To Tube or Not to Tube?
Ben Lawner DO, MS, EMT-P and Frank Guyette MD, MPH

Objectives

• Examine the evidence for alternative airways
• Explore indications for alternative airway management
• Integrate evidence into clinical practice
Acknowledge the Problem

• Intubation is difficult
• Requires initial and ongoing practice
• Requires vigilant QA/QI
• Success rates have historically lagged behind those of physicians/flight crews

What’s the State of the Art of Intubation?

Critical Care

RESEARCH Open Access

The success of pre-hospital tracheal intubation by different pre-hospital providers: a systematic literature review and meta-analysis

K. Crewdson1, D. J. Lockey2, J. Raidien4, H. M. Losslus3,4 and M. Rehn1,3,4
• Reviewed articles from 2006-2016
• 125,177 total ETI attempts, 23,738 by physicians
• Significant heterogeneity
• Included different populations / different drug protocols

![Intubation Success Rates %](chart.png)
Study Summary

- Crude success rate for physicians higher
- Expert skill level (experienced anesthesiologists) overall success at 99.4%
- Intermediate skill level (emergency medicine + anesth experience) 98.6%
- Basic skill mix (non physicians or physicians with little experience) 91.7%
- Skill mix arbitrarily defined but experience proportional to success

History and Background: ETI

- Original description of Paramedic Intubation
- 90% overall success
- 58% 1st pass success
- Complication Rate ~10%
  - Unrecognized esophageal intubations 3/779 (0.4%)
  - Aspiration and Mainstem common
History and Background: ETI

- ETI requires significant investment in time and training
- Initial and ongoing practice
- Lack of opportunity
  - CPAP
  - Change in emphasis for trauma and cardiac arrest from definitive airway to “airway management”

Wang et al CCM 2005

History and Background: Supraglottics

- Initially offered as “Rescue Airways”
- Widespread availability of supraglottic devices
- Decreased cost with supraglottic airways

The “OG” supraglottic
History of Alternative Airways
How did we get here?

• Studies show faster placement
• Success with less training
• Decreased need for cadaveric/human practice
• Widespread adoption by EMS systems
Alternative airways...are coming.

Sir King of LT
The King

• Introduced in 1999
• Improved with a gastric suction port (LTSD)
• ‘Impossible’ to place in trachea
• Faster placement than ETC
• Little to no experience required

The Infallable King in 2016

Clinical Communications: Adult

TRACHEAL MALPLACEMENT OF THE KING LT AIRWAY MAY BE AN IMPORTANT CAUSE OF PREHOSPITAL DEVICE FAILURE

Brian E. Driver, MD, David Plummer, MD, William Heggard, MPH, MD, and Robert F. Reardon, MD

Department of Emergency Medicine, Hennepin County Medical Center, Minneapolis, Minnesota
Corresponding Address: Brian E. Driver, MD, Department of Emergency Medicine, Hennepin County Medical Center, 701 Park Ave South, Mall Stop R2, Minneapolis, MN 55415

Figure 1. A cervical spine radiograph shows tracheal malplacement of the King LT airway (King Systems, Noblesville, IN). The device passes through the laryngeal inlet and is lodged against the wall of the anterior trachea. There is an acute kink in the distal tube between the two balloons.
The Fallible King

• Failure rates vary widely (~15%)
• Factors that Predict Failure
  • Gag reflex
  • Ground EMS
  • Male

Other Problems in the Realm

<table>
<thead>
<tr>
<th>Complication</th>
<th>n (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tongue engorgement</td>
<td>7 (15%)</td>
</tr>
<tr>
<td>Glottic edema</td>
<td>2 (4%)</td>
</tr>
<tr>
<td>Subcutaneous emphysema</td>
<td>2 (4%)</td>
</tr>
<tr>
<td>Pulmonary aspiration</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>Esophageal trauma</td>
<td>1 (2%)</td>
</tr>
<tr>
<td>Total</td>
<td>13 (27%)</td>
</tr>
</tbody>
</table>
The Intellectual Ruler: LMA

- Introduced in 1981 by Dr. Archie Brain
- Widely deployed in the hospital setting
- Blind insertion

The Laryngeal Mask Airway

- Decreased time to insertion
- Faster placement speeds
- Significant “first pass success”
- Overall success rates >82% in one study

LMA Problems

• Aspiration risks
• Tongue edema
• Dislodgement
• Difficult to use in “high pressure” airways
• Not intuitive
  • Technique requires practice
  • Balloon may not seat in all circumstances
The Battle Royale

Round 1: Hasegawa (2013) JAMA

- Prospective nationwide population based study
- 650,000 patients
- January 2005-2010
- Compared neurological outcome in patients who underwent BVM vs SGA vs ETI

Association of Prehospital Advanced Airway Management With Neurologic Outcome and Survival in Patients With Out-of-Hospital Cardiac Arrest
This large, nationwide, population-based cohort study showed that CPR with prehospital advanced airway management, whether endotracheal intubation or supraglottic airways, was independently associated with a decreased likelihood of favorable neurological outcome compared with conventional bag-valve-mask ventilation among adults with OHCA. Our observations contra-
Round 1: Hasegawa (2013) JAMA

- Results may not be generalizable
- Different process for ETI credentialing
- Subgroup analysis limited to patients achieving ROSC still linked intubation to worsened outcomes
- 18% of the cohort in this study experienced trauma, hanging, drowning, or asphyxia
- Inherent limitations of the study design

Why Might Advanced Airways be Harmful?

- Intra arrest
  - Interruptions in CPR are BAD!
- Post Arrest
  - Hypoxia
  - Hypotension
  - Hypercarbia
  - Hypocarbia
Round 2: The Meta-Analysis

Review article

Endotracheal intubation versus supraglottic airway placement in out-of-hospital cardiac arrest: A meta-analysis

Justin L. Benoit*, Ryan B. Gerecht, Michael T. Steuerwald, Jason T. McMullan
University of Cincinnati, College of Medicine, Department of Emergency Medicine, 231 Albert Sabin Way PO Box 670760, Cincinnati, OH, 45267-0760, USA
Benoit (2015) et al

- Structured review of pub-med, Cochrane, other db’s
- Examines advanced airway methods in OHCA
- Outcomes includes: ROSC, survival to hospital admission, survival to discharge
- Pediatrics, physician/RN intubators excluded

Fig. 4. Forest plot for survival to hospital discharge. ETI = Endotracheal intubation; SGA = Supraglottic airway; OR = Odds ratio; CI = Confidence interval; Full Model = Random effects model with all studies included; Sensitivity Analysis Model = Random effects model excluding studies of "very low" quality.
BOTTOM LINE

• In this meta analysis of relatively low quality evidence, OHCA patients receiving intubation experienced improved survival when compared to those who received management via SGA
Round 3: The Wang Study and CARES

- CARES database queries, 10691 patients
- 3110 SGA
- 5591 ETI
- 1929 No advanced airway
- Outcomes: Survival to admission, discharge, and neurologically intact survival

Unadjusted outcomes

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<thead>
<tr>
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<th>BVM</th>
<th>Supraglottic</th>
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<td>ROSC</td>
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## Unadjusted outcomes

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<td>26.6</td>
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<td>Survival, discharge</td>
<td>21.9</td>
<td>6.7</td>
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<td>Survival, discharge</td>
<td>21.9</td>
<td>6.7</td>
<td>8.3</td>
</tr>
<tr>
<td>Survival, good neuro</td>
<td>18.6</td>
<td>5.2</td>
<td>5.4</td>
</tr>
</tbody>
</table>

Results

• Adjusted data confirmed association between superior outcomes of ETI over SGA
• Hospital processes not captured
• Airway processes not captured

5. Conclusion

In the CARES network, survival was higher among OHCA receiving ETI than those receiving SGA. Survival was markedly higher among patients who received no advanced airway than those receiving endotracheal intubation or supraglottic airway placement.
Putting it all together

- Studies are low-quality
- Randomized studies lacking
- Associations between worsened outcomes and SGA devices
- Applications for clinical practice?
The Next Generation

Airways-2

PART

Research

JAMA | Original Investigation
Effect of a Strategy of Initial Laryngeal Tube Insertion vs Endotracheal Intubation on 72-Hour Survival in Adults With Out-of-Hospital Cardiac Arrest
A Randomized Clinical Trial

Henry E. Wang, MD, MS; Robert H. Schreiber, MS; Mohamed R. Daya, MD, MS; Shannon W. Stephens, EMT-P; Ahmed H. Elds, MD, MS; Ira G. Carlin, MD, MS; M. Riccardo Colletti, DO; MPH; Heather Henley, MPH; RN; Matthew Hansen, MD, MCR; Neal J. Richmond, MD, MS; Juan Carlos J. Paezana, BA; Tom P. Aufderheide, MD, MS; Randall E. Gray, MB, BCh, EMT-P; Pamela C. Gray, NREMT-P; Michael Versteeg, AAS, EMT-P; Pamela C. Owens, EMT-P; Ashley M. Brandt, BS; Kenneth J. Sturdivant, MS, EHS, BSN, NRP; Suzanne J. May, PhD; George R. Sopko, MD, MPH; Myron L. Weisfeldt, MD, MPH; Graham Neff, MD, MPH.
### Table 3. Out-of-Hospital and In-Hospital Adverse Eventsa

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Laryngeal Tube (n = 1505)</th>
<th>Endotracheal Intubation (n = 1499)</th>
<th>Difference, % (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Out-of-Hospital Adverse Events</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple (≥3) insertion attemptsb</td>
<td>6/1353 (0.4)</td>
<td>18/1299 (1.4)</td>
<td>-0.9 (-1.7 to -0.2)</td>
<td>.01</td>
</tr>
<tr>
<td>Initial airway</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Across all airways</td>
<td>61/1353 (4.5)</td>
<td>245/1299 (18.9)</td>
<td>-14.4 (-17.0 to -11.7)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td><strong>Unsuccessful insertionb</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>First airway technique</td>
<td>159/1353 (11.8)</td>
<td>573/1299 (44.1)</td>
<td>-32.4 (-35.6 to -29.1)</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>All airway techniques</td>
<td>78/1353 (5.8)</td>
<td>111/1299 (8.5)</td>
<td>-2.8 (-4.8 to -0.8)</td>
<td>.01</td>
</tr>
<tr>
<td>Unrecognized airway misplacement or airway dislodgement</td>
<td>10/1353 (0.7)</td>
<td>24/1299 (1.8)</td>
<td>-1.1 (-2.0 to -0.3)</td>
<td>.01</td>
</tr>
<tr>
<td>Inadequate ventilation</td>
<td>25/1353 (1.8)</td>
<td>8/1299 (0.6)</td>
<td>1.2 (0.3 to 2.1)</td>
<td>.01</td>
</tr>
<tr>
<td><strong>In-Hospital Adverse Events</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pneumothorax (first chest x-ray)c</td>
<td>17/485 (3.5)</td>
<td>30/428 (7.0)</td>
<td>-3.6 (-6.5 to -0.7)</td>
<td>.02</td>
</tr>
<tr>
<td>Rib fractures (first chest x-ray)c</td>
<td>16/485 (3.3)</td>
<td>30/428 (7.0)</td>
<td>-3.8 (-6.9 to -0.7)</td>
<td>.01</td>
</tr>
<tr>
<td>Oropharyngeal or hypopharyngeal injury (first 24 h)</td>
<td>1/460 (0.2)</td>
<td>1/400 (0.3)</td>
<td>0 (-0.7 to 0.6)</td>
<td>.92</td>
</tr>
<tr>
<td>Airway swelling or edema (first 24 h)d</td>
<td>5/460 (1.1)</td>
<td>4/400 (1.0)</td>
<td>0.1 (-1.3 to 1.4)</td>
<td>.90</td>
</tr>
<tr>
<td>Pneumonia or aspiration pneumonitis (first 72 h)e</td>
<td>120/460 (26.1)</td>
<td>89/400 (22.3)</td>
<td>3.7 (-2.1 to 9.6)</td>
<td>.21</td>
</tr>
</tbody>
</table>

### Table 2. Outcomes of Patients Included in the Primary and Secondary Analyses

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>No. (%)</th>
<th>Endotracheal Intubation (n = 1499)</th>
<th>Difference, % (95% CI)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Primary Outcome</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survival to 72 h (intention-to-treat population)</td>
<td>275 (18.3)</td>
<td>230/1495 (15.4)</td>
<td>2.9 (0.2 to 5.6)</td>
<td>.04</td>
</tr>
<tr>
<td><strong>Secondary Outcomes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return of spontaneous circulation on emergency department arrival</td>
<td>420 (27.9)</td>
<td>365 (24.3)</td>
<td>3.6 (0.3 to 6.8)</td>
<td>.03</td>
</tr>
<tr>
<td>Survival to hospital discharge</td>
<td>163 (10.8)</td>
<td>121 (8.1)</td>
<td>2.7 (0.6 to 4.8)</td>
<td>.01</td>
</tr>
<tr>
<td>Favorable neurologic status at discharge (Modified Rankin Scale score ≤3)</td>
<td>107 (7.1)</td>
<td>75 (5.0)</td>
<td>2.1 (0.3 to 3.8)</td>
<td>.02</td>
</tr>
</tbody>
</table>
PART Results Summary

• Increased survival with LT
• Increased neuro recovery with LT
• Decreased complication with LT

Success rate of ETI ➔ 50%

The Next Generation

AIRWAYS-2
-9296 patients enrolled (4886 SGA, 4410 ETI)
-No video laryngoscopy
-National health service paramedics
-BLS first airway management style, intubation w/bougie
-No video laryngoscopy
Outcomes of interest

- Survival
- Modified Rankin score at 30 days
- Regurgitation
- Aspiration
- Loss of airway

AIRWAYS-2 Results
AIRWAYS-2 Results

- For primary outcome, no statistical increase in survival with use of SGA
- Patients with short duration of arrest less likely to receive advanced airway mgmt.
- Supraglottic device more successful in achieving ventilation after 2 attempts
- Aspiration / regurgitation not different between groups

<table>
<thead>
<tr>
<th></th>
<th>AAM</th>
<th>No AAM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Good Outcome</td>
<td>3.3% (251/7576)</td>
<td>21.1% (251/7576)</td>
</tr>
</tbody>
</table>
Discussion

blawner@ahn-emp.com
guyettef@upmc.edu

Oops. Caught me. I was really going for a BVM.