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Airway Management Using LMA-Evaluation of Two Insertional Techniques: A Prospective Randomised Study

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Abstract

The laryngeal mask airway (LMA), originally conceived as a component of anesthesiologists' airway armamentarium, has now become an indispensable airway adjunct for a broad spectrum of healthcare providers, extending to paramedics managing out-of-hospital cardiac arrest scenarios. his randomized trial compares the success rates of the traditional digital technique versus the 180-degree rotational technique for LMA insertion in patients undergoing superficial surgeries under general anesthesia. After ethical approval and informed consent, 120 healthy adults (ASA grade I-II, ages 18-65) scheduled for superficial surgeries were enrolled. Based on a pilot study, 52 cases per group were needed, with an additional 15% to account for dropouts, resulting in 60 participants per group. Exclusion criteria included emergency surgery, obesity, reflux disease, and procedures requiring prone positioning or lasting over an hour. No significant demographic or clinical differences were found between Group A (standard technique) and Group B (180-degree technique). The success rates were similar between the two techniques. However, the 180-degree technique may provide better oropharyngeal leak pressure, improving airway sealing and ventilation.

Keywords: *Adult, General Anaesthesia, Healthcare, Hypopharynx, Laryngeal Mask Airway, Postoperative.*

Introduction

The laryngeal mask airway (LMA), initially designed for anesthesiologists, has now become an essential airway management tool across various medical disciplines, including emergency medicine and pre-hospital care [1]. Paramedics, for instance, frequently utilize the LMA in out-of-hospital cardiac arrest scenarios due to its ease of use and reliability in securing the airway quickly, even under challenging conditions [2]. Given its widespread adoption, the search for the most effective LMA insertion technique, characterized by simplicity and high success rates, continues to be a significant area of interest in clinical research [3].

The traditional digital technique, which has long been the cornerstone of LMA insertion, involves manually guiding the device into the pharynx using fingers. This method, while effective, can be associated with varying success rates depending on the operator's experience and patient anatomy. To enhance success rates, alternative methods such as the 180-degree rotational technique have been explored. Pioneered by Brimacombe in 1993, this technique involves rotating the LMA 180 degrees during insertion to facilitate its passage

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and positioning in the hypopharynx [4]. Research has shown that the 180-degree technique achieves comparable success rates to the traditional method, offering a viable alternative for airway management [5].

Recently, a new approach known as the 90-degree rotational technique has gained attention in the medical community. As described by Hwang et al., this technique involves advancing the LMA until the cuff is entirely within the oral cavity, followed by a counterclockwise 90-degree rotation [6]. The device is then further advanced until resistance is felt in the hypopharynx, after which the LMA is straightened to ensure proper placement [7]. Studies suggest that the 90-degree rotational technique may offer superior success rates compared to the traditional digital technique, possibly due to its more anatomically favorable approach during insertion.

Oropharyngeal leak pressure (OLP) is a key measure of the effectiveness and safety of airway devices like laryngeal mask airways (LMAs). It indicates the pressure at which air leaks around the device, reflecting how well the cuff seals against the soft tissues in the neck. A strong seal, indicated by a higher OLP, ensures secure airway protection and effective positive pressure ventilation, making OLP a critical factor in evaluating and selecting airway management tools [8][9]. In our study we have taken OLP as a parameter to check the seal of LMA.

Despite these advancements, there is still a lack of comprehensive comparative studies examining the success rates of these different LMA insertion techniques, particularly concerning the LMA® UniqueTM Airway from Teleflex® [10]. The potential differences in success rates and safety profiles between the traditional digital technique and the 180-degree rotational technique remain underexplored, presenting a gap in the current literature [11].

Addressing this gap, the present prospective randomized trial aims to compare these two techniques in patients undergoing various superficial surgical interventions under general anesthesia. The findings of this study could provide valuable insights into optimizing airway management strategies, ultimately improving patient outcomes.

Materials and Methods

Following approval from the Institutional Ethical Committee and obtaining informed consent from patients, a total of 120 healthy adults with ASA grade I and II, aged between 18 and 65 years, scheduled for various open superficial surgical procedures under general anesthesia with the LMA® UniqueTM Airway from Teleflex Medical Europe Ltd, Ireland, were enrolled in this prospective randomized study. The sample size calculation determined 52 cases in each group, based on a pilot study comprising 9 cases per group, where the first attempt success rate was 88% and 65% between the groups, with a power of 80% and an alpha error of 0.05. [5]Factoring in a dropout rate of 15%, a sample size of 60 was determined for each group. Exclusion criteria comprised patient refusal, emergency surgery, obesity (BMI >30 kg/sq.m), gastro-esophageal reflux disease, laparoscopic, intra-peritoneal and abdominal procedures, head and neck surgeries, procedures with expected duration exceeding one hour, those necessitating prone positioning, anticipated difficult airway, and suspected full stomach or risk of aspiration due to other co-morbid conditions.

Patients were randomized into two groups: Group A underwent the standard technique, while Group B underwent the 180-degree technique, utilizing computer-generated randomized numbers with randomization concealed by the closed envelope technique. Monitors employed included non-invasive blood pressure, electrocardiography, SpO2 oxygen saturation, end-tidal carbon dioxide, and temperature monitor. All patients received premedication with intravenous midazolam (1 mg) 5-10 minutes before induction of general anesthesia, followed by induction with fentanyl

(2 mcg/kg) and propofol (2 mg/kg). After confirming bag-mask ventilation, all patients received intravenous atracurium (0.05 mg/kg) for paralysis. Maintenance of general anesthesia was achieved using a mixture of sevoflurane (2%) in air-oxygen with a total flow of 3 liters/min and FiO_2 of 0.4, initiated soon after propofol administration. LMA insertion was attempted 3 minutes post-administration of an intubating dose of atracurium.

Insertion was performed by a single experienced anesthesiologist in all cases. In Group A (Standard Technique), the classical digital method was employed as per the manufacturer's instructions, while in Group B (180-degree technique), the LMA was inserted with the laryngeal aperture pointing cephalad and rotated 180 degrees upon entering the hypopharynx. LMA size 3 or 4 was selected based on the patient's body weight, and the cuff was inflated accordingly. Ventilation efficacy with the LMA was assessed by square wave capnograph trace, absence of audible leak, and achieving tidal volume within ± 50 ml of the set tidal volume. External manipulations, if needed, were recorded. One attempt at LMA insertion constituted its introduction into the patient's mouth and removal, with three attempts allowed in each group. Time to insertion was defined as the duration from LMA introduction to cuff inflation and effective ventilation achievement. Oropharyngeal leak pressure (OLP) was measured, and LMA placement was verified post-insertion with a fiber-optic endoscope. After the procedure, LMA removal was performed once the patient regained consciousness and adequate spontaneous ventilation. Neostigmine and glycopyrrolate were administered to reverse neuromuscular blockade, and postoperative sore throat and airway injury were assessed immediately after extubation and up to 24 hours postoperatively.

The collected data were analyzed with IBM.SPSS statistics software 23.0 Version. To describe about the data descriptive statistics frequency analysis, and percentage analysis were used for categorical variables and the mean & S.D were used for continuous variables. To find the significance in categorical data Chi-Square test was used. Student t test was used to compare the demographic data and the time for insertion. The success at first attempt, need for more than one attempt, the presence of bleeding, and the occurrence of complications were compared using Chi-square analysis. In all the above statistical tools the probability value 0.05 is considered as significance value.

Results

The demographic and clinical characteristics of patients in Group A (standard technique) and Group B (180-degree technique) were compared to assess any significant differences between the two groups. The mean age of patients in Group A was 36.78 years (±11.24), while in Group B, it was slightly higher at 38.30 years (±12.21). However, the difference in age between the two groups was not statistically significant ($p = 0.47$). Similarly, there were no significant differences observed in weight ($p = 0.51$), height ($p = 0.72$), gender distribution ($p = 0.71$), and duration of surgery ($p = 0.96$) between Group A and Group B.

These findings suggest that the two groups were well-matched in terms of baseline demographic characteristics and surgical parameters, indicating that any observed differences in LMA insertion success rates between the two techniques are less likely to be influenced by patient-related factors. Therefore, the comparison of LMA insertion success rates between the standard technique and the 180-degree technique can be interpreted with confidence, as the groups were comparable in terms of important demographic and clinical variables (Table 1).

Table 1. Distribution of Demographic Characteristics among the Study Participants (N=120)

Sl. no	Variable	Group A (n=60)	Group B (n=60)	p
1	Age in years	36.78±11.24	38.30±12.21	0.47
2	Weight in kg	57.49±8.29	58.54±9.19	0.51
3	Height in cm	163.42±25.46	164.91±20.48	0.72
4	Gender (Males %)	56.3%	59.5%	0.71
5	Duration of surgery in min	38.86±17.12	39±18.98	0.96

Table 2. Distribution of Study Variables among the Study Participants (N=120)

Sl. no	Insertion Parameters	Group A (n=60)	Group B (n=60)	p
1	Success at First Attempt	51 (85%)	55 (91.7%)	0.26
2	Need for second attempt	7 (11.7%)	3 (5%)	0.18
3	Need for third attempt	1 (1.7%)	-	0.56
4	Need for Airway Manipulation	9 (15%)	6 (10%)	0.41
5	Post Operative Sore Throat	4 (6.7%)	2 (3.3%)	0.40
5	Post Operative Bleeding	9 (15%)	5 (8.3%)	0.25
6	Oropharyngeal Leak Pressure (cm H_2O)	21.48±2.89	22.39±2.69	0.01*
7	Insertion Time (Seconds)	24.79±4.19	26.31±6.52	0.10
8	Fiberoptic view Incidence of grade 4 view	47.3%	50%	0.71
9	Fiberoptic view Incidence of grade 1 view	12.31%	10%	0.76

The comparison of insertion parameters between Group A (standard technique) and Group B (180-degree technique) revealed several interesting findings. Firstly, the success rate at the first attempt of LMA insertion was 85% in Group A and slightly higher at 91.7% in Group B, although this difference was not statistically significant (p = 0.26). Similarly, there was no significant difference in the need for a second attempt at insertion between the two groups (p = 0.18). Interestingly, none of the patients in Group B required a third attempt at insertion, whereas one patient in Group A did, although this difference was not statistically significant (p = 0.56). Regarding the need for airway manipulation during insertion, 15% of patients in Group A required it compared to 10% in Group B, with no statistically significant difference observed (p = 0.41). Furthermore, the incidence of postoperative sore throat and bleeding was similar between the two groups, with no statistically significant differences noted (p = 0.40 and p = 0.25, respectively).

However, notable differences were observed in oropharyngeal leak pressure and insertion time. The mean oropharyngeal leak pressure was significantly higher in Group B (22.39 cm H2O) compared to Group A (21.48 cm H2O), with a statistically significant difference (p = 0.01). In terms of insertion time, although there was a slight difference, it was not statistically significant between the two groups (p = 0.10) (Table 2).

Lastly, the incidence of fiberoptic view, specifically the grade 4 view and grade 1 view, was similar between Group A and Group B, with no statistically significant differences observed (p = 0.71 and p = 0.76, respectively). Overall, while there were some differences in insertion parameters between the two techniques, many of these variances were not statistically significant. However, the higher oropharyngeal leak pressure observed in Group B suggests potential advantages of the 180-degree technique in providing a more secure airway seal during LMA insertion.

Discussion

The discussion presents a comprehensive analysis of the findings derived from comparing the standard technique (Group A) and the 180-degree technique (Group B) for laryngeal mask airway (LMA) insertion. This study aimed to evaluate various insertion parameters and outcomes to determine the efficacy and potential advantages of each technique in facilitating successful airway management during general anaesthesia for superficial surgical procedures. To begin with, the demographic and clinical characteristics of patients in both groups were thoroughly examined to ensure a fair comparison. The results indicated no significant differences between Group A and Group B in terms of age, weight, height, gender distribution, and duration of surgery. This is essential as it establishes a baseline equivalence between the groups, minimizing the influence of confounding variables on the comparison of insertion outcomes.

Moving on to the insertion parameters, several key observations were made. Firstly, while the first attempt success rate was marginally higher in Group B compared to Group A, this difference did not reach statistical significance. Similarly, there was no significant disparity in the need for a second attempt at insertion between the two groups. Notably, none of the patients in Group B required a third attempt at insertion, indicating a potential advantage of the 180-degree technique in achieving successful insertion within fewer attempts. Regarding the need for airway manipulation during insertion, the study found no significant difference between Group A and Group B, suggesting comparable ease of insertion and adjustment for both techniques. Additionally, the incidence of postoperative complications such as sore throat and bleeding was similar between the two groups, reaffirming the safety of both techniques in clinical practice.

The 90° rotation technique for inserting the LMA was initially introduced by Hwang et al. for the ProSeal LMA. Their findings indicated that this rotation method was more successful than the standard approach and resulted in less trauma to the pharyngeal mucosa. They attributed this to the lateral edge of the LMA, which reduced resistance between the LMA and the posterior pharyngeal wall [12].

One of the most significant findings of the study pertained to oropharyngeal leak pressure, which was significantly higher in Group B compared to Group A. This suggests that the 180-degree technique may offer a more effective airway seal during LMA insertion, potentially reducing the risk of air leakage and ensuring optimal ventilation. While there was a slight difference in insertion time between the two groups, it was not statistically significant.

Furthermore, the incidence of fiberoptic view grades was similar between Group A and Group B, indicating comparable visualization of the larynx during insertion, regardless of the technique used. Few other studies have showed statistical significance in fibreoptic viewing grades [9].

The 180-degree rotational technique has been documented to enhance the ease and efficacy of laryngeal mask airway (LMA) insertion in both pediatric [13] and adult populations, presenting an improvement over the standard technique [14]. Despite potential concerns regarding mucosal injury associated with the rotational technique, our investigation, with secondary outcome measures including blood staining on the LMA, did not reveal an increased incidence of injury compared to earlier reviews [15]. Notably, the occurrence of blood staining and postoperative sore throat, both secondary outcomes of our study, did not exhibit significant differences between the two rotational techniques. Moreover, in exploring the impact of muscle relaxants on LMA placement, our findings align with previous research indicating that even minute doses of succinylcholine [16]. notably facilitate LMA insertion, requiring reduced propofol doses and fewer attempts. Thus, we opted for atracurium as the muscle relaxant in our study [18]. During LMA insertion, we observed that rotating the LMA with its lumen, both at 90 degrees and 180 degrees, facilitated insertion along the posterior pharyngeal wall compared to the standard technique [19]. However, realigning it with the laryngeal inlet post-rotation posed challenges in certain cases. This observation is consistent with Brimacombe et al.'s findings , where the 180-degree rotational technique resulted in residual rotation in the coronal plane among adults. This residual rotation of the LMA, despite reaching its final position in the pharynx, contributed to suboptimal fiber-optic views, despite effective ventilation and successful outcomes observed in the 180-degree rotational technique group. These insights shed light on the intricacies of LMA insertion techniques and underscore the need for further exploration to optimize airway management protocols and enhance patient outcomes [20].

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Our study is subject to several limitations. Firstly, blinding was not feasible given the study's nature, introducing a potential source of bias. Secondly, we did not employ a BIS monitor to monitor the depth of anesthesia, relying instead on traditional subjective clinical signs. This approach may lack the precision offered by objective monitoring methods. Thirdly, LMA insertion was performed by a single anaesthesiologist throughout the study, potentially introducing bias. However, it's worth noting that previous studies have also utilized a similar approach with a single experienced anaesthesiologist. Lastly, our investigation focused on the most basic supraglottic airway device, potentially limiting the generalizability of our findings to more advanced airway management techniques or devices.

Conclusion

While both the standard technique and the 180-degree technique demonstrated similar overall success rates and safety profiles for

LMA insertion, the latter may offer advantages in terms of achieving a higher oropharyngeal leak pressure, potentially leading to improved airway sealing and ventilation. These findings underscore the importance of considering alternative insertion techniques in clinical practice to optimize airway management and enhance patient outcomes. Further research, including larger-scale randomized controlled trials, may be warranted to validate these findings and elucidate the optimal technique for LMA insertion in various clinical settings.

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Conflict of Interest

The authors declare no conflicts of interest related to this study.

Consent Declaration

Written informed consent was obtained from the patient for the publication of this case report and any accompanying images.

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