APPARATUS

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

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Summary

The aim of this study was to evaluate the effectiveness of Airtraq® and CTrach™ in lean patients with simulated cervical spine injury after application of a rigid cervical collar. Eighty-six consenting adult patients of American Society of Anesthesiology categories I or II, who required elective tracheal intubation were included in this study in a randomised manner. Anaesthesia was induced using 1 l g.kg−1 of fentanyl, 3 mg.kg−1 of propofol and 0.6 mg.kg−1 of 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 visualisation time of the glottis was shorter in the Airtraq than the CTrach group (11.9 vs 37.6 s, respectively; p < 0.001). The mean time taken for tracheal intubation was shorter in the Airtraq than in the CTrach group (25.6 and 66.3 s, respectively; p < 0.001). There was less mucosal damage in the Airtraq group (p = 0.008). Our findings demonstrate that the Airtraq shortened the tracheal intubation time and reduced the mucosal damage when compared with the CTrach in patients who require cervical spine immobilization.

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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 grade 3 and 4 laryngoscopic views (up to 64%) and decrease the inter-incisor distance when compared with conventional laryngoscopy [2]. Manual inline immobilisation (MII) is an alternative technique that similarly limits the head extension and neck flexion normally used to obtain optimal visualisation of the vocal cords during direct laryngoscopic techniques. A previous study has demonstrated that the view obtained at laryngoscopy in the presence of a cervical collar is considerably worse than during MII [3].

Failure to successfully 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 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 MII, blind nasal-tracheal intubation and fiberoptic intubation [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 with a cervical collar in place. The Airtraq® (Prodol Meditec S A., Vizcaya, Spain) is a single-use laryngoscope designed to facilitate tracheal intubation of normal and difficult airway patients. 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 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 visualization of tracheal intubation via a battery powered monitor which sits on top of the CTrach and is attached via a magnetic-latch connector. During this process it is possible to deliver 100% inspired oxygen concentration, 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 (Philadelphia Cervical Collar; Philadelphia Cervical Collar Co., Thorofare, NJ, USA). We hypothesised that, when compared with the LMA C-Trach, use of the Airtraq would allow quicker visualization 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 patient consent, we studied 86 patients of American Society of Anesthesiology (ASA) categories I or II, aged 18 years of age or older, presenting for elective surgery requiring tracheal intubation, in a randomised clinical trial. Patients were randomised into two groups using a sealed envelope technique. The anaesthesiologists 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’ preoperative stay. Exclusion criteria included patients with a history of hiatus hernia, symptomatic gastric reflux, previous gastric banding procedures, anticipated difficult airway (thyromental distance < 6 cm, mouth opening < 3 cm, mallampati III or IV), pregnancy, morbid obesity (body mass index > 35), and head and neck tumours.

Patients were premedicated with midazolam 0.03 mg.kg⁻¹ intravenously. Standard monitoring, including ECG, \(S_{\text{PO}_2}\), noninvasive blood pressure and end-tidal carbon dioxide was continuously performed. Patients’ age, gender, body mass index, thyromental distance, sternomental distance, Mallampati score, mouth opening, jaw protrusion, tooth morphology and neck circumference were noted. Patients were preoxygenated 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 × [height]²). Following induction of anaesthesia, all 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 (Philadelphia Cervical Collar; Philadelphia Cervical Collar Co.) 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 utilised according to the manufacturer’s guidelines. 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.

Glottis visualisation time was defined as the time elapsing between handling the device and visualisation of the glottis. Total tracheal intubation time was defined as the time elapsing between handling of the device and successful ventilation via the tracheal tube. Hypoxaemia was defined as a drop in peripheral oxygen saturation to 92% or below. Respiratory events including bronchospasm, regurgitation, and aspiration were noted. Heart rate (HR), systolic blood pressure, diastolic blood pressure and mean arterial blood pressure (MAP) were noted before commencing the procedure, following induction of anaesthesia, following insertion of the device, following intubation and at 1 min intervals for the next 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 \(\alpha\)-error of 0.05 and \(\beta\)-error of 0.2 (power of 80%) to detect a difference of 30 s for the intubation
Results

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

The mean time (SD) to visualise the glottis was significantly shorter for the Airtraq group 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 time (SD) taken for tracheal intubation [25.6 (13.5) and 66.3 (29.3) s respectively; p < 0.001]. Three patients in the Airtraq group required a second attempt at tracheal intubation despite initial visualisation of the glottis; two of these were due to rupture of the tracheal tube cuff following insertion, the other was due to an oesophageal intubation. Three patients in the CTrach group underwent ‘blind’ intubation due to inability in visualising 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 Airtrach vs the C-Trach group [9 (21%) vs 21 (48%) patients respectively; p = 0.008] (Table 2). There were no differences in the incidence 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 MII [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 MII, the Airtraq has been found to be superior to the Macintosh laryngoscope. The Airtraq has also been shown to produce less haemodynamic stimulation in patients, 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] studied the cervical spine movement during laryngoscopy using the Airtraq and Macintosh laryngoscopes by fluoroscopy and demonstrated less movement of the cervical spine when using the Airtraq device. The Airtraq device aims to provide high-quality visualisation 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, successful visualisation of the glottis and tracheal intubation were achieved; however, use of the CTrach required more manoeuvres to optimise cord visualisation than the Macintosh laryngoscope. When Bilgin and Bozkurt [28] studied the CTrach in patients undergoing MII, they demonstrated a higher rate of successful tracheal intubation on the first attempt when compared with the ILMA, and a longer time for tracheal intubation when compared with the McCoy’s laryngoscope.

We were able to successfully insert the LMA CTrach and initiate ventilation in all patients, however, three patients required ‘blind’ intubation without visualisation of the cords. According to our study, use of the CTrach was associated with prolonged visualisation and intubation times. Mucosal damage was higher in the CTrach group (p < 0.018) and was probably related to the use of more manoeuvres to optimise 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 MAP but no change in heart rate, while insertion of the CTrach was associated with an increase in heart rate and no change in the MAP. 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, we compared two devices (the LMA AirTrach and CTrach) to ascertain which was most efficacious in aiding the tracheal intubation of patients with a simulated cervical spine injury in whom a rigid cervical collar was in place. Our results show that the AirTrach produced significantly quicker time 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
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