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Comparison of Insertion Techniques of Classical Laryngeal Mask Airway Regarding Ease of Insertion and Complications

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Abstract

Introduction: LMAs is a valuable rescue device in both elective and emergency situations for both anticipated and unanticipated difficult airways. Many studies have shown that rotational technique has been proven to be much more effective in pediatric age group avoiding injury to pharynx without buckling the tip of LMA. This prompted us to study this rotational technique in adult population and compare it with the standard one. *Aims and Objectives:* To study the classic laryngeal mask airway insertion comparing standard and partial cuff inflated rotational technique with respect to ease of insertion and occurrence of complications. *Materials and Methods:* Ethical committee approval and informed consent obtained, 140 patients of age 18 to 70 years, ASA I and II posted for short surgical procedures under general anesthesia were randomized into Group S (Brain's Standard insertion Technique) and Group R (Partially inflated Rotational Technique). Appropriate sized LMA was inserted was hemodynamics monitored. *Data Analysis:* Continuous variables were analyzed with the unpaired *t*-test. Categorical variables were analyzed with the Chi-square Test and Fisher Exact Test. Statistical significance was taken as $p < 0.05$. *Results:* Both groups were comparable with respect to demography. Statistically significant difference among the group with respect to first attempt success and LMA insertion time. Hemodynamically both groups were comparable. There were no statistically significant difference in complications. *Conclusion:* We conclude that the Standard technique of LMA insertion is a better technique when compared to Rotational technique with respect to ease of insertion and lesser number of complications.

Keywords: Brain's standard insertion technique; Classic laryngeal mask airway; Partially inflated rotational technique.

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Introduction

Successful tracheal intubation required one to master the art of laryngoscopy to visualize the larynx, without causing undue trauma to the teeth and walls of the oropharynx.[1–3] In 1983, Archie Brain[3] invented the Laryngeal Mask Airway and introduced it as a safer and reliable alternative rescue device in both elective and emergency situations for both anticipated and unanticipated difficult airways. The Classic LMA became commercially available in 1988 in England. It is a reusable device and may be steam autoclaved up to 40 times. The mask consisted of three components, an inflatable cuff made of silicone rubber that provides a prelaryngeal seal, a semi rigid, semitransparent airway tube and an inflation line.

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The mask is oblong and based on the plaster cast of cadavers. Brain's technique[4] of insertion involved placing the head and neck in the normal intubating position and then inserting the deflated mask with its lumen facing forwards until a resistance was felt. This technique though popular is not without drawbacks. The main problem arises when the tip of the LMA folds against the posterior pharyngeal wall. It requires excessive force to push the LMA into proper position using the index finger, which could also lead to trauma to the guiding finger by the patient's teeth. This would often lead to multiple insertion attempts, trauma to the airway and failure to obtain a proper seal.

Various insertion techniques have been attempted in all age groups with regard to ease of insertion and time required to achieve proper placement of the mask. Among the various techniques used rotational technique has been proven[5–7] to be much more effective in pediatric age group, when compared to the standard Brain's technique. It avoided the structures in the anterior pharynx and the LMA slides along the posterior pharynx without buckling the tip of LMA. This prompted us to study this technique in adult population and compare rotational technique with the standard technique.

Aims

To study the classic laryngeal mask airway insertion comparing standard technique and partial cuff inflated rotational technique with respect to ease of insertion and occurrence of complications.

Objectives

Primary objectives: To evaluate and compare the ease of LMA insertion through the Standard and partially inflated Rotational LMA insertion technique with respect to:

Number of attempts;

Time to secure a successful airway.

Secondary objectives: To evaluate occurrence of complications during insertion process such as:

Hypoxemia (SpO_2 < 90%);

Laryngospasm;

Blood staining on LMA surface upon removal.

Materials and Methods

After getting the ethical committee approval and informed consent 140 patients in the age group of 18 to 70 years, ASA I and II posted for short surgical procedures under general anesthesia were included in the study.

Patients anticipated difficult airway risk for aspiration recent history of upper airway infection ASA III and IV were excluded from the study.

Patients were then randomized into two groups:

Group S: Brain's Standard insertion Technique;

Group R: Partially inflated Rotational Technique.

All the patients were kept nil per oral for a minimum of 8 hours preceding the procedure. All the patients received intravenous inj. midazolam 1 mg, inj. glycopyrollate 0.2 mg and inj. ondansetron 4 mg half an hour before the surgery in the preanesthetic room. On arrival in the operating room, after the placement of standard minimum monitoring devices patients were preoxygenated for three minutes with 100% oxygen. Anesthesia was induced with Inj. Propofol 1%, 2.5 mg/kg/IV and fentanyl 2/kg/IV. Patients were ventilated with oxygen for one minute by bag and mask, after which LMA was inserted according to the study group technique allotted by randomization.

Anesthesia was considered adequate for device insertion when the patient was unresponsive with no spontaneous respiration and had lost eye-lash reflex. Laryngeal mask airway of appropriate size according to the weight of the patient was lubricated using a water based KY jelly and once adequate depth achieved the device was inserted, bilateral air entry was checked and the device was secured with tape. Anesthesia was maintained with nitrous oxide and oxygen in a ratio 2:1 along with isoflurane and patient was maintained in spontaneous ventilation.

Group S: Brain's Standard insertion Technique:[13,14] The patient's head was positioned in sniffing position and LMA was inserted using the index finger which was placed at the junction of cuff and tube while the hood faced the nose and hard palate. The LMA was pushed inside the oral cavity until a resistance was felt. Then the LMA was stabilized using the other hand and the inserting hand was removed.

Group R: Partially inflated Rotational Technique:[15–22] The patient's head was positioned in sniffing position. The LMA cuff was partially inflated and faced the nose and hard palate. The LMA was pushed inside until a resistance was felt and rotated to 180° anti clock wise and position was confirmed.

Insertion Time

Insertion time was calculated from the time taken from picking up the airway in the hand to the successful placement of airway as confirmed by auscultation of bilateral equal air entry over the chest.

Number of Attempts

If an effective airway could not be achieved the LMA was removed and reinserted in the same technique a total of 3 attempts were permitted before failure of insertion was recorded. After 3 unsuccessful attempts, the trachea was intubated.

In the event of desaturation (SpO_2 < 95%) during the three attempts, rescue ventilation was planned with bag and mask and that time period will also be included in the total insertion time. Number of insertion attempts using either technique was recorded.

The following parameters were monitored prior to insertion at 0 and every minute until 10 minute and then every 5 minute until 30 minutes after securing the airway:

Heart Rate (HR) in beats per minute;

Systolic Blood Pressure (SBP) in mm/Hg;

Diastolic Blood Pressure (DBP) in mm/Hg;

Oxygen saturation (SpO_2) in percentage.

Airway Sealing Pressure

Airway sealing pressure was determined by closing the expiratory valve of the circle system at a fixed gas flow of 3L/min and recording the oropharyngeal leak pressure by detection of an audible noise using a stethoscope placed just lateral to the thyroid cartilage. The corresponding airway pressure displayed in the monitor was recorded.

At the end of the surgical procedure, anesthesia was discontinued and the device was removed while the patient was in a deeper plane of anesthesia and oxygen maintained by face mask.

LMA position confirmation:

Visible bilateral equal chest expansion;

Bilateral equal air entry on auscultation;

Appearance of end tidal carbon dioxide tracing;

Absence of audible air leak after standardized cuff inflation;

Fiber optic bronchoscope confirmation, shows in Table 1.

Table 1: FOB grading

Grade1	Larynx only (ideal position)
Grade 2	Epiglottis + larynx
Grade 3	Epiglottis impinging grill + larynx seen
Grade 4	Kinked LMA
Grade 5	Epiglottis down folded + larynx not seen

Complications assessed after device removal

Hypoxemia (SpO_2 < 90%);

Laryngospasm;

Presence of blood on airway device.

Data Analysis

Descriptive statistics was done for all data and were reported in terms of mean values and percentages. Continuous variables were analyzed with the unpaired *t*-test. Categorical variables were analyzed with the Chi-square Test and Fisher Exact Test. Statistical significance was taken as $p < 0.05$. The data was analyzed using SPSS version 16 and Microsoft Excel 2007.

Sample Size Estimation

Sample size was determined based on study done by Dileep Kumar[33] et al.

In this study statistically insignificant difference was found in incidence of blood stained LMA (22% difference).

Description

- The confidence level is estimated at 95%
- With a z value of 1.96
- The confidence interval or margin of error is estimated at ±8
- Assuming p % = 22 and q % = 78

  $n = p\ \% \times q\ \% \times [z/e\%]^2$

  $n = 22 \times 78 \times [1.96/8]^2$

  × = 103

Therefore, 103 is the minimum sample size required for the study.

In our study, we planned to recruit a minimum of 140 subjects (70 per intervention arm).

Results

Both the groups were comparable with respect to age, weight, gender distribution, mallampatti classification and ASA distribution, shows in Table 2.

Among the study subjects, there was no statistically significant difference in relation to

Table 2: Demograph

Parameters	Standard Group (n = 71)	Rotational Group (n = 69)	p - value
Age in years (mean SD)	35.51 ± 10.41	35.09 ± 10.23	0.8101
Gender			
Male	3	0	0.0843
Female	68	69	
Weight in kgs	56.82 ± 7.83	58.09 ± 7.50	0.3290
ASA			
I	59	56	0.7645
II	12	13	
Mallampatti Class			
I	48	50	0.5306
II	23	19	
Number of Attempts			
1	67	42	< 0.0001
2	4	12	
3	0	15	
Mean LMA insertion time	34.28 ± 10.20	69 ± 48.49	< 0.0001
LMA - Fiberoptic Grade Groups			
Grade 1	52	45	0.6642
Grade 2	16	19	
Grade 3	1	3	
Grade 4	2	2	
Mean Oropharyngeal Leak Pressure	38 ±1.68	37.48±1.8	0.07

Table 3: Complications

Complications	Standard Group (n = 71)	%	Rotational Group (n = 69)	%	p - value Fishers Exact Test
Hypoxemia	0	0.00	1	1.45	0.4929
Laryngospasm	0	0.00	1	1.45	0.4929
Blood Stain	1	1.41	5	7.25	0.1131

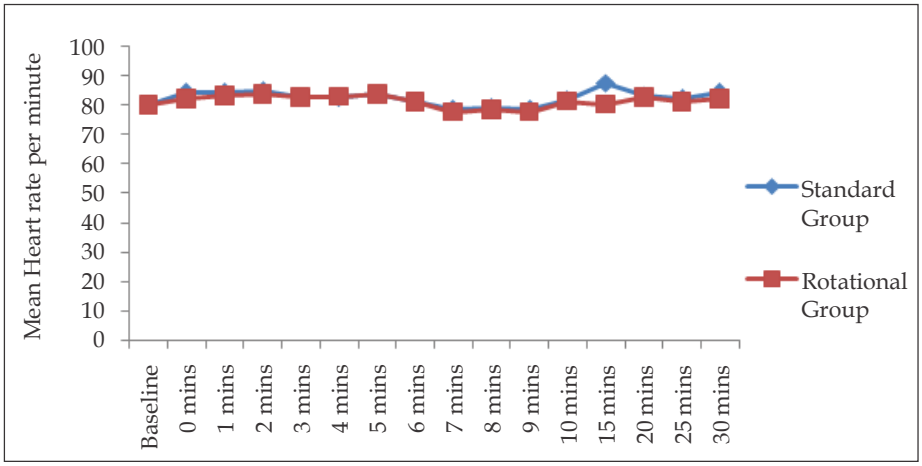

Fig 1: Mean Heart Rate

baseline and intraoperative heart rate, shows in Fig. 1, systolic blood pressure, shows in Fig. 2, diastolic blood pressure shows in Fig. 3 and oxygen saturation between rotational procedure group and standard procedure group during the observation period of 0 to 30 min (0 min and every minute until 10 minute and then every 5 minute until 30 minutes after securing the airway) *p* - value of > 0.05 as per unpaired *t*- test.

Among the study subjects, there was no

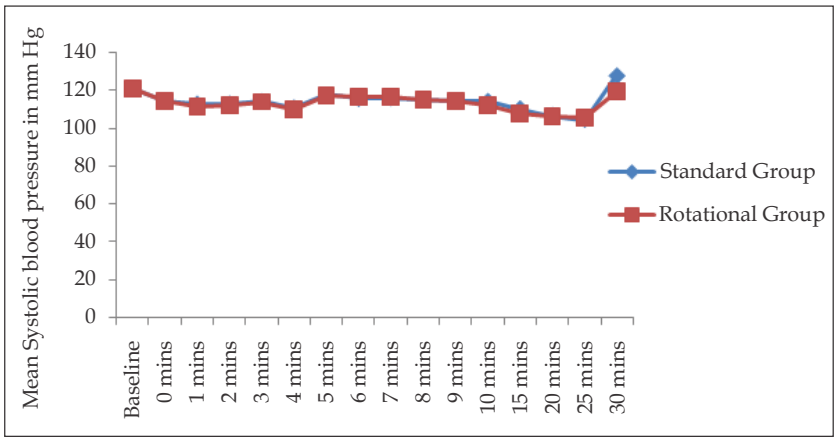

Fig 2: Mean Systolic Blood Pressure

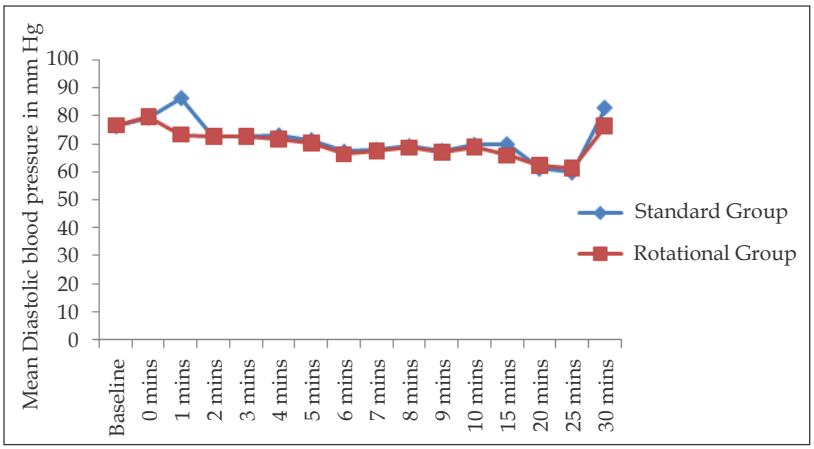

Fig 3: Mean Diastolic Blood Pressure

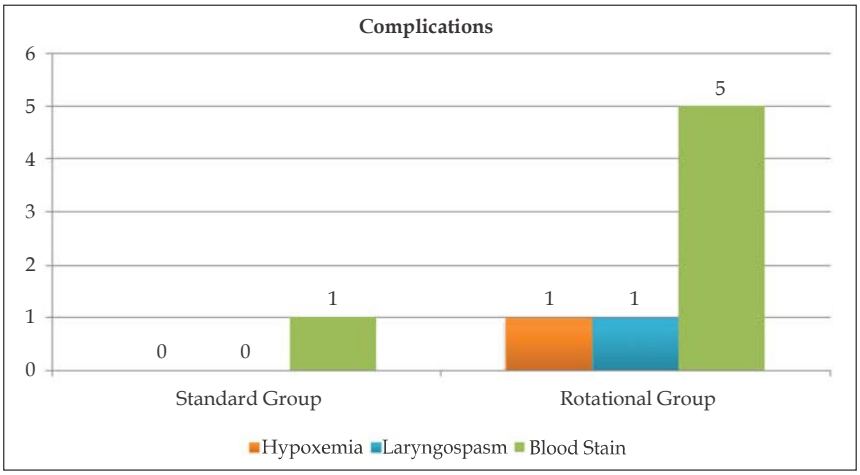

Fig 4: Complications

statistically significant difference in relation to complications status between standard procedure group and rotational procedure group when used in patients undergoing classic laryngeal mask airway insertion with a *p* - value of > 0.05 as per fishers exact test.

LMA insertion timetable shows that majority of the study subjects were distributed in 31–60 secs group (63.38% in standard procedure group and 42.03% in rotational procedure group). with a *p* - value of < 0.05 as per unpaired *t*-test. LMA fiberoptic grading table shows that majority of the study subjects were distributed in Grade I group (71.24% in standard procedure group and 65.22% in rotational procedure group). Among the study subjects, there was no statistically significant difference in relation to LMA fiberoptic grading status between standard procedure group and rotational procedure group LMA oropharyngeal leak pressure distribution between rotational procedure group (mean = 37.48) and standard procedure group (mean = 38.00) when used in patients undergoing classic laryngeal mask airway insertion with a *p* - value of > 0.05 as per unpaired *t*-test.

Incidence of hypoxemia, laryngospasm and blood stain is 0.00%, 0.00% and 1,41% respectively in standard procedure group and 1.45%, 1.45% and 7.25% in rotational procedure group *p* - value of > 0.05 as per fishers exact test, shows in (Table 3).

Discussion

Several techniques of insertion have been attempted in various age groups with regard to ease of insertion and time required to achieve proper placement of the LMA. Among the various techniques used rotational technique[15–22] has been found to have promising results in pediatric age group when compared to the standard Brain's technique.[13,14] Even though there have been several studies to prove the successful use and advantages of rotational technique of LMA in children, there have not been enough evidence to prove the same in adult population.

The main aim of our study is to compare the classical laryngeal mask airway insertion technique and rotational technique of LMA insertion with respect to ease of insertion and occurrence of complications in the adult age group. Based on a study done in the pediatric age group by Ghai B et al.[31] and Nakayama et al.[29] we decided to use partially inflated cuff in the rotational technique so, as to avoid failures and resultant complications. Insertion of an LMA in a similar fashion with the cuff partially inflated in the standard technique was observed by Brimacombe J[6] to be less successful than the cuff fully deflated. Jiwon An et al.[34] also had demonstrated this in his comparison of LMA with the cuff fully deflated and partially inflated in adults and had concluded that inserting the LMA with the cuff fully deflated was more accurate and gave rise to lesser complications. Hence, we decided to use the LMA in the standard technique group with cuff fully deflated as originally described by Archie Brain.[3] We recorded the ease of LMA insertion technique for each group by observing the number of attempts and the time taken to secure a successful airway way.

Both the groups were comparable and there was no statistically significant difference in relation to age, gender, weight, ASA status, Mallampati score, base line heart rate, systolic and diastolic blood pressure and peripheral oxygen saturation between the two groups.

Number of Attempts

In our study, the first attempt success rate for LMA insertion in using the Standard Brains technique was 94.37% which is relatively similar to Kumar D[33] study where they achieved a success rate of 86% using the standard technique. This can also be compared with Achmet Ali et al.[38] who had compared LMA classic with LMA supreme using the standard insertion technique, in the LMA Classic group, the LMA was successfully inserted in 27 patients (77%) at the first attempt and in 31 patients (88.5%) at the second attempt.

This lower insertion success rate on first attempt using the 180° rotational technique when compared to the standard technique had also been observed by Ata Mahmoodpoor et al.[35] in their study comparing three methods of LMA insertion in adults: Standard, Lateral and Rotational. They concluded that lateral 90° rotation technique to be a superior technique than 180° rotation because it did not require approaching the back of the mouth and needed lesser effort and thus led to lesser complications. The 90° rotation technique was studied using Proseal LMA by Jungwon Hwang et al.[32] who had observed that success rate of insertion at the first attempt was higher for the 90° rotational technique (100% *vs* 85% for the standard technique, *p* – value- 0.001). They also found that the overall success rate of the standard technique was 94%. The standard technique failed in five patients after three attempts, and a single attempt with the rotational

technique was successful in these patients.

Similarly Raghavan P et al. in 2016[37] while comparing standard insertion technique with 90° rotation technique found a significant increase in number of attempts in the standard group with *p* value = 0.0001.

In our study, the LMA first attempt success rate was significantly lower in rotational procedure group compared to standard procedure group by a percentage difference of 33.50. This difference is significant with a *p* - value of < 0.0001 as per fishers exact test. Also, noted was the statistically significant increased total number of attempts needed for a successful placement of airway using the Rotational technique with a *p* - value of < 0.05 as per fisher exact scale. This can be attributed to our relative inexperience of using the rotational technique and inability to achieve a proper seal over the laryngeal inlet leading to air leak and repeated attempts to achieve a successful placement around the laryngeal inlet.

It has been observed by Brimacombe J and Berry A[26] that rotational technique tends to result in mild residual rotation in the coronal plane. Even though our study showed statistically no significant changes in the fiberoptic grading of LMA position between the two groups, it is possible that mild residual rotation which was present during the initial attempts could have caused the air leak and improper chest expansion. This in turn could have led to repeated attempts until a perfect seal was achieved and ultimately showing a good fiberoptic grading of LMA placement. This was done in order to avoid putting the patient under risk of hypoxia while using the fiberoptic bronchoscope after every failed attempt at insertion. Hence, we conclude that even though a successful placement of LMA was possible with both techniques, the standard technique has a greater probability of getting a successful placement in the first attempt when compared to rotational technique.

LMA Insertion Time

Raghavan P et al.[37] in 2016, found statistically insignificant difference for the time of duration of LMA insertion when he compared lateral 90° rotational technique with the standard technique.

Jung-won Hwang et al.[32] when they compared Standard *versus* 90-degree Rotation technique of Proseal LMA Insertion technique made no difference to insertion time.

Kim et al.[36] observed that the insertion time at the first attempt in the standard group was longer than that in the rotation group.

In our study, LMA insertion time showed that majority of the study subjects were distributed in 31–60 secs group (42.03% in rotational procedure group and 63.38% in standard procedure group). Among the study subjects, there is a statistically significant difference in relation to LMA insertion time distribution between rotational procedure group and standard procedure group when used in patients undergoing classic laryngeal mask. The LMA insertion time was significantly higher in rotational procedure group (mean = 69.00 seconds) compared to standard procedure group (mean = 34.28 seconds) by a mean difference of 34.72 seconds Oropharyngeal leak pressure.

Kim et al.[36] in his study comparing Standard *vs* rotational insertion technique for I-gel placement found that the standard group had lower airway leak pressure than the rotational group.

Jiwon An, et al.[34] in his study compared fully deflated LMA cuff insertion technique with partially deflated LMA cuff insertion technique and concluded that there was no significant air leak among the groups.

In our study also, there was no statistically significant difference (*p* - value of > 0.05 as per unpaired *t* - test) in relation to LMA oropharyngeal leak pressure distribution between rotational procedure group (mean = 37.48) and standard procedure group (mean = 38.00) when used in patients undergoing classic laryngeal mask airway insertion.

Fiberoptic Grading

After confirming the successful LMA placement by auscultation method, fiberoptic grading of LMA placement was performed by an observer who was blinded to the technique of insertion, with the aid of an assistant holding the LMA in place. In a study, conducted by Jiwon An, et al.[34] comparing FOB grading after insertion by partially inflated cuff *vs* fully deflated cuff, it was found that the grade of fiberoptic view in the fully deflated group was Grade 1 in 94.2%, and Grade 2 in 5.8% of patients. In the partially inflated group, 80.2%, 18.6% and 1.2% of patients presented with fiberoptic view Grade 1, 2, and 3, respectively. This grading was statistically significant between the two groups ($p < 0.05$) Similarly in a study, conducted by CR SOH, ASB NG[28] comparing reverse and standard LMA insertion techniques in pediatrics there was no statistical significance ($p = 0.08$) between the two groups with respect to fiberoptic grading.

In our study, the LMA fiberoptic grading table shows that majority of the study subjects were distributed in Grade I group (71.24% in standard procedure group and 65.22% in rotational procedure group). Among the study subjects, there was no statistically significant difference (*p* - value of > 0.05 as per fishers exact test) between the groups in relation to LMA fiberoptic grading.

Hemodynamics

Kumar D[33] in his study, comparing standard *versus* rotational LMA insertion technique found no considerable differences in terms of Mallampati score, base line heart rate, baseline systolic and diastolic blood pressure and baseline peripheral oxygen saturation between both the study groups.

Raghavan P et al.[37] conducted a study in 2016 comparing lateral 90° rotation technique with standard technique and found no statistical significance in heart rate. However, the mean arterial pressure (78.58 and 79.87) was found statistically significant between the two groups.

In a study, conducted by Jiwon An, et al.[34] comparing fully deflated LMA cuff insertion technique with partially deflated LMA cuff insertion technique observed that there were no significant differences in hemodynamic variables between the groups.

Achmet Ali et al.[38] compared LMA classic insertion with LMA supreme insertion technique and found no statistically significant difference between the groups in terms of hemodynamic parameters

Jung-won Hwang et al.[32] did a study comparing Standard insertion technique *versus* 90-degree Rotation insertion technique of Proseal LMA. There was no statistical significance in change of heart rate, but the mean blood pressure changes showed statistical significance in the standard technique (*p* - value 0.001).

In our study also, there were no statistically significant difference in relation to heart rate, systolic BP, diastolic BP and peripheral capillary oxygen saturation between rotational procedure group and standard procedure group when used in patients undergoing classic laryngeal mask airway insertion

Injuries observed

At the end of the procedure after removing the LMA incidence of complications like hypoxemia, laryngospasm and blood staining of the LMA were recorded.

Jiwon An, et al.[34] in his study observed that the incidence rate of blood observed on the LMA at removal was significantly lower in the fully deflated group than in the partially inflated group (1.7% *vs* 16.3%, $p < 0.05$).

Raghavan *p* et al.[37] in his study observed that the incidence of blood staining and sore throat was significantly lower with the lateral 90° rotational technique (9% and 8%) than the standard technique (36% and 29%) respectively.

Jung-won Hwang et al.[32] compared Standard *versus* 90-degree Rotation technique of Proseal LMA and observed that the incidence of blood staining (9% *vs* 36%, $p < 0.001$) was lower with the rotational technique.

Kim et al.[36] in their study comparing Standard insertion *versus* rotational insertion for I-gel placement observed that the incidence of blood staining was higher in the standard group. In our study the incidences of hypoxemia, laryngospasm and blood stain was 1.45%, 1.45% and 7.25% in rotational procedure group and 0.00%, 0.00% and 1.41% respectively in standard procedure group were statistically insignificant (*p* - value > 0.05).

Conclusion

We conclude that Standard technique of LMA insertion is a better technique when compared to Rotational technique with respect to ease of insertion, and time taken for LMA to secure airway, with relatively lesser number of complications.

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