The Journal of Emergency Medicine, Vol. 44, No. 4, pp. 784–789, 2013

0736-4679/$ - see front matter

ELSEVIER

http://dx.doi.org/10.1016/j.jemermed.2012.07.045

Selected Topics: Prehospital Care

A COMPARISON OF THE SPEED, SUCCESS RATE, AND RETENTION OF RESCUE AIRWAY DEVICES PLACED BY FIRST-RESPONDER EMERGENCY MEDICAL TECHNICIANS: A HIGH-FIDELITY HUMAN PATIENT SIMULATION STUDY

Christopher Voscopoulos, MD,* Tobias Barker, MD,† Todd Listwa, MD,† Steve Nelson, CCEMT-P,† Charles Pozner, MD,† Xiaoxia Liu, MS,* Richard Zane, MD,† and Jill A. Antoine, MD*

*Department of Anesthesiology, Perioperative, and Pain Medicine and †Department of Emergency Medicine, Brigham and Women's Hospital, Harvard Medical School, Boston, Massachusetts

Reprint Address: Jill A. Antoine, MD, 727 27th St, San Francisco, CA 94131

□ **Abstract—Background: Current airway management for most first-responder basic emergency medical technicians (EMT-Bs) does not include the use of blind-advanced-airway devices. Objective: To compare the speed, success rates, and skill retention with which EMT-Bs providers can place three blind-advanced-airway devices. Methods: Prospective study of 43 EMT-Bs trained in the use of the Esophageal-Tracheal-Combitube® (ETC), King LT® (KLT), and Laryngeal Mask Airway™ (LMA). The time it took each participant to place each device correctly and ventilate a human patient simulator was assessed. Primary outcome measures were the success rate of proper insertion for each device and time interval from initiation of mouth insertion to initiation of chest rise. To assess skill retention, at 3 months the providers were reassessed under exact conditions. Results: At Day 1, time required to place an ETC, LMA, and KLT were 32.7 ± 12.3, 19.2 ± 6.2, and 20.1 ± 6.6 s, respectively. Using paired *t*-tests, LMA and KLT were faster than ETC, $p < 0.0001$. At 3 months, pairwise comparisons showed the ETC took longer to place than the KLT and LMA, $p < 0.0001$; and the LMA took longer to place than the KLT, $p = 0.0034$ (36.4 ± 13.1 ETC, 24.8 ± 12.4 LMA, 19.0 ± 6.9 KLT). There was no statistical difference of failures in placing any device. Conclusions: Comparison of three rescue airway devices placed by EMT-Bs providers showed that it takes significantly longer to place an ETC compared to an LMA and KLT both on Day 1 and 3 months later. Three-month retention studies revealed that it took significantly longer to place an LMA compared to the KLT.** © 2013 Elsevier Inc.

□ **Keywords—esophageal-tracheal-combitube; King LT; laryngeal mask airway; emergency medical technician; human patient simulator**

INTRODUCTION

The current standard for ventilation in the prehospital setting by first-responder basic emergency medical technicians (EMT-B) is delivery of ventilation using bag-valve mask ventilation (BVM), or some other mask- or shield-dependent device. Endotracheal intubation (ETI) has been an option for advanced-level providers in the prehospital setting, if necessary, but the situation of field use is often suboptimal for efficacious placement. In many training systems, paramedics have been trained to insert blind-advanced-airway devices as either an alternative to ETI or as a rescue device when ETI is unsuccessful. Studies assessing paramedic placement of the Laryngeal Mask Airway™ (LMA; LMA North America, San Diego, CA) in both the simulated and prehospital settings have shown success rates of 70–88% (1–3). Additionally, paramedics

RECEIVED: 29 August 2011; FINAL SUBMISSION RECEIVED: 9 January 2012;
ACCEPTED: 1 July 2012

and EMT-Bs have been shown to place the Esophageal-Tracheal-Combitube® (ETC; Kendall-Sheridan Corporation, Argyle, NY) in the prehospital setting with success rates between 70% and 95% (4–6). The current airway management armamentarium for most EMT-B prehospital providers does not include these blind-advanced-airway devices, nor has an assessment of the feasibility and relative comparison of use between blind-advanced-airway devices been examined for use in EMT-Bs. The difficulties of correct BVM technique over long periods of time and the resultant inadequacy of ventilation have been studied (7,8). Because BVM is extremely difficult to perform over long periods of time, management of the critical prehospital airway with the use of supraglottic devices may improve patient outcomes by shortening scene time compared to ETI and providing larger and more reliable minute-ventilation volumes compared to BVM ventilation.

Blind-advanced-airway devices currently on the market vary in shape, technique of placement, number of cuffs inflated, number of access ports, location of ventilation ports, and manner in which they require adjustment if ventilation fails after placement. Because the use of these devices is most often in patients who are critically ill, it is necessary that the device selected be placed quickly and correctly to facilitate ventilation if it is possible. Because the use of these devices by EMT-Bs providers is an infrequent procedure, skill retention is an issue that must be considered when selecting an appropriate device. The ETC and the LMA are widely used by advanced, prehospital providers as primary and rescue airways. The laryngeal tube airway (King LT® [KLT]; King Systems, Noblesville, IN) is a recent addition to the airway armamentarium. It is a supraglottic airway device made of silicone that is inserted along the length of the tongue. It has two balloons inflated from a single port that independently seal the upper pharynx and proximal esophagus, allowing ventilation of the lungs as air is expelled from the tube situated between the two balloons. In simulated settings, inexperienced personnel have been shown to deliver greater tidal volumes/minute ventilation with less gastric insufflation when using the KLT compared to the LMA and BVM (9,10). Paramedics and Emergency Medicine residents have been shown to correctly insert the KLT faster than they can perform endotracheal intubation, and with more success in simulation mannequins (11).

Because the use of a supraglottic airway device (LMA, ETC, KLT) is typically reserved for physicians and advanced-level prehospital providers, this study attempts to assess the speed, success rates, and skill retention with which previously untrained EMT-B prehospital providers can place these devices.

MATERIALS AND METHODS

Study Design

This was a prospective study comparing the ability of previously advanced-airway naïve EMT-Bs (as certified by the Massachusetts Office of Emergency Medical Services) to place three different supraglottic airways, the ETC, KLT, and the LMA, in a human patient simulation model. The institutional review board of Brigham and Women's Hospital, Boston, MA approved the study. All participants provided informed consent before involvement in this study.

Setting

All sessions were conducted at the Simulation, Training, Resuscitation, and Technology Utilization Center for Medical Simulation (STRATUS) at Brigham and Women's Hospital, using a high-fidelity computer-controlled patient simulator (SimMan; Laerdal Medical, Wappingers Falls, NY).

Selection of Participants

Advanced airway naïve EMT-Bs from the Metropolitan Boston area were recruited to participate via posters placed at local Emergency Medical Services (EMS) establishments. Each participant received financial remuneration for their participation. The initial phase of the study took place on three consecutive weekends, with each of the participants returning for skills reassessment 90 days later. Data collection was blinded to any personal identification or employer.

Interventions

Each participant received a standardized introduction to the design, indications, and the manufacturer-suggested steps in the use of each of the three airway devices, incorporated into a PowerPoint (Microsoft Corporation, Redmond, WA) presentation of each device (approximately 1 h of training time). Using a human patient simulator and under the direct guidance of physician staff, subjects were provided standardized practical training in the correct technique for placement, the recognition of improper placement, and techniques for adjusting or removing the device if proper ventilation was not occurring (approximately 2 h of training time). Participants were considered competent once they correctly placed the device and effectively ventilated the mannequin on three successive attempts. This was assessed for each device. Upon completion of both the didactic and practical portions of the instructional program, each