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Prevention and Intervention Strategies to Alleviate Preoperative Anxiety in Children

A Critical Review

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Preoperative anxiety (anxiety regarding impending surgical experience) in children is a common phenomenon that has been associated with a number of negative behaviors during the surgery experience (e.g., agitation, crying, spontaneous urination, and the need for physical restraint during anesthetic induction). Preoperative anxiety has also been associated with the display of a number of maladaptive behaviors postsurgery, including postoperative pain, sleeping disturbances, parent-child conflict, and separation anxiety. For these reasons, researchers have sought out interventions to treat or prevent childhood preoperative anxiety and possibly decrease the development of negative behaviors postsurgery. Such interventions include sedative premedication, parental presence during anesthetic induction, behavioral preparation programs, music therapy, and acupuncture. The present article reviews the existing research on the various modes of intervention for preoperative anxiety in children. Clinical implications and future directions are discussed.

Keywords: *children; anxiety; surgery; prevention; interventions*

It has long been recognized that surgery can be a very stressful experience for children. In fact, this phenomenon has piqued the interest of clinical researchers for more than 60 years. For example, Pearson (1941) observed

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significant emotional reactions in young children undergoing anesthesia and surgery. Eckenhoff (1953), in a retrospective study of more than 600 children, identified a link between "unsatisfactory" anesthetic inductions (i.e., those characterized by heightened child anxiety) and postoperative negative personality changes. Today, approximately 4 million children undergo anesthesia and surgery annually in the United States (Kain & Caldwell-Andrews, 2005). It has been suggested that between 40% and 60% of children who undergo surgery experience anxiety (e.g., Corman, Hornick, Kritchman, & Terestman, 1958; Melamed & Siegel, 1975; Vernon, Foley, Sipowiwcz, & Schulman, 1965). The aforementioned reactions are thought to be a reflection of the child's fears of separation from parents and home environment, loss of control, unfamiliar routines, surgical instruments, and hospital procedures (Corman et al., 1958; Kain & Mayes, 1996; Schwartz, Albino, & Tedesco, 1983; Vernon et al., 1965). Children have been observed to manifest such anxiety in many ways including appearing frightened, becoming agitated, breathing deeply, trembling, crying, and stopping talking or playing (Corman et al., 1958; Vernon et al., 1965). Other children may suddenly urinate, experience increased motor tone, or attempt to escape from the medical personnel (Burton, 1984). Up to 25% of children have been noted to require physical restraint to facilitate anesthetic induction (Lumley, Melamed, & Abeles, 1993), a situation that can lead to increased stress in both children and medical personnel (Hunter, 1989). Based on behavioral and physiological responses, anesthesia induction appears to be the most stressful procedure that a child experiences during the pre- or perioperative period (Kain, Mayes, O'Connor, & Cicchetti, 1996; Kain, Mayes, Caramico, et al., 1996). Pre- or perioperative anxiety refers to anxiety regarding the events that take place prior to surgery. Preoperative anxiety would be akin to state anxiety in the preoperative context—as preoperative anxiety is anxiety associated with a particular event (i.e., surgery). However, preoperative anxiety is not the same as trait anxiety. In young children, trait anxiety would be most likely assessed as an "anxious" temperament.

In addition to behavioral changes prior to and during anesthetic induction, behavioral disturbances such as postoperative pain (Kain, Caldwell-Andrews, Lodolce, Krivutza, & Wang, 2002), bad dreams and/or waking up crying, disobeying parents, separation anxiety, temper tantrums (Kain, Mayes, O'Connor, et al., 1996; Kain, Wang, Mayes, Caramico, & Hofstadter, 1999), and although less common, the new onset of enuresis (Kain, Mayes, O'Connor, et al., 1996) have been observed following surgery. The association between preoperative anxiety and negative postoperative behavior

after hospital discharge has been demonstrated in two studies (Kain et al., 1999; Kain, Mayes, O'Connor, et al., 1996). Kain and colleagues (1999) examined 91 children aged 1 to 7 years undergoing day surgery. Preoperative anxiety was found to be an independent predictor of the development of postoperative negative behavior, where postoperative negative behaviors were measured via parental report. Specifically, a child who displayed elevated anxiety prior to surgery was 3.5 times more likely to be at risk for the development of negative postoperative behavior changes in comparison to a child who displayed lower levels of anxiety. In both investigations (Kain et al., 1999; Kain, Mayes, Caramico, Silver, et al., 1996) the frequency of negative behaviors was found to decrease over time. Kain and colleagues (1999) found that 67% of children had new negative behaviors on the day after surgery, 45% on day two, and only 23% at 2 weeks after surgery. Behavior problems were found to persist for up to 6 months for 20% of children and up to 1 year for 7.3% of children (Kain, Mayes, Caramico, Silver, et al., 1996). Furthermore, such preoperative anxiety and fear may have a long-term negative impact on children's responses to later medical care as well as potentially interfere with normal development (Vernon et al., 1966). Neuroendocrinologic changes such as increased serum cortisol, corticotrophin, and increased natural killer cell activity have also been associated with preoperative anxiety (Fell et al., 1985; Ramsay, 1972; Tonnesen, 1989). Due to the immediate and potentially more long-term negative effects of preoperative anxiety, researchers have sought out prevention and intervention strategies to alleviate anxiety and decrease the development of negative behaviors postsurgery.

Prevention and Intervention Strategies

To reduce the incidence of preoperative anxiety in children, a number of prevention strategies have been employed. Both pharmacological (e.g., sedative) and nonpharmacological (e.g., parental presence, behavioral preparation programs, music, acupuncture) approaches have proven useful. Midazolam, a benzodiazepine with anxiolytic and amnestic properties, has proved to be effective in reducing anxiety in the preoperative setting. However, the use of midazolam is not without disadvantages (i.e., delay in emergence, recovery, and discharge; increased incidence of maladaptive behavioral changes postsurgery; amnesia; Watson & Visram, 2003). Given these disconcerting findings, nonpharmacological strategies may be preferable. The research examined within this review has been primarily focused

on "day surgery" procedures (i.e., surgeries where the patient is admitted and discharged from hospital, all in a single day), all of which require general anesthesia. The empirical literature regarding the aforementioned strategies will be discussed next.

Midazolam

Midazolam is a benzodiazepine that produces anxiolytic, amnestic, hypnotic, anticonvulsant, and skeletal muscle relaxant effects (Curran, 1986). Midazolam is also known by the trade names Versed®, Hypnovel®, and Dormicum®. It is the pharmacological agent of choice to address preoperative anxiety in the day surgery context because of its rapid onset and short half-life, meaning that drug effects have all largely subsided by time of discharge from hospital (Smith, Eadie, & O'Rouke-Brophy, 1981). Midazolam can be administered via intranasal, sublingual, rectal, and oral routes.

Sedative premedication (i.e., midazolam) prior to surgery may be avoided due to concerns about its aforementioned side effects (Watson & Visram, 2003). However, it is indicated when children are perceived to be particularly anxious and distressed (Hata, 1997; Nordt & Clark, 1997). The use of pharmacologic interventions for preoperative anxiety in the United States varies widely across patient age groups and geographic locations (Kain, Caldwell-Andrews, Kivutsa, et al., 2004; Kain, Ferris, Mayes, & Rimar, 1996; Kain, Mayes, Bell, et al., 1997). Kain, Mayes, Bell, and colleagues (1997) completed a large-scale mail survey of U.S. anesthesiologists. Results suggested that premedicant sedative drugs are least often used with children fewer than 3 years of age and most often used with adults fewer than 65 years of age (25% versus 75%). Kain Kain, Caldwell-Andrews, Kivutsa, et al. (2004) recently completed a follow-up to their previous survey. Sedative premedication was received by a significantly larger proportion of children undergoing surgery in 2002 than in 1995 (50% versus 30%). Currently, by far the most commonly used sedative premedicant in the preoperative holding area is midazolam (>96%), followed mostly by fentanyl (a synthetic opioid), and ketamine (an arylcycloalkylamine).

Midazolam has been shown to be an effective premedicant for the reduction of preoperative anxiety in children (Cray, Dixon, Heard, & Selsby, 1996). Although midazolam has a number of routes of administration, our attention will be focused on empirical investigations that employ the oral route because this is by far the most common route of administration for pediatric patients in the United States (i.e., 93%; Kain, Caldwell-Andrews, Kivutsa, et al., 2004). There have been a significant number of randomized

controlled investigations of orally administered midazolam's effect on preoperative anxiety in children (for review, see Watson & Visram, 2003). In such studies, preoperative measures of child anxiety, distress, and cooperation and postoperative maladaptive behavioral changes are the typical outcomes. Results from the aforementioned investigations have consistently indicated that, compared with placebo, midazolam is an efficacious method of reducing the preoperative anxiety of young children (ages 1 through 10). Dosages of oral midazolam range from 0.25 mg/kg to 1.00 mg/kg up to a total dose of 20 mg depending on the duration of surgery and anxiety level of the child (Cote et al., 2002). A U.S. Food and Drug Administration approved, commercially available midazolam in a syrup form of 2 mg/ml became available in 1998. Cote and colleagues (2002) determined that a dose of 0.25 mg/kg of commercially available midazolam resulted in satisfactory sedation and anxiety reduction within 20 minutes. Increasing the dose to 0.50 mg/kg or 1.00 mg/kg resulted in an increase in the proportion of patients with satisfactory sedation and a shortened time of onset of action. A subsequent investigation found that the minimum time interval for successfully separating premedicated children from their parents is 10 minutes postdrug with a peak sedative effect occurring between 20 and 30 minutes (Levine, Spahr-Schopfer, Hartley, Lerman, & MacPherson, 1993). Evidence has shown that 0.50 mg/kg is the most effective dose with the least amount of side effects (Kain, Caldwell-Andrews, Kivutsa, et al., 2000a; McMillan, Spahr-Schopfer, Sikich, Hartley, & Lerman, 1992; Parnis, Foate, van der Walt, Short, & Crowe, 1992).

Kain and colleagues (2000a) showed orally administered midazolam at the dosage of 0.50 mg/kg to significantly reduce preoperative observer-rated anxiety (as measured by the modified Yale Preoperative Anxiety Scale [Kain, Mayes, Cicchetti, et al., 1997] a widely used measure of observer-rated anxiety in children) in 103 children aged 2 to 8 years. Results from a recent randomized-controlled study by our group (Finley, Stewart, Buffett-Jerrott, Wright, & Millington, 2006) showed that children (4 to 6 years old) who were observer rated as most anxious at presurgery baseline were those that showed the greatest anxiety reactivity to anesthetic induction. However, this significant relationship was true only of children in placebo group. Midazolam eliminated this relationship suggesting that midazolam may be most beneficial (in terms of facilitating anesthetic induction) for anxious children. An additional result identified a group of children who may not benefit from midazolam premedication. Children scoring higher on the impulsivity subscale of a parent-rated measure of temperament displayed more "anxious" behaviors (e.g., fighting mask placement) during

induction than children scoring significantly lower in impulsivity. However, this was only true of children in the midazolam group, with impulsive midazolam-treated children showing no anxiolytic benefit relative to impulsive children in the placebo group. In contrast, nonimpulsive children in the midazolam group did benefit from the anxiolytic effects of this drug relative to nonimpulsive children in the placebo group. Thus, impulsive children may display a paradoxical response to midazolam (see Roelofse & Joubert, 1990), with disruptive reactions resulting from disinhibition of behavior during anesthetic induction. As impulsivity is a temperamental factor that has been found to be a predictor of future problematic behavior in children, including Oppositional Defiant Disorder (Burns, Leonard, James, 2002; Pardini, Obradovic, & Loeber, 2006), it is also possible that the behavior difficulties they are more likely to exhibit at anesthetic induction are not a reflection of anxiety at all, and, therefore, are not responsive to anxiolytic treatment. In summary, this study suggests that midazolam premedication is most helpful for children high in baseline observer-rated anxiety (i.e., when first arriving for surgery), and least helpful for children who are parent-rated as having an impulsive temperament.

Midazolam has also been compared to some alternative methods of alleviating preoperative anxiety. Kain, Caldwell-Andrews, Krivutza, Weinberg, Gaal, and colleagues (2004) compared the effectiveness of "interactive music therapy" to 0.50 mg/kg oral midazolam and to a control group receiving no anxiety-reducing intervention, in 123 children aged 3 through 7 years undergoing outpatient surgery. In the interactive music therapy group, the music therapist played music to the child prior to surgery and the child was encouraged to sing and play a musical instrument. During anesthetic induction, the music therapist played the child the same song that had been played prior to entering the operating room (OR). Anxiety was measured at four time points (i.e., holding area, separation from parents, entrance to OR, and anesthetic induction). Results indicated that children in the music and midazolam groups were less anxious than control children at separation from parents and entrance to the OR and that the midazolam group was significantly less anxious at anesthetic induction in comparison to both the music intervention and control groups. No differences in anxiety levels were found between the music intervention and control groups at anesthetic induction. Kain, Caldwell-Andrews, Krivutza, Weinberg, Gaal, and colleagues (2004) concluded that interactive music therapy may be useful in alleviating preoperative anxiety on separation from parents and entrance to the OR, however music therapy did not appear to alleviate anxiety at anesthetic

induction. In contrast, midazolam appears to be an effective anxiolytic at all of these potentially stressful time points.

The effectiveness of midazolam in alleviating preoperative anxiety has also recently been compared to hypnosis (i.e., "altered state of consciousness based upon the principle of dissociation, with a concentrated but focused attention" [Calipel, Lucas-Polomeni, Wodey, & Ecoffey, 2005, p. 276]; for a review of hypnosis please see Hammond [1990]). Calipel and colleagues (2005) evaluated the efficacy of hypnosis applied 30 minutes prior to surgery to reduce preoperative anxiety and maladaptive postoperative behavior changes against premedication with midazolam in 50 children aged 2 through 11 years undergoing ambulatory lower abdominal surgery. Results indicated that hypnosis was more effective than midazolam in reducing preoperative anxiety. Some children treated with hypnosis even appeared less anxious at application of the face mask than at arrival at the surgery department. Hypnosis was also found to reduce maladaptive behavioral changes during the first 2 postoperative weeks when compared to midazolam. It was speculated that the use of hypnosis also allows the child to actively participate in the induction experience in a relaxed state, likely leaving them with a pleasant memory. The pleasant memory of the induction experience may facilitate easy inductions in subsequent surgeries, as opposed to the use of midazolam that often leaves the child amnestic of the induction experience, as will be discussed in more detail next. It is important to note that there was no hypnosis placebo control (e.g., relaxation training without hypnotic suggestion) in this study. This is an important control as there is considerable overlap between relaxation and hypnosis (Richardson, Smith, McCall, & Pilkington, 2006), and it would be important to be able to parcel out whether there are specific benefits to providing hypnosis over relaxation training.

Although midazolam is an effective method to alleviate anxiety in children, it is not without its disadvantages. For example, the use of midazolam as a premedicant has been associated with delay in discharge of patients from hospital in some investigations (e.g., Viitanen, Annila, Viitanen, & Tarkkila, 1999; Viitanen, Annila, Viitanen, Yli-Hankala, 1999), whereas others have not observed any associated delay (e.g., Kain, Mayes, et al., 2000; Lewyn, 1993; McGraw & Kendrick, 1998). A subsequent investigation observed significant delays in recovery time but no delays in discharge time from the hospital (Lapin, Auden, Goldsmith, & Reynolds, 1999). Furthermore, some children who receive oral midazolam as a premedicant have been found to experience maladaptive behavioral changes

after outpatient surgery. For example, McGraw and Kendrick (1998) found an increase in adverse behavior changes (nightmares, night terrors, food rejection, anxiety, negativism) in children premedicated with midazolam. Sleep disturbances have also been observed among children who have received midazolam (Stewart, 2006).

Midazolam is also known to impair the explicit memory abilities of adult patients undergoing conscious sedation, whereas their implicit memory abilities stay intact (e.g., Polster, McCarthy, O'Sullivan, Gray, & Park, 1993). Several studies have documented impaired explicit memory in pediatric patients administered midazolam. Nonetheless, the large majority of these studies with children have suffered methodological problems (for further information see Stewart, Buffett-Jerrott, Finley, Wright, & Valois Gomez, 2006). A recent study by our group (Buffett-Jerrott, Stewart, Finley, & Loughlan, 2003) was designed to overcome these methodological limitations. A total of forty 4- to 6-year-old children undergoing myringotomy (ear tube surgery) were randomly assigned to either a midazolam or placebo group. Relative to placebo, midazolam impaired performance on a standardized cued recall task (Greenbaum & Graf, 1989) and decreased free recall of hospital events occurring during the window of drug influence. Moreover, these explicit memory impairments were not simply secondary to midazolam's sedative and attention-impairing effects. Memory becomes impaired in children after oral midazolam as early as 10 minutes postdrug and anxiolytic effects are apparent as early as 15 minutes after administration (Kain, Hofstader, et al., 2000).

Some have argued that amnesia surrounding surgical events may be beneficial (DeJong & Verburg, 1988). However, Watson and Visram (2003) question this assertion. Children may wake up from surgery and not realize that their surgery had been performed. Furthermore, the induction experience may not have been negative. Without the memory of this induction experience, subsequent surgery experiences may appear novel and distressing. One could argue that had the child retained the memory of a prior positive induction experience, a subsequent surgical experience may not induce such distress.

In fact, in a recent placebo-controlled study by our group (Stewart, 2006), we showed an unexpected rebound in observer-rated anxiety among children (4 to 6 years old) randomized to the midazolam versus control group when anxiety ratings were taken postsurgery, just after children had left the recovery room. As in our previous work (Finley et al., 2006), the midazolam was effective in reducing children's anxiety displays relative to placebo at mask induction of anesthetic. The observed paradoxical increase

in anxiety postsurgery among the children receiving midazolam is consistent with Watson and Visram's (2003) suggestion that children may wake up from surgery anxious because they do not realize the surgery has been performed due to midazolam's impairments of their explicit memory abilities (Stewart, 2006).

Parental Presence

The practice of treating or preventing childhood preoperative anxiety by allowing parental presence during the child's anesthetic induction is a hotly debated topic (McCann & Kain, 2001). Results from surveys of parents' and professionals' attitudes regarding parental presence at anesthesia induction suggest that most parents prefer to be present during their child's induction and that they feel that their presence is of benefit to their child (Bauchner, Vinci, & Waring, 1989; Braude, Ridley, & Sumner, 1990; Henderson, Baines, & Overton, 1993; Ryder & Spargo, 1991). Kain, Caldwell-Andrews, Wang, and colleagues (2003) examined parental intervention choices for children undergoing repeated surgeries. More than 80% of all parents of children undergoing a current surgery chose to be present during anesthetic induction (regardless of whether the child was receiving midazolam premedication). This parental preference to be present at induction occurred regardless of the intervention that the child had received previously (i.e., parental presence, sedative premedication, or no intervention). Of those parents who were present during anesthetic induction at the initial surgery, 70% chose to be present during anesthetic induction again. However, only 23% of the parents whose children received midazolam at the initial surgery requested midazolam at the subsequent surgery and only 15% of the patients who received no intervention at the initial surgery requested no intervention at the subsequent surgery. Nevertheless, data obtained from a 1995 survey of U.S. anesthesiologists indicated that parental presence during induction of anesthesia was allowed in only 26% of hospitals and encouraged in even fewer (i.e., only 8% of hospitals; Kain, Mayes, Bell, et al., 1997). Furthermore, although 28% of hospitals had no formal policy on the issue, in 32% of U.S. hospitals, it was against hospital policy to have parents present in the OR. Anesthesiologists from Great Britain encourage parental presence significantly more than those from the United States (Kain, Ferris, et al., 1996, Kain, Mayes, Bell, et al., 1997). Kain, Caldwell-Andrews, Krivutza, and colleagues (2004) recently completed a follow-up survey to examine the trends in practice of parental presence and sedative premedication across the United States. Overall, results

indicated that parents were more frequently allowed to be present during induction in 2002 as compared to 1995. Specifically, parental presence was allowed in 32% of hospitals and encouraged in 11% of hospitals. A total of 23% of hospitals had no formal policy for parental presence. However, 26% of those surveyed indicated that their hospital had a formal policy precluding parental presence. Kain, Caldwell-Andrews, Krivutza, and colleagues (2004) indicated that the significant increase in parental presence and in sedative premedication (discussed previously) may be associated with the increased research efforts regarding interventions for preoperative anxiety and the resulting medical literature. It may also be the case that more anesthesiologists are knowledgeable about the possible benefits of reducing preoperative anxiety and were acting based on their knowledge.

A recent investigation examined parent preference to be present during painful medical procedures (venipuncture, laceration repair, lumbar puncture, fracture reduction, and critical resuscitation) by using hypothetical vignettes (Jones, Qazi, & Young, 2005). Participants were 300 parents from four ethnic groups (Black, White, and Hispanic [divided into English-speaking Hispanic and Spanish-speaking]). Regardless of ethnicity, most parents preferred to be active participants by coaching and soothing their child rather than simply observing. A specific downfall of the investigation was that the research methodology used hypothetical scenarios. Parents may respond differently to *in vivo* situations versus such hypothetical scenarios. Additional research involving the querying of an ethnically and racially diverse sample of parents regarding their preference to be present or absent, and active or passive if present, during their child's actual procedure would provide us with richer and potentially more valid results.

Numerous benefits have been put forth for having parents present during medical procedures (i.e., anesthetic induction) (McCann & Kain, 2001). These suggested benefits include eliminating separation anxiety (Gonzalez et al., 1989; Kain, Mayes, et al., 2000), minimization of premedication use (Cameron, Bond, & Pointer, 1996; Hannallah & Rosales, 1983), increasing child cooperation (Doctor, 1994), enhancing parental satisfaction (Doctor, 1994; Haimi-Cohen, Amir, Harel, Straussberg, & Varsano, 1996; Powers & Rubenstein, 1999), fulfilling parents' perceived sense of duty to be present (Ryder & Spargo, 1991), and enhancing parental satisfaction with the medical care (Kain, Mayes, et al., 2000). Conversely, objections to parental presence have included the possibility of elevation of parental anxiety (e.g., Bevan et al., 1990; Cameron et al., 1996; Johnston, Bevan, Haig, Kirnon, & Tousignant, 1988), the potential of cardiac rhythm abnormalities and myocardial ischemia among parents (Lerman, 2000), increasing staff workload in

caring for the parent as well as the child (Doctor, 1994), concern about disruption of the OR routine (Pond & Aiken, 1996), increasing child behavioral problems (Foertsch, O'Hara, Stoddard, & Kealey, 1996; Gross, Stern, Levin, Dale, & Wojnilower, 1983), and legal implications of having a parent present in the treatment room (Murphy, 1992).

Given the potential advantages and/or disadvantages of parental presence, researchers have sought to definitively confirm and/or refute the efficacy of this approach in preventing preoperative anxiety for children (for reviews, see Palermo, Drotar, & Tripi, 1999; Piira, Sugiura, Champion, Donnelly, & Cole, 2005; Watson & Visram, 2003). Piira, Sugiura, Champion, Donnelly, and Cole (2005) identified 13 investigations that examined the impact of parental presence on childhood preoperative anxiety (in children ages 1 through 10 years). In such studies, measures of child anxiety, distress, and cooperation were the outcomes typically employed. Interestingly, positive effects for parental presence, including lower levels of child anxiety and distress, were reported in studies in which parents were not randomly assigned to condition but were permitted to self-select presence or absence (Cameron et al., 1996; Hannallah & Rosales, 1983). On the other hand, studies that systematically or randomly assigned parents to presence or absence conditions typically report less encouraging results. For example, Hickmott, Shaw, Goodyer, and Baker (1989) examined the effects of maternal presence on mood and postoperative behavior in 49 children aged 1 to 9 years undergoing elective surgery. Children's moods and cooperation during waiting and anesthetic induction periods, and incidence of technical problems, did not differ significantly as a function of parental presence and/or absence. However, anesthetic induction took longer in the parental presence group. Palermo, Tripi, and Burgess (2000) examined the impact of parental presence during anesthetic induction on 73 infants aged 1 to 12 months. Similarly, results demonstrated no impact of parental presence on the infants' behavioral distress.

Results extending from a series of randomized controlled studies conducted by Kain and colleagues suggest that parental presence during anesthesia induction is not beneficial (Kain, Mayes, Caramico, Silver, et al., 1996; Kain, Mayes, et al., 2000; Kain, Mayes, Wang, Caramico, & Hofstadter, 1998). Kain, Mayes, Caramico, Silver, and colleagues (1996) randomly assigned 84 children aged 1 to 6 years to either a parental presence or parental absence condition. Behavioral (i.e., observer- and child self-reported anxiety) and physiological (i.e., cortisol levels) measures were used to assess the children's anxiety and distress. Overall, there were no significant differences between the groups on any of the outcome measures.

However, Kain, Mayes, Caramico, Silver, and colleagues (1996) identified three groups of children who showed a diminished stress response with parental presence: children older than 4 years of age, children whose parents had low trait anxiety, and children who were more temperamentally inhibited according to parental ratings. Supplementary research has shown that child anxiety and distress during anesthetic induction is associated both with parents' level of anxiety (e.g., Bevan et al., 1990; Cameron et al., 1996; Glazebrook, Lim, Sheard, & Standen, 1994; Johnston et al., 1988) as well as with the child's age and temperament (e.g., Glazebrook et al., 1994; Lumley, Abeles, Melamed, Pistone, & Johnson, 1990). For example, Bevan and colleagues (1990) found that children (2 to 10 years old) of parents with elevated anxiety that were present during anesthetic induction, displayed more distress than children of parents with elevated anxiety that were not present during induction. Very recently, Kain, Caldwell-Andrews, Maranets, Nelson, and Mayes (2006) sought to examine whether parental presence during anesthetic induction is useful in reducing child anxiety based on the interaction between child and parents' baseline anxiety using data collected over the course of their various research studies (586 children aged 2-12 years). The presence of a calm parent was beneficial for a baseline anxious child in alleviating child anxiety during anesthetic induction. In contrast, the presence of an anxious parent had no benefit for either baseline calm or anxious children.

Caldwell-Andrews, Kain, Mayes, Kerns, and Ng (2005) noted that over the course of their research, many parents commented on their perioperative experience. These comments highlighted parents' experience of tension about their anxiety regarding being in the OR, their desire to be present when their child undergoes anesthetic induction, and their beliefs about how necessary or helpful their presence might be. Based on these comments, it was postulated that parental motivation might explain why parental presence may reduce anxiety in some children and not in others. In an effort to explore this notion, Caldwell-Andrews and colleagues explored the motivation behind mothers wanting to be present during their child's anesthetic induction in 289 mother-child dyads where the child was undergoing outpatient, elective surgery. The children in this investigation were aged 2 through 12 years. Caldwell-Andrews and colleagues found that children of mothers who were highly motivated to be present during anesthetic induction were more anxious than children of mothers who were less motivated to enter the OR. Furthermore, the group of mothers who highly desired to be present in the OR reported higher state anxiety at anesthetic induction. Caldwell-Andrews and colleagues indicated that they were surprised

about their findings as they had hypothesized that the children of parents who highly desire to be present in the OR would be less anxious. Caldwell-Andrews and colleagues indicated that they believed that their findings could be explained by three mechanisms: (a) some anxious mothers have a high desire to be present during anesthetic induction as a way to manage their own anxiety, and these mothers' anxiety may elevate their children's anxiety; (b) some mothers may have less desire to be present in the OR as a function of their confidence in their child's ability to cope with the experience; (c) mothers who valued preparation and coping had children who were significantly less anxious during anesthetic induction and these mothers also were significantly less anxious themselves in comparison to mothers who did not value preparation and coping. These speculations are deserving of further research.

Given that midazolam has been found to be an effective anxiety-reducing intervention, Kain, Mayes, and colleagues (1998) sought to compare its effectiveness with that of parental presence. Kain and colleagues examined this issue in 93 children aged 2 to 8 years undergoing elective surgery. Children were randomly assigned one of three groups: (a) parental presence, (b) 0.50 mg/kg oral midazolam, or (c) no intervention control. Children in the midazolam group were significantly less anxious at anesthetic induction than both the parental presence and the no-intervention control groups. The difference in anxiety between the parental presence and no-intervention groups was not significant. Kain, Mayes, and colleagues (2000) subsequently hypothesized that even if parental presence alone is not effective in treating or preventing child preoperative anxiety, parental presence might interact with pharmacotherapy to improve clinical outcomes further. They thus examined the effects of 0.50 mg/kg oral midazolam alone versus 0.50 mg/kg oral midazolam plus parental presence versus no intervention control during anesthetic induction in 103 children aged 2 to 8 years who were randomly assigned to one of the three groups. Contrary to hypothesis, parental presence had no additional effects in reducing children's preoperative anxiety over and above midazolam. However, parents who were present during anesthetic induction reported less anxiety after separation from their child and more satisfaction with the separation process and overall care provided relative to parents randomized to the midazolam only group. More recently, Kain, Caldwell-Andrews, Mayes, Wang, and colleagues (2003) examined the physiological effects on parents when parents are present during anesthetic induction in 80 children aged 1 to 8 years undergoing elective surgery. They used a three group design identical to the one mentioned above (i.e., Kain, Mayes, et al., 2000). They

found no significant group differences in parental self-reported anxiety or electrocardiogram abnormalities at children's anesthetic induction. However, increased parental heart rate and skin conductance levels were observed for parents who were present during anesthesia induction, suggesting that parental presence does cause heightened parental arousal.

Piira and colleagues (2005) pointed out that for the most part, parents were not routinely informed about what they could do to help their child if they were going to be present during the procedure. Other investigations have shown that parents desire information regarding how they could best help their child (Neill, 1996; Simons, Franck, & Robertson, 2001). Given this, Piira and colleagues (2005) assert that the combination of information provision and parental presence could further improve parent and child outcomes when parents are present during medical procedures such as anesthetic induction. Unfortunately, however, there is currently a gap in the evidence base to indicate which types of behaviors would be most useful for parents to employ in the operating room context (i.e., limited knowledge of which particular parental behaviors are associated with or cause decreased child anxiety and distress in the context of anesthetic induction).

Preparation Programs

Over the past two decades, there have been promising developments in the field of preparation for medical procedures (i.e., behavioral interventions to help prepare the child for the procedures to come). Initially, it was thought that preparation programs should be designed to facilitate information provision, encourage the expression of emotions, and establish trust between child and medical staff (Vernon et al., 1965). The 1970s brought a shift in the research literature to focus on modeling preparation programs that provided children exposure to the anesthesia experience via videotape or puppet show (e.g., Melamed & Siegel, 1975) and stress-point nursing (repeated information and support) (e.g., Visintainer & Wolfer, 1975; Wolfer & Visintainer, 1975). These programs had a focus on teaching children coping strategies in addition to information provision. By the early 1980s, agreement had been reached that modeling, parental involvement, Child Life preparation (in which Child Life specialists facilitate coping and improved adjustment skills to surgery for children and parents by providing play experiences, making information about procedures more accessible to children, and providing encouragement and support to families) (American Academy of Pediatrics Committee on Hospital Care,

1993), and coping skills instruction (Melamed & Ridley-Johnson, 1988) were components of an effective preparation program.

O'Byrne and colleagues (O'Byrne, Peterson, & Saldana, 1997) were interested in evaluating whether this shift in research had spilled over into actual medical practice. To do so, O'Byrne and colleagues surveyed 123 nonchronic-care pediatric hospitals in the United States. Findings suggested that hospitals had greatly increased their use of empirically supported techniques, such as modeling films and teaching coping strategies. For example, in 1980 (Peterson & Ridley-Johnson, 1980) only 16% of pediatric hospitals taught coping strategies and by 1996 almost half of hospitals taught such strategies (O'Byrne et al., 1997). Furthermore, in 1980, 37% of pediatric hospitals used films for surgery preparation and by 1996 nearly half (48%) did so. In turn, results from this investigation suggested that most hospitals provide some sort of preparation (i.e., tour, printed material, narrative preparation, puppet show, play therapy, film, relaxation, coping) to the majority of children (up from an average of 42% in 1980), and universally the parent and child are involved, consistent with suggestions from the empirical literature. Although these findings are encouraging, O'Byrne and colleagues (1997) pointed out a number of less encouraging results. For example, despite the lack of effectiveness of hospital tours (Peterson, Schultheis, Ridley-Johnson, Miller, & Tracy, 1984), hospital tours were still employed for 87% of child surgery patients. Similarly, play therapy (e.g., play used as a method to learn about the experience of surgery and explore the thoughts and feelings associated with surgery [see Schaefer & O'Connor, 1983, for review of play therapy]) was used more often than teaching relaxation and coping strategies, despite limited empirical evidence for the effectiveness of play therapy in this context (O'Byrne et al., 1997).

The latter finding is particularly interesting as O'Byrne and colleagues (1997) additionally asked a panel of psychological experts to rate the effectiveness of behavioral preparation programs used in the United States prior to surgery. Experts rated each program on a 1 (least effective) to 9 (most effective) Likert scale. Coping skills instruction was ranked as the most effective preoperative intervention, followed by modeling, play therapy, OR tours, and printed materials. As a result of such findings, Kain and colleagues (Kain, Carmico, et al., 1998) compared three types of behavioral preoperative preparation programs including a tour of the OR (information based), a commercially available videotape (modeling based), or a Child Life preparation (coping based) with 75 children aged 2 to 12 years.

Children and parents who received Child Life coping skills preparation exhibited less anxiety immediately following the preparation in the holding area on the day of surgery and on separation to the OR than children and parents who did not receive this preparation. However, there were no significant differences in anxiety levels across the groups during anesthetic induction, in the recovery room, or at 2 weeks following the operation. Kain and colleagues (Kain, Carmico, et al., 1998) asserted that this particular Child Life program, which is more extensive and costly than the other two interventions, was effective for low-stress periods, such as preoperative holding, but not for high-stress periods, such as anesthetic induction. Furthermore, Kain and colleagues speculated that children may not be able to produce or utilize previously learned coping strategies in times of very high stress such as at anesthetic induction. However, they suggested that providing children with cues or reminders of these previously learned techniques during times of higher stress may prove useful (see Kobasigawa, 1974).

Kain and Caldwell-Andrews (2005) indicate that a number of variables are important to consider when designing a preparation program. These variables include child age, timing relative to surgery, and the child's previous hospitalization history. For example, a preparation program that is appropriate for a 3 year old may not be appropriate for a 12 year old. The timing of the particular preparation program prior to the surgery has been identified as a significant factor as well. For example, participation in a preparation program more than 5 to 7 days prior to surgery has been found to be most beneficial for children 6 years and older and the least beneficial when the program is given 1 day before surgery (Kain, Mayes, & Caramico, 1996; Melamed, Meyer, Gee, & Soule, 1976; Robinson & Kobayashi, 1991).

Previous hospitalization history can be a particular challenge for designing a preparation program as well (Kain & Caldwell-Andrews, 2005). Information about what to expect on day of surgery does not offer new knowledge to these children. In turn, Faust and Melamed (1984) demonstrated that simple modeling and play programs are not beneficial for children with previous hospitalizations. Individualized coping skills training in combination with actual practice have been identified as strategies that are more helpful for these children (Kain, Mayes, et al., 1996). Kain and Caldwell-Andrews (2005) suggest that the latter types of programs should be designed with the child's specific past experiences in mind.

Research has shown that parents who participate in a preparation program or who view a preoperative video regarding anesthesia demonstrate reduced preoperative anxiety on the day of surgery (Cassady, Wysocki, Miller,

Cancel, & Izenberg, 1999; Kain, Mayes, et al., 1996; Pinto & Hollandsworth, 1989). However, Kain, Carmico, and colleagues (1998) found that the parental anxiety reduction does not extend to the following important time points: anesthetic induction, recovery, or 2 weeks postoperatively. Kain and Caldwell-Andrews (2005) indicated that the use of videotapes has gained more attention recently as a supplemental mode of education as they facilitate information provision, are possibly anxiolytic, and are less costly than most of the above described procedures (Cassady & Kain, 2000; Pinto & Hollandsworth, 1989).

Music

Both the Canadian Association for Music Therapy (2006) and American Music Therapy Association (2003) support the use of music during the perioperative period to alleviate anxiety. The knowledge that music is useful to alleviate anxiety prior to surgery or medical procedures far precedes this recent assertion. For example, in the early 1900s music was documented as a method to distract patients from trauma associated with surgery (Kane, 1914). In the recent past, the use of music to reduce preoperative anxiety in adult samples has gained research interest (Wang, Caldwell-Andrews, & Kain, 2003; Wang, Kulkarni, Dolev, & Kain, 2002; Wang, Peloquin, & Kain, 2001). For example, Wang and colleagues (2002) examined the utility of music to decrease anxiety prior to surgery in a randomized-controlled investigation of 93 adults undergoing elective outpatient surgery. Results suggested that patients who listened to music reported being less anxious after the intervention. However, no significant differences were identified on physiological measures of anxiety (i.e., blood pressure, heart rate, electrodermal activity) or neuroendocrine variables (i.e., cortisol, epinephrine, and norephinephrine).

Music therapy as a potential anxiety prevention and treatment strategy has been extended to children in recent years (Kain, Caldwell-Andrews, Krivutza, Weinberg, Gaal, et al., 2004). For example, Kain, Caldwell-Andrews, Krivutza, Weinberg, Gaal, and colleagues (2004) compared the effectiveness of an interactive music intervention and midazolam in alleviating preoperative anxiety in 123 children aged 3 to 7 years old. As mentioned in the previous section on the efficacy of midazolam, the results of this study suggested that interactive music therapy may be useful in alleviating preoperative anxiety on separation from parents and entrance to the OR, but that music therapy did not appear to alleviate children's anxiety at anesthetic induction. In addition, this type of intervention is somewhat

costly (US$50-$125 hour). Kain, Caldwell-Andrews, Krivutza, Weinberg, Gaal, and colleagues (2004) assert that it is unlikely that this type of therapy would become routine given its lack of effectiveness in reducing anxiety during anesthetic induction and its relatively high associated cost.

Acupuncture

Acupuncture has been examined as a potential alternative anxiolytic intervention to alleviate preoperative anxiety in several studies in the pediatric surgery context (i.e., Wang & Kain, 2001; Wang, Peloquin, & Kain, 2001). Wang and Kain (2001) indicate that acupuncture represents an intervention modality that is easily administered (less than one minute), is relatively inexpensive, and has few negative side effects. Wang, Gaal, Maranets, Caldwell-Andrews, and Kain (2005) recently employed this intervention modality to alleviate parental anxiety during the pediatric day surgery process. Alleviation of parental anxiety in this context deserves attention as research has established a significant relationship between parental anxiety and child anxiety during the preoperative period (e.g., Bevan et al., 1990; Kain et al., 2006). Participants were parents who were randomly assigned to receive acupuncture (via acupuncture bead) at the Yingtang point (midpoint between the two eyebrows) or at a sham point (control group). The intervention lasted for approximately 20 to 30 minutes. Results suggested that parents who received acupuncture at the Yingtang point reported significantly less anxiety 20 minutes postintervention (postapplication of acupuncture) in comparison to the control group. However, no differences in heart rate and arterial blood pressure were observed. Wang and colleagues (2005) view these findings as promising. Next steps would be to examine the duration of the anxiolytic effect for parents and to determine its effect on child anxiety.

Discussion

A significant number of children undergo surgery. A large proportion of such children experience substantial anxiety. A number of anxiety-reducing intervention strategies have been examined to prevent or alleviate this distress, including sedative premedication (i.e., midazolam), hypnosis, parental presence, behavioral preparation programs, music therapy, and acupuncture. When the applicable literature is examined, some of these interventions are used fairly frequently within the paediatric surgery population (i.e., midazolam,

parental presence, behavioral preparation programs) and others (i.e., acupuncture, hypnosis, interactive music therapy) are used less frequently and may be considered more experimental in nature. The compiled research suggests that midazolam is effective in reducing anxiety prior to surgery and during anaesthetic induction. It has been shown to be superior in this regard relative to parental presence and music therapy, and parental presence does not provide any added benefit when used in conjunction with midazolam. However, midazolam is not without its disadvantages (e.g., delay in emergence, recovery, and discharge, increased incidence of maladaptive behavioral changes postsurgery, amnesia [Watson & Visram, 2003], and paradoxical increase in anxiety postrecovery [Stewart, 2006]).

Parental presence during anaesthetic induction is somewhat controversial. Research suggests that parents often prefer to be present during anaesthetic induction and believe that their presence is helpful. A variety of objections to parental presence have been put forth, however, including possible elevation of parental anxiety, the potential of cardiac rhythm abnormalities and myocardial ischemia among parents, increasing staff workload in caring for the parent as well as the child, concern about disruption of the OR routine, increasing child behavioral problems, and legal implications of having a parent present in the treatment room. In turn, child anxiety during this experience can be affected by parental factors, such parental anxiety. Research suggests that children whose parents are anxious and are present during anesthetic induction have higher anxiety or distress at anesthetic induction than children whose parents are calm and are present during induction. Parents are not typically told what they should do or should not do during induction, and this type of information would be useful to parents (Piira et al., 2005). Research is currently examining the specific child and parent behaviors as well as the interaction between these behaviors that take place during anesthetic induction and its association with child anxiety and distress (Caldwell-Andrews, Blount, Mayes, & Kain, 2005). It is anticipated that findings from this line of research will be used to help inform parents about which strategies are effective to alleviate child anxiety rather than activate or exacerbate existing anxiety.

Research examining behavioral preparation programs indicates that the most effective components of preparation programs include modeling, parental involvement, Child Life preparation, and coping skills instruction. Psychological experts ranked coping skills instruction as the most effective preoperative intervention. Kain, Carmico, et al. (1998) found that children and parents who received Child Life preparation (i.e., where specialists attempt to facilitate coping and improved adjustment skills to surgery for

children and parents) exhibited less anxiety immediately following the preparation in the holding area on the day of surgery and on separation to the OR than children and parents who did not receive this preparation. However, this preparation did not prove helpful in alleviating anxiety during anesthetic induction, in the recovery room, or at 2 weeks following surgery. Children may have difficulty in independently producing previously learned coping strategies during times of heightened stress and may require some memory cueing by parents or adults present during anesthetic induction. Child age, timing of the intervention relative to surgery, and child's history of previous hospitalization are important variables to consider when designing a behavioral preparation program for a given child.

Alternative therapies such as hypnosis, music, and acupuncture have been examined as potential anxiety-reducing interventions. Hypnosis has been found to be more effective than midazolam in reducing preoperative anxiety in one study and also found to reduce maladaptive behavioral changes during the first 2 weeks postsurgery. Future research should continue to explore the utility of hypnosis to prevent preoperative anxiety, and to determine if it is more effective than relaxation therapy alone. Interactive music therapy may be useful in alleviating preoperative anxiety in children on separation from parents and entrance to the OR; however, it does not appear to alleviate children's anxiety at anesthetic induction. In addition, this type of intervention is somewhat costly (Kain, Caldwell-Andrews, Krivutza, Weinber, Gaal, et al., 2004). A preliminary placebo-controlled study on the use of acupuncture to alleviate parental anxiety during the pediatric day surgery process suggests that acupuncture may be effective in reducing parental anxiety reports but that it has no impact on physiological indices of parental anxiety. Future research is necessary to examine the duration of this anxiolytic effect and to determine the effect of acupuncture on child anxiety.

Evidence supporting the use of behavioral strategies such as teaching children coping techniques to alleviate their anxiety has emerged throughout the literature. Although sedative premedication is often employed to reduce anxiety for children during the day surgery process and appears to target the individual symptoms with effect, this intervention modality may not be the most cost-effective option over time. Teaching children coping skills allows them to learn how to calm themselves in times of stress and thus may be useful not just at the time of the surgery in question but at subsequent surgeries as well. In contrast, the use of a sedative may only be useful during that very specific time period. Thus, subsequent surgical experiences may continue to be anxiety-provoking for certain children and

sedative premedication may continue to be required. In fact, some studies indicate that anxiety for subsequent frightening situations may be heightened if a benzodiazepine is used during the first exposure (Wilhelm & Roth, 1997). Given these notions, it would be advantageous for future research to explore the utility of teaching children and parents coping strategies that can be used in the OR during anesthetic induction and to evaluate whether these strategies alleviate child and parent anxiety or distress both at the time they are taught and at future medical procedures.

This review highlights a number of specific research directions. First, limited research has addressed the impact of ethnicity on the preoperative context (e.g., child anxiety, parental preference for parental presence). Subsequent research involving an ethnically and racially diverse sample would provide us with more generalizable findings, given our society is very ethnically and racially rich. Second, the evaluation of the utility of alternative methods of anxiolysis (i.e., parental acupuncture, hypnosis, music therapy) in a randomized manner in children is warranted. Third, the majority of the current research employs the mYPAS (modified Yale Preoperative Anxiety Scale; Kain et al., 1997) as a measure of observer-rated preoperative anxiety. It remains to be determined whether any of the discrepancies that exist within the current literature could be related to measure selection or use. Fourth, because recent research suggests that relatively longer surgeries may be significantly more anxiety-provoking for children (Davidson et al., 2006) future studies could evaluate the efficacy of the various preoperative anxiety interventions as a function of surgery type and duration. Finally, an overarching direction for further research is the identification and clarification of the behaviors that might be helpful for parents to engage in if present during induction; behaviors that would decrease child anxiety and promote coping behaviors. The latter research direction may provide us with greatest source of information—information required for the advancement of the current literature and its application to clinical practice.

References

American Academy of Pediatrics Committee of Hospital Care (CoHC). (1993). Child life programs. *Pediatrics*, *91*, 671-672.

American Music Therapy Association. (2003). *AMTA fact sheet: Music therapy and medicine*. Silver Spring, MD: Author.

Bauchner, H., Vinci, R., & Waring, C. (1989). Pediatric procedures: Do parents want to watch? *Pediatrics*, *84*, 904-909.

Bevan, J. C., Johnston, C., Haig, M. J., Tousignant, G., Lucy, S., Kirnon, V., Assimes, I. K., & Carranza, R. (1990). Preoperative parental anxiety predicts behavioural and emotional

responses to induction of anaesthesia in children. *Canadian Journal of Anesthesia*, *37*, 177-182.

Braude, N., Ridley, S. A., & Sumner, E. (1990). Parents and paediatric anaesthesia: A prospective survey of parental attitudes to their presence at induction. *Annual Royal College of Surgeons of England*, *72*, 41-44.

Buffett-Jerrott, S. E., Stewart, S. H., Finley, G. A., & Loughlan, H. L. (2003). Effects of benzodiazepines on explicit memory in a paediatric surgery setting. *Psychopharmacology*, *168*, 377-386.

Burns, G., Leonard, W., & James, A., (2002). The influence of ADHD-hyperactivity/impulsivity symptoms on the development of Oppositional Defiant Disorder symptoms in a two year longitudinal study. *Journal of Abnormal Child Psychology*, *30*, 245-256.

Burton, L. (1984). Anxiety relating to illness and treatment. In V. Verma (Ed.), *Anxiety in Children* (pp. 151-172). New York: Methuen Croom Helm.

Caldwell-Andrews, A. A., Blount, R. L., Mayes, L. C., & Kain, Z. N. (2005). Behavioral interactions in the perioperative environment. A new conceptual framework and the development of The Perioperative Child-Adult Medical Procedure Interaction Scale. *Anesthesiology*, *103*, 113-1135.

Caldwell-Andrews, A. A., Kain, Z. N., Mayes, L. C., Kerns, R. D., & Ng, D. (2005). Motivation and maternal presence during induction of anesthesia. *Anesthesiology*, *103*, 478-483.

Calipel, S. Lucas-Polomeni, M. M., Wodey, E., & Ecoffey, C. (2005). Premedication in children: Hypnosis versus midazolam. *Paediatric Anaesthesia*, *15*, 275-281.

Cameron, J. A., Bond, M. J., & Pointer, S. C. (1996). Reducing the anxiety of children undergoing surgery: Parental presence during anaesthetic induction. *Journal of Paediatric Child Health*, *32*, 51-56.

Canadian Association for Music Therapy. (2006). *Specific applications of musical techniques in music therapy*. Retrieved June 1, 2006, from www.musictherapy.ca/methods.html

Cassady, J. F. Jr., & Kain, Z. N. (2000). Preoperative preparation for parents of pediatric surgery patients. *Current Anesthesiology Reports*, *1*, 10-17.

Cassady, J. F. Jr., Wysocki, T. T., Miller, K. M., Cancel, D. D., & Izenberg, N. (1999). Use of a preanaesthetic video for facilitation of parental education and anxiolysis before pediatric ambulatory surgery. *Anesthesia and Analgesia*, *88*, 246-250.

Corman, H., Hornick, E., Kritchman, M., & Terestman, N. (1958). Emotional reactions of surgical patients to hospitalization, anesthesia and surgery. *American Journal of Surgery*, *96*, 646-653.

Cote, C. J., Cohen, I. T., Suresh, S., Rabb, M., Rose, J. B., Weldon, B. C., et al. (2002). A comparison of three doses of a commercially prepared oral midazolam syrup in children. *Anesthesia and Analgesia*, *94*, 37-43.

Cray, S. H., Dixon, J. L., Heard, C.M.B., & Selsby, D. S. (1996). Oral midazolam premedication for pediatric day case patients. *Paediatric Anaesthesia*, *6*, 265-270.

Curran, H.V. (1986). Tranquilizing memories: A review of the effects of benzodiazepines on human memory. *Biological Psychology*, *23,* 179-213.

Davidson, A. J., Shrivastava, P. P., Jamsen, K., Huang, G. H., Czarnecki, C., Gibson, M. A., Stewart, S. A., & Stargatt, R. (2006). Risk factors for anxiety at induction of anesthesia in children: A prospective cohort study. *Pediatric Anesthesia*, *16*, 919-927.

DeJong, P. C., & Verburg, M. P. (1988). Comparison of rectal to intramuscular administration of midazolam and atropine for premedication of children. *Acta Anaesthesiology Scandinavia*, *32*, 485-489.

Doctor, M. E. (1994). Parent participation during painful wound care procedures. *Journal of Burn Care Rehabilitation*, *15*, 288-292.

Eckenhoff, J. E. (1953). Relationship of anesthesia to postoperative personality changes in children. *American Journal of Diseases of Children*, *86*, 587-591.

Faust, J., & Melamed, B. (1984). Influence of arousal, previous experience, and age on surgery preparation of same day of surgery and in-hospital pediatric patients. *Journal of Consulting and Clinical Psychology*, *52*, 359-365.

Fell, D., Derbyshire, D. R., Maile, C.J.D., Larsson, I. M., Ellis, R. Achola, K. J., & Smith, G. (1985). Measurement of plasma catecholamine concentrations: An assessment of anxiety. *British Journal of Anaesthesia*, *57*, 770-774.

Finley, G. A., Stewart, S. H., Buffett-Jerrott, S. E., Wright, K. D., & Millington, D. (2006). High levels of impulsivity may contraindicate midazolam premedication in children. *Canadian Journal of Anesthesia*, *53*, 73-78.

Foertsch, C. E., O'Hara, M. W., Stoddard, F. J., & Kealey, G. P. (1996). Parent participation during burn debridement in relation to behavioral distress. *Journal of Burn Care Rehabilitation*, *17*, 372-377.

Glazebrook, C. P., Lim, E., Sheard, C. E., & Standen, P. J. (1994). Child temperament and reaction to induction of anaesthesia: Implications for maternal presence in the anaesthetic room. *Psychological Health*, *10*, 55-67.

Gonzalez, J. C., Routh, D. K., Saab, P. G., Armstrong, F. D., Shifman, L., Guerra, R., & Fawcett, N. (1989). Effects of parent presence on children's reactions to injections: Behavioral, physiological, and subjective. *Journal of Pediatric Psychology*, *14*, 449-462.

Greenbaum, J. L., & Graf, P. (1989). Preschool period development of implicit and explicit remembering. *Bulletin of the Psychonomic Society*, *27*, 417-420.

Gross, A. M., Stern, R. M., Levin, R. B., Dale, J., & Wojnilower, D. A. (1983). The effect of mother-child separation on the behavior of children experiencing a diagnostic medical procedure. *Journal of Consulting and Clinical Psychology*, *51*, 783-785.

Haimi-Cohen, Y., Amir, J., Harel, L., Straussberg, R., & Varsano, Y. (1996). Parental presence during lumbar puncture: Anxiety and attitude towards the procedure. *Clinical Pediatrics*, *35*, 2-4.

Hammond, D. C. (Ed.) (1990). *Handbook of hypnotic suggestions and metaphors.* New York: The American Society of Clinical Hypnosis.

Hannallah, R. S., & Rosales, J. K. (1983). Experience with parents' presence during anaesthesia induction in children. *Canadian Anaesthetists' Society Journal*, *30*, 286-289.

Hata, T. (1997). Preparation and intraoperative management of the pediatric patient. *Pediatric Annals*, *26*, 471-481.

Henderson, M. A., Baines, D. B., & Overton, J. H. (1993). Parental attitudes to presence at induction of paediatric anaesthesia. *Anaesthia Intensive Care*, *21*, 324-327.

Hickmott, K. C., Shaw, E. A., Goodyer, I., & Baker, R. D. (1989). Anaesthetic induction in children: The effects of maternal presence on mood and subsequent behaviour. *European Journal of Anaesthesiology*, *6*, 145-155.

Hunter, D. S. (1989). The use of physical restraint in managing out-of-control behavior in youth: A frontline perspective. *Child and Youth Care Quarterly*, *18*, 141-154.

Johnston, C. C., Bevan, J. C., Haig, M. J., Kirnon, V., & Tousignant, G. (1988). Parental presence during anesthesia induction: A research study. *Association of Operating Room Nurses Journal*, *47*, 187-194.

Jones, M., Qazi, M., & Young, K. D. (2005). Ethnic differences in parental preference to be present for painful medical procedures. *Pediatrics*, *116*, 191-197.

Kain, Z. N., & Caldwell-Andrews, A. A. (2005). Preoperative psychological preparation of the child for surgery: An update. *Anesthesiology Clinics of North America*, *23*, 597-614.

Kain, Z. N., Caldwell-Andrews, A. A., Krivutza, D. M., Weinberg, M. E., Gaal, D., Wang, S-M., & Mayes, L. C. (2004). Interactive music therapy as a treatment for preoperative anxiety in children: A randomized controlled trial. *Anesthesia and Analgesia*, *98*, 1260-1266.

Kain, Z. N., Caldwell-Andrews, A. A., Krivutza, D. M., Weinberg, M. E., Wang, S-M., & Gaal, D. (2004). Trends in the practice of parental presence during induction of anesthesia and the use of preoperative sedation premedication in the United States, 1995-2000: Results of a follow-up national survey. *Anesthesia and Analgesia*, *98*, 1252-1259.

Kain, Z. N., Caldwell-Andrews, A. A., Lodolce, M. E., Krivutza, D. M., & Wang, S-M. (2002). The perioperative behavioral stress response in children. *Pediatric Anesthesia*, *97*, A1242.

Kain, Z. N., Caldwell-Andrews, A. A., Maranets, I., Nelson, W., & Mayes, L. C. (2006). Predicting which child-parent pair will benefit from parental presence during induction of anesthesia: A decision-making approach. *Anesthesia and Analgesia*, *102*, 81-84.

Kain, Z. N., Caldwell-Andrews, A. A., Mayes, L. C., Wang, S-M., Krivutza, D. M., & Lodolce, M. E. (2003). Parental presence during induction of anesthesia: Physiological effects on parents. *Anesthesiology*, *98*, 58-64.

Kain, Z. N., Caldwell-Andrews, A. A., Wang, S-M., Krivutza, D. M., Weinberg, M. E., & Mayes, L. C. (2003). Parental intervention choices for children undergoing repeated surgeries. *Anesthesia and Analgesia*, *96*, 970-975.

Kain, Z. N., Carmico, L. A., Mayes, L., Genervo, J. L., Bornstein, M.H., & Hofstader, M.B. (1998). Preoperative preparation programs in children: A comparative examination. *Anesthesia and Analgesia*, *87,* 1249-1255.

Kain, Z. N., Ferris, C. A., Mayes, L. C., & Rimar, S. (1996). Parental presence during induction of anaesthesia: Practice differences between the United States and Great Britain. *Paediatric Anaesthesia*, *6,* 187-193.

Kain, Z. N., Hofstader, M. B., Mayes, L. C., Krivutza, D. M., Alexander, G., Wang , S. M., & Reznick, J. S. (2000). Midazolam: Effects of amnesia and anxiety in children. *Anesthesiology*, *93*, 676-684.

Kain, Z. N., & Mayes, L. (1996). Anxiety in children during the perioperative period. In M. Bornstein, & J. Genevro (Eds.), *Child development and behavioral pediatrics* (pp. 85-103). Mahwah, NJ: Lawrence Erlbaum.

Kain, Z. N., Mayes, L., Bell, C., Weisman, S., Hofstader, M .B., & Rimar, S. (1997). Premedication in the United States: A status report. *Anesthesia and Analgesia*, *84*, 427-432.

Kain, Z. N., Mayes, L. C., & Caramico, L. A. (1996). Preoperative preparation in children: A cross-sectional study. *Journal of Clinical Anesthesia*, *8*, 508-514.

Kain, Z. N., Mayes, L. C., Caramico, L. A., Silver, D., Spieker, M., Nygren, M. M., Anderson, G., & Rimar, S. (1996). Parental presence during induction of anesthesia: A randomized controlled trial. *Anesthesiology*, *84*, 1060-1067.

Kain, Z. N., Mayes, L. C., Cicchetti, D. V., Bagnall, A. L., Finley, J. D., & Hofstadter, M. B. (1997). The Yale Preoperative Anxiety Scale: How does it compare with a "gold standard"? *Pediatric Anesthesia*, *85*, 783-787.

Kain, Z. N., Mayes, L., O'Connor, T. Z., & Cicchetti, D. V. (1996). Preoperative anxiety in children: Predictors and outcomes. *Archives of Pediatric and Adolescent Medicine*, *150*, 1238-1245.

Kain, Z. N., Mayes, L., Wang, S-M., Caramico, L. A., & Hofstadter, M. B. (1998). Parental presence during induction of anesthesia versus sedative premedication: Which intervention is more effective? *Anesthesiology*, *89*, 1147-1156.

Kain, Z. N., Mayes, L., Wang, S-M., Caramico, L. A., Krivutza, M. A., & Hofstadter, M. B. (2000). Parental presence and a sedative premedication for children undergoing surgery: A hierarchical study. *Anesthesiology*, *92*, 939-945.

Kain, Z. V., Wang, S-M., Mayes, L. C., Caramico, L. A., & Hofstadter, M. B. (1999). Distress during the induction of anesthesia and postoperative behavioral outcomes. *Anesthesia and Analgesia*, *88*, 1042-1047.

Kane, E. (1914). The phonograph in the operating room. *Journal of the American Medical Association*, *62*, 1829.

Kobasigawa, A. (1974). Utilization of retrieval cues by children in recall. *Child Development*, *45*, 127-134.

Lapin, S. L., Auden, S. M., Goldsmith, J., & Reynolds, A-M. (1999). Effects of sevoflurane anaesthesia on recovery in children: A comparison with halothane. *Paediatric Anaesthesia*, *9*, 299-304.

Lerman, J. (2000). Anxiolysis: By the parent or for the parent? *Anesthesiology*, *92*, 925-927.

Levine, M. F., Spahr-Schopfer, I. A., Hartley, E., Lerman, J., & MacPherson, B. (1993). Oral midazolam premedication in children: The minimum time interval for separation from parents. *Canadian Journal of Anaesthesia*, *40*, 726-729.

Lewyn, M. J. (1993). Should parents be present while their children receive anesthesia? *Anesthesia Malpractice Protection*, *5*, 56-57.

Lumley, M. A., Abeles, L. A., Melamed, B. G., Pistone, L .M., & Johnson, J. H. (1990). Coping outcomes in children undergoing stressful medical procedures: The role of child-environmental variables. *Behavioral Assessment*, *12*, 223-238.

Lumley, M. A., Melamed, B. G., & Abeles, L. A. (1993). Predicting children's presurgical anxiety and subsequent behavior changes. *Journal of Pediatric Psychology*, *18*, 481-497.

Mccann, M., & Kain, Z. N. (2001). The management of preoperative anxiety in children: An update. *Anesthesia and Analgesia*, *93*, 98-105.

Mcgraw, T., & Kendrick, A. (1998). Oral midazolam premedication and postoperative behavior in children. *Paediatric Anaesthesia*, *8*, 117-121.

McMillan, C. O., Spahr-Schopfer, I. A., Sikich, N., Hartley, E., & Lerman J. (1992). Premedication of children with oral midazolam. *Canadian Journal of Anaesthesia*, *39*, 545-550.

Melamed, B., Meyer, R., Gee, C., & Soule, L. (1976). The influence of time and type of preparation on children's adjustment to hospitalization. *Journal of Pediatric Psychology*, *1*, 31-37.

Melamed, B., & Ridley-Johnson, R. (1988). Psychological preparation of families for hospitalization. *Developmental and Behavioral Pediatrics*, *9*, 96-102.

Melamed, B., & Siegel, L. J. (1975). Reduction of anxiety in children facing hospitalization and surgery by use of film modeling. *Journal of Consulting and Clinical Psychology*, *43*, 511-521.

Murphy, E. K. (1992). Issues regarding parents in the operating room during their children's care. *AORN Journal*, *56*, 120-124.

Neill, S. J., (1996). Parent participation II: Findings and their implications for practice. *British Journal of Nursing*, *5*, 110-117.

Nordt, S., & Clark, R. F. (1997). Midazolam: A review of therapeutic uses and toxicity. *Journal of Emergency Medicine*, *15*, 357-365.

O'Byrne, K. K., Peterson, L., & Saldana, L. (1997). Survey of pediatric hospitals' preparation programs: Evidence of the impact of health psychology research. *Health Psychology*, *16*, 147-154.

Palermo, T. M., Drotar, D. D., & Tripi, P. A. (1999). Current status of psychosocial intervention research for pediatric outpatient surgery. *Journal of Clinical Psychology in Medical Settings*, *6*, 405-426.

Palermo, T. M., Tripi, P. A., & Burgess, E. (2000). Parental presence during anaesthesia induction for outpatient surgery of the infant. *Paediatric Anaesthesia*, *10*, 487-491.

Pardini, D., Obradovic, J., & Loeber, R. (2006). Interpersonal callousness, hyperactivity/impulsivity, inattention and conduct problems as precursors to delinquency persistence in boys: A comparison of three grade based cohorts. *Journal of Clinical Child and Adolescent Psychology*, *365*, 46-59.

Parnis, S. J., Foate, J. A., van der Walt, J. H., Short, T., & Crowe, C. E. (1992). Oral midazolam is an effective premedication for children having day-stay anaesthesia. *Anaesthesia and Intensive Care*, *20*, 9-14.

Pearson, G. (1941). Effect of operative procedures on the emotional life of a child. *American Journal of Diseases of Children*, *62*, 716-729.

Peterson, L., & Ridley-Johnson, R. (1980). Pediatric hospital response to survey on prehospital preparation for children. *Journal of Pediatric Psychology*, *5*, 1-7.

Peterson, L., Schultheis, K., Ridley-Johnson, R., Miller, D. V., & Tracy, K. (1984). Comparison of three modeling procedures on the presurgical and postsurgical reactions of children. *Behavior Therapy*, *15*, 197-203.

Pinto, R. P., & Hollandsworth, J. G. Jr. (1989). Using videotape modeling to prepare children psychologically for surgery: Influence of parents and costs versus benefits of providing preparation services. *Health Psychology*, *8*, 79-85.

Piira, T., Sugiura, T., Champion, G. D., Donnelly, N., & Cole, A.S.J. (2005). The role of parental presence in the context of children's medical procedures: A systemic review. *Child: Care, Health, and Development*, *31*, 233-243.

Polster, M. R., McCarthy, R. A., O'Sullivan, G., Gray, P. A., & Park, G. R. (1993). Midazolam-induced amnesia: Implications for the implicit/explicit memory distinction. *Brain and Cognition*, *22*, 244-265.

Pond, W. W., & Aiken, J. M. (1996). Parental presence not necessary during induction of anesthesia. *Anesthesiology*, *85*, 1212.

Powers, K. S., & Rubenstein, J. S. (1999). Family presence during invasive procedures in the pediatric intensive care unit. *Archives of Pediatrics Adolescent Medicine*, *153*, 955-958.

Ramsay, M.A.E. (1972). A survey of pre-operative fear. *Anesthesia*, *27*, 396-402.

Richardson, J., Smith, J. E., McCall, G., & Pilkington, K. (2006). Hypnosis for procedure-related pain and distress in pediatric cancer patients: A systematic review of effectiveness and methodology related to hypnosis interventions. *Journal of Pain and Symptom Management*, *31*, 70-84.

Robinson, P. J., & Kobayashi, K. (1991). Development and evaluation of a presurgical preparation program. *Journal of Pediatric Psychology*, *16*, 193-212.

Roelofse, J. A., & Joubert, J. J. De V. (1990). Unpleasant sequelae of benzodiazepine sedation. *Anaesthesia*, *45*, 890-891.

Ryder, I. G., & Spargo, P. M. (1991). Parents in the anaesthetic room: A questionnaire survey of parents' reactions. *Anaesthesia*, *46*, 977-979.

Schaefer, C. E., & O'Connor, K. J. (Eds.). (1983). *Handbook of play therapy, Volume 1*. New York: John Wiley and Sons.

Simons, J., Franck, L., & Robertson, E. (2001). Parent involvement in children's pain care: Views of parents and nurses. *Journal of Advanced in Nursing*, *36*, 591-599.

Smith, M. T., Eadie, M. J., & O'Rourke-Brophy, T. (1981). The pharmacokinetics of midazolam in man. *European Journal of Clinical Pharmacology*, *19*, 271-278.

Stewart, S. H. (2006, February). *The use of midazolam in anxiety prevention in the pediatric surgery context.* Presented at the 1st Winter Anxiety Summit, Jay Peak, Vermont.

Stewart, S. H., Buffett-Jerrott, S. E., Finley, G. A., Wright, K. D., & Valois Gomez, T. (2006). Effects of midazolam on explicit versus implicit memory in a pediatric surgery setting. *Psychopharmacology*, *186*, 1432-2072. Retrieved from www.springerlink.com

Schwartz, B. H., Albino, J. E., & Tedesco, L. A. (1983). Effects of psychological preparation on children hospitalized for dental operations. *Journal of Pediatrics*, *102*, 634-638.

Tonnesen, E. (1989). Immunological aspects of anaesthesia and surgery-with special reference to NK cells. *Danish Medical Bulletin*, *36*, 263-281.

Vernon, D. T., Foley, J. M., Sipowiwcz, R., & Schulman, J. (1965). *The psychological responses of children to hospitalization and illness.* Springfield, MA: Thomas Books.

Vernon, D. T., Schulman, J. L., & Foley, J. M. (1966). Changes in children's behavior after hospitalization. *American Journal of Diseases of Children*, *111*, 581-593.

Viitanen, H., Annila, P., Viitanen, M., & Tarkkila, P. (1999). Premedication with midazolam delays recovery after ambulatory sevoflurane anesthesia in children. *Anesthesia and Analgesia*, *89*, 75-79.

Viitanen, H., Annila, P., Viitanen, M., & Yli-Hankala, A. (1999). Midazolam premedication delays recovery from propofol-induced sevoflurane anesthesia in children 1-3 yr. *Canadian Journal of Anaesthesia*, *46*, 766-771.

Visintainer, M. A., & Wolfer, J. A. (1975). Psychological preparation for surgical patients: The effect on children's and parents' stress responses and adjustment. *Pediatrics*, *56*, 187-202.

Wang, S-M., Caldwell-Andrews, A., & Kain, Z. N. (2003). The use of complimentary and alternative medicines by surgical patients: A follow-up survey study. *Anesthesia and Analgesia*, *97*, 1010-1015.

Wang, S-M., Gaal, D., Maranets, I., Caldwell-Andrews, A., & Kain, Z. N. (2005). Acupressure and preoperative parental anxiety: A pilot study. *Anesthesia and Analgesia*, *101*, 666-669.

Wang, S-M., & Kain, Z. N. (2001). Auricular acupuncture: A potential treatment for anxiety. *Anesthesiology and Analgesia*, *92*, 548-553.

Wang, S-M., Kulkarni, L., Dolev, J., & Kain, Z. N. (2002). Music and preoperative anxiety: A randomized, controlled study. *Anesthesia and Analgesia*, *94*, 141-147.

Wang, S-M., Peloquin, C., & Kain, Z. N. (2001). The use of auricular acupuncture to reduce preoperative anxiety. *Anesthesia and Analgesia*, *93*, 1178-1180.

Watson, A. T., & Visram, A. (2003). Children's preoperative anxiety and postoperative behaviour. *Paediatric Anaesthesia*, *13*, 188-204.

Wilhelm, F. H., & Roth, W. T. (1997). Acute and delayed effects of alprazolam on flight phobics during exposure. *Behaviour Research and Therapy*, *35*, 831-841.

Wolfer, J. A., & Visintainer, M. A. (1975). Pediatric surgical patients' and parents' stress responses and adjustment as a function of psychological preparation and stress-point nursing care. *Nursing Research*, *24*, 244-245.

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