

Airway Management with the Laryngeal Mask Airway (LMA) in Emergency Medical Services

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Background: Airway management is an important aspect of care in emergency medical services (EMS) used to prevent obstruction of the respiratory track and inadequate oxygenation. The laryngeal mask airway (LMA) is an easy-to-use supraglottic airway device developed in 1988 that has a high success rate in both adults and children. However, there have yet been no studies regarding LMA use in EMS in Thailand.

Objective: To determine the success rate of LMA in EMS and factors associated with successful LMA insertion.

Materials and Methods: This was a cross-sectional study consisting of Srinagarind Hospital EMS patients over 18 years of age who underwent LMA airway management between March 2016 and March 2020. Data were collected from the Srinagarind Hospital EMS operation database and hospital information database system.

Results: A total of 154 patients were enrolled with a mean age of 43.1±8.5 years, 89 (57.8%) of whom were male. Non-trauma patients accounted for 72.7% of all cases. The average oxygen saturation before and after LMA use were 71.4±12.3% and 94.4±3.2%, respectively ($p = 0.022$). Students in their first and third year of residency training were able to successfully perform LMA airway management on the first attempt in 83.3% and 98.4% of cases, respectively ($p = 0.025$).

Conclusion: Airway management using the LMA had a high success rate on the first attempt, required less time for insertion than other comparable devices, and resulted in a high level of oxygen saturation.

Keywords: Laryngeal mask airway, Emergency medical services, Airway management, Internship and residency

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Airway management is an important aspect of care in emergency medical services (EMS), as obstruction of the respiratory track and inadequate oxygenation lead to more serious morbidity and a higher mortality rate. Basic techniques include open airway and bag-valve mask (BVM) ventilation⁽¹⁻³⁾. The use of endotracheal intubation or supraglottic devices requires a high level of skill, whereas the laryngeal mask airway (LMA) is an easy-to-use supraglottic airway device that has a high success rate both adults and children⁽⁴⁻⁷⁾. Paramedics can use the LMA for pre-hospital airway management⁽⁸⁾, with an overall success rate, according to an Australian study, of 74%⁽⁹⁾. Another study from the Netherlands reported a 100% success rate, with

98% of procedures being successful on the first attempt⁽¹⁰⁾. The American College of Surgeons Advanced Trauma Life Support (ATLS) program suggests the LMA as an alternative device for airway management in trauma patients whose neck motion is restricted⁽¹¹⁾. In Israel⁽¹²⁾, the LMA has been used in combat casualties during scene-to-hospital air transport⁽¹³⁾. Another study in Korea found LMA use to be associated with improved out-of-hospital cardiac arrest outcomes⁽¹⁴⁾. In Srinagarind Hospital, LMA airway management is performed by emergency medicine residents which specifies the ability to perform procedures for insertion of the LMA. As there have yet been no studies regarding LMA use in EMS in Thailand, this study was conducted to examine the LMA airway management success rate in this setting.

Materials and Methods

Study population and design

This was a cross-sectional study consisting of Srinagarind Hospital EMS patients over 18 years of age who underwent LMA airway management between March 2016 and March 2020. The exclusion criteria were inability to open the mouth and complete upper airway obstruction. Ethics approval was provided by the Khon Kaen University Ethics Committee for Human Research (HE631280). The requirement for informed consent was

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waived, as patients were identified by a unique study number rather than by name. Data were recorded using the operation national standard checklist for EMS in Thailand. Data were collected from the Srinagarind Hospital EMS operation database and hospital information database system.

Statistical analysis

The sample size was calculated based on the frequency of airway management from a Shin study⁽¹⁴⁾. In order to achieve a significance level of 5% and power of test of 0.8, we determined that a sample size of 154 would be required. Statistical analysis was performed using SPSS for Windows version 17.0 (SPSS Inc., Chicago, IL, USA). Categorical data were presented as percentages, and continuous data were presented using mean and standard deviation. Univariable analysis was performed using a two-sample t-test for numerical data and a Chi-squared or Fisher's exact test for data comparison between the two groups.

Data collection

During EMS operations, emergency medicine residents (doctors) performed symptom assessment and history-taking according to professional standards. If patients met the criteria and required advanced airway management, the LMA was used. Patients' hemodynamic parameters, including diastolic and systolic blood pressure (DBP and SBP), heart rate (HR), and oxygen saturation, were recorded. We also measured parameters and the number of attempts and the time required to insert the LMA.

Results

A total of 154 patients were enrolled between March 2016 and March 2020 (Table 1), 89 (57.8%) of whom were male and 112 (72.7%) of whom were non-trauma patients. The mean age was 43.1±8.5 years. The level of operations was advanced with doctor in 98.7% of cases. The most common indication was cardiac arrest (134 cases; 87.0%).

In the non-cardiac arrest patients, hemodynamic parameters before the application of LMA were as follows: SBP 118.1±42.5 mmHg, DBP 80.4±25.1 mmHg, and HR 103.4±40.5 per minute. The average oxygen saturation levels before and after LMA airway management were 71.4±12.3% and 94.4±3.2%, respectively ($p = 0.022$; Table 2).

The first attempt at airway management using the LMA was successful in 83.3% of cases when administered by first-year emergency medicine residents and 98.4% when performed by third-year residents ($p = 0.025$). The average time required for LMA insertion for first-year, second-year, and third-year residents was 82.8±8.4 seconds, 70.4±10.1 seconds, and 70.2±8.4 seconds, respectively ($p = 0.010$; Table 3). The majority of participants rated the ease of the procedure as four out of five, with a lower score indicating greater difficulty.

Table 1. Characteristics of the subjects

Characteristics	LMA used (n = 154), n (%)
Age (years), mean ± SD	43.1±8.5
Gender: male	89 (57.8)
Type of patient	
Non-trauma	112 (72.7)
Trauma	42 (27.3)
Level of operation	
Advanced with doctor	152 (98.7)
Advanced without doctor	2 (1.3)
Indication for LMA	
Cardiac arrest	134 (87.0)
GCS <9	18 (11.7)
Failed BVM ventilation	2 (1.3)

SD = standard deviation; LMA = laryngeal mask airway; GCS = Glasgow Coma Scale; BVM = bag valve mask

Table 2. Vital signs before and after LMA use (excluding cardiac arrest patients, n = 20)

Vital signs, mean ± SD	Before LMA use	After LMA use	p-value
SBP (mmHg)	118.1±42.5	111.5±40.6	0.920
DBP (mmHg)	80.4±25.1	81.4±22.4	0.862
HR (per minute)	103.4±40.5	95.4±42.8	0.820
Oxygen saturation (%)	71.4±12.3	94.4±3.2	0.022*

* Statistical significance

LMA = laryngeal mask airway; SD = standard deviation; SBP = systolic blood pressure; DBP = diastolic blood pressure; HR = heart rate; mmHg = millimeter of mercury

Discussion

The present study analyzed LMA airway management over a four-year period. In Srinagarind Hospital, first- to third-year emergency training residents are assigned to EMS operations rather than paramedics. In one case of operation contain with doctor, emergency nurse practitioners (ENPs), emergency medical responders (EMRs) and emergency medical technicians (EMTs). Residents undergo an Advanced Cardiac Life-Support (ACLS) course in which they are trained to perform airway management using the LMA in simulations. The population in the study was similar to those of similar previous studies in terms of gender, age and indication^(8,10). In most cases, LMA airway management is performed by doctors but in rare cases in which there is no doctor on the team, it can be performed by ENPs with online medical oversight. We found that

Table 3. LMA insertion in EMS

Procedures (n = 152)	Residency year			p-value
	First	Second	Third	
First-attempt success (%)	30/36 (83.3)	52/54 (96.3)	61/62 (98.4)	0.025*
Time required for insertion, mean \pm SD (sec)	82.8 \pm 8.4	70.4 \pm 10.1	70.2 \pm 8.4	0.010*
Ease of procedure [#] , self-assessment, median (IQR)	3 (2 to 4)	4 (4 to 5)	4 (4 to 5)	0.140

* Statistical significance, [#] Scale of 1 to 5 (1: very difficult; 5: very easy)
SD = standard deviation; IQR = interquartile range; sec = seconds

the LMA was able to increase oxygen saturation, which is consistent with previous studies⁽⁸⁾. The first-attempt success rate in our study was also similar to those in previous studies in paramedics^(8,10,11).

The authors also found that the time required for LMA insertion was much shorter than that for endotracheal tube intubation (ETI) in a previous study⁽¹³⁾, which may be due to the fact that LMA preparation requires less time and expertise than that of ETI. Although ETI is the gold standard in advanced airway management, the LMA plays an important role in EMS operations in which resources and/or equipment are limited. We also found that the first-attempt success rate and time required for LMA insertion depended on the experience of resident. The second- and third-year residents had better success rates and were able to complete the procedure in a shorter time than the first-years.

Our study has some limitations. First, data were gathered from only one EMS center. Second, the study design was retrospective, which may have resulted in incomplete data collection⁽¹⁵⁻¹⁹⁾.

Conclusion

Airway management using the LMA had a high success rate on the first attempt, required less time for insertion than other comparable devices, and resulted in a high level of oxygen saturation.

What is already known on this topic?

Advanced airway management using endotracheal intubation or supraglottic devices requires a high level of skill, while the laryngeal mask airway (LMA) is easier to use.

What this study adds?

Airway management using the LMA resulted in high first-attempt success rates and required less time than other similar devices for insertion, both of which depended on the experience of the resident performing the procedure.

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Conflicts of interest

The authors declare no conflict of interest.

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