Update on Pediatric Ambulatory Anesthesia

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Disclosure

- I've moved

Introduction

Table 1
Statistics on ambulatory surgery in patients younger than 15 years of age

Total ambulatory procedures (all ages)	53,329,000
Ambulatory procedures younger than 15 y	3,266,000
Case breakdown—patients younger than 15 y	
Myringotomy and tubes	667,000
Tonsillectomy with or without adenoidectomy	530,000
Orthopedic procedures	295,000
Operations on the male genital organs	166,000
Adenoidectomy	132,000
Hernia repair	73,000

Adapted from Centers for Disease Control and Prevention. National Survey of Ambulatory Surgery 2006. Available at: http://www.cdc.gov/nchs/nsas.htm. Accessed January 30, 2014.

Common Considerations

- Patient selection:
  - ASA 3, 4
  - Ex-premature or young infant
  - Sleep ordered breathing/OSA
- Presence of URI
- Post-operative Pain
- PONV

Goals of Lecture:

- Discuss:
  - Child with a runny nose
  - Ex-premature infant
  - Sleep Disordered Breathing/OSA
  - Patients undergoing T&A
  - Post-Operative Pain

Included in Handout:

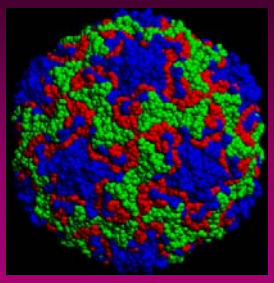
- Previously undetected murmur

Will discuss on Tuesday:

- Post operative Respiratory Complications
- Surgical Environment
- Codeine
- And more

Child with a Runny Nose

The Child With a Runny Nose

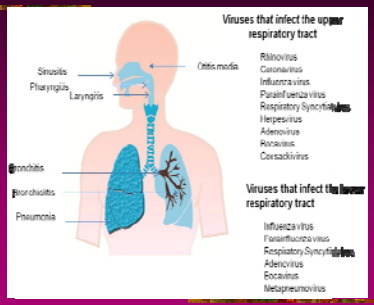


Mutating rhinovirus

- 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" (secretions, anesthetic agents etc.)

The Child With a Runny Nose

- Pulmonary function tests - -↓ FVC, FEV_1 and PEF
- ↓ Diffusion capacity and ↑ desaturation after apnea



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?"
- ↑ anesthetic risk usually minor
- Intubation ↑ risk
- Bronchodilators do not ↓ risk
- Glycopyrrolate does not ↓ risk

Ellis. Anaesthesia 10:78-9, 1955

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

Cohen and Cameron. Anesth Analg 72: 282-8 1991

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

Tait et.al. Anesthesiology 95:299-305, 2001

The Child With a Runny Nose

- Parnis 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

Parnis et.al Paed Anaesth 11:29-40,2001

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

- Kim, Kim et.al Korean J Anesthesiol:65; 136-141, 2013
  - Oral ETT, inhalation agents and passive smoking ↑ risk
- Schebesta, Gŭloglu 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

COLDS Score

Table 1 The COLDS score. Each category (column 1) is assigned 1, 2, or 5 points (columns 2–4), to obtain a total score ranging from 5 to 25. Examples are illustrative and not intended to be all-inclusive

	1	2	5
C Current signs/ symptoms	None	Mild Examples: Parent confirms URI AND/OR congestion, rhinorrhea, sore throat, sneezing, low fever, or dry cough	Moderate/severe Examples: Purulence, wet cough, abnormal lung sounds, lethargy, 'toxic' appearance, or high fever
O Onset	>4 weeks ago	2–4 weeks ago	<2 Weeks ago
L Lung disease	None	Mild Examples: Hx of RSV, mild intermittent asthma, CLD if >1 year old, loud snoring, or passive smoker	Moderate/severe Examples: Moderate persistent asthma, infant with CLD, OSA, or pulmonary HTN
D Airway device	None or facemask	Laryngeal mask airway or supraglottic	Tracheal tube
S Surgery	Other (including ear tubes)	Minor airway Examples: T/A, NLD probe, flexible bronchoscopy, and dental extractions	Major airway Examples: Cleft palate, rigid bronchoscopy, and maxillofacial

URI, upper respiratory tract infection; Hx, history; RSV, respiratory syncytial virus; CLD, chronic lung disease, also known as bronchopulmonary dysplasia; OSA, obstructive sleep apnea; HTN, hypertension; T/A, tonsillectomy and/or adenoidectomy; NLD, nasolacrimal duct.

The Child With a Runny Nose

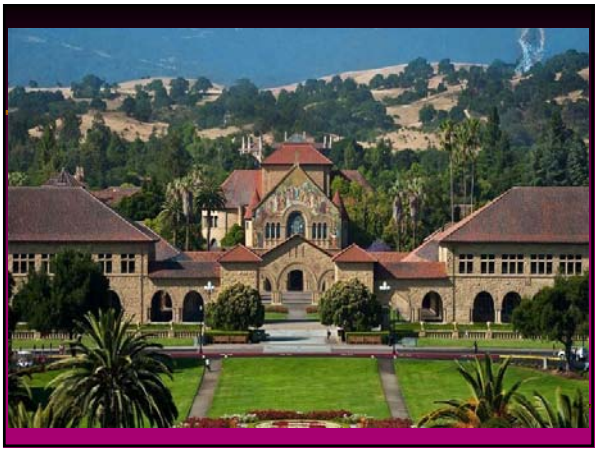
- Anesthetic Management
  - Avoid irritants!!! (ETT, excessive secretions)
  - Keep child well hydrated, consider humidification
  - Consider anticholinergics
  - Ensure adequate anesthetic depth before any airway manipulations
  - Awake or deep extubation per practioner's preference

Cancel When:

- Fever
- Lethargy, wheezing or other pulmonary signs

Consider Cancellation

- Unable to escalate care
- Can't admit
- "just don't feel right"



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?
- What about full term infant

Apnea and the Ex-preemie

- Risk is low
- Occurs in PACU
- Younger gestational age
- Pre-existing apnea
- Need for opioids or other sedatives

Guidelines for Ex-Premature infants (CHCO)

- **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 then 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.**

Lucille Packard

It is the policy of Lucile Packard Children's Hospital Stanford to admit infants for observation after receiving anesthesia or sedating drugs if they meet any of the following criteria:

A. Born prior to 37 weeks gestational age (GA) AND current age is less than 52 weeks post-menstrual age (PMA).

B. All infants less than 44 weeks PMA irrespective of GA.

C. Meet criteria 1 AND currently less than 60 weeks PMA AND have concurrent pertinent medical issues as defined by anesthesiologist.

These infants will be admitted to a monitored bed in a unit with the staff, equipment, and experience necessary to respond immediately to an apneic episode. Observation will occur for a minimum of 12 hours post anesthetic, and will be continued for at least 12 hours following any apneic event.

Full Term Infants

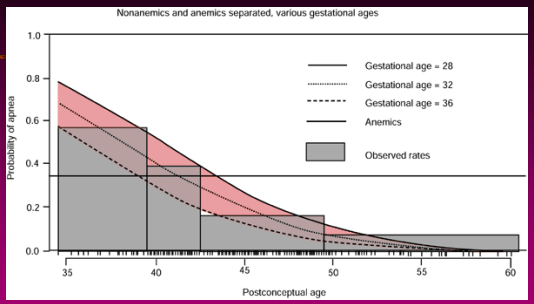
- Several case reports
- One with clonidine in caudal
- Some of these babies were found to have abnormal sleep studies
- < 44 weeks PMA

Ambulatory Surgicenter (CHCO)

- 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.

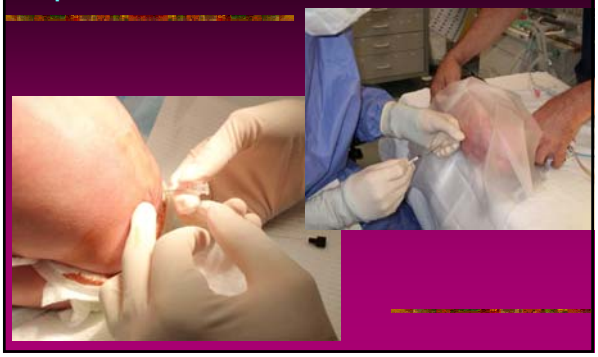
Cote: A Practice for Infants and children

- 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 anesthestics have been implied



Predicted probability of apnea for all patients, by gestational age and weeks of postconceptual age.. The risk for apnea diminishes for infants born at a later gestational age. The shaded boxes represent the overall rates of apnea for infants within that gestational age range. (From Coté et al)

Spinal Anesthesia?



Williams J M et al. Br. J. Anaesth. 2001;86:366-371

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

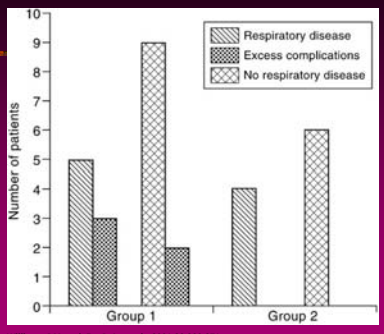
Table 1
Patient characteristics and intra-operative data. A comparison of post-conceptual age (PCA), gestational age (GA), weight (Wt), pre-operative haemoglobin (Hb) and anaesthetic time (induction–skin closure) for the two groups (median [range]). There was no significant difference between the groups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

	Group 1 (*n* =14) sevoflurane	Group 2 (*n* =10) spinal
PCA (weeks)	38 [32–46]	40 [36–44]
GA (weeks)	30 [23–35]	8 [26–33]
Wt (kg)	2.6 [1.2–3.5]	2.8 [1.7–3.6]
Hb (g dl^{-1})	10.2 [9.0–13.4]	10.9 [9.6–12.7]
Bilateral repairs (*n*)	7	5
Induction–incision (min)	23 [16–29]	19 [11–28]
Incision–closure (min)	26 [10–45]	28 [12–48]

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

	Sevo Pre	Sevo Post	Spinal Pre	Spinal Post
SpO2 (%)	97	97	96	96
Heart Rate (BPM)	150	155	142	150
% time SPO2 < 90%	6 (1-63)	6 (0-48)	6 (0-17)	6 (2-28
# of episodes of desat/hour	9 (3-20)	10 (4-14)	6 (2-11)	7 (3-16

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



Williams J M et al. Br. J. Anaesth. 2001;86:366-371

BJA British Journal of Anaesthesia

Cochrane Database Syst Rev. 2003;(3):CD003669.
Regional (spinal, epidural, caudal) versus general anaesthesia in preterm infants undergoing inguinal herniorrhaphy in early infancy.
Craven PD, Badawi N, Henderson-Smart DJ, O'Brien M.

- No difference-but small numbers

- Pediatr Surg Int. 2014 Oct;30(10):1069-73. Epub 2014 Sep 4. **Spinal anesthesia for inguinal hernia repair in infants: a feasible and safe method even in emergency cases.**Lambertz A et.al
- No complications, smaller babies

Pediatr Surg Int. 2013 Aug;29(8):801-4. doi: 10.1007/s00383-013-3330-8. Epub 2013 Jun 19.

Postoperative apnea after inguinal hernia repair in formerly premature infants: impacts of gestational age, postconceptional age and comorbidities.

Ozdemir T[1], Arikan A.

Author information

Abstract

PURPOSE: It is common practice for premature infants undergoing elective inguinal hernia (IH) repair to be hospitalized for postoperative apnea monitoring. This study evaluated the risk of apnea after IH repair with regard to gestational age (GA) and postconceptional age (PCA) in formerly premature infants.

METHODS: Formerly premature infants who had undergone elective IH repair between 01/2000 and 12/2012 were reviewed retrospectively in terms of GA, PCA, body weight, and comorbidities. All postoperative apneas were evaluated.

RESULTS: A total of 428 formerly premature infant charts were reviewed. Eleven babies had postoperative apnea. Infants younger than 45 weeks PCA were found more prone to develop postoperative apnea after IH repair. In older infants (PCA between 46 and 60 weeks), comorbidities create predisposition to apnea postoperatively. These comorbidities are bronchopulmonary dysplasia, necrotizing enterocolitis and former apnea episodes. Anemia and lower birth weight are also risk factors.

CONCLUSION: This study suggests that low GA and PCA, low birth weight, anemia, and complicated past medical history affect respiratory complication rates, particularly apnea in formerly premature infants undergoing elective IH repair. Severe apneas occurred earlier than mild ones. Overnight monitoring is mandatory in small infants with low GA and PCA. Otherwise healthy, older infants may be operated on outpatient basis.

Peds Surg Int 2013

- 428 infants
- Group 1: <45 weeks PCA
- Group 2: 45-60 weeks PCA
- 9 apnea in Group 1 (4.7%)
- 2 apnea in Group 2 (0.8%)

Comorbidites and demographic data of the patients in both groups

	Group 1	Group 2
Total no. of patients	191	237
GA (week)	30 ± 3.5	31 ± 4
PCA (week)	42 ± 4	53 ± 7
Birth weight (g)	1,600 ± 660	1,550 ± 700
History of mechanical ventilation	38 %	39 %
Associated cardiac anomaly	21 %	20 %
BPD	17 %	19 %
NEC	1.2 %	1 %
Hemoglobin level (g/dl)	9.6 ± 2	9.2 ± 1.5

BPD bronchopulmonary dysplasia, *NEC* necrotizing enterocolitis

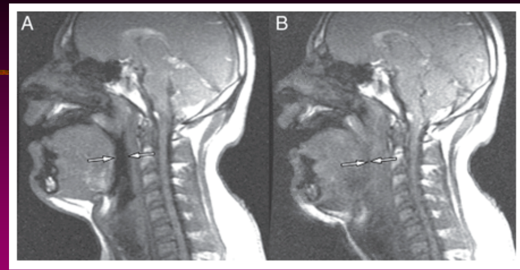
Cross tabulation of the apnea groups

	Apnea		Total
	Apnea (−)	Apnea (+)	
Group			
G1			
Count	182	9	191
% Within group	95.3	4.7	100.0
% Within apnea	43.6	81.8	44.6
G2			
Count	235	2	237
% Within group	99.2	0.8	100.0
% Within apnea	56.4	18.2	55.4
Total			
Count	417	11	428
% Within group	97.4	2.6	100.0
% Within apnea	100.0	100.0	100.0

Current Recommendations (Cóte)

- 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



Sagittal midline fast gradient MRI images obtained during expiration (A) and inspiration (B) show intermittent collapse of the retroglossal airway (arrows). At expiration (A), the retroglossal airway (arrows) is patent. During inspiration (B), there is glossoptosis, with the tongue moving posteriorly and obstructing the retroglossal airway (arrows).

Anesthesia & Analgesia:
June 2014 - Volume 118 - Issue 6 - p 1157–1159
doi: 10.1213/ANE.0b013e31829ec1e6
Editorials: Editorial
The Elephant in the Room: Lethal Apnea at Home after Adenotonsillectomy
Brown, Karen A. MD*; Brouillette, Robert T. MD†

Society for Pediatric Anesthesia
Section Editor: Peter J. Davis

Death or Neurologic Injury after Tonsillectomy in Children with a Focus on Obstructive Sleep Apnea: Houston, We Have a Problem!

Charles J. Coté, MD,* Karen L. Posner, PhD,† and Karen B. Domino, MD, MPH†

BACKGROUND: Obesity is epidemic in the United States and with it comes an increased incidence of obstructive sleep apnea (OSA). Evidence regarding opioid sensitivity as well as recent descriptions of deaths after tonsillectomy prompted a survey of all members of the Society for Pediatric Anesthesia regarding adverse events in children undergoing tonsillectomy.
METHODS: An electronic survey was sent to 2377 members of the Society for Pediatric Anesthesia. Additionally, data from the American Society of Anesthesiologists Closed Claims Project were obtained. Adverse events during or after tonsillectomy with or without adenoidectomy in children were included. Children at risk for OSA were identified as either having a positive history for OSA or a post hoc application of the American Society of A
practice guidelines. These children were compared with all other children b
proportions and t test for continuous variables.
RESULTS: A total of 129 cases were identified from the 731 replies to
meeting inclusion criteria for having adequate data. Another 19 cases wit

Anesthesia & Analgesia
June 2014 - Volume 118
Issue 6 - p 1276–1283

Table 2

	Overall (N = 111)	Children at risk for OSA (n = 63)	All other children (n = 48)	P
Outcome				0.035
Death	73 (66%)	42 (67%)	31 (65%)	
Permanent neurologic injury	13 (11%)	4 (6%)	9 (19%)	
Prolonged hospitalization	11 (10%)	6 (10%)	5 (10%)	
No harm	3 (3%)	1 (2%)	2 (4%)	
Not provided or unknown	11 (10%)	10 (16%)	1 (2%)	
Location of event				0.218
In the operating room	18 (16%)	9 (14%)	9 (19%)	
Postanesthesia care unit	13 (12%)	6 (10%)	7 (15%)	
On a ward	12 (11%)	9 (14%)	3 (6%)	
In an automobile	2 (2%)	0 (0%)	2 (4%)	
At home	53 (48%)	29 (46%)	24 (50%)	
Not provided or unknown	13 (12%)	10 (16%)	3 (6%)	
Attributed cause of event				0.018
Hemorrhage	31 (28%)	11 (17%)	20 (42%)[a]	
Apnea	40 (36%)	29 (46%)[b]	11 (23%)	
Other	17 (15%)	9 (14%)	8 (17%)	
Not provided or unknown	23 (21%)	14 (22%)	9 (19%)	

OSA = obstructive sleep apnea.
[a]Hemorrhage versus all other causes P = 0.006 by Fisher exact test.
[b]Apnea versus all other cau
P values by χ^2 (cause of eve

Outcome, Venue of Event, and Attributed Cause of the Event

Case	Narrative
Anesthesia event	3 year old was extubated, there was no blood pressure or oxygen saturation on arrival in PACU; the child died.
Anesthesia event	After extubation, a 3 year old developed laryngospasm, postobstructive pulmonary edema, required ECMO and died.
Possible rapid codeine metabolizer	A 9 year old was discharged after overnight observation and found dead that night, high morphine levels found; possible rapid codeine metabolizer.
Anesthesia event	A 4 year old developed apnea in PACU, was given multiple doses of naloxone, and discharged on codeine. Apnea spells occurred at home but the parents decided not to go to the hospital and he was found dead the next morning.
Surgical/anesthesia event	A 5 year old suffered cardiac arrest in the operating room due to kinking of tracheal tube by Dingman retractor; permanent neurologic injury resulted.
Nursing event	A 6 year old developed apnea and respiratory arrest 10 h after surgery on the ward with death as the outcome.
Anesthesia event	A morbidly obese 15-year-old 250-kg teenager arrested on induction of anesthesia; death.
Anesthesia/surgical event	An obese 2-year-old child with a positive OSA history was found dead at home 2 h after discharge. The child left with the grandmother's boyfriend while the mother and grandmother went shopping.
Anesthesia/surgical event	An 8-year-old obese child with a positive history for OSA spent the first night in the pediatric intensive care unit, was discharged home the next morning, and found dead that night.

PACU = postanesthesia care unit; ECMO = extracorporeal circulation membrane oxygenation; OSA = obstructive sleep apnea.

Table 5

Risk factor
Obesity as well as increasing obesity
Positive family history
Ethnicity (African American)
History of reactive airway disease
Congenital airway abnormality (e.g., mid facial hypoplasia)
Congenital syndrome (e.g., Down syndrome)
Male gender
Enlarged tonsils
Symptoms
Loud snoring (heard through closed door)
Gasps at night
Pauses in breathing at night
Night terrors
Restless sleep
Confusion arousals
Mouth breathing
Drooling
Sleep walking
Unusual sleep positions
Difficult to awaken in the morning
Daytime irritability
Morning headache
Daytime somnolence
Enuresis
Poor school performance
Frequent upper respiratory infections

Risk factors and symptoms abstracted from the following references; Refs. 2-5,9,10,15,16,19,34-38

Death or Neurologic Injury after Tonsillectomy in Children with a Focus on Obstructive Sleep Apnea: Houston, We Have a Problem!

Coté, Charles J.; Posner, Karen L.; Domino, Karen B.
Anesthesia & Analgesia. 118(6):1276-1283, June 2014.
doi: 10.1213/ANE.0b013e318294fc47

Table 5. Risk Factors and Symptoms of Obstructive Sleep Apnea

Wolters Kluwer | Lippincott Williams & Wilkins

ANESTHESIA & ANALGESIA

We get the picture, now what?

Childhood versus Adult OSAS features

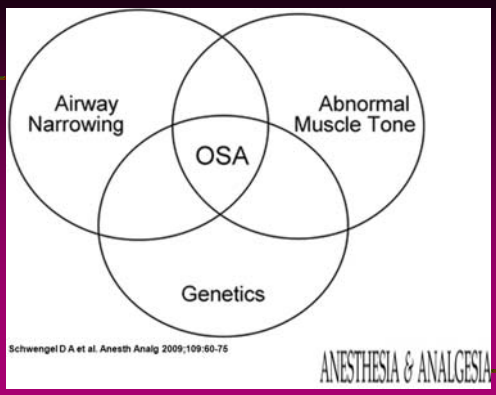
Table 1. Childhood Versus Adult Obstructive Sleep Apnea Syndrome Features

	Children	Adults
Presentation		
Age	2-6-yr peak	Increased elderly
Gender	Male = female	Males > females
Obesity	Few	Most
Tonsils and adenoids	Often enlarged	Rarely enlarged
Daytime sleepiness	Less common than in adults but can be seen	Common
Sleep		
Obstruction	Obstructive apnea or hypoventilation	Obstructive apnea
Sleep architecture	Usually normal	Decreased delta and REM
Arousals with obstruction	May not be seen	At end of each apnea
Treatment		
Surgical	Definitive therapy in most patients	Minority of cases with inconsistent results
Medical (positive airway pressure)	Selected patients	Most common therapy

Adapted from Sterni and Tunkel, Pediatr Clin North Am 2003;50:427-43.
REM = rapid eye movement.

Severity Ranking System Based on Polysomnography

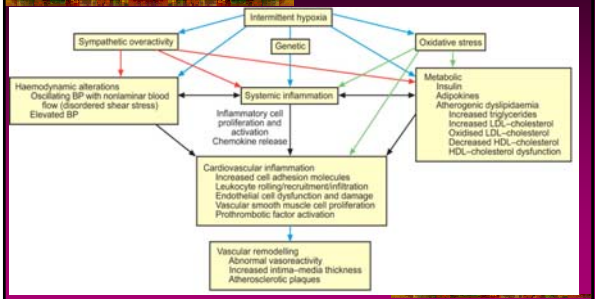
	Apnea-hyponea index	Oxygen Saturation Nadir
Normal	0-1	>92
Mild OSA	2-4	
Moderate OSA	5-9	
Severe OSA	>10	<80



Role of Hypoxia

- Rats -- intermittent hypoxia → ↑ develop opioid sensitivity
- Hypoxia → inflammatory response and vascular remodeling
- Wilson et.al and others have found a 2 ½ X increase in the incidence of respiratory complications in children undergoing T&A who had evidence of nocturnal desaturation to 80% or less

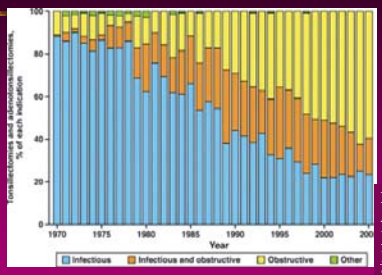
Relationship between intermittent Hypoxia and Systemic responses



Tonsillectomy in 2012

- **Pediatric Anesthesia** Volume 21, Issue 7, pages 771–780, July 2011 Karen Brown
- 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

Outcome, risk, and error and the child with obstructive sleep apnea
Karen A. Brown



Surgical indications for adenotonsillectomy (T&A) in Olmsted County, Minnesota, USA between 1970 and 2005.

Pediatric Anesthesia Volume 21, Issue 7, pages 771–780, July 2011

STBUR

Paediatr Anaesth. 2013 Jun;23(6):510-6. doi: 10.1111/pan.12155. Epub 2013 Apr 1.

The STBUR questionnaire for predicting perioperative respiratory adverse events in children at risk for sleep-disordered breathing.

Tait AR, Voepel-Lewis T, Christensen R, O'Brien LM.

- Snoring
- Trouble Breathing
- UnRefreshed

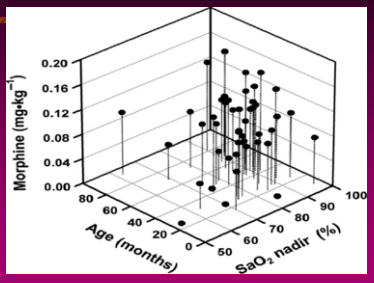
STBUR

- 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**

Outcome, risk, and error and the child with obstructive sleep apnea



Pediatric Anesthesia
Volume 21, Issue 7, pages 771-780, 3 MAY 2011

Original Article

A multicenter, randomized, double-blind placebo-controlled, single dose trial of the safety and efficacy of intravenous ibuprofen for treatment of pain in pediatric patients undergoing tonsillectomy

Jonathan R. Moss[1,*], Mehernoor F. Watcha[2], Laima P. Bendel[3], Denise L. McCarthy[3], Stacy L. Witham[4] and Chris D. Glover[2]

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DOI: 10.1111/pan.12381

Issue

Pediatric Anesthesia
Volume 24, Issue 5, pages 483–489, May 2014

IV Ibuprofen *vs.* Placebo

- 161 patients
- T&A
- Lower fentanyl requests
- Lower # of doses
- Lower total dose

Table 3 Adverse events, prior to discharge

	Placebo (*N* = 79) No. of events	IV-Ibuprofen (*N* = 82) No. of events
Vomiting	2	3
Agitation	3	1
Infusion site pain	0	3
Nausea	1	2
Hemorrhage*	1	2
Restlessness	2	0
Rash erythematous	2	0
Bronchospasm	2	0
Urticaria	0	2
Headache	1	0
Epistaxis	1	0
Pyrexia	1	0
Erythema	1	0
Swelling Face	1	0
Infusion site discomfort	0	1
Cough	0	1
Hypoxia	0	1
Irritability	0	1
Hematemesis*	0	1

*Three patients experienced four bleeding-related adverse events.

Pediatrics 2015

Morphine or Ibuprofen for Post-Tonsillectomy Analgesia: A Randomized Trial

Lauren E. Kelly, PhD[a,b], Doron D. Sommer, MD[c], Jayant Ramakrishna, MD[c], Stephanie Hoffbauer, BHSc[c], Sadaf Arbab-tafti, BHSc[c], Diane Reid, MD[c], Jonathan Maclean, MD[c], Gideon Koren, MD[a,b,d]

Morphine *vs.* Ibuprofen

TABLE 2 Patient Demographics in the Morphine and Ibuprofen Groups

Demographics	Morphine (*N* = 46)	Ibuprofen (*N* = 38)
Age, y	5.07 (2.45)	5.14 (2.25)
Weight, kg	27.36 (8.78)	22.36 (9.59)
BMI	17.31 (3.00)	18.29 (4.56)
Gender, female	50% (23)	54% (22)
Preoperative tonsil size	2.80 (0.61)	3.05 (0.58)
Total number of desaturation events (preoperative)	3.55 (3.63)	4.51 (8.48)
Diagnosis		
SDB	57% (26)	48% (19)
Obstructive sleep apnea	32% (15)	45% (18)
SDB with recurrent tonsillitis	11% (5)	7% (3)
Ethnicity		
Caucasian	87% (40)	93% (38)
African American	7% (3)	7% (3)
Middle Eastern	4% (2)	0
South American	2% (1)	0

Data are presented as mean (SD) for continuous variables, and as a percentage for categorical data.

Morphine *vs.* Ibuprofen

TABLE 3 Primary Outcome Variables in the Morphine and Ibuprofen Groups

	Ibuprofen (N = 26)	Morphine (N = 30)	P Value
Lowest O_2 saturation (% nadir)			
Preoperative	85.39 (6.93)	83.97 (7.86)	
Postoperative	81.27 (15.81)	81.63 (12.75)	
Δ Lowest O_2 saturation	3.96 (12.65)	2.38 (12.30)	.64
Mean O_2 saturation (% nadir)			
Preoperative	97.41 (1.02)	97.20 (1.22)	
Postoperative	96.55 (2.07)	95.00 (2.18)	
Δ Mean O_2 saturation	0.79 (2.33)	2.13 (1.42)	.33
Total number of desaturation events/h			
Preoperative	4.52 (7.87)	3.64 (3.71)	
Postoperative	3.04 (3.27)	14.26 (11.85)	
Δ Total desaturation events/h	−1.79 (7.57)	+ 11.17 (15.02)	<.01
Number of children improved	65% (17/26)	13% (4/30)	<.01

Data are presented as mean (SD) unless otherwise noted. The number of children improved is defined as a child having

Morphine *vs.* Ibuprofen

- Demographics
- Pain scores
- O2 nadirs and mean O2 nadirs-similar

	Ibu	MS	
Total number of desaturation events/h			
Preoperative	4.52 (7.87)	3.64 (3.71)	
Postoperative	3.04 (3.27)	14.26 (11.85)	
Δ Total desaturation events/h	−1.79 (7.57)	+ 11.17 (15.02)	<.01
Number of children improved	65% (17/26)	13% (4/30)	<.01

Medscape Medical News

Morphine Unsafe for Some Children After Tonsillectomy

Lara C. Pullen, PhD

January 27, 2015

Morphine After Tonsillectomy Tied to Breathing Problems in Study

Like 4 +1 1 Tweet 14

MONDAY Jan. 26, 2015, 2015 -- Using morphine at home to treat pain in children after tonsil and/or adenoid removal may cause life-threatening respiratory problems, according to a new study.

ADVERTISEMENT

Race

- African Americans compared to Caucasians
  - ↑ SDB
  - ↑ OSAS
- African Americans have lower O_2Sat nadir
- May need higher doses

Gender

Pain Medicine

Original Article

Opioid-Related Adverse Effects in Children Undergoing Surgery: Unequal Burden on Younger Girls with Higher Doses of Opioids

Senthilkumar Sadhasivam MD, MPH[1,*], Vidya Chidambaran MD[1], Vanessa A. Olbrecht MD[1], Andrew Costandi MD[1], Smokey Clay MD[1], Cynthia A. Prows MSN, RN[2,3], Xue Zhang PhD, MSPH[2,4] and Lisa J. Martin PhD[2,4]

Article first published online: 17 DEC 2014

DOI: 10.1111/pme.12660

Issue

Pain Medicine

Early View (Online Version of Record published before inclusion in an issue)

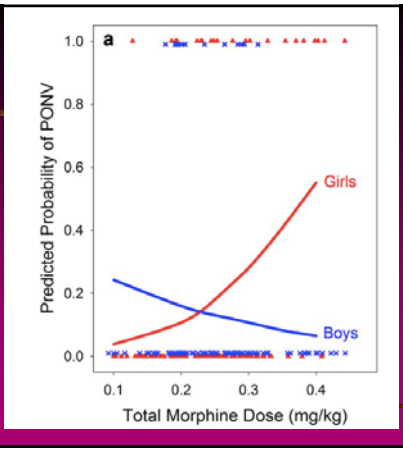
Morphine *vs.* Gender

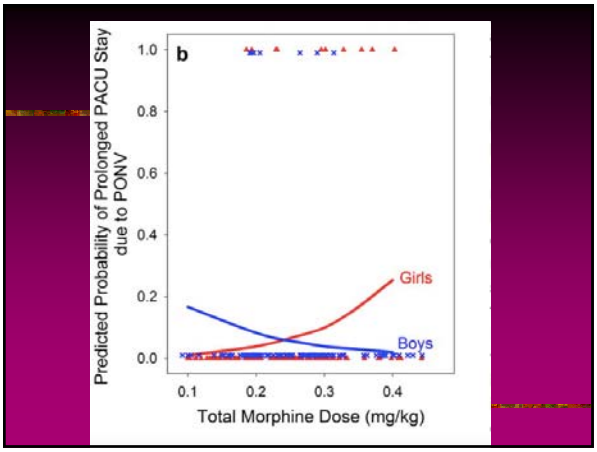
Table 3 Sex-specific association of adverse effects and total morphine doses

		Total Morphine by Weight (mg/kg) <0.2	0.2–<0.3	≥0.3	
		Number of Cases (%)	Number of Cases (%)	Number of Cases (%)	P Value*
RD	F	5 (12)	3 (6)	12 (52)	**0.001**
	M	4 (12)	6 (13)	8 (32)	0.079
PONV	F	4 (10)	8 (16)	10 (43)	**0.003**
	M	6 (18)	7 (15)	1 (4)	0.172
Pruritus	F	29 (73)	42 (84)	17 (74)	0.636
	M	24 (73)	35 (76)	20 (80)	0.521
Prolonged stay in PACU due to RD	F	2 (5)	1 (2)	8 (35)	**0.002**
	M	5 (15)	3 (6)	5 (20)	0.841
Prolonged stay in PACU due to PONV	F	2 (5)	3 (6)	5 (22)	0. 068
	M	4 (12)	3 (6)	1 (4)	0.295

*Exact test on the Spearman correlation coefficient.

F = female; M = male; PACU = post-anesthesia recovery unit; RD = respiratory depression; PONV = postoperative nausea and vomiting.





BMI

ORIGINAL ARTICLE

Perioperative outcomes of severely obese children undergoing tonsillectomy

Stephen J. Gleich[1], Michael D. Olson[2], Juraj Sprung[1], Toby N. Weingarten[1], Darrell R. Schroeder[3], David O. Warner[1], Randall P. Flick[1]

Article first published online: 9 JUL 2012
DOI: 10.1111/j.1460-9592.2012.03905.x
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Issue

Pediatric Anesthesia
Volume 22, Issue 12, pages 1171–1178, December 2012

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

Table 2. Frequency of QA events between normal weight, overweight and obese children

QA Events	Normal weight (n = 4171), (%)	Overweight (n = 875), (%)	Obese (n = 1048), (%)	P values
Preoperative				
Asthma	12.7	14.4	16.1	0.006
Diabetes	0.53	0.4	2.6	0.001
Hypertension	1.4	2.6	4.1	0.001
Intraoperative				
Difficult mask airway	2.2	3.6	7.4	0.001
Difficult laryngoscopy	0.4	0.2	1.3	0.005
Bronchospasm	0.4	0.0	0.5	0.156
Dental injury	0.0	0.1	0.1	0.111
Cardiac arrest	0.0	0.0	0.0	ns
PACU				
Upper airway				
Obstruction	0.07	0.3	1.6	0.001
Stay >3 h	0.86	1.3	1.9	0.026
≥2 antiemetics	0.6	1.1	1.3	0.039
Vomiting	0.4	0.8	0.6	0.263
Unplanned admit	0.5	0.5	1.0	0.063

Nafiu OO, et al. Childhood body mass index and perioperative complications. Pediatr Anesth2007; 17: 426–430.

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

Adverse events	Normal weight (n = 200)	Severely obese (n = 100)	P*
Any intraoperative or emergence events[a]	3 (1.5)	14 (14.0)	<0.001
Bronchospasm	1	2	0.259
Airway obstruction	0	7	<0.001
Stridor/laryngospasm	1	4	0.044
Aspiration	0	0	–
Severe hypoxemia, $SpO_2 \leq 70\%$	1	5	0.017
Any recovery room events[a]	1 (0.5)	3 (3.0)	0.074
Bronchospasm	0	1	1.000
Airway obstruction	0	3	0.036
Aspiration	0	0	–
Reoperation for tonsillar bleeding	1	0	1.000
Tracheal reintubation[b]	1	1	1.000
Any perioperative events[a]	4 (2.0)	15 (15.0)	<0.001

More References

- Brown KA, et.al. Recurrent hypoxemia in children is associated with increased analgesic sensitivity to opiates. Anesthesiology. 2006 Oct;105(4):665-9
- 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;

- Obstructive sleep apnoea in children: perioperative considerations. Patino M, Sadhasivam S, Mahmoud M. Br J Anaesth. 2013 Dec;111
- Counsel Family
- Discuss with Surgery

Other Analgesics

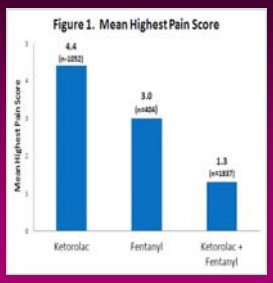
- Dexmedetoidine
- IV Acetaminophen
- Ibuprofen
- Short Acting Opioids
- Topical LA infiltration

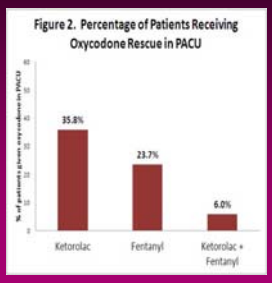
Post-operative Pain

ASA 2014 Abstracts

Multimodal Versus Single Agent Analgesia for Pediatric Myringotomy and Pressure Equalization Tube Insertion

- >3000 pts undergoing ear tubes
- RCT
  - Fentanyl
  - Entanyl + ketorolac
  - Ketorolac





FDA Drug Approvals and Changes: January Edition

Mary L Windle, PharmD

January 23, 2015

18 of 26

Pain

Dyloject (diclofenac)

- *New dosage route* for management of mild-to-moderate **pain** and of moderate-to-severe pain alone or in combination with opioid analgesics.
- Approval was based on 277 patients undergoing elective orthopedic surgery who were randomized to receive diclofenac injection, ketorolac tromethamine, or placebo starting within 6 hr after surgery and given for up to 5 days. Efficacy was measured by the sum of pain intensity differences (SPID). SPID scores were significantly better with diclofenac and ketorolac than with placebo ($P<0.0001$). In patients aged >65 yr, diclofenac was associated with significantly improved analgesia ($P= 0.05$) and lower opioid requirement versus ketorolac.[18]
- Mechanism: NSAID that exhibits anti-inflammatory analgesic and antipyretic activities. Inhibits cyclooxygenase (COX-1 and COX-2) pathways, thereby inhibiting prostaglandin synthesis.
- Dosage: 37.5 mg IV bolus injection infused over 15 sec every 6 hr as needed, not to exceed 150 mg/day. Use for the shortest duration consistent with individual patient treatment goals.

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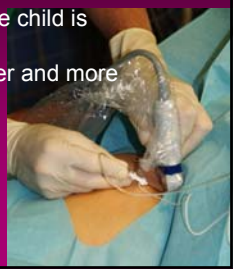
Post-operative Pain Management

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



Catheters

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

PRAN Data Base

- Caudals
- Transverse Abdominas plane blocks

Can J Anaesth. 2009 Nov;56(11):843-50. **Continuous peripheral nerve blocks for postoperative analgesia in children: feasibility and side effects in a cohort study of 339 catheters.**
Dadure C, Bringuier S, Raux et.al

Anesth Analg. 2003 Sep;97(3):687-90.
Perioperative continuous peripheral nerve blocks with disposable infusion pumps in children: a prospective descriptive study.
Dadure C, Pirat P, Raux et.al

Paediatr Anaesth. 2011 Apr;21(4):406-10**Feasibility and efficacy of placement of continuous sciatic perineural catheters solely under ultrasound guidance in children: a descriptive study.**
Ponde VC, Desai AP, Shah DM, Johari AN.

Post-operative Pain Management

- 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
- Hydromorphone 5-15 ug/kg
- Ketorolac 0.5 mg/kg IV, 1mg/kg IM , intranasal max doses 30mg

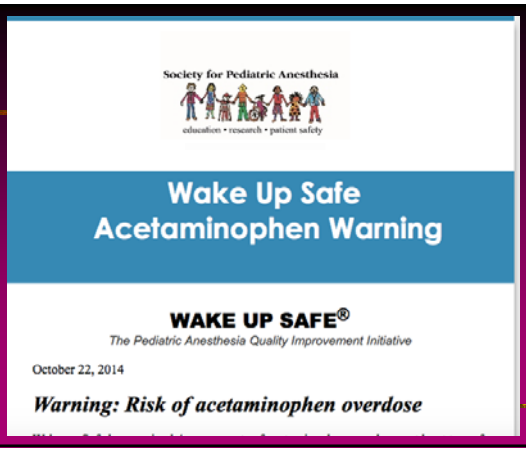
Post-operative Pain Management

- Acetaminophen (A) up to 45 mg/kg p.r.
- Bolton et.al measured serum levels in 55 pts undergoing T&T, who received 40 mg/kg p.r. pre-operatively.
  - Levels did not reach toxicity in any pts
  - Efficacy, esp post discharge was deemed greater (although no control group)

Bolton et.al. Paed Anaesth 12:29-35,2002

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



Society for Pediatric Anesthesia

education • research • patient safety

Wake Up Safe Acetaminophen Warning

WAKE UP SAFE®

The Pediatric Anesthesia Quality Improvement Initiative

October 22, 2014

Warning: Risk of acetaminophen overdose

Paediatric anaesthesia [1155-5645] Moncel yr:2015

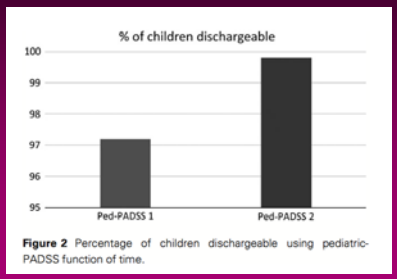
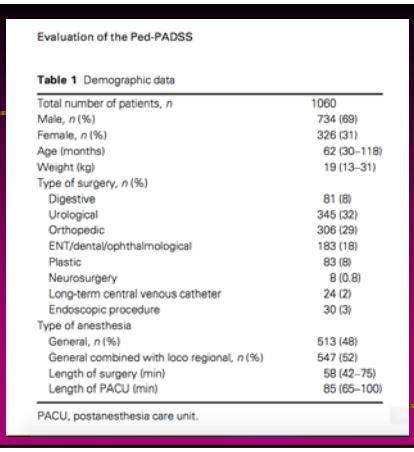


Figure 2 Percentage of children dischargeable using pediatric-PADSS function of time.



Evaluation of the Ped-PADSS

Table 1 Demographic data

Total number of patients, *n*	1060
Male, *n* (%)	734 (69)
Female, *n* (%)	326 (31)
Age (months)	62 (30–118)
Weight (kg)	19 (13–31)
Type of surgery, *n* (%)	
Digestive	81 (8)
Urological	345 (32)
Orthopedic	306 (29)
ENT/dental/ophthalmological	183 (18)
Plastic	83 (8)
Neurosurgery	8 (0.8)
Long-term central venous catheter	24 (2)
Endoscopic procedure	30 (3)
Type of anesthesia	
General, *n* (%)	513 (48)
General combined with loco regional, *n* (%)	547 (52)
Length of surgery (min)	58 (42–75)
Length of PACU (min)	85 (65–100)

PACU, postanesthesia care unit.

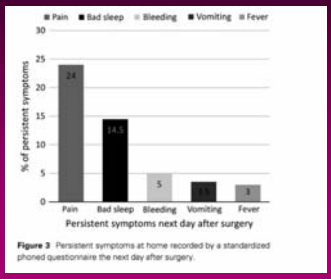


Figure 3 Persistent symptoms at home recorded by a standardized phoned questionnaire the next day after surgery.

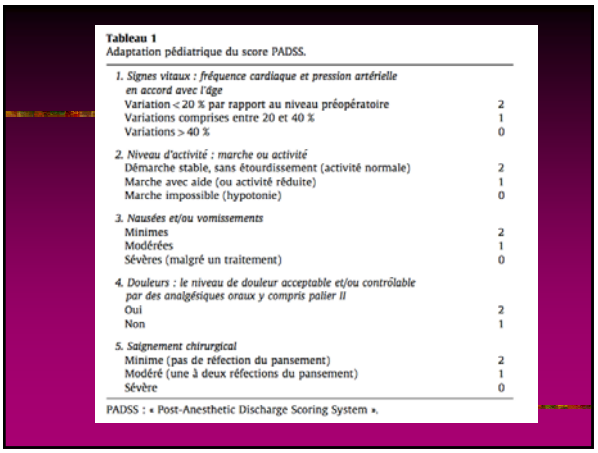


Tableau 1
Adaptation pédiatrique du score PADSS.

1. Signes vitaux : fréquence cardiaque et pression artérielle en accord avec l'âge	
Variation < 20 % par rapport au niveau préopératoire	2
Variations comprises entre 20 et 40 %	1
Variations > 40 %	0
2. Niveau d'activité : marche ou activité	
Démarche stable, sans étourdissement (activité normale)	2
Marche avec aide (ou activité réduite)	1
Marche impossible (hypotonie)	0
3. Nausées et/ou vomissements	
Minimes	2
Modérées	1
Sévères (malgré un traitement)	0
4. Douleurs : le niveau de douleur acceptable et/ou contrôlable par des analgésiques oraux y compris palier II	
Oui	2
Non	1
5. Saignement chirurgical	
Minime (pas de réfection du pansement)	2
Modéré (une à deux réfections du pansement)	1
Sévère	0

PADSS : « Post-Anesthetic Discharge Scoring System ».

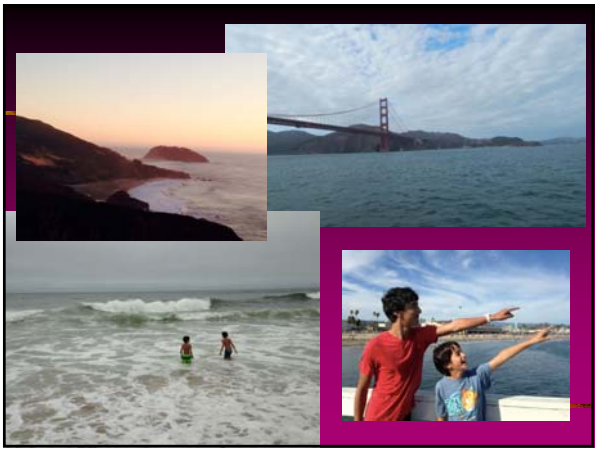
Demographics of Unplanned Admissions Following Ambulatory Surgery During 33 Months at a Children's Hospital

Arlyne K. Thung, M.D., Vidya T. Raman, M.D., Thomas A. Taghon, D.O., Joseph Tobias, M.D.
Nationwide Childrens, Columbus, Ohio, United States

- All Ambulatory patients 2011-2013
- 1.07% unplanned admission
- Most common cause: surgery
- Most common service: ENT

Conclusion

- RTI have increased but minor risks of respiratory complications
- Ex-premature infants
- STBUR score and opioids dosing
- T&A-new concerns, new options for pain relief
- PAD-SS

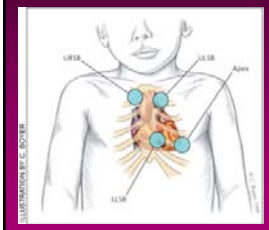


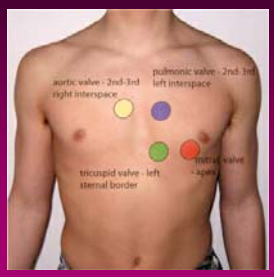
I hear a "new" murmur, now what?

Murmurs

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

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

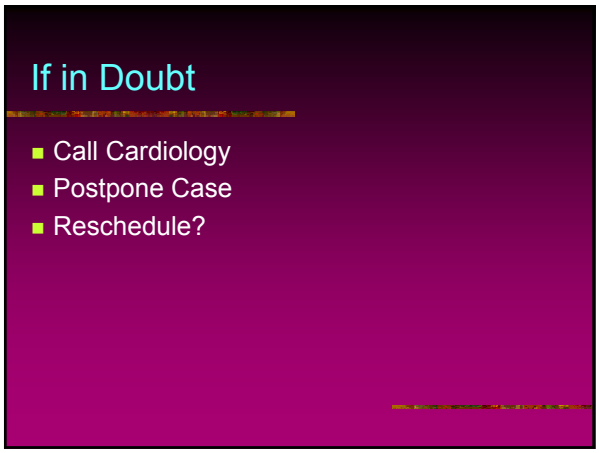
What to do?

- Controversial
- If child is growing well, acyanotic 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

Modifi ed from Pelech AN: Evaluation of the pediatric patient with a cardiac murmur. Pediatr Clin North Am 1999; 46:167-188.


If in Doubt
Call Cardiology
Postpone Case
Reschedule?