ORIGINAL RESEARCH

Comparison of Jaw-Thrust Maneuver and Standard Method for Airway Management with Laryngeal Mask Airway by Paramedics during Chest Compression: A Randomized, Crossover, Manikin Study

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Abbreviations:
LMA: laryngeal mask airway
OHCA: out-of-hospital cardiac arrest

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Abstract

Introduction: The first priority of the primary survey of trauma care is airway management. For patients who have a known or suspected cervical spine injury, using the jaw-thrust maneuver is critical. It was hypothesized that the jaw-thrust maneuver would ease the insertion of the laryngeal mask airway (LMA) by moving the tongue forward from the palate and posterior pharyngeal wall.

Study Objectives: The aim of the study was to evaluate the effect of jaw-thrust maneuver on LMA insertion times of the paramedics with or without chest compression and with or without cervical stabilization in a manikin.

Methods: Eleven experienced paramedics inserted LMA in jaw-thrust position and standard position in chest compression without cervical stabilization scenario, chest compression with cervical stabilization scenario, cervical stabilization without chest compression scenario, and the scenario where neither cervical stabilization nor chest compression were performed. The primary outcome of the study was the comparison of LMA insertion times for each method. The secondary outcome measures were first-pass success rates and the comparison of the difficulty level of each method.

Results: During the LMA placement, performing the jaw-thrust maneuver instead of the standard method did not shorten the LMA insertion times. Adding chest compression and/or cervical stabilization did not complicate the LMA insertion. All of the LMA insertion attempts during the jaw-thrust maneuver and standard method were successful.

Conclusion: The findings of this study suggest that LMA insertion might be attempted both during the jaw-thrust maneuver and standard position in patients with or without chest compression and with or without cervical stabilization.

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Introduction

Prehospital airway management is an integral part of the on-scene resuscitation. Airway management in prehospital setting is challenging, especially in trauma patients. Trauma patients might require airway procedures in a wide spectrum of different scenarios, however there is not significant differences between airway approaches in trauma patients.[1] The mortality rate of traumatic out-of-hospital cardiac arrest (OHCA) has been reported as 96.7%.[2] Therefore, it is important to reduce the mortality rate of the traumatic OHCA, and the first priority of the primary survey of trauma care is airway management because inadequate oxygenation of the vital organs might quickly lead to death.[3] If the patient is in cardiac arrest or is unconscious, airway obstruction often occurs due to the posterior movement of the soft palate into the hypopharynx and displacement of the epiglottis on the trachea.[4,5] Accordingly, for patients who have a known or suspected cervical spine injury, using the jaw-thrust maneuver (which moves the tongue forward and also prevents displacement of the epiglottis) is critical.[6,7] At the same time as assessment and management of a patient's airway, restriction of the cervical spinal motion is prominent. Trauma patients often need to

be assumed to have a spinal injury and cervical spinal motion restriction should be applied to those who have a suspected cervical spine injury during the prehospital period until it has been excluded after the comprehensive evaluation of the patient. Furthermore, in trauma patients, since the airway procedures might aggravate the possible cervical spine injury, during the airway management, using the jaw-thrust maneuver combined with inline bimanual cervical spinal motion restriction is recommended.[7,8] During the traumatic cardiac arrest settings in which both spinal motion restriction and chest compression are implemented, supraglottic airways would be the first choice for most of the Emergency Medical Services personnel. The last guideline for Advanced Life Support indicates that during cardiac arrest, if an advanced airway is needed, supraglottic airways might be used as an alternative to endotracheal intubation.[7] Supraglottic airways can be used as the first choice, especially in prehospital settings where endotracheal intubation success rates and experience are low.[9] The use of laryngeal mask airway (LMA) is reasonable during the prehospital OHCA settings that is blindly inserted and consequently easy to be used by inexperienced providers.[10] Repeated failed insertion attempts of the LMA might increase complications such as aspiration, edema, and bleeding.[11] Thus, different techniques such as single-handed cricoid pressure, bimanual cricoid pressure, rotation, and the triple airway maneuver have been studied to improve the first-pass success rates and the insertion times.[12–15]

It was hypothesized that the jaw-thrust maneuver would ease the insertion of the LMA by moving the tongue forward from the palate and posterior pharyngeal wall. In this randomized, cross-over study, the effect of jaw-thrust maneuver on LMA insertion times of the paramedics with or without chest compression and with or without cervical stabilization in a manikin has been evaluated.

Methods

Study Design and Settings

The study was a randomized, cross-over manikin study. The study was approved by the local ethics committee (2021/123). Paramedics who were undertaking periodical prehospital training module in the Prehospital Command and Control Center were informed about the study following the module. Paramedics who wanted to participate to the study were enrolled, whereas those who did not want to enroll or continue to participate to the study were excluded. Written informed consent was obtained from all paramedics included in the study. Eleven paramedics participated in the study. All of the participants had prior experience of LMA insertion.

Prior to the study, a randomization table had been created for each participant by an online program and participants were assigned to a randomization paper prior to their attempts. Participants inserted LMA in jaw-thrust position and standard position in a crossover order of a total of eight scenarios following LMA insertion: (1) chest compression without cervical stabilization scenario; (2) chest compression with cervical stabilization scenario; (3) cervical stabilization without chest compression scenario; and (4) the scenario where neither cervical stabilization nor chest compression were performed.

Each participant was offered to practice each LMA insertion method once on the manikin (Life/form Deluxe Crisis Manikin Torso with advanced airway management; Nasco Healthcare Inc.; Saugerties, New York USA). The Lund University Cardiac Arrest System version 2 (LUCAS 2; Lund, Sweden) mechanical compression device was used to perform chest compressions. A size five silicone LMA (Hitech Medical Co. Ltd.; Shanghai, Republic of China) was used in this study. The manikin was placed on a stretcher in a supine position. The equipment necessary for the interventions was placed near the head of the manikin. Based on the previous studies, each participant was requested to finish the LMA insertion procedure in two minutes.[16] Participants were allowed one attempt for each LMA insertion scenario. Following the interventions, participants were asked to grade the difficulty of each method on a five-point Likert scale: one = "very difficult;" two = "difficult;" three = "moderate;" four = "easy;" and five = "very easy."

Outcome Measures

Insertion time was defined as the time from when the LMA was picked up to obtaining effective ventilation. Effective ventilation was defined as the presence of chest rise with ventilation. The primary outcome of the study was the comparison of LMA insertion times for each method. The secondary outcome measures were first-pass success rates and the comparison of the difficulty level of each method.

Primary Data Analysis

Statistical analyses were performed using SPSS version 22 (SPSS, Inc.; Chicago, Illinois USA). The normality of the distribution of data was examined by the Kolmogorov–Smirnov/Shapiro–Wilk tests. Descriptive statistics are presented as the mean and standard deviation (SD) for parametric variables and the median and interquartile range (IQR) for nonparametric variables. The data showing a normal distribution were compared using a paired t test, and the data lacking a normal distribution were compared using the Mann–Whitney U test. Categorical variables in independent groups were analyzed with the X^2 test. P values less than .05 were considered statistically significant.

Results

Eleven participants were included in the study with each participant conducting eight different LMA insertions. Participants had a mean of 28.1 (SD = 5.9) years of age and 3/11 (27%) were male. Each participant had at least two years of experience with a mean of 5.5 (SD = 7.2) years.

A total of 88 attempts have been evaluated for the study. The means of LMA insertion times of the 88 attempts were 9.51 (SD = 1.86) seconds. When jaw-thrust and standard position were compared for each scenario, LMA insertion times did not differ significantly between jaw-thrust and standard position groups (P = .753, P = .834, P = .146, and P = .697, respectively). The means and statistical differences of each scenario in the study have been summarized in Table 1. When all scenarios were evaluated together, LMA insertion times did not significantly differ between jaw-thrust and standard position groups (P = .426). The LMA insertion times did not significantly differ with or without chest compression (P = .729). The LMA insertion times did not significantly differ with or without cervical stabilization (P = .07). The means and statistical differences of each scenario in the study have been summarized in Table 2. First-pass success rates were 88/88 (100%) for every attempt of the study. The majority of the participants perceived the overall attempts as "very easy" or "easy" (64/88; 73%). The self-perceived difficulty of the LMA placement on different scenarios has been summarized in Figure 1.

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	CS (+) CC (+)	CS (+) CC (-)	CS (-) CC (+)	CS (-) CC (-)
Jaw-Thrust	9.0 (SD = 1.9)	9.1 (SD = 2.1)	9.5 (SD = 1.9)	9.8 (SD = 1.4)
Standard	9.3 (SD = 2.1)	9.3 (SD = 1.9)	10.6 (SD = 1.8)	9.6 (SD = 1.8)
P Value	.753	.834	.146	.697

Table 1. The mean insertion times of each scenario
Note: Values presented as mean (SD) secs.
Abbreviations: CS, cervical stabilization; CC, chest compression.

	Applied	Not Applied	P Value
Jaw-Trust	9.7 (SD = 1.9)	9.3 (SD = 1.8)	.426
Chest Compression	9.6 (SD = 2.0)	9.4 (SD = 1.8)	.726
Cervical Stabilization	9.2 (SD = 1.9)	9.9 (SD = 1.7)	.07

Table 2. Mean Insertion Times during the Jaw-Thrust Maneuver, Chest Compression, and Cervical Stabilization
Note: Values presented as mean (SD) secs.

Discussion

The results of the study showed that during the LMA placement, performing the jaw-thrust maneuver instead of the standard method did not shorten the LMA insertion times. In addition, adding chest compression and/or cervical stabilization did not complicate the LMA insertion. All of the LMA insertion attempts, both during the jaw-thrust maneuver and standard method, were successful. The LMA insertion was perceived as "very easy" or "easy" during most of the scenarios. The jaw-thrust maneuver is often used to open the airway in prehospital settings. Therefore, while the chest compression and/or cervical stabilization is implemented, it might be safe to insert LMA when the airway is opened with the jaw-thrust maneuver.

Airway patency is essential for effective ventilation and oxygenation. According to the recent guideline for Advanced Life Support, head tilt-chin lift maneuver, jaw-thrust maneuver, or multiple approaches might be required to open the airway of the patient when cervical spine injury hasn't been suspected.[7] Providing an advanced airway might be needed for those who can't be ventilated with a bag-valve-mask. Although supraglottic airways might be preferred as the first choice for prehospital airway management, the success rates of supraglottic airway insertion range between 65% to 100% among the patients with difficult airway.[17] The difficulty during the placement of the supraglottic airways might be derived from the obstruction of the hypopharynx and trachea by the displacement of the soft palate and the epiglottis, respectively. Therefore, to increase the first-pass success of the supraglottic airway devices, usage of the triple airway maneuver that comprises head tilt, jaw-thrust, and mouth opening was studied, and it was reported that usage of the triple airway maneuver might shorten the i-gel insertion times and might provide wider pharyngeal space in the operating room.[15,18] In contrast, the results of this study indicated that while placing the LMA, insertion times did not differ by performing jaw-thrust maneuver or standard method. This discrepancy might be attributable to differences in the design of the studies, that this study was conducted during chest compression and/or cervical stabilization whereas Akkus, et al carried out the study in the operating room without chest compression and/or cervical stabilization. However, the triple airway maneuver was performed by Akkus, et al; in contrast, only the jaw-thrust maneuver was performed in the current study.[18] Another reason might be, the participants of this study were experienced in LMA insertion with the standard method so that they placed the LMA quickly with the mean insertion times of 9.3 (SD = 1.8) seconds.

The mean LMA insertion times of this study were consistent with the previous studies.[13,19] However, the study results showed an overall first-pass success rate of 100% for every attempt of the study, which was reported between 84%-87% in previous trials.[13,19] Conditions of the study and experience of the participants might have caused the difference in the results that the LMA was placed by novice participants in the study conducted by Komasawa, et al.[19]

In this study, chest compression did not affect the first-pass success rates which were consistent with the previous studies.[20–22] However, the chest compression and LMA insertion time relationship remains controversial in that Bielski, et al and Lee, et al reported that there was no statistical association between chest compression and LMA insertion times, whereas Kohama, et al reported elongation of the LMA insertion times due to chest compression.[21–23]

Inline bimanual cervical spinal motion restriction might render LMA insertion more difficult because the angle between the oral and pharyngeal axes becomes acute at the back of the tongue.[24] However, in the present study, inline bimanual cervical spinal motion restriction did not affect the first-pass success rates and insertion times. Although the results that were reported by Brimacombe, et al were consistent with these results, Asai, et al reported a significant extension of the insertion times when the cervical stabilization was performed.[13,24]

Limitations

The study had several limitations. First, this was a single-center, manikin study. Thus, the results of the study cannot be generalized. Furthermore, in this study, the difficult airway situations that are often encountered in prehospital trauma settings like vomit, edema, and blood haven't been simulated. However, this study tried to imitate the real clinical settings with cervical stabilization and chest compressions. Second, the participants' pre-existing LMA insertion experience on the standard method might have affected the results of the study. However, to overcome this limitation, participants were offered to practice each LMA insertion method once on the manikin. Third, in this study, "LMA Classic" has been used. There are several different types of LMAs available for supraglottic airway management, therefore these results cannot be generalized.

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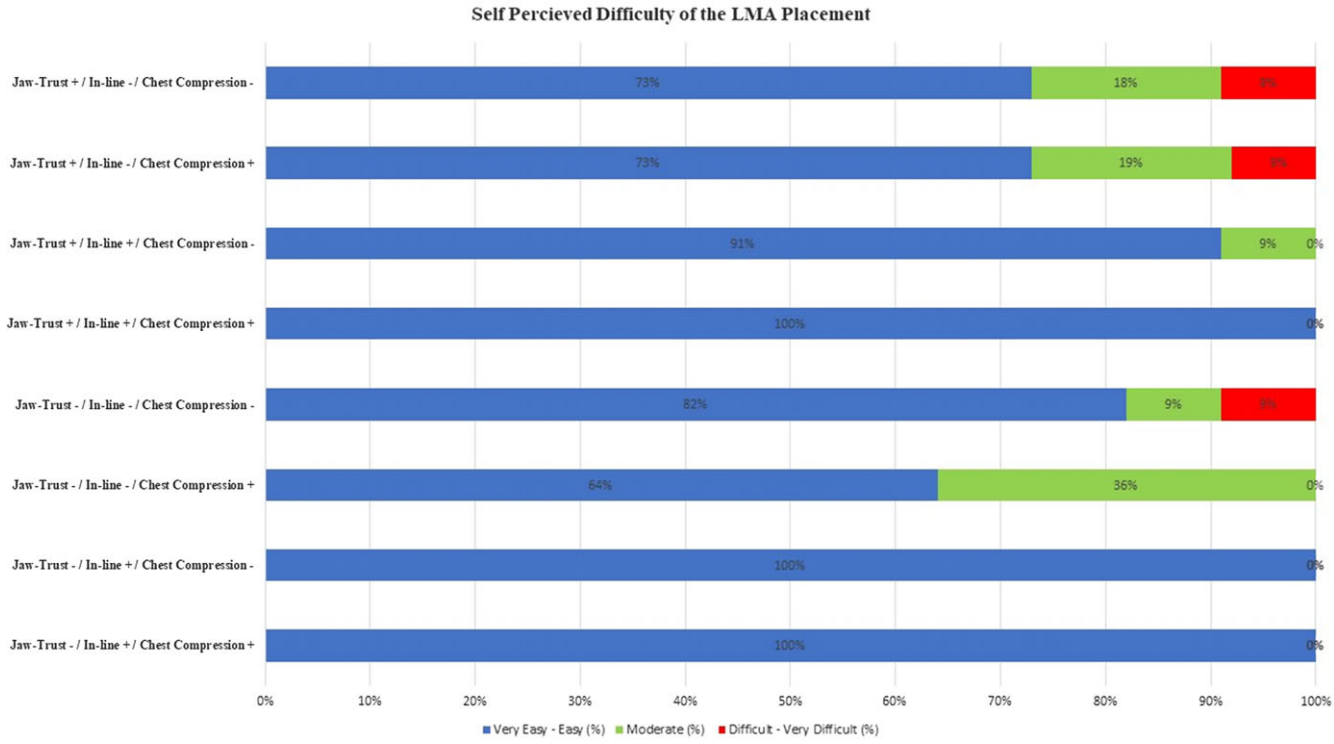

Figure 1. Perception of Difficulty during the Insertion of Laryngeal Mask Airway in Eight Scenarios.

Conclusion

The findings of this study show that LMA insertion might be attempted both during the jaw-thrust maneuver and standard position in patients with or without chest compression and with or without cervical stabilization. Furthermore, since the jaw-thrust maneuver is a frequently preferred method to open the airway, while the chest compression and/or cervical stabilization is implemented, it might be safe to insert LMA when the airway is opened with the jaw-thrust maneuver. Future research should focus on the investigation of the difference of the LMA insertion times and first-pass success rates between the two methods in the clinical settings.

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