

Role of Laryngeal Mask Airway in First Aids in Confined Space

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Abstract

Laryngeal mask airway (LMA) has been shown to be an alternative method of definite airway but its role in rescue from confined space has not been determined. One hundred and sixty seven persons who attended the training course of disaster medicine were enrolled as the study population. Sixty two of them were men whereas the other 105 women. Thirty four of the study population were medical doctors, 95 nurses, 30 emergency medical technicians, and 8 laypersons. We arranged a workshop of confined space medicine. The comparison of applicability between conventional endotracheal intubation and LMA was made. Before evaluation, every participant accepted detailed illustration and demonstration of the skills. Every one was asked to perform airway management for the manikins in confined space with face down, sitting position, side position and "reverse" supine position. The success rate and the time elapse for both endotracheal intubation and LMA application/intubation was compared. Success rate of first LMA application is 100% for all positions which is significantly better than those of endotracheal intubation (85% for sitting position, $P<0.01$; 80% for side position, $P<0.01$; 76% for face down, $P<0.01$; and 74% for "reverse" supine position, $P<0.001$). The time elapse for first LMA application was also significantly lower than those of endotracheal intubation (as presented). The success rate and time elapse of first LMA intubation and the number of trials before success was comparable to endotracheal intubation. LMA was preferred as a choice of airway management in confined space rescue. (*Ann Disaster Med.* 2003;1:85-96)

Key words: Laryngeal Mask Airway; Confined Space; First Aid; Disaster

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Introduction

Although there have been many advances in first aids in recent decades, the rescue in confined space still remained a great challenge. For example, it may be difficult for the rescue team or disaster medical assistant team (DMAT) to maintain airway in a narrow space with no good preparation. The laryngeal mask airway (LMA) may be a resolution under such circumstances.

The LMA was designed in the 1980's and has gained widespread popularity in clinical use in the last decade.^{1,2} It allows either spontaneous or positive-pressure ventilation. With advances in the design, it has also received more attention as a tool for management of the difficult airway.³⁻⁵ Because the placement of this device is less technique-dependent, the learning curve will be adequate.⁶⁻¹⁰ In other words, the LMA has theoretical basis for the rescue team or DMAT to learn and use under difficult situations.¹⁰⁻¹⁴ We then underwent the following study to compare the efficiencies between traditional intubation and the LMA with or without intubation in the confined space.

Materials and Methods

Study population

One hundred and sixty seven persons who attended the training course of disaster medicine in 2001 were enrolled as the study population. Sixty two of them were men whereas the other 105

women. Thirty four of the study population were medical doctors, 95 nurses, 30 emergency medical technicians, and 8 laypersons. According to the education background, 147 of them (88%) have ever qualified as the basic life science providers, 70 (42%) as the providers of advanced cardiovascular life support, and 55 of them (12%) were neither. We therein classified the students into 4 classes according to their self-determination in performance of intubation: Class A (n=30), those who had good clinical experiences in intubation; Class B (n=18) who ever completed the training of intubation but had only limited clinical experiences; Class C (n=99) who had ever attended the training course of intubation with no real performance; and Class D (n=55) that had never been trained.

Study protocol

We arranged a workshop of confined space medicine to compare the applicability between conventional endotracheal intubation and LMA with and without intubation. Before evaluation, every participant accepted detailed illustration and demonstration of the skills. Every one was asked to perform airway management for the manikins in confined space with the following four positions: face down, sitting position, side position and "reverse" supine position. The students would be asked to re-prepare and

intubate if initial attempts failed. The success rate and the time elapse for both endotracheal intubation and LMA application/intubation was compared.

Statistic Analysis

The categorical data were inputted in Microsoft Excel 2000 for descriptive statistics and further qualitative analysis. These results were analyzed using the chi-squared test. ANOVA with a Newman-Keuls post hoc test was used to determine whether any significant differences existed among continuous data. A $P < 0.05$ was considered to be statistically significant.

Results

For all positions, the success rate of first LMA application is 100% and significantly better than those of endotracheal intubation (85% for sitting position, $P < 0.01$; 80% for side position, $P < 0.01$; 76% for face down, $P < 0.01$; and 74% for “reverse” supine position, $P < 0.001$) (Figure 1). The time elapse for first successful LMA application was also significantly lower than those of endotracheal intubation (Figure 2A). The success rate of first LMA intubation was comparable to that of endotracheal intubation (88% vs. 85% for sitting position, $P = \text{NS}$; 80% vs. 80% for side position, $P = \text{NS}$; 78% vs. 76% for face down, $P = \text{NS}$; and 76% vs. 74% for “reverse” supine position, $P = \text{NS}$) (Figure 3), as was the time elapse between two comparisons (Figure 2B).

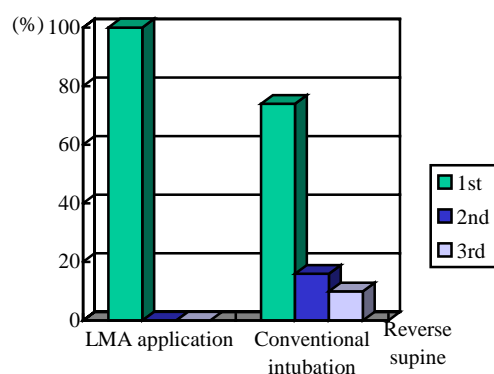
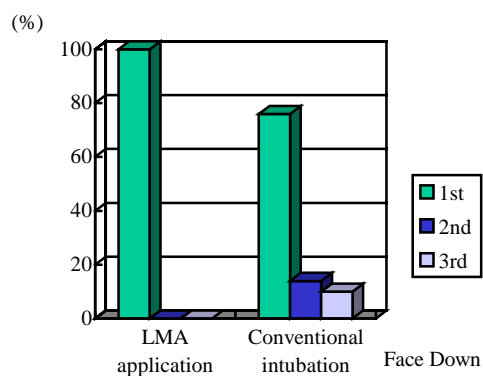
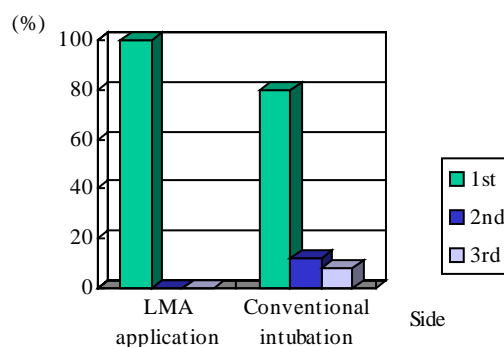
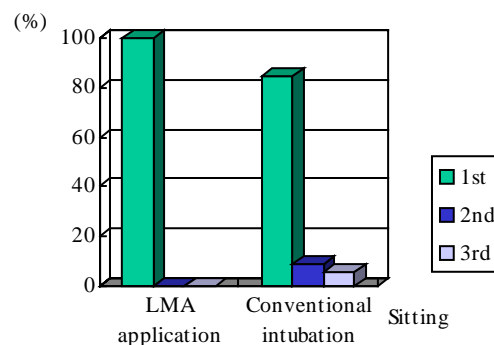


Figure 1. The comparisons in success rate of first LMA application and conventional intubation

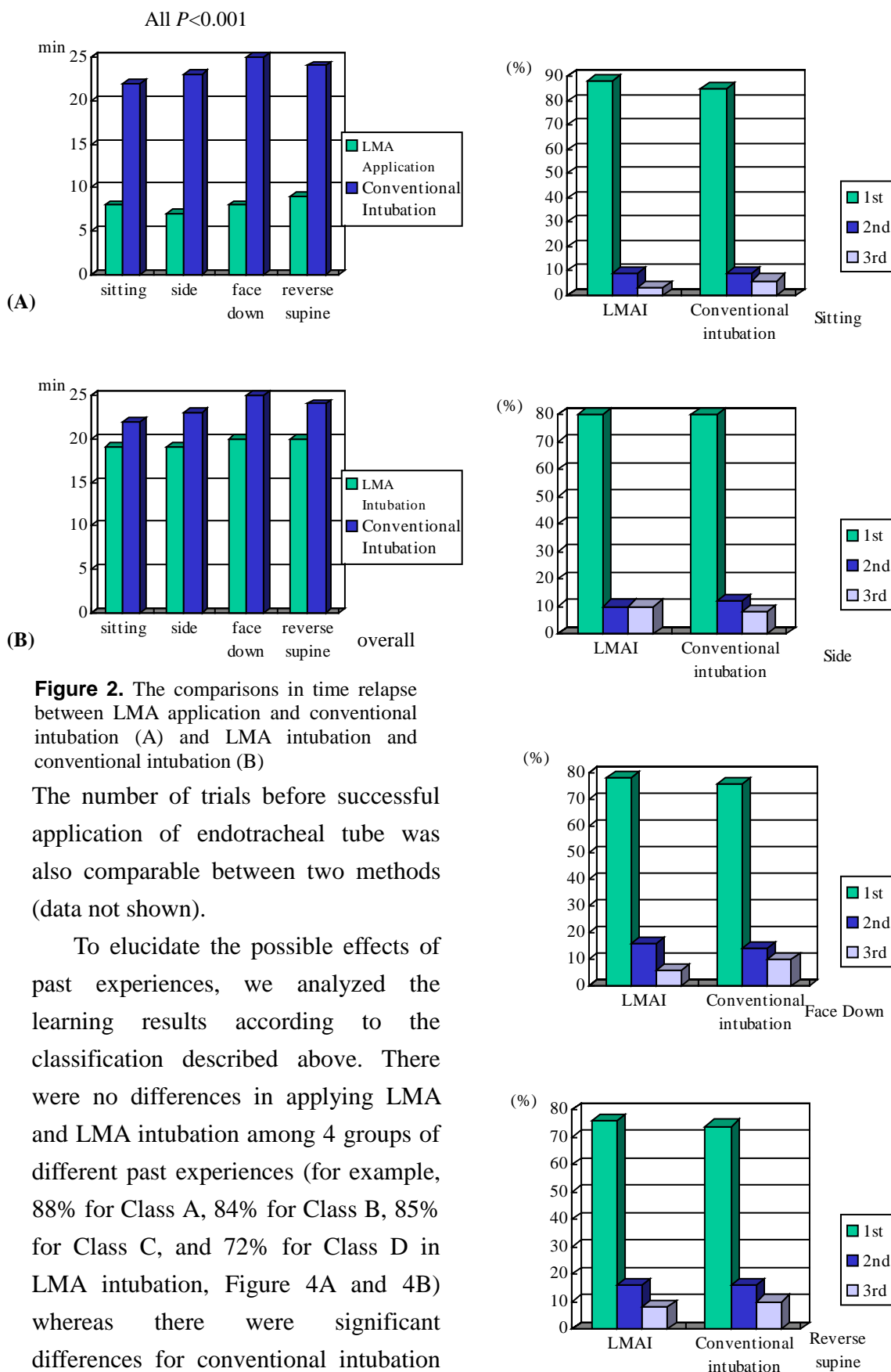


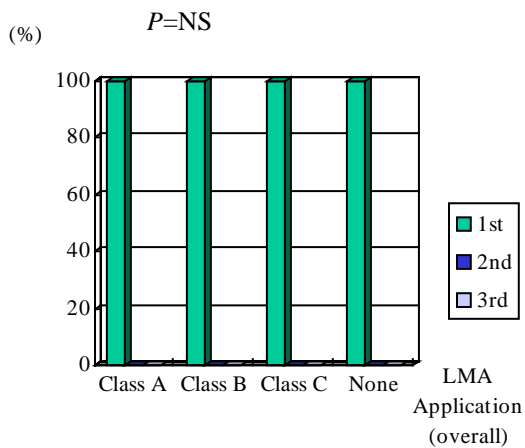
Figure 2. The comparisons in time relapse between LMA application and conventional intubation (A) and LMA intubation and conventional intubation (B)

The number of trials before successful application of endotracheal tube was also comparable between two methods (data not shown).

To elucidate the possible effects of past experiences, we analyzed the learning results according to the classification described above. There were no differences in applying LMA and LMA intubation among 4 groups of different past experiences (for example, 88% for Class A, 84% for Class B, 85% for Class C, and 72% for Class D in LMA intubation, Figure 4A and 4B) whereas there were significant differences for conventional intubation (96% for Class A, 80% for Class B,

Figure 3. The comparisons in success rate of first LMA intubation and conventional intubation

64% for Class C, and 30% for Class D in LMA intubation, $P < 0.001$ among 4 groups) (Figure 4C). The similar findings were also observed according to the performance among different



medical background. In other words, the success rate were not significantly different in applying LMA or LMA intubation no matter the students were physicians, nurses, emergency medical technicians, or laypersons (Figure. 5).

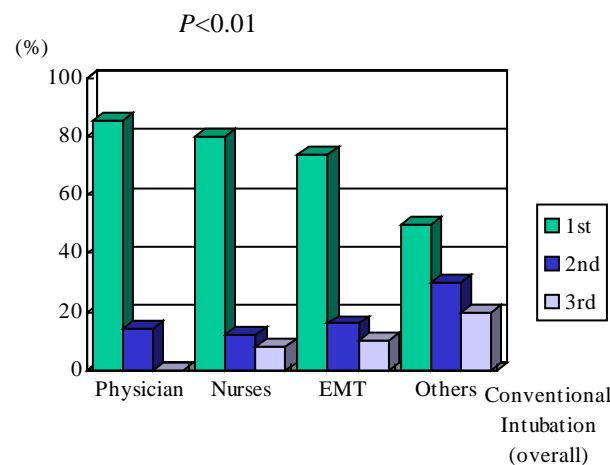
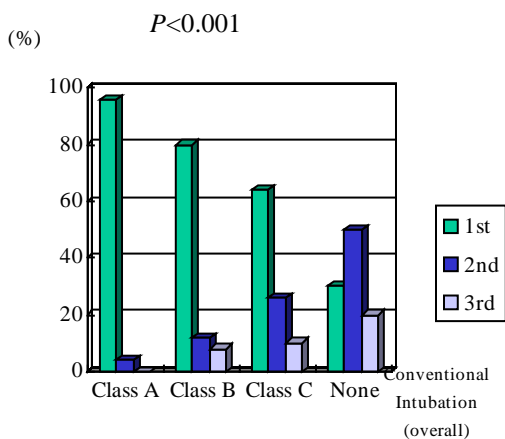
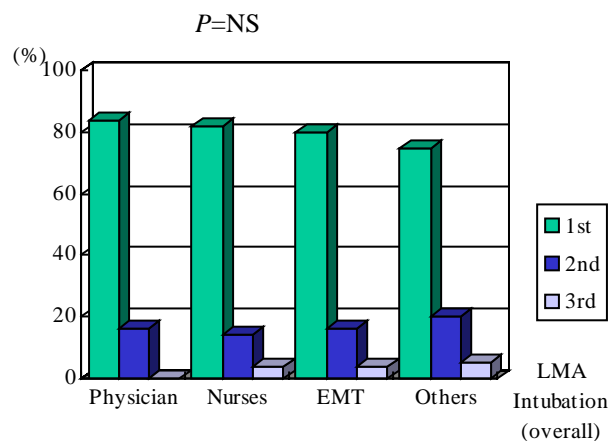
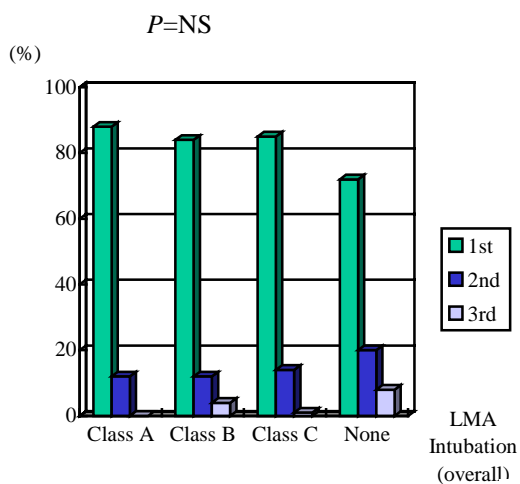
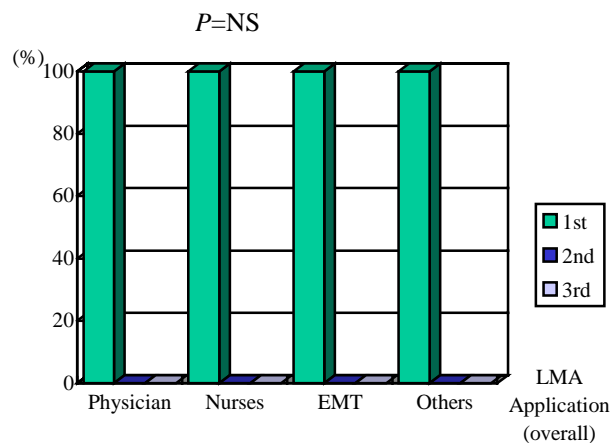


Figure 4. The comparisons in success rate of LMA application, LMA intubation and conventional intubation in groups of different experiences

Figure 5. The comparisons in success rate of LMA application, LMA intubation and conventional intubation in groups of different medical backgrounds

Discussion

In prehospital situations, the LMA and the Combitube dual-lumen tube are both time-saving procedure for maintaining patent airways.^{9,10,15-17} However, in one study comparing the LMA and the Combitube for inexperienced operators, the rate of successful LMA placements in anesthetized and paralyzed patients was 100%, but the success rate only 92% with a Combitube.¹⁰ More complicated procedures may contribute to the failure of the Combitube. In addition, the Combitube cannot be used in patients with a protective reflex or in pediatric victims, whereas the LMA has no such limitations.¹⁸ Another study⁷ showed that physicians-in-training could insert an LMA successfully in 90% of victims with cardiopulmonary arrest even when they hadn't had any clinical experience using an LMA.

The above observations have been again proven in our investigations. The success rate of LMA application was almost 100% for every student, independent of their education background and experiences. Evidence from some preliminary studies (including our data) revealed that the application of the LMA is not affected by the patient position,¹⁹ past experience,⁷⁻⁹ consciousness level,¹⁻⁴ or cervical immobilization.²¹⁻²³ These characteristics make the LMA more attractive in rescue of victims in confined spaces. Our data revealed that the success rate of first LMA application

was 100% for various patient positions, which is significantly better than the rates for endotracheal intubation (85% for the sitting position; 80% for side position; 76% for face down; and 74% for "reverse" supine position). The time elapsed for first LMA application was also significantly lower than that for endotracheal intubation. The success rate and time elapsed for first ILMA and the number of trials before success was comparable to endotracheal intubation. The advantages of LMA over conventional intubation in different positions have demonstrated that the pre-shaped design in LMA has overcome many clinical difficulties in using laryngoscope and preparations.

However, the success of LMA rescue in the clinical settings still depends on several factors such as the operator's experience, clinical pathways in airway management, and understanding of the interaction between LMA insertion and cricoid pressure.⁶ Surveys have demonstrated that the success rates in emergency rescue are probably lower overall due to lack of familiarity with the device.⁷⁻¹⁰ The overall LMA insertion success rate was 81% in 233 cases in an Australian prehospital study.¹¹ Japanese paramedics' experiences also showed overall excellent outcomes.¹² Brimacombe et al.^{13,14} therein suggested an algorithm for use of the LMA in failed intubation of the nonfasting patient.

LMA as a Conduit Passage

Although the ILMA may be not the first priority for most pre-hospital and confined space rescues, it is still worthwhile to understand the LMA's role as a conduit for passing an endotracheal tube. A newly designed ILMA was specifically designed for intubation. The trachea may thus be intubated blindly through a properly placed LMA.²⁴ However, success rates vary, depending on the operator's experience,²⁵ technique, number of attempts, and equipment^{26,27} according to others' reports. With the advances in design modification, the LMA may be used as a guide for a thin flexible airway stent such as an elastic bougie or an intubating stylet for the passage of an endotracheal tube.^{13,28-30} Retrograde tracheal intubation over a catheter through an LMA has also been reported.³¹⁻³⁶ Because of technical difficulty in fiberoptic intubation and retrograde tracheal intubation for emergency physicians and being impractical in clinical use, the usefulness in disaster medicine should be underscored.

Limitations of LMA

The primary concern with LMA use by emergency physicians and paramedics is incomplete protection of the airway. There is a risk of aspiration in prehospital use of the LMA because the device does not separate the trachea and

esophagus completely.³⁷⁻³⁸ The Sellick maneuver should be maintained continuously for high-risk patients, such as those who have had bag ventilation and those in a non-fasting state, in late pregnancy, with morbid obesity, or with upper gastrointestinal hemorrhage. Although these were conflicting results in some reports,^{39,40} Brimacombe's meta-analysis⁴¹ found an incidence of 2 aspirations in 10,000 patients. We still need to elucidate is whether aspiration is more commonly encountered in the emergency department and prehospital situations because of inadequate preparation.

Another problem is the use of the LMA in patients with either increased airway resistance or very low lung compliance.¹⁸ Inadequate ventilation due to air leakage and gastric distension are predictable in attempting positive ventilation in "tight" asthmatics. The LMA, as in conventional intubation, may induce reflex bronchospasm. However, the severity is always less because the diameter of the LMA is larger and because the LMA does not pass through the trachea.^{18,42} Patients already in bronchospasm need to be monitored carefully.⁴³ Other complications resulting from LMA use are local irritation causing coughing and bucking, upper airway injuries, pressure-induced lesions (such as twelfth cranial nerve palsy), and sometimes hemodynamic compromise.^{44,45} Among them,

pressure-induced injuries may be related to an over-inflated cuff which causes mucosal ischemia with subsequent injury.⁴⁶⁻⁴⁸ Adequate cuff pressure and proper insertion technique are the primary prevention strategies.

Conclusion

The success rate and time elapse of LMA application and first LMA intubation and the number of trials before success were comparable to endotracheal intubation. LMA and its intubation were preferred as a choice of airway management in confined space rescue.

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喉罩呼吸道在侷限空間急救的角色

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摘要

喉罩呼吸道已經被證明是確保呼吸道通暢的另一個選擇，但在侷限空間搜救時所能發揮的功效仍尚未證實。我們以參加災難醫學訓練的 167 位人員作為本研究的樣本，其中 62 個是男性，105 個是女性。總共有 34 個醫師、95 個護士、30 個急診技術員以及 8 位一般民眾。我們舉辦了一個侷限空間搜救的研討會，比較傳統插管方式與喉罩呼吸道的實際應用。在評估之前，每個參與者都接受了詳細的說明與技巧示範。每個人都要對身處侷限空間的人偶建立呼吸道，人偶的姿勢包括顏面部位向下、坐姿、側向以及”反轉”的仰臥。我們比較傳統插管與喉罩呼吸道的成功率以及所花費的時間。喉罩呼吸道第一次嘗試的成功率在所有的姿勢都達到 100%，明顯優於傳統插管（坐姿成功率 85%， $P < 0.01$ ；側方成功率 80%， $P < 0.01$ ；顏面向下成功率 76%， $P < 0.01$ ；以及”反轉”仰臥姿勢成功率 74%， $P < 0.001$ ）第一次嘗試喉罩呼吸道所花費的時間也明顯低於傳統插管（如圖所示），喉罩呼吸道無論是在插管成功率、花費時間以及嘗試次數方面都可以與傳統插管相匹敵。在侷限空間搜救時，喉罩呼吸道會是較適合的考量。（*Ann Disaster Med.* 2003;1:85-96）

關鍵詞：喉罩呼吸道；侷限空間；急救；災難

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收件：91 年 8 月 8 日

修正：91 年 10 月 20 日

接受刊載：91 年 11 月 20 日

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