Out Patient Anesthesia in Children

Common Controversies

- Previously undetected murmur
- Child with a runny nose
- Ex-premature infant
- SDB
- Post-Operative Pain
- PONV

Murmurs

- Very common
- Highest incidence at 3 or 4 years
- “Functional” = normal heart
- Usually short, and soft
- Louder when pt supine or ↑ heart rate

I hear a “new” murmur, now what?

Common Locations to hear murmurs

Common “functional” murmurs

- Still murmur-
  - musical or vibratory, midsystolic,
  - left sternal border
- Peripheral pulmonary stenosis-
  - ejection murmur
  - LUSB, radiates-neonates
- Venous Hum-
  - continuous murmur louder in upright position
  - Upper chest
How loud?

- Grade I: Heard only with intense concentration
- Grade II: Faint, but heard immediately
- Grade III: Easily heard, of intermediate intensity
- Grade IV: Easily heard, palpable thrill/vibration on chest wall
- Grade V: Very loud, thrill present, audible with only edge of stethoscope on chest wall
- Grade VI: Audible with stethoscope off the chest wall

What to do?

- Controversial
- If child is growing well, asymptomatic and has good exercise tolerance—anesthesia well tolerated
- Look for systemic symptoms
- If in doubt—Echo +/- Pediatric cardiologist

Symptoms of Heart Disease

- Feeding difficulties: disinterest, fatigue, diaphoresis, tachypnea, dyspnea
- Poor exercise tolerance
- Resp distress, grunting, nasal flaring, retractions
- Frequent respiratory tract infections
- Central cyanosis or poor capillary refill
- Absent or abnormal peripheral pulses

If in Doubt

- Call Cardiology
- Postpone Case
- Reschedule?

Child with a Runny Nose

95% of RTI are viral—wide spectrum of species and respiratory tract involvement
Hyper-reactivity of airways is common for several weeks
Airways may be more sensitive to "irritants" (secrections, anesthetic agents etc.)
The Child With a Runny Nose

- Pulmonary function tests abnormalities are not uncommon, including ↓ FVC, FEV, and PEF
- ↓ Diffusion capacity and ↑ desaturation after apnea

Ellis. Anaesthesia 10:78-9, 1955

The Child With a Runny Nose

- “although anesthesia is not good for the common cold, might it not be a good way of passing the time till the cold is gone?”
- No reason for automatic cancellation
- ↑ anesthetic risk usually minor
- Intubation ↑ risk
- Bronchodilators do not ↓ risk
- Glycopyrrolate does not ↓ risk

The Child With a Runny Nose

- Cohen and Cameron:>
  - >20,000 children
  - 2-7 x increased risk of respiratory complications with URI
  - 11 x increased risk if they were intubated
  - Study criticized for incomplete documentation as to signs and symptoms of URI


The Child With a Runny Nose

- Tait et.al examined >1000 children for elective surgery. Risk factors for increased complications included:
  - Use of ETT in child < 5 yrs
  - H/O prematurity or RAD
  - Paternal smoking (?)
  - Airway surgery
  - Copious secretions and/or nasal congestion


The Child With a Runny Nose

- Parmis et.al examining predictors of complications in 2051 patients found that the risk increased with:
  - ETT > LMA > mask airway
  - Parent’s report that child has a “cold”
  - H/o snoring, passive smoking
  - Presence of sputum and or nasal congestion
  - Induction with STP > halo > sevo > propofol
  - Non-reversal of muscle relaxant

Parmis et.al Paed Anaesth 11:20-40,2001

The Child With a Runny Nose

- The increased risk associated with RTI’s seems to be minimal
  - No closed claims cases
  - There are a few cases of increased atelectasis
  - In Tait et.al’s study of >1000 pts, 3 required admission post-op, 2 for pneumonia, 1 for stridor
  - One case report of death related to laryngospasm and cardiac arrest after extubation in a 15 month old child with a URI

Tait and Malviya. Anesthesia with Upper Respiratory Tract Infection, A&A 100, 2005
More Recent Studies

  - Oral ETT, inhalation agents and passive smoking ↑ risk
- Schebesta, Gürloglu et.al Can J Anesth: 57; 745-50. 2010
  - Lidocaine gel on LMA ↓ airway complications

The Child With a Runny Nose

- Assessment:
  - History of "cold" by parents better predictor of laryngospasm than reliance on symptoms
  - Presence of sputum, nasal congestion and RAD ↑ incidence of adverse resp events
  - ✓ for fever, dyspnea, lethargy, wheezing, productive cough and lung field abnormalities
  - Labs, CXR, naso-pharyngeal swabs, rarely practical or helpful

- Anesthetic Management
  - Avoid irritants!! (ETT, excessive secretions)
  - Keep child well hydrated, consider humidification
  - Consider anticholinergics
  - Ensure adequate anesthetic depth before any airway manipulations
  - Awake or deep extubation per practioner’s preference

Cancel When:

- Fever
- Lethargy, wheezing or other pulmonary signs

Ex-Premature infant for Out Patient Anesthesia

Ex-premature infant

- When are they candidates for outpatient anesthesia?
- Does type of anesthetic matter?
- Does Procedure Matter?
GUIDELINES: Risk of post-operative apnea and need for post-procedure admission or observation will be determined at the discretion of the attending anesthesiologist. PCA, or post-conception age, is gestational age + post-natal age.

- Former premature infants born prior to 37 weeks gestational age who are less than 56 weeks PCA at the time of surgery should be admitted overnight for cardiorespiratory monitoring or may require prolonged observation in the PACU prior to discharge.
- Full term infants (gestational age greater than 37 weeks) require overnight admission or extended PACU observation if they are less than 44 weeks PCA at the time of surgery.
- Patient who receive local anesthesia or spinal anesthesia only without systemic sedation, may be post-operatively managed at the discretion of the attending anesthesiologist.

Term infants > 6 months of age
Or a former premature infant older than 60 weeks post-conception and not currently on home monitors may be discharged home on the day of surgery if no other indications for admission exist.

Risk of apnea exceeds 1% in infants born at 32 weeks PCA until ~ 56 weeks
Increased risk with:
- Anemia
- AGA infants
- On-going apnea at home
All anesthesics have been implied

Spinal Anesthesia?


Post-operative recovery after inguinal herniotomy in ex-premature infants: comparison between sevoflurane and spinal anaesthesia

Table 1
Patient characteristics and intra-operative data. A comparison of post-conceptual age (PCA), gestational age (GA), weight (Wt), pre-operative haemoglobin (Hb) and anaesthetic time (induction–skin closure) for the two groups (median [range]). There was no significant difference between the groups with regard to any variable. *Number of patients

<table>
<thead>
<tr>
<th>Variable</th>
<th>Group 1 (n = 14) sevoflurane</th>
<th>Group 2 (n = 10) spinal</th>
</tr>
</thead>
<tbody>
<tr>
<td>PCA (weeks)</td>
<td>38 [22–46]</td>
<td>40 [38–46]</td>
</tr>
<tr>
<td>GA (weeks)</td>
<td>31 [23–36]</td>
<td>39 [36–46]</td>
</tr>
<tr>
<td>Wt (kg)</td>
<td>2.8 [1.2–3.6]</td>
<td>2.9 [1.7–3.4]</td>
</tr>
<tr>
<td>Hb (g dl⁻¹)</td>
<td>10.2 [9.0–13.4]</td>
<td>10.3 [9.6–12.7]</td>
</tr>
<tr>
<td>Bilateral repairs (n)</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Incision–closure (min)</td>
<td>26 [10–45]</td>
<td>28 [12–45]</td>
</tr>
</tbody>
</table>
Post-operative recovery after inguinal herniotomy in ex-premature infants: comparison between sevoflurane and spinal anaesthesia

<table>
<thead>
<tr>
<th></th>
<th>Sevo Pre</th>
<th>Sevo Post</th>
<th>Spinal Pre</th>
<th>Spinal Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>SpO2 (%)</td>
<td>97</td>
<td>97</td>
<td>96</td>
<td>96</td>
</tr>
<tr>
<td>Heart Rate (BPM)</td>
<td>150</td>
<td>155</td>
<td>142</td>
<td>150</td>
</tr>
<tr>
<td>% time SpO2 &lt; 90%</td>
<td>6 (1-63)</td>
<td>6 (0-48)</td>
<td>6 (0-17)</td>
<td>6 (2-28)</td>
</tr>
<tr>
<td># of episodes of desat/hour</td>
<td>9 (3-20)</td>
<td>10 (4-14)</td>
<td>8 (2-11)</td>
<td>7 (3-16)</td>
</tr>
</tbody>
</table>

Fig 1 Group distribution of 'excess' post-operative cardiorespiratory complications related to pre-operative respiratory function.

Current Recommendations (Cote)
- Admit all ex preemie < 60 weeks PCA until apnea free for at least 12 hours
- Consider Caffeine (10mg/kg)
- Consider regional
- Ensure adequate Hgb
- Full term infants < 44 weeks PMA may be at risk

Sleep Disorder Breathing and OSA

Childhood versus Adult OSAS features
### Severity Ranking system based on Polysomnography

<table>
<thead>
<tr>
<th>Severity</th>
<th>Apnea-hypopnea index</th>
<th>Oxygen Saturation Nadir</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>&gt;1</td>
<td>&gt;92</td>
</tr>
<tr>
<td>Mild OSA</td>
<td>2-4</td>
<td></td>
</tr>
<tr>
<td>Moderate OSA</td>
<td>5-9</td>
<td></td>
</tr>
<tr>
<td>Severe OSA</td>
<td>&gt;10</td>
<td>&lt;80</td>
</tr>
</tbody>
</table>

A & A July 2009 vol. 109 no. 1 60-75

Table 7. Key Questions to Ask Parents

- Does your child have difficulty breathing during sleep?
- Have you observed symptoms of apnea?
- Have you observed sweating while your child sleeps?
- Does your child have restless sleep?
- Does your child breathe through his/her mouth when awake?
- Are you worried about your child’s breathing at night?
- Do you have any family history of obstructive sleep apnea, sudden infant death syndrome, or apparent life-threatening events?
- Does your child have behavioral problems?


### Role of Hypoxia

- Rats exposed to intermittent hypoxia develop increased opioid sensitivity
- Hypoxia can lead to inflammatory response and vascular remodeling
- Wilson et al and others have found a 2.5 X increase in the incidence of respiratory complications in children undergoing T&A who had evidence of nocturnal desaturation to 80% or less

### Relationship between intermittent Hypoxia and Systemic responses

After Adenotonsillectomy and, in Some Cases, Persistent Obstructive Sleep Apnea

- Severe obstructive sleep apnea on polysomnography
- History of prematurity, especially with respiratory disease
- Age <3 yr
- Morbid obesity
- Nasal problems (deviated septum, enlarged turbinates)
- Mallampati score 3 or 4
- Neuromuscular disorders/disordered pharyngeal tone
- Genetic or chromosomal disorders
- Craniofacial disorders
- Enlarged lingual tonsils
- Upper respiratory infection within 4 wk of surgery
- Cor pulmonale
- Systemic hypertension
- Marked obstruction on inhalational induction
- Disordered breathing in the postanesthesia care unit
- Difficulty breathing during sleep
- Growth impairment due to chronic obstructed breathing
**Tonsillectomy in 2012**

- Obstructive symptoms and sleep disordered breathing are most common causes of T&A
- Few polysomnography
- ↑ incidence of peri-op complications
- ↓ doses of opioids or sedatives

**STBUR**

- Snoring
- Trouble Breathing
- UnRefreshed

**STBUR**

- Does your child:
  - Snore more than ½ the time?
  - Snore loudly?
  - Trouble/struggle to breath
  - Stop breathing during the night
  - Wake up Unrefreshed
  - Score > 3 = 3X risk of PRAE (perioperative respiratory adverse events)
  - Score =5 + 10 X risk of PRAE

**Anesthetic Considerations**

- ↑ pre-op desat = ↑ sensitivity to opioids
- Require less opioids
- Standard opioid doses may be relative overdose
- Consider nocturnal oxygen monitoring prior to surgery
Race

- African Americans compared to Caucasians
  - ↑ SDB
  - ↑ OSAS
- African Americans have lower O₂Sat nadir
- Pharmacogenetics work on different ethnicities

BMI

- Severely obese children have a higher incidence of unplanned admission and readmission

**Table 1.** Frequent postoperative adverse events between normal weight, overweight and obese children

<table>
<thead>
<tr>
<th>Event</th>
<th>Normal weight (n = 105) (%)</th>
<th>Overweight (n = 120) (%)</th>
<th>Obese (n = 100) (%)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nausea</td>
<td>12.7</td>
<td>16.4</td>
<td>16.1</td>
<td>0.281</td>
</tr>
<tr>
<td>Diarrhea</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1.9</td>
<td>2.6</td>
<td>1.1</td>
<td>0.981</td>
</tr>
<tr>
<td>Hypotension</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Difficult mask away</td>
<td>2.2</td>
<td>5.0</td>
<td>2.2</td>
<td>0.384</td>
</tr>
<tr>
<td>Difficult intubation</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Gag reflex</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>DVT</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Cardiac arrest</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>HOC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uproar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uproar</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Opioid use</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Preoperative events</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Intubation</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Suction</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Vomiting</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Postoperative events</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

**Table 2.** Severe intraoperative and immediate postoperative adverse events among severely obese children undergoing tonsillectomy

<table>
<thead>
<tr>
<th>Event</th>
<th>Normal weight (n = 105)</th>
<th>Severe obesity (n = 100)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any unplanned events</td>
<td>3 (1.5%)</td>
<td>4 (4.0%)</td>
<td>0.080</td>
</tr>
<tr>
<td>Anesthesia failure</td>
<td>1 (0.9%)</td>
<td>2 (2.0%)</td>
<td>0.485</td>
</tr>
<tr>
<td>Airway obstruction</td>
<td>0 (0.0%)</td>
<td>4 (4.0%)</td>
<td>0.047</td>
</tr>
<tr>
<td>Intravenous sedation</td>
<td>1 (0.9%)</td>
<td>4 (4.0%)</td>
<td>0.075</td>
</tr>
<tr>
<td>Aspiration</td>
<td>0 (0.0%)</td>
<td>3 (3.0%)</td>
<td>0.005</td>
</tr>
<tr>
<td>Central hypoxemia, 30% ≤ 70%</td>
<td>1 (1.0%)</td>
<td>6 (6.0%)</td>
<td>0.597</td>
</tr>
<tr>
<td>Any recovery room monitor</td>
<td>1 (0.9%)</td>
<td>3 (3.0%)</td>
<td>0.474</td>
</tr>
<tr>
<td>Breathing</td>
<td>0 (0.0%)</td>
<td>1 (1.0%)</td>
<td>1.000</td>
</tr>
<tr>
<td>Airway obstruction</td>
<td>0 (0.0%)</td>
<td>3 (3.0%)</td>
<td>0.080</td>
</tr>
<tr>
<td>Aspiration</td>
<td>0 (0.0%)</td>
<td>4 (4.0%)</td>
<td>0.005</td>
</tr>
<tr>
<td>Nasal airway obstruction</td>
<td>1 (1.0%)</td>
<td>1 (1.0%)</td>
<td>1.000</td>
</tr>
<tr>
<td>any perioperative events</td>
<td>4 (3.95)</td>
<td>16 (15.9%)</td>
<td>0.597</td>
</tr>
</tbody>
</table>

More References

- Brown KA, et al. Recurrent hypoxemia in young children with obstructive sleep apnea is associated with reduced opioid requirement for analgesia. *Anesthesiology*. 2004 Apr;100(4):806-10

Parental Presence During Induction of Anesthesia

- Brown KA, et al. Recurrent hypoxemia in young children with obstructive sleep apnea is associated with reduced opioid requirement for analgesia. *Anesthesiology*. 2004 Apr;100(4):806-10;
**Parental Presence at Induction**
- Premedication is probably better
- PPIA and midazolam -- no additional benefits
- Parents want to be with their kids
- Parents are more satisfied

**Parental Presence**
- Prepared parents are awesome
- Calm parents are helpful
- Anxious parents are a challenge
- Recent Case report: Mother freaked out after induction
  - A & A December 2012 vol. 115 no. 6 1371-1372

**Lots of other distraction techniques**
- Books, music
- Screens
- Video Games
- Stories, etc.
- Studies underway by Kain et.al to determine best parental/health care worker interactions

**The Studies of Kain et.al**
- 93 ASA I-II pts, 2-8 yrs, outpt surgery
- Randomized to parents only in OR, midazolam 0.5mg/kg only, or neither
- Multiple anxiety scales and coping and temperament measures prior to intervention
- Lower anxiety at induction in midazolam group
  - Anesthesiology. 1998 Nov; 89(5): 1147-56

**Kain et.al**
- 103 pts, 2-8 yrs, ASA I-II outpt surgery
- Randomized to midaz or midaz + PPIA
- Multiple anxiety scales and coping and temperament measures prior to interventions
- Anxiety and compliance scores were equal between the 2 groups, but parental satisfaction was higher
  - 2003 Apr; 92(4): 939-46

**PPIA**
- If given a choice, the majority parents will choose PPIA, even if their child had minimal or no anxiety on a previous surgery
- PPIA is associated with ↑ HR and skin conductance level, but no EKG changes in the parents
  - Anesthesiology. 2003 Jan; 98(1): 58-64
Post-operative Pain

- Combined general-regional techniques are very common
- Most blocks are placed after the child is anesthetized.
- Ultrasound has made this easier and more practical

Post-operative Pain Management

- Catheters
  - With good education and follow up, easy and effective
  - Minimal complications
    - Skin
    - Mechanical
    - Leaking

- Acetaminophen (A) up to 45 mg/kg p.r.
- Fentanyl can be used intra-nasally if no IV access. Blood levels appear to be equivalent to IV
- Morphine 0.05-0.1 mg/kg
- Ketorolac 0.5 mg/kg IV, 1mg/kg IM , intranasal max doses 30 and 60 mg respectively

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Catheters

- With good education and follow up, easy and effective
- Minimal complications
  - Skin
  - Mechanical
  - Leaking

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Dadure C, Pirat P, Raux et al

Dadure C, Benjouidi S, Raux et al

Ponde VC, Desai AP, Shah DM, Johari AN.

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Agarwal, Rita, MD, FAAP

Out Patient Anesthesia in Children
Acetaminophen
- Intravenous-
  - 12.5mg/kg IV infused over 15mins q 4 hours
  - 15mg/kg over 15 minutes q 6 hours
- Very effective can be used in a wide variety of situations
- Educate health care providers regarding other meds with acetaminophen

PONV
- Eberhart et al have developed a score to determine the risk of POV in children. Four independent factors were found:
  - Duration of surgery > 30 minutes,
  - age ≥ 3 yrs
  - strabismus surgery
  - h/o prior POV or a relative with a h/o POV

PONV--Treatment
- Keeping the patient well hydrated
- Don’t force oral intake
- Minimize use of volatile agents
- Medications
  - Dexamethasone has been shown to be anti-emetic in doses of 0.05-1mg/kg
  - Ondansetron, granisetron etc are all effective esp in combination with Dex

Respiratory Complications
- Perioperative respiratory complications occur in about 10-30% of patients in the peri-operative period
- Bronchospasm, laryngospasm, airway obstruction, oxygen desaturation and stridor are the most commonly seen complications
- Deep vs awake extubation is not implicated as a risk factor
Laryngospasm-Treatment

- 100% oxygen + Fink maneuver (painful jaw thrust)
- Positive pressure ventilation to PIP of 20 cm H2O
- Propofol 0.8 mg/kg has been shown to help in ~76% of patients
- Sux 10-20% of intubating dose

Selected References


Conclusion

- A new scale has been developed to help assess the risk of PONV in children
- Respiratory complications are fairly common, but easily treated