

ORIGINAL RESEARCH

AIRWAY MANAGEMENT

Evaluation of gum elastic bougie guided Proseal laryngeal mask airway insertion technique

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Abstract

Introduction: Endotracheal intubation (ETI) is the highest quality level for airway management. LMA ProSeal™ (PLMA) insertion under gum elastic bougie (GEB) guidance has got 100% first attempt success rate, but it also requires laryngoscopy for its success; hence nullifying its advantage of being a supraglottic airway device. We compared the hemodynamic responses associated with laryngoscopy assisted GEB guided PLMA placement with that of conventional endotracheal intubation.

Method: One hundred normotensive ASA I or II patients of either sex (age 18 to 40 y) undergoing general anesthesia for elective surgery were included and evaluated for the pressor response. Following a uniform premedication and standard anesthesia technique (thiopentone + vecuronium), either of airway was placed and heart rate (HR) and mean blood pressure (MAP) were recorded at Tb = base line, T0 = just before laryngoscopy and PLMA/ETT placement, T1 = 1 min, T3 = 3 min, T5 = 5 min, T7 = 7 min after placement. Statistical analysis was done to find the significance.

Results: Patients demographics between the PLMA and ETT groups were similar. Following laryngoscopy and PLMA/ETT placement, both were associated with statistically significant increases in HR and MAP with respect to its basal value. Although it was less marked in case of PLMA Group, when compared to the ETT Group. Duration of laryngoscopy and the time to successful placement were longer in PLMA Group as compared to ETT Group (35.71 and 12.69 sec. vs 21.30 and 10.76 sec. respectively). ETT insertion was related with a higher incidence of cough ($p < 0.05$), but was equivalent for sore throat and hoarseness ($p > 0.05$).

Conclusion: Hence GEB guided PLMA method must be used as a reinforcement method in cases where standard insertion methods of airway management fail and in failed tracheal intubation. The bougie proves helpful in quick control of the airway route when used with PLMA.

Key words: Gum elastic bougie; Laryngeal Mask Airway; Hemodynamics; Pressor response

Abbreviations: LMA – laryngeal mask airway; ETI – Endotracheal Intubation; GEB – Gum Elastic Bougie; ETT – Endotracheal tube; PLMA – Laryngeal Mask Airway ProSeal

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1. Introduction

The laryngeal mask airway (LMA) is a supraglottic airway presented by Dr. Archie Brain in 1983. It fills the gap in the airway management between tracheal

intubation and utilization of the face mask. The main benefit of LMA over endotracheal tube (ETT) is that it avoids the use of laryngoscope to visualize and

penetrate the laryngeal opening and hence produces less hemodynamic changes.^{1,2}

In the year 2000 a new version of LMA was introduced by the manufacturer named LMA ProSeal™ (PLMA), which incorporates another tube to allow second seal against upper esophageal sphincter giving continuity with the alimentary tract and isolating it from the airway.³ PLMA can achieve an additional effectual seal and facilitates gastrointestinal tube positioning without an expansion in straightforwardly estimated mucosal pressure.^{4,5}

PLMA route is intended to be embedded utilizing either forefinger or introducer tool (IT) as described by the manufacturer.⁶ However, another new method of insertion has recently been described which involves the use of gum elastic bougie (GEB). The drain tube of PLMA is primed with bougie whose distal end is placed in the esophagus under laryngoscopic guidance. Then the PLMA is inserted digitally along palatopharyngeal curve and bougie removed.⁷ The authors claimed that GEB guided inclusion of PLMA has a higher first endeavor achievement rate as compared to other methods (GEB, 100%; digital 88%; IT 84%),⁸ and is linked with less hemodynamic changes and a less prevalence of injury.⁷ The main cause of insertion difficulty with older techniques is disorder of PLMA sleeve on rear of the mouth and failure of the distal sleeve to arrive at the hypopharynx which is overcome by GEB guided technique.⁹

Laryngoscopy has been implicated as the main culprit for increase in pressor response due to stimulation of the base of the tongue induced by the tip of its blade lifting the epiglottis.⁷ The most significant factor affecting the cardiovascular reaction is time taken for laryngoscopy and powers applied during it.^{8,9}

Hence this seems likely that laryngoscopic assisted PLMA placement with GEB guided technique might also have increased pressor response thus nullifying its advantage of being a good supraglottic device. Keeping this in mind, we studied the difference in pressor responses with this technique of insertion of PLMA as against conventional placement of ETT which also requires laryngoscopy.

2. Methodology

One hundred normotensive patients of either sex, ASA I or II, between 20-40 y of age, booked to go through

elective medical procedure, requiring general sedation were incorporated.

Patients with a known or anticipated complicated airway, mouth opening < 2.5 cm, body mass index > 35 kg/m², any patient with a history of regurgitation, known case of hypertension and ischemic heart disease were excluded.

Every patient was inspected during the preoperative visit a day prior to surgery. Insights about the patient's clinical history, physical assessment, Mallampati score, mouth opening, and basic routine investigations were recorded. Notified consent was taken for patient's involvement in the study. Each patient was fasted for six hours and premedicated with tablet alprazolam 0.25 mg and tablet ranitidine 150 mg orally at bedtime and at two hours preoperatively. On arrival in the operating room, non-invasive blood pressure (NIBP), ECG and pulse oximetry were recorded using Siemens SC 5000 monitor. Basal readings of systolic (SBP) and diastolic blood pressure (DBP), heart rate (HR) and arterial saturation of oxygen (SpO₂) on air were noted. An intravenous line was started. Patients were then randomly assigned to either Group PLMA (n = 50) or Group ETT (n = 50) by lottery method.

Patient's head was placed on a 7 cm tall pad to make the standard sniffing position for intubation. After induction using sleep dose of thiopentone followed by vecuronium bromide patients were ventilated for 2 min via face mask.

For patients in PLMA Group, a well lubricated PLMA with fully deflated cuff, size 3 for females or size 4 for males, loaded with GEB, was introduced using standard midline approach i.e., positioned the GEB 5-10 cm into the throat under direct laryngoscopic direction, advanced the PLMA against palatopharyngeal curve utilizing digital guidance when an associate held the curved end of bougie, withdrawing the bougie while holding the PLMA in position. Then the cuff was inflated with sufficient air to keep cuff pressure around 60 cmH₂O. The correct placement of PLMA was judged clinically by the capacity to ventilate the patient without substantial leak at an air pressure of more than 20 cmH₂O and by auscultation of breath sounds.

For Group ETT patients, an appropriate size cuffed ETT (size 7.0 mm / 7.5 mm ID for females and size

Table 1: Comparative demographic of the groups

Parameter	PLMA Group	ETT Group	p value
Age (y)	33.80 ± 9.16	31.82 ± 7.39	> 0.05
Weight (kg)	57.78 ± 9.6	57.52 ± 11.76	> 0.05
Height (cm)	160.62 ± 5.88	160.66 ± 5.94	> 0.05
Gender (male/female) (n)	22/28	20/30	> 0.05

Data given as Mean ± SD, unless specified otherwise.

Table 2: Comparative duration of laryngoscopy and time to successful placement

Parameter	PLMA Group	ETT Group	p value
Duration of laryngoscopy (sec)	12.69 ± 2.33	10.76 ± 1.35	< 0.001**
Time to placement (sec)	35.71±4.80	21.30±3.18	< 0.001**

*Data given as Mean ± SD; **p < 0.001 (highly significant)*

8.0 mm / 8.5 mm ID for males) was inserted using standard technique for intubation.

General anesthesia in both groups was administered with 0.5% halothane in nitrous oxide and O₂. Heart rate (HR), SBP, DNP, MAP and SpO₂ were recorded at following time intervals;

T_b – Basal i.e. before start of induction of anesthesia

T₀ – Just before PLMA or ETT insertion but after administration of thiopentone and vecuronium bromide

T₁ – One min after successful placement of PLMA/ETT

T₃ – Three min after

T₅ – Five min after

T₇ – Seven min

Number of attempts, duration of laryngoscopy and time required for the proper placement of PLMA/ETT were recorded. Time required for successful placement was measured from the start of laryngoscopy to the confirmation of proper placement.

At the end of a surgical procedure, neuromuscular block was reversed. Any postoperative complications like cough, sore throat, hoarseness of voice, were noted.

Statistical Analysis: Parameters collected were compiled and analyzed utilizing matched and unmatched 't' test, chi-square test and Fisher precise analysis. Data is presented as Mean ± SD or n (%).

3. Results

Demographic data of the patients are compared in Table 1. The differences were statistically not significant.

The comparative duration of laryngoscopy and the time taken to successful placement of the airway device in two groups is presented in Table 2. The difference was statistically highly significant (p < 0.001).

In Table 3 mean HR in both of the groups at all specified time interval are comparable, except at **T₁** (one min after airway insertion) when the rise in the HR in Group B was significantly more than the Group A.

The baseline SBP (**T_B**) as well as at **T₀** were statistically equivalent in two groups (p > 0.05). However, at one min and at 3 min after ETT/PLMA placement (**T₁**) the rise in SBP was greater in Group B as compared to Group A (p < 0.001). The variation in rise in SBP in both the groups remained statistically significant till **T₃**, after which it returned to near base line values (**T₅**) or even low (**T₇**) (Table 3).

DBP were statistically comparable in two groups (p > 0.05) at **T_B**, **T₀** and at **T₇** (p > 0.05). However, following airway placement at **T₁** there was a greater rise in DBP in Group B as compared to Group A (p < 0.001). The difference in both groups remained statistically significant till **T₅** which ultimately touched

Table 3: Comparative duration of laryngoscopy and time to successful placement

Parameter	Time	PLMA Group	ETT Group	p value
Heart rate	T _B	81.96 ± 12.21	85.26 ± 16.05	> 0.05
	T ₀	87.92 ± 13.93	90.62 ± 10.58	> 0.05
	T ₁	96.30 ± 16.02	104.34 ± 13.10	> 0.05*
	T ₃	92.08 ± 19.93	97.44 ± 11.39	> 0.05
	T ₅	84.46 ± 13.88	90.80 ± 11.60	> 0.05
	T ₇	80.14 ± 13.19	84.22 ± 9.36	> 0.05
Systolic blood pressure	T _B	122.96 ± 12.97	124.22 ± 11.72	> 0.05
	T ₀	108.64 ± 10.41	104.54 ± 11.56	> 0.05
	T ₁	135.52 ± 16.30	146.96 ± 14.36	< 0.001**
	T ₃	123.74 ± 13.09	131.54 ± 13.99	< 0.001**
	T ₅	122.26 ± 45.20	120.42 ± 12.51	> 0.05
	T ₇	113.80 ± 10.12	116.16 ± 12.41	> 0.05
Diastolic blood pressure	T _B	78.32 ± 8.13	79.62 ± 7.81	> 0.05
	T ₀	70.34 ± 3.45	67.98 ± 7.91	> 0.05
	T ₁	89.96 ± 14.13	97.56 ± 12.96	< 0.001**
	T ₃	80.40 ± 10.25	87.12 ± 7.62	< 0.001**
	T ₅	75.56 ± 8.86	79.20 ± 8.39	> 0.05*
	T ₇	74.58 ± 8.13	76.48 ± 9.16	> 0.05
Mean arterial pressure	T _B	93.20 ± 9.04	94.48 ± 8.48	> 0.05
	T ₀	83.10 ± 7.65	80.16 ± 8.4	> 0.05
	T ₁	105.14 ± 14.45	114.03 ± 12.59	> 0.05*
	T ₃	94.84 ± 10.62	101.92 ± 8.86	> 0.05*
	T ₅	91.13 ± 18.38	92.94 ± 9.05	> 0.05
	T ₇	87.65 ± 8.17	89.70 ± 9.42	> 0.05

Data given as Mean ± SD; *p (Significant); **p < 0.001 (highly significant)

Table 4: Incidence of adverse effect in two groups at removal of airway

Adverse effect	PLMA Group	ETT Group	p value
Sore throat	1 (2)	2 (4)	> 0.05
Cough	5 (10)	13 (26)	< 0.05*
Hoarseness	0	1 (2)	> 0.05

Data given as Mean ± SD; *p (Significant)

base line at T₇ (i.e. 7 min after airway placement) (p > 0.05) (Table 3).

MAP at baseline (T_B) as well as just before airway placement (T₀) were statistically comparable in two groups (p > 0.05). At T₁ and T₃ MAP registered a significant rise which was more marked in Group B.

At 5 and 7 min after airway placement (T₅ and T₇) MAP returned to near baseline reading in both groups, which was statistically not significant (p > 0.05) (Table 3). As shown in Table 4, the frequency of cough was higher in Group B as compared to Group A, which was statistically significant (p < 0.05).

On the other hand, occurrence of sore throat and hoarseness did not achieve statistical significance (Table 4)

4. Discussion

In our study in Group A patients, PLMA was used as an airway device which was introduced using GEB technique following laryngoscopy.⁷ In Group B patients, ETT was introduced using conventional technique. Pressor reactions as a rise in HR, SBP, DBP and MAP were recorded and compared using chi-square, paired and unpaired 't' tests.

Pressor response is a common occurrence following laryngoscopy and tracheal intubation due to sympathoadrenal response in the form of a rise in catecholamine concentration.¹³ Shribman et al. suggested that the main reason of sympathoadrenal response to tracheal intubation is the stimulation of upper airways by laryngoscope. He added that the introduction of tracheal tube through the vocal cords and inflating a cuff in the infraglottic area donate small added inspiration.¹⁴

To avoid pressor response to laryngoscopy, supraglottic devices have been introduced in anaesthesia practice which do not require laryngoscopy for their placement. One such device is PLMA, which has been used in this study.

Conventionally PLMA is placed using either index finger or introducer tool technique. However, Hawath et al. reported that the GEB aided placement of PLMA under laryngoscopic guidance is better than index finger or introducer tool technique. They suggested that GEB guides the tip of PLMA towards the hypopharynx and prevents its impaction at the back of the pharynx.¹⁵ He evaluated this new technique and concluded that it is associated with no difference in heart rate or blood pressure.⁷

In our study, however, laryngoscopic assisted GEB guided placement of PLMA was associated with considerable rise in MAP and HR. This difference might be because of differences in the method of induction in the two studies. While we used sleep dose of thiopentone and vecuronium bromide for induction of anesthesia in our patients, Howath et al. used midazolam, fentanyl and propofol. Midazolam and fentanyl used in their study are known to modulate the pressor response of laryngoscopy. Also use of propofol for induction of anesthesia is known to achieve greater fall in blood pressure in comparison with the use of thiopentone alone. Moreover, they also

used lack of response to jaw thrust as an end point of induction, unlike our study where we used loss of eye lash reflex for the same. It is a known fact that lack of response to jaw thrust requires deeper planes of anesthesia as compared to loss of eyelash reflex which might explain milder pressor response in their study. This interpretation is in compliance with the analysis conducted by Yakaittis et al. which concluded that greater depth of anesthesia abolishes the tracheal and carinal reflexes which are responsible for the pressor response.¹⁶

In our study, the time duration of laryngoscopy and time of placement of PLMA/ETT were remarkably elevated in PLMA as compared to ETT Group (12.69 and 35.71 sec. vs 10.76 and 21.30 sec.) respectively. It is well known that hemodynamic response to laryngoscopy is proportional to the duration of laryngoscopy.¹⁷

In our study, basal hemodynamic values were equivalent in both the category. Following laryngoscopy and PLMA/ETT placement BP and HR elevated pointedly in both the groups. The rise in BP and HR following PMLA placement was significantly less marked than tracheal intubation ($p < 0.05$). Hence, it is evident from the above observations that, although duration of laryngoscopy was more in PLMA Group, pressor response was more in ETT Group. This interpretation is in compliance with the study conducted by Hassan et al. which states that laryngoscopy stimulates the proprioceptors at the base of tongue leading to stimulus reliant increase of pressor response and catecholamine concentration and subsequent orotracheal intubation recruits additional receptors that augment the hemodynamic and catecholamine responses to laryngoscopy.¹⁷

Our study is also in agreement to an evaluation carried out by Ganzouri et al. who compared the pressor responses of PLMA using index finger/introducer tool technique with those of endotracheal intubation. They concluded that endotracheal intubation is associated with significant pressor response, while it is minimal with the use of PLMA with standard technique.¹⁸ Similarly, Evan et al., while evaluating PLMA using index finger/introducer tool technique, observed minimal hemodynamic response to its insertion in their patients. On the other hand, laryngoscopic assisted PLMA guided placement of PLMA in our study was associated with significant pressor

response.¹⁹ Two reasons can be elicited for this discrepancy of observation. One obvious reason is that we used laryngoscopic assisted GEB guided technique for PLMA placement, while Evan et al. used conventional index finger or introducer tool technique. Another reason is difference in method of induction in two studies. While we used sleep dose of thiopentone and vecuronium bromide for induction, Evan et al. also used fentanyl and propofol for induction of anesthesia in their study.

Braun et al. reported that using the standard technique, hemodynamic responses to PLMA insertion and classic LMA insertion were similar,²⁰ Jung et al., while evaluating LMA in children, reported that when insertion of classic LMA using laryngoscopic guidance is associated with greater hemodynamic response as compared to, when inserted using index finger technique.²¹

It can be postulated from our study that laryngoscopy assisted GEB guided placement of PLMA is associated with pressor response, which is although lesser than laryngoscopy followed by intubation, but greater than PLMA when inserted using standard technique.

5. Conclusion

This study suggests that GEB primed laryngeal mask airway Proseal™ when placed under laryngoscopic guidance, is associated with pressor response in the form of an increase in pulse rate and blood pressure. However, this pressor reaction is of lesser magnitude and lasts for lesser duration as compared to laryngoscopy and intubation.

6. Conflict of interest

None declared by the authors. No funding was involved in this study.

7. Authors' contribution

MKU: Conceived and designed the analysis, collected the data

GK: Collected the data, contributed data analysis tools

AC: Performed the analysis; manuscript writing

DN: Data analysis, literature search, reference search, manuscript editing

8. References

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LMA-PROSEAL™ USAGE OVERVIEW

Preparation

- Fully deflate the LMA-ProSeal™ to a high vacuum immediately before it is sterilized
- Do not allow water to enter the LMA-ProSeal™
- Carry out the performance tests before each use

Insertion

- Ensure correct deflation of the LMA-ProSeal™ before attempting insertion
- Use one of the recommended insertion techniques; do not use non-recommended techniques
- Do not use excessive force to insert the LMA-ProSeal™
- If using the LMA-ProSeal™ Introducer, always remove it from the LMA-ProSeal™ after insertion and before inflation
- Use sufficient lubricant to prevent the mask folding backwards during insertion

Inflation and positioning

- Inflate to a "just seal" pressure. Do not inflate to more than 60cm H₂O intracuff pressure
- Check for correct placement of the LMA-ProSeal™ by gentle lung inflation
- If gas leaks through the drain tube, the device must be repositioned more deeply
- If there is obstruction to lung inflation, remove the device and reinsert • Ensure the bite-block is between the teeth

Oro-gastric tube

- Do not pass an oro-gastric tube when there is either airway obstruction or an inadequate seal
- Do not pass an oro-gastric tube when there is known or suspected esopharyngeal damage
- Do not cool or refrigerate an oro-gastric tube before use

Reuse

- Do not use the LMA-ProSeal™ more than 40 times

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