Research Article

# A study to compare the stability of proseal laryngeal mask airway and standard laryngeal mask airway in different head and neck positions

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## ABSTRACT

**Background:** Laryngeal mask airway (LMA)-Classic (CLMA) and Laryngeal mask airway (LMA)-Proseal (PLMA) are commonly used supraglottic devices for different kind of surgeries. We compared oropharyngeal leak pressure, intracuff pressure and anatomical position for LMA-Proseal and LMA-classic in four different head and neck positions: neutral, flexion, extension and left lateral rotation.

**Materials and Methods:** LMA-Proseal and LMA-Classic were inserted randomly in 100 adult patients. Oropharyngeal leak pressure, intracuff pressure and anatomical position of the airway were recorded in four head and neck positions (neutral first, then flexion, extension and left lateral rotation).

**Results:** Compared with neutral position, oropharyngeal leak pressure for both LMA-Proseal and LMA-Classic was higher in flexion and left lateral rotation but lower in extension (all p values <0.005). Changes in head-neck position did not alter the anatomical position of the airway. Oropharyngeal leak pressure was always higher for LMA-Proseal than for LMA-Classic (p value < 0.001).

**Conclusion:** The anatomical position of LMA-Proseal and LMA-Classic is stable in different head-neck positions, but head-neck flexion and left rotation are associated with an increase and head-neck extension is associated with a decrease in oropharyngeal leak pressure and intracuff pressure as compared to neutral position. LMA-Proseal forms a better seal than LMA-Classic in all the different head and neck positions.

**Key words:** Laryngeal Mask Airway, Proseal, classic laryngeal mask airway, oropharyngeal leak pressure, supraglottic devices.

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## INTRODUCTION

Laryngeal mask airways (LMA) are a useful advance in airway management, filling the niche between face mask and the endotracheal tube in terms of both anatomical position and degree of invasiveness.[1, 2]

Laryngeal mask airways (LMA) are also being used for surgeries with different head & neck positions, for example ENT surgeries like thyroplasty and medialization laryngoplasty.[3-7] A well functioning LMA is not necessarily ideally placed anatomically and head & neck movement could distort the oropharyngeal space and affect the anatomical position and function of LMA.

The stability of PLMA & CLMA in different head & neck positions can be assessed by change in oropharyngeal leak pressure, intracuff pressure and anatomical position by fibreoptic laryngoscope.[8] Here, it is important to see whether the airway device is maintaining an adequate seal and ventilation with the patient in different head & neck positions. There are just a few studies regarding the stability of

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PLMA & CLMA in different head & neck positions. As CLMA and PLMA are increasingly being used for various surgeries, some of which may also involve intra-operative movement of head and neck position, we planned to perform a randomized study to compare the stability of PLMA and CLMA in different head & neck positions.

## MATERIALS AND METHODS

### Study setting

This study was conducted in the Department of Anaesthesiology and Critical care, Pt B D Sharma PGIMS Rohtak from year 2004 to 2007. The study has been approved by Institute PG board of studies of Pt. B D Sharma PGIMS Rohtak, Haryana, India.

### Inclusion criteria

All patients between the age group of 18-70 years having American Society of Anesthesiologists (ASA) physical status grade I & II, scheduled for orthopedic or general surgery were included in the study.

### Exclusion criteria

Patients having mouth opening < 2.5 cm, BMI > 35, predicted difficult airway, cervical spine disease and history of regurgitation were excluded from the study.

### Different study groups

All patients were examined during the preoperative visit and informed consent was obtained from all the patients. They were randomly allocated to one of the two groups comprising of 50 patients each by drawing coded slips from an envelope. Group I (n = 50) patients were inserted with Proseal LMA and group II (n=50) were inserted with standard/classic LMA.

### Intervention protocol

Patients were kept fasting for six hours prior to surgery and pre-medicated with tab Alprazolam 0.25mg at bedtime. Induction was performed with Inj. Midazolam 0.05mgkg$^{-1}$ and Inj. Propofol 2.5mgkg$^{-1}$ intravenously followed by Inj Vecuronium bromide 0.1mgkg$^{-1}$ IV. Patients were then ventilated with 50% $N_2O$ in $O_2$ for 90 seconds via facemask using Bain's circuit. Thereafter, either CLMA (using standard recommended technique) or the Proseal LMA (using introducer tool technique) was inserted. In female patients, no. 3 and in male patients, no. 4 of the airway device was used. The cuff was inflated to achieve an intra-cuff pressure of 60 cm of $H_20$ with head & neck in neutral position. The device was secured with the help of a tape.

### Data collection

#### *Oropharyngeal Leak Pressure (OLP)*

OLP was measured by closing the expiratory valve of the circle system at a fixed gas flow of 3L/min with ventilatory support off and noting the airway pressure at which dial on the manometer reached equilibrium in the following head & neck positions: neutral, flexion, extension and left lateral rotation. Care was taken to avoid displacement of airway device.

#### *Intra-cuff Pressure (ICP)*

Intra-cuff Pressure was adjusted to 60 cm of $H_2O$ by using the cuff pressure manometer with head & neck in neutral position before each measurement. Then intracuff pressure was noted with head & neck in four positions: neutral, flexion, extension and left lateral rotation.

#### *Anatomic Position*

The anatomic position was studied by using fibreoptic scope passed down the airway tube just proximal to mask aperture and the view was scored as per the classification given by Mizushima et al.[9] and is as follows;

grade 1: glottis only seen, grade 2: epiglottis and glottis seen, grade 3: epiglottis impinging on the aperture and glottis also seen, and grade 4: epiglottis downfolded and glottis not seen.

### Statistical analysis

The data of various parameters of this randomized study were compiled and analyzed statistically by using – student's 't' test (paired/ unpaired), Wilk's Lambda test, Mann Whitney U-test and chi-square test.

## RESULTS

### Demographic Profile

There were 23 females and 27 males in LMA-Proseal group and 26 males and 24 females in LMA-Classic group. Mean Age of Patients was 35.30 ± 11.22 in LMA-Proseal group and 32.58 ± 12.50 in LMA-Classic group (p value-0.092). Demographic profile was comparable between the two groups.

### Oropharyngeal Leak Pressure (OLP)

OLP was measured in four different head & neck positions - neutral, flexion, extension and left lateral rotation. On statistical analysis using Mann whitney U-test and Student's t test (paired), OLP was found to be higher for group I (PLMA) than group II (LMA) in all four different head and neck positions. On analyzing the change in OLP in different head & neck positions as compared to neutral position, using Student's 't' test (paired) and Wilcoxon Signed Rank test, significant ($p < 0.005$) changes were observed. In both the groups, there was increase in OLP in flexion & left lateral rotation and decrease in extension (Table 1).

**Table 1: Oropharyngeal Leak Pressure (cm $H_2O$) in different positions**

| POSITION | GroupI(PLMA) (n=50) (Mean ± SD) | GroupII (CLMA) (n=50) (Mean ± SD) | 'p' value |
|---|---|---|---|
| Neutral | 31.52 ± 2.53 | 22.76 ± 3.07 | < 0.001 |
| Flexion | 36.32 ± 3.11 | 26.92 ± 3.12 | < 0.001 |
| Extension | 27.70 ± 3.59 | 19.92 ± 2.39 | < 0.001 |
| Left lateral rotation | 34.24 ± 2.92 | 25.64 ± 2.87 | < 0.001 |

When compared irrespective of the groups, an increase in OLP in flexion & left lateral rotation and a decrease in extension was found, both the changes being significant ($p < 0.001$).

### Intra Cuff Pressure (ICP) (Table 2)

Intra cuff pressure for both groups was adjusted to 60 cms of $H_2O$ in neutral position using cuff pressure manometer. Then intracuff pressure was measured and documented in different head & neck positions for both groups.

**Table 2: Intra Cuff Pressure (ICP) in different positions**

| POSITION | Group I (n=50) (Mean ± SD) | Group II (n=50) (Mean ± SD) |
|---|---|---|
| Neutral | 60.00 ± 0.00 | 60.00 ± 0.00 |
| Flexion | 88.78 ± 2.17 | 84.32 ± 3.58* |
| Extension | 56.88 ± 1.72 | 53.98 ± 2.76* |
| Left lateral rotation | 77.44 ± 2.83 | 74.84 ± 3.25* |

* $p < 0.001$ vs. group 1.

The above data was analyzed statistically by Mann Whitney U-test and Students't' test (unpaired), the ICP was found to be higher for group I (PLMA) ($p < 0.001$) as compared to group II in all different head & neck positions other than neutral position.

When compared irrespective of the groups using Wilk's Lambda test, ICP was higher in flexion (86.55 + 2.96) & left lateral rotation (76.14 + 0.30) and lower in extension (55.43 + 0.23). All these changes were significant.

### Fibreoptic Score in different Anatomic Position by Fibreoptic Laryngoscope (Table 3, 4)

In neutral position, we found grade I fibreoptic score in 58% of patients in group I and 56% of patients in group II. The score of grade II was seen in 42% and 40% of patients in group I and II respectively. Only 2 patients in group II had a score of grade 3. With changes in head and neck position, fibreoptic score remained similar in left lateral rotation and extension in both the groups. However, on placing head and neck in flexion, significantly less number of patients both in group I and II had a

**Table 3: Fibreoptic Score of Both Groups (Neutral Position)**

| Fibreoptic Score | Group I(PLMA) (n=50) | Group II(CLMA) (n=50) |
|---|---|---|
| 1 | 29 | 28 |
| 2 | 21 | 20 |
| 3 | 0 | 2 |
| 4 | 0 | 0 |

a fibreoptic score of 1 i.e. 30% and 32% of patients respectively. The data for scoring of anatomic position of both groups in neutral position was analyzed statistically using Chi-square test. We observed that the difference in anatomic position between two groups was not statistically significant.

The data for this scoring was not statistically significant in flexion, extension or left lateral rotation. However on analyzing the change in anatomic position in flexion, extension & left lateral rotation as compared to neutral position by Student's t test (paired) and Wilcoxan Signed Rank test in both the groups a highly significant change in flexion, where as no significant change in extension and left lateral rotation was found i.e. the anatomic position of PLMA and CLMA was better in neutral position than in flexion.

## DISCUSSION

Our study on hundred patients compared the stability of PLMA and standard LMA (CLMA) in different head and neck positions by OLP, ICP and anatomic position by fibreoptic laryngoscope.

### Oropharyngeal leak pressure (OLP)

We found that OLP was higher for PLMA than CLMA in all different head and neck positions. It increased with neck flexion, left lateral rotation and decreased with neck extension as compared to neutral position in group I. However though it decreased in extension, but in all patients it remained equal to or greater than 20 cm of $H_2O$ in group I, thus permitting an adequate seal and positive pressure ventilation.

We found an increase in OLP with neck flexion, left lateral rotation and decrease with extension as compared to neutral position in group II. Cook et al compared PLMA and CLMA in anaesthetized nonparalyzed patients and found that OLP was higher for PLMA than CLMA.[10] The mean seal pressure for PLMA was 12 cms of $H_2O$ higher than CLMA which is in accordance with our study.

Brimbacombe et al compared PLMA and standard LMA in anaesthetized paralyzed patients and found that PLMA formed a more effective seal than CLMA.[11] In another study they compared PLMA and CLMA in different head and neck positions and they found that the OLP was higher for PLMA than CLMA. It was higher in flexion for PLMA, left lateral rotation for CLMA and lower during extension for PLMA and CLMA as compared to neutral position.[8] This is in accordance with our study. The changes in OLP were highly significant in all positions. The probable reasons may be reduction in pharyngeal volume during flexion & left lateral rotation and increase in pharyngeal volume during extension. During flexion and left lateral rotation the cuff presses more firmly into the periglottic tissues, therefore higher OLP than in neutral position. OLP is higher for PLMA than CLMA. The reasons being wedge shaped ventral cuff plugs the gaps into the

**Table 4: Change in Fibreoptic Score (%) with change in Head & Neck Position**

| | CLMA (Group II) | | | | PLMA (Group I) | | | |
|---|---|---|---|---|---|---|---|---|
| **Fibreoptic Score** | 1 | 2 | 3 | 4 | 1 | 2 | 3 | 4 |
| **Neutral → extension** | 56 → 40 | 40 → 60 | 4 → 0 | - | 58 → 60 | 42 → 40 | - | - |
| **Neutral → left rotation** | 56 → 40 | 40 → 58 | 4 → 2 | - | 58 → 48 | 42 → 52 | - | - |
| **Neutral → Flexion** | 56 → 32 | 40 → 66 | 4 → 2 | - | 58 → 30 | 42 → 70 | - | - |

proximal pharynx, dorsal cuff pushes the ventral cuff more firmly into the periglottic tissues and the cuff shape better matches the pharyngeal anatomy.

**Intracuff pressure (ICP)**

In our study we found higher ICP for PLMA than CLMA in flexion, extension and left lateral rotation and lower in extension as compared to neutral position. The results were similar with CLMA. The increase in ICP was very highly significant.

Brimbacombe et al compared PLMA and CLMA and found higher ICP with head and neck flexion, left lateral rotation and lower with extension as compared to neutral position.[8] Neck flexion removes the longitudinal tension in the anterior pharyngeal muscles, allowing them to settle down onto the mask to form a better seal. Their results are consistent with those of our study, but they found no significant difference in ICP between PLMA and CLMA which is not in accordance with our study where we found a significant difference between the same.

Buckham et al found similar results with CLMA. The mechanism of change in ICP is probably due to decrease in the pharyngeal volume during flexion, left lateral rotation and increase in pharyngeal volume during extension. [12] During flexion and left lateral rotation the cuff presses more firmly into the periglottic tissues that leads to increase in ICP and during extension cuff does not press firmly leading to a decrease in the ICP.

Anatomic position for PLMA and CLMA in different head and neck positions was found comparable in two groups. Changing to flexion also did not significantly change the good fibreoptic scores of grade 1&2 for both PLMA & CLMA.

Braun et al compared PLMA and CLMA and found statistical equivalence between the endoscopic position of larynx in neutral position in the two groups which is in accordance with our study.[13] Cook et al had similar results in 2002.[10]

Keller et al found that the anatomic positions of CLMA remained unchanged with change in head and neck position in extension and left lateral rotation, but the epiglottis moved towards the mask aperture bars during flexion. [14]

Brimbacombe and Keller in 2003 compared PLMA and CLMA and found that anatomic position of the airway tube of the CLMA was better than the PLMA in all the different head and neck positions whereas we have found PLMA and CLMA to be comparable.[14] They found no changes in anatomic position for both PLMA and CLMA in different position which is consistent with our results.

We conclude that the change in head and neck position does not alter the anatomical position of PLMA and CLMA but the oropharyngeal leak pressure and intracuff pressure are higher with flexion, left lateral rotation and lower with extension as compared to neutral position. The PLMA forms a better seal than LMA in all the different head and neck positions.

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Not reported.

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