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

Lolwot.com

- 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 ?

Crewdson *et al. Critical Care* (2017) 21:31
DOI 10.1186/s13054-017-1603-7

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. Crewdson[1,2*], D. J. Lockey[1,2,3], J. Røislien[4], H. M. Lossius[3,4] and M. Rehn[1,3,4]

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Critical Care

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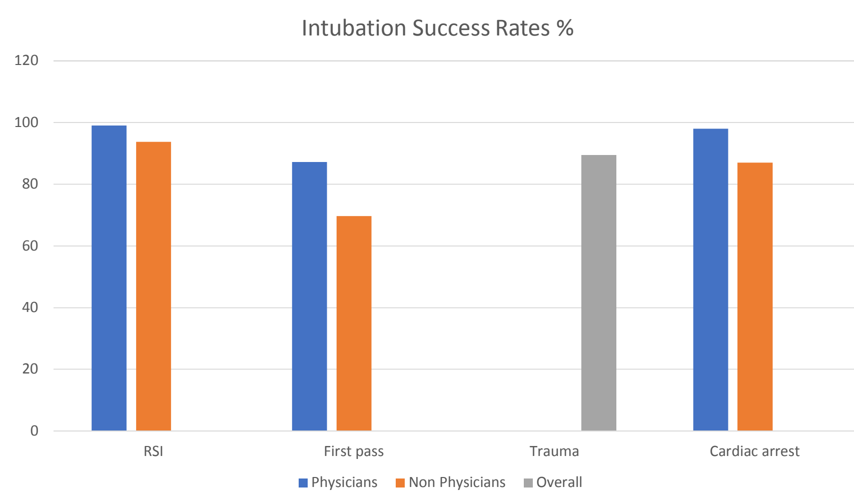
The success of pre-hospital tracheal intubation by different pre-hospital providers: a systematic literature review and meta-analysis

K. Crewdson[1,2*], D. J. Lockey[1,2,3], J. Røislien[4], H. M. Lossius[3,4] and M. Rehn[1,3,4]

- Reviewed articles from 2006-2016
- 125,177 total ETI attempts, 23,738 by physicians
- Significant heterogeneity
- Included different populations / different drug protocols



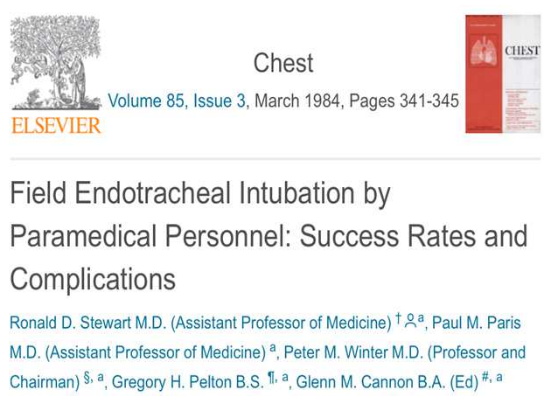
Study Summary

- Crude success rate for physicians higher
- Expert skill level (experienced anesthetists) 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

Basic skill mix for non physicians??!?!?
Intermediate skill level for EM?!?!!?

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



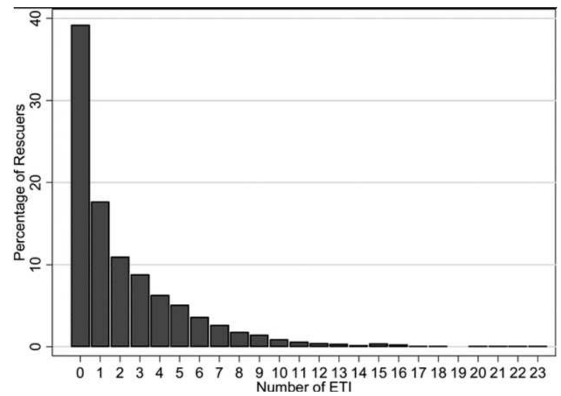
ELSEVIER
Chest
Volume 85, Issue 3, March 1984, Pages 341-345

Field Endotracheal Intubation by Paramedical Personnel: Success Rates and Complications

Ronald D. Stewart M.D. (Assistant Professor of Medicine) [†, a], Paul M. Paris M.D. (Assistant Professor of Medicine) [a], Peter M. Winter M.D. (Professor and Chairman) [§, a], Gregory H. Pelton B.S. [¶, a], Glenn M. Cannon B.A. (Ed) [#, a]

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

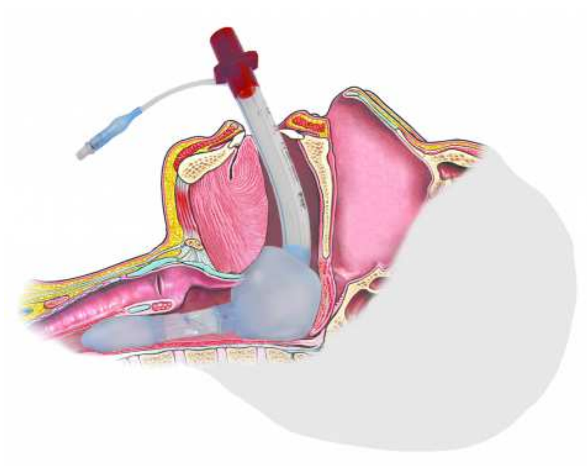
The "OG" supraglottic

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

Sir King of LT



16

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 Heegaard, 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, Mail 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

Resuscitation
Volume 86, January 2015, Pages 25-30

Clinical paper

Risk factors for unsuccessful prehospital laryngeal tube placement ☆

Christian Martin-Gill [a], Heather A. Prunty [a], Seth C. Ritter [a], Jestin N. Carlson [b], Francis X. Guyette [a]

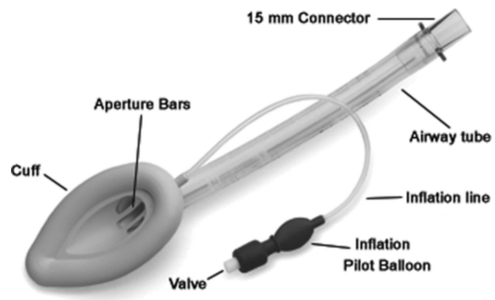
Other Problems in the Realm

Table 3 Complications associated with the King Laryngeal Tube

Complication	*n* (%)
Tongue engorgement	7 (15%)
Glottic edema	2 (4%)
Subcutaneous emphysema	2 (4%)
Pulmonary aspiration	1 (2%)
Esophageal trauma	1 (2%)
Total	13 (27%)

The Intellectual Ruler: LMA

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



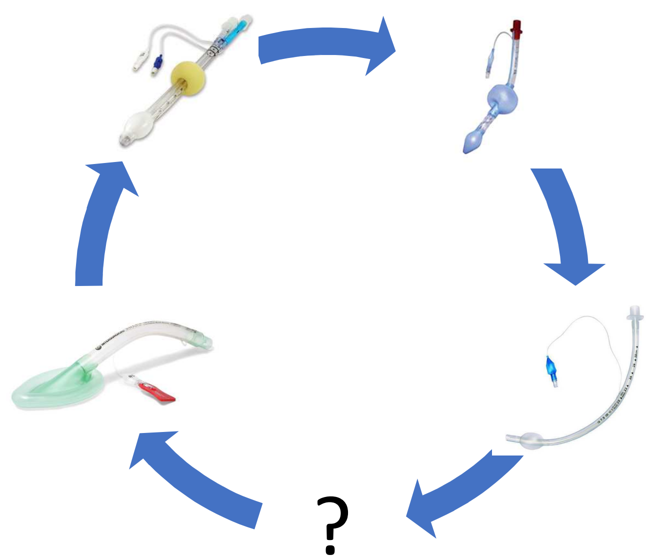
The Laryngeal Mask Airway

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

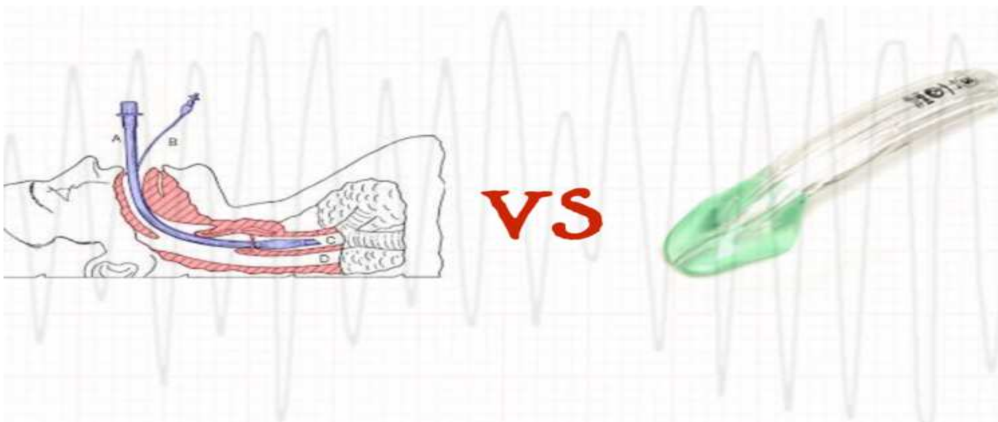
Hubble MW, Wilfong DA, Brown LH, Hertelendy A, Benner RW. A meta-analysis of prehospital airway control techniques, part II: alternative airway devices and cricothyrotomy success rates. Prehosp Emerg Care. 2010;14(4):515–30.

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

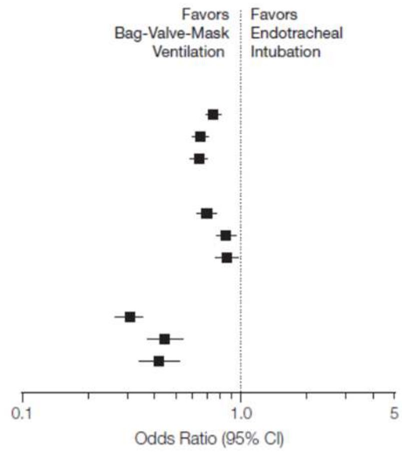
CARING FOR THE
CRITICALLY ILL PATIENT

Association of Prehospital Advanced Airway Management With Neurologic Outcome and Survival in Patients With Out-of-Hospital Cardiac Arrest

Round 1: Hasegawa (2013) JAMA

A Endotracheal intubation vs bag-valve-mask ventilation

Model	Total No. of Patients	No. (%) Endotracheal Intubation	No. (%) Bag-Valve-Mask Ventilation	Odds Ratio (95% CI)[a]
Total		26013 (7.3)	178614 (50.0)	
Return of spontaneous circulation				
Unadjusted	357228	1734 (6.7)	14824 (8.3)	0.76 (0.71-0.81)
Adjusted for selected variables[b]				0.66 (0.61-0.72)
Adjusted for all variables[c]				0.64 (0.58-0.70)
1-month survival				
Unadjusted	357228	1069 (4.1)	10373 (5.8)	0.70 (0.65-0.76)
Adjusted for selected variables[b]				0.87 (0.79-0.97)
Adjusted for all variables[c]				0.88 (0.79-0.98)
Neurologically favorable survival				
Unadjusted	357228	257 (1.0)	5799 (3.2)	0.31 (0.27-0.35)
Adjusted for selected variables[b]				0.45 (0.37-0.55)
Adjusted for all variables[c]				0.42 (0.34-0.53)



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

Resuscitation 93 (2015) 20–26

Contents lists available at ScienceDirect

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

ELSEVIER

EUROPEAN RESUSCITATION COUNCIL

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 670769, Cincinnati, OH, 45267-0769, 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

Study	N (ETI)	N (SGA)	OR (95% CI)
FULL MODEL:			
Cady 2009	4335	1487	1.01 (0.79-1.32)
Hanif 2010	1027	131	10.03 (0.61-164.25)
Kajino 2011	1679	3698	1.11 (0.92-1.34)
McMullan 2014	5591	3110	1.72 (1.24-2.39)
Noda 2007	4	24	1.75 (0.14-21.39)
Shin 2012	250	391	1.46 (0.78-2.73)
Tanabe 2013	12992	29640	1.04 (0.93-1.18)
TOTAL	25878	38481	1.15 (0.97-1.37)
SENSITIVITY ANALYSIS MODEL:			
McMullan 2014	5591	3110	1.72 (1.24-2.39)
Cady 2009	4335	1487	1.01 (0.79-1.32)
Tanabe 2013	12992	29640	1.04 (0.93-1.18)
TOTAL	22918	34237	1.17 (0.70-1.94)

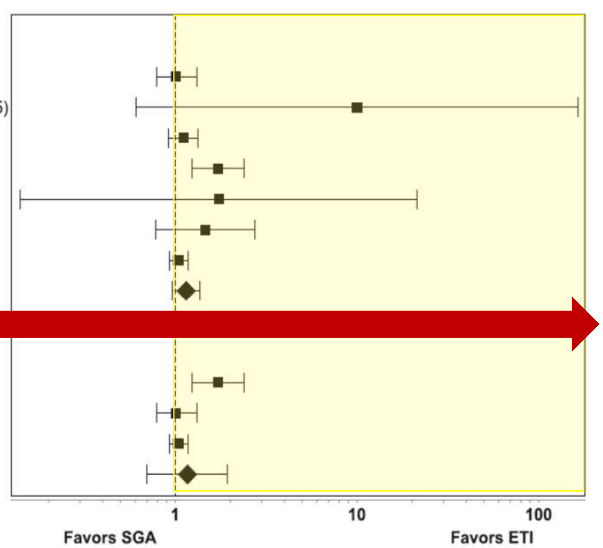


Fig. 4. Forest plot for survival to hospital discharge. ETI = Endotracheal intubation; SGA = Supraglottic airway; OR = Odds ratio; CI = Confidence interval; Full Model = Random effects model with all studies included; Sensitivity Analysis Model = Random effects model excluding studies of "very low" quality.

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

Resuscitation 85 (2014) 617–622

Contents lists available at ScienceDirect

ELSEVIER

Resuscitation

journal homepage: www.elsevier.com/locate/resuscitation

Clinical paper

Airway management and out-of-hospital cardiac arrest outcome in the CARES registry☆

Jason McMullan[a,*], Ryan Gerecht[a], Jordan Bonomo[a], Rachel Robb[b], Bryan McNally[b], John Donnelly[c], Henry E. Wang[c], On behalf of the CARES Surveillance Group

[a] Department of Emergency Medicine, University of Cincinnati, United States
[b] Department of Emergency Medicine, Emory University, United States
[c] Department of Emergency Medicine, University of Alabama School of Medicine, United States

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

Table 1
Airway management technique used on adult out-of-hospital cardiac arrests treated by EMS agencies in the CARES network. Supraglottic airway and endotracheal tube groups include successful advanced airway insertions only; failed insertion efforts were included in the subgroup "no successful advanced airway intervention".

Advanced management technique	N (%)
Supraglottic airway	3110 (29.3%)
Esophageal-tracheal combitube	309 (2.9%)
Laryngeal mask airway	55 (0.5%)
King laryngeal tube	2746 (25.8%)
Endotracheal intubation	5591 (52.6%)
No successful advanced airway intervention	1929 (18.2%)
Other[a]	61 (0.5%)

Unadjusted outcomes

OUTCOME	BVM	Supraglottic	ETI
ROSC	36.5	25.5	33.8

Unadjusted outcomes

OUTCOME	BVM	Supraglottic	ETI
ROSC	36.5	25.5	33.8
Survival, admission	33.4	21.4	26.6

Unadjusted outcomes

OUTCOME	BVM	Supraglottic	ETI
ROSC	36.5	25.5	33.8
Survival, admission	33.4	21.4	26.6
Survival, discharge	21.9	6.7	8.3

Unadjusted outcomes

OUTCOME	BVM	Supraglottic	ETI
ROSC	36.5	25.5	33.8
Survival, admission	33.4	21.4	26.6
Survival, discharge	21.9	6.7	8.3
Survival, good neuro	18.6	5.2	5.4

Results

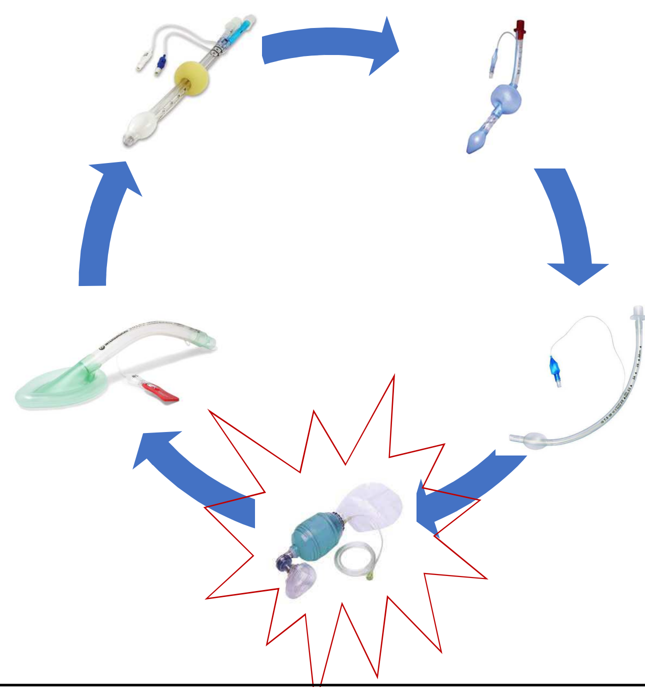
- Adjusted data confirmed association between superior outcomes of ETI over SGA
- Hospital processes not captured
- Airway processes not captured

5. Conclusion

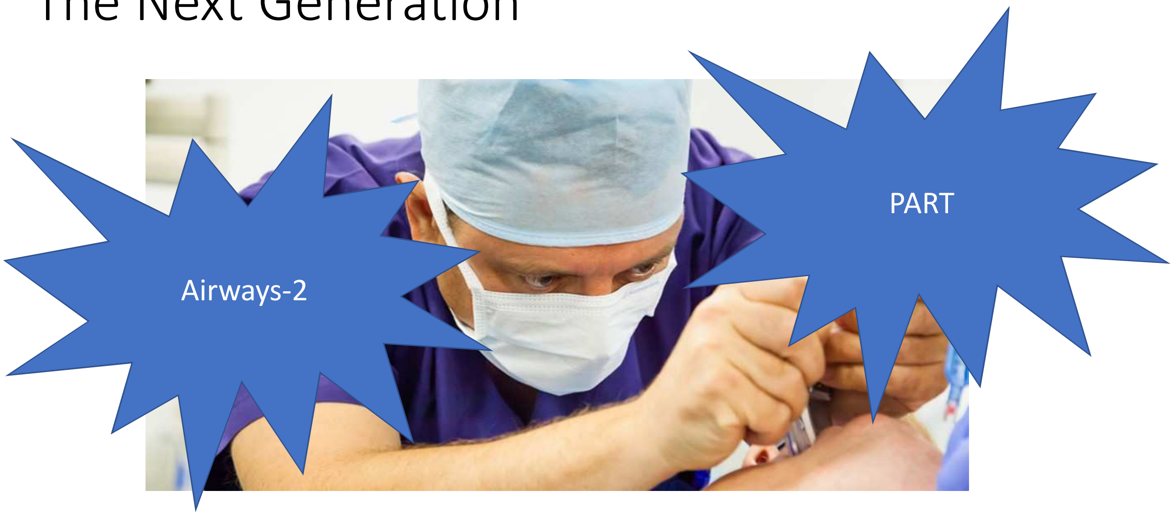
In the CARES network, survival was higher among OHCA receiving ETI than those receiving SGA. Survival was markedly higher among patients who received no advanced airway than those receiving endotracheal intubation or supraglottic airway placement.

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



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. Schmicker, MS; Mohamud R. Daya, MD, MS; Shannon W. Stephens, EMT-P; Ahamed H. Idris, MD; Jestin N. Carlson, MD, MS; M. Riccardo Colella, DO, MPH; Heather Herren, MPH, RN; Matthew Hansen, MD, MCR; Neal J. Richmond, MD; Juan Carlos J. Puyana, BA; Tom P. Aufderheide, MD, MS; Randal E. Gray, MEd, NREMT-P; Pamela C. Gray, NREMT-P; Mike Verkest, AAS, EMT-P; Pamela C. Owens; Ashley M. Brienza, BS; Kenneth J. Sternig, MS-EHS, BSN, NRP; Susanne J. May, PhD; George R. Sopko, MD, MPH; Myron L. Weisfeldt, MD; Graham Nichol, MD, MPH

PRAGMATIC AIRWAY RESUSCITATION TRIAL

ROC

Table 3. Out-of-Hospital and In-Hospital Adverse Events[a]

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

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

Characteristic	No. (%) Laryngeal Tube (n = 1505)	Endotracheal Intubation (n = 1499)	Difference, % (95% CI)[a]	P Value
Primary Outcome				
Survival to 72 h (intention-to-treat population)	275 (18.3)	230/1495 (15.4)	2.9 (0.2 to 5.6)	.04
Secondary Outcomes				
Return of spontaneous circulation on emergency department arrival	420 (27.9)	365 (24.3)	3.6 (0.3 to 6.8)	.03
Survival to hospital discharge	163/1504 (10.8)	121/1495 (8.1)	2.7 (0.6 to 4.8)	.01
Favorable neurologic status at discharge (Modified Rankin Scale score ≤3)	107/1500 (7.1)	75/1495 (5.0)	2.1 (0.3 to 3.8)	.02

PART Results Summary

- Increased survival with LT
- Increased neuro recovery with LT
- Decreased complication with LT
- ***Success rate of ETI→ 50%***

The Next Generation

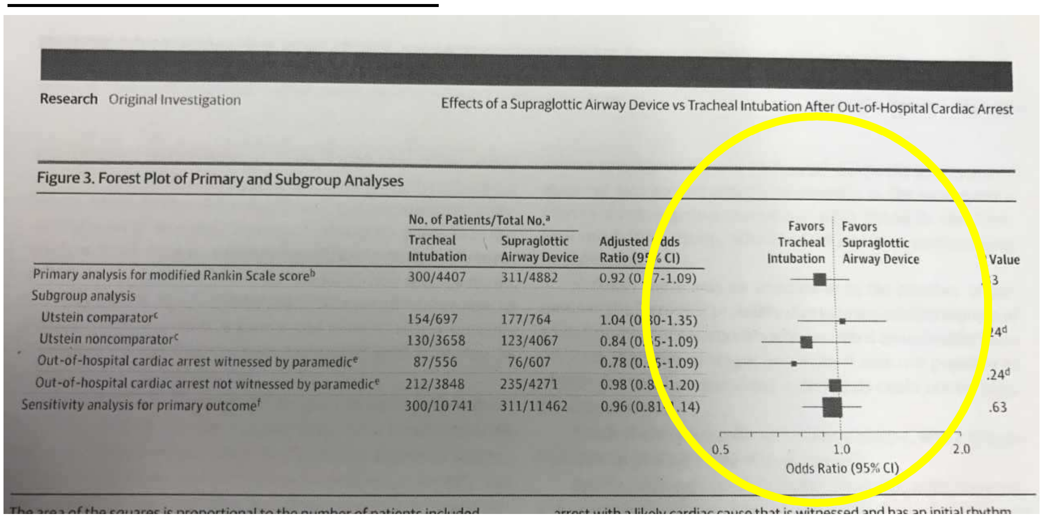
AIRWAYS-2

-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


Research Original Investigation

Effects of a Supraglottic Airway Device vs Tracheal Intubation After Out-of-Hospital Cardiac Arrest

Figure 3. Forest Plot of Primary and Subgroup Analyses

	No. of Patients/Total No.[a]				
	Tracheal Intubation	Supraglottic Airway Device	Adjusted [illegible]dds Ratio (9[illegible]% CI)	Favors Tracheal Intubation / Favors Supraglottic Airway Device	[illegible] Value
Primary analysis for modified Rankin Scale score[b]	300/4407	311/4882	0.92 (0.[illegible]7-1.09)		[illegible]3
Subgroup analysis					
Utstein comparator[c]	154/697	177/764	1.04 (0.[illegible]0-1.35)		[illegible]24[d]
Utstein noncomparator[c]	130/3658	123/4067	0.84 (0.[illegible]5-1.09)		
Out-of-hospital cardiac arrest witnessed by paramedic[e]	87/556	76/607	0.78 (0.[illegible]5-1.09)		.24[d]
Out-of-hospital cardiac arrest not witnessed by paramedic[e]	212/3848	235/4271	0.98 (0.8[illegible]-1.20)		
Sensitivity analysis for primary outcome[f]	300/10741	311/11462	0.96 (0.81-[illegible].14)		.63

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

	AAM	No AAM
Good Outcome	3.3% (251/7576)	21.1% (251/7576)

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
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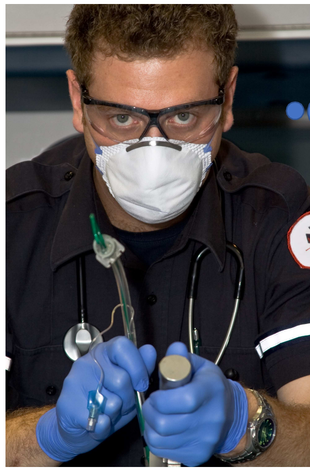
	AAM	No AAM
Good Outcome	3.3% (251/7576)	21.1% (251/7576)

Discussion



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

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