J Anesth (2012) 26:296–298
DOI 10.1007/s00540-011-1301-6

SHORT COMMUNICATION

Addition of a video camera system improves the ease of Airtraq® tracheal intubation during chest compression

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Received: 5 September 2011 / Accepted: 28 November 2011 / Published online: 9 December 2011

Abstract Recent resuscitation guidelines for cardiopulmonary resuscitation emphasize that rescuers should perform tracheal intubation with minimal interruption of chest compressions. We evaluated the use of video guidance to facilitate tracheal intubation with the Airtraq (ATQ) laryngoscope during chest compression. Eighteen novice physicians in our anesthesia department performed tracheal intubation on a manikin using the ATQ with a video camera system (ATQ-V) or with no video guidance (ATQ-N) during chest compression. All participants were able to intubate the manikin using the ATQ-N without chest compression, but five failed during chest compression ($P < 0.05$). In contrast, all participants successfully secured the airway with the ATQ-V, with or without chest compression. Concurrent chest compression increased the time required for intubation with the ATQ-N (without chest compression 14.8 ± 4.5 s; with chest compression, 28.2 ± 10.6 s; $P < 0.05$), but not with the ATQ-V (without chest compression, 15.9 ± 5.8 s; with chest compression, 17.3 ± 5.3 s; $P > 0.05$). The ATQ video camera system improves the ease of tracheal intubation during chest compressions.

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Keywords Airtraq optic laryngoscope · Video camera system · Chest compression · Manikin

The American Heart Association (AHA) and European Resuscitation Council (ERC) have updated cardiopulmonary resuscitation (CPR) guidelines to emphasize the importance of minimizing interruptions of chest compression to maximize coronary and cerebral perfusion pressure [1, 2]. The guidelines suggest that skilled operators should be able to secure the airway without interrupting chest compression or with only a brief pause [1, 2].

The Airtraq® (ATQ; Prodol Meditec, Vizcaya, Spain) laryngoscope is a recently introduced rigid optic laryngoscope for tracheal intubation [3]. This device provides a non-sightline view of the airway and may be used to intubate patients in various clinical settings, including difficult intubations during anesthesia and emergency situations [4, 5].

A recent study reported that physicians were less successful intubating with the ATQ laryngoscope than with the Pentax-AWS Airway Scope® (Hoya, Tokyo, Japan) during chest compression [6]. The report suggested the possible reason for failed intubation with the ATQ to be head movement during chest compressions that obscures the view of the larynx.

An optional video camera system is available for the ATQ [7]. The video camera easily clips on and off the proximal viewfinder of the ATQ and transmits to an external medical-grade monitor via a lightweight cable. Video guidance with this system enables the viewing and recording of the laryngoscopy and intubation.

We hypothesized that the ATQ with camera system (ATQ-V) improves the ease of airway management during CPR while performing chest compressions. We compared

the time required to successfully intubate a manikin during chest compression using the ATQ-V or the ATQ without video guidance (ATQ-N).

The Research Ethics Committee of Hyogo College of Medicine approved the study protocol. From April to June 2011, we recruited 18 novice physicians in the anesthesia department at the Hyogo College of Medicine. Participants had an average of 3.3 ± 3.1 (mean ± standard deviation) months of clinical anesthesia training but no previous experience with the ATQ.

We assessed the time it took for participants to secure the airway of an Airman® manikin (Laerdal, Sentrum, Stavenger, Norway) using the ATQ-V or ATQ-N [8, 9]. The regular size ATQ was used, and the internal diameter of the tracheal tube (Portex, St. Paul, MN, USA) was 7.5 mm. In the ATQ-V trial, ATQ with the camera system was attached to a 30 cm × 40 cm monitor by a 2-m-long cable. The monitor was placed about 1 m from the ATQ-V. The manikin was placed on a table, and all insertions were performed at the same table height. For each intubation attempt, the airway devices and the manikin's airway were lubricated according to the manufacturer's instructions [9].

Participants performed tracheal intubation (ATQ-N or ATQ-V) on the manikin, with or without concurrent chest compressions performed by an Advanced Cardiac Life Support (ACLS) instructor, for a total of four intubation attempts. To minimize potential learning effects, the order of interventions was randomized for each participant by drawing tickets from an opaque envelope.

For each intubation attempt, the participant stood at the head of the manikin; the necessary equipment was placed on the pillow next to the manikin's head. Before the timed intubation attempts, participants were given 5 min to practice intubating the manikin.

Participants were instructed to place the airway device, inflate its cuff, connect a self-inflating bag, and then attempt to ventilate the lungs of the manikin. They were not required to tie the airway device in place. Timing began when the participant picked up the airway device and ended at the point of manual ventilation after intubation. We defined successful intubation as tracheal intubation, and failed intubation as esophageal intubation.

The ACLS instructor began chest compressions on the manikin before participants started to secure the airway. The chest was compressed about 5 cm (100/min) in accordance with AHA and ERC guidelines [1, 2].

Intubation times were compared by two-way analysis of variance and Tukey's multiple comparison test. Intubation success rates were compared by χ^2 test. Results are expressed as mean ± standard deviation (SD). $P < 0.05$ was considered statistically significant.

Results of our preliminary study showed that successful ventilation using the ATQ required about 16 ± 6 s. Considering an α error of 0.05 and β error of 0.2, we estimated that 18 participants would be required for two independent groups.

All participants were able to intubate the manikin using the ATQ-N without chest compression, but five failed tracheal intubation during chest compression ($P < 0.05$). In contrast, all participants were able to intubate the manikin using the ATQ-V, with or without chest compression ($P > 0.05$). Thus, participants achieved a higher rate of successful intubation during chest compressions with the ATQ-V than with the ATQ-N ($P < 0.05$).

The times required for intubation with each system (ATQ-N and ATQ-V) are shown in Fig. 1. Intubation time was significantly increased during chest compressions using the ATQ-N (14.8 ± 4.5 s without chest compressions vs. 28.2 ± 10.6 s with chest compressions). In contrast, intubation time using the ATQ-V appeared to be only slightly longer with concurrent compressions (15.9 ± 5.8 s without chest compressions vs. 17.3 ± 5.3 s with chest compressions). For comparison of the ATQ-N and ATQ-V, the intubation time did not differ significantly without chest compression (NS). In contrast, intubation time was significantly longer in ATQ-N than ATQ-V during chest compression ($P < 0.05$).

The 2010 AHA and ERC ACLS guidelines strongly encourage rescuers to minimize the interruption of chest compressions [1, 2]; however, airway management during CPR is often performed under suboptimal conditions

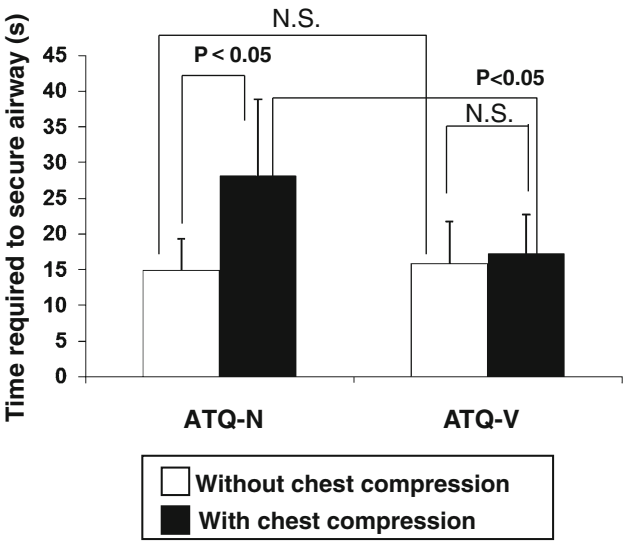

Fig. 1 Times required for intubation with Airtraq (ATQ) with or without video system (mean ± standard deviation). *ATQ-N*, Airtraq only; *ATQ-V*, Airtraq with video system. Differences were analyzed with two-way analysis of variance. *NS* no significant difference, $^*P < 0.05$

because of severity of the trauma, hemorrhage, obstruction of the airway with a foreign object, patient position, the CPR skills of the rescuer, and patient anatomy [8].

The Macintosh laryngoscope is the most widely used laryngoscope for intubation; however, it is considered difficult to master, especially with patients who require cervical stabilization or chest compressions [9]. The rate of incorrect tube placement can thus be unacceptably high for occasional users of the Macintosh laryngoscope, which requires axial alignment of the oral cavity, pharynx, and larynx, and handling of tracheal tubes [10]. In contrast, the ATQ and Pentax-AWS Airway Scope provide a non-sightline view of the airway, which alleviates the need for axial alignment [4, 5]. By improving the laryngeal view and providing a tube guide, these devices facilitate rapid and reliable intubation, even for difficult cases, such as patients with cervical neck immobility or morbidly obese patients [4, 5].

In the present study, participants required a relatively long time to complete intubation during chest compression; some participants failed to secure the airway without video guidance. A likely reason for failure with the ATQ-N is that rescuers needed to bring their eyes close to the ATQ while intubating; head movements during chest compression obscured the view of the larynx, making it difficult to visualize tube passage thorough the glottis. Video guidance provided by the ATQ-V system improved the ease of intubation during chest compression.

Four sizes are available for the ATQ, making it suitable for tracheal tubes with inner diameters of 7.0–8.5 mm (regular), 6.0–7.5 mm (small), 4.0–5.5 mm (pediatric), and 2.5–3.5 mm (infant). The ATQ video system may improve the ease of tracheal intubation during chest compression for children and infants, as well as for adults [11].

The present study has several limitations worth noting. First, simulated intubation with a manikin does not take into account factors such as the oropharynx filling with blood, vomitus, or sputum. Use of the ATQ may be difficult in patients whose mouth openings are restricted by rigid cervical collars. In addition, there is a theoretical risk of fogging with the ATQ, resulting in blurred images. We used a manikin that was designed to teach airway management during chest compressions. One drawback of using a manikin to evaluate laryngoscopes is that securing the airway generally takes longer with patients [12]. Randomized trials are needed to evaluate the ATQ camera system in patients receiving CPR under cervical stabilization in clinical situations.

Conflict of interest The authors have no affiliation with any manufacturer of any device described in the manuscript and declare no financial interest in relationship to the material described in the manuscript.

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