



Tracheal intubation in patients with rigid collar immobilisation of the cervical spine: a comparison of Airtraq[®] and LMA CTrach[™] devices[★]

Z. I. Arslan,¹ T. Yildiz,² Z. N. Baykara,² M. Solak³ and K. Toker³

1 Specialist in Anaesthesiology, 2 Associate Professor of Anaesthesiology, 3 Professor of Anaesthesiology, Medical Faculty, Department of Anaesthesiology, University of Kocaeli, Kocaeli, Turkey

Summary

The aim of this study was to evaluate the effectiveness of the Airtraq[®] and CTrach[™] in lean patients with simulated cervical spine injury after application of a rigid cervical collar. Eighty-six consenting adult patients of ASA physical status 1 or 2, who required elective tracheal intubation were included in this study in a randomised manner. Anaesthesia was induced using 1 µg.kg⁻¹ fentanyl, 3 mg.kg⁻¹ propofol and 0.6 mg.kg⁻¹ rocuronium, following which a rigid cervical collar was applied. Comparison was then made between tracheal intubation techniques using either the AirTraq or CTrach device. The mean (SD) time to see the glottis was shorter with the Airtraq than the CTrach (11.9 (6.8) vs 37.6 (16.7)s, respectively; $p < 0.001$). The mean (SD) time taken for tracheal intubation was also shorter with the Airtraq than the CTrach (25.6 (13.5) and 66.3 (29.3)s, respectively; $p < 0.001$). There was less mucosal damage in the Airtraq group ($p = 0.008$). Our findings demonstrate that use of the Airtraq device shortened the tracheal intubation time and reduced the mucosal damage when compared with the CTrach in patients who require cervical spine immobilisation.

Correspondence to: Dr Tulay S. Yildiz

E-mail: tsyildiz@yahoo.com

[★]Presented in part at the Turkish Anaesthesiology & Reanimation Congress (TARK), Annual Meeting, Antalya, Turkey; 2008.

Accepted: 17 June 2009

Spinal cord injury has been reported in association with the airway management of patients with cervical spine instability in whom cervical spine immobilisation was not performed [1]. Tracheal intubation must be performed with the utmost of care in patients with cervical spine fractures or other cervical pathology that requires stabilisation to prevent cord damage. However, the use of a semi-rigid cervical collar has been shown to increase the incidence of Cormack-Lehane grades 3 and 4 laryngoscopic views (up to 64%) and decrease the inter-incisor distance when compared with conventional laryngoscopy [2]. Manual in-line immobilisation is an alternative technique that similarly limits the head extension and neck flexion normally used to obtain the optimal view of the vocal cords during direct laryngoscopy. A previous study has demonstrated that the view obtained at laryngoscopy in the presence of a cervical

collar is considerably worse than during manual in-line immobilisation [3].

Failure to intubate the trachea and secure the airway remains a leading cause of morbidity and mortality in the operative [4] and emergency settings [5, 6]. Consequently, airway devices that increase the ease of performing tracheal intubation, particularly in settings where laryngoscopy is likely to be difficult due to anatomical or other abnormalities, can have a profound clinical impact. However, the optimal method of securing the airway in patients with potential cervical spine injuries remains the subject of debate. The Advanced Trauma Life Support (ATLS) protocol mentions several options for such patients: direct laryngoscopy with manual in-line immobilisation, blind nasal intubation and fiberoptic intubation of the patient's trachea [7]. Direct laryngoscopy with the aid of a gum elastic bougie [8], McCoy's

laryngoscope [9], Bullard laryngoscope [10] and intubating laryngeal mask airway [11, 12] are all alternative strategies that have been suggested by other authors.

In this article, we present the first comparison of intubation using two new devices in patients wearing a cervical collar. The Airtraq® (Prodol Meditec S A., Vizcaya, Spain) is a single-use laryngoscope designed to facilitate the tracheal intubation of patients with normal and difficult airways. As a result of the exaggerated curvature of the blade and an internal arrangement of optical components, a view of the glottis is provided without need for alignment of the oral, pharyngeal and tracheal axes.

The LMA CTrach™ (SEBAC, Pantin, France) is functionally identical to the Intubating Laryngeal Mask Airway (ILMA; SEBAC), but has an integrated fiberoptic bundle that provides a view of the larynx. This enables a view of tracheal intubation via a battery powered monitor that sits at the top of the CTrach and is attached via a magnetic-latch connector. During this process it is possible to deliver 100% inspired oxygen, with or without an inhalational anaesthetic.

We studied the efficiency of these two new devices in lean patients with simulated cervical spine injury after application of a rigid cervical collar (Philedelphia Cervical Collar; Philedelphia Cervical Collar Co., Thorofare, NJ, USA). We hypothesised that, when compared with the LMA C-Trach, use of the Airtraq would allow a quicker view of the glottis, quicker tracheal intubation, a reduced number of optimisation manoeuvres to facilitate intubation and reduced mucosal damage.

Methods

Following approval from the Kocaeli University Hospital Research Ethics Committee (Kocaeli, Turkey), and with written consent, we studied 86 adult patients of ASA physical status 1 or 2 presenting for elective surgery requiring tracheal intubation, in a randomised clinical trial. Patients were randomly assigned to two groups using a sealed envelope technique. The anaesthetists involved had experience of at least 10 successful intubations using the Airtraq and the CTrach devices. All data were collected by an independent, unblinded observer during the patients' peri-operative stay. Exclusion criteria included a history of hiatus hernia, symptomatic gastric reflux, previous gastric banding procedures, anticipated difficult airway (thyromental distance < 6 cm, mouth opening < 3 cm, Mallampati score of 3 or 4), pregnancy, morbid obesity (body mass index > 35 kg.m⁻²), and head and neck tumours.

Patients were premedicated with midazolam 0.03 mg.kg⁻¹ i.v. Standard monitoring, including ECG, S_pO₂, noninvasive blood pressure and end expiratory

carbon dioxide concentration was applied. Patients' age, gender, body mass index, thyromental distance, sterno-mental distance, Mallampati score, mouth opening, jaw protrusion, tooth morphology and neck circumference were noted. Patients' lungs were pre-oxygenated with 100% inspired oxygen for between 3 and 5 min using a facemask. Intravenous anaesthesia was induced using fentanyl 1 µg.kg⁻¹ and propofol 3 mg.kg⁻¹. The propofol dose was adjusted to lean body weight (as calculated by $24 \times [\text{height}]^2$). Following induction of anaesthesia, patients' lungs were manually ventilated via a facemask, using 2% sevoflurane in oxygen. Rocuronium (0.6 mg.kg⁻¹) was then administered and 3 min later the first assessment of the Cormack–Lehane grade [13] was made using a Macintosh laryngoscope. No manipulation was done during the first grading. The pillow was subsequently removed and an appropriately sized rigid cervical collar was fitted in accordance with the manufacturer's recommendations. Tracheal intubation was then undertaken using one of the study devices. Thereafter, anaesthesia was maintained using sevoflurane 2% in a mixture of nitrous oxide and oxygen, and mechanical ventilation was commenced. No other medications were administered or procedures performed during the data collection.

For each of the devices studied, the appropriate size and insertion technique was used according to the manufacturers' guidelines [14, 15]. The technique was considered to have failed if tracheal intubation was not achieved within 120 s or within a maximum of three intubation attempts. Mucosal damage was defined as the presence of blood on the devices following intubation.

Glottic visualisation time was defined as the time between handling the device and obtaining a view of the glottis. Total tracheal intubation time was defined as the time between handling the device and successful ventilation via the tracheal tube. Hypoxaemia was defined as a drop in S_pO₂ to 92% or below. Respiratory events including bronchospasm, regurgitation, and aspiration were noted. Heart rate, systolic blood pressure, diastolic blood pressure and mean arterial blood pressure were noted before commencing the procedure, following induction of anaesthesia, following insertion of the device, following intubation and at 1-min intervals for the subsequent 15 min. Sore throat, hoarseness, dysphagia, tooth and tongue damage were recorded at the end of the operation and 24 h postoperatively.

Statistics

Allowing for an α -error of 0.05 and β -error of 0.2 (power of 80%) a sample size of 43 was calculated for each group in order to detect a difference of 30 s for the intubation time. The analysis was undertaken using SPSS software,

version 13.0 for Windows (SPSS Inc, Chicago, IL, USA). For categorical variables, we used the chi-squared test. Continuous data were analysed using independent samples *t*-tests and the Mann–Whitney *U*-test. Comparisons of haemodynamic data within groups was analysed using the paired sample *t*-test. A *p* value of < 0.05 was considered to be statistically significant.

Results

Of the 86 patients studied, no serious complications relating to anaesthesia and airway management occurred. There were no significant differences between the patients' characteristics of the groups (Table 1).

The mean (SD) time to obtain a view of the glottis was significantly shorter for the Airtraq than for the CTrach group (11.9 (6.8) vs 37.6 (16.7) s respectively; *p* < 0.001) (Table 2), as was the mean (SD) time taken for tracheal intubation (25.6 (13.5) vs 66.3 (29.3) s respectively; *p* < 0.001). Three patients in the Airtraq group required a second attempt at tracheal intubation despite an initial view of the glottis; two of these were due to rupture of the tracheal tube's cuff following insertion, the other was due to an oesophageal intubation. Three patients in the CTrach group underwent 'blind' intubation due to inability to view the vocal cords. In all patients, tracheal

intubation was successfully carried out within 120 s. None of the recruited patients were subsequently excluded from the study.

Additional manoeuvres were required to provide an optimal view of the glottis in two patients (5%) from the Airtraq and 27 patients (63%) from the CTrach groups. Facemask ventilation was adequate for all patients. Mucosal damage was lower in the Airtraq vs the C-Trach group (9 (21%) vs 21 (48%) patients respectively; *p* = 0.008) (Table 2). There were no differences in the incidences of postoperative sore throat, dysphagia, hoarseness, and tooth, tongue or mouth damage when the two study groups were compared.

Of the haemodynamic parameters, mean arterial pressure increased significantly following insertion of the Airtraq (*p* = 0.02) while heart rate increased significantly following insertion of the CTrach (*p* < 0.001) (Table 3).

Discussion

Glottic views obtained during direct laryngoscopy in patients with cervical spine immobilisation have been shown to be consistently poorer when compared with non-immobilised controls. In such conditions with cervical spine injury, direct laryngoscopy can be harmful [8]. There are published reports on the use of the Airtraq intubating device in patients with normal airways [16], difficult airway scenarios simulated in manikins [17] and with manual in-line immobilisation [18], but not with a cervical collar in place. In a manikin-based study where increased tongue volume was used to simulate difficult airway management and in a study in patients undergoing simulated cervical immobilisation using manual in-line immobilisation, the Airtraq has been found to be superior to the Macintosh laryngoscope. The Airtraq has also been shown to produce less haemodynamic stimulation, a potentially important advantage in certain clinical situations. In a study of morbidly obese patients where tracheal intubation was compared using the Airtraq and Macintosh laryngoscopes, the mean time taken for tracheal intubation was found to be shorter in the Airtraq group [19, 20]. Hirabayashi et al. [21] used fluoroscopy to study cervical spine movement during laryngoscopy using the Airtraq

Table 1 Patients' status and pre-operative airway characteristics for patients whose tracheas were intubated using the Airtraq or CTrach device. Values are mean (SD) or number.

| | Airtraq (n = 43) | CTrach (n = 43) |
|--|---------------------|--------------------|
| Age; years | 45.5 (17) | 40.5 (13.4) |
| Gender; M/F | 15/28 | 9/34 |
| ASA 1/2 | 29/14 | 30/13 |
| BMI; kg.m ⁻² | 25.5 (4.7) | 25.9 (4.2) |
| Thyromental distance; cm | 8.37 (1.5) | 8.5 (1.3) |
| Sternomental distance; cm | 14.64 (1.5) | 14.7 (2.1) |
| Tooth morphology; normal/ absent/prosthetic | 23/12/8 | 31/9/3 |
| Mouth opening; cm | 4.5 (0.4) | 4.7 (0.5) |
| Mallampati score 1/2/3 | 34/8/1 | 31/11/1 |
| Neck circumference; cm | 36 (6.8) | 36.1 (2.8) |

| | Airtraq (n = 43) | CTrach (n = 43) | <i>p</i> value |
|-----------------------------------|------------------|-----------------|----------------|
| Time to view the glottis; s | 11.9 (6.8) | 37.6 (16.7) | 0.001 |
| Time to tracheal intubation; s | 25.6 (13.5) | 66.3 (29.3) | 0.001 |
| S _p O ₂ ; % | 99.6 (0.7) | 99.5 (0.7) | 0.44 |
| Number of insertion attempts; 1/2 | 42/1 | 40/3 | 0.31 |
| Mucosal damage | 9 (21%) | 21 (48%) | 0.01 |

Table 2 Comparison of airway management for patients whose tracheas were intubated using the Airtraq or CTrach device. Values are mean (SD), number or number (proportion).

Table 3 Haemodynamic variations during tracheal intubation using the Airtraq or CTrach devices. MAP, mean arterial pressure; HR, heart rate. Values are mean (SD).

| | Airtraq® | | CTrach™ | |
|-----------------------|-------------|-----------------------------|------------|-----------------------------|
| | MAP; mmHg | HR; beats.min ⁻¹ | MAP; mmHg | HR; beats.min ⁻¹ |
| Pre-induction | 100.7; 16 | 84.2; 15 | 96.4; 16 | 91.7; 19.5 |
| Post-induction | 83.1; 15.1 | 82.8; 17.4 | 86.9; 16 | 86; 18.6 |
| Post-insertion | 90.6; 24.8* | 86.1; 14 | 85.2; 17.2 | 97; 17‡ |
| 1 min post-intubation | 80.4; 19.9† | 81.2; 13.7† | 85.7; 15.6 | 95.6; 17.8 |
| 3 min post-intubation | 77.9; 15.9 | 79.2; 13 | 76.7; 9.4 | 90.1; 14.8 |

*p < 0.05 compared with post-induction value.

†p < 0.05 compared with post-insertion value.

‡p < 0.001 compared with post-induction value.

and Macintosh laryngoscopes and demonstrated less movement of the cervical spine when using the Airtraq device. The Airtraq device aims to provide a high-quality view of the glottis without the need to align the oral, pharyngeal, and tracheal axes, and therefore requiring the application of less force during laryngoscopy.

Reports have been published on the use of the CTrach in patients with normal airways [22, 23], in morbidly obese patients [24], and in patients with anticipated difficult airways [25–27]. In the study of patients with normal airways, tracheal intubation was successful at the first attempt in 100% of cases. When the CTrach was compared with the Macintosh laryngoscope in patients with normal airways and in morbidly obese patients, use of the CTrach was found to prolong the time for tracheal intubation. In all patients, a view of the glottis and tracheal intubation were achieved; however, use of the CTrach required more manoeuvres to optimise the view than the Macintosh laryngoscope. When Bilgin and Bozkurt [28] studied the CTrach in patients undergoing manual in-line immobilisation, they demonstrated a higher rate of successful tracheal intubation on the first attempt when compared with the intubating laryngeal mask airway, and a longer time for tracheal intubation when compared with the McCoy laryngoscope.

We were able to insert the LMA CTrach and initiate ventilation successfully in all patients; however, three patients required 'blind' intubation without obtaining a view of the cords. According to our study, use of the CTrach was associated with prolonged view and intubation times. Mucosal damage was more common with the CTrach and this was probably related to the use of more manoeuvres to optimise the glottic view when using this device. Twenty-seven (63%) of the patients in the CTrach group required some form of additional manoeuvre compared to two (5%) in the AirTraq group.

We found that insertion of the AirTraq device was associated with a significant increase in blood pressure but

no change in heart rate, while insertion of the CTrach was associated with an increase in heart rate and no change in the blood pressure. This is in keeping with the findings of several authors who have commented on the haemodynamic changes following insertion of different intubating aids [14, 29, 30].

In conclusion, our results show that the AirTraq produced significantly quicker times to tracheal intubation and less airway mucosal damage than the CTrach; however, both devices can be used safely in patients suffering from cervical trauma.

References

- Hastings RH, Kelley SD. Neurologic deterioration associated with airway management in a cervical spine-injured patient. *Anesthesiology* 1993; **78**: 580–3.
- Goutcher CM, Lochhead V. Reduction in mouth opening with semi-rigid cervical collars. *British Journal of Anaesthesia* 2005; **95**: 344–8.
- Heath KJ. The effect of laryngoscopy of different cervical spine immobilisation techniques. *Anaesthesia* 1994; **49**: 843–5.
- Peterson GN, Domino KB, Caplan RA, Posner KL, Lee LA, Cheney FW. Management of the difficult airway: a closed claims analysis. *Anesthesiology* 2005; **103**: 33–9.
- Mort TC. Esophageal intubation with indirect clinical tests during emergency tracheal intubation: a report on patient morbidity. *Journal of Clinical Anesthesia* 2005; **17**: 255–62.
- Mort TC. Emergency tracheal intubation: complications associated with repeated laryngoscopic attempts. *Anesthesia and Analgesia* 2004; **99**: 607–13.
- Advance Trauma Life Support. *Student Manual*. Chicago: American College of Surgeons Committee on Trauma, 1997; 27: 66–8, 228.
- Fitzgerald RD, Krafft P, Skrbensky G, et al. Excursions of the cervical spine during tracheal intubation: blind oral intubation compared with direct laryngoscopy. *Anaesthesia* 1994; **49**: 111–5.
- Gabbott DA. Laryngoscopy using the McCoy laryngoscope after application of a cervical collar. *Anaesthesia* 1996; **51**: 812–4.

- 10 Nileshwar A, Thudamalinne A. Comparison of intubating laryngeal mask airway and Bullard laryngoscope for oro-tracheal intubation in adult patients with simulated limitation of cervical movements. *British Journal of Anaesthesia* 2007; **99**: 292–6.
- 11 Asai T, Murao K, Tsutsami T, Shingu K. Ease of tracheal intubation through the intubating laryngeal mask during manual in-line head and neck stabilisation. *Anaesthesia* 2000; **55**: 82–5.
- 12 Komatsu R, Nagata O, Kamata K, Yamagata K, Sesler DI, Ozaki M. Intubating laryngeal mask airway allows tracheal intubation when the cervical spine is immobilized by a rigid collar. *British Journal of Anaesthesia* 2004; **93**: 655–9.
- 13 Cormack RS, Lehane J. Difficult tracheal intubation in obstetrics. *Anaesthesia* 1984; **39**: 1105–11.
- 14 Dhonneur G, Ndoko SK, Amathieu R, et al. A comparison of two techniques for inserting the Airtraq laryngoscope in morbidly obese patients. *Anaesthesia* 2007; **62**: 774–7.
- 15 LMA-CTrach™ instruction manual. The Laryngeal Mask Company Limited. 2006; 1–22.
- 16 Maharaj CH, O’Croinin D, Curley G, Harte BH, Laffey JG. A comparison of tracheal intubation using the Airtraq or the Machintosh laryngoscope in routine airway management: a randomised, controlled clinical trial. *Anaesthesia* 2006; **61**: 1093–9.
- 17 Maharaj CH, Higgins BD, Harte BH, Laffey JG. Evaluation of intubation using the Airtraq or Macintosh laryngoscope by anaesthetists in easy and simulated difficult laryngoscopy – a manikin study. *Anaesthesia* 2006; **61**: 469–77.
- 18 Maharaj CH, Buckley E, Harte BH, Laffey JG. Endotracheal intubation in patients with cervical spine immobilization. A comparison of Macintosh and Airtraq laryngoscopes. *Anesthesiology* 2007; **107**: 53–9.
- 19 Dhonneur G, Ndoko S, Amathieu R, Housseini LE, Poncet C, Tual L. Tracheal intubation using the Airtraq in morbid obese patients undergoing emergency cesarean delivery. *Anesthesiology* 2007; **106**: 629–30.
- 20 Ndoko SK, Amathieu R, Tual L, et al. Tracheal intubation of morbidly obese patients: a randomized trial comparing performance of Macintosh and Airtraq laryngoscopes. *British Journal of Anaesthesia* 2008; **100**: 263–8.
- 21 Hirabayashi Y, Fujita A, Seo N, Sugimoto H. A comparison of cervical spine movement during laryngoscopy using the Airtraq or Macintosh laryngoscopes. *Anaesthesia* 2008; **63**: 635–40.
- 22 Lui EH, Goy RW, Chen FG. The LMA CTrach, a new laryngeal mask airway for endotracheal intubation under vision: evaluation in 100 patients. *British Journal of Anaesthesia* 2006; **96**: 396–400.
- 23 Goldman AJ, Wender R, Rosenbatt W, Theil D. The Fiberoptic Intubating LMA-CTrach: an initial device evaluation. *Anesthesia and Analgesia* 2006; **103**: 508.
- 24 Dhonneur G, Ndoko SK, Yavchitz A, et al. Tracheal intubation of morbidly obese patients: LMA CTrach vs direct laryngoscopy. *British Journal of Anaesthesia* 2006; **97**: 742–5.
- 25 Goldman AJ, Rosenblatt WH. The LMA CTrach in airway resuscitation: six case reports. *Anaesthesia* 2006; **61**: 975–7.
- 26 Timmermann A, Russo S, Natge U, Heuer J, Graf BM. LMA CTrach: initial experiences in patients with difficult-to-manage airways. *Anaesthesist* 2006; **55**: 528–34.
- 27 Bjerkelund CE. Use of a new intubating laryngeal mask – CTrach – in patients with known difficult airways. *Acta Anaesthesiologica Scandinavica* 2006; **50**: 388.
- 28 Bilgin H, Bozkurt M. Tracheal intubation using the ILMA, C-Trach or McCoy laryngoscope in patients with simulated cervical spine injury. *Anaesthesia* 2006; **61**: 685–91.
- 29 Maharaj CH, Costello JF, Harte BH, Laffey JG. Evaluation of the Airtraq and Macintosh laryngoscopes in patients at increased risk for difficult tracheal intubation. *Anaesthesia* 2008; **63**: 182–9.
- 30 Zhang GH, Xue FS, Sun HY, et al. Comparative study of hemodynamic responses to orotracheal intubation with intubating laryngeal mask airway. *Chinese Medical Journal* 2006; **119**: 899–904.