

# The use of laryngeal mask airway during transesophageal echocardiography in pediatric patients

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## ABSTRACT

**Background:** Transesophageal echocardiography (TEE) in the cardiac lab is usually performed in pediatric patients under general anesthesia with an endotracheal intubation (ET). This study was performed to investigate the safety and efficacy of using the laryngeal mask airway (LMA) as an alternative to ET to maintain pediatric airway during the general anesthesia for TEE. **Materials and Methods:** A total of 50 pediatric patients undergoing TEE in the cardiac lab were randomized to have their airway maintained during the procedure with either LMA (LMA group) or ET (ET group). Hemodynamic, respiratory parameters, time to extubation, recovery time, the incidence of complication and operator satisfaction were compared between the two groups. **Results:** There were no differences between both groups in hemodynamic and respiratory parameters. Laryngeal spasm was reported in one patient in the LMA group and two patients in the ET group. TEE operators were equally satisfied with the procedure in groups. The time to extubation was shorter in the LMA group ( $P < 0.01$ ). The mean recovery time was also significantly shorter in the LMA than in the ET group ( $44 \pm 8$  min and  $59 \pm 11$  min, respectively;  $P < 0.001$ ). **Conclusion:** The LMA is safe and effective in securing the airway of children undergoing diagnostic TEE.

**Key words:** Laryngeal mask airway, randomized clinical trial, transesophageal echocardiography

## INTRODUCTION

Many of the studies examined the use of laryngeal mask airway (LMA) for protecting the patient's airway during the anesthesia. LMA has many advantages over endotracheal intubation (ET) including easier insertion, no need for laryngoscope,<sup>[1]</sup> fewer hemodynamic complications<sup>[2]</sup> and less upper airway sequelae.<sup>[3,4]</sup> In addition, the use of LMA is associated with shorter time to extubation and earlier recovery.<sup>[5]</sup>

Unlike adults, pediatric patients do not tolerate many diagnostic procedures without general anesthesia. When these procedures involve airway sharing, ET is usually used

to secure airway. Although some authors reported the use of LMA in children undergoing upper gastrointestinal endoscopy,<sup>[5,6]</sup> its use to secure airway during the transesophageal echocardiography (TEE) in the cardiac lab in pediatric patients was not reported before.

The aim of this controlled, double-blind, randomized prospective study is to examine the safety and effectiveness of LMA during TEE in pediatric patients. We hypothesized that the use of LMA would result in a shorter recovery time when compared with ET without causing any respiratory, hemodynamic complications or affecting TEE operator satisfaction.

## MATERIALS AND METHODS

### Subjects

The study was approved by the Research and Ethics Committee of the Deanship of Scientific Research of the University of Dammam (approval number #2012085). After parental written informed consent, a total of 50 pediatric patients aged range of 2-14 years old scheduled

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for elective TEE diagnostic study in the cardiac lab, were included in this study.

Patients were evaluated for eligibility the day before the procedure by an investigator who do not control or know the future patients group assignment. Hemodynamically, stable patients with non-cyanotic congenital heart disease were included in the study. Patients with predicted difficult airway, known cervical spine disease, esophageal or gastrointestinal bleeding, pulmonary disease, tracheotomy, neurodevelopmental delay, or relevant drug allergy were excluded from the study.

Patients were randomly allocated using a computer generated random numbers into two equal groups to have their airway maintained during the procedure with either LMA (The Laryngeal Mask Company, Ltd., Bucks, United Kingdom) or an (ET) (Portex Ltd., Kent, United Kingdom).

### Procedures

Patients were pre-medicated with oral midazolam 0.5 mg/kg, 1 h before the procedure.

In the cardiac lab, patients were monitored by continuous electrocardiogram, non-invasive blood pressure and pulse oximetry. After insertion of intravenous cannula, an infusion of lactated Ringer solution was initiated at the rate of 10 ml/kg/h. Anesthesia was induced with ketamine 1 mg/kg I.V, propofol 1 mg/kg, sevoflurane 2% in 100% oxygen was then administered through a face mask.

After reaching adequate depth of anesthesia, guided by end-tidal anesthetic gas concentration,<sup>[7]</sup> In the LMA group, the TEE probe (5.5/7.5-MHz pediatric biplane transducer (Hewlett-Packard 2500) was inserted to the mid-esophagus followed by insertion of proper sized LMA in front of the TEE probe. In the ET group, the proper sized ET was inserted through the larynx followed by TEE probe insertion through the esophagus.

In both groups, the selected airway was attached to the breathing circuit. The airway was considered to be secured once a positive capnographic waveform was observed with positive bilateral breathing sound and visible chest movements. Sevoflurane 1-2, age-adjusted, minimum alveolar concentration in oxygen 100% was administered for anesthetic maintenance.

At the end of the TEE study, the TEE was removed and sevoflurane administration was discontinued. The LMA or ET tube was removed when swallowing and regular spontaneous breathing movements were resumed. Patients were discharged to the recovery room when  $\geq 8$  points of Aldrete scale were reached. Once in the recovery room,

patients were clinically monitored and Aldrete scale was evaluated every 5 min until they reached 10 points of the scale and were then discharged.

### Study outcomes

Heart rate (beats/min), systolic, diastolic blood pressures (mmHg), arterial oxygen saturation measured by pulse oximetry (SpO<sub>2</sub> in %) and end-tidal carbon dioxide (mmHg) were measured every 5 min. However, for study purpose, these parameters were registered at the following times: Pre-anesthetic induction, post-anesthetic induction, post-intubation, at the end of anesthesia, post-extubation and at the time the patient was discharged. The extubation time is defined as the time (min) elapsed from the discontinuation of sevoflurane to removal of ET or LMA and the recovery time is defined as the time (min) elapsed from extubation to the discharge of the patient from the recovery room, were registered.

Complications during the procedure and in the recovery room such as laryngeal spasm, cough and vomiting were recorded. The operator were asked grade their satisfaction into 1 = excellent, 2 = very good, 3 = good and 4 not satisfied.

### Statistical analysis

Power analysis was based on a previous study<sup>[5]</sup> that showed an average difference in the recovery time between LMA and ET groups of 7.5 min with standard deviation of 9 min. A total of 23 patients were required in each group to have an 80% chance to detect a significant difference between the two groups at the 5% level of significance. To compensate for dropout cases, 25 cases were studied in each group. Data were tested for normal distribution using the Kolmogorov-Smirnov test. Differences between groups in demographic data and baseline values of hemodynamic variables was analyzed using unpaired *t*-test or  $\chi^2$  test as appropriate. For comparison of different observations within and between the groups, data was first analyzed by repeated-measures analysis of variance and differences then calculated by *post hoc* testing (Newman-Keuls test). Fisher's Exact test was used to compare the incidence of complications between groups. Analysis was performed using Statistical software version 7.0 for windows (Statsoft, Inc., Tulsa, USA). A *P* < 0.05 was considered significant.

## RESULTS

All the patients completed the study. As shown in Table 1, there were no differences between the two groups in the demographic data. There was also no difference between both groups in the duration of the procedure, which ranged between 30 and 50 min.

There were no significant differences between the two groups in the oxygenation and ventilation parameters

[Table 2]. There were also no significant differences in the hemodynamic parameters at any of the observation times [Figure 1].

Patients in the LMA group had shorter extubation and recovery times when compared to endotracheal group patients. Extubation time in the LMA group was  $4 \pm 2$  and in the ET group was  $6 \pm 2$  ( $P < 0.001$ ). Recovery times in the LMA and ET group were  $44 \pm 8$  and  $59 \pm 11$ , respectively ( $P < 0.001$ ). One patient in the LMA group and two patients in the ET group developed perioperative laryngeal spasm. None of the patients in the LMA group needed changing to ET to maintain airway. LMA placement from the first attempt was successful in 23 patients (92%) and had no displacement during the procedure. One patient required reinsertion to initiate adequate airway and another patient required repositioning during the procedure. All the TEE operators in both groups were satisfied with the procedure and there were no differences between the two groups in the degree of satisfaction.

**DISCUSSION**

This study shows that LMA can be used effectively and safely for securing the airway as a proper alternative

to ETT in children undergoing TEE with or without cardiac catheterization. The respiratory and cardiovascular parameters were similar in the two groups with an added advantage of earlier recovery.

TEE in pediatric patients is usually performed under general anesthesia. Because the procedure involves sharing the airway, ET is usually used. This study is the first study describing the use of LMA to secure the pediatric airway during TEE in the cardiac lab.

LMA was used, with success, in children in several procedures, which involve airway sharing.

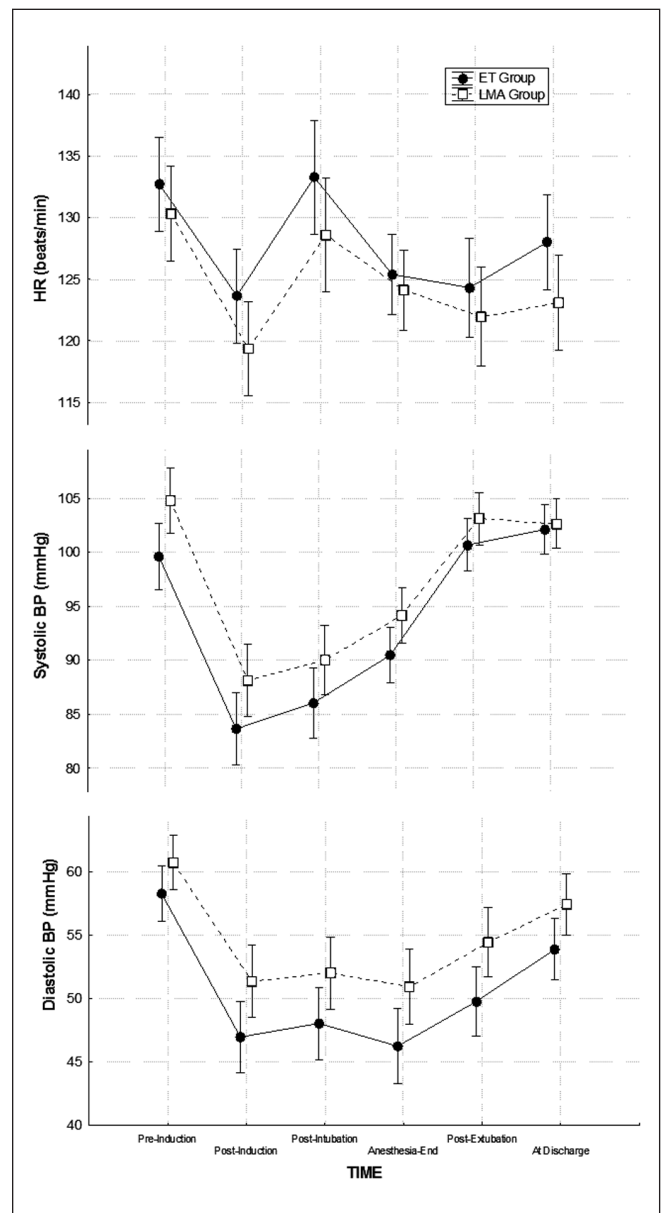
**Table 1: Demographic data: Age mean (range), gender (frequency) weight and height (mean ± SD)**

Data	Laryngeal mask airway (n = 25)	Endotracheal tube (n = 25)	P
Age (years)	9 (2-13)	9 (3-14)	0.954
Gender (M/F)	12/13	14/11	0.777
Weight (kg)	30±13	28±13	0.661
Height (cm)	132±25	129±25	0.603

SD: Standard deviation

**Table 2: Oxygenation and CO<sub>2</sub> variables**

Variables	Laryngeal mask airway (n = 25)	Endotracheal tube (n = 25)	P
<b>SpO<sub>2</sub></b>			
Before induction	96±1	96±1	0.89
After induction	98±1	98±1	0.58
After intubation	98±3	98±1	0.38
During maintenance	99±0.4	99±0.5	0.06
After extubation	98±0.5	97±3	0.48
At discharge	98±0.3	98±0.4	0.96
<b>ETCO<sub>2</sub></b>			
After induction	37±1	37±1	0.91
After intubation	38±2	39±1	0.18
After anesthesia	41±1	40±1	0.07
After extubation	40±1	40±1	0.52
At discharge	39±1	39±1	0.21



**Figure 1:** Changes in the heart rate, systolic blood pressure, diastolic blood pressure in the endotracheal tube group and laryngeal mask airway group vertical bars denote 0.95 confidence intervals. There are no significant differences between the two groups

In 1993, Webster *et al.*, conducted a study of 109 children to evaluate the suitability of the LMA for anesthesia during pediatric adenotonsillectomy. Although there was no difference between ET and LMA as regard laryngospasm, children in the LMA group were significantly less likely to have stridor after the procedure.<sup>[8]</sup> Williams and Bailey,<sup>[9]</sup> published a series that included 100 patients (adults and children) who were assigned to receive ETT or LMA during adenotonsillectomy. There was no difference in laryngospasm between the 2 groups. However, the authors concluded that recovery was less eventful in the LMA group, with significantly less airway obstruction and better airway acceptance compared with the ETT. LMA was a proper alternative to ETT in pediatric patients undergoing upper gastrointestinal endoscopies.<sup>[5,6]</sup> In parallel with our study results, the success rate of LMA placement in children has been reported to be as high as 90% of patients on the first attempt and in almost 100% on subsequent attempts.<sup>[10]</sup>

In our study, the mean extubation time was 2 min shorter in the LMA group when compared to ET group. This difference may not be considered to be significant in daily clinical practice. Similarly, previous studies reported shorter extubation times with LMA of variable duration depending on the type of the procedure and duration of anesthesia.<sup>[6]</sup> On the other hand, the difference in the mean recovery time between LMA and ET was more evident in our study where it was  $44 \pm 8$  and  $59 \pm 11$  min, in the LMA and ETT group respectively. This difference was explained in previous studies by the less anesthetic requirements in the LMA group.<sup>[11]</sup> Similarly, Heath and Sinnathamby., reported less intraoperative narcotic requirement and shorter duration of time spent in the PACU.<sup>[12]</sup> Other advantages that were reported when using LMA in pediatric patients include lower incidence of cough during emergence, lower incidence of post-operative sore throat and lower incidence of post-operative vomiting.<sup>[13]</sup>

Our study has some limitations. First, it may be argued that the study is not a double blind study as TEE operator and anesthesiologists were aware of the type of airway used. However, all the hemodynamic and respiratory variables were recorded automatically by the anesthesia monitor and were registered later by an observer who was unaware of group assignment. Recovery time and the post-operative complications were recorded also by a recovery nurse who did not know patients group. Unfortunately, blinding was not possible with some variables like intraoperative complications or extubation time. Second, although there was a difference in the incidence of laryngeal spasm, it did not reach statistical significance, as our study was not powered to detect the incidence of complications.

## CONCLUSION

Based on the limitations of our study it can be concluded that using of LMA in children undergoing TEE is as safe and effective as using ETT for securing airways in such patients.

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