

POSTOPERATIVE MALADAPTIVE BEHAVIORAL CHANGES IN CHILDREN

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Abstract

Induction of anesthesia can be a very stressful period for a child and his family and can be associated with increased risk of psychological disturbances. These disturbances are categorized as preoperative anxiety, emergence delirium and postoperative behavioral changes. Several tools have been developed to measure these psychological manifestations as well as the baseline personality traits of these patients.

Postoperative negative behavioral changes, such as sleep and eating disorders, separation anxiety, temper tantrum, aggression toward authorities, may occur in up to 60% of all children undergoing general anesthesia. Several studies found a strong association between these postoperative behavioral changes, the distress of the child on induction and his individual personality characteristics, although a cause-effect relationship could not be determined. Understanding the risk factors for behavior changes helps us determine the best way for prevention and treatment of these changes in the perioperative period.

Introduction

Induction of anesthesia may be the most stressful procedure a child experiences during his hospitalization. Psychological and behavioral changes can be observed in three different aspects; preoperative anxiety, emergence delirium and post operative behavioral changes¹.

These behavioral changes have been a target of interest for more than 60 years. In 1945, Levy reviewed the records of 124 postoperative children referred for behavior problems and found that some of them did not have any preoperative history of emotional difficulties². In a retrospective study of 612 children undergoing otolaryngological operation, Eckenhoff identified the association between unsatisfactory anesthesia inductions and postoperative negative personality changes³. This led to the recognition of the importance of addressing children's anxiety in the postoperative period. Although these are important landmark studies, measurement tools to assess the level of anxiety and classify behaviors were not validated. Since then, various investigators developed new measurement modalities validated in several studies with good reliability.

Negative behavioral changes observed postoperatively include separation anxiety, sleep disturbance, aggression toward authority, temper tantrum, and eating problems, and have been described in as much as 50-60% of children undergoing surgery⁴. They can be associated with poor perioperative outcomes, including

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delayed hospital discharge and poor parental satisfaction, and if they persist for an extended period time, they can interfere with the child's emotional and cognitive development⁵. Understanding the risk factors for behavior changes helps us to determine the best way for prevention and treatment of these changes in the perioperative period. Several studies have been conducted to determine this relationship with contradictory results.

We will review the risk factors for maladaptive behaviors and suggested interventions.

Characteristics of maladaptive behaviors

Common behavioral problems after surgery include nightmares, waking up crying, sleep disorders, disobeying parents, separation anxiety, and temper tantrums^{4,6}. More serious behavioral changes, such as new-onset enuresis are uncommon. Interestingly, some children experience positive behavioral change following surgery, which may be attributed to the treatment of their medical conditions^{7,8}.

Maladaptive behaviors subside with time. Kain et al. found that 67% of children had new negative behaviors on the first day after surgery, 45% on day two, and 23% at two weeks after surgery, but these changes could persist for up to up to 6 months in 20% of children and for up to one year for 7.3% of children⁴.

Some children may have several surgical procedures during their childhood. Whether or not repeated surgical experience has a cumulative effect on the development of maladaptive behaviors is unknown.

Behavioral instruments

Behavioral instruments that are used to assess both the predictor variable and the primary end point must be properly validated and reliable. Until now various measurement modalities have been developed to assess anxiety and behaviors, and include:

The State-trait Anxiety Inventory (STAI)

This self-reported anxiety instrument contains two separate 20-item subscales that measure trait (baseline) and state (situation) anxiety. It is used to assess situational anxiety of parents immediately after being present for anesthesia induction of their child. This is the gold standard for assessing anxiety in adults and has been used with good validity and reliability⁹.

The modified Yale Preoperative Anxiety Scale (mYPAS)

This is an observational state anxiety measurement for young children, containing 27 items in 5 categories (activity, emotional expression, state of arousal, vocalization, and use of parents). However, it does not include non-anxiety behaviors of children and adults. It has excellent reliability and validity for measuring children's anxiety in the preoperative holding area and during induction of anesthesia^{10,11}.

The Induction Compliance Checklist (ICC)

This is an observational checklist, previously developed by Kain et al., containing 10 negative behavioral groupings that describe child's anxiety, fear and negative behaviors during induction of anesthesia with good reliability. However, it does not assess a child's non-anxiety distress behaviors or any adult behaviors¹².

The Perioperative Adult Children Behavioral Interaction Scale (PACBIS)

This instrument was developed to assess perioperative children and parents behaviors that might predict postoperative problematic behavior and emergence excitement. It uses a 5-point rating scale to evaluate perioperative behaviors in real-time on six dimensions (child coping, child distress, parent coping promoting, parent distress promoting, staff coping promoting, and staff distress promoting). Coping promoting behaviors include nonprocedural talk to children, distraction, praising, encouragement, humor, and commands to use coping strategy. Distress promoting behaviors include excessive reassurance, criticism, apologies, giving inappropriate control to the child and empathic comments. Inclusion of coping behavioral assessment might render behavioral intervention amendable to improve overall perioperative outcome. This test has good concurrent validity and good reliability⁵.

The Post-Hospitalization Behavioral Questionnaire (PHBQ)

This is a parental, self-reported questionnaire consisting of 27 items in 6 domains: general anxiety, separation anxiety, sleep anxiety, eating disturbances, aggression against authority, and apathy/withdrawal. It is used to evaluate maladaptive behavioral responses in children after anesthesia and surgery. It has a good profile of reliability and validity¹³.

The Emotionality, Activity, Sociability, Impulsivity (EASI)

This temperament scale is a parental reported instrument that assesses four temperament categories (emotionality, activity, sociability, and impulsivity) in children and is widely used in the literature. Good reliability and validity data are available for this instrument¹⁴.

Risk factors for postoperative, maladaptive behavioral changes

Age

Postoperative behavioral issues seem to be present in younger children. Eckenhoff found children less than 3 years of age to be more at risk³. Vernon found that children aged 6 months to 4 years had more postoperative negative behaviors than older children¹⁵. Consistently, recent studies showed similar findings^{4,7,16}.

Temperament and personality

Impulsive children (i.e. high EASI score for impulsivity) have an increased risk of general anxiety and separation anxiety at 2 weeks postoperatively, as well as children with poor social adaptability, children who are shy and inhibited, with higher intelligence, and with increased parental anxiety⁴.

Anxiety exhibited in the preoperative holding area

It is estimated that about 70% of all children exhibit significant stress and anxiety before surgery[4]. Reasons for this behavioral response include the child's perception of the threat of bodily discomfort, or harm, the threat of being separated from parents, of unknown and strange environment, of uncertainty of what is acceptable behavior, and the threat of losing control and autonomy¹⁷. Several studies support the association of preoperative anxiety and postoperative maladaptive behavioral changes^{4,6,18,19}, but this finding was challenged by several other studies^{1,20}. Tripi et al. found that even though anxious children have a significantly increased incidence of distress on emergence, they were no more likely than children without emergence distress to manifest long lasting evidence of continued psychological changes when studied at 1 and 4 weeks post operatively²⁰.

Parental anxiety

The association between parental anxiety and negative behavioral changes has been described^{1,19,21}.

Pain

The association of pain and postoperative behavioral changes has been a subject of controversy. Initial investigations by Kain et al. as well as by other groups denied this correlation^{1,4}. But with better pain evaluation and assessment of causal factors, subsequent studies showed an association between preoperative anxiety, postoperative pain and postoperative behavioral problems²². In a study of children 5 to 12 years old undergoing elective outpatient tonsillectomy and adenoidectomy, preoperative anxiety was associated with increased pain postoperatively and a higher incidence of sleep and behavioral problems²². There is no study that shows the direct cause-effect relationship of postoperative pain with the occurrence of postoperative behavioral problems²³. However, it is unethical to under-treat pain and study the subsequent incidence of postoperative behaviors. Given that pain is undertreated postoperatively in many children²⁴, it would be important to emphasize the importance of postoperative pain treatment. Reduction of pain severity has the potential of decreasing maladaptive behaviors.

Length and type of hospitalization

Outpatient surgery settings is associated with less post operative behavioral changes than inpatient settings, and the length of hospitalization beyond 4 days can influence such behavioral changes in comparison to shorter stays of 2-3 days^{1,7,25}.

Anesthetic induction

Whether the type of anesthetic medication affects the incidence of postoperative maladaptive behaviors is an important issue to be investigated.

Foesel and Reisch evaluated the role of anesthetic induction agents (sevoflurane versus halothane) on the occurrence of negative behaviors postoperatively by reviewing patients charts as well as sending questionnaires to parents postoperatively²⁶. They enrolled patients younger than 8 years of age who had minor ENT surgery in most cases. There was no difference in the frequency of postoperative negative behaviors between halothane and sevoflurane in patients under 4 years, whereas patients above 4 years of age who had sevoflurane induction had more frequent behavioral issues. One of the criticisms of this study is the possible bias induced by the prolonged time lag of 6 to 24 months between the dates of anesthesia and when parents answered questions.

In a double-blinded, randomized, controlled trial including children aged 3 to 10 years²⁷, the incidence of emergence delirium, maladaptive postoperative behavioral changes, and sleep disturbances did not differ between halothane and sevoflurane induction groups. However, this study did not include patients younger than 3 years of age, who are considered as a high-risk group for postoperative negative behaviors. Based on the available data, it is reasonable to use sevoflurane as an induction agent. Some studies suggested that emergence delirium and new-onset postoperative maladaptive behavior changes are closely related. The odds ratio of having one or more new-onset postoperative maladaptive behavior changes is 1.43 for children with marked emergence delirium when compared with children with no symptoms of emergence delirium¹⁹, although this correlation was not reproducible in other studies.

Kotiniemi et al. evaluated the effect of the mode of induction of anesthesia on anxiety and subsequent behavioral problems in 90 children, 2 to 7 year old undergoing ENT surgery²⁸. They randomly allocated patients to intravenous thiopentone, inhaled halothane, or rectal methohexitone induction. Behavioral changes were detected in 59% of patients in the thiopentone group, 50% of patients in the halothane group, and 58% of patients in the methohexitone group, but children in halothane group had more negative memories of induction. There is no evidence to say one mode of induction is superior to the other.

Surgery

Kain et al. evaluated patients 1 to 7 year old undergoing elective outpatient surgery (ENT surgery, general surgery, genitourinary surgery) and who had a mask induction of anesthesia using halothane. They found that genitourinary surgery was associated with the most negative postoperative behavioral changes and pressure-equalizing tube placement was associated with the least postoperative negative behavioral changes⁶. However, the difference was not statistically significant. Whether the trend observed reflected the degree of postoperative pain is not clear. The earlier meta-analysis done by Vernon et al. did not find the association between surgical procedures and the incidence of postoperative behavior changes²⁹.

Interventions

The initial investigations about postoperative behavioral changes were mainly found in pediatric and psychology literatures, till they recently became a hot topic in pediatric anesthesia. Actually the preparation of a child and his family for surgery falls into the domain of pediatric anesthesiologists, and focuses mainly on reduction of preoperative anxiety in the hope of reducing long term effects. These measures include sedative

premedication, parent presence during induction, and preoperative preparation programs.

Premedication

The effect of midazolam on postoperative behavioral changes has been better studied as compared to other sedatives. Kain et al. found that midazolam premedication had a positive effect on decreasing the incidence of behavioral changes at postoperative days 1-7, although this effect decreased over time and at 2 weeks post operatively, there was no difference between the midazolam and the placebo group³⁰. Postoperative behavioral problems most reduced by the intervention (midazolam) were separation anxiety and eating disturbances. Another study found similar results, with a significantly reduced incidence of postoperative behavioral changes in the midazolam premedication group at 2 weeks³¹. Interestingly, a study by McGraw et al. showed an opposite result; where children in midazolam group significantly exhibited increased negative behavior at one week compared with those in the control³². However, the interpretation of this study is rather difficult because the data were collected from two separate hospitals, which reflects the results from different study protocols. Certainly, midazolam may not be beneficial to all patients and further studies need to point the potential patient population who may not benefit from premedication. Interestingly, the study by Finley et al. provides some insight into this issue³³. They compared anxiety at induction between impulsive and nonimpulsive children with or without midazolam premedication. Impulsive, midazolam-treated children showed no anxiolytic benefit relative to impulsive children in the placebo group. In contrast, nonimpulsive children in the midazolam group benefited from the anxiolytic effects relative to nonimpulsive children in the placebo group, suggesting that midazolam premedication is most helpful in children with anxiety and least helpful for children with impulsive temperament.

The major concern about routine premedication is its potential adverse effects and the delay in recovery and discharge. However, the majority of studies showed that recovery times were not significantly increased by preoperative midazolam administration^{32,34,35}.

Parent presence

The effect of parent presence on postoperative behavior was evaluated. One group investigated the value of parental presence during emergence from anesthesia as soon as the patient was separated from the ventilator but did not find a decrease in the incidence or the severity of emergence distress behavior in children²⁰. The presence of parents in the PACU has been studied as well and was found to have no effect on crying in the PACU, but have some long term effect: negative behavior changes 2 weeks postoperatively occurred more frequently in the parent absent group than the parent present group³⁶.

Family program

Age appropriate information and preparation for surgery has been described in the medical literature since the 1950s. These techniques vary and have evolved along the years, from simple preoperative instruction, to more demonstrative shows with books, movies, puppet therapy, to play therapy and the possibility of active interaction and role playing with the help of a *child life specialist* who can teach the children relaxation and

coping techniques³⁷.

Most of the hospitals in the US offer some sort of preoperative behavioral programs to children and their parents in the hope that this will benefit patients coming for surgery, by getting them familiar with the new and potentially anxiety-provoking environment, and would eventually lessen their anxiety. Closer investigation about the efficacy of such programs showed that the benefits are not uniformly distributed on all patients' population, but differs according to age group, the duration of the hospitalization, the severity of the medical condition, previous experiences, as well as the patient's personal temperament and personal coping strategies and the program offered. Furthermore, some studies suggested a negative effect of some preparation techniques on children.

In 1975, Melamed compared 2 groups of pediatric patients undergoing surgery under general anesthesia and who received a typical preoperative counseling followed or not by watching a film "*Ethan Has an Operation*", which demonstrates a child going through the experiences of being hospitalized for an operation. Analysis of the data showed that the movie was more effective in alleviating anxiety on all measures of transitory and situational anxiety at both the preoperative and postoperative assessments, and at a follow up examination 3-4 weeks following discharge³⁷. On the other hand, in a study evaluating the benefit of a preparation book illustrating a considerable amount of information about the procedure, the equipment and the personnel involved, it was found that children exposed to this book had an increased incidence of behavioral disturbance 1-month postanesthesia. This was mostly true in the group of children undergoing shorter procedures, but not those having longer procedures. These authors then concluded that the mode of preparation should be tailored to the severity or complexity of surgery¹.

Kain et al. evaluated the effectiveness of a behavioral preoperative preparation program on alleviating the anxiety of children and their parents in the perioperative period. In a study of 143 children undergoing outpatient surgery, they found that behavioral preparation program was not uniformly effective³⁸. Children older than 6 years of age and who received the preparation at least 5 to 7 days prior to surgery benefited from the intervention. In contrast, the program had a negative effect on children younger than 3 years of age, and may be a result of their inability to distinguish fantasy from reality.

The timing of the preparation program relative to the day of surgery was identified as a significant variable. Children 6 years and older were found to be least anxious if they participated in the program more than 5 to 7 days prior to surgery and were most anxious if the program was given one day prior to surgery. Previous investigations also have suggested that older children may benefit from a longer interval between preparation and the date of the procedure. Although the ideal timing in respect to surgery has never been determined, a minimum of one week seems necessary for reduced anxiety in older children. Some authors suggest that if the preparation cannot be done at least one week prior to surgery, no preparation is more advantageous than having it done 1 or 2 days before the intervention^{38,39}.

Surgery center personnel should consider these factors and individualize their prescription of preparation programs for children and families undergoing surgery.

An additional challenge was the group of patients with previous hospital experience. The preparation programs do not provide them with new information, and may actually sensitize them. It is therefore suggested that these patients have an alternative individualized program with more coping skills training and actual practice, tailored to their previous experiences⁴⁰.

Further studies were conducted to evaluate the effectiveness of these programs in alleviating anxiety at

several points during a child's hospitalization. In a study designed to compare several degrees of preparation, from simple to extensive: simple information based program during an OR tour, to adding a videotaping as a modeling-based program, to adding a coping based program provided by a child life specialist, it was found that children and parents who received the extensive preoperative preparation program exhibited lower levels of anxiety. But the beneficial effects of this preparation were limited to the preoperative period and the separation from the parents, without being significant at the induction of anesthesia or in the postoperative period.

Conclusion

Management of preoperative anxiety should be a part of the perioperative management of children, as it has been shown in different studies to impact on the occurrence of long-term postoperative behavioral changes. Several factors have been associated with a higher incidence of postoperative behavioral changes, and include the younger age of the patient, his personality and impulsivity, previous hospital or anesthesia experiences, and parental anxiety.

The role of midazolam as a sedative premedication has been well established and shown its efficacy in reducing children's anxiety, but not in controlling impulsive behaviors. Parent presence at induction of anesthesia is another mode of alleviating induction anxiety and is gaining popularity among pediatric anesthesiologists and is the preferred method when parents are given a choice. Although it is not uniformly efficacious, it provides good parental satisfaction level. Family programs and preoperative preparation are evolving as well, and they are offered to most of children undergoing anesthesia in the United States. Most importantly is to individualize the care of each patient, taking into account all the possible causal factors, previous individual and parental experience of child, in addition to the best judgment of the anesthesiologist.

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