Advanced Airway Management in Out of Hospital Cardiac Arrest: A Systematic Review and Meta-Analysis

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Objectives:
To assess the difference in survival and neurological outcomes between endotracheal tube (ETT) intubation and supraglottic airway(SGA) devices used during OHCA.

Methods:

Search Strategy:
- Five databases were searched from the inception of the databases until July, 2018.
- Medical Subject Headings (MeSH) terms: "Airway management" plus "cardiac arrest"; "Emergency Medical Service" plus "out-of-hospital cardiac arrest" plus "airway management".
- The term "Airway Management" consists of MeSH terms "intubation", "laryngeal mask" and "positive pressure respiration".
- "Emergency Medical Service" consists of MeSH terms "ambulance" and "prehospital emergency care".

Eligibility Criteria:
1. Out of hospital cardiac arrest or cardiopulmonary resuscitation
2. Endotracheal intubation versus supraglottic airway device intubation. Supraglottic airway devices included laryngeal masks and laryngeal tubes.

Primary Outcomes:
1. Return of spontaneous circulation (ROSC)
2. Survival to hospital admission
3. Survival to hospital discharge
4. Survival to discharge with a cognitively intact state.

Data collection and extraction:
The data extracted included study design, sample size, airway device, cause of cardiac arrest, registry utilized and outcome measures.

Risk of Bias:
RCTs were assessed for risk of bias using the Cochrane Collaboration's tool for assessing the risk of bias [2]. Non-randomised were assessed using the ROBINS-I tool [3].

Statistical Analyses:
The combined data was analysed using RevMan 5.3 software. Dichotomous outcomes were analysed using an Odds Ratio (OR) with 95% confidence interval (CI). The Mantel-Haenszel (M-H) random effects model was used. The absolute difference between the two groups was measured utilizing the risk difference with 95%CIs. An I^2>50% indicated significant heterogeneity. A p value of <0.0125 provided evidence of significant OR.

Subgroup and Sensitivity Analyses:
Sensitivity analyses were performed based on automatic chest compressions and study quality.

Assessment of Quality of Evidence:
The quality of evidence and confidence in estimates of effect were assessed using the GRADE approach [4].

Results

- The systematic literature search yielded 26 studies with 526,642 patients for inclusion
- Overall, ETT use resulted in a heterogenous, but significant increase in ROSC (OR=1.52; 95% CI=1.35 to 1.71; I2=88%; p<0.00001; Figure 1) and survival to admission (OR=1.45; 95%CI=1.17 to 1.78; I2=90%; p=0.0006).
- There was no significant difference in survival to discharge or neurological outcome(p=0.10).
- On sensitivity analysis of RCTs, without heterogeneity, there was no significant difference in ROSC (I2=0%; p=0.59) or survival to admission (I2=0%; p=0.99) between ETT and SGA
- On analysis of automated chest compression, without heterogeneity, ETT provided a significant increase in ROSC (OR=1.55; 95%CI=1.20 to 2.00; I2=0%; p=0.0009) and survival to admission (OR=2.16; 95%CI=1.54 to 3.02; I2=0%; p<0.00001).

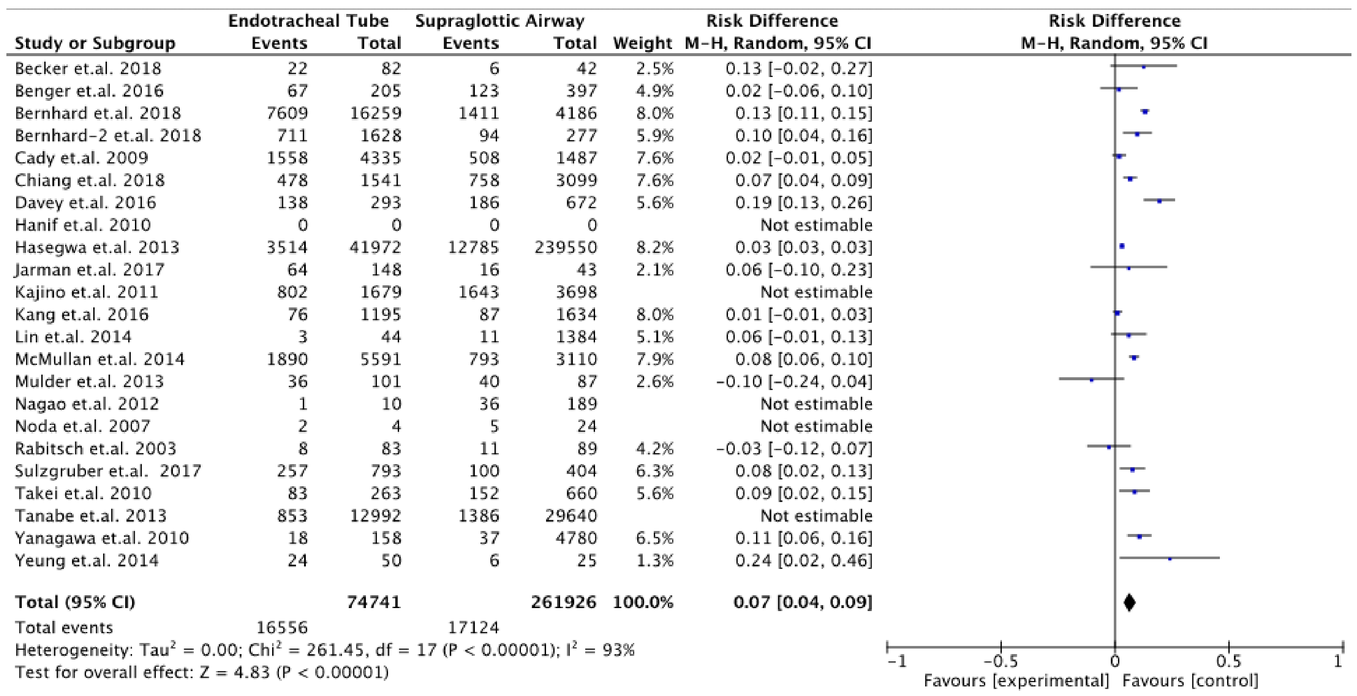

Figure 1: Forest Plot for ROSC in OHCA using ETT vs SGA

Discussion:

- The clinical application of the overall improvements in early survival with the use of ETT is limited due to the significant heterogeneity (I^2=88-90%). This reflects the multifactorial nature of both cardiac arrest aetiology and management.
- Sensitivity analyses of low risk RCTs showed no difference between ETT in regard to ROSC (OR=0.90; 95%CI= 0.65 to 1.25; I2= 12%; p=0.59) or survival to admission (OR= 1.00; 95%CI= 0.68 to 1.47; I2=0%; p=0.99). Between the studies, the first attempt success rate for LMA (Supreme and I-gel) insertion was reasonably consistent (75-79%). There was a higher than expected first attempt success rate for ETC 98% and wide variation in ETT first attempt success rate (56-94%).
- Therefore, these three RCTs serve as the first level 1 recommendation to show no difference in early survival between ETT and SGA in advanced airway management for OHCA.
- Interestingly, the only management related sensitivity analysis to show a significant benefit without heterogeneity was use of ETT in the presence of concurrent automated chest compressions. The benefit of ETT over SGA in this setting is likely related to elevated intrathoracic pressure and thus reduced efficacy of SGAs. These findings suggest that if an emergency response service utilises automated compression devices, endotracheal tubes are likely to result in increased survival.

Limitations:

- The predominant limitation is the lack of RCTs and a significant number of retrospective studies from overlapping databases. On the subgroup analysis removing the overlapping studies, this did not affect any of the results.
- The three RCTs ultilised different supraglottic airways, which may impact the overall outcome.
- The diminishing effect of the overall result on longer term outcomes such as neurological status on discharge likely reflects the multifactorial nature of arrest cause, provider type and management strategy.

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