# WORKSHEET for Evidence-Based Review of Science for Emergency Cardiac Care

**Worksheet author(s):**
Michael Shuster

**Date Submitted for review:**
October 18, 2008, June 17, 2009, October 1, 2009, December 14, 2009

## Clinical question.

In adult cardiac arrest (prehospital [OHCA], in-hospital [IHCA]) (P), does use of a supraglottic airway device (I) vs an endotracheal tube (I), improve any outcomes (O).

Is this question addressing an intervention/therapy, prognosis or diagnosis? intervention

State if this is a proposed new topic or revision of existing worksheet: revision of existing worksheets

## Conflict of interest specific to this question

Do any of the authors listed above have conflict of interest disclosures relevant to this worksheet? NO

## Search strategy (including electronic databases searched).

**Medline:** (((LMA[All Fields] OR "laryngeal mask"[All Fields]) OR combitube[All Fields] OR "laryngeal tube"[All Fields] OR "supraglottic airway"[All Fields] OR i-gel[All Fields]) AND ("endotracheal tube"[All Fields] OR "endotracheal intubation"[All Fields] OR "tracheal tube"[All Fields] OR "tracheal intubation"[All Fields])) AND ((“resuscitation”[MeSH Terms] OR "resuscitation"[All Fields]) OR "heart arrest"[All Fields] OR "cardiac arrest"[All Fields]) 219

**Cochrane Database of Systematic Reviews:** “intubation” 53

**EMBASE:** (Combitube OR i-gel OR laryngeal tube OR exp laryngeal mask) AND (exp endotracheal tube) 816

**Hand search:** 4

### State inclusion and exclusion criteria

**Exclusion:**
- Duplicates = 64
- Letter OR case report OR review OR editorial OR practice guideline OR newborn OR animals = 551
- No comparison of endotracheal intubation with supraglottic airway

**Inclusion:**
- Any supraglottic airway compared to endotracheal intubation

### Number of articles/sources meeting criteria for further review:

- Medline/Embase/hand search: 36 articles were selected for complete review
- Cochrane: 0 were selected for complete review
Summary of evidence

Evidence Supporting Clinical Question

Underline = cardiac arrest or simulated cardiac arrest
Patients undergoing anaesthesia
Manikin study without cardiac arrest simulation

**BOLD=** rescue airway

**BOLD=** rescue airway not cardiac arrest

<table>
<thead>
<tr>
<th>Good</th>
<th>Staudinger 1993 p1573 ( ^c )</th>
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**Level of evidence**

A = Time to insertion  C = Survival to hospital discharge  E = Other endpoint
B = Success rate  D = Time to ventilation  Italics = Animal studies

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Evidence Neutral to Clinical Question

Underline = cardiac arrest or simulated cardiac arrest
Patients undergoing anaesthesia
Manikin study without cardiac arrest simulation

**BOLD=** rescue airway

**BOLD=** rescue airway not cardiac arrest

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**Level of evidence**

A = Time to insertion  C = Survival to hospital discharge  E = Other endpoint
B = Success rate  D = Time to ventilation  Italics = Animal studies
## Evidence Opposing Clinical Question

Underline = cardiac arrest or simulated cardiac arrest  
**BOLD**=rescue airway  
**BOLD**=rescue airway not cardiac arrest  

**Patients undergoing anaesthesia**  
**Manikin study without cardiac arrest simulation**

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A = Time to insertion  
B = Success rate  
C = Survival to hospital discharge  
D = Time to ventilation  
E = Other endpoint  

*Italics* = Animal studies
REVIEWER’S FINAL COMMENTS AND ASSESSMENT OF BENEFIT / RISK:

Studies of airway devices in cardiac arrest and during anaesthesia demonstrate that supraglottic airways can be used successfully both by experts and by non-experts who have received brief training: The SGA is invariably faster to insert than a tracheal tube, time to ventilation is faster, and the failure rate is lower. [see table below] Similarly in manikin studies, supraglottic airways outperform the tracheal tube in time to insertion, time to ventilation and successful insertion. However, each of the supraglottic airways has different characteristics and all cannot be expected to perform identically. 1 study [Calkins 2006 p97] found a high rate of complications with the Combitube, and other studies using this device have found insertion times longer than those of other SGAs. The newer supraglottic airways such as the Igel and the LT airway have performed well in anaesthetized patients and in simulations or with manikins but have not been assessed in cardiac arrest so potential problems with these devices or complications from their use may not yet be apparent. The esophageal obturator airway (EOA), which is no longer produced, is an example of a supraglottic airway in which complications didn’t become apparent until after it became widely used in resuscitation.

While this worksheet examines 36 studies comparing supraglottic airways to the tracheal tube, only eight of the studies were performed during cardiac arrest. Caution must be exercised in extrapolating manikin studies and anaesthesia studies to cardiac arrest. Manikin studies, whether simulating cardiac arrest or not, may not be a reliable test of the ease, speed, or success of insertion of either the supraglottic airway or a tracheal tube because of the different compliance, distensibility, lubrication and other factors of human tissue compared to the artificial material which comprises a manikin and also the different response providers may have to a real cardiac arrest compared to a simulation on a doll. Intubating a patient under anaesthesia overcomes some of the drawbacks of the manikin simulation but the anaesthesia situation has problems of its own. When intubating under anaesthesia, all of the equipment required is set up in an organized fashion at the proper height to intubate a patient who is on a table at the correct height to be intubated. There is nothing to impede access to the patient's head and the patient has been prepared in advance for intubation and the provider performing the intubation is fully prepared to do so before he or she walks into the operating room. So while the intubation appearance and feel is similar to that of a cardiac arrest, all of the other parameters are very different.

<table>
<thead>
<tr>
<th>Study</th>
<th>Method</th>
<th>Time to Insertion (seconds)</th>
<th>Time to Ventilation (seconds)</th>
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Complications:
- 9.5% SGA, 44% TT
- Positioned correctly on 1st attempt
- Positioned correctly on 1st attempt
- Without protective clothing
- With protective clothing
- 2nd attempt
- p<.01
- p=0.049
- p<.001
- p<.01
- p<.002
- Same 3 scenarios with ETC vs ET. ETC better in 2/3
- 5 groups, 6 devices -- different results by group
Acknowledgements:

Citation List

Supraglottic Airway vs Tracheal Tube in Cardiac Arrest

Supraglottic Airway as Rescue Airway in Cardiac Arrest

Supraglottic Airway vs Tracheal Tube in Cardiac Arrest Simulation

Supraglottic Airway vs Tracheal Tube in Anaesthetized patients

Supraglottic Airway vs Tracheal Tube in Manikin without Cardiac Arrest Simulation

Supraglottic Airway as Rescue Airway in patients not in Cardiac Arrest
[Martin SE, 1999, 352-7]


LOE 5
Good
Positive

Twenty-one, two member paramedic teams used combitube or TI, in a prospective randomized manner, during cardiac arrest simulation. The study evaluated time to complete 4 tasks and time without compressions. Statistically significant reduced time to airway placement (median difference 26.5 seconds) and time without compressions (median difference 8.5 seconds) with ETC. Other times were not different.


LOE 2
Fair
neutral
Prospective controlled study by alternate day allocation of paramedic use of Combitube vs ETT. Successful Combi insertion in 71% 27/38 and ETT in 84% 6/81. No statistical tests are performed by the authors but with the data provided, z value is 1.648 (NS). Skill retention after 15 months was inadequate.


LOE 3
good
neutral

Retrospective comparison of 5,822 cardiac arrest patients treated with Combitube (1437 - EMT care) or tracheal tube (4335 - Paramedic care). There was no difference in ROSC, survival to admission, or survival to discharge.


LOE 3
fair
opposing

Retrospective review of ETC placed as a rescue airway by paramedics primarily as a rescue airway when tracheal intubation failed. 128/162 patients were in cardiac arrest. 145/162 patients failed tracheal intubation prior to attempting ETC. 113/162 ETC placements were successful. Complications defined as broken teeth, subcutaneous emphysema, difficult to pass ETC, oral bleeding, emesis from both ports occurred in 27% (complications defined a priori) or 40% if emesis from both ports is included as a complication.


LOE 5
good
positive

Pediatric manikin study in which 52 EMTs randomly intubated with an LMA or ETT during simulated cardiac arrest. Time to successful ventilation was a mean of 23 seconds longer for TI. Malposition and complications were more common with TI than LMA (however the feel, resistance of tissues, etc will be different in a human and the study may not accurately reflect either the time to intubate or the malposition/complication rate.


LOE 1
fair
supportive

Randomized crossover trial of ETC or ETT in 43 patients in cardiac arrest. Time to insertion was approximately 11 seconds less for ETC (p<0.001). Blood gas data was similar for both devices.


LOE 5
good
supportive

40 physicians inserted LMA, PLMA, TT, and Igel into a manikin during CPR. Insertion time was 3 seconds longer for the TT with compressions ongoing than without but was not different for any of the other devices. Insertion times were comparable (not clinically significant) between SADs and TT though the Igel was significantly quicker to insert than all other devices regardless of whether compressions were ongoing.


LOE 5
fair
neutral

Manikins were sequentially intubated with laryngeal tube, bag-mask and tracheal tube. Ventilation volumes and gastric inflation was measured using a bag-valve device and using a transport ventilator during CPR. The laryngeal tube performed similarly to the tracheal tube.


LOE 3
fair
supportive

Retrospective analysis of LT airway use as rescue airway after unsuccessful TI or "anticipated difficult airway" by paramedics. LT was used in 26 patients of 575 patients requiring airway management and 24 of the 26 had failed TI. 5/26 patients were in cardiac arrest. LT was successfully placed in 24 pateints and failed in 2.


LOE 5
fair
Supportive
60 Firefighters were pseudo-randomized use of TI, LT, or BVM in cardiac arrest scenario on manikin. Mean time to delivery of first shock was similar for the 3 groups. Mean time to first ventilation was 64.0 seconds in the LT group, 81.0 seconds in the BVM group, and 95.0 seconds in the TI group. The difference between the LT and the ETI group was significant. (P < 0.0001)

Expired minute ventilation was not significantly different between LT and TI.


LOE 2
good
neutral

Pre-hospital study in patients undergoing resuscitation by physicians experienced in the use of ETA. Alternate day allocation. Time of insertion reported as statistically less with ETC but not clinically significant (12±5 vs 18±6 seconds). Survival not significantly different.


LOE 2
fair
supportive

Prospective pseudorandomized comparison of Combitube and ETT (2 weeks ETT, 1 week Combitube) by basic EMTs. Successful insertion/ventilation rates similar (ETI NMP - 63%, ETI MP - 76%, ETC NMP 62%, ETC MP 75%). Success rates higher when manikin practice employed.


LOE 2
poor
neutral

Prospective study of LMA (15 patients) vs ETT (5 patients) during resuscitation. LMA successful in 100%. No significant differences in pO2 or ETCO2. Not stated how different groups were compiled therefore assumed non-random. Could have been randomized but unclear from article. Some Data not reported or not reported clearly. ?groups comparable - complete demographics not provided. very small groups (7, 8, & 5)

LOE 2
good
supportive

Prospective non-random cohort study comparing RN intubation with Combitube to MD intubation with ETT. Time of insertion reported as statistically less with ETC (though not likely clinically significant (18.5±6.2 vs 27.2±7.3 seconds)). Survival not significantly different.


LOE 2
fair
supportive

Prospective controlled study allocated to ETT or Combitube by alternate day assignment. 35/38 combitube successful, 28/42 ETT successful. 14 of 42 patients allocated to ETT could not be intubated and 11 of these were successfully ventilated with Combitube. Survival, regardless of airway device employed, was similar.


LOE 4
Quality fair
Supportive

Prospective study of out of hospital use of the Intubating laryngeal mask airway after failed tracheal intubation by emergency physicians. 2082 patients were intubated: 45 patients failed endotracheal intubation and 43 were successfully intubated with the intubating laryngeal mask airway (ILMA). 24 of the 45 patients with attempted ILMA insertion were in cardiac arrest.


LOE 4
Fair
Supportive

Prospective study of out of hospital difficult airway management using the intubating laryngeal mask airway (ILMA). 146 patients required airway management. 11 patients failed endotracheal intubation and were successfully intubated with an ILMA. 55 of the 146 patients were undergoing CPR. 4 of the 11 cases receiving ILMA were undergoing CPR.

LOE 3
fair
supportive

Prospective observational study with historical control trained nurses to use LMA as first response airway in cardiac arrest. LMA was used to secure the airway in 64/115 patients in cardiac arrest while TT was used in 20/115 while in the control period, LMA was used in 2/79 vs TT 57/79. ROSC was 61% in the study period vs 36% in the control period.


LOE 5
good
supportive

50 emergency physicians were randomized to perform LT intubation or TI on a manikin in a cardiac arrest scenario. Speed of insertion averaged 13 seconds with LT vs 52 seconds with TI. No flow time averaged 109 seconds with LT vs 190 seconds with TI. Positioning success was 98% with LT vs 72% TI.


LOE 5
good
supportive

150 paramedics were prospectively randomized to use LT-S, ETT or BVM in simulated cardiac arrest on manikin. The LT-S was inserted faster, respirations were established sooner and no flow time was reduced compared to both the ETT and the BVM (all statistically significant).

Not Cardiac Arrest or Simulated Cardiac Arrest


LOE 5
good
supportive

prospective randomized crossover manikin study comparing ET vs LMA by 10 anaesthetists and 10 non-anaesthetists wearing antichemical protective gear. Mean time to LMA insertion was significantly less for LMA (less than 6 seconds) compared to ETT (more than 26 seconds). Failure rates were similar.

LOE 5 - good supportive

Paramedics prospectively randomized Easytube, combitube or tracheal tube for airway management on a manikin. Time to successful ventilation was statistically faster for the Combitube compared to the tracheal tube but the difference (9 seconds) is unlikely to be clinically significant. Success rate with Easytube and with Combitube (103/104) was significantly higher than for tracheal intubation 45/52.


LOE 5 good neutral

RCT of airway management by 12 Navy SEALs or RCCs using ETT, ETC, and LMA on a manikin in a casualty scenario. There were no significant differences between the devices in insertion success rates or mean number of insertion attempts. Time to insertion was not significantly different for ETC vs ETT but was shorter for LMA insertion 36.5 vs 40.0 vs 22.3 seconds.

LOE 5 good supportive

RCT comparing successful insertion of LMA vs ETT in anaesthetized ASA I patients by 11 inexperienced personnel following video and manikin training. Ventilation was successful in 104 patients with LMA vs 56 patients with ETT. All LMA 1st attempts successful whereas ETT success was progressive. LMA insertion 15 seconds faster than ETT.


LOE 5 good positive

Paramedics sequentially intubated 52 patients undergoing anaesthesia first with an LMA and then with an ETT. Success was 88.5% LMA vs 71.2% ETT. Time to secure the airway was not different between the 2 devices. LMA insertion was successful in 12 of 15 patients in whom ETI was unsuccessful.


LOE 5 good supportive
Prospective randomized crossover trial of LMA vs ET intubation by 15 anaesthesists wearing normal surgical attire vs full chemical protective gear in 60 ASA I-III patients. Chemical protective gear slows ETT insertion (31 vs 54 sec) but not LMA insertion (44 vs 39 sec). Time differences between LMA and ETT insertion in resuscitation may not be clinically significant.


LOE 5
good supportive

Prospective randomized cohort study assessing the speed of placement, number of attempts, and time to ventilation with the ETC, Laryngeal Mask Airway (LMA), or endotracheal tube in a mannequin with restricted airway access. Number of attempts were similar among all three devices. Time to insertion - Scenario 1: 35s ET vs 24s LMA vs 34s ETC Scenario 2: 83.5s ET vs 30.5s LMA vs 36.5s ETC, Scenario 3: 42.5s ET vs 21.5s LMA vs 32.5s ETC


LOE 5
poor
Supportive

Prospective non-randomized study assessing LMA after failed endotracheal intubation by skilled paramedics in patients requiring air transport. 25 patients received LMA following failed TI but 8 were excluded: 5 because of incomplete data, 2 because they were transported elsewhere, and 1 who died prior to transport. 16/17 (94%) were successfully intubated with the laryngeal mask airway and 15/16 demonstrated adequate ventilation.


LOE 5
good supportive

RCT in anesthetized adults comparing intubation by medical and paramedical students with LMA or ETT. Intubation with LMA was successful in 94% on 1st attempt vs 69% with ETI. There were 5 ETI failures and no LMA failures.


LOE 5
fair
supportive
Randomized placement of LMA and ETT by paramedics and RTs in anaesthetized patients. LMA success was 100% vs 52% for ETT. Time to successful ventilation was significantly less with LMA and number of attempts were significantly fewer.


LOE 5  
fair  
supportive

Nonrandomized trial of intubation with LT vs ETT vs ETC by paramedics on a difficult intubation simulator. ETT was successfully placed in 31/45, ETC in 37/45 and LT in 45/45. Mean time to ETT placement (91.3 seconds) was significantly longer than to ETC (53.7 seconds) or LT (27 seconds) placement.


LOE 5  
good  
supportive

Prospective randomized crossover study in anesthetized patients comparing the time to intubation and success rate of the ILMA compared to TI by airway management novices. Ventilation was successful in 88/90 by ILMA patients and in 54/90 by TI. Mean time to successful ventilation was 33.6 seconds for ILMA vs 89.1 seconds for TI.


LOE 5  
fair  
supportive

Non-randomized comparison of intubation by 119 medical students using ILMA and ETT on a manikin. All students were successful in ventilation with the ILMA on the first attempt. Intubation with the ETT was successfully accomplished in 60 (50.4%), 31 (26.1%) and 12 (10.1%) cases on the first, second and third attempt, respectively, while 16 (13.4%) failed in all three attempts.


LOE 5
Nonrandomized study of intubation by medical students on manikins using LMA and ETC and ET. Success was significantly higher for LMA and ETC than the ETT both immediately (100%, 100%, 57.4%) and at 6 months (92.6%, 96.2%, 62.9%).


Randomized trial of intubation with TT and 5 supraglottic devices by medical personnel with different backgrounds, training and experience in a manikin. Success rates were higher and time to insertion was faster for the supraglottic devices in all groups.


Non-randomized controlled trial comparing placement of LMA, ETC, and ETT by unskilled emergency physicians in a manikin. Mean time to insertion was statistically faster with LMA (21.4 sec) than ETT (30.3 sec) or ETC (34.1 sec) though clinical significance is questionable.