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Observational Study to Compare the Efficacy of Macintosh Laryngoscope Guided Insertion of Laryngeal Mask Airway with Conventional Blind Insertion Technique

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ABSTRACT

Background: Maintaining a patent airway is a fundamental responsibility of anesthesiologists during general anesthesia. The laryngeal mask airway (LMA) is widely used as a supraglottic airway device because of its ease of insertion and favorable safety profile. Conventionally, LMA insertion is performed using a blind technique; however, this method may lead to suboptimal placement due to the absence of direct visualization of airway structures. Laryngoscope-guided insertion has been proposed as a technique that may improve anatomical alignment and airway sealing.
Aim: To compare the efficacy of Macintosh laryngoscope-guided insertion of the laryngeal mask airway with the conventional blind insertion technique.
Methods: This prospective observational study was conducted in the Department of Anesthesiology at Travancore Medical College Hospital, Kollam. A total of 204 adult patients undergoing elective surgeries under general anesthesia were included and allocated into two groups: Group A (blind insertion, n = 102) and Group B (Macintosh laryngoscope-guided insertion, n = 102). Insertion characteristics, fiberoptic bronchoscopy (FOB) grading, oropharyngeal leak pressure (OPLP), hemodynamic parameters, and postoperative complications were evaluated.
Results: Baseline demographic characteristics were comparable between the groups. The first-attempt success rate was higher in the laryngoscope-guided group (85.3%) compared with the blind insertion group (75.5%), although the difference was not statistically significant ($p = 0.078$). Ease of insertion was significantly better in the laryngoscope-guided group ($p < 0.001$). Fiberoptic bronchoscopy demonstrated significantly improved anatomical positioning with guided insertion ($p = 0.002$). The mean OPLP was significantly higher in the laryngoscope-guided group (24.78 ± 1.56 cmH_2O) compared with the blind group (19.96 ± 1.16 cmH_2O, $p < 0.001$). However, insertion time was longer with laryngoscope guidance ($p < 0.001$). Hemodynamic parameters and postoperative complications were comparable between groups.
Conclusion: Macintosh laryngoscope-guided LMA insertion improves anatomical positioning and airway sealing compared with the conventional blind technique while maintaining similar hemodynamic stability and complication rates. Although insertion time is slightly longer, the guided technique may provide a more reliable airway seal and improved device placement.

***Keywords**: Laryngeal mask airway; Macintosh laryngoscope; blind insertion technique; supraglottic airway device; oropharyngeal leak pressure; fiberoptic bronchoscopy; airway management.*

INTRODUCTION

Maintaining a patent airway is one of the most critical responsibilities of an anesthesiologist during the administration of general anesthesia. Traditionally, endotracheal intubation has been regarded as the gold standard for airway management because it provides a secure airway with a reliable glottic seal and effective ventilation [1]. However, endotracheal intubation requires significant expertise, involves greater airway manipulation, and may be associated with complications such as airway trauma, sore throat, laryngeal injury, and postoperative hoarseness. With advances in airway management technology, supraglottic airway devices (SGADs) have emerged as valuable alternatives for maintaining airway patency during anesthesia. Among these devices, the laryngeal mask airway (LMA) has become one of the most widely used airway adjuncts in modern anesthetic practice due to its ease of insertion, reduced invasiveness, and favorable safety profile [2].

The LMA was first introduced as a supraglottic airway device designed to maintain airway patency without the need for endotracheal intubation [3]. Since its introduction, the LMA has gained widespread acceptance and is now routinely used in both elective surgical procedures and emergency airway management. Its advantages include rapid insertion, minimal hemodynamic disturbance, and a lower incidence of airway complications when compared with conventional endotracheal intubation. As a result, in many institutions, supraglottic airway devices have increasingly replaced endotracheal tubes for a variety of surgical procedures where a definitive airway is not mandatory [2].

Traditionally, the LMA has been inserted using a blind technique in which the device is advanced along the palatal curvature until resistance is encountered. Although this technique is simple and widely practiced, it does not allow direct visualization of airway structures during placement. Consequently, blind insertion may lead to suboptimal positioning of the device relative to the laryngeal inlet. Malposition of the LMA can result in inadequate ventilation, partial airway obstruction, increased oropharyngeal leak pressure, gastric insufflation, or even ventilation failure. In addition, repeated attempts at insertion may cause airway trauma and increase the risk of postoperative complications such as sore throat, mucosal injury, and bleeding [4,5].

To overcome these limitations, alternative techniques have been proposed to improve the accuracy of LMA placement. One such method is laryngoscope-guided insertion, in which a Macintosh laryngoscope is used to visualize the oropharyngeal structures and facilitate the accurate positioning of the LMA over the laryngeal inlet. By providing direct visualization of the airway anatomy, this technique may improve anatomical alignment between the LMA cuff and the laryngeal opening, thereby enhancing ventilation efficiency and airway sealing. Accurate positioning of the LMA is essential for achieving optimal ventilation, minimizing air leakage, and reducing the likelihood of airway complications. Furthermore, better anatomical alignment may reduce airway manipulation and decrease postoperative morbidity [6,7].

Several clinical studies have investigated the effectiveness of laryngoscope-guided insertion techniques compared with conventional blind insertion. The primary rationale for using a laryngoscope during LMA placement is that visualization of airway landmarks may facilitate more accurate placement of the device and improve ventilation parameters. However, the findings of these studies have been inconsistent. For instance, Kim GW et al. reported that the first-attempt success rate did not differ significantly between blind insertion and laryngoscope-guided insertion techniques [8]. Similarly, Patil PC et al. observed comparable fiberoptic scores, hemodynamic responses, and postoperative complications between the two approaches, suggesting that the benefits of laryngoscope guidance may not always be clinically significant [9].

In contrast, other investigations evaluating various LMA designs have demonstrated potential advantages of laryngoscope-guided insertion. These studies have reported improved anatomical placement, higher oropharyngeal leak pressures, better fiberoptic visualization of the glottic structures, and higher first-attempt success rates with guided insertion techniques [8,10]. Improved initial placement may also reduce the need for reinsertion and minimize repeated airway manipulation, which can further decrease the risk of airway trauma and associated complications [8–10]. Given the variability in results reported in the literature, further evaluation is necessary to determine whether laryngoscope-guided LMA insertion offers a significant clinical advantage over the conventional blind technique.

Therefore, the present study was undertaken to evaluate whether Macintosh laryngoscope-guided insertion of the laryngeal mask airway provides superior anatomical alignment with the laryngeal inlet compared with the standard blind insertion technique. Accurate alignment of the LMA with the laryngeal inlet is essential for ensuring effective ventilation, minimizing oropharyngeal leakage, and reducing the risk of airway-related complications. By comparing these two techniques, this study aims to provide further evidence regarding the optimal method for LMA insertion in clinical anesthetic practice.

METHODOLOGY

Study Design and Setting: This prospective observational study was conducted in the Department of Anesthesiology at Travancore Medical College Hospital, Kollam, over a period of 16 months, following approval from the Institutional Ethics Committee.

Study Population: The study included adult patients scheduled for elective surgical procedures under general anesthesia at the institution. Patients meeting the eligibility criteria and providing written informed consent were enrolled.

Sample Size: The sample size was calculated based on the study which reported optimal fiberoptic bronchoscope (FOB) positioning in 60% of patients with the conventional blind technique and 78.1% with direct laryngoscopic insertion. Considering a 95% confidence level and 80% power, the sample size was calculated using the formula:

$N = (Z_{1-\alpha/2} + Z_{1-\beta})^2 \times 2p(1-p)/(p_1 - p_2)^2$

Where ($Z_{1-\alpha/2} = 1.96$), ($Z_{1-\beta} = 0.84$), ($p_1 = 0.6$), ($p_2 = 0.78$), and (p=0.69). The final sample size was 102 patients per group, giving a total of 204 patients.

Inclusion Criteria

- ASA physical status **I or II**
- **Age 18–60 years**
- Patients undergoing **elective surgery under general anesthesia**
- Surgeries performed in the **supine position**

Exclusion Criteria

- Patient refusal
- Anticipated or known difficult airway
- Pregnancy
- ASA physical status III or IV
- Morbid obesity
- Risk of gastric aspiration
- Neurosurgical procedures requiring active intervention
- History of neck surgery
- Upper airway anomalies

Preoperative Preparation: Patients were evaluated during pre-anesthetic check-up on the day before surgery and kept nil per oral according to Indian Society of Anesthesiologists fasting guidelines. Premedication included tablet alprazolam 0.25 mg and tablet pantoprazole 40 mg administered the night before and on the morning of surgery.

In the preoperative area, intravenous access was secured and baseline parameters including pulse rate, blood pressure, and SpO_2 were recorded. In the operating room, standard monitoring with ECG, pulse oximetry, and non-invasive blood pressure was applied.

Anesthetic Technique: All patients received intravenous midazolam (1 mg/kg), lignocaine (1 mg/kg), and fentanyl (2 µg/kg). Induction was performed with propofol (2 mg/kg) after preoxygenation with 100% oxygen for three minutes. An appropriately sized Ambu Aura40 LMA was selected according to body weight and inserted with the patient in the sniffing position.

Group Allocation and Procedure: Patients were allocated into two groups of 102 each using the odd–even allocation method:

- **Group A – Blind insertion:** LMA inserted using the conventional digital technique along the curvature of the hard palate until resistance was encountered.
- **Group B – Macintosh laryngoscope-guided insertion:** A Macintosh laryngoscope was introduced to the vallecula, the tongue displaced laterally and the epiglottis lifted anteriorly. The LMA was then advanced under vision until its proximal bowl rested below the epiglottis.

Outcome Measures

The following parameters were recorded:

- Insertion time (from mouth opening to appearance of square-wave capnography)
- Number of insertion attempts
- First-attempt success rate

A maximum of three attempts was permitted; failure after three attempts resulted in endotracheal intubation and exclusion from the study.

Oropharyngeal Leak Pressure and Fiberoptic Assessment: Oropharyngeal leak pressure (OPLP) was measured by closing the expiratory valve of the breathing circuit with a fresh gas flow of 3 L/min during manual ventilation. The pressure at which an audible leak was detected over the thyroid cartilage was recorded, with a maximum limit of 40 cm H_2O.

LMA position was assessed using a fiberoptic bronchoscope and graded according to the Brimacombe scoring system (Grades 0–4). Grades 3 and 4 were considered optimal placement.

Postoperative Assessment: Placement was confirmed using square-wave capnography, symmetrical chest expansion, and adequate tidal volume. Anesthesia was maintained with sevoflurane (1.2–2%) in a 50% air–oxygen mixture. Postoperative complications including blood staining, sore throat, hoarseness, desaturation, nausea, and vomiting were recorded.

Statistical Analysis: Data were entered into Microsoft Excel and analyzed using SPSS software. Continuous variables were expressed as mean ±standard deviation, and categorical variables as frequency and percentage. Unpaired Student's t-test and Chi-square test were used for comparison, with $p < 0.05$ considered statistically significant.

RESULTS

A total of 204 patients undergoing elective surgical procedures under general anesthesia were included in the study and equally allocated into Group A (blind LMA insertion, n = 102) and Group B (Macintosh laryngoscope-guided insertion, n = 102).

The baseline demographic and clinical characteristics of patients are summarized in Table 1. The two groups were comparable with respect to age distribution, gender, anthropometric parameters, ASA physical status, and LMA size used, with no statistically significant differences ($p > 0.05$).

Table 1: Baseline Demographic and Clinical Characteristics

	Variable	**Group A (n=102)**	**Group B (n=102)**	**p-value**
Age group (years)	18–30	28 (27.5%)	28 (27.5%)	**0.99**
	31–40	34 (33.3%)	33 (32.4%)	
	41–50	24 (23.5%)	25 (24.5%)	
	>50	16 (15.7%)	16 (15.7%)	
Gender	Female	47 (46.1%)	50 (49.0%)	**0.674**
	Male	55 (53.9%)	52 (51.0%)	
Weight (kg)		65.71 ± 11.34	65.41 ± 10.39	0.845
Height (cm)		165.58 ± 8.52	166.50 ± 8.93	0.454
BMI (kg/m²)		24.14 ± 4.76	23.85 ± 4.89	0.661
ASA Grade	I	63 (61.8%)	64 (62.7%)	**0.885**
	II	39 (38.2%)	38 (37.3%)	
LMA Size	3	11 (10.8%)	8 (7.8%)	**0.36**
	4	52 (51.0%)	62 (60.8%)	
	5	39 (38.2%)	32 (31.4%)	

Insertion characteristics and fiberoptic bronchoscopy findings are shown in Table 2. The first-attempt success rate was higher in the laryngoscope-guided group (85.3%) compared with the blind insertion group (75.5%), although the difference was not statistically significant ($p = 0.078$).

Ease of insertion differed significantly between the groups ($p < 0.001$), with higher ease scores observed in the laryngoscope-guided group. Fiberoptic bronchoscopy assessment demonstrated significantly better glottic visualization in Group B ($p = 0.002$), with a greater proportion of FOB grade 4 views.

Table 2: Insertion Characteristics and FOB Findings

	Parameter	**Group A (n=102)**	**Group B (n=102)**	**p-value**
Number of Attempts	1 attempt	77 (75.5%)	87 (85.3%)	**0.078**
	2 attempts	25 (24.5%)	15 (14.7%)	
Ease of Insertion Score	Score 2	36 (35.3%)	0	**<0.001**
	Score 3	38 (37.3%)	31 (30.4%)	
	Score 4	28 (27.5%)	32 (31.4%)	
	Score 5	0	39 (38.2%)	

FOB Score	Grade 1	10 (9.8%)	4 (3.9%)	**0.002**
	Grade 2	26 (25.5%)	14 (13.7%)	
	Grade 3	44 (43.1%)	38 (37.3%)	
	Grade 4	22 (21.6%)	46 (45.1%)	

The procedural performance parameters are summarized in Table 3. The mean insertion time was significantly longer in Group B (29.12 ±3.03 s) compared with Group A (23.14 ±2.93 s, $p < 0.001$). However, the mean oropharyngeal leak pressure (OPLP) was significantly higher in the laryngoscope-guided group (24.78 ±1.56 cmH_2O) compared with the blind insertion group (19.96 ±1.16 cmH_2O, $p < 0.001$), indicating a better airway seal.

Table 3: Procedural Performance Parameters

Parameter	**Group A**	**Group B**	**p-value**
Insertion time (sec)	23.14 ± 2.93	29.12 ± 3.03	**<0.001**
OPLP (cmH_2O)	19.96 ± 1.16	24.78 ± 1.56	**<0.001**

Hemodynamic variables including heart rate, oxygen saturation, systolic blood pressure, diastolic blood pressure, and mean arterial pressure measured at baseline, induction, and insertion are summarized in Table 4. No statistically significant differences were observed between the two groups at any time point.

Table 4: Hemodynamic Parameters

Parameter	**Group A**	**Group B**	**p-value**
HR Baseline (bpm)	76.87 ± 7.48	76.91 ± 8.14	0.971
HR Induction (bpm)	71.11 ± 7.49	70.93 ± 8.01	0.871
HR Insertion (bpm)	80.92 ± 9.28	81.35 ± 9.77	0.747
SpO_2 Baseline (%)	99.16 ± 0.28	99.15 ± 0.31	0.776
SpO_2 Induction (%)	99.01 ± 0.37	98.95 ± 0.39	0.283
SpO_2 Insertion (%)	98.71 ± 0.48	98.69 ± 0.48	0.760

Postoperative complications are summarized in Table 5. The incidence of blood staining, sore throat, hoarseness, cough, desaturation, and nausea/vomiting was low and comparable between the two groups, with no statistically significant differences.

Table 5: Postoperative Complications

Complication	**Group A (n=102)**	**Group B (n=102)**	**p-value**
Blood stain	14 (13.7%)	6 (5.9%)	0.06
Sore throat	11 (10.8%)	13 (12.7%)	0.664
Hoarseness	12 (11.8%)	6 (5.9%)	0.139
Cough	6 (5.9%)	6 (5.9%)	1.00
Desaturation	2 (2.0%)	4 (3.9%)	0.407
Nausea/Vomiting	7 (6.9%)	5 (4.9%)	0.552

DISCUSSION

The laryngeal mask airway (LMA) has become an important component of modern airway management because of its ease of insertion, reduced invasiveness compared with endotracheal intubation, and relatively stable hemodynamic profile. Conventionally, LMA insertion is performed using a blind digital technique; however, this technique relies on proper anatomical alignment without direct visualization and may result in suboptimal placement, multiple insertion attempts, airway trauma, and inadequate airway seal. In recent years, laryngoscope-guided insertion techniques have been explored as an alternative method to improve the accuracy of LMA placement by facilitating tongue displacement and creating more favorable pharyngeal space for device advancement. Improved anatomical alignment with guided insertion may enhance fiberoptic positioning, increase oropharyngeal leak pressure, and reduce the need for repositioning, although it may require slightly longer insertion time.

In the present study, baseline demographic characteristics were well matched between the blind insertion and laryngoscope-guided groups. Age distribution, gender, anthropometric parameters, ASA physical status, and LMA size selection were comparable between the groups, minimizing potential confounding effects. Similar findings have been reported in several studies. Patil et al. [9] observed comparable demographic characteristics and ASA physical status between study groups, ensuring uniformity at baseline. Ayan Ghorui et al. [11] also reported no significant differences in age or sex distribution between conventional blind and laryngoscope-guided insertion groups. Comparable results were reported by Naveen Gowda et al. [12], where the mean age and gender distribution were similar between groups. Likewise, Kim et al. [8], Yoo et al. [13], Choo et al. [14], and Soedarso et al. [15] all demonstrated demographic homogeneity between comparison groups. These consistent observations indicate that differences in procedural performance and airway outcomes across studies are unlikely to be influenced by baseline demographic variability.

Anthropometric parameters including weight, height, and body mass index were also comparable between the two groups in the present study. Similar findings have been reported in the literature. Ayan Ghorui et al. [11] found no significant intergroup differences in weight, height, or BMI between blind and laryngoscope-guided insertion groups. Kim et al. [8] similarly reported well-matched anthropometric characteristics between groups. Soedarso et al. [15] also observed comparable BMI distribution between video-laryngoscope-guided and classic insertion techniques. These findings suggest that differences observed in insertion success, airway seal, and device positioning are likely attributable to the insertion technique rather than patient body habitus.

Preoperative clinical status assessed using ASA physical status classification was comparable between the groups in this study, with similar proportions of ASA I and ASA II patients. Comparable ASA distribution has also been reported by Patil et al. [9], Ayan Ghorui et al. [11], and Kim et al. [8]. Homogeneity in anesthetic risk profiles strengthens the validity of comparisons between insertion techniques and suggests that the outcomes observed are unlikely to be influenced by differences in baseline clinical status.

The distribution of LMA sizes used in this study was also similar between groups, with size 4 being the most frequently used device. Comparable findings were reported by Patil et al. [9], who also observed no significant difference in LMA size selection between blind and laryngoscope-guided insertion groups. Uniformity in device size selection helps ensure that differences in airway seal or insertion characteristics are related primarily to the insertion technique rather than variations in equipment.

Regarding insertion success, first-attempt placement was achieved in 85.3% of patients in the laryngoscope-guided group compared with 75.5% in the blind insertion group, although the difference was not statistically significant. Similar findings were reported by Ayan Ghorui et al. [11] and Kim et al. [8], who found comparable first-attempt success rates between techniques. However, other studies have demonstrated improved first-pass success with guided insertion. Naveen Gowda et al. [12] reported a first-attempt success rate of 100% with laryngoscope guidance compared with 80% with blind insertion. Zheng et al. [16] also reported significantly higher first-attempt success in the guided group. These findings suggest that although blind insertion can be effective, guided techniques may improve first-pass success in certain settings.

Ease of insertion in the present study was significantly better in the laryngoscope-guided group ($p < 0.001$). The ability of the laryngoscope to displace the tongue and elevate the epiglottis likely facilitates smoother device advancement. Similar advantages have been reported in some studies. Naveen Gowda et al. [12] demonstrated easier insertion with laryngoscope guidance compared with the standard technique. In contrast, Ayan Ghorui et al. [11] and Kim et al. [8] reported no significant difference in ease of insertion between the two techniques. These variations may reflect differences in operator experience or airway characteristics.

Fiberoptic bronchoscopy evaluation in the present study demonstrated significantly better anatomical positioning in the laryngoscope-guided group ($p = 0.002$). A higher proportion of patients achieved optimal glottic visualization with guided insertion. Similar trends have been reported in previous studies. Patil et al. [9] observed improved fiberoptic positioning with guided insertion, although the difference was not statistically significant. Yoo et al. [13], Choo et al. [14], and Soedarso et al. [15] reported significantly better fiberoptic views and anatomical alignment with laryngoscope-guided techniques. These findings suggest that direct visualization during insertion can improve LMA positioning and airway alignment.

Another important finding of this study was the significantly higher oropharyngeal leak pressure (OPLP) observed in the laryngoscope-guided group. Higher OPLP indicates a more effective airway seal and improved ventilation efficiency.

Similar observations have been reported in several studies. Ayan Ghorui et al. [11], Zheng et al. [16], Kim et al. [8], Zheng et al. [17], and Yoo et al. [13] all reported higher OPLP values with guided insertion techniques. Improved anatomical alignment achieved with laryngoscope guidance likely contributes to better seating of the LMA cuff and enhanced airway sealing.

Insertion time in the present study was longer with the laryngoscope-guided technique. Similar findings were reported by Ayan Ghorui et al. [11], Zheng et al. [16], Kim et al. [8], and Yoo et al. [13], who also observed increased insertion time with guided techniques due to the additional step of performing laryngoscopy. However, the modest increase in insertion time may be acceptable when balanced against the benefits of improved positioning and airway seal.

Hemodynamic parameters including heart rate, blood pressure, mean arterial pressure, and oxygen saturation remained comparable between groups in the present study. Similar hemodynamic stability has been reported by Patil et al. [9], Zheng et al. [16], Kim et al. [8], and Choo et al. [14]. Although Ayan Ghorui et al. [11] reported transient increases in heart rate and blood pressure following laryngoscope-guided insertion, overall evidence suggests that both techniques are generally hemodynamically well tolerated.

Oxygen saturation remained well maintained in both groups throughout the procedure, with no episodes of clinically significant hypoxia. Yoo et al. [13] similarly reported the absence of hypoxic events during LMA insertion with either technique.

Post-procedural complications in the present study were infrequent and comparable between groups. Blood staining, sore throat, hoarseness, cough, desaturation, and nausea/vomiting occurred at low rates without statistically significant differences. Comparable safety profiles have been reported by Patil et al. [9], Ayan Ghorui et al. [11], Zheng et al. [16], and Kim et al. [8]. Choo et al. [14] and Soedarso et al. [15] reported slightly lower rates of airway trauma with guided insertion techniques. Overall, the evidence suggests that both techniques are safe, with laryngoscope guidance potentially reducing minor airway trauma in some cases.

Overall, the findings of the present study suggest that Macintosh laryngoscope-guided LMA insertion improves anatomical alignment and airway seal while maintaining comparable hemodynamic stability and complication rates, although the technique requires slightly longer insertion time.

CONCLUSION

The present study compared the efficacy of Macintosh laryngoscope-guided insertion of the laryngeal mask airway (LMA) with the conventional blind insertion technique in patients undergoing elective surgeries under general anesthesia. The findings demonstrate that laryngoscope-guided insertion provides significantly better anatomical alignment of the LMA with the laryngeal inlet, as evidenced by improved fiberoptic bronchoscopy grading and higher oropharyngeal leak pressures. These results indicate a more effective airway seal and improved ventilation efficiency with the guided technique. Although the laryngoscope-guided approach required a slightly longer insertion time, it was associated with better ease of insertion and a higher first-attempt success rate, though the latter did not reach statistical significance. Importantly, both techniques showed comparable hemodynamic stability and similar rates of postoperative complications, indicating that laryngoscope guidance does not increase procedural risk. Overall, Macintosh laryngoscope-guided LMA insertion appears to be a safe and effective technique that improves anatomical placement and airway sealing, and may be considered a useful alternative to the conventional blind insertion method.

DECLARATIONS

Ethics Approval and Consent to Participate: The study was conducted after obtaining approval from the Institutional Ethics Committee of Travancore Medical College Hospital, Kollam. Written informed consent was obtained from all participants prior to enrollment in the study.

Consent for Publication: All participants provided consent for the use of anonymized clinical data for research and publication purposes.

Availability of Data and Materials: The datasets generated and analyzed during the current study are available from the corresponding author upon reasonable request.

Competing Interests: The authors declare that they have no competing interests.

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Authors 'Contributions: All authors contributed to the study conception, data collection, analysis, and manuscript preparation. All authors reviewed and approved the final manuscript.

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