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Comparison of the airway access skills of prehospital staff in moving and stationary ambulance simulation: A randomized crossover study☆

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ABSTRACT

Objectives: We aimed to compare the procedural success and intervention durations regarding various airway access skills in moving and stationary ambulance simulations.
Material and methods: An ambulance simulator was used to simulate the moving ambulance environment, and a standard manikin was used for airway simulation. The study included 38 paramedics and paramedic students. In stationary and moving environments, a classical endotracheal intubation with a stylet, an intubation with a gum elastic bougie (GEB), a laryngeal mask airway (LMA), and a laryngeal tube (LT) were applied randomly. The cuff inflation duration, the duration until the first ventilation, and the intubation success were assessed.
Results: There was no difference in terms of success and intubation durations of the four methods in moving and stationary environments. In both environments, the LT and LMA were inserted most rapidly ($p < 0.001$). There was no difference in the intubation duration and the success among the supraglottic methods. In moving and stationary environments, the intubation with a classic stylet was faster than the intubation with a GEB. The use of a GEB did not increase the intubation success.
Conclusions: In this simulation study, the moving environment did not affect the duration or success of the endotracheal intubation. Supraglottic methods were applied more quickly in both moving and stationary environments. A GEB was used successfully by practioners with no previous experience; however, the duration of the intubation was longer.

1. Introduction

Opening the airway and maintaining it continuously before reaching the hospital is one of the most important technical skills in emergency medicine. Intubation can be performed by a staff with sufficient experience. A staff with insufficient experience in intubation must be familiar with alternative airway techniques. The selected alternative airway management technique should be easy to use, and the method should protect the patient from airway aspiration.[1] There is evidence that an appropriate and timely intubation affects mortality and morbidity. The supraglottic airway maintains standard airways. Studies in simulated clinical environments have obtained high success speeds versus endotracheal intubation.[2,3] In a surgical series, the reported success rates were between 44% and 100%.[4,5] Studies have reported that for airway management outside the hospital, supraglottic airway access methods are extremely successful.[6,7]

The European Resuscitation Council recommends supraglottic airway management techniques outside the hospital. However, the most appropriate method for use in patients in a moving ambulance remains unknown. Although endotracheal intubation (ETT) outside the hospital is slightly less successful than other methods, it is the gold standard. In a study comparing various airway management techniques applied to cases with a cardiac arrest outside the hospital, the survival rates of patients with ETT were slightly better than patients with other airway management techniques.[8]

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There are many studies evaluating various airway access methods both inside and outside the hospital. Studies evaluating intubation methods in an ambulance or a simulator are rare. A study by Gough et al. showed that paramedics could successfully complete ETT in a moving ambulance.[9] In contrast, when a patient requires an airway access outside the hospital, the ambulance is stopped and started again only after the airway is secured, which may delay patients from reaching in time for emergency services. As a result, we planned to complete a study assessing the airway skills of emergency medical personnel in the ambulance environment.

We compared various airway management techniques (LMA, LT, and endotracheal intubation with normal and gum elastic stylets) in moving and stationary ambulance simulations to test the hypothesis that choosing the correct airway management technique will allow a successful airway intervention in a moving ambulance. We proposed that ETT with a GEB could increase the possibility of success and would be as easy to apply as supraglottic methods. The criteria for success were the duration until sufficient respiration, a cuff inflation and first respiration, and the number of attempts. In addition, the practitioners were asked about their perception of ease or difficulty of the methods in both environments.

2. Materials and methods

This study was planned as a methodological and randomized crossover study. Following the grant of permission by the Dokuz Eylul University Medical Faculty Research Ethics Committee, the study began in March 2014.

2.1. Research sampling

The study population included paramedics actively working with the Izmir 112 Provincial Ambulance Service as well as paramedic students. A sufficient number of individuals participated in order to fulfill the previously determined sampling number.

In a study carried out on 121 Turkish paramedic students, Cinar et al. reported successful airway provision rates of 78.5% using a Macintosh laryngoscope.[10] Using this data, we calculated that a sample size of 30 is required to determine a 20% difference in airway provision devices with an alpha error of 0.5 and power of 80%. Four methods were selected at random by selecting envelopes describing the intervention in moving or stationary environments.

2.2. Ambulance environment simulation

The Simsoft Computer Technologies (Ankara, Turkey) ambulance simulator was used, which is a full-size ambulance that can simulate airway conditions as well as vibrations in the ambulance and driver use, controlled by computer software, in order to reproduce the ambulance environment in standard road and normal weather conditions. Before each use, the standard road choice and weather conditions are set and operated by a driver each time. This program allows the driver to follow the road visually. The ambulance is set to allow only the use of the fourth gear after the third gear. The individual drives the ambulance by visually tracking the road on three projectors mounted on the ambulance.

The cameras within the simulator monitor interventions in the back of the ambulance, which allows the director operating the main command system of the ambulance simulation to observe two different camera images simultaneously.

Inside the ambulance, an advanced cardiac life support manikin allowing airway intervention was placed on a trolley for patient simulation (Deluxe CRiSis™ Manikin — LF03955U. Wisconsin. USA, Fig. 1). A sufficient tidal volume ventilation value for this manikin was set to 0.8 L, and this was monitored from outside the ambulance. After intubation, successful ventilation was assessed by monitoring this metrically.

2.3. The training of practitioners

Before the study, 38 paramedics were given theoretical and practical training in all airway management techniques on two different days. After a 45-minute classic presentation, each practitioner completed each intervention three times. Each application was recorded, and a successful completion of 12 intubations was documented. In addition, the paramedics participating in the study were informed of the study method.

2.4. The airway material used

1. An intubation tube No: 7.5
2. An laryngeal tube (LT) No: 3 (VBM Medizintechnik, Sulz, Germany)
3. An laryngeal mask airway (LMA) Supreme® Size 3 (Hangzhou Fushan Medical Appliances Co., Ltd. Lin'an City Zhejiang, China)
4. A standard Macintosh laryngoscope, blade 3
5. An gum elastic bougie (GEB) ([AMTI15750] Armstrong Medical Ltd, Coleraine, Northern Ireland)

2.5. The airway interventions applied

1. A standard Macintosh laryngoscope and classic stylet
2. A standard Macintosh laryngoscope and GEB (Before each intubation, the GEB was prepared by inserting it into the intubation tube)
3. An laryngeal mask application
4. An LT application

2.6. An assessment

To prevent a bias based on the previous experience and skills of the paramedics participating in the study related to the airway management techniques, the airway management technique to be applied was determined at random by choosing four envelopes. Before this, four envelopes containing each of the four airway management techniques were prepared. The order of the envelopes determined the order of the methods.

In general, one driver and two health personnel work in ambulances in Turkey. Permission was granted for an assistant to be present during the application because there is always an assistant in the ambulance environment. The assistant only gave the requested tube to the practitioner.

A study team watching the camera images outside the ambulance assessed the progress. One of the cameras was positioned in order to assess the patient's airway and chest and the other showed the ambulance team.

2.7. The intubation success

When an endotracheal tube (ET) is inserted into the oropharynx, it was defined as an intubation attempt. The intervention was

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