The Changing Scope of Airway Management

Warren S. Sandberg, M.D., Ph.D.
Professor & Chair, Anesthesiology
Vanderbilt University School of Medicine
Disclosures

• None
At the conclusion of the activity participants should be able to:

1. Review airway management related morbidity and mortality over time and relate this to changes in airway management technology and cognitive tools
2. Review controversies in airway management approaches
3. Inventory currently available and emerging cognitive aids related to difficult airway assessment and management
The Changing Scope of Airway Management

Warren S Sandberg, M.D. Ph.D.
Chair, Department of Anesthesiology
Vanderbilt University School of Medicine
Airway Management Related M & M; Relation to Techniques, Technology and Training
Good News: We’re Getting Better

- Death, Brain Damage and Nerve injury diminishing over time

ASA Closed Claims Database

Cheney, Anesthesiology 91: 552-6, (1999)
Airway Events Declining

Cheney, ASA Newsletter 66(6): 6-8, 2002

• Airway events down from 50% to ~1/3 between 1980s to 1990s.
Profile of Respiratory Events Changing

• Proportion of an absolute reduction is changing

ASA Closed Claims Database

Bailie, ASA Newsletter 75(2): 28-9, (2011)
Aspiration is... just like we thought

- People throw up at the beginning, off site.

ASA Closed Claims Database

Bailie, ASA Newsletter 75(2): 28-9, (2011)
History of Difficult Airway Management

- <1975: TTJV described
- 1981: LMA developed
- 1987: Combitube introduced
- 1991: ASA Difficult Airway Algorithm first described.
- 1993: ASA Difficult Airway Algorithm formally adopted / PUBLISHED
- 1996: Inclusion of LMA proposed
- 2003: 2nd Iteration of Difficult Airway Algorithm

Claims related to adverse airway events (death, brain damage) plummet during ‘90s
Changing Practice

• 12 years of data
• Changing intubation strategies
• Reduction in fraction judged ‘difficult’
• Tending towards LMA
• Pocket-portable video is reality
If it’s easy with video + bougie, what do you record?
Controversies in Airway Management and Approaches
Definitions

- Difficult Airway:
  - Conventionally trained anesthesiologist
  - Difficulty with FM ventilation of upper airway
  - Difficulty with tracheal intubation
  - Difficulty with both
Definitions

• Difficult Mask Ventilation:
  • Not possible to give FM ventilation due to:
    • Inadequate seal
    • Excessive resistance to gas flow
  • Signs of inadequate ventilation:
    • Chest movement absent / inadequate
    • Breath sounds absent / inadequate / severe obstruction
    • Cyanosis
    • Hypoxia (low / falling SpO2)
    • Exhaled CO2 absent / inadequate
    • Spirometric gas flow absent / inadequate
Definitions

- **Difficult laryngoscopy:**
  - Not possible to see vocal cords
  - After multiple attempts

- **Difficult tracheal intubation:**
  - Requires multiple attempts
  - +/- Tracheal pathology

- **Failed intubation:**
Definition of Degrees of Difficulty

Mask Ventilation

0

Natural Airway
Easy, Chin Lift Only
One Person Jaw Thrust/Mask Seal
One Person Jaw Thrust/Mask Seal + Oropharyngeal or Nasopharyngeal Airway or Both Airways
Two Person Jaw Thrust/Mask Seal
Impossible, Gas Exchange Unsatisfactory or Nonexistent

Direct Vision Laryngoscopy and Intubation

0

Grade I or II Laryngoscopic View
Grade III or IV Laryngoscopic View

One Attempt, Increasing Lifting Force
One Attempt, Increasing Lifting Force, Use Better Sniff Position
Multiple Attempts, External Laryngeal Pressure, Multiple Blades
Multiple Attempts, External Laryngeal Pressure, Multiple Blades, Multiple Laryngoscopists
Impossible, Unsuccessful

Brain Damage, Death
Definitions

• Practice Guidelines:
  • Systematically developed recommendations
  • Assist, not constrain decisions
    • Reject, modify, adopt according to clinical situation
  • Not standards or requirements
  • Use does not guarantee outcomes
  • Not exhaustive
Most Recent:

- 30” Airway exam
- Requires preoxygenation!
- LMA as 1st emergency rescue option
- Confirm intubation (capnography, EDD)

Difficult Airway Algorithm:

- Assess the likelihood and clinical impact of basic management problems:
  - Difficult Intubation
  - Difficult Ventilation
  - Difficulty with Patient Cooperation or Consent
  - Difficult Tracheostomy

Difficult Airway Algorithm:

- Awake Intubation
- Non-invasive Technique for Initial Approach to Intubation
- Preservation of Spontaneous Ventilation

VS.

- Intubation Attempts After Induction of General Anesthesia
- Invasive Technique for Initial Approach to Intubation
- Ablation of Spontaneous Ventilation

*Anesthesiology*, 98, 1269-77, 2003
Difficult Airway Algorithm:

Anesthesiology, 98, 1269-77, 2003
Recognized Difficult Airway:

Potential Difficult Airway

- Recognized
  - Proper Preparation
    - Awake
      - Intubation Choices
    - Invasive Airway
  - Fail
    - Regional Anesthesia
    - Cancel Case & Regroup
    - Invasive Airway
  - Succeed

Unrecognized

- General Anesthesia ± Paralysis
  - Uncooperative Patient
  - Vent: YES
    - Non-emergency pathway
    - Intubation Choices
    - Awaken
    - Surgical Airway
    - Mask Anesthesia
    - Extubate Over Jet Stylette or Tube Changer
  - Vent: NO
    - Emergency pathway
    - Rigid Bronch Combitube TTJV
    - Intubation Choices
    - Awaken
    - Invasive Airway
    - LMA

CONFIRM

Vanderbilt Anesthesiology, 98, 1269-77, 2003

© Warren Sandberg
Awake Options

☐ Shouldn’t be a dog-show
Recognized
What People Actually Do

- ASA: Recognized Awake Intubation
- Survey of active ASA members: staff & residents
- Survey period: Winter 1996
- 1000 subjects, 472 actually returned survey
- 14 scenarios presented; anesthesiologists chose first, best response

- Stratified by years in practice
- Respondents:
  - 81% male
  - 88% Board Certified
  - 88% primarily adult practice

Rosenblatt, et. al. Anes Analg, 87, 153-157
# What People Actually Do

- Recognized Awake Intubation Choices

---

### Table 1. Percentage of Each Anesthetic Induction Condition and Tracheal Intubation Technique Chosen by Anesthesiologists for Each Scenario

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Induction condition</th>
<th>Intubation technique</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>General anesthesia with airway</td>
<td>General anesthesia with apnea</td>
</tr>
<tr>
<td>Upper airway difficulty</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Examination consistent with difficult intubation</td>
<td>70</td>
<td>26</td>
</tr>
<tr>
<td>2 Pharyngeal obstructing tumor</td>
<td>75</td>
<td>22</td>
</tr>
<tr>
<td>3 Epiglottitis(^a)</td>
<td>15</td>
<td>80</td>
</tr>
<tr>
<td>4 Retropharyngeal abscess</td>
<td>61</td>
<td>26</td>
</tr>
<tr>
<td>5 Bleeding postoperative tonsil</td>
<td>23</td>
<td>14</td>
</tr>
<tr>
<td>6 Obstructive sleep apnea</td>
<td>74</td>
<td>22</td>
</tr>
<tr>
<td>7 Obese and preeclamptic patient</td>
<td>47</td>
<td>16</td>
</tr>
<tr>
<td>8 Crushing injury to face</td>
<td>91</td>
<td>4</td>
</tr>
<tr>
<td>Lower airway difficulty</td>
<td>60</td>
<td>35</td>
</tr>
<tr>
<td>9 Mediastinal mass(^b)</td>
<td>27</td>
<td>62</td>
</tr>
<tr>
<td>10 Tracheal foreign body</td>
<td>93</td>
<td>7</td>
</tr>
<tr>
<td>11 Crushing injury to neck</td>
<td>40</td>
<td>55</td>
</tr>
<tr>
<td>Other</td>
<td>37</td>
<td>43</td>
</tr>
<tr>
<td>13 Facial burns</td>
<td>78</td>
<td>14</td>
</tr>
<tr>
<td>14 Unstable neck</td>
<td>57</td>
<td>30</td>
</tr>
<tr>
<td>Subsets</td>
<td>87</td>
<td>8</td>
</tr>
<tr>
<td>Trauma (Scenarios 8,11,14)</td>
<td>51</td>
<td>42</td>
</tr>
<tr>
<td>Pathology below vocal cords (Scenarios 9–11)</td>
<td>57</td>
<td>26</td>
</tr>
</tbody>
</table>

\(^a\) Included in the nonresponse telephone survey.

\(^b\) General anesthesia with spontaneous ventilation or apnea after successful testing of the airway with positive pressure ventilation.

\(^c\) Devices or techniques used by <5% of anesthesiologists in all scenarios, including Bullard laryngoscope, blind nasal, lighted stylet, retrograde wire, Combitube™, gum elastic bougie.

*Anes Analg, 87, 153-157*
### What People Actually Do

#### Recognized Awake Intubation Choices

**Table 1. Percentage of Each Anesthetic Induction Condition and Tracheal Intubation Technique Chosen by Anesthesiologists for Each Scenario**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Awake</th>
<th>GA</th>
<th>GA/apnea</th>
</tr>
</thead>
<tbody>
<tr>
<td>All scenarios</td>
<td>57</td>
<td>30</td>
<td>13</td>
</tr>
<tr>
<td>Trauma (Scenarios 8,11,14)</td>
<td>87</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>Pathology below vocal cords (Scenarios 9–11)</td>
<td>51</td>
<td>42</td>
<td>7</td>
</tr>
<tr>
<td>Pathology above vocal cords (Scenarios 1–8)</td>
<td>57</td>
<td>26</td>
<td>17</td>
</tr>
</tbody>
</table>

- **Upper airway difficulty**
  1. Examination consistent with difficult intubation
  2. Pharyngeal obstructing tumor
  3. Epiglottitis
  4. Retropharyngeal abscess
  5. Bleeding postoperative tonsil

- **Obstructive sleep apnea**
- **Obese and preeclamptic patient**

- **Crushing injury to face**
- **Lower airway difficulty**
- **Mediastinal mass**

- **Tracheal foreign body**
- **Crushing injury to neck**

- **History of difficult intubation**
  1. Facial burns
  2. Unstable neck

- **All scenarios**
- **Trauma (Scenarios 8,11,14)**
- **Pathology below vocal cords (Scenarios 9–11)**
- **Pathology above vocal cords (Scenarios 1–8)**

*GA*: General anesthesia with spontaneous ventilation or apnea after successful testing of the airway with positive pressure ventilation.

*GA/apnea*: General anesthesia with spontaneous ventilation or apnea after successful testing of the airway with positive pressure ventilation.

*Aes Analg, 87, 153-157*
### Table 1. Percentage of Each Anesthetic Induction Condition and Tracheal Intubation Technique Chosen by Anesthesiologists for Each Scenario

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Induction condition</th>
<th>Intubation technique</th>
<th>Surgical airway</th>
<th>Laryngeal mask airway</th>
<th>Other device</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>General anesthesia with patient airway</td>
<td>General anesthesia with apnea</td>
<td>Direct rigid laryngoscope</td>
<td>Fiberoptic bronchoscope</td>
<td></td>
</tr>
<tr>
<td>Upper airway difficulty</td>
<td>70</td>
<td>26</td>
<td>4</td>
<td>20</td>
<td>67</td>
</tr>
<tr>
<td>Examination consistent with</td>
<td>75</td>
<td>22</td>
<td>3</td>
<td>36</td>
<td>52</td>
</tr>
<tr>
<td>difficult intubation</td>
<td>Pharyngeal obstructing tumor</td>
<td>80</td>
<td>6</td>
<td>92</td>
<td>6</td>
</tr>
<tr>
<td>Epiglottitis</td>
<td>81</td>
<td>26</td>
<td>13</td>
<td>57</td>
<td>36</td>
</tr>
<tr>
<td>Retropharyngeal abscess</td>
<td>23</td>
<td>14</td>
<td>62</td>
<td>95</td>
<td>2</td>
</tr>
<tr>
<td>Bleeding postoperative tonsil</td>
<td>74</td>
<td>22</td>
<td>4</td>
<td>30</td>
<td>61</td>
</tr>
<tr>
<td>Obstructive sleep apnea</td>
<td>47</td>
<td>16</td>
<td>37</td>
<td>67</td>
<td>24</td>
</tr>
<tr>
<td>Obese and preeclamptic patient</td>
<td>91</td>
<td>4</td>
<td>5</td>
<td>28</td>
<td>18</td>
</tr>
<tr>
<td>Crushing injury to face</td>
<td>60</td>
<td>35</td>
<td>5</td>
<td>53</td>
<td>44</td>
</tr>
<tr>
<td>Lower airway difficulty</td>
<td>27</td>
<td>62</td>
<td>11</td>
<td>74</td>
<td>22</td>
</tr>
<tr>
<td>Mediastinal mass</td>
<td>93</td>
<td>7</td>
<td>1</td>
<td>19</td>
<td>51</td>
</tr>
<tr>
<td>Tracheal foreign body</td>
<td>40</td>
<td>55</td>
<td>5</td>
<td>59</td>
<td>30</td>
</tr>
<tr>
<td>Crushing injury to neck</td>
<td>37</td>
<td>43</td>
<td>20</td>
<td>63</td>
<td>29</td>
</tr>
<tr>
<td>History of difficult intubation</td>
<td>78</td>
<td>14</td>
<td>7</td>
<td>14</td>
<td>78</td>
</tr>
<tr>
<td>Subsets</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All scenarios</td>
<td>57</td>
<td>30</td>
<td>13</td>
<td>51</td>
<td>37</td>
</tr>
<tr>
<td>Trauma (Scenarios 8,11,14)</td>
<td>87</td>
<td>8</td>
<td>4</td>
<td>20</td>
<td>49</td>
</tr>
<tr>
<td>Pathology below vocal cords</td>
<td>51</td>
<td>42</td>
<td>7</td>
<td>55</td>
<td>37</td>
</tr>
<tr>
<td>(Scenarios 9–11)</td>
<td>Pathology above vocal cords</td>
<td>57</td>
<td>26</td>
<td>17</td>
<td>53</td>
</tr>
</tbody>
</table>

* Included in the nonresponse telephone survey.

* General anesthesia with spontaneous ventilation or apnea after successful testing of the airway with positive pressure ventilation.

* Devices or techniques used by <90% of anesthesiologists in all scenarios, including Bivillard laryngoscope, blind nasal, lighted styllet, retrograde wire, Combitube®; gum elastic bougie.

(Aumes Analg, 87, 153-157)
Roughly 450 anesthesiologists, surveyed at ASA 1999

Table 3. Most Common Choices of Difficult Airway Management

<table>
<thead>
<tr>
<th>First Choice</th>
<th>Second Choice</th>
<th>Third Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anticipated difficult intubation</td>
<td>RA (if suitable)</td>
<td>Awake FOI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>48</td>
</tr>
<tr>
<td></td>
<td>Unanticipated failed intubation</td>
<td>LMA as a conduit for intubation</td>
</tr>
<tr>
<td></td>
<td>with adequate mask ventilation</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>29</td>
</tr>
<tr>
<td></td>
<td>Unanticipated failed intubation</td>
<td>LMA as a ventilation device</td>
</tr>
<tr>
<td></td>
<td>with difficult or impossible mask</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ventilation</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Awake FOI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>34</td>
</tr>
<tr>
<td></td>
<td></td>
<td>LMA as a conduit for intubation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>22</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Wake-up and perform FOI</td>
</tr>
<tr>
<td></td>
<td></td>
<td>18</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>LMA</td>
<td>Combitube</td>
</tr>
<tr>
<td></td>
<td></td>
<td>48</td>
</tr>
<tr>
<td></td>
<td></td>
<td>TTJV</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Data are presented as percentages of respondents.

RA = regional anesthesia, FOI = fiberoptic intubation, LMA = laryngeal mask airway, and TTJV = transtracheal jet ventilation.
Unexpected Difficult Airway

1:10000 chance of walking into unexpected “Can’t Ventilate / Can’t Intubate” situation

Anesthesiology, 98, 1269-77, 2003
GA → test mask.

If mask inadequate → EMERGENCY.

Think: GET HELP!

Attempt LMA, readying other options.
LMA as Rescue Airway:

- Laryngeal mask airway provides an excellent conduit to the larynx.
- Reliably relieves supraglottic obstruction.
- Effective in abnormal upper airway anatomy
- “Works well even when used poorly.”

2.6/10k incidence of aspiration (same as for GA)

Anesthesiology 84, 686-699, 1996

Int Anes Clin 38 29-45, 2000
What People Actually Do:

- Single, large academic practice
- Airway SWAT team
- LMA 1st rescue choice in CV/CI scenario
- Difficult oxygenation: SpO2<90%
- Rescue: SpO2>90%
- 25 episodes in 24k cases over 2 years (1:1000)

Anes Analg 87 661-65, 1998
What People Actually Do:

- SWAT team called in 13/25 cases
- LMA succeeded in 16/17 uses; failure due to airway thrombus after failed TTJV

Anes Analg 87 661-65, 1998

Vanderbilt Anesthesiology
What People Actually Do:

- Alternate techniques not so reliably effective as initial intervention
- Other rescue technique

Anes Analg 87 661-65, 1998
What People Actually Do:

- LMA 1st rescue choice in CV/CI scenario 17/25 instances
- Difficult oxygenation: SpO2<90%
- Lowest SpO2 noted before LMA placement
- Many laryngoscopies prior to first rescue application of LMA

Figure 2. Distribution of peripheral Spo2 values in 17 cases in which the laryngeal mask airway was used to provide airway rescue. Each box represents one case. The number in each box represents the number of direct laryngoscopies performed before airway intervention. The lowest Spo2 value did not correlate with the number of direct laryngoscopy attempts.

Anes Analg 87 661-65, 1998
What People Actually Do:

**Prediction and Outcomes of Impossible Mask Ventilation**

_A Review of 50,000 Anesthetics_

Sachin Kheterpal, M.D., M.B.A.;* Lizabeth Martin, M.D.,† Amy M. Shanks, M.S.;‡ Kevin K. Tremper, Ph.D., M.D.§

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>N</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Ventilated by mask</td>
<td>37,857</td>
<td>71.3%</td>
</tr>
<tr>
<td>2</td>
<td>Ventilated by mask with oral airway/adjuvant with or without muscle relaxant</td>
<td>13,966</td>
<td>26.3%</td>
</tr>
<tr>
<td>3</td>
<td>Difficult ventilation (inadequate, unstable, or requiring two providers) with or without muscle relaxant</td>
<td>1,141</td>
<td>2.2%</td>
</tr>
<tr>
<td>4</td>
<td>Unable to mask ventilate with or without muscle relaxant</td>
<td>77</td>
<td>0.15%</td>
</tr>
<tr>
<td></td>
<td>Total cases</td>
<td>53,041</td>
<td></td>
</tr>
</tbody>
</table>

Unable to mask ventilate with or without muscle relaxant

_Anesthesiology, 110, 891-7, 2009_
### Outcomes & Predictors:

**Table 3. Airway Outcomes in Cases of Impossible Mask Ventilation**

<table>
<thead>
<tr>
<th>Description</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intubated without difficulty (grade I or II direct laryngoscopy view and no more than three attempts)</td>
<td>58</td>
</tr>
<tr>
<td>Intubated with difficulty using direct laryngoscopy (grade III or IV direct laryngoscopy view or at least four attempts)</td>
<td>8</td>
</tr>
<tr>
<td>Intubated with difficulty using McCoy blade for direct laryngoscopy</td>
<td>2</td>
</tr>
<tr>
<td>Intubated using rigid indirect laryngoscopy (e.g., Bullard, Glidescope)</td>
<td>4</td>
</tr>
<tr>
<td>Intubated using blind lightwand</td>
<td>1</td>
</tr>
<tr>
<td>Patient woken, subsequent awake fiberoptic intubation</td>
<td>2</td>
</tr>
<tr>
<td>Patient woken, subsequent awake tracheostomy by surgical team</td>
<td>1</td>
</tr>
<tr>
<td>Emergent cricothyrotomy</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>77</td>
</tr>
</tbody>
</table>

**Table 4. Independent Predictors of Impossible Mask Ventilation**

<table>
<thead>
<tr>
<th>Predictor</th>
<th>$\beta$ Coefficient</th>
<th>Standard Error</th>
<th>$P$ Value</th>
<th>Weighted Points*</th>
<th>Adjusted Hazard Ratio (95% Confidence Interval)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neck radiation changes</td>
<td>1.964</td>
<td>0.628</td>
<td>0.002</td>
<td>6</td>
<td>7.1 (2.1–24.4)</td>
</tr>
<tr>
<td>Male sex</td>
<td>1.206</td>
<td>0.322</td>
<td>&lt; 0.001</td>
<td>4</td>
<td>3.3 (1.8–6.3)</td>
</tr>
<tr>
<td>Sleep apnea</td>
<td>0.859</td>
<td>0.302</td>
<td>0.005</td>
<td>3</td>
<td>2.4 (1.3–4.3)</td>
</tr>
<tr>
<td>Mallampati III or IV</td>
<td>0.678</td>
<td>0.276</td>
<td>0.014</td>
<td>2</td>
<td>2.0 (1.1–3.4)</td>
</tr>
<tr>
<td>Presence of beard</td>
<td>0.639</td>
<td>0.284</td>
<td>0.024</td>
<td>2</td>
<td>1.9 (1.1–3.3)</td>
</tr>
</tbody>
</table>
Summary

• We have a useful algorithm (in revision)
• Have we hit ceiling with this guideline?
  • i.e., can it be improved?
• When faced with the critical ‘Can’t mask’ scenario, most people intubate.
• Better tools make that more possible
This is Not Always the Answer
Needle Cricothyrotomy & Transtracheal Jet Ventilation

- Never elective; establishes emergency airway when there is a supraglottic obstruction and laryngoscopy is impossible.
- Successful in inexpert hands but many potential complications.
Perc Cricothyrotomy Requires Practice

- Perc Dilational Cric with a kit:
- Most people plateau at 5 attempts on a mannequin
- People under 45 are better in earlier attempts (difference gone by 4th attempt)
- Everyone can do this in <40 sec with practice.
- Take-home: PRACTICE THIS

Wong et al, Anesthesiology 98: 349-53

Fig. 1. (Top) Cricothyroidotomy times (mean ± SD; s) over the 10 attempts. (Bottom) Percentage of participants successful at thresholds of 40 s or less over the 10 attempts.
Airway Management Doesn’t End with Successful Intubation
• Significant residual paralysis (Post-Op Residual Curarization) defined as TOF ratio < 0.9
  • TOF Ratio: (Twitch 4/ Twitch 1)
  • TOF Ratio <0.9 - inadequate secretion handling, significant airway closure
• Expert can’t detect TOF ratio differences once 0.7 has been achieved
Impacts PACU Stay

Postoperative residual curarization from intermediate-acting neuromuscular blocking agents delays recovery room discharge†

A. Butterly†, E. A. Bittner†, E. George†, W. S. Sandberg, M. Eikermann†,3* and U. Schmidt†

BJA Advance Access published June 24, 2010
And Worse...

- NMBA use raises risk of reintubation post-op
- Monitoring does not protect
- Neostigmine use makes it even worse
Recommendations

- NMBs facilitate safe intubation
- Avoid ‘convenience’ relaxation
- Titrate relaxants carefully
- Monitor NMB effect - and strongly consider buying a quantitative monitoring device - with aim to limit dose
- Reverse - but recognize the consequence
- Tell the PACU nurse if there is any concern of PORC - they need this info
Currently Available and Emerging Cognitive Aids to Improve Airway Management
We Don’t Do Too Well Under Pressure:

Performance of Certified Registered Nurse Anesthetists and Anesthesiologists in a Simulation-Based Skills Assessment


Table 2. Anesthesiologists and Certified Registered Nurse Anesthetists—Demographic Profile

<table>
<thead>
<tr>
<th></th>
<th>Practicing physicians</th>
<th>CRNAs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age</td>
<td>43 (33–57)</td>
<td>45.4 (38–55)</td>
</tr>
<tr>
<td>Number of females/male</td>
<td>6/29</td>
<td>15/11</td>
</tr>
<tr>
<td>Practice setting: community</td>
<td>22</td>
<td>20</td>
</tr>
<tr>
<td>Practice setting: teaching</td>
<td>9</td>
<td>4</td>
</tr>
<tr>
<td>Average years in practice</td>
<td>11.9 (2–26)</td>
<td>11.1 (3–32)</td>
</tr>
<tr>
<td>Type of practice: team</td>
<td>26</td>
<td>24</td>
</tr>
<tr>
<td>Type of practice: individual</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>Type of practice: both team</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>and individual</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 1. Description of Events and Scoring Items for 12 Scenarios

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Scoring items</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bronchospasm</td>
<td>Listen to chest, increase inspired oxygen, state diagnosis, administer beta agonist/epinephrine.</td>
</tr>
<tr>
<td>Anaphylaxis</td>
<td>Increase inspired oxygen, auscultate lungs, check blood pressure, state diagnosis, stop antibiotic infusion, administer epinephrine.</td>
</tr>
<tr>
<td>Unstable ventricular tachycardia</td>
<td>State diagnosis, increase inspired oxygen, deliver shock, deliver synchronized cardioversion, give/request antiarrhythmic.</td>
</tr>
<tr>
<td>Malignant hyperthermia</td>
<td>State diagnosis, turn-off agent, call for Dantrolene® or malignant hyperthermia cart.</td>
</tr>
</tbody>
</table>

Lake Wobegon for Anesthesia...Where Everyone Is Above Average Except Those Who Aren’t: Variability in the Management of Simulated Intraoperative Critical Incidents


“Not only are the mean scores [in the Henrichs article] ordinary, the individual scores are not bunched-up around the average, which means that some people did very poorly. **No matter how artificial the tests might be, this level of mediocre performance is unacceptable for both groups of anesthesia professionals.**”
Even for Defibrillation...

### Delayed Time to Defibrillation after Intraoperative and Periprocedural Cardiac Arrest

Jill M. Mhyre, M.D.,* Satya Krishna Ramachandran, M.D., F.R.C.A.†, Sachin Kheterpal, M.D., M.B.A.,* Michelle Morris, M.S., † Paul S. Chan, M.D., M.Sc., † for the American Heart Association National Registry for Cardiopulmonary Resuscitation Investigators

*Anesthesiology 2010; 113:782-93*

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>≤2 Min to Defibrillation (n = 746)</th>
<th>&gt;2 Min to Defibrillation (n = 119)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrocardiographic monitoring in place at the time of arrest, No. (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Operating room</td>
<td>299 (96.6)</td>
<td>59 (92.2)</td>
<td>0.09</td>
</tr>
<tr>
<td>Perianesthesia care unit</td>
<td>117 (96.9)</td>
<td>20 (87.0)</td>
<td>0.09</td>
</tr>
<tr>
<td>Cardiac catheterization laboratory</td>
<td>250 (99.6)</td>
<td>13 (100.0)</td>
<td>0.82</td>
</tr>
<tr>
<td>Diagnostic suites</td>
<td>46 (71.9)</td>
<td>16 (84.2)</td>
<td>0.28</td>
</tr>
<tr>
<td>Survived event, No. (%)</td>
<td>541 (72.5)</td>
<td>71 (59.7)</td>
<td>0.004</td>
</tr>
<tr>
<td>Survived to discharge, No. (%)</td>
<td>396 (53.1)</td>
<td>47 (39.5)</td>
<td>0.006</td>
</tr>
</tbody>
</table>

- Coding is bad enough; waiting increases mortality
Help In Your Hand

A randomised control trial to determine if use of the iResus® application on a smart phone improves the performance of an advanced life support provider in a simulated medical emergency.

![Diagram showing the process of assessing rhythm, determining shockability, and managing shockable and non-shockable rhythms.](image)
Check Lists Help

• When cues are provided performance improves
• Expect more cues...

**Figure 2** Cardiac arrest scenario test scores for participants. (■) No smart phone and (□) Smart phone (iResus).

Cognitive Aids

- Currently in fashion: Stanford edition
Cognitive Aids

• www.vortexapproach.com

• Mental construct to have in mind each time starting a case:

Every case starts here:

Very quickly get to EMERG SURG AIRWAY
Internally Consistent c ASA Diff AW

The Vortex

For Each NSA Technique Consider:
1. Manipulations:
   - Head & Neck
   - Larynx
   - Device
2. Adjuncts
3. Size/Type
4. Suction/O₂ Flow
5. Muscle Tone

Maximum three tries at each non-surgical airway technique. At least one try should be had by most experienced available clinician.
<table>
<thead>
<tr>
<th>VORTEX OPTIMISATION STRATEGIES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FACE MASK</strong></td>
</tr>
<tr>
<td>manipulation head &amp; neck</td>
</tr>
<tr>
<td>dentures in</td>
</tr>
<tr>
<td>larynx</td>
</tr>
<tr>
<td>device</td>
</tr>
<tr>
<td>adjuncts</td>
</tr>
<tr>
<td>size/type</td>
</tr>
<tr>
<td>suction</td>
</tr>
<tr>
<td>pharyngeal muscle tone</td>
</tr>
</tbody>
</table>

© Nicholas Christie & Peter Kits. 2011. All Rights Reserved.
ESA Status

READY
Kit Out At Bedside
Confirm Contents
Allocate Proceduralist

SET
Open Kit & Prepare Equipment
Palpate/US & Mark Landmarks
Infiltrate Adrenaline Containing LA*

GO
Perform Emergency Surgical Airway

ESA Status escalates with a failed optimal attempt at any non-surgical airway technique

Consider additional escalation in ESA Status if:**
- Predicted difficult airway
- Rapidly deteriorating SaO2
- SaO2 <70%

*Time permitting. Must not delay GO status.
**Ensure reasonable optimal attempts at all 3 non-surgical techniques before declaring GO status

© Copyright Nicholas Chrimis & Peter Fritz 2014. Adapted with permission from CriCon by S. Weingart, 2012
Perc Cric Requires Practice

- Perc Dilational Cric with a kit:
- Most people plateau at 5 attempts on a mannequin
- People under 45 are better in earlier attempts (difference gone by 4th attempt)
- Everyone can do this in <40 sec with practice.

Take-home:
PRACTICE THIS

Fig. 1. (Top) Cricothyroidotomy times (mean ± SD; s) over the 10 attempts. (Bottom) Percentage of participants successful at thresholds of 40 s or less over the 10 attempts.

Wong et al, Anesthesiology 98: 349-53
Take Home Messages

• Difficult airways are neither as common nor as difficult as they used to be.

• Almost no scenario cannot be overcome as long as you have a plan.

• The plan must include LIMITED but fundamentally DIFFERENT approaches to allow for all possibilities.

• Trick-scopes are not the answer without expertise.

• Cognitive aids now can and should be readily available in the environment - use them.