliability of this prototype PACBIS was moderate to very good across all categories (weighted kappa >0.4), but this is not deemed sufficient. Execution of prototype PACBIS was somewhat difficult as it measured many areas and required 5 points of differentiation on each construct (Table 2). Thus, it was not as feasible as hoped and inter-rater reliability suffered in some categories as a result. It was determined that focusing the measure on key areas that would guide intervention efforts and reducing the number of points on each construct would be important. To increase its perioperative adaptability, the PACBIS will be refined to make it a simple, more reliable, and effective instrument. The main purpose of refining the PACBIS is to identify major modifiable behaviors that can be easily identified even by perioperative staff minimally trained in behavioral interactions (e.g., nurses, anesthesiologists). This will enable the implementation of real-time interventions by perioperative staff.

In conclusion, we have described the first clinically feasible, real-time, perioperative-specific child and adult behavioral assessment instrument, the PACBIS. The PACBIS has good concurrent validity with other scales in assessing perioperative behaviors and is able to predict postanesthetic emergence excitation in children. The real-time advantage of perioperative period-specific PACBIS presents a number of future clinical utilities, including immediate identification and modification of behaviors that are associated with poor perioperative outcomes in children.

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