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Original Article

Comparative Study of the Effectiveness of Three Techniques of Insertion of Proseal Laryngeal Mask Airway in Adults Posted For Elective Surgery

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Abstract

Background: ProSeal laryngeal mask airway (PLMA) (Laryngeal Mask Co. limited, Mahe, Seychelles) introduced by Dr. Archie Brain, as a modification of the classic laryngeal mask airway (LMA) designed for positive pressure ventilation, has increasingly become the mainstay of anesthesia practice in a variety of settings. The dorsal cuff and drain tube broaden its application. However, it was found to be relatively difficult to insert as compared to classic LMA.

Aim: The aim of the present study was to assess the ease of insertion and correct placement of PLMA using three different techniques, namely Gum elastic bougie (GEB), insertion with an aid of introducer tool (IT), and digital (D) technique in adults undergoing elective surgeries requiring general anesthesia.

Materials and Methods: A total of 150 adult patients of age group 18–60 years of either sex of American Society of Anesthesiologists (ASA) Class I and II, undergoing elective surgery for various procedures requiring general anesthesia with PLMA were included in this study. The study subjects were divided into three groups, namely GEB where insertion of PLMA is aided using a GEB, IT where insertion of PLMA is aided using an introducer, and D where PLMA is inserted using conventional D technique. These techniques were then correlated with each other in terms of ease of insertion, correct placement, time to insert PLMA, and unwanted adverse effects if any. Data are presented as the mean ± standard deviation. Fisher's extract test and the Chi-square test were applied for the statistical analysis. Results having $P < 0.05$ were considered statistically significant.

Results: Insertion time for the 1st attempt was similar in all the three groups but was significantly less in GEB group the incidence of visible blood staining of the device was significantly less in GEB group. The GEB-guided insertion technique is more frequently successful than the D or IT techniques and suggested that GEB-guided technique may be a useful backup technique when the D and IT techniques fail.

Key words: Anesthesia, Gum elastic bougie, ProSeal laryngeal mask airway

INTRODUCTION

ProSeal LMA (PLMA) (Laryngeal Mask Co. limited, Mahe, Seychelles) introduced by Dr. Archie Brain, as a modification of the classic LMA designed for positive pressure ventilation (PPV), has increasingly become the mainstay of anesthesia practice in a variety of settings.[1] The dorsal cuff and drain tube broaden its application.[1-3] However, it was found to be relatively difficult to insert as compared to classic LMA.[4] The aim of the present study was to assess the ease of insertion and correct placement of PLMA using a gum elastic bougie (GEB)[5] and compare it with an introducer tool (IT) and digital (D) technique in adults undergoing elective surgeries.

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MATERIALS AND METHODS

After obtaining Institutional Ethical Committee approval and informed consent, 150 patients of ASA physical status

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A and unwanted adverse effects i–60 years scheduled to undergo elective surgeries under general anesthesia were randomly allocated in our study performed over a period of 6 months.

Exclusion Criteria

Patients were excluded if they had any of the following criteria:

i) Aged younger than 18 years or older than 60 years.
ii) Previously known/predicted difficult airway.
iii) History of any pathology of neck, upper respiratory tract/upper alimentary tract.
iv) Having cardiovascular disease, bleeding disorders.
v) Mouth opening <2.5 cm.
vi) Body mass index greater than 25 kg/m^2.
vii) Had a high risk of aspiration.
viii) Recent history of a sore throat.

Randomization

Patients were randomized using a computer-generated random number table into three groups GEB, IT, and D as per the choice of the technique of insertion of PLMA in each group (n = 50).

- Group GEB - GEB group
- Group IT - IT group
- Group D - D group.

All the patients were monitored as per the ASA standards of monitoring.

After taking informed consent, all the patients were examined on the previous day, and necessary investigations for general fitness were done. Patients were kept nil per oral for 6 h. Randomization was done before surgery during the preanesthetic checkup.

Premedication was given 30 min before surgery with glycopyrrolate 0.2 mg iv and midazolam 1 mg iv and standard monitors attached. Preoxygenation for 3 min with 100%O_2 followed by induction with sleep dose of propofol and fentanyl at a dose of 1.5–2 mcg/kg iv was administered. Neuromuscular blockade was achieved with 0.5 mg/kg iv atracurium as the first dose followed by top-ups. PLMA was inserted by an experienced anesthesiologist with different techniques (GEB technique, IT technique, and D technique).

D technique: The D technique involved the use of the index finger to press the PLMA into and advancing it around the palatopharyngeal curve [Figure 1].

IT guided technique: In IT technique, introducer was attached to the PLMA, a single-handed technique was used to press the PLMA into and advancing it around the palatopharyngeal curve and the tool was then removed while the PLMA was held in position [Figure 2].

GEB guided technique: The GEB-guided technique involved the following steps: (1) Drain tube of PLMA was primed with lubricated GEB with its straight end first; (2) under gentle laryngoscope guidance, the distal portion of the GEB was placed into the esophagus while the assistant held the PLMA and the proximal portion [Figure 3]; (3) the laryngoscope was removed; (4) the PLMA was inserted using the D insertion technique while the assistant applied

Figure 1: Conventional PLMA insertion using digital technique

Figure 2: PLMA insertion using Gum elastic bougie

Figure 3: Gentle laryngoscopy during Gum elastic boogie guided PLMA insertion

jaw thrust [Figure 4]; and (5) the GEB was removed while the PLMA was held in position [Figure 5].

After the PLMA was inserted, gastric tube was placed into the stomach through the gastric channel. The effective airway was judged by the normal thoracoabdominal movement, bilateral air entry by auscultation, waveform of capnogram trace, oropharyngeal leak pressure <30 cm H_2O, bubble test, suprasternal notch tap, and passage of gastric tube.[6-8] In case, the effective placement is not achieved, the device was removed and reinserted to a maximum of three attempts, and even then if the placement remains unsuccessful after three attempts, the patient was intubated. Ease of insertion including number of attempts and time required to insert the PLMA was recorded. The time to insert PLMA was recorded between picking up the laryngoscope or prepared PLMA (cuff deflated, lubricated, and IT attached) and its successful placement. Ease of the placement of gastric tube was also recorded.

Anesthesia was maintained with intermittent PPV with 1:1 O_2 in the air with sevoflurane maintaining minimum alveolar concentration between 1.2 and 1.4 and intermittent doses of iv atracurium.

Anesthesia was discontinued at the conclusion of surgery, and the patient was reversed with a standard dose of neostigmine (0.05 mg/kg iv) and glycopyrrolate (0.01 mg/kg iv), and the PLMA was removed once the patient was awake. Blood staining of the device and tongue, lip and dentition were recorded. Any adverse reaction in the post-anesthesia care unit within the next hour was recorded.

Statistics

In our study, we compared three different techniques of insertion (GEB technique, IT technique, and D technique) of LMA-ProSeal for the ease of insertion including insertion attempts, time to insert, airway sealing pressure, blood staining of device, dental and soft tissue injury and bronchospasm/laryngospasm, and any post-operative complication.

The sample size was calculated based on a previously published study.[9] Student t-test was used to compare the demographic data and the time for insertion. The number of insertion attempts (success rates), the presence of the blood on the PLMA, and the occurrence of complications were compared using Chi-square analysis and Fisher exact test. $P < 0.05$ was considered significant.

Demographic parameters for age and weight in all groups were statistically not significant [Table 1]. The first attempt success rate was better with GEB technique (100% successful) as compared to IT (86%) and D groups (84%), which was found to be statistically significant.

Insertion time for the 1st attempt was similar in all the three groups but was significantly less in GEB group (27.12 se) compared to other groups (31.71sec in D group and 31.45 s in IT group) when overall insertion time was considered [Table 2].

Airway sealing pressure was similar, Group D 31.86 cm/H_2O, Group IT 31.71cm/H_2O, and Group GEB 31.54 cm/H_2O and was not statistically significant [Table 3].

The incidence of visible blood staining of the device was significantly less in the GEB group (6%) compared to the

Table 1: Demographic profile of the patients (mean±SD) among the three groups

	Group					
	D	IT	GEB	*P* value		
	Mean±SD	Mean±SD	Mean±SD	D and IT	D and GEB	IT and GEB
Age (in years)	36.02±12.69	40.12±13.14	39.88±12.87	0.116	0.134	0.927
Weight (in Kg)	59±4.25	58.22±4.61	58.82±4.78	0.381	0.843	0.524
Height (in cm)	160.76±4.71	160.4±4.66	160.32±4.81	0.702	0.645	0.933
BMI (Kg/mts^2)	22.81±1.06	22.61±1.13	22.85±0.99	0.344	0.857	0.250

SD: Standard deviation, GEB: Gum elastic bougie, IT: Introducer tool, D: Digital

Table 2: Insertion attempts comparing the three groups

Attempts	Group				*P* value		
	D (%)	IT (%)	GEB (%)	Total	D and IT	D and GEB	IT and GEB
1st attempt (n)	42 (84.00)	43 (86.00)	50 (100.00)	135 (90.00)	0.779	0.003	0.006
2nd attempt (n)	5 (10.00)	4 (8.00)	0 (0.00)	9 (6.00)	0.727	0.022	0.041
3rd attempt (n)	2 (4.00)	2 (4.00)	0 (0.00)	4 (2.70)	1.000	0.153	0.153
Failure (n)	1 (2.00)	1 (2.00)	0 (0.00)	2 (1.30)	1.000	0.315	0.315

SD: Standard deviation, GEB: Gum elastic bougie, IT: Introducer tool, D: Digital

other groups (26% and 24%, respectively, in Group D and IT). *P* value between D and GEB was 0.006 and between IT and GEB is 0.12, both being significant. The incidence of trauma was similar in all the groups [Table 4]. There was no incidence of bronchospasm/laryngospasm in any of the groups [Table 5].

DISCUSSION

The first attempt success rate was significant with GEB technique as compared to D and IT technique. The principal cause of failed insertion was malposition of PLMA as detected by suprasternal notch tap test and the cause of malposition was impaction of PLMA at the back of the mouth which resulted in failed passage into the pharynx or folding over of the distal cuff, or the distal cuff being directed into glottic inlet rather than the hypopharynx. Several studies conducted on adult and pediatric patients confirm this finding. The higher first attempt success rate with GEB technique was due to the fact that the incidence of distal cuff folding over is reduced when PLMA is primed with GEB.

Other advantage of GEB technique was that the overall insertion time was less due to higher first attempt success rate. The potential disadvantages of GEB technique were potential for airway stimulation and pharyngoesophageal trauma as GEB was stiff and was not meant for esophageal placement. However, there was no case of bronchospasm or laryngospasm using this technique. Furthermore, blood staining of the device was significantly less in GEB guided technique. The further potential disadvantage was that of the assistance that was required more often than D and IT technique.

In the year 2004, Brimacombe *et al*.[9] compared the three different techniques of the introduction of ProSeal LMA which included standard D technique, IT technique, and GEB guided technique.[9] They concluded that the GEB-guided insertion technique is more frequently successful than the D or IT techniques and suggested that GEB-guided technique may be a useful backup technique when the D and IT techniques fail. They found that the first attempt success rate in GEB group was 100% compared to 87% and 84% in D and IT group, respectively, which was similar to our study finding of GEB (100%), Group D (84%), and Group IT (86%). They reported that the time required for single insertion attempt in all the three groups were comparable but due to failure to pass the PLMA in single attempt in Groups D and IT; they had a significant difference in overall insertion time in comparison with GEB group. Oropharyngeal leak pressures were similar in all the three groups. We have found there is a significant difference in visible blood staining of the device between GEB groups from rest of the groups.

Eschertzhuber *et al*.[10] compared three techniques of introducing PLMA in patients with simulated difficult laryngoscopy using a rigid neck collar, and they found out that the GEB guided insertion technique was far superior

Table 3: Insertion time (mean±SD) among the three groups

	Group					
	D	IT	GEB	*P* value		
	Mean±SD	Mean±SD	Mean±SD	D and IT	D and GEB	IT and GEB
Insertion time 1st attempt (sec)	26.96±1.63	27.06±1.8	27.12±1.7	0.769	0.632	0.867
Insertion time overall (sec)	31.71±12.66	31.45±12.67	27.12±1.7	0.918	0.013	0.019

SD: Standard deviation, GEB: Gum elastic bougie, IT: Introducer tool, D: Digital

Table 4: Airway sealing pressure (mean±SD) among the three groups

	Group					
	D	IT	GEB	*P* value		
	Mean±SD	Mean±SD	Mean±SD	D and IT	D and GEB	IT and GEB
Airway sealing pressure/oropharyngeal leak pressure (cmH_2O)	31.86±2.27	31.71±2.26	31.54±2.57	0.756	0.517	0.721

SD: Standard deviation, GEB: Gum elastic bougie, IT: Introducer tool, D: Digital

Table 5: Adverse events during different techniques of insertion

Adverse Events	Group				*P* value		
	D (%)	IT (%)	GEB (%)	Total	D and IT	D and GEB	IT and GEB
Blood staining of the device (visible blood only) (n)	13 (26.00)	12 (24.00)	3 (6.00)	28 (18.70)	0.817	0.006	0.012
Tongue, lip, dental trauma (n)	1 (2.00)	4 (8.00)	2 (4.00)	7 (4.70)	0.169	0.558	0.400

Figure 4: Gum elastic boogie guided PLMA insertion technique showing one assistant giving jaw thrust

Figure 5: PLMA inserted using Gum elastic bougie

to the D or the IT techniques.[10] They found that in all the cases PLMA could be inserted in the very first attempt using GEB (100%), it was successful only in 64% cases with D technique and 61% with IT technique and our finding was quite distinct from their study where we found 84% first-pass success in Group D and that of 86% in Group IT though it was the same 100% in Group GEB. This difference might be due to the exclusion of predicted difficult airway cases from our study. However, the success rate of insertion after three attempts and also visible blood staining of the device in our study was consistent with their study. They found that all failed insertions with the D and IT techniques were subsequently successful with the guided technique. However, in our study, we intubated the cases after three failed insertion attempts rather than opting for an alternative technique. However, the above-mentioned study did not compare the values of airway sealing pressure.

Nileswar and Goyal[11] compared insertion and placement of ProSeal LMA using a IT and GEB in patients undergoing minor surgical procedures.[11] They supplemented the condition of insertion with a comparison of actual views through each lumen using fiber-optic bronchoscope. They also found that the success rate of the insertion of PLMA was higher in GEB group (96.67%) compared to IT group (80%), our study result is also similar to their study in that respect but with respect to insertion time, our study showed no difference in the first attempt insertion time among the groups which was inconsistent with their study finding, where they found that the insertion time for GEB group (40.8 s) was comparably higher than IT group (19.8 s). This might be due to the fact that we assigned only experienced anesthesiologist for PLMA insertion.

Kuppusamy and Azhar[12] compared bougie-guided insertion of PLMA with D technique in the adult. They found that the GEB-guided, laryngoscope aided insertion of PLMA is an excellent alternative technique to D technique in adults. They found that bougie-guided insertions of PLMA took longer time, but they helped achieve higher oropharyngeal leak pressures (30.63 cm H_2O vs. 23.13 cm H_2O) which were quite distinct from our study finding. Again the reason might be the difference in the expertise or might be due to difference in sample size (our study $n = 50$ in each group, their study $n = 30$ in each group).

However, there are also some limitations of the present study:

- All insertions were by an experienced user and may not necessarily apply to the less experienced user.
- We did not measure the hemodynamic response and possibly GEB-guided insertion technique is associated with greater response.
- Data were collected by unblinded observers.

CONCLUSION

From the outcome analysis of our study, we can conclude that compared to the D and IT PLMA insertion technique, GEB-guided PLMA insertion is an easier, reliable, having higher first-pass success rate and relatively atraumatic technique through all techniques have similar airway seal and ease of insertion of the gastric tube. Hence, GEB-guided insertion technique of PLMA can act as a better alternative to standard D and IT technique.

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