Paediatric Anaesthesia – An Update

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The difficulties with children....

- Small – airways, veins etc etc
- High metabolic rate
- High oxygen requirement
- Airway is crucial....
- Need good, committed assistance
- Knowledge of equipment
- Extends into the post-op period.....

Rehash

- Fasting
- Premeds
- Laryngospasm
- No venous access
- Blood loss
- Syndromes

New stuff

- Obesity
- Cuffed ETT in kids / circuits
- Difficult airway / LMAs
- Emergence delirium
- Who does paediatric anaesthesia ?
- Safety / complications

FASTING

6 4 2

- 6 HOURS SOLIDS & FORMULA
- 4 HOURS BREAST MILK
- 2 HOURS CLEAR FLUIDS
- UNIFORM APPROACH
- FLEXIBILITY

PREMEDS

- Less than we use to
- Atropine rarely now
  - Can give orally 10mcg/kg
- Topical
  - EMLA
  - 4% amethocaine gel
    - Faster onset
    - RCH Melbourne
  - Other

PREMEDS

- Midazolam
  - Oral 0.5mg/kg / nasal 0.3mg/kg (max 15mg)
  - Quick onset 15mins
  - Beware of ataxia
- Other
  - Ketamine / midazolam (3mg/kg / 0.3mg/kg)
  - Clonidine
Anaesthesia: Induction
- Whatever is easier for you and the patient
  - Inhalation
  - Easy
  - Familiar equipment
  - Good airway control
  - Sevoflurane
  - Better conditions for IV access
- Intravenous
  - Use EMLA or amethocaine
  - more skill required
  - more rapid control gained
  - more pleasant
  - IV access established before GA
  - May be phobic re needles

Anaesthesia: Induction
- Parental presence during induction
  - Has to be in the best interests of the child
  - Often done for the parent not the child
  - Depends upon layout of theatres
  - Adequate staff to escort parent out
  - Only in elective cases
  - Anaesthetist has final say

Infant and Adult Larynx

Position of the Larynx in Children
Westhorpe RN. Anaes Intens Care 1987; 15:384-388

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Infant Larynx—Implications for the Anaesthetist
- Larynx may appear displaced anteriorly
- Epiglottis more likely to require physical displacement to view glottis
- Neck flexion unlikely to improve intubation angle
- Supraglottic structures more likely to feature in pathology
What is Laryngospasm?

Glottic closure caused by reflex constriction of the intrinsic and extrinsic laryngeal muscles

- Closure of vocal cords
- Closure of vocal cords plus false cords
- Closure of vocal cords, false cords and supraglottis

Factors increasing the risk of Laryngospasm

- Anaesthetic factors:
  - Airway surgery: 2x
  - Parent: recent URI: 2.33
  - Atropine: 1.97

- Patient factors:
  - URI: 1.05
  - Asthma: 2.5x

- Surgical/procedure factors:
  - Intubation: 3x
  - Oesophagoscopy/dilatation: 4x

What is Laryngospasm?

- Glottic closure caused by reflex constriction of the intrinsic and extrinsic laryngeal muscles

Incidence of Laryngospasm

- Adults: 8.7/1000
- Children: 17.4/1000 (2x)
- Young Infants: 27.6/1000 (3x)

Laryngospasm and URTI's

- Risk Factors
  - Parent: active URTI: OR 0.01
  - Age <1yr: OR 2.33
  - Atropine: OR 1.97

No apparent risk

- Parent: recent URI: OR 1.05

Sequelae of Laryngospasm

- SpO2 < 85%
- HR < 80% baseline
- Muscle relaxant given

- 136,929 pts - 1232 cases of laryngospasm
- 6 cardiac arrests (5/1000): ?adults/paediatrics

- 150 episodes of cardiac arrest in 1 million+ anaesthetics: 9 due to laryngospasm

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- Surgical/procedure factors:
  - Intubation: 3x
  - Oesophagoscopy/dilatation: 4x
  - Appendicectomy: 2x
  - Hypospadius repair: 3x
Preventing laryngospasm

- Avoid trouble
  - Cancel if active URTI
  - If occurs at induction, be ready for laryngospasm at emergence!

- Suggested treatments:
  - IV lignocaine
  - Topical lignocaine

Treatment of Laryngospasm:

1. Jaw thrust / clear upper airway
2. CPAP / Gentle +ve press
3. Remove / stop stimulus
4. Stabilise & continue planned management
5. Suxamethonium 0.1-2 mg/kg
6. Suction
7. Suxamethonium 1-2 mg/kg
8. Intubation

Suggested treatments:

- IV lignocaine
- Topical lignocaine

Treatment of Laryngospasm: Complete airway obstruction - NO IV!

- Sux administration:
  - IM
  - Intra-Lingual
    - (1) 4 mg/kg
      - Max onset: 3 min
      - Apnoea: 3.5 min
      - 2 mg/kg
    - (2) 1 mg/kg
      - Apnoea: 1.25 min
    - (3) 3 mg/kg
      - Max onset: 4.5 min
      - + massage: 2.15 min

Comparison of sub glottic oedema in Adult and Paediatric patients

- Normal
- Edema
- Resistance
- Cross-sectional area

Shortcomings of cuffed paediatric tracheal tubes


Eckenhoff JE. Anesthesiology 1951; 12: 401-410
Poor venous access

- Other tricks
- Where are your options?
  - Cubital fossa
  - Anterior wrist
  - Lateral aspect of foot
- Blind cephalic vein at wrist
- Blind long saphenous vein
- Intraosseous

Other tricks

Where are your options?

Cubital fossa

Anterior wrist

Lateral aspect of foot

Blind cephalic vein at wrist

Blind long saphenous vein

Intraosseous

Intraosseous vascular access

- Up to 6 years
- Can give anything
- Upper medial aspect of tibia – level of tibial tuberosity
- Push firmly
- Medullary cavity via emissary vv to systemic circulation
- Use a large flush

Paediatric anaesthetic circuits

- T – piece vs Paediatric circle
- Increasing use of paediatric circle with expensive volatile agents
- Paediatric circle:
  - Slower inhalational induction
  - Greater potential for leaks
  - Compliance of circle important
  - Most relevant in infants / neonates
- USE WHAT YOU ARE FAMILIAR WITH

Blood Loss
Pre-operative preparation

- Know your surgery/know your surgeon
- Estimate blood volume:
  - Neonate - 100 ml/kg
  - Child - 80 ml/kg
  - Adult - 70 ml/kg
- Pre-op tests - FBC, coagulation studies
- HAVE THE BLOOD READY PRE-OP !!
Blood loss is USUALLY obvious

BUT beware of loss:
• Under the drapes
• Into drains eg chest drain
• Concealed in the wound eg pelvis
• Into soft tissues eg # femur

Replacement - What & How Much??
• Be guided by BP, HR, urine output,
• Maintain cardiac output/oxygen delivery
• If in doubt, 10ml/kg bolus and re-assess
• "Children tolerate fluid loading well"
• “Rather be 10-20% ahead than 20% behind”

WHAT TO DO IF YOU GET BEHIND IN REPLACING BLOOD LOSS
• Get help
• Tell the surgeon to stop operating or pack the wound
• Patient head down
• Extra IV drips – arms
  - external jugular vein
  - intraosseous in children (leg)

Replacement - What & How Much??
• Maintain patient’s Hct > 24 (Hb > 70 g/L)
• Important:
  • Warm the blood
  • Ca²⁺ supplements (0.5ml/10kg)
  • Beware K⁺ load (may need frusemide)

Syndromes
• Know the common ones
• If in doubt, look it up
• I think about:
  • Airway – can I get the tube in ?
  • MH risk ?
  • Myopathy? How they handle muscle relaxants, can I use
  • Suxamethonium
  • Normal doses of nondepolarisers

Syndromes and Anaesthesia
• Down’s syn
  • Large tongue
  • C spine instability
  • Subglottic stenosis
  • floppy / URTI’s
  • Delayed
  • Heart disease
Airway and Syndromes

Micrognathia


Myopathies

- Consider use of muscle relaxant carefully
- Suxamethonium
  - K+ release / rhabdomyolosis
  - Pronounced muscle contraction/ no relaxation
- Non – depolarisers
  - Response – often need less
  - Metabolism - ? cisatracurium

Malignant Hyperthermia

- Take a family history
- Beware of Lithgow !
- Ring Neil Street at CHW
- Specific myopathies
  - Central core disease

Worrying airway signs

- Stridor
- Altered voice or aphonia
- Right neck pathology
- Drooling
- Sitting, won’t lie down
- Copious blood
- Surgical emphysema

A difficult airway – how I do it

- Another pair of hands – iv, give drugs etc
- In theatre, everything drawn up, ? ENT
- 100% O2 / sevoflurane
- Take your time
- Topical lignocaine to airway
- Plan airway
  - consider ETT size, maybe smaller than for age
  - Steroids – hydrocortisone 1mg/kg
  - Be happy with an oral ETT
**Airway LA Topicalisation**
- 2-3mg/kg lignocaine

**Bougies**
- Soft and flexible
- Facilitate intubation by guiding ETT into trachea
- Intubate trachea with bougie first, then railroad ETT over bougie and into trachea

**Trauma scenario**
- 4 years
- Rooster attack!
- Puncture wound to neck
- Screamed
- Rapidly swelling face & neck
- Altered voice
- Sats 95%, bilateral BS

Concerns?
Management

- Leave spontaneous ventilating!
- Bilateral chest drains if intubation required
- OT for LBO

- Quiet / smooth inhalational induction
- 100% O2 / sevoflurane
- Avoid PEEP / CPAP
- Spray cords – topical lignocaine 2-3mg/kg

Paediatric Obesity & Anaesthesia

- 6171 patients
- Used pre-obesity epidemic growth charts – 1960's

Table 1: Biophysical characteristics of a pediatric surgical population

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<thead>
<tr>
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<th>Male</th>
<th>Female</th>
<th>Total</th>
<th>P-value</th>
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<tbody>
<tr>
<td>Age (years ± std)</td>
<td>11.6 ± 3.2</td>
<td>12.2 ± 3.2</td>
<td>11.9 ± 3.2</td>
<td>.001</td>
</tr>
<tr>
<td>Height (cm ± std)</td>
<td>154 ± 15.3</td>
<td>148 ± 15.3</td>
<td>151 ± 15.3</td>
<td>.001</td>
</tr>
<tr>
<td>Weight (kg ± std)</td>
<td>52.3 ± 20.2</td>
<td>49.0 ± 24.1</td>
<td>51.1 ± 27.6</td>
<td>.001</td>
</tr>
<tr>
<td>BMI (kg/m² ± std)</td>
<td>21.6 ± 5.6</td>
<td>21.6 ± 5.7</td>
<td>21.6 ± 5.7</td>
<td>.0001</td>
</tr>
<tr>
<td>BMI category (%)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Normal (weight &lt; 85%)</td>
<td>41.0</td>
<td>73.5</td>
<td>64.4</td>
<td>.0006</td>
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<tr>
<td>Overweight (BMI 85-90%)</td>
<td>16.0</td>
<td>16.0</td>
<td>16.0</td>
<td>.007</td>
</tr>
<tr>
<td>Obese (BMI &gt; 90%)</td>
<td>4.0</td>
<td>4.0</td>
<td>4.0</td>
<td>.0003</td>
</tr>
</tbody>
</table>

Nafiu et al.  
Paed Anaesthesia  
2007; 17: 426-430
Emergence Delirium

- Common
- Injury to child, distressing to parents, increase nursing care, if treat may delay discharge
- Lasts up to 30 mins, self limiting, resolves spontaneously
- May be separate from pain
- Increased with:
  - Tonsils or thyroid surgery
  - Middle ear surgery
  - Eye surgery
  - Exclude other causes
  - Use of midazolam – conflicting studies

Aetiology of Emergence Delirium

- Patient related factors
  - Age
  - Pre-op anxiety
  - Child temperament
- Anaesthetic related factors
  - Rapid emergence
  - Intrinsic characteristics of an anaesthetic
  - Adjunct medication
- Surgery related factors
  - Post-op pain
  - Type of surgery

Emergence Delirium - DD

- D Drugs (inhaled volatile, ketamine, neuroleptics, anaesthetics)
- I Infection
- M Metabolic (post op pain, hypoglycaemia, uraemia, hepatic encephalopathy, adrenal insufficiency, hypoxia, hypotension)
- T Toxins (withdrawal syndromes – alcohol, cocaine, opiates, benzodiazepines, hallucinogens)
- O Oxygen (hypoxia, CO, anaemia)
- P Psychiatric (psychosis) & CNS disorders (dementia, parkinsonism, cerebrovascular insufficiency)
- P Physical (BP, CO, bladder & bowel distension)

Emergence Delirium - Summary

- Aetiology of EA/ED still not fully established
- Younger age, pre-op anxiety, pain important
- Newer, insoluble inhaled anaesthetics (sevo, des) have ↓ incidence. Less c propofol
- Lack of reliable assessment tool (use of PAED scale?)
- No clear-cut preventive strategy

ANZCA PS29 Anaesthesia Care of Children in health care facilities without dedicated paediatric facilities 2002

- 2nd anaesthetist if ASA 3 or more
- Transfer to a specialist children’s hospital if
- (and need to consider distance)
- Neonate
- Prem (<37 weeks) and now < 52 weeks PCA
- History of apnoeas
- Infants & Children w/ unusual and/or complex
  medical or surgical problems who are ASA 3 or greater
**New Literature 2000 - 2007**

Factors to consider:
- Change in anaesthetic agents eg halothane to sevoflurane
- Improved monitoring
- Some studies look at all complications including 'minor' ones eg vomiting, itch etc
- Many studies come from paediatric hospitals so may not reflect what happens in normal hospitals
- No further studies of no. of cases and outcome after Auroy's letter in 1997 (study done in 1992)

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**Critical incidents in paediatric anaesthesia: audit of 10,000 anaesthetics in Singapore. Tay et al. Paed Anaesthesia 2001; 11: 711-718**

- 297 critical incidents (2.97%)
- 80.1% in ASA 1 or 2, 73% elective
- If < 1 year, 4x as common
- Most incidents during maintenance of anaesthesia 80%
- Respiratory events common 77% with laryngospasm alone being 35.7%
- Incidence of pharmacological / equipment problems low
- NO anaesthetic mortality

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**Paediatric Anesthesia 2004; 14: 158-166**


- 24,165 anaesthetics over 30 months in a paediatric teaching hospital – no cardiac / neuro
- 1 death - bleed from PDA ligation in a preterm infant
- 724 adverse events intraop and 1105 in PACU
- 53% of intraop events were respiratory, 12.5% cardiac
- More common in ENT, tracheal intubation, ASA 3-5
- Prospective reporting, anaesthetists may not have reported minor desaturation
- NO anaesthesia related deaths

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- 92,881 anaesthetics < 18yo
- PCA in non-cardiac surgery 2.9 / 10,000
- PCA in cardiac surgery 127 / 10,000
- 90% of PCA in children occur in children with Congenital heart disease
- Neonates
- Having cardiac surgery
- POCA registry 2000
- Figures include surgical reasons eg hypovolaemia
- Commonest anaesthetic cause was halothane

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- 1996-2004 = 15,253 anaesthetics
- 35 arrests (22.9 / 10,000) 16 deaths (0.8 / 10,000)
- 7 arrests due to anaesthesia (4.58 / 10,000)
- Due to: respiratory (71.5%) and medication events (28.5%)
- Major risk factors:
  - < 1 year; ASA 3, emergency

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- 532 claims – 1973 – 2000 < 16 yrs
- Steady downward trend in claims for death and brain damage but these remain the dominant complications of pediatric anesthesia
- Cardiovascular (26%) and respiratory (23%) were most common damaging events

ANZCA Anaesthesia Related Mortality in Australia 2000-2002
- NO anaesthetic related deaths < 1 yo (76% over 60yo)
- 66% of deaths were in emergencies
- 50% were ASA 4 or 5 BUT 20% were ASA1-2
- No specific mention of paediatric incidence of anaesthetic related mortality

Paediatric Anaesthesia …
You can’t afford to become distracted…..

The End
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