Study of effect of head elevation in PROSEAL laryngeal mask airway insertion at a tertiary hospital.
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Abstract

Background & Aims: Proseal Laryngeal Mask Airway (PLMA) is a supra-glottic airway device that prevents gastric insufflation and pulmonary aspiration. In the present study, we intend to determine the effect of head elevation in PLMA insertion.

Methodology: The present study was a single-center, comparative, interventional study, conducted in patients of 18-60 years of age, either gender, American Society of Anaesthesiologists (ASA) grade I-II, patients posted for elective surgical procedures under general anaesthesia. 123 adult patients were randomized into three groups using a random number table. Group C: No head elevation (No pillow), Group LP: 4 cm head elevation (4 cm pillow), and Group HP: 8 cm head elevation (8 cm pillow).

Results: PLMA insertion at first attempt was successful in 30 patients (73.17%) in Group C, 40 patients (97.56%) in Group LP & 22 patients (53.66 %) in Group HP, the difference was statistically significant (P <0.001). The mean insertion time of LMA in Group C, Group LP, and Group HP was found to be 21.90 ± 4.48s, 16.12 ± 5.35s, and 25.14 ± 8.79s respectively which was significantly less in Group LP when compared with Group C and Group HP (P< 0.001).
incidence of blood staining on PLMA was significant in Group HP (20 patients) as compared to Group C (3 patients) & Group LP (2 patients), the difference was statistically significant (P <0.001).

Conclusion: A head elevation by a pillow of height of 4 cm was effective for PLMA insertion in adult patients when compared with an 8 cm pillow.

Keywords: Laryngeal Mask Airway, intubation, PLMA, head elevation, general anaesthesia.

### Introduction

Endotracheal intubation is the gold standard of securing the airway during general anaesthesia (GA) to maintain adequate oxygenation and ventilation.\(^1\) However when there is difficult airway, supraglottic airway devices are used to maintain adequate oxygenation and ventilation.\(^2\) These devices overcome many of the disadvantages of endotracheal intubation such as oesophageal intubation, endobronchial intubation, pressor response of laryngoscopy, and sore throat.\(^3\) Proseal Laryngeal Mask Airway (PLMA) is a supra-glottic airway device which has a posterior cuff to improve the seal around the glottis and a channel for gastric tube placement which prevents gastric insufflation and pulmonary aspiration.\(^3\) The snifing position has been shown to be effective for facemask ventilation and intubation.\(^4\) This ‘snifing position’ is optimal for direct laryngoscopy and intubation, as it aligns the laryngeal, pharyngeal, and oral axes and is influenced by pillow height.\(^5\) For PLMA insertion also, a snifing position has been recommended and is effective.\(^3\)\(^,\)\(^6\) However the appropriate degrees of neck flexion is not clear. The superiority of the snifing position over head extension (without a pillow) for PLMA insertion has been questioned. Hence in the present study, we intend to determine the effect of head elevation in PLMA insertion and whether the snifing position (4cm or 8cm pillow) results
in a higher success rate of PLMA insertion as compared to simple extension of the head without a pillow.

**Material and methods**

After obtaining institutional ethical clearance and clinical trial registration in India (CTRI/2018/04/013484), this comparative interventional study, was conducted in the Department of Anaesthesiology, at M S Ramaiah Medical College & Hospital, Bangalore, India. Patients 18-60 years of age, either gender, American Society of Anaesthesiologists (ASA) grade I-II, posted for elective surgical procedures under GA using PLMA, were included in the study. Patients with predicted difficult airway (such as mouth opening < 2.5cm, upper airway anomalies, morbid obesity, edentulous patients), risk of aspiration like pregnancy, gastro-oesophageal reflux disease, non-fasted, recent sore throat were excluded. The sample size was calculated based on a previous study conducted by Mi-Jung Yun et al. in which the success rate was found to be 87% for head elevation by 3 cm versus 60% for head elevation by 6 cm. In the present study, the sample size was calculated assuming an equivalence margin of 50%, considering the power of 80% and α-error of 5%; which was estimated to be 41 patients in each group. After obtaining informed consent 123 adult patients were randomized into three groups using a random number table which was concealed in a sealed envelope until the start of anaesthesia.

Group C: No head elevation (No pillow) (Fig 1).

Group LP: 4 cm Head elevation (4 cm pillow) (Fig 2).

Group HP: 8 cm Head elevation (8 cm pillow) (Fig 3).

Patients were made to lie supine either without a pillow or with an uncompressible firm pillow (4cm or 8cm) under the head. After connecting monitors (ECG, Spo2, and NIBP), patients were preoxygenated for 3
minutes. Anesthesia was induced with Injection of Midazolam 0.05 mg kg\(^{-1}\), Fentanyl 2mcg kg\(^{-1}\), Propofol 2.0 mg kg\(^{-1}\), and Atracurium 0.5 mg kg\(^{-1}\). Based on the patient’s weight, PLMA 3 or 4 was inserted after lubrication with a water-soluble jelly in one of the above three different positions, using a standard digital technique by an anaesthetist who was trained for one year. After PLMA was inserted, the cuff was inflated with an appropriate volume of air, and PLMA was connected to a breathing circuit. An effective airway was judged by a square wave capnography and no audible oropharyngeal air leak with peak airway pressures of 12-14cm H\(_2\)O. Insertion time, which is the time between picking up the PLMA and successful placement, was noted. The PLMA was repositioned if there was a failed passage into the pharynx, audible air leak, failed gastric tube insertion, or ineffective ventilation (expired tidal volume < 8 ml kg\(^{-1}\) and end-tidal carbon dioxide > 45 mmHg) and was regarded as the next attempt.

If insertion fails after 3 attempts, it was regarded as a failure and excluded from the study. The number of insertion attempts was recorded. Heart rate and mean blood pressure were recorded at baseline and 1 minute, 5 minutes, and 10 minutes after the PLMA insertion. After the surgery, patients were reversed with Inj. Neostigmine 0.05mg kg\(^{-1}\) and Inj. Glycopyrrolate 0.01 mg kg\(^{-1}\) and extubated. Any visible blood stain on PMLA was noted. Patients were asked for sore

![Fig 1: Group C](image1.png)  ![Fig 2: Group LP](image2.png)  ![Fig 3: Group HP](image3.png)
throat 1 hour postoperatively.

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) were calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Differences in proportions between qualitative variables were tested using the chi-square test or Fisher exact test as applicable. P value less than 0.05 was considered statistically significant.

**Results**

General characteristics were comparable (Table 1). LMA insertion at the first attempt was successful in 30 patients (73.17%) in Group C, 40 patients (97.56%) in Group LP & 22 patients (53.66 %) in Group HP, the difference was statistically significant. (P <0.001) (Table 2).

Mean insertion time was significantly less in the LP group when compared with group C (P< 0.001) and group HP (P< 0.001) and insertion time was significantly less in the C group when compared with group HP (P=0.02). Incidence of blood staining on PLMA was significantly higher in Group HP as compared to Group C & Group LP, difference was statistically significant. (P <0.001) (Table 3). The incidence of patient experiencing sore throat was comparable in Group C, LP & HP.

**Discussion**

Though the endotracheal tube (ETT) is time tested excellent airway securing device that is available at all times, it too has its demerits such as pressor response, trauma

<table>
<thead>
<tr>
<th></th>
<th>GROUP C (n=41)</th>
<th>GROUP LP (n=41)</th>
<th>GROUP HP (n=41)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>40.16±15.34</td>
<td>42.67±16.89</td>
<td>41.79±14.47</td>
<td>0.67</td>
</tr>
<tr>
<td>Males / Females</td>
<td>16 / 25</td>
<td>17 / 24</td>
<td>18 / 23</td>
<td>0.93</td>
</tr>
<tr>
<td>ASA 1 / ASA 2</td>
<td>29 / 12</td>
<td>34 / 7</td>
<td>24 / 17</td>
<td>0.052</td>
</tr>
<tr>
<td>No. 3 / No. 4</td>
<td>17 / 24</td>
<td>19 / 22</td>
<td>16 / 25</td>
<td>0.79</td>
</tr>
<tr>
<td>Weight (in kg)</td>
<td>60.09 ± 10.19</td>
<td>57.09 ± 8.74</td>
<td>60.85 ± 8.47</td>
<td>0.15</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>23.7 ±3.79</td>
<td>23.33±3.21</td>
<td>24.12± 3.97</td>
<td>0.82</td>
</tr>
</tbody>
</table>

Table 1: General characteristics
to vocal cords and sore throat are worrisome to the anesthesiologist.\textsuperscript{7} This led to the use of supraglottic devices such as PLMA which offers many advantages such as lesser incidence of sore throat, reduced coughing and bucking on emergence, and improved hemodynamic stability.\textsuperscript{3}

A properly positioned PLMA is a safe alternative to ETT for airway management in adequately fasted adult patients undergoing elective surgeries. The sniffing position has been advocated as a standard for direct laryngoscopy and has been effective for providing adequate mask ventilation.\textsuperscript{4, 8} As per standard recommendations even for PLMA sniffing position with pillow is advocated.\textsuperscript{3, 9}

While the anatomic sniffing position has been traditionally considered the standard head and neck position for laryngoscopy, in contrast to our study there are few other studies which suggest that the sniffing position provides no significant advantage over simple head extension. Adnet et al.,\textsuperscript{10} found that the oral, pharyngeal and laryngeal axes in eight healthy unanesthetized volunteers were not aligned with the ‘sniff’ position (with a 7-cm headrest) with the use of Magnetic Resonance Imaging (MRI). Another study by Schmitt et al.,\textsuperscript{11} suggested that additional flexion of the lower neck by means of head and neck elevation beyond the ‘sniff’ position (causes a posterior movement and brings the glottis into view) may

Table 2: Attempt for LMA insertion among groups.

<table>
<thead>
<tr>
<th>No. of Attempts for LMA insertion</th>
<th>GROUP C (n=41)</th>
<th>GROUP LP (n=41)</th>
<th>GROUP HP (n=41)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>30</td>
<td>40</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>02</td>
<td>09</td>
<td>01</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>03</td>
<td>02</td>
<td>00</td>
<td>06</td>
<td></td>
</tr>
<tr>
<td>First attempt success rate</td>
<td>73.17%</td>
<td>97.56%</td>
<td>53.66%</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

P value less than 0.05 was considered as statistically significant.

Table 3: Insertion time, blood stain and sore throat in various groups.

<table>
<thead>
<tr>
<th>Variable</th>
<th>GROUP C (n=41)</th>
<th>GROUP LP (n=41)</th>
<th>GROUP HP (n=41)</th>
<th>P VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean insertion time of LMA (sec)</td>
<td>21.90 ± 4.48</td>
<td>16.12 ± 5.35</td>
<td>25.14 ± 8.79</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Blood staining on PLMA</td>
<td>3</td>
<td>2</td>
<td>20</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Sore throat after recovery</td>
<td>15</td>
<td>14</td>
<td>24</td>
<td>0.04</td>
</tr>
</tbody>
</table>

P value less than 0.05 was considered as statistically significant.
Adnet et al.,\textsuperscript{12} recommended that the routine use of the sniffing position appears to provide no significant advantage over simple head extension for tracheal intubation. While assessing the glottis exposure by Cormack Lehane (CL) grading, in comparison to simple head extension, they have found out that sniffing position improved glottis exposure in 18\% of patients and worsened in 11\% of patients. They found no significant advantage of the sniffing position over simple head extension except for obese patients and those with limited extension.

Analyzing radiologically, the sniffing position provides greater occipital-Atlanta axial extension compared to simple head extension and hence provides a better view of the glottis.\textsuperscript{13} There are other studies\textsuperscript{14,15} as well where the sniffing position was better compared to a simple head extension. However, there have been only a few studies conducted for PLMA insertion without a pillow, in easy and difficult airways.\textsuperscript{6} The ‘sniff’ position increases the submandibular space and facilitates vertical alignment of the mandible, tongue base, and larynx.

In our study, on comparing 4cm with 8cm pillow, the 4 cm pillow had a higher first attempt success rate (97.56\% vs 53.662\% respectively). This result correlates with the study done by Mi Jung Yun et al.,\textsuperscript{6} where they found that the first attempt success rate was higher in 3cm (87\%) than in 6cm (60\%).

The influence of head elevation for sniffing position for ETT insertion is different from that of PLMA insertion. In a clinical study done to find the optimal pillow height between 3cm, 6cm, and 9cm, they recommend a 9cm pillow for improved laryngeal view during endotracheal intubation.\textsuperscript{8}

The overall success rate of PLMA insertion after 3 attempts was 100\% in all the 3 groups. Similar results were seen in the study
conducted by Jun et al.,\textsuperscript{16} where he compared the ease of PLMA insertion with head in neutral position and head in sniffing position of height of 8cm. This was also similar to the result of Brimacombe et al.,\textsuperscript{17} and Figueredo et al.\textsuperscript{18} In our study, on comparing 8cm with 4 cm pillow, the number of 2\textsuperscript{nd} attempt and 3\textsuperscript{rd} attempt was higher. This might be due to a limited head extension in the 8cm group which made it harder to open the patient’s mouth and insert the PLMA vertically. Our results were in concurrence to a study done by Mi Jung Yun et al.,\textsuperscript{6} where the number of 2\textsuperscript{nd} and 3\textsuperscript{rd} attempts of a 3cm pillow is much lesser when compared to a 6cm high pillow. Insertion time was significantly less in the low Pillow (16.12 ± 5.35 sec) group when compared with group C (21.90 ± 4.48 sec) and high pillow group (25.14 ± 8.79 sec) and was statistically significant. This time difference may not be significant for routine cases, but it is important in emergency situations where securing an airway is of prime importance.

Blood staining on PMLA was found in 20 patients of the 8cm pillow group, whereas it was found in 3 patients with no head elevation and 2 patients with 4cm head elevation. This airway morbidity may be due to tissue trauma due to repeated insertion, removal, and adjusting maneuvers of PLMA or from the passage of devices into the respiratory or gastrointestinal tracts.\textsuperscript{3, 7} In our study using the digital technique of insertion of PLMA, the main reason for blood stains in a greater number of patients in the high pillow group may have been due to an increased number of attempts. Cook et al.,\textsuperscript{3} demonstrated that PLMA causes a minimal hemodynamic response to the insertion. In our study, the PLMA was inserted with adequate depth of anesthesia and relaxation which have contributed to insignificant hemodynamic changes between the three groups. Similar results were found in study done by Nalini et al.,\textsuperscript{19} where they
compared different insertion techniques of PLMA under the adequate depth of anaesthesia with controlled ventilation. Limitations of our study were, manometry measurement of cuff pressure of PLMA was not documented, no maneuvers were used to aid PLMA insertion for repeated attempts and correct positioning of PLMA was not assessed with a fiberoptic bronchoscope.

Conclusion

The first attempt success rate of PLMA was higher and insertion time was faster with a 4 cm pillow than with an 8 cm pillow and no head elevation. The incidence of post-operative complications like blood stains on PLMA and sore throat was lesser with a 4 cm head elevation than with an 8 cm head elevation. Hence, a head elevation by a pillow of height of 4 cm was effective for PLMA insertion in adult patients when compared with an 8 cm pillow.

Financial support and sponsorship Nil

Conflicts of interest Nil

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