

APPARATUS

Use of the Airtraq laryngoscope in a model of difficult intubation by prehospital providers not previously trained in laryngoscopy

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Summary

This study evaluated the ability of prehospital providers who had no previous training in intubation, to use an Airtraq laryngoscope to intubate a manikin model of a Cormack and Lehane grade III/IV view. Volunteers attending the Australian College of Ambulance Professionals conference, Adelaide, in November 2006 received approximately 5 min of Airtraq training. First-time intubation success rate was 26/33 (79%) (95% CI 61–91%); oesophageal intubation rate was 0/33 (0%) (95% CI 0–11%); median time to intubation was 17 s (IQR 10–25 s (range 5–30 s)); and median subject-rated difficulty of use score was 21 out of a maximum of 100 (IQR 7.5–35.5 (range 1–65)). Pre-hospital providers without previous laryngoscopy training achieved high first-time intubation success rates when managing a model of a grade III/IV difficult intubation with an Airtraq laryngoscope. Users evaluated it as easy to use and achieved intubation within an acceptable breath-to-breath interval.

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A recent literature review discussing prehospital intubation expressed concerns about 'adverse events and errors, interaction with other important resuscitation interventions, and challenges in providing and maintaining procedural skill' and suggested that new strategies to improve airway management in this setting were required [1].

The Airtraq laryngoscope (UK Distributors, B M Browne, Reading, Berks, UK) was designed specifically to improve glottic views in the context of difficult intubation in the emergency setting. It is a disposable device that uses simple plastic prisms and lenses to allow indirect visualisation of the laryngeal structures without requiring alignment of oral, pharyngeal and laryngeal

axes. The distal lens is heated to minimise misting and is adjacent to a light source. The user looks through a proximal lens (Fig. 1) which provides a view from the perspective of the tracheal tube that is clipped to a slot in the side of the Airtraq (which acts as an insertion guide) before intubation (Fig. 2).

Although a limited amount of research has been published concerning the Airtraq laryngoscope, it does suggest that it may aid intubation in the hands of inexperienced providers. Forty novice medical students with no prior airway management experience achieved greater success rates and shorter duration of intubation attempts when using an Airtraq compared to a Macintosh laryngoscope, and it was noted that there was also reduced



Figure 1 The Airtraq device (proximal lens).



Figure 2 The Airtraq device (lateral view).

potential for dental trauma [2]. Skill acquisition with the Airtraq vs a standard Macintosh laryngoscope has also been compared in 25 anaesthetists, who achieved a shorter time to intubation with the former device (9.5 vs 14.2 s) [3].

This study aimed to test the ability of the Airtraq to facilitate intubation in the prehospital setting in challenging circumstances. Consequently, we invited prehospital providers without previous training and experience in laryngoscopy to attempt to manage a difficult intubation, as represented by a manikin model of a grade III/IV Cormack and Lehane view [4].

Methods

Ethics approval and consent

Ethics approval to conduct this trial was obtained from the Ethics in Human Research Committee, Charles Sturt University. Potential volunteers were provided with an

information sheet and a briefing by a researcher, with an opportunity to ask questions. Written informed consent was obtained prospectively from all subjects agreeing to participate in the study. Data were anonymised and information on the performance of individuals was not made available to anyone outside of the study team.

Study design

This prospective study sought volunteers from prehospital providers without previous training in laryngoscopy who were attending the Australian College of Ambulance Professionals conference in Adelaide, Australia, in November 2006.

During breaks in the conference presentations, researchers manned a clearly marked stand in the trade hall. Potential subjects were provided with a handout to read that included a written and diagrammatic description of the technique for using the Airtraq and a study participant information sheet. A researcher subsequently demonstrated and explained use of the Airtraq on a one-to-one basis, and each volunteer was permitted a single practice attempt with the Airtraq.

For the purpose of data collection, subjects were asked to intubate a Laerdal Advanced Life Support Manikin (MegaCode Kelly, Laerdal Pty. Ltd, Oakleigh, Victoria, Australia). A Cormack and Lehane grade III or IV laryngoscopy view (epiglottis visible but no other glottic structures seen or no structures seen, depending on individual practitioners' skill, as assessed with a Macintosh laryngoscope) was produced by applying a cervical collar, strapping the manikin to a long spine board with the head immobilised, and inflating its tongue (Fig. 3).

Participants were limited to a single 30-s intubation attempt using the Airtraq device and an 8.0-mm cuffed tube. Success was defined as placement of a tracheal tube in the trachea within 30 s or less following the last



Figure 3 Manikin model of difficult intubation.

ventilation using a bag-valve-mask to the start of the first ventilation via the tracheal tube. Correct positioning of the tracheal tube was confirmed by the researchers.

Immediately following the use of the Airtraq device, subjects were asked to rate its difficulty of use by marking a 10-cm line, with 0 cm representing 'very easy' and 10 cm representing 'very hard'.

Outcome measures

Primary outcome measure

- Proportion of subjects successfully intubating the trachea in one attempt within a breath to breath interval of < 30 s.

Secondary outcome measures

- Proportion of oesophageal intubations;
- Proportion of failed intubations;
- Median time to intubation (breath-to-breath interval);
- Subject-rated difficulty of use score, using a visual analogue scale.

We also collected data on subjects' age and gender.

Outcome variables were recorded by a researcher and documented immediately the intubation attempt was completed.

Statistical analysis

95% confidence intervals for proportions were calculated using STATS DIRECT software (version 2.4.4, StatsDirect Ltd, Altrincham, UK). Data were entered into the statistical software package SPSS (version 10.5, SPSS Inc., Chicago, IL) to calculate medians, ranges, and interquartile ranges.

Sample size

Based on previous research (Woollard et al., unpublished data) we calculated that a minimum of 23 subjects would be required to detect a 44% first-time intubation success rate with the Airtraq with a 95% confidence interval (CI) of 23–66%. However, this calculation was based on data obtained in a trial involving student paramedics with 8 h of intubation training, and we felt that prehospital providers without any previous education in laryngoscopy might have substantially lower success rates. Consequently, we aimed to recruit all subjects volunteering to participate in the current study and meeting the inclusion criteria.

Results

Thirty-three subjects volunteered to take part in the study, of whom 18 (55%) were female. The median age of study participants was 35 years (range 18–65, interquartile range 28–43 years). Three of the participants were nurses,

Table 1 Main findings (proportions and 95% confidence intervals).

Tracheal tube correctly sited within 30 s	26/33 (79%, 95% CI 61–91%)
Oesophageal intubation rate	0/33 (0%, 95% CI 0–11%)
Failure rate	7/33 (21%, 95% CI 9–39%)

29 were ambulance personnel, and one had no clinical training whatsoever.

Exact time to intubation was not documented for 3/26 of the successful attempts, although it was confirmed that for these cases the tube was correctly sited in 30 s or less.

Table 1 reports the main findings.

The median time to intubation was 17 s (IQR 10–25 s (range 5–30 s)), and the median difficulty of use visual analogue score for the Airtraq was 21 out of a maximum of 100 (IQR 7.5–35.5 (range 1–65)) (higher values = more difficult).

Discussion

This study indicates that, even when used by prehospital providers with no previous training in laryngoscopy, the Airtraq laryngoscope can facilitate high first-time tracheal intubation success rates in a manikin model of a difficult airway.

Some studies of paramedics' tracheal intubation (ETI) skills have presented success rates as high as 98–99% [5, 6]. The ability of Emergency Medical Technicians without other advanced life support skills to learn to intubate has also been investigated, reporting a success rate of 30/32 in patients in the prehospital setting (94%, 95% CI 80–98%) with no oesophageal intubations occurring [7]. Other research has been less positive, however, reporting an incidence of misplaced tracheal tubes of between 6 and 25% [8, 9], with between 67 and 75% of these being in the oesophagus [9, 10]. A prospective case series of 1272 cardiac arrests from 42 different ambulance services over an 18-month period reported a first-time ETI success rate of 70% [11]. Research comparing paramedics' tracheal intubation (ETI) success rates in 52 patients in a UK anaesthetic department reported a cumulative success rate of only 71% after two ETI attempts: however, this fell to zero in the presence of a Cormack and Lehane grade III or IV view [12]. The intubation success rate of 79% in our study of prehospital providers with no training in traditional laryngoscopy and only 5 min with the Airtraq compares very favourably with these findings, as does the absence of tracheal tubes incorrectly placed in the oesophagus. Most importantly, it should be remembered that all of the 'cases' in our investigation presented with

a grade III/IV view – in the patient studies described above, however, it seems reasonable to suggest that the relevant populations probably had a more typical distribution of Cormack and Lehane scores, with most being grade II or better.

Concerns about the limited abilities of paramedics and others to intubate patients successfully and safely have led to suggestions that this skill should be at best reviewed and at worst withdrawn altogether [1, 12]. Despite this, intubation remains the gold standard of airway care and has been shown to improve the probability of survival from out-of-hospital cardiac arrest when used sufficiently early [13].

Limitations of this study

Recruiting volunteers from attendees of a clinically focused conference risks a sampling bias as this population is arguably more likely to consist of practitioners with a greater commitment to their on-going education. They may therefore be more knowledgeable about airway anatomy and management than members of the prehospital profession who did not attend and who may have achieved greater or lesser success with the Airtraq. The ability of manikin models to predict the performance of devices in patients is uncertain, and studies using this method do not obviate the requirement for clinical trials.

Conclusions

Further research is required to determine whether the findings of this trial are representative of a similar benefit in patients with a range of different grades of view of the glottic structures. The authors are not suggesting that basic-life support-level prehospital providers may now be safely given 5 min of instruction before being permitted to intubate patients with the Airtraq in the prehospital setting. However, our study results suggest that this new laryngoscope can facilitate high rates of successful intubation in particularly challenging circumstances represented by a combination of practitioners with only 5 min laryngoscopy training presented with a model of a Cormack and Lehane grade III/IV view. The Airtraq may therefore offer an effective tool to improve first-time intubation success rates and reduce the incidence of misplaced tracheal tubes when used by trained advanced life support providers working in the testing environment of the prehospital setting. Clinical trials are required to confirm this hypothesis.

Potential conflict of interest

Malcolm Woollard undertook this research whilst on a scholarship funded by Charles Sturt University and

Australian College of Ambulance Professionals. The Airtraq laryngoscopes used during the study were provided without charge by Prodol, the manufacturers of the device.

None of the study sponsors had any role in the study design, collection, analysis or interpretation of data; or in the writing of the manuscript and in the decision to submit it for publication.

The authors are unaware of any other potential conflict of interest.

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References

- 1 Wang HE, Yealy DM. Out-of-hospital endotracheal intubation: where are we? *Annals of Emergency Medicine* 2006; **47** (6): 532–41.
- 2 Maharaj CH, Costello JF, Higgins BD, Harte BH, Laffey JG. Learning and performance of tracheal intubation by novice personnel. a comparison of the Airtraq and Macintosh laryngoscopes. *Anaesthesia* 2006; **61**: 671.
- 3 Maharaj CH, Higgins BD, Harte BH, Laffey JG. Evaluation of intubation using the Airtraq or standard Macintosh laryngoscope by anaesthetists in easy and simulated difficult laryngoscopy – a manikin study. *Anaesthesia* 2006; **61**: 469.
- 4 Cormack RS, Lehane J. Difficult tracheal intubation in obstetrics. *Anaesthesia* 1984; **39**: 1105–11.
- 5 Bulger EM, Copass MK, Maier RV, Larsen J, Knowles J, Jurkovich GJ. An analysis of advanced prehospital airway management. *Journal of Emergency Medicine* 2002; **23**: 183–9.
- 6 Colwell CB, McVane KE, Haukoos JS, et al. An evaluation of out-of-hospital advanced airway management in an urban setting. *Academic Emergency Medicine* 2005; **12**: 417–22.
- 7 Pratt JC, Hirshberg AJ. Endotracheal tube placement by EMT – Basics in a rural EMS system. *Prehospital Emergency Care* 2005; **9**: 172–5.
- 8 Jones JH, Murphy MP, Dickson RL, Somerville GG, Brizendine EJ. Emergency physician-verified out-of-hospital intubation: miss rates by paramedics. *Academic Emergency Medicine*, 2004; **11**: 707–9.
- 9 Katz SH, Falk JL. Misplaced endotracheal tubes by paramedics in an urban emergency medical services system. *Annals of Emergency Medicine* 2001; **37**: 32–7.

- 10 Jemmett ME, Kendal KM, Fourre MW, Burton JH. Unrecognized misplacement of endotracheal tubes in a mixed urban to rural emergency medical services setting. *Academic Emergency Medicine* 2003; **10**: 961–5.
- 11 Wang HE, Yealy DM. How many attempts are required to accomplish out-of-hospital endotracheal intubation? *Academic Emergency Medicine*, 2006; **13**: 372–7.
- 12 Deakin CD, Peters R, Tomlinson P, Cassidy M. Securing the prehospital airway: a comparison of laryngeal mask insertion and endotracheal intubation by UK paramedics. *Emergency Medicine Journal* 2005; **22**: 64–7.
- 13 Shy BD, Rea TD, Becker LJ, Eisenberg MS. Time to intubation and survival in prehospital cardiac arrest. *Prehospital Emergency Care*, 2004; **8**: 394–9.