A meta-analysis of prehospital airway control techniques. Part II: Alternative airway devices and cricothyrotomy success rates

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CRD summary
This review concluded that the King laryngeal tube airway device had the highest placement success rate in prehospital settings based on limited data. The authors recommended that surgical cricothyrotomy should be the preferred percutaneous rescue airway. This review had some methodological problems which together with the poor quality of the included studies suggest a cautious interpretation of the authors' conclusions.

Authors' objectives
To determine placement success rates of alternative airway devices, needle cricothyrotomy and surgical cricothyrotomy. Part 1 of this research analysed orotracheal and nasotracheal intubation (see Other Publications of Related Interest).

Searching
The authors searched PubMed for English articles up to July 2009. Search terms were reported. Bibliographies of selected studies were searched for additional studies.

Study selection
All published reports of airway procedures performed by emergency medical technicians, paramedics, nurses or physicians in the prehospital environment were eligible for inclusion in the review. Eligible studies were randomised controlled trials (RCTs), cohort studies and retrospective chart reviews. Studies needed to include sufficient data to calculate a procedural success rate. Studies conducted on cadavers or manikins and studies not conducted in a field setting were excluded.

The included studies examined the following: oesophageal obturator airway-oesophageal gastric tube airway; pharyngotracehal lumen airway; oesophageal-tracheal combitube; laryngeal mask airway; King laryngeal tube airway; needle cricothyrotomy; and surgical cricothyrotomy. Most studies were prospective in design, involved a ground emergency medical setting and assessed interventions performed by non-physician clinicians using intubator self-verification of successful placement. Trauma and non-trauma patients were included. Patients who had experienced cardiac arrest and those who had not were included. Patient age varied across the studies: some studies focused on adults, others on children and some were either mixed or unspecified.

Two reviewers independently performed study selection. Disagreements were resolved by consensus.

Assessment of study quality
Two reviewers independently assessed study quality using a 10-point scale devised by the study authors. The scale scored studies according to study design, personnel, patient mix, setting, verification of successful placement of airway device and patient population. Disagreements between reviewers were resolved by consensus.

Data extraction
Two reviewers independently extracted data on numbers of patients where airway placement was attempted and numbers placed successfully. Success rates and 95% confidence intervals (CI) were calculated. Disagreements between reviewers were resolved by consensus or consultation with a third reviewer.

Methods of synthesis
Random-effects meta-analysis was undertaken to calculate the pooled success rate and 95% CIs. Oesophageal obturator airway and oesophageal gastric tube airway were assessed together as they were considered sufficiently similar. Statistical heterogeneity was assessed through the Cochrane Q test and the I² statistic. Subgroup analysis was undertaken for patient groups (such as trauma versus non-trauma patients), clinician credentials and airway function (primary versus rescue airway). Publication bias was assessed using funnel plots and Egger's regression test.
Results of the review
Fifty-six studies were included in the review: 35 of alternative airway devices (n=10,172 patients) and 21 of needle cricothyrotomy/surgical cricothyrotomy (n=512).

Pooled success rates were:

Oesophageal obturator airway-oesophageal gastric tube airway 92.6% (95% CI 90.1% to 94.5%, $I^2=62.5%$; eight studies comprised nine data sets, n=1,833, quality score 2 to 8).

Pharyngeotracheal lumen airway 82.1% (95% CI 74% to 88%; one study, n=117, quality score 6).

Oesophageal-tracheal combitube 85.4% (95% CI 77.3% to 91%, $I^2=95%$; 16 studies comprised 19 data sets, n=4,243, quality score 3 to 10).

Laryngeal mask airway 87.4% (95% CI 79% to 92.8%, $I^2=93.6%$; 12 studies, n=3,829 patients, quality score 2 to 8).

King laryngeal tube airway 96.5% (95% CI 71.2% to 99.7%, $I^2=73.4%$; three studies, n=150, quality score 3 to 7).

Needle cricothyrotomy 65.8% (95% CI 42.3% to 83.5%, $I^2=14.1%$; four studies, n=27 patients, quality score 2 to 5).

Surgical cricothyrotomy 90.5% (95% CI 84.8% to 94.2%, $I^2=94.2%$; 18 studies, n=485 patients, quality score 1 to 7).

Further subgroup analyses were detailed in the report.

Authors' conclusions
The King laryngeal tube airway device had the highest placement success rate compared to other devices, but this was based on limited data. Needle cricothyrotomy had a low rate of success and surgical cricothyrotomy should be considered the preferred percutaneous rescue airway.

CRD commentary
This review was based on defined inclusion criteria. The search was limited to one database and reference searching, which may have resulted in studies being missed. Searching was only for studies in English, which raised the possibility of language bias. Unpublished material was ineligible, which opened up the possibility of publication bias. Publication bias was found to be present in at least some analyses. Quality assessment was based on reviewer-defined criteria and indicated the overall poor quality of the included studies. The authors acknowledged problems of self-reported outcomes, comparative lack of recent reports and lack of control of potentially confounding variables (such as experience in airway management). Attempts were made to reduce reviewer error and bias throughout the review process.

Pooling was undertaken in the face of study design, patient and intervention diversity and as such estimates may not be wholly reliable. Differences in success rates between devices were not directly assessed and may have reflected factors other than the intervention.

Caution is warranted when interpreting the authors' conclusions in view of the issues highlighted. It should be noted that this review investigated placement only and not patient outcomes or complications.

Implications of the review for practice and research
Practice: The authors stated that when oesophageal-tracheal combitube or laryngeal mask airway were used as the primary airway management devices, practitioners should anticipate up to a 17% failure rate necessitating additional contingency airway measures. Where these devices are used as backup for unsuccessful oral endotracheal intubation, it should be recognised that they do not have 100% success rates. The authors further recommended that surgical cricothyrotomy should be considered the preferred technique for establishing a prehospital percutaneous rescue airway.

Research: The authors stated that additional studies of the King laryngeal tube device would help to improve on the
uncertainty of existing estimates and assess its utility among certain patient populations (such as those suffering from traumatic injuries or failed attempts at oral endotracheal intubation).

**Funding**
No external funding.

**Bibliographic details**

**PubMedID**
20809690

**DOI**
10.3109/10903127.2010.497903

**Original Paper URL**

**Other publications of related interest**

**Indexing Status**
Subject indexing assigned by NLM

**MeSH**
Adolescent; Airway Management /methods; Child; Cricoid Cartilage /surgery; Emergency Medical Services; Humans; Outcome Assessment (Health Care); Thyroid Cartilage /surgery; Tracheotomy /methods

**AccessionNumber**
12010008133

**Date bibliographic record published**
04/05/2011

**Date abstract record published**
02/11/2011

**Record Status**
This is a critical abstract of a systematic review that meets the criteria for inclusion on DARE. Each critical abstract contains a brief summary of the review methods, results and conclusions followed by a detailed critical assessment on the reliability of the review and the conclusions drawn.