Airway Management of the Difficult Airways in Children

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Geneva University Children’s Hospital

www.walidhabre.org
I have no COI to disclose
2.5/1000 in children < 1 year of age: unexpected difficult intubation

<table>
<thead>
<tr>
<th>Respiratory event</th>
<th>Intraoperative</th>
<th></th>
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<th>PACU</th>
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<tbody>
<tr>
<td></td>
<td>0–1 year</td>
<td>1–7 years</td>
<td>8–16 years</td>
<td>0–1 year</td>
<td>1–7 years</td>
<td>8–16 years</td>
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<tr>
<td>No. of anaesthetics</td>
<td>3681</td>
<td>12,495</td>
<td>6,867</td>
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<td>Bronchospasm</td>
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<td>25</td>
<td>4</td>
<td>4</td>
<td>11</td>
<td>5</td>
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<tr>
<td>Hypercarbia</td>
<td>8</td>
<td>10</td>
<td>1</td>
<td>5</td>
<td>5</td>
<td>8</td>
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<tr>
<td>Hypoxaemia</td>
<td>56</td>
<td>90</td>
<td>24</td>
<td>21</td>
<td>34</td>
<td>15</td>
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<td>Aspiration</td>
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<td>4</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>3</td>
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<tr>
<td><strong>Unanticipated difficult intubation</strong></td>
<td>9</td>
<td>7</td>
<td>6</td>
<td>1</td>
<td>5</td>
<td>3</td>
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<tr>
<td>Oesophageal intubation</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>–</td>
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<tr>
<td>Endobronchial intubation</td>
<td>6</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>Laryngospasm</td>
<td>17</td>
<td>31</td>
<td>9</td>
<td>1</td>
<td>6</td>
<td>4</td>
<td></td>
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<tr>
<td>Pulmonary oedema</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>9</td>
<td>7</td>
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<tr>
<td>Pneumothorax</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Reintubation</td>
<td>13</td>
<td>17</td>
<td>7</td>
<td>5</td>
<td>11</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Dental trauma</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>0</td>
<td>3</td>
<td>1</td>
<td></td>
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<tr>
<td>Respiratory depression</td>
<td>–</td>
<td>–</td>
<td>–</td>
<td>12</td>
<td>17</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>133</td>
<td>191</td>
<td>59</td>
<td>54</td>
<td>113</td>
<td>75</td>
<td></td>
</tr>
<tr>
<td><strong>Rate per 1000 anaesthetics</strong></td>
<td>36.1</td>
<td>15.3</td>
<td>8.6</td>
<td>14.7</td>
<td>9.0</td>
<td>10.9</td>
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</tbody>
</table>

Younger children are at higher risk

Airway management complications in children with difficult tracheal intubation from the Pediatric Difficult Intubation (PeDI) registry: a prospective cohort analysis

<table>
<thead>
<tr>
<th></th>
<th>Anticipated difficult airway (n=821)</th>
<th>Unanticipated difficult airway (n=197)</th>
<th>Total (n=1018)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Success*</td>
<td>810 (99%)</td>
<td>188 (95%)</td>
<td>998 (98%)</td>
</tr>
<tr>
<td>Surgical or failed airway*</td>
<td>10 (1%)</td>
<td>9 (5%)</td>
<td>19 (2%)</td>
</tr>
<tr>
<td>Any complications</td>
<td>157 (19%)</td>
<td>47 (24%)</td>
<td>204 (20%)</td>
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<tr>
<td>Severe complications†</td>
<td>19 (2%)</td>
<td>11 (6%)</td>
<td>30 (3%)</td>
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<tr>
<td>Cardiac arrest</td>
<td>10 (1%)</td>
<td>5 (3%)</td>
<td>15 (1%)</td>
</tr>
<tr>
<td>Severe airway trauma</td>
<td>8 (1%)</td>
<td>6 (3%)</td>
<td>14 (1%)</td>
</tr>
<tr>
<td>Death</td>
<td>3 (&lt;1%)</td>
<td>2 (&lt;1%)</td>
<td>5 (&lt;1%)</td>
</tr>
<tr>
<td>Aspiration</td>
<td>1 (&lt;1%)</td>
<td>0</td>
<td>1 (&lt;1%)</td>
</tr>
<tr>
<td>Pneumothorax</td>
<td>1 (&lt;1%)</td>
<td>0</td>
<td>1 (&lt;1%)</td>
</tr>
<tr>
<td>Non-severe complications†</td>
<td>148 (18%)</td>
<td>44 (22%)</td>
<td>192 (19%)</td>
</tr>
<tr>
<td>Hypoxaemia</td>
<td>65 (8%)</td>
<td>29 (15%)</td>
<td>94 (9%)</td>
</tr>
<tr>
<td>Minor airway trauma</td>
<td>36 (4%)</td>
<td>8 (4%)</td>
<td>44 (4%)</td>
</tr>
<tr>
<td>Oesophageal intubation with immediate recognition</td>
<td>21 (3%)</td>
<td>11 (6%)</td>
<td>32 (3%)</td>
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<tr>
<td>Laryngospasm</td>
<td>24 (3%)</td>
<td>8 (4%)</td>
<td>32 (3%)</td>
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<tr>
<td>Epistaxis</td>
<td>12 (1%)</td>
<td>2 (1%)</td>
<td>14 (1%)</td>
</tr>
<tr>
<td>Bronchospasm</td>
<td>7 (1%)</td>
<td>5 (3%)</td>
<td>12 (1%)</td>
</tr>
<tr>
<td>Pharyngeal bleeding</td>
<td>10 (1%)</td>
<td>2 (1%)</td>
<td>12 (1%)</td>
</tr>
<tr>
<td>Arrhythmia</td>
<td>3 (&lt;1%)</td>
<td>1 (1%)</td>
<td>4 (&lt;1%)</td>
</tr>
<tr>
<td>Emesis</td>
<td>4 (&lt;1%)</td>
<td>0</td>
<td>4 (&lt;1%)</td>
</tr>
</tbody>
</table>
Airway management complications in children with difficult tracheal intubation from the Pediatric Difficult Intubation (PeDI) registry: a prospective cohort analysis

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<thead>
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<th>Unanticipated difficult airway (n=197)</th>
<th>Total (n=1018)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No complications</td>
<td>Complications</td>
<td>p value</td>
</tr>
<tr>
<td></td>
<td>(n=664)</td>
<td>(n=157)</td>
<td></td>
</tr>
<tr>
<td>Mask ventilation</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Easy mask ventilation</td>
<td>430 (65%)</td>
<td>66 (42%)</td>
<td>&lt;0.0001</td>
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<tr>
<td>Airway adjunct needed</td>
<td>119 (18%)</td>
<td>39 (25%)</td>
<td>0.03</td>
</tr>
<tr>
<td>Difficult mask ventilation</td>
<td>39 (6%)</td>
<td>28 (18%)</td>
<td></td>
</tr>
<tr>
<td>Impossible for mask ventilation</td>
<td>0 (0%)</td>
<td>5 (3%)</td>
<td></td>
</tr>
<tr>
<td>Not attempted</td>
<td>76 (11%)</td>
<td>19 (12%)</td>
<td></td>
</tr>
</tbody>
</table>

Impossible face mask ventilation

- Extremely rare and predicted in 5/6 patients
- Improvement by muscle relaxation 4/6, SAD 2/6
- Tracheal intubation was successful in all cases
Incidence of difficult tracheal intubation in ICU: 9%.

Risk factors:
- Younger age (median 1 year (0-4) vs. 2 (0-8) years, p = 0.046)
- History of difficult tracheal intubation, particularly if associated to airway obstruction (22 vs. 8%, p<0.001)

Difficult tracheal intubation

SaO\textsubscript{2} < 80% (48 vs. 15%, p<0.001)
Adverse TI associated events (53 vs. 20%, p<0.001)
Severe TI associated events (13 vs. 6%, p = 0.003)

Basic considerations

Preoperative assessment

Skills

Be prepared
Be prepared = difficult airway cart

Suggested contents of the portable storage unit for difficult airway management

- Rigid laryngoscope blades of alternate design and size from those routinely used; this may include a rigid fiberoptic laryngoscope.
- Videolaryngoscope.
- Tracheal tubes of assorted sizes.
- Tracheal tube guides. Examples include (but are not limited to) semirigid stylers, ventilating tube-changer, light wands, and forceps designed to manipulate the distal portion of the tracheal tube.
- Supraglottic airways (e.g., LMA or ILMA of assorted sizes for noninvasive airway ventilation/intubation).
- Flexible fiberoptic intubation equipment.
- Equipment suitable for emergency invasive airway access.
- An exhaled carbon dioxide detector.

Updated Report by the American Society of Anesthesiologists Task Force on Management of the Difficult Airway
Anesthesiology. 2013;118(2):251-270.
Drawer 1: “Failed oxygenation”
LMA # sizes, Intubating LMA
Alternative supraglottic devices

Drawer 2: “Failed intubation” Plan A:
Laryngoscopy blades# (McCoy, Wisconsin, Miller), Stylets (2F, 5F), Bougie (5F, 10F)
# intubating aids (#preference/availability)

Drawer 3: “Failed intubation” Plan B:
Airway exchange catheters # sizes
Endoscopy masks, Fiberoptic intubation

Drawer 4: “Rescue”:
Circoidotomy needle kit (Melker) – Label (age >8 years)
Surgical Circoidotomy kit – Label (age <8 years)
Different-sized cannulas for cricoidotomy, Manujet, and connection tubing
Scalpel (×2), tracheal hook, artery forceps
Checking for potential difficult intubation

Most children are healthy,
There are also patients with syndromes and genetic disorders:
- Down syndrome,
- Apert syndrome,
- Crouzon…

Be aware of children with co-morbidities:
- Obesity
- CHD, …
Criteria for difficult intubation in children

Careful assessment of the neck and the thyromental distance:
Detect any difficult intubation.

- **Mallampati**: low sensitivity and specificity
- **Clinical assessment**:
  - Neck: flexion-extension
  - Soft tissues, tongue, palate, incisive protrusion
  - Thyromental distance: Child’s three fingers
  - Mouth opening: Child’s three fingers

Consider multiple criteria to enhance the sensitivity and the percentage of false positive
Adequate oxygenation

Adequate ventilation
Preoxygenation ou Denitrogenation?

- Usefulness?
- For how long?
- Time before desaturation?

### Length between apnoea and SaO₂ of 90% (early) and SaO₂ of 40% (late)

<table>
<thead>
<tr>
<th>Age</th>
<th>No preO₂</th>
<th>1 min preO₂</th>
<th>3 min preO₂</th>
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<tbody>
<tr>
<td></td>
<td>Early</td>
<td>Late</td>
<td>Total</td>
</tr>
<tr>
<td>Obstructed airways</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>1 month</td>
<td>0.25</td>
<td>1.40</td>
<td>1.65</td>
</tr>
<tr>
<td>1 year</td>
<td>0.36</td>
<td>1.48</td>
<td>1.84</td>
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<tr>
<td>8 years</td>
<td>0.47</td>
<td>1.47</td>
<td>1.94</td>
</tr>
<tr>
<td>18 years</td>
<td>0.74</td>
<td>1.72</td>
<td>2.46</td>
</tr>
<tr>
<td>Patent airways</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 month</td>
<td>0.30</td>
<td>1.68</td>
<td>1.98</td>
</tr>
<tr>
<td>1 year</td>
<td>0.40</td>
<td>1.69</td>
<td>2.09</td>
</tr>
<tr>
<td>8 years</td>
<td>0.51</td>
<td>1.65</td>
<td>2.16</td>
</tr>
<tr>
<td>18 years</td>
<td>0.82</td>
<td>1.91</td>
<td>2.73</td>
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</table>
DIFFICULT AIRWAY ALGORITHM

1. Assess the likelihood and clinical impact of basic management problems:
   - Difficulty with patient cooperation or consent
   - Difficult mask ventilation
   - Difficult supraglottic airway placement
   - Difficult laryngoscopy
   - Difficult intubation
   - Difficult surgical airway access

2. Actively pursue opportunities to deliver supplemental oxygen throughout the process of difficult airway management.

3. Consider the relative merits and feasibility of basic management choices:
   - Awake intubation vs. intubation after induction of general anesthesia
   - Non-invasive technique vs. invasive techniques for the initial approach to intubation
   - Video-assisted laryngoscopy as an initial approach to intubation
   - Preservation vs. ablation of spontaneous ventilation

4. Develop primary and alternative strategies:

   **AWAKE INTUBATION**
   - Airway approached by Noninvasive intubation
   - Invasive Airway Access
   - Succeed
   - Cancel Case

   **INTUBATION AFTER INDUCTION OF GENERAL ANESTHESIA**
   - Initial intubation attempts successful
   - Initial intubation Attempts UNSUCCESSFUL
   - FROM THIS POINT ONWARD CONSIDER:
     - Calling for help
     - Returning to spontaneous ventilation
     - Performing of other option

   **FACE MASK VENTILATION ADEQUATE**
   - SGA ADEQUATE
   - SGA NOT ADEQUATE OR NOT FEASIBLE
   - Emergency pathway Ventilation not adequate, intubation unsuccessful
   - Alternative approaches to intubation
   - Successful intubation
   - Failure after multiple attempts
   - Invasive airway access

   **FACE MASK VENTILATION NOT ADEQUATE**
   - CONSIDER/ATTEMPT SGA

   **NONEMERGENCY PATHWAY**
   - Ventilation adequate, intubation unsuccessful

   **EMERGENCY PATHWAY**
   - Ventilation not adequate, intubation unsuccessful
   - Emergency noninvasive airway ventilation

   **FAILED OXYGENATION PLAN A**
   - Direct laryngoscopy
   - Exclude/remove foreign body in/from hypopharynx/larynx Intubate trachea

   **FAILED OXYGENATION PLAN B**
   - Insert LMA
   - Wake-up
   - Ventilate through LMA
   - Emergency surgery with LMA

   *In a child with previously no signs, no symptoms and no history of / for a difficult airway → invasive ventilation techniques are not needed

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Pediatric Anesthesia 2010; 20: 454-464

Anesthesiology. 2013;118(2):251-270.
Difficult mask ventilation (MV) – during routine induction of anaesthesia in a child aged 1 to 8 years

**Difficult MV**

1. **Give 100% oxygen**
2. **Call for help**

**Step A Optimise head position**
- Consider:
  - Adjusting chin lift/jaw thrust
  - Inserting shoulder roll if <2 years
  - Neutral head position if >2 years
  - Adjusting cricoid pressure if used
  - Ventilating using two person bag mask technique
- Check equipment
- Consider changing:
  - Circuit
  - Mask
  - Connectors
  - If equipment failure is suspected, change to self-inflating bag and isolate from anaesthetic machine promptly
- Depth of anaesthesia
  - Consider deepening anaesthesia
  - Use CPAP

**Step B Insert oropharyngeal airway**
- Assess for cause of difficult mask ventilation
  - Light anaesthesia
  - Laryngospasm
  - Gastric distension – pass OG/NG tube
- Call for help again if not arrived
- Maintain anaesthesia/CPAP
  - Deepen anaesthesia (Propofol first line)
  - If relaxant given – intubate
  - If intubation not successful, go to unanticipated difficult tracheal intubation algorithm

**Step C Second-line: Insert SAD (e.g. LMA™)**
- Insert SAD (e.g. LMA™) – not > 3 attempts
- Consider nasopharyngeal airway
- Release cricoid pressure
  - Good airway
    - **Yes**
    - **SpO₂ >80%**
    - **No**
    - **SpO₂ <80%**
  - **Attempt intubation**
  - **Consider paralysis**
  - **Succeed**
    - Continue
    - Wake up patient
    - Proceed
  - **Fail**
    - Go to scenario cannot intubate cannot ventilate (CICV)

*SAD = supraglottic airway device*
Differences?

Separation of the problems

Oxygenation
Ventilation

Anatomical Airway Obstructions

Tracheal intubation

Functional Airway Obstructions

?
Anatomical Airway Obstructions

- Inadequate head position
- Poor facemask technique
- Large adenoids/tonsils/obesity
- Secretions

Functional Airway Obstructions

- Inadequate anaesthesia
- Laryngospasm
- Muscle rigidity
- Bronchospasm

Repositioning
Reopen Airways
Oro/naso-pharyngeal airway
Two-hand – jaw thrust/open mouth
2 persons ventilation

Deepen anesthesia
Myorelaxant
Epinephrine
'Even if it was not part of the initial airway management strategy, if CICV occurs and waking the patient up is not an option, a muscle relaxant should be given before determining the need to proceed to a surgical airway.'
CAN VENTILATE – CANNOT INTUBATE

**Prevention**

- **(A) Oxygenation**
  - Initial Face Mask Ventilation
    - Basic Rules
    - Exclude obstructed anatomical airway obstruction
  - Initial Tracheal Intubation
    - Basic Rules
    - Use laryngeal mask or BVM

- **(B) Tracheal Intubation**
  - Initial Tracheal Intubation
    - Basic Rules
    - Use laryngeal mask or BVM
    - Ensure adequate level of muscle paralysis

- Failed Oxygenation
  - \(\rightarrow\) Can’t Help
  - \(\rightarrow\) Failed Intubation

- Failed Oxygenation
  - \(\rightarrow\) Failed Intubation

**Good conditions**

Adequate level of anaesthesia
Adequate myorelaxation
Good position
Good size laryngoscope
Good light, Stylet
Soft pressure on the Larynx

**Rescue**

- Failed Oxygenation and Failed Intubation

- Explore pathophysiology
  - Perform flexible bronchoscopy

- Failed Oxygenation Plan A
  - Oxygenate and ventilate
  - Inflate bag with room air

- Failed Intubation Plan A
  - Oxygenate, ventilate and anaesthetise
  - Insert endotracheal intubation

- Failed Oxygenation Plan B
  - Insert LMA or LMA
  - Intubate through the LMA

- Failed Intubation Plan B
  - Oxygenate, ventilate and anaesthetise
  - Insert LMA and intubate through the LMA

- Failed Intubation Plan C
  - Oxygenate, ventilate and anaesthetise
  - Insert LMA and intubate through the LMA

**After Care**

- Patients all ages
  - Surgical Cricotomy

- Patients aged < 6 years
  - Cannula Cricotomy

- If Operator and Equipment available
  - Surgical Tracheotomy

- If Operator and Equipment available
  - Rigid Bronchoscopy
Myorelaxant for tracheal intubation: is there a debate?

**Pros:**
- Sub-optimal intubation conditions
- Important hemodynamic modifications
- Increase respiratory complications
  
  (Mamie Ch et al. Paediatr Anaesth. 2004; 14:218)
- Increase laryngeal morbidity
  
  (Mencke T, anesth analg 2003; 98: 1049
  Mencke T, anesth analg 2006; 102: 306)

**Cons:**
- Possible intubation: Propofol-fenta, -alfenta, -remifenta
- Sevoflurane with or without lidocaine
- Decrease risk for allergy
- Lack of residual curarisation
Why should you question the use of myorelaxant?

**SEVO**

**PROPOFOL**

<table>
<thead>
<tr>
<th>Anesthesiologist characteristic</th>
<th>OR for Infants</th>
<th>P value</th>
<th>OR for Children</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nonacademic practice</td>
<td>4.17 (2.38–7.14)</td>
<td>&lt;0.0001</td>
<td>3.57 (2.09–6.25)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Anesthetize &gt;400 children annually</td>
<td>0.58 (0.34–0.99)</td>
<td>0.046</td>
<td>0.90 (0.54–1.51)</td>
<td>0.67</td>
</tr>
<tr>
<td>Learned IAWMR as a resident</td>
<td>0.70 (0.40–1.20)</td>
<td>0.017</td>
<td>0.74 (0.43–1.29)</td>
<td>0.26</td>
</tr>
<tr>
<td>Learned IAWMR as a resident or fellow</td>
<td>0.49 (0.24–0.96)</td>
<td>0.03</td>
<td>0.74 (0.37–1.50)</td>
<td>0.37</td>
</tr>
<tr>
<td>More than 10 yr since training</td>
<td>1.14 (0.67–1.93)</td>
<td>0.60</td>
<td>1.09 (0.65–1.83)</td>
<td>0.72</td>
</tr>
<tr>
<td>Supervise residents &gt;25% of cases</td>
<td>0.26 (0.15–0.45)</td>
<td>&lt;0.0001</td>
<td>0.34 (0.20–0.57)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Supervise anyone &gt;50% of cases</td>
<td>0.24 (0.13–0.42)</td>
<td>&lt;0.0001</td>
<td>0.30 (0.17–0.52)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td>Practice primarily in a children’s hospital</td>
<td>0.64 (0.38–1.08)</td>
<td>0.075</td>
<td>0.93 (0.56–1.55)</td>
<td>0.86</td>
</tr>
<tr>
<td>Fellowship trained in pediatric anesthesia</td>
<td>0.67 (0.79–1.16)</td>
<td>0.12</td>
<td>0.88 (0.51–1.49)</td>
<td>0.60</td>
</tr>
</tbody>
</table>

IAWMR = inhaled anesthetic without muscle relaxant.
An OR <1.0 indicates a negative association of the characteristic with preference for IAWMR, whereas an OR >1.0 indicates a positive association.

### Main risk factors for Respiratory SCE

<table>
<thead>
<tr>
<th>Airway Sensitivity</th>
<th>Univariate (n=31127)</th>
<th>Multivariate* (n=28512)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Total</td>
<td>4.2 6.4</td>
<td>0.88 (0.86-0.90); p&lt;0.0001</td>
</tr>
<tr>
<td>SD or n (%)</td>
<td>3.8 4.5</td>
<td></td>
</tr>
<tr>
<td>Airway sensitivity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upper respiratory tract infection in the past 2 weeks</td>
<td>4200 26046</td>
<td>2.82 (2.45-3.25); p&lt;0.0001</td>
</tr>
<tr>
<td>(6.3%) 2.2%</td>
<td>265 582</td>
<td></td>
</tr>
<tr>
<td>Wheezing in the past 12 months</td>
<td>1967 27398</td>
<td>3.53 (2.99-4.17); p&lt;0.0001</td>
</tr>
<tr>
<td>(8.3%) 2.4%</td>
<td>164 646</td>
<td></td>
</tr>
<tr>
<td>Asthma diagnosis</td>
<td>1886 28645</td>
<td>1.71 (1.38-2.13); p&lt;0.0001</td>
</tr>
<tr>
<td>(4.6%) 2.7%</td>
<td>86 764</td>
<td></td>
</tr>
<tr>
<td>Passive smoking</td>
<td>3400 21814</td>
<td>1.39 (1.15-1.69); p=0.0065</td>
</tr>
<tr>
<td>(3.8%) 2.3%</td>
<td>128 646</td>
<td></td>
</tr>
<tr>
<td>Airway sensitivity†</td>
<td>8821 22058</td>
<td>2.38 (2.09-2.72); p&lt;0.0001</td>
</tr>
<tr>
<td>(4.8%) 1.9%</td>
<td>426 430</td>
<td></td>
</tr>
<tr>
<td>Physical condition</td>
<td></td>
<td>2.23 (1.93-2.57); p&lt;0.0001</td>
</tr>
<tr>
<td>Prematurity</td>
<td>2363 25272</td>
<td></td>
</tr>
<tr>
<td>(5.1%) 2.6%</td>
<td>121 666</td>
<td></td>
</tr>
<tr>
<td>Fever</td>
<td>904 29522</td>
<td></td>
</tr>
<tr>
<td>(4.6%) 3.4%</td>
<td>44 801</td>
<td></td>
</tr>
<tr>
<td>Handicap</td>
<td>4083 26672</td>
<td></td>
</tr>
<tr>
<td>(3.0%) 2.7%</td>
<td>121 732</td>
<td></td>
</tr>
<tr>
<td>Snoring</td>
<td>4129 21814</td>
<td></td>
</tr>
<tr>
<td>(4.9%) 2.3%</td>
<td>217 510</td>
<td></td>
</tr>
<tr>
<td>Medication</td>
<td>7242 23611</td>
<td></td>
</tr>
<tr>
<td>(3.1%) 2.7%</td>
<td>222 633</td>
<td></td>
</tr>
<tr>
<td>ASA status (p&lt;0.0001)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ASA status II</td>
<td>8739 18883</td>
<td></td>
</tr>
<tr>
<td>(3.4%) 2.4%</td>
<td>300 448</td>
<td></td>
</tr>
<tr>
<td>ASA status III</td>
<td>3497 18883</td>
<td></td>
</tr>
<tr>
<td>(3.2%) 2.4%</td>
<td>111 448</td>
<td></td>
</tr>
<tr>
<td>Physical condition II</td>
<td>14253 16872</td>
<td></td>
</tr>
<tr>
<td>(3.5%) 2.2%</td>
<td>493 366</td>
<td></td>
</tr>
<tr>
<td>Anaesthesia plan**</td>
<td>27119 4008</td>
<td></td>
</tr>
<tr>
<td>(2.9%) 1.6%</td>
<td>793 66</td>
<td></td>
</tr>
<tr>
<td>Myorelaxant for intubation</td>
<td>8382 5284</td>
<td>0.78 (0.66-0.91); p=0.0023</td>
</tr>
<tr>
<td>(3.6%) 4.7%</td>
<td>305 248</td>
<td></td>
</tr>
</tbody>
</table>
Optical and videolaryngoscope that might help

- Storz straight Blade laryngoscopes
- Glidescope
- Seward & Macintosh McCoy levering laryngoscopes
- Bullard™
- Airtraq®

Population of Airtraq®, with potentially insertion of a bougie

Walker R et al. Ped Anesth 2009; 19 (S1) 77-87
Limitations of Video and Optical Laryngoscopes

- Requires good mouth opening
- Despite visualization, often difficult to advance and insert tracheal tube
- No standardization
- Not enough evidence of their benefit in children
Can ventilate, cannot intubate

Failed intubation Plan A

Use improved or visualized intubation technique

Limit to 3 attempts

LMA

Insert LMA and intubate through the LMA
Fiberoptic Intubation through the LMA: gold standard

Control of the ventilation, oxygenation and anaesthesia depth

Equipment needed: LMA, guidewire, Cook airway exchanger.
Intubation through the LMA

Guidewire technique
-An extra long J-tipped guidewire is passed through the suction channel of the bronchoscope than Insert a Cook airway exchanger.
-Needs minimum 2.8 mm bronchoscope

Two ETT technique
-Telescoping of the 2 ETT tubes over bronchoscope than through the LMA

Direct vision
-Toddlers

Walker R et al. Ped Anesth 2009; 19 (S1) 77-87
Flexible bronchoscopy via the facial mask

Could be an alternative if failed to insert a LMA: 2 attempts

Paed Anaesth 1999, 9: 47-52
Multimodal approach for difficult airways
New Trend

Combination of a videolaryngoscopy + FOB

Facilitate the process of FOB intubation
Cannot ventilate, cannot intubate

Rescue

Maintain 2-hands/2-persons face mask ventilation with naso/oropharynx airway to provide some oxygen to the patient while preparing rescue manoeuvres.
Failed intubation, increasing hypoxaemia and difficult ventilation in the paralysed anaesthetised patient: Rescue techniques for the "can't intubate, can't ventilate" situation

Failed intubation and difficult ventilation (other than laryngospasm)

- Face mask
- Oxygenate and ventilate patient
- Maximum head extension
- Maximum jaw thrust
- Assistance with mask seal
- Oral ± 6 mm nasal airway
- Reduce cricoid force - if necessary

Failed oxygenation with face mask (e.g. SpO₂ <90% with FiO₂ 1.0)

Call for help

LMA™ Oxygenate and ventilate patient
- Maximum 2 attempts at insertion
- Reduce any cricoid force during insertion

Oxygenation satisfactory and stable: Maintain oxygenation and awaken patient

"can't intubate, can't ventilate" situation with increasing hypoxaemia

Plan D: Rescue techniques for "can't intubate, can't ventilate" situation

- Cannula Cricothyroidotomy
- Surgical Cricothyroidotomy

Notes:
1. These techniques can have serious complications - use only in life-threatening situations
2. Convert to definitive airway as soon as possible
3. Postoperative management - see other difficult airway guidelines and flow-charts
4. 4 mm cannula with low-pressure ventilation may be successful in patient breathing spontaneously

Difficult Airway Society guidelines Flow-chart 2004 (use with DAS guidelines paper)
Rescue airways in children

Cannula cricotomy
> 8 years of age

Surgical airway

Cricotomy
Tracheostomy

Rigid bronchoscopy

All ages

www.Isanesthesia.org
Which is the best rescue technique?

- Urgency of the situation
- Presence of bleeding
- Operator and/or equipment available

Surgical airway: «not so easy»
Cannula cricotomy

The Arndt Emergency Cricothyrotomy Set (Cook Critical Care) provides a 3.0-mm ID airway.

The Ventilation-Catheter (VBM): 16 gauge (infant), 14 gauge (child). Two lateral eyes at its distal end and a combined Luer LOCK and 15 mm connector at its proximal end allowing either jet or standard bag valve ventilation.

Portex PediaTrake

The Pertach®: a split needle on a syringe function.

The QuickTrach Emergency Cricothyrotomy Device (Rüsch Inc) 2 sizes: (2 and 4 mm).

Be prepared: 6 Rules

Rule 1: Never start a case before doing the Check List

Rule 2: Identify potentially difficult intubation during preoperative assessment

Rule 3: Maintain spontaneous breathing: in case you expect difficult intubation

Rule 4: Do the right things and the things right: do not innovate

Rule 5: Proceed step by step and always rule out anatomical or mechanical obstruction

Rule 6: Adapt the procedures to your environment
**Unexpected Difficult Ventilation/Oxygenation**

**Basic Rules**
Ensure adequate level of anaesthesia and muscle paralysis

1. **Failed**
   - Exclude/treat anatomical airway obstruction
     - Re-open airway / Oro-pharyngeal airway
     - 2-hand/2-person bag-mask-ventilation
   - **Failed**
     - Call for help

2. **Failed Oxygenation Plan A**
   - Direct laryngoscopy
     - Exclude/remove foreign body in/from hypopharynx/larynx
   - **Failed**

3. **Failed Oxygenation Plan B**
   - Insert LMA
     - Wake-up
     - Ventilate through LMA
     - Emergency surgery with LMA
     - *In a child with previously no signs, no symptoms and no history of / for a difficult airway invasive ventilation techniques are not needed*

**Failed Intubation Plan A***
Use improved direct laryngoscopic technique/conditions or
Use indirect laryngoscopic technique
Limit to 2 intubation attempts

1. **Failed**
   - Maintain oxygenation, ventilation and anaesthesia
     - **Call for help**

2. **Failed Intubation Plan B***
   - Insert LMA
     - Perform fiberoptic tracheal intubation through the LMA
     - Limit to 2 intubation attempts

**Basic Rules**
Ensure adequate level of anaesthesia and muscle paralysis
Use laryngeal pressure or BURP

1. **Failed**
   - Maintain oxygenation, ventilation and anaesthesia

2. **Failed**
   - Consider surgery with LMA