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Original Contribution

Should laryngeal tubes or masks be used for out-of-hospital cardiac arrest patients?☆,☆☆

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ABSTRACT

Objective: Few studies have compared airway management via laryngeal masks (LM) or laryngeal tubes (LT) in patients with out-of-hospital cardiac arrest (OHCA). This study evaluated whether LT insertion by emergency medical service (EMS) personnel affected ventilation and outcomes in OHCA patients (vs. the standard LM treatment).
Methods: This prospective, cluster-randomized, and open-label study evaluated data that were collected by the Sapporo Fire Department between June 2012 and January 2013. We selected the 14 EMS teams that treated the greatest number of OHCA patients in Sapporo, Japan during 2011, and randomized the teams into Groups A and B. In the first study period (June 2012 to September 2012), Group A treated OHCA patients via LT and Group B treated OHCA patients via LM. In the second period (October 2012 to January 2013), Group A treated OHCA patients via LM and Group B treated OHCA patients via LT. If necessary, both groups were allowed to use an esophageal obturator airway (EOA) kit. The primary endpoints were time from cardiopulmonary resuscitation to device insertion and the rate of successful pre-hospital ventilation. The secondary endpoints were return of spontaneous circulation and survival and favorable neurological outcomes at 1 month after cardiac arrest.
Results: LT was used in 148 OHCA patients and LM was used in 165 OHCA patients. Our intention-to-treat analyses revealed no significant differences in the primary and secondary outcomes of the LT- and LM-treated groups.
Conclusion: Prehospital advanced airway management via LT provides similar outcomes to those of LM in OHCA patients.

1. Introduction

Effective airway management is an important technical skill in the treatment of patients with out-of-hospital cardiac arrest (OHCA). For many years, the optimal method for airway management was considered to be endotracheal intubation (ETI), because it provided better airway control and protection against upper airway obstruction, with a decreased risk of gastric aspiration and control of carbon dioxide removal. However, the performance of ETI by emergency medical services (EMS) personnel has been questioned recently [1,2]. In addition, the 2010 International Consensus on Cardiopulmonary Resuscitation and Emergency Cardiovascular Care Science [3] and the 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care [4] have reduced the level of urgency for early ETI unless it can be performed by highly skilled medical personnel with minimal interruption of chest compressions. Furthermore, several studies [5–9] have compared the efficacy of endotracheal tube (ETT) to that of other supraglottic airway devices (SGAs) in patients with OHCA, and reported no improvements in the survival or outcomes of the patients who were treated with ETT. Moreover, the failure rate of ETI that is performed by EMS personnel in the prehospital setting can be as high as 30% [10]. Therefore, because attempted ETI typically requires the interruption in chest compressions during cardiac arrest (which can increase detrimental outcomes) [11], correct ETI administration requires continuous training and advanced skills [12–14].

In this context, various SGAs have become preferred to ETT for the advanced airway management of patients with OHCA. Recently developed examples of SGAs include the esophageal obturator airway (EOA), laryngeal mask (LM), laryngeal tube (LT), and i-gel devices. In 1991, Brain reported the invention of the LM [15], which is easy to insert and provides effective management of difficult airways. Since that time, various reports have compared LM and ETT, and have confirmed the effectiveness of LM [7–9]. In addition, Samarkandi et al. [16] have reported that LM is a good alternative to ETT in cases that require cardiopulmonary resuscitation. Similarly, LT was recently introduced as an alternative device for managing difficult airways, and numerous reports [17–20] have emphasized the benefits of LT during resuscitation in the emergency department, because the LT insertion procedure is very simple (even for inexperienced individuals) and requires minimal

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instruction prior to its first use [21,22]. Furthermore, LT has been successfully used by paramedics to treat cases of OHCA [23–25]. Therefore, although no studies have directly compared LM and LT, it is possible that the time for LT insertion might be shorter than that for LM insertion, which might improve the prognosis and outcomes for patients with OHCA. Before this study, EMS personnel in Sapporo, Japan used EOA and LM (rather than LT) as the standard treatment for patients with OHCA. Thus, we hypothesized that EMS personnel might be able to skillfully use LT after short-term training, and that the shorter time for LT insertion might improve the rate of successful ventilation and prognosis of patients with OHCA, compared to LM.

2. Methods

2.1. Study design

This study used a prospective, cluster-randomized, and open-label design, which was reviewed and approved by the institutional review committee of Hokkaido University Hospital. The Sapporo Fire Department kindly performed the data collection. In Sapporo, LM and EOA are the standard of care for OHCA, and LT was only introduced after a week-long training period, which involved lectures and practical exercises to improve LT insertion into a mannequin.

Figure shows the study protocol. First, we selected the 14 EMS teams that had treated the greatest number of patients with OHCA during the past year in Sapporo. We then randomized these teams into Groups A and B (using sealed envelopes). During the first part of this study (4 months), Group A treated patients with OHCA via LT, while Group B treated the patients via LM. During the second part of this study (4 months), we exchanged the treatment methods for each group (Group A used LM and Group B used LT). If necessary, both groups were permitted to use EOA.

2.2. EMS system and procedures

The EMS system in Sapporo has been described previously [26]. In brief, each patient is transported in an ambulance with three EMS personnel. When cardiac arrest is detected, chest compressions and ventilation by bag valve mask are immediately started by two of the EMS personnel, and cardiopulmonary resuscitation (CPR) is provided according to the 2010 International Guidelines. Before this study, the standard advanced airway devices were EOA or LM, and ETT was only permitted when rescue breathing via the bag valve mask or SGA was not sufficient, due to foreign bodies in the respiratory tract. The EMS personnel apply an automated defibrillator (AED) if necessary, and attempt to gain peripheral venous access and administer intravenous adrenaline every 4 min until the return of spontaneous circulation (ROSC) or arrival at the hospital. If necessary, the EMS personnel can request that an emergency physician be transported directly to the scene, instead of transporting the patient.

2.3. Data collection

For this study, we enrolled consecutive OHCA patients from June 2012 to January 2013. The data that was collected included the patient's sex and age, cardiac rhythm at CPR initiation and upon hospital arrival, the time course of resuscitation, if a bystander had witnessed the cardiac arrest and/or initiated CPR, if the patient had been intubated, if adrenaline had been administered, if an AED had been used, if an emergency physician had been requested, or if ROSC had been achieved before arrival at the hospital. Follow-up data (i.e., survival rates) were also collected at 1 month after the events, during a meeting between the EMS personnel who had treated the patient and the hospital's medical control director.

2.4. Study endpoints

The primary endpoints were the time from CPR initiation to device insertion and the rate of successful ventilation upon arrival at the hospital. A positive outcome was confirmed if the EMS personnel could observe sufficient chest elevations and assess the degree of oropharyngeal leakage, based on their professional judgment. The EMS personnel also examined the patients' respiratory sounds by using a stethoscope to confirm whether the ventilation was adequate. The secondary endpoints were defined as the rate of ROSC, survival, and favorable neurological outcomes at 1 month after cardiac arrest. A favorable neurological outcome was defined as a cerebral performance category score of 1 (good performance) or 2 (moderate disability), and an unfavorable neurological outcome was defined as a score of 3 (severe cerebral disability), 4 (vegetative state), or 5 (death).

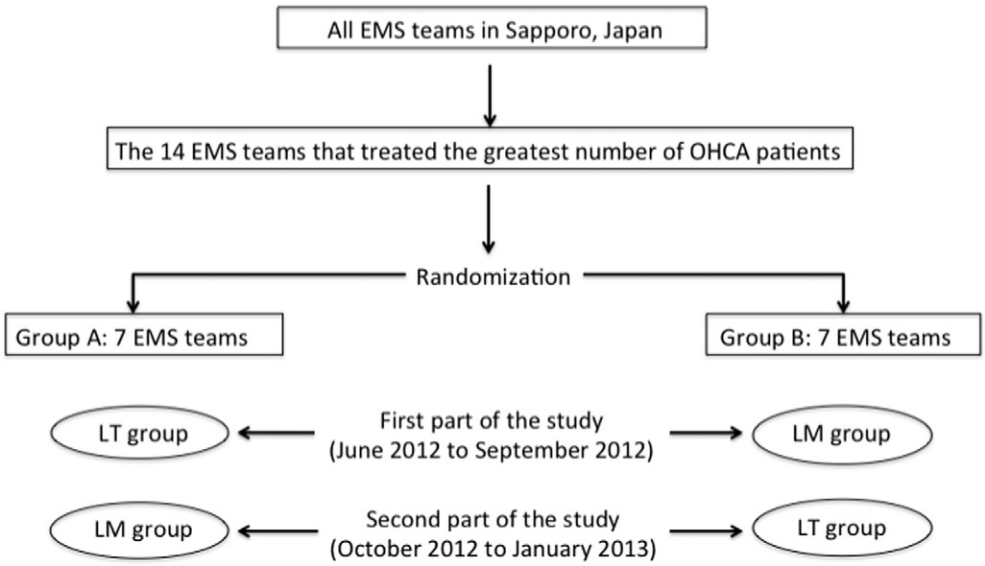

Figure. Study flow chart. We selected 14 emergency medical services (EMS) teams. In the first part, Group A treated using laryngeal tubes (LT), and Group B treated using laryngeal masks (LM). In the second part, the two groups switched their treatment methods.