Laryngeal Tube and Intubating Laryngeal Mask Insertion in a Manikin by First-Responder Trainees after a Short Video-Clip Demonstration

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Abbreviations:
FDF = Finnish Defense Force
ILMA = intubating laryngeal mask
LMA = laryngeal mask airways
LT = laryngeal tube
VAS = visual analogue scale

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Abstract

Introduction: This study was performed in the Finnish Defense Forces to assess the potential applicability and value of short video clips as educational material to teach advanced airway management and as the first means of introducing the use of a laryngeal tube (LT) or an intubating laryngeal mask (ILMA) to inexperienced, military, first-responder trainees with no prior hands-on experience.

Methods: The 60 non-commissioned medical officers participating in this study were randomly assigned into one of two groups: the LT- and the ILMA-group. After viewing the video clips, the trainees were required to perform 10 consecutive, successful insertions of the given instrument into a manikin. The number and duration of the attempts required prior to the 10 consecutive successful insertions were measured.

Results: The goal of 10 consecutive successful insertions was attained by all 30 subjects in the LT-group, and by 27 of 29 subjects in the ILMA-group with a maximum of 30 attempts. Improvement in the ease and speed of insertion was evident between the first and last consecutive insertions in both groups.

Conclusions: "Satisfactory" to "good" skill levels are achieved with the applied video-clip demonstration method, even in inexperienced first-responder trainees lacking previous hands on experience.

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Introduction

Establishing and securing an open airway plays an integral part in basic life support. The cuffed endotracheal tube remains the golden standard for restoring and maintaining adequate blood oxygenation to patients in respiratory distress. However, endotracheal intubation only can be used by experienced personnel.[1] Ventilation with a facemask also can be applied, but several potential risks, including over-ventilation with gastric inflation and subsequent regurgitation, must be taken into consideration.[2]

To overcome the difficulties and risk factors associated with intubation and face masks, oropharyngeal airways such as the Combitube® (Tyco Healthcare/Sheridan, Argyle, NY), laryngeal tube (LT) (VBM, Medizintechnik, Germany) and the intubating laryngeal mask airway (ILMA) (LMA-Fastrach™, LMA North America, Inc. San Diego, CA) have been developed. These devices are inserted blindly into the patient's oropharynx.[3–6] The devices in this study, the LT and the ILMA, were chosen for their superior simplicity of use by non-trained personnel as compared to the Combitube.

The LT, a device somewhat like a single-lumen, shortened Combitube® was introduced in 1999.[5–7] An identical, polyvinylchloride (PVC) version of the LT for single use has been available since 2004.[8] It has two cuffs that are inflated with a single syringe. The distal cuff lies at the orifice of the esophagus and the proximal cuff blocks the pharynx at the base of the tongue.

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Figure 1—Disposable laryngeal tube (LT)

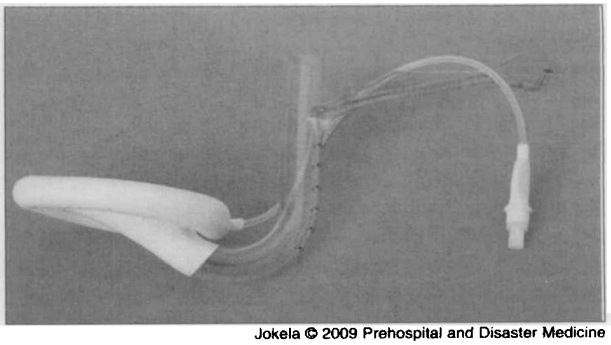
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Figure 2—Intubating laryngeal mask airway (ILMA)

Between the two cuffs, there are two apertures through which air enters the lungs via the larynx.

The original laryngeal mask airway (LMA), also known as the classic LMA (invented in 1981), was modified in 1988 by adding an inflatable cuff and using latex and silicon. It gained vast success in UK hospitals in 1989 and was approved by the US Food and Drug Administration in 1991.[9] The classic LMA is recommended by the European Resuscitation Council.[10] The ILMA (LMA-Fastrach™), a variant of the LMA, was introduced in 1973,[4] and it has been studied mainly in the context of difficult intubations.[10] Compared to the standard LMA, it is inserted without digital manipulation and is designed to be used with the patient's head and neck in the neutral position and the cervical spine immobilized. The ILMA also allows blind or fiberoptically conducted tracheal intubation without removing it.

In the Finnish Defense Forces (FDF), the total service period for conscripts becoming non-commissioned medical officers is 362 days. The first eight weeks consists of basic training. After basic training, they participate in a three-month period of education and practical training in first aid and basic life support in the FDF Medical School. After graduating from the Medical School, the non-commissioned officers return to their own units where they practice and improve their skills in first aid and basic life support by working at the FDF's health officers. By working at the FDF health office's bureau, they also participate in martial training in the field and camps, where manikins are, as a rule, employed in simulated situations. The standard airway management has been head-neck-tilt, oropharyngeal airway, and mouth-to-mouth ventilation, if needed.

The aim of this study was to investigate the applicability of the LT and the ILMA as the first airway management instruments for use by inexperienced military trainees in the FDF Medical Corps. The instruments were used by novice trainees after viewing a short video-clip teaching the proper insertion technique. Both LT (Figure 1) and ILMA (Figure 2) are supraglottic devices inserted blindly into the patient's oropharynx. These investigations are only one part of a larger project at the FDF's Centre of Military Medicine for further improving the level of education and practical skills of the conscript trainees during their time of military service.

Methods

Sixty volunteer conscripts (56 males and 4 females) 18–21 years of age at the Non-Commissioned Officers' School of the Cavalry Battalion in the Hame Regiment participated in the present study after receiving 50 hours of training in first aid and basic life support. The conscripts were randomly assigned into one of two separate groups: 30 to the LT and 30 to the ILMA group. Prior to initiation of the actual study, there was one dropout in the ILMA group.

The subjects in the LT group were shown a 35-second video-clip demonstrating insertion of the LT and the inflation of its cuffs. The subjects in the ILMA group were shown a 20-second video-clip on the insertion of the ILMA. Both the LT and the ILMA video clips were shown without audio comments. The respective video clips were shown only once and just before the insertions were performed by participants of both groups.

After viewing the video clip and prior to any personal hands-on experience, the participants in both groups were requested to express their subjective opinion on the ease of performing a successful insertion on first attempt using a 10 cm visual analogue scale (VAS). The scale ranged from "I believe I can use the instrument" to "I believe I can not use the instrument". A score of 0 indicated the greatest confidence and a score of 10 the greatest doubt in one's own personal performance. After completion of the required series of insertions, the experienced difficulty in using the device was measured with a 10 cm VAS ranging from "Using the device was very easy" to "Using the device was very difficult".

The settings in the test room were identical for both groups. A Resusci® Anne Simulator (Laerdal Medical AS, Stavanger, Norway) was placed on the floor; its airway was prelubricated with a water-based gel.

In the LT group, a completely deflated laryngeal tube (size 4; for adults weighing 50–70 kg/110–154 lbs) was placed next to the manikin's head and the color-coded 100 ml filled syringe was located on the opposite side. Similarly, in the ILMA group, a completely deflated, intubating laryngeal mask airway (ILMA, size 4) was placed next to the manikin's head and the 20 ml filled syringe on the opposite side.

During the testing, the participants were not permitted to watch each others' performances, nor were they allowed to communicate with each other until the end of the test series. Moreover, they received no information on their personal performance times or the level of effectiveness prior to completion of the whole test series by all participants.

Performance times were measured starting from the moment the LT or the ILMA was picked up and ending when the syringe was laid down after cuff inflation. These

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	LT		ILMA	
Attempts	n	%	n	%
1	29	96.7	20	74.1
2	1	3.3	3	11.1
4	--	--	1	3.7
8	--	--	2	7.4
11	--	--	1	3.7
Total	30	100.0	27	93.1

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Table 1—Number of insertion attempts in the laryngeal tube (LT) group (n = 30) and the Intubating laryngeal mask airway (ILMA) group (n = 29) prior to accomplishing 10 consecutive successful insertions

times were registered by an independent observer. Insertion of both the LT and the ILMA was judged by an instructor as "successful", when a tidal volume of at least 400 ml was achieved. According to Dörges *et al*, this is the amount that doesn't result in gastric insufflation with a bag-valve device.[5]

Intuitive ease of use was assessed by counting the number of attempts needed by each subject before the first successful insertion of the instrument. For the evaluation of repetitive insertion, the participants had to perform 10 consecutive successful insertions. Before each insertion attempt, the test conditions were the same as at the beginning of the trial. When an insertion attempt failed, counting was restarted from the beginning until a series of 10 consecutive successful intubations were accomplished. The numbers of failed attempts prior to the 10 consecutive successful insertions of the LT or the ILMA, as well as the execution times of each individual insertion, were recorded.

Statistical processing was performed using GraphPad Prism version 4.0a for Macintosh (GraphPad Software, San Diego, CA). The numerical data presented in the results are median values if not stated otherwise. The 95% confidence intervals (CI) were calculated using modified Wald method. Fisher's exact test and the Mann-Whitney test were used to analyze differences between groups, as appropriate. A p-value ≤0.05 was considered significant.

Results

The goal of performing 10 consecutive successful insertions was attained by all 30 subjects (100%) in the LT group and by 27 (93.1%) of the 29 subjects in the ILMA group ($p = 0.682$). On first attempt at 10 consecutive successful insertions, 29 (96.7%) of the 30 subjects in the LT group and 20 (74.7%) of the 29 subjects in the ILMA group succeeded in inserting the device (Table 1). In the other cases, the series of 10 consecutive insertions was preceded by 1 to 10 failures. The mean total time of a successful insertion in the LT-group was 22.0 seconds (range 14–29 seconds) and 23.9 seconds (range 7–67 seconds) in the ILMA group ($p = 0.459$). Insertion times were ≤10 seconds in 102 (34%) of the 300 successful insertions in the LT group and in 155 (57.4%) of the 270 successful insertions in the ILMA group. Correspondingly, the insertion times were >10 seconds in 198

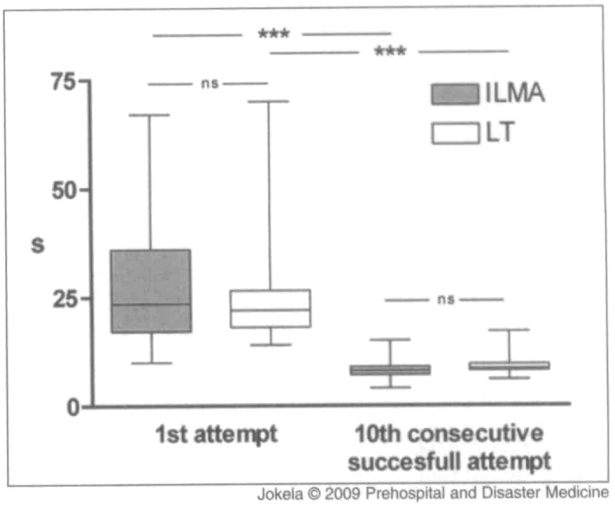

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Figure 3—The duration of the first insertion attempt and the last insertion of a series of ten consecutive successful attempts using intubating laryngeal mask (ILMA) or laryngeal tube (LT)

(66%) insertions in the LT group and in 115 (42.6%) insertions in the ILMA group. A comparison of the times of the first and last insertion in the series of 10 consecutive successful insertions in both groups is shown in Figure 3.

The mean intuitive VAS score for the presumed difficulty of use, after seeing the video clip was 5.1 cm (range 0–10 cm) for the LT and 5.0 cm (range 0–10 cm) for the ILMA. The corresponding median values were 5.0 cm and 5.0 cm, respectively ($p = 0.873$). The mean value of the VAS score for the perceived difficulty of use after personal hands-on experience and completion of the required 10 consecutive successful insertions, was 0.8 cm (range 0–4.7 cm) in the LT-group and 0.45 cm (range 0–2.5 cm) in the ILMA-group. The respective median values were 3.0 and 2.5 cm ($p = 0.466$). Two subjects in the LT group and one in the ILMA-group failed to remit both their VAS scores.

Discussion

The present study is part of a continuous project aimed at gathering new information, experiences, and practical examples that can be adopted and applied to updating and improving the methods and practices employed in the education and training of the non-commissioned medical officers in the FDF.

The Laerdal Resusci Anne Simulator employed in the present study has previously been used in various manikin trials.[8,11,12] The use of a manikin in the primary evaluation and comparison of different devices and instruments for airway management is recommended by the authors. First and foremost, a manikin is not subject to individual variations that human beings are, and no harm can be done to a manikin. Thus, the factors determining the ease or difficulty of insertion and the basis for evaluation of the insertion technique remain identical and unaltered for all test subjects and depend mainly on the instrument to be inserted and the manual skills of the subjects. The use of the manikin also allowed for the measurement of the tidal volumes and recognition of gastric inflation, when peak insufflation pressure exceeded 150 mmHg H_2O.[11]

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Rarely used skills are known to deteriorate, and during an airway emergency, there is no time to seek help when there is a great distance to the nearest hospital or doctor. Using a video clip to show a safe and easy way of rapidly securing the airway is a method that can be viewed on a regular mobile telephone that nearly everybody already carries with them. When there is less time to teach, new methods of teaching must to be sought.

In a previous study by Kurola *et al*, the number of insertion attempts and insertion times of 32 inexperienced paramedical students were recorded for the LT and the ILMA, as well as the CobraPLA (COB; Engineered Medical Systems, Indianapolis, IN), in a series of consenting patients (ASA I-II).[12] On first attempt the ILMA was inserted successfully by 75%, the LT by 44% and the COB by 22% of the students. However, in the present study, the LT was inserted on first attempt by 96.7% and the ILMA by 74.1% of the trainees. In addition, the mean insertion time for the first of the 10 consecutive successful insertions was shorter with the LT than the ILMA (22.0 and 23.9 seconds) compared to the respective 24.9 and 22.9 seconds in the study by Kurola *et al*.

Komatsu *et al* compared the insertion of the LT and the ILMA in a series of patients whose necks were stabilized with manual, in-line traction, and found that the insertion of the ILMA was quicker and easier than the insertion of the LT.[13] In their crossover study, the mean time required for the LT insertion was longer than for the ILMA (28 seconds; range 23–35 versus 20 seconds; range 15–25. These results support the present study in which insertion times were ≤10 seconds in 34% of the insertions in the LT-group and in 57.4% in the ILMA group. The paramedic students participating in the study by Kurola *et al*, rated the ILMA as the best device and considered it to be the most useful one when compared to the LT and the COB.[12] Initial insertion success rate was higher with the LT in the current trial. The mean VAS scores for the ILMA for the perceived ease of use given by trainees after completion of the required 10 consecutive successful insertions (0.82 for the LT and 0.45 for the ILMA) show that supraglottic devices are well-accepted by inexperienced personnel.

The LT and the ILMA are devices that can be used as alternatives for endotracheal intubation and mask ventilation. Clinical studies during real emergencies are warranted to better evaluate the LT and ILMA as alternatives to ensure the airway safely.

In peacetime, the main beneficiary of the education and training in first aid and basic life support skills received by the conscripts during their service in the FDF's Medical Corps is the civilian sector. Annually, some 260 non-commissioned medical officers complete their service and on returning to civilian life, they receive a diploma certifying this ability.

Conclusions

No absolute superiority of the LT or the ILMA could be demonstrated with respect to their applicability for emergency airway management. Hence, both the LT and ILMA provide important alternatives to the endotracheal tube for non-professional, emergency medical personnel.

Short video clips can be valuable educational and instructional tools as demonstrated in the present study. Video clips possess several significant advantages, including, among others, repeatability, slow motion viewing, or still-pictures, and the possibility of using them for self-teaching.

These results strongly support the incorporation of the method in the training of advanced life supporting skills to the non-commissioned medical officers in the FDF's Medical School. This method even could be applied to other non-professional life support training programs.

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