Pediatric Outpatient Anesthesia

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No Financial Disclosures
Objectives

• To outline Patient Selection for Pediatric Outpatient Anesthesia

• To review Procedure Selection for Pediatric Outpatient Anesthesia

• To describe the Considerations (Controversies) in Pediatric Outpatient Anesthesia
HOCM
Heterotaxy
Severe OSA
AICD
Known difficult airway
MH in 1st degree relative, King-Denborough/Central Core/Multiminicore myopathy
Unexplained Hypotonia/Myopathy
History

• 1st pediatric outpatient procedure
• Dr. Crawford Long
  1842 - Jack a little boy had a toe amp using ether
Epidemiology

• Rise of Free-standing surgicenters in 1970s

• <10% of cases in 1970 to 50% in 1990s

• 53 million ambulatory anesthetics

Rabbits 2010
Cullen 2009
Inpatient vs Ambulatory

Figure 1. Ambulatory surgery visits and discharges of hospital inpatients with procedures: United States, 1996 and 2006 (revised)

1The number of ambulatory surgery visits includes ambulatory surgery patients admitted to hospitals as inpatients for both 1996 and 2006. As a result, the data differ from those presented in the 1996 report (5).

SOURCES: CDC/NCHS, National Survey of Ambulatory Surgery, 2006 and National Hospital Discharge Survey.
Hospital based vs Freestanding


Figure 2. Percent distribution of ambulatory surgery visits by type of facility: United States, 2006.
Epidemiology

• 3.3 Million in 2006

• 57.2% Hospital based

• 42.8% Freestanding surgicenters

Age and Gender Distribution

Figure 4. Rate of ambulatory surgery procedures by age and sex: United States, 2006 (revised)
3 locations

- In hospital
- Ambulatory surgical centers
- Offices
Advantages:
• Minimizes emotional disturbances
• Reduces risk of nosocomial infections
• Reduces cost of treatment

Steward 1975
Patient selection

- Age > 6 months
- ASA I and II
- Shorter Duration
- Minimal risk of bleeding
- Patients located nearby
Facility

• Ability to run labs Hgb, UA
• Resuscitation facilities like inpatient facilities
• Difficult airway cart
• Ability to transfer to an inpatient facility
• Waiting and play areas (carpeted)
American College of Surgeons: Verification of Children's Hospital

2-8 Children’s surgical center must perform surgical procedures for at least 1,000 patients younger than 18 years annually.

2-9 Two or more pediatric surgeons must be on the medical staff.

2-10 Two or more pediatric anesthesiologists must be on the medical staff.

2-11 A pediatric anesthesiologist must serve as the primary anesthesiologist for all children two years or younger.


ACS 2016: Quick Reference Guide
Ann & Robert H. Lurie Children's Hospital of Chicago
Arkansas Children's Hospital
Arnold Palmer Hospital for Children (Orlando, Fl)
Boston Children's Hospital
C.S. Mott Children's Hospital
Children's Hospital of Wisconsin
Children's Hospitals and Clinics of Minnesota
The Children’s Mercy Hospital (Kansas City, Mo)
Children's National Health System
Cincinnati Children's Hospital Medical Center
Dell Children’s Medical Center (Austin, Tx)
Doernbecher Children’s Hospital (Portland, OR)/OHSU
New York-Presbyterian Morgan Stanley Children's Hospital
Penn State Children's Hospital
Primary Children's Hospital (Salt Lake City, UT))
Randall Children's Hospital (Emmanuel Legacy, Portland, OR)
Seattle Children's Hospital
Texas Children’s Hospital
University of California–Davis Children's Hospital
Laboratory Studies

- UA: no
- Hb/Hct: not unless preemie or Sickle cell disease
- HCG/UCG

Anesthetic Selection

- General
- Sedation
- Regional
Procedure Selection

- Under 4 hours**
- Low surgical risk or anesthetic
- Minimal physiologic changes/blood loss
- Minimal to moderate pain only

Polanar 2006
Procedure Selection

• ENT
  • 3 most common procedures: Tonsillectomies, Adenoidectomies and Ear tubes

• Urology
• Pediatric Surgery
• Ophthalmology
• GI studies
• Radiologic Studies

Rabbits in 2010
3.3 million procedures

- 670,000 M&T
- 1 million on nose, mouth, pharynx of which 660,000 T&A
- 300,000 musculoskeletal
- 240,000 radiologic
- 160,000 urologic

Cullen/NHSR 2009
Pediatric ASC Case Distribution

- Ear
- M+T
- T ± A
- A
- Male
- MSK
- Skin
- DX

(Cullen 2009)
Single Visit Surgery

Pre-op Surgical Visit and OR on same day

Pediatric Surgeons

Helpful for low income families

Nordin 2018
Surgical Procedures: ENT

If < 3 yr:
- 2.5% return to surgical facility
- 9.3% transfer rate

Risks:
- OSA
- Central sleep apnea
- Facial/oral dysmorphism
- URIs
Apnea Hypopnea Index

Polysomnography

- Events of hypopneas, apneas and desaturations
- >10 is considered severe in children

Garetz 2019
# Pediatric and Adult AHI

<table>
<thead>
<tr>
<th>OSA severity</th>
<th>AHII in children</th>
<th>AHII in adults</th>
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<tbody>
<tr>
<td>None</td>
<td>0</td>
<td>0–5</td>
</tr>
<tr>
<td>Mild</td>
<td>1–5</td>
<td>5–15</td>
</tr>
<tr>
<td>Moderate</td>
<td>5–10</td>
<td>15–30</td>
</tr>
<tr>
<td>Severe</td>
<td>&gt;10</td>
<td>&gt;30</td>
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</table>
# Conditions that Warrant PSG

<table>
<thead>
<tr>
<th>Condition/Issue</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age &lt;2</td>
<td>Increased respiratory complications; symptoms don’t predict OSA</td>
</tr>
<tr>
<td>Obesity (BMI &gt; 95\textsuperscript{th}%)</td>
<td>OSA increases with obesity</td>
</tr>
<tr>
<td>Down’s Syndrome</td>
<td>R/O Hypothyroid; Atlanto-axial instability; multiple sites of obstruction</td>
</tr>
<tr>
<td>Craniofacial anomalies</td>
<td>Variable severe airway obstruction</td>
</tr>
<tr>
<td>Neuromuscular Disorders</td>
<td>Significant hypoventilation/obstruction</td>
</tr>
<tr>
<td>Mucopolysaccharidosis</td>
<td>Pulmonary and cardiac dysfunction</td>
</tr>
<tr>
<td>Sickle Cell Disease</td>
<td>Larger than normal tonsil and adenoid; Peri-op complications: Acute Chest Syndrome</td>
</tr>
</tbody>
</table>

Garetz 2019
Rapid Turnover

15-20 ENT cases
ASA 1 (or 2)
2 ear tubes then a T&A or A
1 Faculty : 2 fellows/CRNAs/senior res.
Dedicated team lunch break
Pre-op Screening

- Prematurity
- OSA
- Obesity
- CHD
- Myopathy
- URI
- MH risk
- Difficult airway
- Coagulation disorders
- Downs Syndrome
- Severe developmental delay

Polaner 2006
Prematurity

Check for apneas and anemia

- All neonates in first 4-6 wks $\rightarrow$ fetal circulation
- 32 weeks PCA $\rightarrow$ 56 wks
- 35 weeks PCA $\rightarrow$ 54 wks
- Term $\rightarrow$ 45 wks

No difference in risk using a spinal or GA

Cote 1990
OSA

Peak incidence 3-8 yrs

- Increasing incidence
- Occurs in preemies
- Kids in resp distress
- Associated with
  - Craniofacial anomalies
  - Hypotonia
  - Myelomeningocele
  - CP
  - Downs

Various sources
Obesity

16% of children

Comorbidities

• Asthma
• HTN
• Reflux
• Type 2 Diabetes

Polaner 2006
Upper Respiratory Tract Infections

Postpone for 4 weeks for severe symptoms

- Fever, lethargy, purulent secretions, productive cough or pulmonary involvement
- Infections
- Airway inflammation, irritability
- Increased resp tract secretions
- Active URI increases incidence of respiratory events

Tait et al 2001
URI algorithm
Asthma

- 9% of children
- Most serious childhood illness
- Severity-ER admissions
- Triggers
- Treatment
- Better at inpatient capable place if:
  - Hosp. <3 mos ago
  - Exacerbation <1 mo ago
  - >3 episodes in 12 mos
  - Need for IV steroids within 1 mo
  - RA sat<96%
Malignant Hyperthermia

• Ability to obtain ABGs and treat
• Better to not be at an ASC or office
Native American myopathy (NAM)

- A neuromuscular disorder characterized by weakness, arthrogryposis, kyphoscoliosis, short stature, cleft palate, ptosis and susceptibility to malignant hyperthermia during anesthesia.

- NAM is reported exclusively in Native American Indians (Lumbee Indian population of North Carolina). Within this population, the prevalence of NAM is estimated at approximately 1:5,000.

- The NAM locus has been localized to 12q13.13-14.1.

- The disease is transmitted in an autosomal recessive manner.

Visit the Orphanet disease page for more resources.
Pre-op Preparation

- Pre-op phone calls
- Pre-op site visits
- Child life

Premeds

- Oral midazolam
- Parental presence

no better than pre-med
Pain Management

- Pain management/MPOP
  - Oral or IV Tylenol
  - IV Morphine or fentanyl
  - Ketorolac except for T&A
  - Regional or local per surgeons
Freestanding vs. Hospital ASC

1. Full term neonates at 4 weeks should be observed for 2 hrs
2. Preterm if at 50-60 wks, should be observed 12 hrs
3. T&A should be > 3 and no comorbidities (obesity, T21, craniofacial problems, severe OSA)

Hanallah 2017
POV: 8.9-42%--twice the rate of adults

Risk factors

• Surgery
  Type (strabismus, T&A, laparoscopy, GU, duration)

• Patient
  Age >3, h/o PONV, family history; **Female sex

• Anesthetic
  +/- N2O, difficult mask ventilation, opioids, reversal agents

Eberhart et al 2004
Prophylaxis vs treatment

- **Serotonin receptor antagonist**: ondansetron
- **Steroids**: dexamethasone
- **Antihistamines**: promethazine (Phenergan) or diphenhydramine (Benadryl)
- **Metoclopramide** (Reglan)
- **Droperidol** (Inapsine)
- **Hydroxyzine** (Vistaril)
- **Aprepitant** (Emend): NK-1 blocker; blocks substance P; decreases PONV in adults
### Prophylaxis Score

#### Risk Factors (1 point each):
- Age > 3 years
- Predisposition to PONV*
- Strabismus repair, tonsillectomy, groin surgery, or tympanoplasty surgery
- Duration of anesthesia > 45 minutes
- Anticipated post-op opioids
- Female AND ≥10yo

#### *Personal or family history of PONV or motion sickness

<table>
<thead>
<tr>
<th>RISK SCORE:</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low Risk</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Moderate Risk</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>High Risk</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

#### Drugs:
- None or Dexamethasone
- Diphenhydramine
- Ondansetron
- Consider Total IV Anesthesia (TIVA)
- Dexamethasone
- Dexamethasone
Game Changers

Dexmedetomidine

- Alpha-2 agonist
- Procedural sedation
- Emergence agitation

JTobias 2002-2004, J Cravero 2019
Game Changers

Sugammadex

- Selective Relaxant Binding Agent (SRBA)
- Blocks aminosteroids

Rocuronium > Vecuronium > Pancuronium
Recovery and discharge

- Normalization of physiology
- Baseline sensorium and activity level
- Emotional and psychological recovery
- Aldrete Score and PADSS
# Aldrete Score

**Chart 1. The ‘modified’ Aldrete Scale**

<table>
<thead>
<tr>
<th></th>
<th>2</th>
<th>1</th>
<th>0</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>RESPIRATION</strong></td>
<td>Able to take deep breath and cough</td>
<td>Dyspnea/Shallow Breathing</td>
<td>Apnea</td>
</tr>
<tr>
<td><strong>O2 SATURATION</strong></td>
<td>Maintains &gt; 92% on room air</td>
<td>Needs O2 inhalation to maintain O2 saturation &gt; 90%</td>
<td>Saturation &lt; 90% even with supplemental O2</td>
</tr>
<tr>
<td><strong>CONSCIOUSNESS</strong></td>
<td>Fully awake</td>
<td>Arousable on calling</td>
<td>Not responding</td>
</tr>
<tr>
<td><strong>CIRCULATION</strong></td>
<td>BP ± 20mmHg pre op</td>
<td>BP ± 20-50mmHg pre op</td>
<td>BP ± 50mmHg pre op</td>
</tr>
<tr>
<td><strong>ACTIVITY</strong></td>
<td>Able to move 4 extremities voluntarily or on command</td>
<td>Able to move 2 extremities voluntarily or on command</td>
<td>Able to move 0 extremities voluntarily or on command</td>
</tr>
</tbody>
</table>
## Postanesthesia Discharge Scoring System

<table>
<thead>
<tr>
<th>Vital Signs (BP and Pulse)</th>
<th>Activity</th>
<th>Nausea and Vomiting</th>
<th>Pain</th>
<th>Surgical Bleeding</th>
</tr>
</thead>
<tbody>
<tr>
<td>2: Within 20% of preoperative baseline</td>
<td>2: Steady gait, no dizziness</td>
<td>2: Minimal: treat with PO meds</td>
<td>2: Acceptable control per the patient; controlled with PO meds</td>
<td>2: Minimal: no dressing changes required</td>
</tr>
<tr>
<td>1: 20-40% of preoperative baseline</td>
<td>1: Requires assistance</td>
<td>1: Moderate: treat with IM medications</td>
<td>1: Not acceptable to the patient; not controlled with PO medications</td>
<td>1: Moderate: up to 2 dressing changes</td>
</tr>
<tr>
<td>0: &gt;40% of preoperative baseline</td>
<td>0: Unable to ambulate</td>
<td>0: Continues: repeated treatment</td>
<td></td>
<td>0: Severe: more than 3 dressing changes</td>
</tr>
</tbody>
</table>

Chung 1991
Complications

Rare morbidity and mortality

- Death rate 2/100,000
- Problems:
  - Pain 25-91%
  - PONV
  - Others: drowsiness, headache, dizziness, fever, hoarseness, mild croup, difficulty voiding
I DON'T ALWAYS BLAME ANESTHESIA

WHO AM I KIDDING, YES I DO
Unplanned admission

- Respiratory/Airway (25%)
- Pain (11%)
- PONV (10%)
- Prolonged PACU stay >3 hr

  - Cost is worse than a planned admission
  - Inconvenient
  - Incidence 1%

Whippy 2016
Unplanned Admissions

**Adults**
- Duration > 3 hr
- Age > 80
- ASA 3 or 4
- BMI 30-35

**Pediatrics**
- Age < 2 years (4.26)
- ASA 3 (3.77)
- Duration > 1 hr (6.54)
- Completion of Surgery after 3 pm (2.17)
- Orthopedic (2.52)
- Dental (.2)
- ENT (6.47)
- OSA (6.32)

Whippy 2016
Conclusion

Come up with criteria that you and your surgeons can work with

Adenoid > 2 yrs

T& A > 3 yrs

AHI

Birth at 34 wks or later with no sequelae
Question 1

Which patient has the highest risk of PONV?

A. 3-year-old male for bilateral hernia repair with sevoflurane and caudal block

B. 4-year-old female for laparoscopic appendectomy with sevoflurane

C. 20-month-old female for myringotomy tube placement with sevoflurane

D. 3-year-old male for laparoscopic orchidopexy with sevoflurane
Question 2
The most effective prophylaxis for PONV in pediatric patients is:

A. Ondansetron
B. Dexamethasone
C. Transdermal scopolamine
D. Metoclopramide
Question 3
Which of the following is a discharge criterion for pediatric ambulatory patients?

A. Pain controlled by oral pain medications

B. Blood pressure +/- 30 mmHg

C. Able to tolerate PO intake

D. Observation for 60 min after flumazenil
Question 4

Which patient is most appropriate to undergo bilateral hernia repair under general anesthesia in an ambulatory setting?

A. Gestational age 32 weeks, PCA 56 weeks

B. Gestational age 34 weeks, PCA 54 weeks

C. Gestational age 28 weeks, PCA 44 weeks

D. Gestational age 35 weeks, PCA 44 weeks
References

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Thank-you!