

# What's New in Pediatric Anesthesia?

Rita Agarwal MD, FAAP

Associate Professor of Anesthesiology  
The Children's Hospital, Denver/UCHSC

The 2006 Pediatric Anesthesiology meeting precedes CRASH by one week. I may change or update this lecture if appropriate.

## Awareness in Children

- Until recently there have been very few studies looking at awareness in children. It was assumed to be lower than in adults, and even more difficult to accurately determine. Awareness in adults is reported to be 0.1-0.2%
- The only previous studies investigating the incidence of awareness or dreaming in children were done almost 20 years ago, using the Liverpool technique (nitrous oxide-oxygen-muscle relaxant). The incidence as expected, was quite high ~5% for awareness, 19% for dreaming. This technique is rarely used now.
- A recent study from The Royal Children's Hospital in Australia found the incidence of awareness to be 0.8% and dreaming to be 10.4%
  - 864 children aged 5-12, randomized, prospective study, anesthesiologist doing case didn't know whether child was included in study
  - Screening questionnaire presented 3 times--immediately post-op, at 3 days and at 30 days (see Appendix, Table 1)
  - Responses were sent to 4 independent anesthesiologist who decided if the responses represented possible awareness
  - 7 responses were rated as "awareness" by all 4 adjudicators
  - A total of 12 responses were rated as "awareness" by at least one, but not all adjudicators
  - There was no difference in post-operative behavioral problems in children who had awareness compared to children who didn't. There was also no significant difference in anesthetic technique, age, gender, medical condition, surgical procedure, use of pre-medication, use of neuromuscular agents, length of case, or seniority of the anesthesiologist in either group. However, the number of aware children was too small to draw definitive conclusions.
  - The incidence of post-operative behavioral problems in both groups was similar, 16% in the non-aware group and 20% in the aware group
  - None of the children reporting awareness were distressed by their experience
  - Most of the children reported auditory or tactile sensations, 4 reported mild pain, one reported moderate pain, none reported severe pain.
  - All were offered psychological support, only one child accepted for unrelated phobias.
  - The aware children did have longer hospital stays.
- This incidence is clearly higher than most of us expected. More work needs to be done to help elucidate mechanism and preventative strategies. While it is reassuring that none



of the children from this study were disturbed by their experience. Children may have different expectations and greater ability to and accept dreaming and fantasy. Children are more suggestible and although the authors made every attempt to avoid leading questions and to follow standard protocols and study designs accepted in the adult literature, it is still possible that parents, siblings etc contributed to some of the recall. The authors frequently used induction rooms and transfer the child to the OR after he/she is asleep. 5 of the 7 cases of awareness may have occurred around the time of the transfer.

- Children have higher anesthetic requirements and MAC, but may be susceptible to the hemodynamic consequences of the required doses. Are we under-dosing?



## BIS Monitoring in Children

- BIS monitoring appears to be reliable and useful in children older than a year of age with different anesthetic agents except for halothane and ketamine.
- There is considerable variability in infants
  - Several studies have shown greater inter-patient variability and more difficulty in predicting awakening in children in general, and in infants particularly.
  - Davidson et al showed that median pre-awakening BIS values were significantly lower in infants (56) versus the older children aged 1-12 years of age (median 72-78 depending on age).
- There is currently no evidence that BIS monitoring prevents or reduces recall in children
- Bannister et.al found that the use of BIS in painful procedures (T&A), decreased the use of sevoflurane during maintenance and the last 15 minutes of the procedure, resulting in faster emergence and recovery. Interestingly in the same study they found that this effect was not observed in patients who were undergoing inguinal hernia repair and who had received a caudal block for pain relief.
- There are studies underway on the Narcotrend Index, Auditory Evoked Response monitor, and Entropy, Patient State Analyzer and others, however they are still too few to draw reliable conclusions. In the published literature to date, the evidence suggests that these techniques are as effective in children aged 2 years and above as they are in adults.
- Two particularly interesting areas of research and possible clinical applications are in sedation and spinal surgery, however other uses of BIS have included detecting cerebral ischemia and possible cerebral hypoperfusion during cardiac surgery, analysis of natural sleep, changes during induction of anesthesia with sevoflurane and evaluation of anesthetic effects in patients with cerebral palsy or mental retardation.

## **BIS and sedation**

- There is increasing interest in using BIS to help guide sedation techniques, both by the anesthesia community and by other pediatric specialists.
- BIS has been used in children undergoing procedural sedation and found to correlate well with commonly used observational sedation scales (McDermott). BIS has also revealed that despite standardized protocols with different medications, a wide depth of sedation was achieved (Motas)
- Powers et.al. used the BIS to titrate levels of propofol to a BIS of 50 in order to maintain adequate sedation for painful procedures. Intensivists performed all the sedation, and there were 2 treatment failures, i.e. despite a BIS of 50, the patient was still “uncomfortable”. The next group of patients had their BIS adjusted to a value of 45. These patients required a mean bolus dose of 2.25mg/kg and a mean infusion of 0.52mg/kg/minute to maintain these BIS scores. There were no complications and all procedures in the second group were successfully completed.
- Tobias and others have done a series of studies investigating the use of BIS in the ICU and found it to be a useful tool to help guide sedation in critically ill children, especially in the presence of neuromuscular blocking agents. There does seem to be more variability of response compared to standard ICU Pain and Sedation Scores. There was a high incidence of under or over sedation in this setting based on the BIS value. It’s potential utility remains to be seen

## **BIS and Spinal Surgery**

- There has been increasing interest in using BIS to help guide optimum anesthetic levels to maintain both hypnosis and adequate somatosensory evoked potential (SSEP) monitoring
- Liu et.al found that at equivalent BIS (40-50), propofol preserves SSEP amplitude and latency better than isoflurane
- Fletcher et.al found that in contrast to other studies, isoflurane maintained cortical amplitude evoked potential measurements from the posterior tibial nerve better than desflurane did. Theirs was the first study to use BIS to confirm equivalent anesthetic depth with des and iso. They maintained their patients at a BIS of 60
- In a small study of healthy adolescents undergoing idiopathic scoliosis, Clapich et.al confirmed that propofol infusion preserved cortical SSEP’s better than isoflurane +/- nitrous oxide, while providing a deeper level of hypnosis as measured by BIS.
- McCann et.al investigated the utility of BIS studied during the “wake-up test” in 34 otherwise healthy children or adolescents undergoing scoliosis surgery. During the wake-up test, the patients were asked to recall a color “teal”. Only one patient recalled the wake-up test, but did not recall the color. 5 patients recalled the color, but not the wake-up test. Although not all the BIS values for the operations were recorded, the mean BIS value immediately prior to the wake-up test was reported as 72+/-8, and 91+/- 8 during the wake-up test. It is intriguing that there wasn’t a higher incidence of recall.

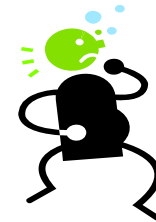
## Laryngospasm

- Laryngospasm (L) continues to be a common source or perioperative complication, with variable morbidity.
- The last published analysis of the POCA (Pediatric Peri-operative Cardiac Arrest) registry (Murray et.al) found that of the 150 cases reported to the registry and attributed directly to anesthesia, 20% were caused by respiratory problems. Of those, 9 could directly be attributed to laryngospasm. The estimated number of cases performed during that time period from reporting institutions was 1,089,200.
- Its incidence is reported to be anywhere from <1% up to 25% depending on the type of surgery, patients' age and underlying condition.
- ENT and airway surgery, younger age, presence of URI, less experienced practitioner and passive smoking increase the incidence of laryngospasm
- Several recent studies have investigated the use of a variety of techniques to prevent or treat L.



- Oberer and colleagues found that L and apnea occurred more frequently in children anesthetized with sevoflurane, compared to propofol at equivalent levels of hypnosis. Airway reactivity was measured at BIS values of 40 and 60 with each agent, by spraying normal saline on the cords via an LMA. The incidence of active and passive cord closure was measured.
  - Batra et.al used 0.5mg/kg of propofol 60 seconds prior to extubation in 60 children undergoing tonsillectomy and/or adenoidectomy (T+/-A) and found a decreased incidence of L (6.6% versus 20%) in the patients receiving propofol.
  - Afshan et.al used propofol 0.8 mg/kg to treat laryngospasm once it had occurred in 13 patients after general anesthesia, 77% responded favorably with resolution of symptoms. They studied 752 patients over a course of 3 years aged 3-10, who were having inguinal hernia repair, hydrocelectomy or orchiopexy. All patients received a caudal block and had an LMA placed; anesthesia was maintained with isoflurane and nitrous oxide. A total of 20 patients developed L (incidence 2.6%), 7 of whom responded to 100% oxygen and gentle positive pressure. The remaining 13 received propofol. The 3 patients who did not improve with propofol required intubation.
- Magnesium 15mg/kg was found to prevent laryngospasm in children aged 3-12 undergoing T+/-A administered at the start of the procedure and infused over 20 minutes. There were 40 children studied, 20 in each group. The patients who received magnesium had no laryngospasm compared to the control group (25%). There were apparently no other significant side effects (Gulhas et.al)
  - In short procedures such as T+/- A, lidocaine either administered topically at the start of the procedure, or intravenously towards the end of the procedure may decrease L.
  - Deep or awake extubation does not appear to have an impact on the incidence of laryngospasm except when desflurane is used for deep extubation (Valley et.al.) Desflurane was associated with a higher incidence of respiratory complications, including coughing, desaturation and laryngospasm, when used with deep extubation compared to sevoflurane. In an earlier study comparing sevoflurane and isoflurane for deep extubation, no difference was found in the number of adverse events.

- Use of an LMA, face mask or endotracheal tube also doesn't seem to effect the incidence of laryngospasm
- Minimal stimulation when extubating a patient may help. Tsui et.al found no laryngospasm in 20 patients in whom they used the "no-touch" technique after T+/-A. All patients were moved and placed on their sides in the "recovery position" after the end of the surgery. Patients were suctioned and the desflurane anesthetic was then stopped. Patients were extubated when they showed signs of spontaneous awakening. The average surgical time was 24 minutes; the average time to extubation was 7.7 minutes. Their numbers are really too small to draw definitive conclusions.
- Finally despite all these new techniques and approaches to treating or preventing laryngospasm, oxygen, gentle positive pressure, jaw thrust and succinylcholine are still the most effective and reliable of all treatments! However, propofol has now become my first line of treatment in a patients with laryngospasm and in high risk procedures such as T+/A, I will often give a small dose prior to extubation.



## Post-Operative Vomiting (POV)

- Traditional teaching supported by previous studies, has been that the incidence of POV in infants < 24 months is very low. At least one study has shown in to be < 1% for those 1-12 months of age and ~20% for children 12-24 months of age. Consequently many pediatric anesthesia care providers have argued against giving these population routine prophylactic anti-emetics.
- Khalil et.al in a multi-institutional, prospective, randomized, blinded study investigated the utility of ondansetron in 650 infants. They found that incidence of vomiting was 28% in the placebo groups and 11% in the treatment group.
  - Patients were ASA 1-3, scheduled for elective surgery, excluding cardiac and neurosurgical operations.
  - Patients were excluded if their anesthetic was maintained with halothane or propofol, or if they received any other anti-emetic in the 48 hours preceding the operation.
  - The 6 most common operations included: adenoidectomy, myringotomy, orchiopexy, plastic surgery, orthopedic procedures and hernia repairs.
  - Patients received 0.1mg/kg of ondansetron IV after induction and prior to the start of surgery.
  - The incidence of adverse events was the same as for placebo and was minimal.
  - The total incidence and severity of emetic events was reduced in the study population, and the time to first rescue medication was increased.
- Oral disintegrating ondansetron (ODT) (4mg) is both palatable and effective in children aged 5-11 undergoing T+/- A. Cohen compared ODT with placebo and while the placebo tasted better it was not nearly as effective as the ODT in reducing the incidence of post-operative vomiting(73 vs.38%). Patients received the ODT prior to anesthesia induction

- In an effort bring rationale to the chaos of determining POV risk in children; Eberhart and colleagues took on the Herculean task of devising a Risk Score similar to those available in adults. Data from 1257 children from 4 institutions (a community children's hospital, 2 university hospitals and an outpatient surgical center were recorded). The authors found that 4 major factor increased the incidence of POV:
  - Age > than 3, length of surgery > 30minutes, strabismus surgery and a history of previous POV or a history of POV in a parent or sibling
  - The incidence of POV was 9%, 10%, 30%, 55%, and 70% for 0,1,2,3,or 4 risk factors observed
- Dexamethasone has repeatedly been shown to be an effective anti-emetic either alone or in combination with other anti-emetics, In a recent dose ranging stud, a British group found that 0.25mg/kg of dexamethasone was as effective as higher doses (0.5mg/kg and 1mg/kg) and significantly more effective than placebo in preventing POV in children undergoing strabismus surgery. No other prophylactic anti-emetic was used in the study. The incidence of POV ranged from 40-60% in the placebo group depending on age. The youngest age group (2-4year olds) had the lowest incidence. In the treatment group the incidence was 0-25% (again age dependant)
- Increased FiO<sub>2</sub> >0.8 does not decrease the incidence of POV in patients having strabismus repair. A German group looked at 210 ASA 1-2 patients undergoing strabismus repair, of whom approximately 1/3 were children < 15years of age. They found no difference in the incidence of POV in the patients who received 30% versus 80% oxygen.(Treschan)

## Parental Presence at Anesthesia Induction (PPIA)

- Despite a great deal of research and time spent discussing this topic, there are surprisingly few places where this is a routine practice. Kain and his colleagues have shown in several studies that the use of premedication with midazolam is in most cases superior for anxiolysis at induction, than parental presence. Many parents will have physiologic changes including tachycardia and increased perspiration during induction. While no parent in their study had any major adverse effects, the potential is certainly there. Their studies have also shown that even if children and parents have a good first experience without PPIA, when offered a choice at subsequent procedures, parents will most often request to be present for their child's induction.
- This same group has more recently, tried to determine which parent/child pairing would most benefit from PPIA and what the parent/child interaction was during induction. They found that high maternal motivation was often accompanied by high anxiety. The authors attribute this to several factors ( this particular study only examined mother/child pairings)
  - Mothers with high levels of anxiety may feel greater motivation to be present for their child's induction as a means to help control their own anxiety.
  - Children with increased anxiety may increase both the mother's motivation for PPIA and the mother's anxiety levels
  - Mothers who were more confident in their child's preparation and coping skills may have felt less need (∴ motivation) to be present for their child's induction.
- Interestingly, mothers of girls had a greater desire for PPIA, as did mother's of younger children

- In another set of studies, Kain et.al found that calm parents provided a definite benefit to their anxious children. Calm parents had minimal effect on their calm children. Anxious parents were successful in increasing the anxiety of their calm children, and were unhelpful to anxious ones.
- Kain and his colleagues to sent a survey to 5000 ASA members regarding their use of premedication and PPIA in pediatric and adult patients. They had a 27% response rate (1362). Listed is a summary of their findings
  - Sedative premedication was used in 50% of pediatric patients
  - Midazolam is the most commonly used sedative in both outpatients and inpatients (>96%)
  - The median age at which respondents would never premedicate a child was 12months or less
  - 1.9% or respondents from children's hospital and 25.3% of respondents from free-standing surgery centers never pre-medicated outpatients
  - Fifty percent of respondents never allowed for PPIA, however only 10% allowed it for the majority of their patients. These anesthesiologists tended to be younger, female and with a greater percentage of their practice devoted to pediatrics.



## Procedural Sedation

- There are several new developments in procedural sedation in recent years. The first is the increased interest by non-anesthesia medical personnel in providing general anesthesia disguised as “deep sedation”. The second is expanding the use of ketamine.
- Increasingly, intensivists, emergency physicians and others are using propofol +/- additional medication to achieve sedation for a variety of procedures. Medical establishments, parents and society demand more humane ways of providing analgesia and amnesia for painful procedures. Anesthesia departments may not have the manpower to meet these demands. At some institutions intensivists have stepped in to fill the void. In the previously mentioned Powers et.al. study, they authors used BIS to titrate sedation. They found that BIS values of 45 provided ideal sedation conditions for these procedures. The mean dose of propofol required to achieve these values was 0.52mg/kg/hour. There is no discussion that these values and doses are consistent with general anesthesia. Intensivists in a monitored setting provided all the sedation in this study, and although there were no complications, 5.4 % of their patients did require oxygen or other airway maneuvers. Patients ages ranged from 27 weeks to 18 years and

procedures included bone marrow aspirations, lumbar puncture, upper and lower endoscopy and renal biopsy. They do qualify their conclusions that propofol is a safe and effective means to provide sedation in such settings, by noting that those providing the sedation should be skilled at airway management and resuscitation.

- Ketamine continues to be a popular and widely used agent for procedural sedation, particularly in the ED, burn units and other locations where painful procedures are being performed. Gottschling looked at patients with malignancies and hematologic disorders, undergoing painful procedures. They compared the use of ketamine/midazolam with propofol +/- morphine for sedation. Their success rate (procedure completed, adequate sedation) was high with both techniques, however the rate of complications, most commonly desaturation, was much higher with propofol.
- There are several other studies that have examined the utility and safety of propofol in the emergency department (ED) and other locations.
- There is increased interest at some institutions including TCH, Denver for non-anesthesia medical personnel to use other induction agents for sedation. Etomidate and remifentanyl are 2 that are attracting interest.

## Appendix

**Table 1.** Structured Awareness Screening Interview

---

### Interview on Day 1

1. Were you upset, worried, or frightened about your operation?
2. How upset, worried, or frightened were you?
3. What was the last thing you remember before the operation?
4. How did the doctor make you go to sleep?
5. What is the next thing you remember after the operation?
6. Did you have any dreams or feel or hear anything while you were having the operation?
7. Were you sore after the operation?
8. How much did it hurt?
9. What did you like least about having an operation?
10. What did you like best about having an operation?
11. Did someone talk to you about what the operation was going to be like?
12. Was that about the same as what happened?
13. How do you feel about the operation?
14. Would you like to have known more?

### Questions asked by parents on Day 3 and Day 30

1. What was the last thing you remember before the operation?
  2. How did the doctor make you go to sleep?
  3. What is the next thing you remember after the operation?
  4. Did you have any dreams or feel or hear anything while you were having the operation?
-

**Table 3.** Experiences of the 12 Cases for Which at Least 1 Adjudicator Classified the Memory as Awareness

Patient No.	Memory
1	"Felt the tubes going into my ears." "The right ear hurt." "Heard a loud noise and beeping." When asked, the child reproduced a noise very similar to operating room suction. "Tried to talk but couldn't let it out." "Got freaked out." "Felt a sort of rug covering me." The child later dreamt of a tortoise.
2	"I could hear during my operation and people talking." The child described definitely hearing men talking for a long time about the operation and how it was going to be when it was finished. The child then "went back to sleep again." There were no men in recovery.
3	"Felt a jab in my hip." The child remembered going to sleep then "something touching my bone and then a shiver went up my spine." The child later dreamt he was a stunt man.
4	"Heard drill noises and beeping." The child also described trying to talk but could not.
5	"Heard the saw. It sounded like a bee." When asked, the child accurately reproduced the sound of an orthopedic saw. The child described feeling pain in her leg and also hearing people talking. "Chatter, chatter, chatter." "Tried to block my ears and it worked." The child then described going back to sleep and later dreamt of a Mars chocolate bar.
6	"Felt a steel plate being put into my mouth to open it up wide."
7	The child described falling asleep then "felt a thing going down my throat, it hurt." "Going down my neck, just in and out again." The child then described falling asleep again and dreaming of her cat.
8	"I heard the doctors working." The child described going to sleep and then hearing male voices and hearing them "putting stitches in." The child described feeling no pain and reported being pleased that the surgeons were doing their work. The surgeons had used local anesthetic infiltration before suturing.
9	The child clearly remembered the surgeon talking during the operation along with some female voices. The child also dreamt about Disneyland.
10	"Heard a loud noise." The child described going to sleep and then felt warmth on her hand and a "pillow sound as they put me on the table." The child also dreamt about monsters.
11	"Felt the machine spinning him around." The child later remembered "the spinning thing around him."
12	"Felt the needles." The child tried to move his arms but couldn't. He also heard laughing, beeping, and babies crying. The account was inconsistent and became increasingly complex and fantastic. The child also dreamt of birds.

Patients 1-7 were classified as true awareness, with all four adjudicators in agreement. For patients 8-12, at least one adjudicator, but not all, classified the case as awareness.



## Selected References

1. [Davidson AJ, Huang GH, Czarnecki C, Gibson MA, Stewart SA, Jansen K, Stargatt R.](#) Awareness during anesthesia in children: a prospective cohort study. *Anesth Analg.* 2005 Mar;100(3):653-61
2. [Huang GH, Davidson AJ, Stargatt R.](#) Dreaming during anaesthesia in children: incidence, nature and associations. *Anaesthesia.* 2005 Sep;60(9):854-61
3. [Davidson AJ, Huang GH, Rebmann CS, Ellery C.](#) Performance of entropy and Bispectral Index as measures of anaesthesia effect in children of different ages. *Br J Anaesth.* 2005 Nov;95(5):674-9
4. [Kim HS, Oh AY, Kim CS, Kim SD, Seo KS, Kim JH.](#) Correlation of bispectral index with end-tidal sevoflurane concentration and age in infants and children. *Br J Anaesth.* 2005 Sep;95(3):362-6. Epub 2005 Jul 15
5. Weber Frank MD, Hollnberger Harald MD, Gruber Michael pHd, Frank Bernhard MD, Taeger Kai MD. The correlation of the Narcotrend Index with endtidal sevoflurane concentrations and hemodynamic parameters in children. *Pediatric Anesthesia.* 15(9):727-732, September 2005
6. McDermott NB, Van Sickle T, Motas D, Friesen RH. Validation of the bispectral index monitor during conscious and deep sedation in children. *Anesth Analg.* 2003;97 :39 –43
7. Motas D, McDermott NB, VanSickle T, Friesen RH. Depth of consciousness and deep sedation attained in children as administered by non anaesthesiologists in a children's hospital. *Pediatr Anesth.* 2004;14 :256 –260
8. [Tobias JD, Grindstaff R.](#) Bispectral index monitoring during the administration of neuromuscular blocking agents in the pediatric intensive care unit patient. *J Intensive Care Med.* 2005 Jul-Aug;20(4):233-7
9. Twite MD, Zuk J, Gralla J, et al: Correlation of the Bispectral Index Monitor with the COMFORT scale in the pediatric intensive care unit. *Pediatr Crit Care Med* 2005; 6:648–653
10. [Powers KS, Nazarian EB, Tapyrik SA, Kohli SM, Yin H, van der Jagt EW, Sullivan JS, Rubenstein JS.](#) Bispectral index as a guide for titration of propofol during procedural sedation among children. *Pediatrics.* 2005 Jun;115(6):1666-74.
11. [Fletcher JE, Hinn AR, Heard CM, Georges LS, Freid EB, Keifer A, Brooks SD, Bailey AG, Valley RD.](#) The effects of isoflurane and desflurane titrated to a bispectral index of 60 on the cortical somatosensory evoked potential during pediatric scoliosis surgery. *Anesth Analg.* 2005 Jun;100(6):1797-803
12. [Liu EH, Wong HK, Chia CP, Lim HJ, Chen ZY, Lee TL.](#) Effects of isoflurane and propofol on cortical somatosensory evoked potentials during comparable depth of anaesthesia as guided by bispectral index. *Br J Anaesth.* 2005 Feb;94(2):193-7
13. [Clapcich AJ, Emerson RG, Roye DP Jr, Xie H, Gallo EJ, Dowling KC, Ramnath B, Heyer EJ.](#) The effects of propofol, small-dose isoflurane, and nitrous oxide on cortical somatosensory evoked potential and bispectral index monitoring in adolescents undergoing spinal fusion. *Anesth Analg.* 2004 Nov;99(5):1334-40
14. [Hayashida M, Kin N, Tomioka T, Orii R, Sekiyama H, Usui H, Chinzei M, Hanaoka K.](#) Cerebral ischaemia during cardiac surgery in children detected by combined monitoring of BIS and near-infrared spectroscopy. *Br J Anaesth.* 2004 May;92(5):662-9

15. [Bannister CF, Brosius KK, Sigl JC, Meyer BJ, Sebel PS.](#) The effect of bispectral index monitoring on anesthetic use and recovery in children anesthetized with sevoflurane in nitrous oxide. *Anesth Analg.* 2001 Apr;92(4):877-81
16. [Murray JP, Geiduschek JM, Ramamoorthy C, Haberkern CM, Hackel A, Caplan RA, Domino KB, Posner K, Cheney FW.](#) Anesthesia-related cardiac arrest in children: initial findings of the Pediatric Perioperative Cardiac Arrest (POCA) Registry. *Anesthesiology.* 2000 Jul;93(1):6-14.
17. [Oberer C, von Ungern-Sternberg BS, Frei FJ, Erb TO.](#) Respiratory reflex responses of the larynx differ between sevoflurane and propofol in pediatric patients. *Anesthesiology.* 2005 Dec;103(6):1142-8.
18. Batra, Yatindra Kumar, Ivanova, Maya, Ali, Syed Shujat, Shamsah, Mohammed, Qattan, Abdul Raheem Al & Belani, Kumar G. (2005) The efficacy of a subhypnotic dose of propofol in preventing laryngospasm following tonsillectomy and adenoidectomy in children. *Pediatric Anesthesia* **15** (12), 1094-1097
19. [Afshan G, Chohan U, Qamar-Ul-Hoda M, Kamal RS.](#) Is there a role of a small dose of propofol in the treatment of laryngeal spasm? *Paediatr Anaesth.* 2002 Sep;12(7):625-8.
20. [Gulhas N, Durmus M, Demirbilek S, Tugal T, Ozturk E, Ersoy MO.](#) The use of magnesium to prevent laryngospasm after tonsillectomy and adenoidectomy: a preliminary study. *Paediatr Anaesth.* 2003 Jan;13(1):43-7
21. [Staffel JG, Weissler MC, Tyler EP, Drake AF.](#) The prevention of postoperative stridor and laryngospasm with topical lidocaine. *Arch Otolaryngol Head Neck Surg.* 1991 Oct;117(10):1123-8.
22. [Koc C, Kocaman F, Aygenc E, Ozdem C, Cekic A.](#) The use of preoperative lidocaine to prevent stridor and laryngospasm after tonsillectomy and adenoidectomy. *Otolaryngol Head Neck Surg.* 1998 Jun;118(6):880-2.
23. [Valley RD, Freid EB, Bailey AG, Kopp VJ, Georges LS, Fletcher J, Keifer A.](#) Tracheal extubation of deeply anesthetized pediatric patients: a comparison of desflurane and sevoflurane. *Anesth Analg.* 2003 May;96(5):1320-4
24. [Tsui BC, Wagner A, Cave D, Elliott C, El-Hakim H, Malherbe S.](#) The incidence of laryngospasm with a "no touch" extubation technique after tonsillectomy and adenoidectomy. *Anesth Analg.* 2004 Feb;98(2):327-9.
25. [Khalil SN, Roth AG, Cohen IT, Simhi E, Ansermino JM, Bolos ME, Cote CJ, Hannallah RS, Davis PJ, Brooks PB, Russo MW, Anschuetz GC, Blackburn LM.](#) A double-blind comparison of intravenous ondansetron and placebo for preventing postoperative emesis in 1- to 24-month-old pediatric patients after surgery under general anesthesia. *Anesth Analg.* 2005 Aug;101(2):356-61
26. [Cohen IT, Joffe D, Hummer K, Soluri A.](#) Ondansetron oral disintegrating tablets: acceptability and efficacy in children undergoing adenotonsillectomy. *Anesth Analg.* 2005 Jul;101(1):59-63
27. [Eberhart LH, Geldner G, Kranke P, Morin AM, Schauffelen A, Treiber H, Wulf H.](#) The development and validation of a risk score to predict the probability of postoperative vomiting in pediatric patients. *Anesth Analg.* 2004 Dec;99(6):1630-7
28. [Treschan TA, Zimmer C, Nass C, Stegen B, Esser J, Peters J.](#) Inspired oxygen fraction of 0.8 does not attenuate postoperative nausea and vomiting after strabismus surgery. *Anesthesiology.* 2005 Jul;103(1):6-10

29. [Kain ZN, Mayes LC, Wang SM, Caramico LA, Hofstadter MB](#) Parental presence during induction of anesthesia versus sedative premedication: which intervention is more effective? *Anesthesiology*. 1998 Nov; 89(5): 1147-56; discussion 9A-10A.
30. [Kain ZN, Mayes LC, Wang SM, Caramico LA, Krivutza DM, Hofstadter MB](#). Parental presence and a sedative premedicant for children undergoing surgery: a hierarchical study. *Anesthesiology*. 2000 Apr; 92(4): 939-46
31. [Kain ZN, Caldwell-Andrews AA, Mayes LC, Wang SM, Krivutza DM, LoDolce ME](#) Parental presence during induction of anesthesia: physiological effects on parents. *Anesthesiology*. 2003 Jan; 98(1): 58-64.
32. [Kain ZN, Caldwell-Andrews AA, Wang SM, Krivutza DM, Weinberg ME, Mayes LC](#). Parental intervention choices for children undergoing repeated surgeries. *Anesth Analg*. 2003 Apr; 96(4): 970-5
33. [Kain ZN, Wang SM, Mayes LC, Caramico LA, Hofstadter MB](#). Distress during the induction of anesthesia and postoperative behavioral outcomes. *Anesth Analg*. 1999 May; 88(5): 1042-7
34. [Kain ZN, Mayes LC, Wang SM, Hofstadter MB](#). Postoperative behavioral outcomes in children: effects of sedative premedication. *Anesthesiology*. 1999 Mar; 90(3): 758-65.
35. [Caldwell-Andrews AA, Kain ZN, Mayes LC, Kerns RD, Ng D](#). Motivation and maternal presence during induction of anesthesia. *Anesthesiology*. 2005 Sep;103(3):478-83.
36. [Caldwell-Andrews AA, Blount RL, Mayes LC, Kain ZN](#). Behavioral interactions in the perioperative environment: a new conceptual framework and the development of the perioperative child-adult medical procedure interaction scale. *Anesthesiology*. 2005 Dec;103(6):1130-5.
37. [Kain ZN, Caldwell-Andrews AA, Maranets I, Nelson W, Mayes LC](#). Predicting which child-parent pair will benefit from parental presence during induction of anesthesia: a decision-making approach. *Anesth Analg*. 2006 Jan;102(1):81-4.
38. [Pershad J, Godambe SA](#). Propofol for procedural sedation in the pediatric emergency department. *J Emerg Med*. 2004 Jul;27(1):11-4.