

Pediatric Anesthesia Update 2010

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Outline

- Airway Devices, Anatomy and Other Issues
- Laryngospasm
- MH update
- Emergence Agitation
- POV
- Pain

Cool new pictures!

- Things we already knew, but it is nice to have confirmed
 - Airway Axes under MRI scan show better alignment
Chin Lift and jaw thrust were found to improve stridor score in children with head extension
 - Lateral position improves maintenance of the passive pharyngeal airway in patients with obstructive sleep apnea and in spontaneously breathing children under propofol anesthesia
 - Chin Lift and jaw thrust were found to improve stridor score in children

Disclosures

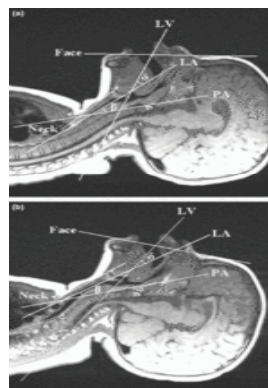
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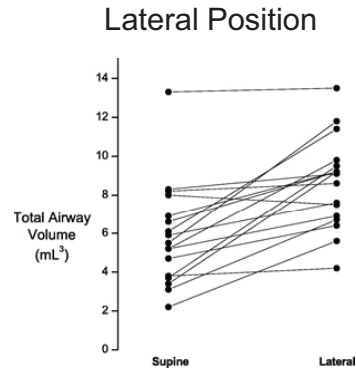
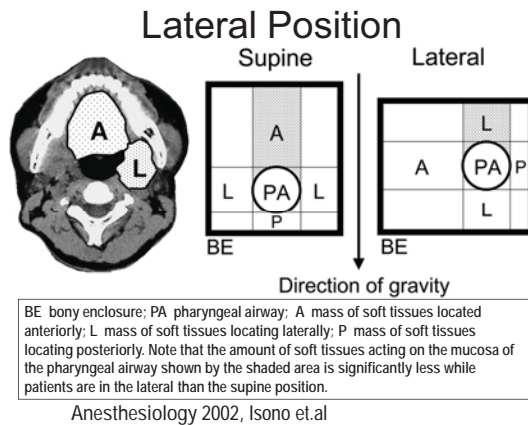
Airway Devices, Anatomy and Other



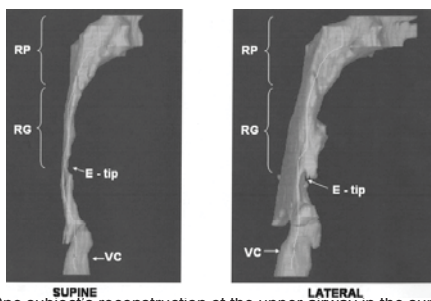
Airway Anatomy



- Effects of head posture on the oral, pharyngeal and laryngeal axis alignment in infants and young children by magnetic resonance imaging
- [Pediatric Anesthesia Volume 18, Issue 6, 2008, Pages: 525–531](#)



Litman: Anesthesiology, Volume 103(3), September 2005, 484-488



- One subject's reconstruction of the upper airway in the supine and lateral positions. The centerline passes through all points maximally distant from the perimeter of the airway at sequential planes orthogonal to the airway axis. E-tip = tip of the epiglottis; RG = retroglossal region (i.e., oropharynx); RP = retropalatal region (i.e., nasopharynx); VC = vocal cords (also indicated by the small x in the center of the airway).
From: Litman: Anesthesiology, Volume 103(3), September 2005, 484-488

Airway Anatomy

- Lateral position improves stridor score
- Jaw thrust in both supine and lateral improve stridor
- Lateral + jaw thrust has greatest effect

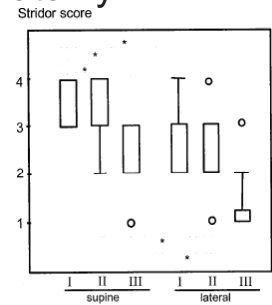
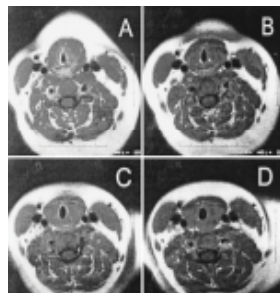


Figure 2. Changes of stridor score with airway maneuvers and position shifting. I = neutral neck position, II = chin lift maneuver, III = jaw thrust maneuver. The 5, 10, 25, 50, 75, 90, and 95 percentiles are presented. *P < 0.05.

Young-Chang P. Arai, MD et.al, Anesth Analg 2004, pp1638-41

Airway Anatomy

- 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



Litman RS., Anesthesiology 2003; 98: 41-45

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

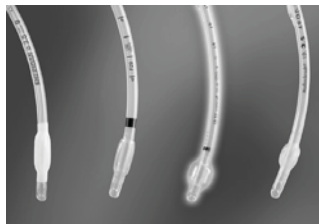


Cuffed Endotracheal Tubes

- Formulas used to calculate size :
 - Age/4 +3.
 - Age/4 +4—go down ½ size.
- **Cuff Pressure should be kept < 20cm H₂O.**
- 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

Airway Anatomy

- Yoo et.al investigated 3 ways to determine appropriate ETT depth in 107 children ages 2-8:
 - Group 1: tube placed in R mainstem and then gently withdrawn
 - Group 2: placing markings at vocal cords
 - Group 3: palpating the ETT tip at the supra-sternal notch



Airway Anatomy

Table 2. Measured Tracheal Length, Distance Between the Endotracheal Tube Tip and Carina, Change in the Distance Between the Endotracheal Tube Tip and Carina After Neck Movement, and the Angle of Neck Movement in Each Group

	Group I	Group II	Group III	P
Tracheal length (cm)	7.9 ± 1.1 (5.2 to 10.0)	7.8 ± 0.9 (6.2 to 9.7)	7.8 ± 1.0 (6.3 to 10.0)	0.298
T-C neut (cm)	1.7 ± 0.5	3.6 ± 1.0	3.4 ± 0.9	<0.05
T-C flex (cm)	0.7 ± 0.8	3.0 ± 1.0	2.5 ± 1.0	<0.05
T-C ext (cm)	3.4 ± 0.8	5.5 ± 1.2	5.3 ± 1.0	<0.05
ΔT-C flex-neut (cm)	-0.9 ± 0.7 (-2.1 to 0.5)	-0.6 ± 0.5 (-2.1 to 0.2)	-0.9 ± 0.6 (-2.6 to 0.0)	0.726
ΔT-C ext-neut (cm)	1.8 ± 0.7 (0.7 to 3.6)	1.9 ± 0.7 (0.6 to 3.2)	1.9 ± 0.7 (0.1 to 3.1)	0.284
Angle flex (°)	43.6 ± 5.6	44.5 ± 3.7	43.4 ± 4.2	0.073
Angle ext (°)	47.6 ± 7.2	49.4 ± 5.4	46.7 ± 4.5	0.171

Group I: using auscultation; Group II: using prescribed marks; Group III: using palpation.
 flex = neck flexion; ext = neck extension; T-C = distance between the endotracheal tube tip and carina; ΔT-C = change in the T-C after neck movement.

Yoo, S.-Y. et al. *Anesth Analg* 2007;105:620-625
 Copyright restrictions apply.

Relative Depth of the Endotracheal Tube (ETT) Tip from the Carina to the Vocal Cords in the Trachea

Table 3. Relative Depth of the Endotracheal Tube (ETT) Tip from the Carina to the Vocal Cords in the Trachea

	Group I	Group II	Group III	P
T-neut (%)	21.4 ± 6.7	46.5 ± 13.0	43.4 ± 11.1	<0.05
T-flex (%)	9.5 ± 10.3	38.3 ± 13.4	32.4 ± 12.5	<0.05
T-ext (%)	44.3 ± 12.1	71.7 ± 16.1	67.9 ± 14.7	<0.05

Group I: using auscultation; Group II: using prescribed marks; Group III: using palpation. Relative position of the ETT tip: the ETT tip at the carina and vocal cords was considered to be 0% and 100%, respectively.

T-neut = distance from the carina to the ETT tip in the neutral position/tracheal length; T-flex = distance from the carina to the ETT tip in full flexion of the neck/tracheal length; T-ext = distance from the carina to the ETT tip in full extension of the neck/tracheal length.

Yoo, S.-Y. et al. *Anesth Analg* 2007;105:620-625
 Copyright restrictions apply.

ANESTHESIA & ANALGESIA

Results

- Auscultation placed the ETT deeper in the trachea
- Higher incidence of endobronchial intubations in Group 1 (auscultation)
- No accidental extubation in any group
- Group 2 and 3 most accurate (markings or ETT palpation at supra-sternal notch)

Difficult Airway Management



Difficult Airway Management

- COPURway
- Video-laryngoscopes
- Creative Solutions
 - Lightwand
 - Proseal LMA
 - FOB via LMA

COPURway score

- C = Chin
- O = Oral opening
- P = Previous Intubations, Past History
- U = Uvula (Mallampati Score)
- R = Range
- Modifiers: mucopolysaccharidoses, morbid obesity, “buck teeth”, large tongue

COPURway score

Table 1 Colorado Pediatric Airway Score (COPURway score)

	Points		Points
C - Chin		U - Uvula	
From side view, is chin:		Mouth open, tongue out, observe palate:	
Normal sized?	1	Tip of uvula visible	1
Small, moderately hypoplastic?	2	Uvula partially visible, fauces	2
Markedly recessive?	3	Uvula concealed, soft palate visible	3
Extremely hypoplastic?	4	Soft palate not visible at all	4
D - Opening		R - Range	
Interdental distance between front teeth		Observe line from ear to orbit, estimate range of movement, looking up and down	
>40 mm	1	>120 degrees	1
20-40 mm	2	60-120 degrees	2
10-20 mm	3	30-60 degrees	3
<10 mm	4	<30 degrees	4
P - Previous intubations, OSA		Modifiers - add points for:	
Previous intubations without difficulty	1	Prominent front 'buck' teeth	1
No past intubations, no evidence of OSA	2	Very large tongue, macroglossia	1
Previous DI, or symptoms of OSA	3	Extreme obesity	1
DI - acute or unsuspected; emergency tracheotomy; unable to sleep supine	4	Micropolyarthroses	2

Lane, G. Intubation Techniques: Operative Techniques in Otolaryngology: 16, Sept 2005

Predictions:	Intubation difficulty	Glottic view (Cormack and Lehane)
Points 5-7	Easy, normal intubation	1
8-10	More difficult, laryngeal pressure may help	2
12	DI, fiberoptic intubation less traumatic	3
14	DI, requires fiberoptic or other advanced methods	3
16	Dangerous airway, consider awake intubation, advanced methods, potential tracheotomy. (Patient with hypercarbia awake, severe obstruction)	4
16+	Scores >16 are usually incompatible with life without an artificial airway	

Supraglottic Airway Devices

- Increased interest in various Supraglottic airway devices for use in routine, elective cases and difficult intubations
- LMA now part of PALS, ACLS and increased interest for use by emergency personnel for airway management in the field.
- "Sometimes the smartest way to intubate the difficult airway is to "just say NO".--use other techniques to manage the airway Lane, G. Intubation Techniques: Operative Techniques in Otolaryngology: 16, Sept 2005

Supraglottic Airway Devices

- There is increased evidence that use of supraglottic devices (LMA) in patient simulators leads to a more rapid establishment of adequate ventilation and is associated with less complications.
- Very few comparison studies b/w the different devices in children

Pediatrics. 2008 Aug;122(2):e294-7.

LMA-ProSeal®

- Sizes 1.5-5 now available.
- Does not have a rear cuff in children.
- Sizing the same as for LMA classic
 - 5-10 kg LMA 1.5
 - 10-20 kg LMA 2
 - 20-30 kg LMA 2.5
 - 30-50 kg LMA 3

ProSeal®

- Found to be simple to place with high success rates for first attempt at placement, sealing pressures and positioning confirmed by fiber optic visualization
- Higher sealing pressures compared to LMA-classic

British Journal of Anaesthesia 93 (4): 528-31 (2004)
 D. R. R. Lardner, R. G. Cox, et al Can J Anesth, January 1, 2008; 55(1): 29 - 35

ProSeal LMA

- Detection, frequency and prediction of problems in the use of the proseal laryngeal mask airway in children. Sanders JC, Olomu PN, Furman JR. Paediatr Anaesth. 2008 Dec;18(12):1183-9



PLMA success rate and problems

- Multiinstitutional study , 222 children aged 2 months (>5kg)-20 years
- Digital insertion
- 91% success on 1st attempt – 100% on 3rd attempt
- 99% successful placement of gastric tube
- 4 patients with inadequate ventilation

Cobra PLA

- May be more stable than LMA unique® (LMAU)
- Increased sealing pressures and less leak
- Less gastric Insufflation



Szmuk, P. et al. Anesth Analg 2008;107:1523-1530

Szmuk, P. et al. Anesth Analg 2008

Table 2. Major Outcomes

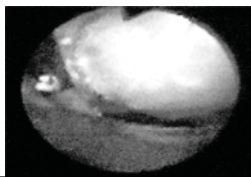
	CobraPLA subgroups		LMA subgroups		P
	Small 0.5 and 1 (n = 50)	Large 1.5 and 2 (n = 50)	Small 1 and 1.5 (n = 50)	Large 2 and 2.5 (n = 50)	
Insertion of device					
Insertion time (sec)	16 ± 6 ^a	20 ± 7 ^b	15 ± 4 ^a	19 ± 6 ^b	<0.001
Ease of insertion (1/2/3) ^d	48/2/0	47/2/1	47/2/1	49/1/0	0.429
Attempts (1/2/3)	48/2/0	49/1/0	47/2/1	49/1/0	0.515
Anatomical fit after induction (1/2/3/4) ^e	0/1/13/3 ^a	1/1/6/9 ^b	6/7/5/0 ^b	2/5/6/0 ^b	<0.001
Anatomical fit before emergence (1/2/3/4) ^e	0/2/11/4 ^a	1/1/6/9 ^b	8/9/0/1 ^b	6/6/0/1 ^b	<0.001
Maintenance of anesthesia					
Airway sealing pressure at 40 cm H ₂ O	15 ± 4 ^a	18 ± 6 ^b	16 ± 5 ^b	15 ± 5 ^a	0.032
Airway sealing pressure at 60 cm H ₂ O	18 ± 5 ^a	22 ± 7 ^b	18 ± 5 ^a	16 ± 5 ^a	<0.001
Peak airway pressure at 20 min (cm H ₂ O)	17 ± 5 ^a	17 ± 5 ^a	16 ± 3 ^b	14 ± 4 ^b	0.004
Removal of airway device and complications					
Laryngospasm (no/yes)	48/2	49/0	48/2	46/3	0.420
Brucelospasm (no/yes)	49/0	49/0	48/1	47/0	0.396
Blood staining (no/yes)	47/3	44/6	42/8	39/11	0.130
Score throat (no/yes)	47/3 ^a	38/12 ^b	47/3 ^a	40/10 ^b	0.012
Dysphonia (no/yes)	42/8	44/6	41/9	41/9	0.827
Gastric gas volume (mL)	8 ± 5 ^a	11 ± 10 ^b	15 ± 9 ^a	21 ± 21 ^a	<0.001

Data presented as means ± sd or counts. For post hoc tests, the letters "a", "b", and "c" are used to designate which groups are similar and which are different. Groups that share the same letter are considered to NOT be statistically different from each other. ^dEase of insertion graded as 1 = smooth insertion without any need for adjustment; 2 = need for at least one adjustment maneuver; 3 = more than one adjustment maneuver required to insert without resistance. ^eFor the anatomical fit 30 LMA and 33 CobraPLA patients were assessed. Scoring: 1 = vocal cords not therapeutically visible; 2 = vocal cords plus anterior epiglottis visible; 3 = vocal cords plus posterior epiglottis visible; 4 = only vocal cords visible.

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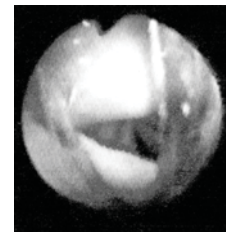
Video Assessment of Supraglottis through PLA



Grade 4 view of larynx through the perilaryngeal airway in a 1-yr-old patient. The grill bars are splayed, and the epiglottis is completely folded over the glottic inlet, obstructing the view of the vocal cords.

Polaner, D. M. et al. Anesth Analg 2006; 102:1685-1688

Grade 1 view of the vocal cords through the perilaryngeal airway in a 9-yr-old patient



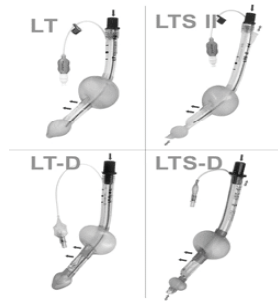
Polaner, D. M. et al. Anesth Analg 2006;102:1685-1688

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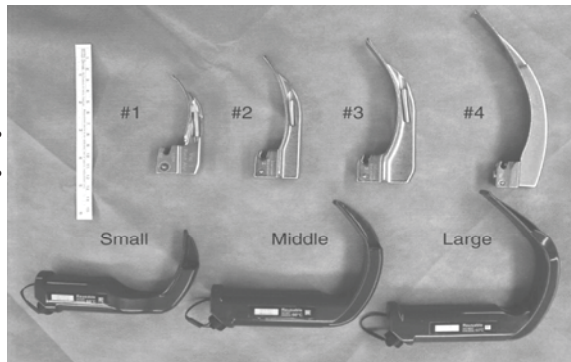
Other Supraglottic Airways

- Laryngeal tubes have been used successfully in children
- May provide better sealing and less gastric insufflation
- May be less traumatic to place



Glidescope®

- One of many video-laryngoscopes available
- Pediatric and neonatal handles available
- Portable and disposable shields available
- Neonatal difficulty airway management is much easier and less stressful.



GlideScope® video laryngoscope blades and conventional laryngoscopic Macintosh blades. JT Kim et.al British Journal of Anaesthesia 2008 101(4):531-534;

Glidescope



- Laryngoscopic views equal or better than DL in normal children
- Longer time to intubation compared to DL
- Learning curve

Pediatric Anesthesia Vol.17: 484-487 2007

Bonfils Pediatric Fiberscope



- Reasonable cost and easy portability
- Steep learning curve after limited training
- No suction port and small aperture can create difficulty with secretion

Pediatric Anesthesia Vol. 18, 11 Pages: 1040-1044
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Laryngospasm

- Flick et.al identified 130 pts with laryngospasm 1996-2005, compared to case controls
 - Intercurrent respiratory tract infection and airway anomalies and LMA use → ↑ laryngospasm

Laryngospasm

- Excellent editorial and articles in April 2008 issue of Pediatric Anesthesiology

Pediatric Anesthesia 2008 18: 279-280

Editorial

Laryngospasm in pediatric practice

Laryngospasm

- 9/150 cases reported to the Pediatric Peri-operative Cardiac Arrest Registry (POCA) attributed to laryngospasm
- Incidence of ~1%-25%
- ENT, airway surgery, passive smoking younger age, less experienced practitioner, and presence of URI increase risk

Laryngospasm

- Propofol causes less upper airway irritation and laryngospasm than sevoflurane
- It has been used to both treat and prevent laryngospasm in small studies
 - Batra et. al used 0.5mg/kg 60 secs prior to extubation in T+/- A pts
 - Incidence of L ↓ from 20% → 6.6%
 - Afshan used 0.8 mg/kg to treat laryngospasm
 - 10/13 pts responded

Laryngospasm

- Other agents/techniques that may ↓ L:
 - Magnesium 15mg/kg infused at the start of the procedure ↓'ed incidence from 25% to 0% in pts undergoing T+/- A
 - Topical lidocaine
 - IV lidocaine +/-
 - “Minimal stimulation” post extubation “No Touch”



Laryngospasm

- Doesn't change the incidence:
 - Deep versus Awake-except with desflurane
 - LMA vs. Face Mask vs. ETT
 - +/- IV lidocaine-some studies show benefit from IV and/or topical lidocaine, others do not

Laryngospasm

- Treatment:
 - Not much is new
 - O2, positive pressure, jaw thrust
 - Propofol 0.25-0.8mg/kg
 - SUX

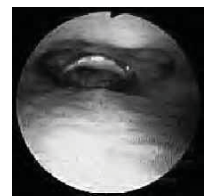
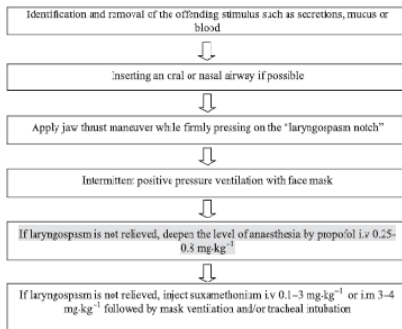


Table 2
A simplified algorithm for treatment of laryngospasm



Pediatric Anesthesia, 18, 281-288



Updates on Malignant hyperthermia

- Anesthesiology 2008; 108:603-11, **Cardiac Arrests and Deaths Associated with Malignant Hyperthermia in North America from 1987 to 2006** A Report from The North American Malignant Hyperthermia Registry of the Malignant Hyperthermia Association of the United States Marilyn Green Larach, M.D., F.A.A.P.,* Barbara W. Brandom,

Cardiac Arrests in MH patients

- Median age was 12 years old, there were 8 cardiac arrests 4 patients survived 4 died
- "Relative to the others, cardiac arrest/death patients were 18.7 times more likely to have a muscular body build. Two of these were elite athletes"

Recent Study

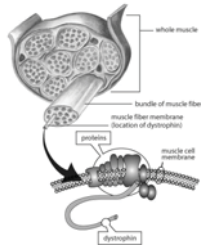
- Anesthesiology 2008; 108:603-11, **Cardiac Arrests and Deaths Associated with Malignant Hyperthermia in North America from 1987 to 2006** A Report from The North American Malignant Hyperthermia Registry of the Malignant Hyperthermia Association of the United States Marilyn Green Larach, M.D., F.A.A.P.,* Barbara W. Brandom,

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Muscular Dystrophies

- lack membrane stabilizing proteins in the post synaptic nicotinic receptor
- Volatile agents and Sux can have a further destabilizing effect on the membrane
- Rhabdomyolysis, hyperkalemia and cardiac arrest can develop
- There are many cases of this with volatiles alone



Muscular Dystrophies

- Etiology unclear, but may be related to activation of unstable muscle fibers trying to regenerate
- Many cases of “MH” in pts with muscular dystrophies may have been rhabdomyolysis
- Should we avoid volatile agents in all pts with Muscular dystrophy? MHAUS consensus is probably not
- Definitely avoid sux

Davis, P. J. et al. *Anesth Analg* 2009;109:1001-1003

Muscular Dystrophy

- Only 2 diseases definitively associated with MH
 - King Denborough Syndrome- craniofacial abnormalities, myopathy, potentially difficult airway
 - Central Core Myopathy



Fig 1. Patient 7 at 27 months. Note the dysmorphic changes, characteristic craniofacial features, hyperlordosis, wide hyperplastic and micrognathic. (Photos authorized by the legal representative)

Mitochondrial myopathy

- Defects in electron chain transport or oxidative phosphorylation
- 3 types
 - There are respiratory chain deficiencies, mitochondrial DNA mutations that include mitochondrial encephalopathy, lactic acidosis and stroke-like episodes (MELAS),
 - mitochondrial neurogastrointestinal encephalopathy (MNGIE) and myoclonic epilepsy with ragged red fibers
 - (MERRF) syndrome and mitochondrial deletions such as Kearns-Sayre syndrome

Mitochondrial myopathy

- Propofol with its lipid carrier composed of long-chain fatty acids may have an adverse effect on fatty acid oxidation and mitochondrial respiratory chain function
- Patients with mitochondrial disorders and closely-related carnitine deficiency syndromes may develop symptoms of Propofol Infusion Syndrome (bradycardia, metabolic acidosis, rhabdomyolysis, and lipidemia and cardiac failure)

Table 1. Descriptive Risk of Malignant Upper Trauma*

Disease	Risk of MH
Duchenne muscular dystrophy	No increased risk over general population. Weak evidence for MH
Becker dystrophy	No increased risk over general population. Weak evidence for MH
Nicoian syndrome	Weak evidence for MH. But closer to zero than dystrophinopathies
Osteogenesis imperfecta	Weak evidence for MH. But closer to zero than dystrophinopathies
Arthrogryposis	Weak evidence for MH. But closer to zero than dystrophinopathies
King Denborough	MHS
Carnitine palmitoyltransferase II deficiency	MHS plausible but unproven. Increased risk of rhabdomyolysis but less risk of MH than in dystrophinopathies. Weak evidence
Myophosphorylase B deficiency (McArdle syndrome)	Weak evidence for MH. Increased risk of rhabdomyolysis but less risk of MH than in dystrophinopathies
Myoadenylate deaminase deficiency	Weak evidence for MH. Increased risk of rhabdomyolysis but less risk of MH than in dystrophinopathies
Brody disease	Weak not zero but Rx patients for MH because intracellular Ca ²⁺ abnormal. Less risk of MH than in dystrophinopathies
Asymptomatic hyperCKemia	Weak evidence for MH. Increased risk of rhabdomyolysis but less risk of MH than in dystrophinopathies
Myotonia congenita	No increased risk over general population
Paramyotonia congenita	No increased risk over general population
Potassium aggravated myotonia	No increased risk over general population
Myotonia fluctuans	No increased risk over general population
Myotonia permanens	No increased risk over general population
Acetazolamide-responsive myotonia	No increased risk over general population
Hyperkalemic periodic paralysis = myotonia	No increased risk over general population
Myotonic dystrophy Type I (Steinert disease)	No increased risk over general population
Myotonic dystrophy Type II	No increased risk over general population
Hypokalemic periodic paralysis	Unclear, may be greater risk than in general population but less risk of MH than in dystrophinopathies
Central core myopathy	MHS
Multi-minicore disease with RYR1 mutation	MHS
Multi-minicore disease, Davis, P. J. et al. <i>Anesth Analg</i> 2009;109:1001-1003	Increased risk of MH than in dystrophinopathies
Nemaline rod myopathy without RYR1 mutation	No increased risk over general population
Nemaline rod myopathy with RYR1 mutation	MHS risk of MH not yet determined

MH = malignant hyperthermia, MHS = malignant hyperthermia susceptibility.
* Described in Refs. 1, 3, 4, 5, and 7.

Emergence Agitation

- Emergence Agitation (EA) is a disturbing phenomenon that can delay discharge from the PACU, cause injury to the child or caregiver, decrease parental satisfaction and potentially be associated with a higher incidence of prolonged negative behaviors postoperatively

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 (ENT)
 - 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

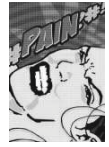
- ASA I-II patients undergoing MRI
 - 80% incidence of EA with sevoflurane
 - 12% incidence with halothane
 - Addition of 1 ug/kg fentanyl 10 mins prior to end of procedure ↓ EA to 12%
 - No significant itching or vomiting post-op
 - Slightly higher incidence of EA in boys

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.
 - 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!

Pre-operative Anxiety?

- Maternal heart rate variability just before surgery significantly correlated with emergence behavior of children undergoing general anesthesia.
Arai YC, *Paediatr Anaesth.* 2008 Feb;18(2):167-71.
- Parental anxiety prior to induction can increase emergence agitation in the child

Propofol

- 2 studies have shown that the addition of 1mg/kg of propofol at the end of anesthesia significantly educe the incidence of emergence agitation.

Aoud M et.al *Anesthesiology* Volume 107(5), November 2007, pp 733-738

Abu-Shahwan I. Paediatr Anaesth. 2008 Jan;18(1):55-9

Other Medications

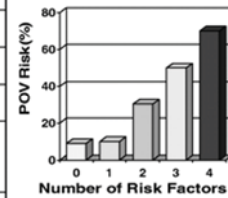
- Dexmedetomidine—mostly +
- Clonidine—mostly +
- Tropisteron—one study
- Ketamine—one study
- Nalbuphine—one study
- Most consistent results have been with fentanyl (IV or IN),in preference to morphine

Post Operative Vomiting



Post-Operative Vomiting Score in Children

Risk Factors	Points
Surgery \geq 30 min.	1
Age \geq 3 years	1
Strabismus surgery	1
History of POV or PONV in relatives	1
Sum =	0 . . . 4



Gan, T. J. et al. *Anesth Analg* 2007;105:1615-1628

ANESTHESIA & ANALGESIA

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Anesthesiology 2008; 110:1021-25

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How Much Does Pharmacologic Prophylaxis Reduce Postoperative Vomiting in Children?

- Engleman and colleagues analyzed the effects of 6 single drug and 5 combination regimens on prevention of post operative vomiting
- With the 2-hydroxytryptamine agonists there was at least a 50-60% risk reduction
- The addition of dexamethasone increased the risk reduction to 80%

Now for the JAMA article.....

- [Dexamethasone and risk of nausea and vomiting and postoperative bleeding after tonsillectomy in children: a randomized trial. Czarnetzki C..JAMA. 2008 Dec 10;300\(22\):2621-30.](#)
- Decreased POV and pain
- Higher incidence of bleeding in patients receiving any dose of dexamethasone
- Different techniques? Con-founding variables?
- Our surgeons continue to use dexamethasone (0.5-1mg/kg)

Pain Control

- TAP Blocks
- Ultrasound
- Intravenous acetaminophen
 - Available in Europe
 - Propacetamol hydrolyzed by plasma esterases to active metabolites



Acetaminophen

- Pro-drug propacetamol –
 - more rapid onset than oral
 - opioid sparing
- Minimal side effects, except for burning at the site of injection
- Intravenous form of acetaminophen has been developed that has decreased side effects and appears to be as effective as propacetamol.
- Multi-institutional study- intravenous acetaminophen reduced the morphine requirements after major orthopedic surgery by one third.

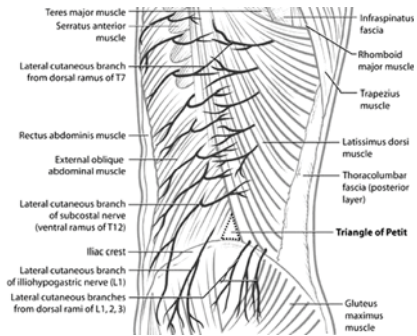
Anesthesiology 2005; 102: 822-31

Transversus Abdominis Plane Block

- Anesth Analg 2007;104:193-197 John G. McDonnell, MB, FCARCSI*, Brian O'Donnell, MB, FCARCSI
- Has been used to provide pain relief after major abdominal surgery
- Block the lower 6 thoracic and upper lumbar afferent



Line drawing of the anatomy of the abdominal wall, including the lumbar triangle of Petit (TOP)

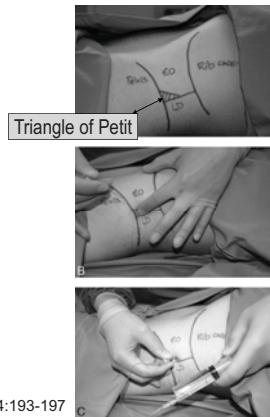


McDonnell, J. G. et al. Anesth Analg 2007;104:193-197

ANESTHESIA & ANALGESIA

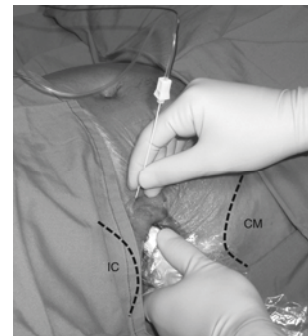
Copyright restrictions apply.

- Injection through the Triangle of Petit
- EO = External Oblique
- LD = Latissimus Dorsi
- Place needle perpendicular and feel for 2 pops



Anesth Analg 2007;104:193-197

Probe placement on the lateral abdominal wall cephalad to the iliac crest

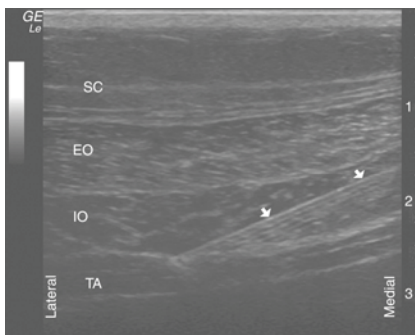


Tran, T. M. N. et al. Br. J. Anaesth. 2009 102:123-127; doi:10.1093/bja/aen344

Copyright restrictions may apply.

BJA British Journal of Anaesthesia

Transverse sonogram of lateral abdominal wall with in-plane image of needle

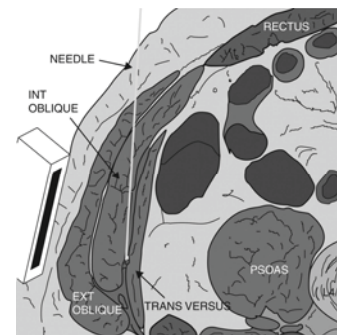


Tran, T. M. N. et al. Br. J. Anaesth. 2009 102:123-127; doi:10.1093/bja/aen344

Copyright restrictions may apply.

BJA British Journal of Anaesthesia

Diagram shows needle trajectory in the TAP between the internal oblique and the transversus abdominis muscles



Tran, T. M. N. et al. Br. J. Anaesth. 2009 102:123-127; doi:10.1093/bja/aen344

Copyright restrictions may apply.

BJA British Journal of Anaesthesia

TAP block in pediatrics

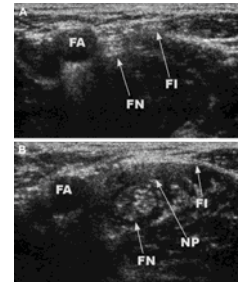
- Ongoing clinical trials
- Case series
- Ultrasound visualization makes finding exact landmarks less important



**Paediatr Anaesth. 2008
Sep;18(9):891-2**

Ultrasound Guidance

- Improves success rate and speed of block onset
- Decreased doses of local anesthetic
- Recent review for both peripheral nerve and neuraxial blocks



**Pediatric Anesthesia 19:p 92-96,
2009 Rubin, Sullivan, Sadhasivam**

Femoral nerve (FN)

Thank You

