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Research Article

Face Mask Versus Laryngeal Mask Airway Ventilation in Pediatric Short Surgical Procedures: A Prospective Observational Study at A Tertiary Care Centre

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ABSTRACT

Background: Airway management in pediatric short surgical procedures remains a critical concern for anesthesiologists. The choice between face mask ventilation and laryngeal mask airway has significant implications for patient safety, hemodynamic stability, and procedural efficiency. This study was conducted to compare the efficacy and safety profile of face mask ventilation versus laryngeal mask airway in pediatric patients undergoing short surgical procedures.
Methods: This prospective observational study was conducted at a tertiary care centre from June 2024 to July 2025. A total of 120 pediatric patients aged 2 to 12 years, scheduled for elective short surgical procedures with expected duration of less than 60 minutes, were included. Patients were divided into two groups: Group M (face mask ventilation, n=60) and Group L (laryngeal mask airway, n=60). Parameters evaluated included ease of airway management, hemodynamic stability, ventilation adequacy, complications, and recovery characteristics.
Results: The laryngeal mask airway group demonstrated significantly better airway stability ($p<0.001$), fewer episodes of oxygen desaturation ($p=0.003$), and reduced need for airway manipulation ($p<0.001$) compared to face mask ventilation. The mean time to achieve adequate ventilation was shorter in the LMA group (45.2±8.3 seconds versus 62.5±12.7 seconds, $p<0.001$). Hemodynamic parameters remained more stable in the LMA group. Post-operative complications including sore throat and airway trauma were comparable between groups ($p>0.05$).
Conclusion: Laryngeal mask airway provides superior airway management with enhanced stability and fewer ventilatory complications compared to face mask ventilation in pediatric short surgical procedures, while maintaining comparable safety profiles and recovery characteristics.

Keywords*: Pediatric anesthesia, Face mask ventilation, Laryngeal mask airway, Short surgical procedures, Airway management.*

INTRODUCTION

Pediatric anesthesia presents unique challenges that demand specialized knowledge, technical expertise, and meticulous attention to anatomical and physiological differences between children and adults. Airway management constitutes the cornerstone of safe anesthetic practice in the pediatric population, where even minor complications can rapidly progress to life-threatening situations due to limited physiological reserves and distinctive anatomical characteristics.(1) The selection of an appropriate airway management technique for short surgical procedures in children requires careful consideration of multiple factors including patient age, body weight, anticipated procedure duration, surgical field requirements, and individual patient characteristics.

Short surgical procedures, typically defined as those lasting less than 60 minutes, encompass a wide spectrum of pediatric surgeries including diagnostic endoscopies, minor orthopedic interventions, dental procedures, ophthalmic surgeries, superficial mass excisions, and various other brief operative interventions.(2) The anesthetic management of these procedures necessitates a delicate balance between ensuring adequate airway control, maintaining optimal ventilation,

minimizing hemodynamic disturbances, and facilitating rapid recovery with minimal post-operative complications. The traditional approach utilizing face mask ventilation and the relatively modern technique employing laryngeal mask airway both represent viable options, each with distinct advantages and potential limitations that warrant systematic evaluation.

Face mask ventilation has historically served as the fundamental technique for airway management in pediatric anesthesia since the inception of modern anesthetic practice. This non-invasive method offers several theoretical advantages including avoidance of instrumentation of the airway, preservation of spontaneous ventilation when desired, minimal equipment requirements, and rapid application without specialized training beyond basic anesthetic skills.(3) The technique involves maintaining a patent airway through proper head positioning, achieving an effective seal between the face mask and facial structures, and delivering positive pressure ventilation when required. However, face mask ventilation in pediatric patients presents numerous challenges including the need for continuous manual airway maintenance, potential for inadequate seal due to anatomical variations, risk of gastric insufflation with positive pressure ventilation, occupying the anesthesiologist's hands thereby limiting multitasking capabilities, and variable success rates particularly in younger children with specific craniofacial features.(4)

The laryngeal mask airway, introduced by Dr. Archie Brain in 1983 and subsequently adapted for pediatric use, revolutionized supraglottic airway management by providing an intermediate option between face mask ventilation and endotracheal intubation.(5) This device consists of an inflatable silicone mask connected to a ventilation tube, designed to create a seal around the laryngeal inlet when properly positioned, thereby establishing a secure airway without entering the trachea. The pediatric laryngeal mask airway is available in various sizes ranging from size 1 for neonates to size 2.5 for older children, allowing selection based on patient weight and anatomical considerations. The widespread adoption of laryngeal mask airway in pediatric anesthesia practice has been driven by multiple documented advantages including hands-free airway maintenance once properly positioned, more reliable ventilation compared to face mask, reduced anesthetic gas exposure to operating room personnel, lower incidence of airway trauma compared to endotracheal intubation, maintenance of spontaneous or controlled ventilation as clinically indicated, and generally well-tolerated insertion and removal with minimal coughing or laryngospasm.(6)

The pediatric airway exhibits distinctive anatomical features that significantly influence the selection and performance of airway management techniques. Children possess proportionally larger heads with prominent occiputs, relatively larger tongues in relation to oral cavity size, more anterior and cephalad laryngeal position, shorter and narrower trachea with increased compliance, and the narrowest portion of the pediatric airway located at the cricoid cartilage rather than the glottis as in adults.(7) These anatomical differences create specific challenges for face mask ventilation including difficulty maintaining proper head position to align the airway axes, increased likelihood of airway obstruction from posterior displacement of the tongue, and challenges in achieving consistent mask seal particularly in infants and toddlers. The laryngeal mask airway, designed to conform to the supraglottic anatomy, may theoretically circumvent some of these anatomical challenges by providing a more consistent perilaryngeal seal independent of continuous manual manipulation. Physiological considerations further complicate pediatric airway management decisions. Children demonstrate higher metabolic rates with correspondingly increased oxygen consumption, lower functional residual capacity relative to body weight, increased chest wall compliance with reduced lung compliance, and more rapid onset of hypoxemia during apnea or hypoventilation.(8) These physiological characteristics mandate reliable and consistent ventilation throughout anesthetic procedures, making the choice between face mask and laryngeal mask airway particularly consequential. Any technique that reduces the frequency of ventilatory interruptions, minimizes episodes of inadequate ventilation, and provides more stable oxygenation deserves serious consideration for routine clinical implementation.

The existing literature presents conflicting perspectives regarding the optimal airway management strategy for pediatric short procedures. Several studies have advocated for face mask ventilation as the primary technique, citing its non-invasive nature, avoidance of supraglottic instrumentation, and theoretical reduction in post-operative airway complications.(9) Proponents of this approach emphasize the extensive clinical experience with face mask ventilation, familiarity among anesthesia providers across all training levels, and successful outcomes achieved in millions of pediatric anesthetic procedures worldwide. Conversely, an expanding body of evidence supports the preferential use of laryngeal mask airway in pediatric patients, demonstrating superior airway stability, reduced anesthesiologist workload, improved ventilatory parameters, and enhanced patient safety profiles particularly in the hands of less experienced practitioners.(10)

Despite numerous published studies examining various aspects of pediatric airway management, significant gaps remain in the comparative evaluation of face mask ventilation versus laryngeal mask airway specifically in the context of short surgical procedures. Previous research has often focused on specific age groups, particular surgical subspecialties, or limited outcome parameters, thereby restricting the generalizability of findings to broader pediatric populations undergoing diverse short procedures. Furthermore, many existing studies were conducted in developed healthcare settings with specific resource availability, practitioner expertise, and patient demographics that may not reflect the realities of tertiary care centers in developing nations where resource optimization, efficiency, and safety must be simultaneously prioritized.

The present study was conceived and executed to address these knowledge gaps by conducting a comprehensive comparative evaluation of face mask ventilation and laryngeal mask airway in a representative cohort of pediatric patients undergoing various short surgical procedures at a tertiary care teaching hospital. The investigation encompasses multiple dimensions of airway management including technical ease of application, adequacy and stability of ventilation, hemodynamic responses, intraoperative complications, recovery characteristics, and post-operative airway sequelae. By employing a prospective observational study design with systematic data collection and rigorous statistical analysis, this research aims to generate robust evidence that can inform clinical decision-making and potentially influence institutional protocols for pediatric airway management in short surgical procedures. The findings of this study hold potential implications not only for individual patient care but also for anesthesia training programs, resource allocation decisions, and the development of evidence-based clinical practice guidelines in pediatric anesthesia.

AIMS AND OBJECTIVES

The primary aim of this prospective observational study was to compare the efficacy, safety, and clinical outcomes of face mask ventilation versus laryngeal mask airway for airway management in pediatric patients undergoing short elective surgical procedures at a tertiary care centre. The study was designed to provide comprehensive comparative data that would inform evidence-based clinical decision-making regarding optimal airway management strategies in this specific population and procedural context.

The primary objective was to evaluate and compare the ease of airway management between face mask ventilation and laryngeal mask airway techniques in pediatric patients aged 2 to 12 years undergoing short surgical procedures with anticipated duration of less than 60 minutes. The secondary objectives included comparison of time required to establish adequate ventilation between the two techniques, assessment of ventilatory adequacy through measurement of end-tidal carbon dioxide levels and oxygen saturation throughout the intraoperative period, evaluation of hemodynamic stability by monitoring heart rate and blood pressure at defined time intervals, documentation of the number of airway manipulations or interventions required during the procedure, comparison of intraoperative complications including laryngospasm, bronchospasm, oxygen desaturation episodes, and gastric insufflation between the two groups, assessment of recovery characteristics including time to eye opening and time to achieve modified Aldrete score of 9 or above, and evaluation of post-operative airway complications including sore throat, hoarseness, cough, and signs of airway trauma within the first 24 hours following the procedure.

MATERIALS AND METHODS

Study Design and Setting

This prospective observational comparative study was conducted in the Department of Anesthesiology at a tertiary care teaching hospital over a period of 13 months from June 2024 to July 2025. The study protocol was approved by the Institutional Ethics Committee prior to commencement, and the study was conducted in accordance with the Declaration of Helsinki and Good Clinical Practice guidelines. Written informed consent was obtained from parents or legal guardians of all participating children after detailed explanation of the study objectives, procedures, potential risks, and benefits in the language best understood by them.

Sample Size Calculation

The sample size was calculated based on anticipated difference in the primary outcome measure of adequate ventilation time between face mask and laryngeal mask airway groups. Considering a mean difference of 15 seconds with standard deviation of 20 seconds, alpha error of 0.05, and power of 80%, the calculated sample size was 56 patients per group. Accounting for potential dropouts and incomplete data, 60 patients were enrolled in each group, yielding a total sample size of 120 patients.

Patient Selection and Grouping

Pediatric patients aged between 2 and 12 years, of either gender, with American Society of Anesthesiologists physical status classification I or II, scheduled for elective short surgical procedures with anticipated duration of less than 60 minutes, were screened for eligibility. Inclusion criteria included body weight between 10 and 40 kilograms, normal airway anatomy on clinical examination with Mallampati grade I or II, fasting status as per institutional guidelines (minimum 6 hours for solid foods and 2 hours for clear fluids), and parental consent for participation in the study. Exclusion criteria comprised history of difficult airway or previous difficult mask ventilation, presence of craniofacial abnormalities or congenital syndromes, active upper respiratory tract infection or history of recent respiratory infection within 2 weeks, gastroesophageal reflux disease or risk of aspiration, emergency surgical procedures, procedures requiring prone or lateral positioning, and parental refusal to provide consent.

Patients meeting the eligibility criteria were allocated to one of two groups based on the airway management technique employed: Group M received face mask ventilation throughout the procedure, while Group L received laryngeal mask airway for airway management. The allocation was performed through systematic sampling method wherein alternate eligible patients were assigned to each group in sequence of presentation to the operating room.

Anesthetic Protocol
All patients were kept nil per oral according to institutional fasting guidelines. Pre-operative assessment was conducted on the day prior to surgery including detailed history, physical examination, airway assessment, and review of relevant investigations. No premedication was administered in the pre-operative holding area. Standard monitoring including electrocardiography, non-invasive blood pressure measurement, pulse oximetry, capnography, and temperature monitoring was established prior to induction of anesthesia.

Induction of anesthesia was performed using intravenous propofol at a dose of 2 to 3 milligrams per kilogram body weight along with fentanyl 1 to 2 micrograms per kilogram body weight. Mask ventilation with 100% oxygen was initiated immediately following loss of consciousness. In Group M patients, anesthesia was maintained with face mask ventilation using an appropriately sized face mask with two-handed mask holding technique and spontaneous or assisted ventilation as clinically indicated. In Group L patients, an appropriately sized laryngeal mask airway was inserted following adequate depth of anesthesia, with size selection based on patient weight (size 1.5 for 10-15 kg, size 2 for 15-25 kg, and size 2.5 for 25-40 kg). The laryngeal mask airway was inserted using standard technique without the use of muscle relaxants, and cuff was inflated with appropriate volume of air to achieve an effective seal with leak pressure below 20 centimeters of water.
Maintenance of anesthesia was achieved using oxygen, nitrous oxide (50:50 ratio), and sevoflurane at a concentration of 2 to 3% to maintain adequate depth of anesthesia. Ventilation was maintained spontaneously or with assisted/controlled ventilation as required to maintain end-tidal carbon dioxide between 35 and 45 millimeters of mercury. Standard intraoperative fluid management was provided according to patient weight and fasting duration. At the conclusion of surgery, anesthetic agents were discontinued, and patients were allowed to breathe 100% oxygen. In Group M, the face mask was removed once adequate spontaneous ventilation was established. In Group L, the laryngeal mask airway was removed when the patient demonstrated return of protective airway reflexes including swallowing and ability to open mouth on command.

Data Collection
Baseline demographic data including age, gender, body weight, height, and American Society of Anesthesiologists physical status were recorded for all patients. Surgical procedure type and actual duration were documented. The following parameters were recorded at defined time points: time required to establish adequate ventilation (defined as achievement of normal end-tidal carbon dioxide waveform with values between 35-45 mmHg), number of attempts required for successful airway device placement or mask ventilation establishment, ease of ventilation scored on a four-point scale (1=very easy, 2=easy, 3=difficult, 4=very difficult), hemodynamic parameters including heart rate and mean arterial pressure recorded at baseline, immediately after airway device placement/mask application, at 5-minute intervals throughout the procedure, and at the time of airway device removal/discontinuation of mask ventilation.
Ventilatory parameters including oxygen saturation, end-tidal carbon dioxide levels, and peak inspiratory pressure were recorded at 5-minute intervals throughout the procedure. Any episodes of oxygen desaturation (defined as SpO2 <95%), laryngospasm, bronchospasm, or other airway complications were documented along with interventions required. The number of airway manipulations or adjustments required during the procedure was recorded. Recovery parameters including time to eye opening following discontinuation of anesthetic agents and time to achieve modified Aldrete score of 9 or more were documented. Post-operative airway examination was performed at 2 hours and 24 hours following the procedure to assess for complications including sore throat (assessed using visual analog scale), hoarseness, persistent cough, and evidence of airway trauma.

Statistical Analysis
Data were entered into Microsoft Excel spreadsheet and analyzed using Statistical Package for Social Sciences version 26.0. Categorical variables were expressed as frequencies and percentages, while continuous variables were expressed as mean and standard deviation. Comparison of categorical variables between the two groups was performed using chi-square test or Fisher's exact test as appropriate. Continuous variables were compared using independent samples t-test for normally distributed data or Mann-Whitney U test for non-normally distributed data. Normality of distribution was assessed using Kolmogorov-Smirnov test. Hemodynamic and ventilatory parameters measured at multiple time points were compared using repeated measures analysis of variance. A p-value of less than 0.05 was considered statistically significant for all comparisons.

RESULTS
A total of 120 pediatric patients who underwent short elective surgical procedures during the study period were included in the analysis, with 60 patients in each group. The demographic characteristics and baseline parameters of the study population were comparable between the two groups. The mean age of patients in Group M was 6.8±2.4 years compared to 6.5±2.6 years in Group L, with no statistically significant difference (p=0.512). The gender distribution showed 35 males and 25 females in Group M, while Group L comprised 38 males and 22 females, with no significant difference between groups (p=0.588). The mean body weight was 22.3±6.7 kilograms in Group M and 21.8±7.1 kilograms in Group L, which was statistically comparable (p=0.689). The distribution of American Society of Anesthesiologists physical status classification showed that 42 patients (70.0%) in Group M and 44 patients (73.3%) in Group L belonged to ASA grade I,

while the remaining patients in both groups were classified as ASA grade II, with no significant difference between groups (p=0.674).

The types of surgical procedures performed included diagnostic endoscopies (18 patients in Group M and 16 patients in Group L), dental procedures (14 patients in Group M and 15 patients in Group L), ophthalmic procedures (11 patients in Group M and 13 patients in Group L), minor orthopedic procedures (9 patients in Group M and 8 patients in Group L), superficial mass excisions (5 patients in Group M and 6 patients in Group L), and other miscellaneous short procedures (3 patients in Group M and 2 patients in Group L). The distribution of procedure types was statistically comparable between the two groups (p=0.892). The mean duration of surgical procedures was 38.6±11.2 minutes in Group M and 39.4±10.8 minutes in Group L, with no significant difference (p=0.698).

The primary outcome measure of time required to establish adequate ventilation demonstrated statistically significant difference between the two groups. In Group M, the mean time to achieve adequate ventilation was 62.5±12.7 seconds, whereas in Group L, it was significantly shorter at 45.2±8.3 seconds (p<0.001). The number of attempts required for successful airway management also differed significantly between groups. In Group M, successful face mask ventilation was achieved in the first attempt in 38 patients (63.3%), required second attempt in 18 patients (30.0%), and needed third attempt in 4 patients (6.7%). In contrast, Group L showed successful laryngeal mask airway insertion in the first attempt in 52 patients (86.7%), required second attempt in 7 patients (11.7%), and needed third attempt in only 1 patient (1.7%), with this difference being statistically significant (p=0.003).

The ease of airway management, assessed on a four-point scale by the managing anesthesiologist, revealed significant differences between groups. In Group M, ventilation was rated as very easy in 22 patients (36.7%), easy in 26 patients (43.3%), difficult in 10 patients (16.7%), and very difficult in 2 patients (3.3%). In Group L, airway management was rated as very easy in 38 patients (63.3%), easy in 19 patients (31.7%), difficult in 3 patients (5.0%), and very difficult in none of the patients, with this distribution showing statistically significant difference (p=0.001). The number of airway manipulations or adjustments required during the procedure was significantly higher in Group M with a mean of 4.7±2.3 interventions compared to 1.2±0.8 interventions in Group L (p<0.001).

Hemodynamic parameters were monitored at defined intervals throughout the procedure. The baseline heart rate was comparable between groups (Group M: 112.4±14.6 beats per minute versus Group L: 110.8±15.2 beats per minute, p=0.564). Immediately following airway device placement or mask application, the heart rate increased in both groups, but the increase was significantly more pronounced in Group M (128.6±18.4 beats per minute) compared to Group L (118.2±14.7 beats per minute), with p=0.001. At 5 minutes after airway establishment, the heart rate was 120.4±16.2 beats per minute in Group M and 112.6±13.8 beats per minute in Group L (p=0.006). Subsequently, at 15 minutes, 30 minutes, and 45 minutes, the heart rates remained relatively stable in both groups with values in Group M of 116.8±14.9, 114.2±13.7, and 112.6±13.2 beats per minute respectively, while in Group L the corresponding values were 110.4±12.6, 108.7±11.9, and 107.3±11.4 beats per minute respectively, all showing statistically significant differences (p=0.019, p=0.024, and p=0.031 respectively).

The mean arterial pressure at baseline was 76.4±8.6 millimeters of mercury in Group M and 75.8±8.2 millimeters of mercury in Group L, with no significant difference (p=0.704). Following airway management, the mean arterial pressure showed an increase in both groups, with values of 88.2±10.4 mmHg in Group M and 82.6±9.1 mmHg in Group L immediately after airway establishment (p=0.003). At subsequent time intervals of 5, 15, 30, and 45 minutes, the mean arterial pressure values in Group M were 84.6±9.8, 80.4±8.7, 78.6±8.2, and 77.2±7.9 mmHg respectively, while in Group L the corresponding values were 79.2±8.4, 77.8±7.6, 76.4±7.3, and 75.8±7.1 mmHg respectively. The differences were statistically significant at immediate post-airway establishment and at 5 minutes (p=0.003 and p=0.001 respectively), but became non-significant at later time points (p=0.104, p=0.148, and p=0.352 at 15, 30, and 45 minutes respectively).
Ventilatory parameters including oxygen saturation and end-tidal carbon dioxide levels were monitored throughout the procedure. The mean oxygen saturation remained above 97% in both groups throughout the procedure, but episodes of transient desaturation (SpO2 <95%) were documented in 14 patients (23.3%) in Group M compared to only 4 patients (6.7%) in Group L, with this difference being statistically significant (p=0.003). The mean end-tidal carbon dioxide levels were maintained within the target range of 35 to 45 mmHg in both groups, with mean values of 39.6±3.4 mmHg in Group M and 38.4±2.8 mmHg in Group L during the steady-state period, showing no significant difference (p=0.056). The peak inspiratory pressure required to maintain adequate ventilation was significantly higher in Group M (16.8±3.2 cm H2O) compared to Group L (13.2±2.4 cm H2O), with p<0.001.

Intraoperative complications were documented and compared between the two groups. Laryngospasm occurred in 3 patients (5.0%) in Group M and in 2 patients (3.3%) in Group L, with no statistically significant difference (p=0.648). All episodes of laryngospasm were successfully managed with deepening of anesthesia and administration of 100% oxygen, with one patient in Group M requiring a small dose of succinylcholine. Bronchospasm was not observed in any patient in either group. Gastric insufflation, detected clinically by epigastric distension, was observed in 6 patients (10.0%) in Group M but was not documented in any patient in Group L, with this difference being statistically significant (p=0.013). None

of these patients required orogastric tube insertion, and the insufflation resolved spontaneously following airway optimization. Regurgitation or aspiration was not observed in any patient in either group.

Recovery characteristics were systematically assessed in all patients. The time to eye opening following discontinuation of anesthetic agents was 8.4±2.6 minutes in Group M and 7.8±2.3 minutes in Group L, with no significant difference (p=0.193). The time to achieve a modified Aldrete score of 9 or above was 16.8±4.2 minutes in Group M and 15.4±3.8 minutes in Group L, which was also not statistically significant (p=0.064). All patients in both groups achieved the discharge criteria from post-anesthesia care unit within 30 minutes following discontinuation of anesthetic agents.

Post-operative airway complications were assessed at 2 hours and 24 hours following the procedure. Sore throat was reported by 11 patients (18.3%) in Group M and 8 patients (13.3%) in Group L at 2 hours post-operatively, with no significant difference (p=0.446). At 24 hours, sore throat persisted in 5 patients (8.3%) in Group M and 3 patients (5.0%) in Group L (p=0.459). The severity of sore throat, assessed using visual analog scale (0-10), showed mean scores of 2.6±1.8 in Group M and 2.2±1.4 in Group L at 2 hours (p=0.412), and 1.4±0.9 in Group M and 1.1±0.7 in Group L at 24 hours (p=0.524). Hoarseness of voice was reported by 2 patients (3.3%) in Group M and 1 patient (1.7%) in Group L at 2 hours, both resolving completely by 24 hours (p=0.558). Persistent cough was documented in 4 patients (6.7%) in Group M and 2 patients (3.3%) in Group L at 2 hours (p=0.400), with all cases resolving by 24 hours. Blood-tinged secretions suggestive of minor airway trauma were observed in 1 patient (1.7%) in Group M and none in Group L (p=0.315). No major airway complications or adverse events requiring intervention beyond routine post-operative care were documented in either group.

Table 1: Demographic and Baseline Characteristics

Parameter	Group M (n=60)	Group L (n=60)	p-value
Age (years), mean±SD	6.8±2.4	6.5±2.6	0.512
Gender (Male/Female)	35/25	38/22	0.588
Body weight (kg), mean±SD	22.3±6.7	21.8±7.1	0.689
Height (cm), mean±SD	118.4±16.2	116.8±17.4	0.596
ASA Grade I/II	42/18	44/16	0.674
Procedure duration (min), mean±SD	38.6±11.2	39.4±10.8	0.698

Table 2: Airway Management Parameters

Parameter	Group M (n=60)	Group L (n=60)	p-value
Time to adequate ventilation (sec), mean±SD	62.5±12.7	45.2±8.3	<0.001
First attempt success, n (%)	38 (63.3)	52 (86.7)	0.003
Number of attempts, mean±SD	1.4±0.6	1.2±0.4	0.026
Ease of ventilation (Very easy/Easy/Difficult/Very difficult)	22/26/10/2	38/19/3/0	0.001
Number of airway manipulations, mean±SD	4.7±2.3	1.2±0.8	<0.001
Peak inspiratory pressure (cm H2O), mean±SD	16.8±3.2	13.2±2.4	<0.001

Table 3: Hemodynamic Parameters at Different Time Intervals

Time point	Heart Rate (beats/min)		Mean Arterial Pressure (mmHg)	
	Group M	Group L	Group M	Group L
Baseline	112.4±14.6	110.8±15.2	76.4±8.6	75.8±8.2
Post-airway establishment	128.6±18.4*	118.2±14.7	88.2±10.4*	82.6±9.1
5 minutes	120.4±16.2*	112.6±13.8	84.6±9.8*	79.2±8.4
15 minutes	116.8±14.9*	110.4±12.6	80.4±8.7	77.8±7.6
30 minutes	114.2±13.7*	108.7±11.9	78.6±8.2	76.4±7.3
45 minutes	112.6±13.2*	107.3±11.4	77.2±7.9	75.8±7.1

*p<0.05 compared to Group L at same time point

Table 4: Ventilatory Parameters and Intraoperative Complications

Parameter	Group M (n=60)	Group L (n=60)	p-value
Mean SpO2 (%), mean±SD	98.4±1.2	98.9±0.8	0.012
Episodes of desaturation (SpO2 <95%), n (%)	14 (23.3)	4 (6.7)	0.003
Mean ETCO2 (mmHg), mean±SD	39.6±3.4	38.4±2.8	0.056
Laryngospasm, n (%)	3 (5.0)	2 (3.3)	0.648
Bronchospasm, n (%)	0 (0)	0 (0)	-
Gastric insufflation, n (%)	6 (10.0)	0 (0)	0.013
Regurgitation/Aspiration, n (%)	0 (0)	0 (0)	-

Table 5: Recovery Characteristics

Parameter	Group M (n=60)	Group L (n=60)	p-value
Time to eye opening (min), mean±SD	8.4±2.6	7.8±2.3	0.193
Time to Aldrete score ≥9 (min), mean±SD	16.8±4.2	15.4±3.8	0.064
Time to PACU discharge (min), mean±SD	24.6±5.8	23.2±5.2	0.172

Table 6: Post-operative Airway Complications

Parameter	Group M (n=60)	Group L (n=60)	p-value
Sore throat at 2 hours, n (%)	11 (18.3)	8 (13.3)	0.446
Sore throat at 24 hours, n (%)	5 (8.3)	3 (5.0)	0.459
VAS score at 2 hours, mean±SD	2.6±1.8	2.2±1.4	0.412
VAS score at 24 hours, mean±SD	1.4±0.9	1.1±0.7	0.524
Hoarseness at 2 hours, n (%)	2 (3.3)	1 (1.7)	0.558
Persistent cough at 2 hours, n (%)	4 (6.7)	2 (3.3)	0.400
Blood-tinged secretions, n (%)	1 (1.7)	0 (0)	0.315

DISCUSSION

The present study compared face mask ventilation with laryngeal mask airway for airway management in pediatric patients undergoing short elective surgical procedures. The findings demonstrated significant advantages of laryngeal mask airway over face mask ventilation in terms of ease of airway establishment, ventilatory stability, hemodynamic parameters, and intraoperative complications, while maintaining comparable safety profiles regarding post-operative airway complications and recovery characteristics. These results have important implications for clinical practice and support the preferential consideration of laryngeal mask airway for this specific patient population and procedural context.

The demographic characteristics and baseline parameters of the study population were well-matched between the two groups, eliminating potential confounding variables and strengthening the validity of comparative analyses. The distribution of surgical procedure types was also comparable, ensuring that observed differences in outcomes could be attributed to the airway management technique rather than variations in surgical interventions. The mean procedure duration of approximately 39 minutes in both groups was appropriate for the study design and reflected typical short surgical procedures encountered in pediatric anesthesia practice.(11)

The significantly shorter time required to establish adequate ventilation in the laryngeal mask airway group represents an important clinical advantage. The difference of approximately 17 seconds may appear modest in absolute terms, but assumes greater significance when considering the limited physiological reserves of pediatric patients and their rapid progression to hypoxemia during inadequate ventilation. This finding aligns with the study by Lopez-Gil et al., who demonstrated that laryngeal mask airway insertion required less time compared to establishing effective face mask ventilation in children.(12) The higher first-attempt success rate observed with laryngeal mask airway (86.7% versus 63.3%) further supports its superior reliability and ease of use, which is particularly relevant in teaching institutions where anesthesia providers with varying levels of experience manage pediatric cases.

The ease of airway management, subjectively assessed by the managing anesthesiologist, favored laryngeal mask airway significantly. This subjective assessment correlates well with objective parameters including reduced number of airway manipulations and lower peak inspiratory pressures required in the laryngeal mask airway group. These findings are consistent with previous research by Mason and Bingham, who reported that laryngeal mask airway provided more stable airway maintenance with reduced need for continuous manual intervention compared to face mask ventilation.(13) The reduction in anesthesiologist workload achieved with laryngeal mask airway has practical implications, allowing the practitioner to focus attention on other aspects of patient management and potentially improving overall patient safety.

The hemodynamic responses observed in this study revealed more pronounced increases in heart rate and mean arterial pressure immediately following face mask ventilation compared to laryngeal mask airway insertion. This difference likely reflects the greater stimulation associated with repeated airway manipulation and the stress response to intermittent ventilatory insufficiency commonly encountered with face mask technique. Although these hemodynamic changes were transient and remained within clinically acceptable ranges in this healthy pediatric population, they assume greater importance in patients with cardiovascular comorbidities or limited cardiac reserve. Similar findings were reported by Brimacombe and colleagues, who documented less hemodynamic disturbance associated with laryngeal mask airway compared to face mask ventilation in pediatric patients.(14) The gradual convergence of hemodynamic parameters between groups at later time points suggests that the primary differences relate to the airway establishment phase rather than ongoing maintenance.

The significantly higher incidence of oxygen desaturation episodes in the face mask ventilation group represents perhaps the most clinically relevant finding of this study. Transient desaturation occurred in 23.3% of patients managed with face mask compared to only 6.7% in the laryngeal mask airway group, demonstrating superior ventilatory reliability with the

supraglottic device. This finding corroborates the results reported by Mizushima et al., who observed fewer episodes of intraoperative oxygen desaturation with laryngeal mask airway compared to face mask ventilation in pediatric patients undergoing various surgical procedures.(15) The maintenance of adequate oxygenation throughout anesthesia represents a fundamental safety imperative, and any technique that reduces desaturation risk deserves serious consideration for routine clinical implementation.

The occurrence of gastric insufflation in 10% of face mask ventilation patients, with no cases observed in the laryngeal mask airway group, highlights another important safety consideration. Gastric insufflation increases the risk of regurgitation and potential aspiration, particularly if positive pressure ventilation is required. The seal provided by laryngeal mask airway around the laryngeal inlet appears to direct ventilation more effectively into the respiratory tract while minimizing gastric insufflation. This advantage of laryngeal mask airway has been previously documented by Timmermann and colleagues in their comprehensive review of supraglottic airway devices in pediatric anesthesia.(16) Although none of the patients in the current study experienced clinically significant complications from gastric insufflation, this finding supports the enhanced safety profile of laryngeal mask airway for pediatric airway management.

The comparable incidence of laryngospasm between groups suggests that the choice of airway management technique does not significantly influence this complication, which is primarily related to anesthetic depth, patient characteristics, and surgical stimulation. The overall low incidence of laryngospasm in both groups (approximately 4%) reflects appropriate patient selection, adequate anesthetic depth, and competent airway management. These rates are consistent with published literature on laryngospasm incidence in pediatric anesthesia practice.(17) The absence of bronchospasm in any patient in either group similarly reflects appropriate patient selection with exclusion of children with active respiratory pathology.

The recovery characteristics demonstrated no significant differences between the two groups, with comparable times to eye opening and achievement of discharge criteria from the post-anesthesia care unit. This finding is reassuring and indicates that the choice of airway management technique during the procedure does not adversely affect emergence and early recovery. Several previous studies have similarly reported equivalent recovery profiles between face mask and laryngeal mask airway techniques in pediatric patients.(18) The rapid recovery observed in both groups, with all patients achieving discharge criteria within 30 minutes, reflects the short duration of anesthesia and the use of short-acting anesthetic agents appropriate for brief surgical procedures.

Post-operative airway complications including sore throat, hoarseness, and persistent cough were comparable between the two groups, with no statistically significant differences at either 2 hours or 24 hours following the procedure. This finding contrasts with some earlier studies that suggested laryngeal mask airway might be associated with increased throat discomfort compared to face mask ventilation due to supraglottic instrumentation. However, more recent literature supports the current finding that modern laryngeal mask airway devices, when properly sized and appropriately inflated, cause minimal airway trauma and post-operative discomfort.(19) The relatively low overall incidence of sore throat in both groups (approximately 15% at 2 hours) is consistent with expected rates for short procedures with minimal airway instrumentation. The absence of significant airway trauma in either group reflects careful patient selection, appropriate technique, and competent airway management.

While the present study demonstrates clear advantages of laryngeal mask airway over face mask ventilation for pediatric short procedures, it is important to acknowledge certain limitations. The study was conducted at a single tertiary care center, which may limit generalizability to other settings with different patient populations, practitioner expertise, or resource availability. The exclusion of patients with difficult airway predictors, active respiratory pathology, or aspiration risk means that findings cannot be extrapolated to these higher-risk populations where face mask ventilation might remain preferable to avoid supraglottic instrumentation. The study evaluated relatively short procedures with mean duration of approximately 39 minutes, and findings may not apply to longer procedures where considerations such as device tolerance and tissue pressure effects assume greater importance. The subjective assessment of ease of airway management, while clinically relevant, introduces potential for observer bias despite attempts to standardize evaluation criteria.

Despite these limitations, the study provides robust comparative data supporting the preferential use of laryngeal mask airway for airway management in appropriately selected pediatric patients undergoing short surgical procedures. The consistency of findings across multiple outcome measures, including objective parameters such as desaturation episodes and airway manipulation frequency as well as subjective assessments of ease of use, strengthens the validity of conclusions. The practical implications extend beyond individual patient care to inform institutional protocols, equipment procurement decisions, and anesthesia training curricula. The superior reliability and reduced workload associated with laryngeal mask airway may be particularly valuable in teaching institutions where anesthesia residents and less experienced practitioners manage pediatric cases under supervision.(20)

Future research directions should include multi-center studies to enhance generalizability, cost-effectiveness analyses comparing the two techniques while accounting for equipment costs and practitioner time requirements, evaluation of learning curves for novice practitioners managing pediatric airways with both techniques, investigation of specific patient

subgroups including very young children or those with mild airway abnormalities not meeting exclusion criteria, and long-term follow-up studies to assess any delayed airway complications beyond the immediate 24-hour post-operative period examined in the current study. Additionally, research examining patient and parent satisfaction with the two techniques could provide valuable patient-centered outcome data to complement the clinical and safety parameters evaluated in the present investigation.

CONCLUSION

This prospective observational study comparing face mask ventilation with laryngeal mask airway for airway management in pediatric patients undergoing short elective surgical procedures demonstrated significant advantages of laryngeal mask airway across multiple outcome measures. The laryngeal mask airway group exhibited shorter time to establish adequate ventilation, higher first-attempt success rates, superior ease of airway management, reduced requirement for airway manipulations, better hemodynamic stability, fewer episodes of oxygen desaturation, and lower incidence of gastric insufflation compared to face mask ventilation. Recovery characteristics and post-operative airway complications were comparable between the two techniques, indicating equivalent safety profiles in these domains. These findings support the preferential consideration of laryngeal mask airway as the airway management technique of choice for appropriately selected pediatric patients undergoing short surgical procedures at tertiary care centers. The enhanced reliability, reduced practitioner workload, and superior ventilatory stability associated with laryngeal mask airway have important implications for patient safety, clinical efficiency, and anesthesia training programs in pediatric anesthesia practice.

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