

What's New In Pediatric Anesthesia 2007

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What's New?

- Sleep Disordered Breathing/OSA
- Cuffed Endotracheal tubes
- Pre-medication
- Emergence Agitation
- Post-operative Vomiting
- New airway devices



Sleep Disordered Breathing

- There is ↑ evidence that sleep problems can have significant medical and behavioral impact in children
- Continuum:
 - normal breathing ⇒ chronic intermittent nocturnal desaturation ⇒ obstructive sleep apnea
- Gold standard for diagnosis is polysomnography



Sleep Disordered Breathing

- Causes include:
 - adeno-tonsillar hypertrophy
 - neuromuscular problems
 - obesity
 - craniofacial abnormalities
- Most patients will not have had polysomnography or overnight pulse oximetry

Sleep Disordered Breathing

- In the past differentiating snoring from obstructive sleep apnea was emphasized.
- However studies have shown that in children with snoring and adenotonsillar hypertrophy, tonsillectomy +/-adenoidectomy improve behavioral, performance, mood and executive function measures post-op.





Sleep Disordered Breathing

- In addition these patients may have an increase in cerebral blood flow velocity at night and increased brain natriuretic peptides. While the significance of these findings is not yet known, the increase in brain natriuretic peptide may indicate an increase in nocturnal cardiac strain



Sleep Disordered Breathing

- Obstructive sleep apnea has been associated with:
 - ↑ sensitivity to and need for opioids.
 - blunted CO₂ response curve.
 - ↑ peri-operative respiratory complications.
- Mounting evidence indicates that ↑ opioid sensitivity may be related to chronic desaturation at night.



Sleep Disordered Breathing

- Children who had desaturation at night < 85% were found to need ½ the dose of opioids after T&A.
- Rat pups exposed to chronic intermittent nocturnal desaturation were found to have an increased sensitivity to the respiratory effects of opioids.



Sleep Disordered Breathing

- Causes may include:
 - up-regulation in the opioid μ sub-receptor
 - alterations in the balance between excitatory neurokinins and inhibitory sub-receptors
 - remodeling of the pulmonary vascular and carotid body activity

Anesthesiology. 2006
Oct; 645-7.



Sleep Disordered Breathing

- ASA Guidelines were published in May 2006.
- Scoring system was developed to assess peri-operative risk.
- Only 3 types of procedures and anesthetics were thought to be appropriate to be done on an outpatient basis. These were superficial surgery under local or regional anesthesia and lithotripsy



OSA Scoring System

A. Severity of OSA

- Sleep study or clinical symptoms--Score: 0-3

B. Invasiveness of surgery and anesthesia

- Superficial or peripheral surgery with local regional +/- moderate sedation 1
- General anesthesia 2
- Major surgery, general anesthesia 3

C. Requirement for post-op opioids

- None 0
- Low dose oral 1
- High dose 3



OSA Scoring System

- The pts total score is the sum of A + whichever is greater from B or C. Score >4 indicates increased peri-operative risk
- Score of 5 or 6 = significantly increased risk

Table 3. Consultant Opinions Regarding Procedures That May Be Performed Safely on an Outpatient Basis for Patients at Increased Perioperative Risk from OSA

| Type of Surgery/Anesthesia | Consultant Opinion |
|---|--------------------|
| Superficial surgery/local or regional anesthesia | Agree |
| Superficial surgery/general anesthesia | Equivocal |
| Airway surgery (adult, e.g., UPPP) | Disagree |
| Tonsillectomy in children less than 3 years old | Disagree |
| Tonsillectomy in children greater than 3 years old | Equivocal |
| Minor orthopedic surgery/local or regional anesthesia | Agree |
| Minor orthopedic surgery/general anesthesia | Equivocal |
| Gynecologic laparoscopy | Equivocal |
| Laparoscopic surgery, upper abdomen | Disagree |
| Lithotripsy | Agree |

OSA = obstructive sleep apnea; UPPP = uvulopalatopharyngoplasty.

Premeds, Parental Presence and More





Pre-operative Anxiety

■ Risk Factors

- Younger age
- Behavioral problems
- 5 or previous hospital admissions
- Longer procedure
- Anxious parents
- Still a great deal of variability

Pre-operative Anxiety

- Pre-operative anxiety may:
 - Increase post-op agitation
 - Increase post-op pain
 - Increase negative post-operative behavior





Premedication

- Midazolam continues to be the most popular agent used in this country
- Doses as low as 0.25 mg/kg have been shown to be effective
- Higher pH of vehicle may improve absorption and speed effect
- ? Effects of post-op recovery and emergence agitation



Midazolam

■ Côté et.al

- Comparison of 3 doses of commercially prepared oral midazolam
- 405 children ages 6 mos-16 yrs in a multi-institutional study
- They found dose as low as 0.25 mg/kg effective and blood levels 36% higher than expected

Anesth Analg 94:37-43, 2002



Midazolam

- Composition of commercially prepared midazolam and pH may be factors
- Other studies have found that mixing IV midazolam with Syrpalta[®] syrup ⇒ higher pH and faster onset
- Sodium citrate added to midazolam may speed onset of the medication



Midazolam

- Midazolam exists as equilibrium between a water soluble and lipophilic form. The proportion of each is pH dependant. At a pH < than 2.5 the water soluble form predominates, at a pH > 4.5 the molecule exists almost entirely in the lipophilic form.
- The lipophilic form may increase oral mucosal absorption, thus decreasing first pass metabolism.



Midazolam and Emergence

- Compelling evidence that midazolam may ↓ incidence of negative post-op behavior for up to 2 weeks.
- However there is conflicting evidence regarding its effects on speed of recovery and emergence agitation.

Premedication



- Clonidine $4\mu\text{g}/\text{kg}$ seems to be as effective as diazepam for pre-op anxiety, but not as effective as midazolam
- +/- effects on need for analgesia
- May \downarrow incidence of post-op vomiting compared to placebo, after propofol anesthesia for strabismus surgery

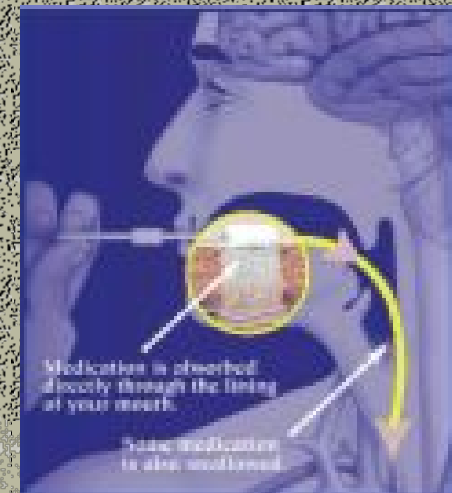


Premedication

- Ketamine in combination with midazolam can provide more profound sedation than with either drug alone
- Lower incidence of disturbing side effects than with ketamine alone
- Does not prolong emergence or discharge from PACU

Oral transmucosal fentanyl citrate

- More acceptable taste cf. midazolam
- Similar onset time
- Similar anxiolysis
- Higher incidence of pre-op nausea and vomiting



Parental Presence at Induction of Anesthesia PPIA



Parental Presence at Induction of Anesthesia

■ PRO

- Increase parental satisfaction
- Calm parents benefit anxious children
- May ↓ need for pre-medication
- It is standard practice in many parts of the world





Parental Presence at Induction

■ CON:

- Kain and colleagues have shown there is no benefit vs premed
- The addition of PPIA to a premed does not ↓ anxiety
- Anxious parents ↑ calm child's anxiety
- Often the parents that are most motivated to be present are the most anxious
- Parents can suffer physiologic consequences

Parental Presence at Induction

- CON-cont
- The majority of US institutions do not routinely offer PPIA
- Many anesthesia care providers and OR staff are uncomfortable





Parental Presence at Induction

- The latest from Kain et.al:
 - Children who benefit from PPIA are older, have lower levels of activity in their temperament, have calmer parents and parents who value coping skills and preparation.
 - Family centered pre-op preparation programs decrease both anxiety and post-op agitation.



Parental Presence at Induction

- Auricular acupuncture was found in one study to decrease maternal anxiety associated with PPIA
- As a result the children of the mothers who underwent acupuncture were less anxious during induction
- The majority of parents who are allowed to be present for induction felt they were helpful

Miscellaneous

- Clown Doctors
- Interactive Music Therapy
- Hand held Video Games
- Hypnosis



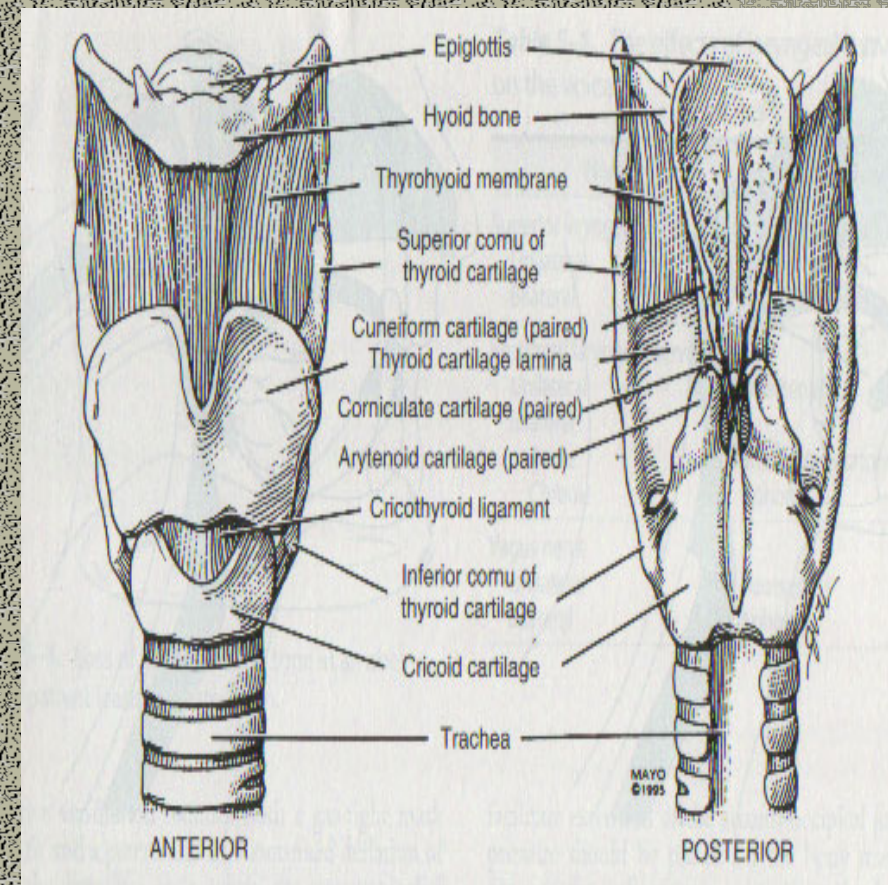
Cuffed Endotracheal Tubes

Their time has come



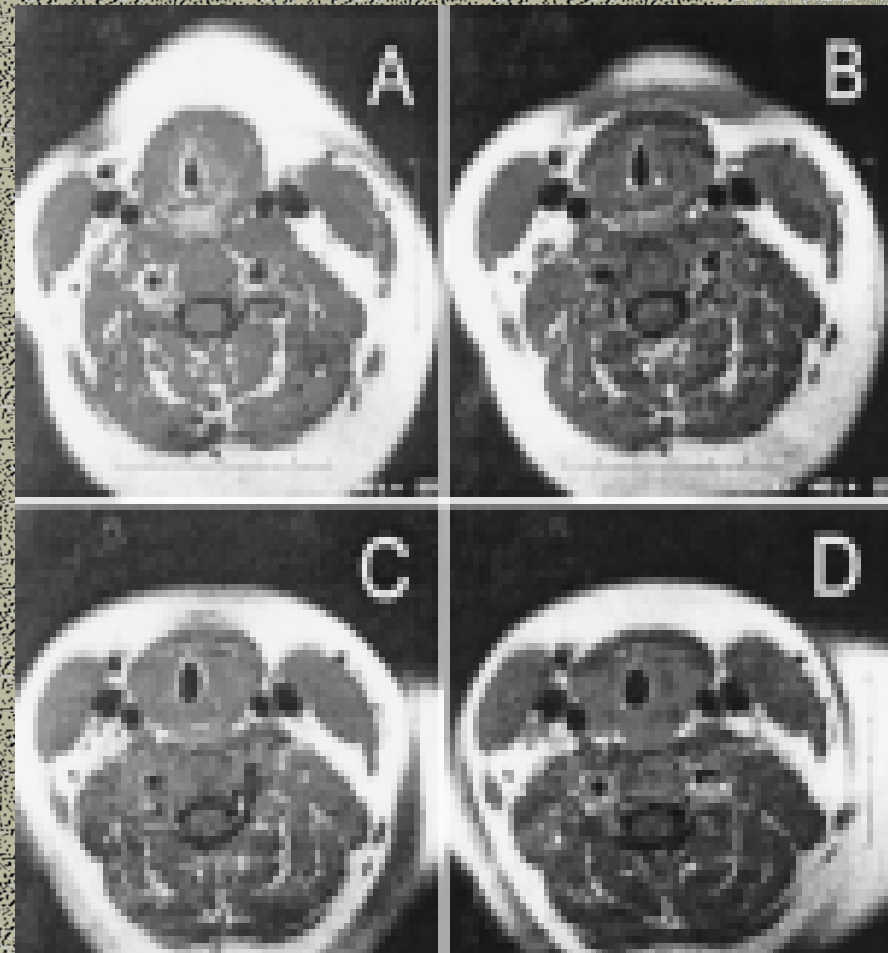
Cuffed Endotracheal Tubes

- Early investigations on airway anatomy in children were done on cadavers.
- The trachea was found to be a cone shaped structure with its apex at the cricoid



Cuffed Endotracheal Tubes

- Litman examined airways in children aged 2mos-13yrs who were deeply sedated for MRI
- Narrowest part of the airway was at the vocal cords
- Airway was elliptical





Cuffed Endotracheal Tubes

- Khine et.al published a large series investigating the use of cuffed vs. uncuffed ETT in young children
 - No increase in post-op complications
 - Fewer # of intra-operative tube changes
 - Decreased OR pollution
 - Increased ability to use low flow ventilation

Cuffed Endotracheal Tubes

- Cuffed tubes have been used successfully in the ICU for long term intubations without increased complications
- In all patients cuff pressure was checked every 8 hours



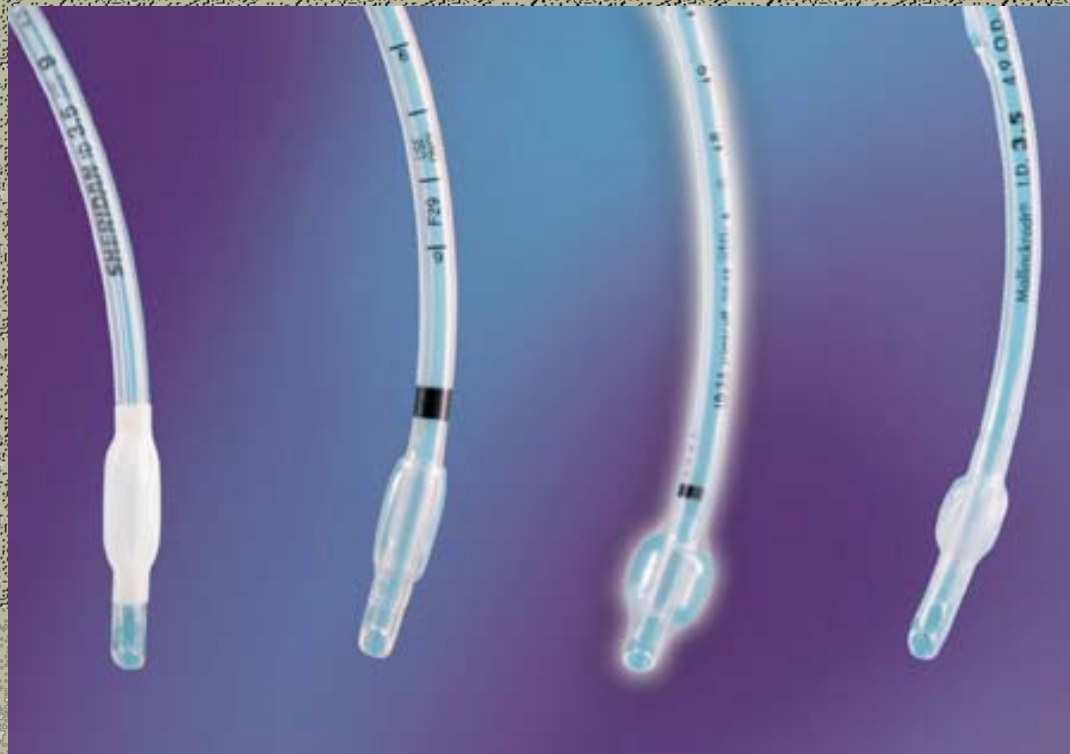


Cuffed Endotracheal Tubes

- Formulas used to calculate size :
 - $\text{Age}/4 + 3$
 - $\text{Age}/4 + 4$ —go down $\frac{1}{2}$ size
- Cuff Pressure should be kept $< 20\text{cm H}_2\text{O}$
- Cuff pressure should be checked every 2 hours if nitrous is being used, or for long term intubation.

Cuffed Endotracheal Tubes

- Previous concerns over cuff design seem to be ameliorated with the arrival of the new Microcuff[®] ETT





Cuffed Endotracheal Tubes

- Cuff should be placed below cricoid ring.
- This could lead to mainstem intubation.
- New depth marking and smaller, thinner cuff improve placement.
- The polyurethane cuff is less potentially damaging to delicate mucosa and has lower sealing pressures.



Cuffed Endotracheal Tubes

- Downsides:
 - No Murphy eye
 - Smaller ID tube required
 - Uncuffed tubes have a long and successful track record

Emergence Delirium





Emergence Agitation

- First reported in 1953
- We still don't know the cause or how to prevent it
- Difficult to distinguish from pain
- Seems to be characterized by fear and defined by agitation, restlessness, thrashing, incoherence, inconsolability and/or unresponsiveness

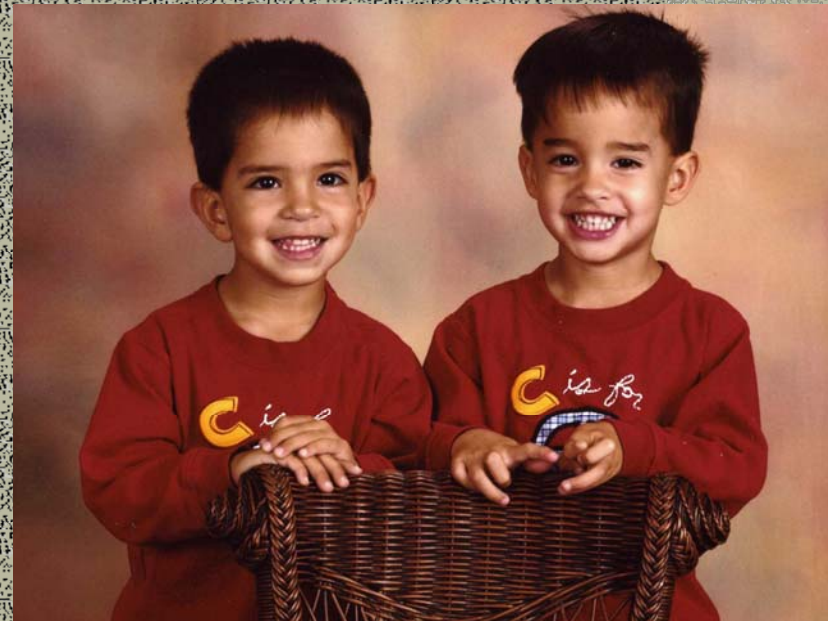


Emergence Agitation

- Emergence agitation/delirium may:
 - Require additional nursing care
 - Require additional medications
 - Increase the incidence of postoperative maladaptive behavior
 - Disturb other patients
- Decreases parent/patient satisfaction

Emergence Agitation

- Risk Factors:
 - Short acting volatile agents
 - Preschool aged children
 - Boys
 - Types of procedure
 - Pain
 - Personality



Emergence Agitation

- Incidence varies from 20-80%
- Until recently-no standardized score
- Many studies have contradictory results
- Characterized by extreme fear





Cravero et.al

- ASA I-II patients undergoing MRI
 - 80% incidence of EA with sevoflurane
 - 12% incidence with halothane
 - Addition of 1 ug/kg fentanyl 10 mins prior to end of procedure ↓ EA to 12%
 - No significant itching or vomiting post-op
 - Slightly higher incidence of EA in boys

Paediatr Anaesth. 2000; 10(4): 419-24.

Anesth Analg. 2003 Aug; 97(2): 364-7



Emergence Agitation

- Role of Volatile Agents?
 - Many theories
 - Much lower incidence with halothane
 - Isoflurane/Sevoflurane/Desflurane – unclear if one is better/worse
 - Minimal emergence agitation/delirium with propofol anesthetic, despite similar emergence times

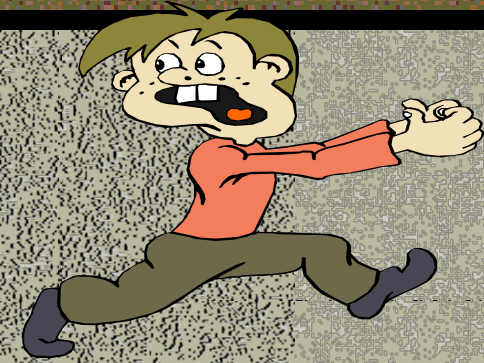
Emergence Agitation



■ Role of Pain

- Multiple studies confirm that measures that decrease pain will also decrease emergence agitation and delirium
- This includes use of ketorolac, regional analgesia, opioids, best results
- Intranasal fentanyl 2ug/kg significantly reduced agitation for patients undergoing T&T (PE tubes).

Pre-operative Anxiety?



- Pre-operative anxiety seems to be associated with EA
- Most studies show ↓ pre-op anxiety ⇒ ↓ in emergence agitation/delirium
- Premedication with midazolam ↓'s anxiety
- Some studies show a ↓ in emergence agitation/delirium with midazolam—but not all!



Other Medications

- Dexmetatomodine—mostly +
- Clonidine—+/-
- Tropisteron—one study
- Ketamine—one study
- Nalbuphine—one study

Table 2. Reports on Some Preventive Measures Recommended for Reducing Emergence Agitation/Delirium in Children

| Medication | Population | Study design ^a | Outcome | Sedation/Analgesia |
|-------------------------------|--|--|---|---|
| Oral midazolam (32) | 100 children 6 mo to 6 yr BMT | SEVO or HALO and oral midazolam 0.5 mg/kg or placebo | SEVO + placebo 67% SEVO + midazolam 39% HALO + placebo 29% HALO + midazolam 33% | Rectal acetaminophen 15–30 mg/kg |
| Clonidine IV or caudally (55) | 80 children 3–8 yr Lower abdominal and minor genital surgery | Clonidine (caudally 1 µg/kg, caudally 3 µg/kg, IV 3 µg/kg) or placebo | Placebo 39% Clonidine (caudally 1 µg/kg) 22% Clonidine (caudally 3 µg/kg) 0% Clonidine IV (3 µg/kg) 5% | Oral midazolam 0.4 mg/kg Caudal block |
| Clonidine IV (56) | 169 children 3.2 ± 1.4 yr Lower abdominal and minor urologic surgery | Clonidine IV 2 µg/kg or placebo | Placebo 33% Clonidine 14% | Oral midazolam 0.5 mg/kg Regional or central block |
| Dexmedetomidine inf. (57) | 50 children 1–10 yr Elective outpatient surgery | Dexmedetomidine 0.2 µg · kg ⁻¹ · h ⁻¹ or placebo | Placebo 61% Dexmedetomidine 26% | No premedication |
| Dexmedetomidine bolus (58) | 90 children 1–10 yr Lower abdominal and genital surgery | Dexmedetomidine IV 0.15 µg/kg or 0.3 µg/kg or placebo | Placebo 37% Dexmedetomidine (0.15 µg/kg) 17% Dexmedetomidine (0.3 µg/kg) 10% | No premedication |
| Fentanyl IV (65) | 32 children 18 mo to 10 yr MRI | Fentanyl IV 1 µg/kg or placebo | Placebo 56% Fentanyl 12% | No premedication |
| Fentanyl intranasally (54) | 150 children 6 mo to 5 yr BMT | Fentanyl intranasally 1 µg/kg or 2 µg/kg or placebo | Placebo 46% Fentanyl (1 µg/kg) 25% Fentanyl (2 µg/kg) 15% | No premedication Rectal acetaminophen 40 mg/kg |
| Ketorolac IV (17) | 200 children 1–5 yr BMT | SEVO or HALO and ketorolac IV 1 mg/kg or placebo | SEVO + placebo 38% SEVO + ketorolac 14% HALO + placebo 42% HALO + ketorolac 12% | Nasal midazolam 0.2 mg/kg |

BMT = bilateral myringotomy/tube insertion; HALO = halothane; MRI = magnetic resonance imaging; SEVO = sevoflurane.

^a All studies cited above were prospective, randomized, double-blinded and placebo-controlled.

Post-Operative Vomiting

Nausea is harder to evaluate in children





Post-operative Vomiting

- Recent meta-analysis confirmed that dexamethasone and/or 5HT blockers are efficacious agents in children
- Metaclopramide was somewhat helpful
- Supra-hydration (30ml/kg) decreased post-op vomiting for up to 24hours

Br J Anaesth. Nov

2006

**Paediatr Anaesth.
Jan 2006**



POV— Risk Score

- Data from 1257 children in 4 different types of institutions was evaluated
- Risk factors:
 - Age > 3yrs
 - Procedure > 30 Minutes
 - Strabismus surgery
 - H/O PONV or PONV in immediate family
 - Risk increases with # of risk factors



of Risk Factors

Incidence of POV

| | |
|---|-----|
| 0 | 9% |
| 1 | 10% |
| 2 | 30% |
| 3 | 55% |
| 4 | 70% |



Post-operative Vomiting

- Surprisingly Khalil et.al found a 28% incidence post-op vomiting in a :
 - Multi-institutional study
 - 650 ASA I-III pts < 24 months
 - Elective surgery
 - RCT, double blinded study group rec'd ondansetron
- Followed patients for up to 24 hours

**Khalil et.al: Anesth
Analg Aug 2005**



Have a Great Day!



