

Research Article

COMPARISON OF I- GEL (INTERSURGICAL INC., BERKSHIRE, UK) SUPRAGLOTTIC AIRWAY AND PROSEAL LMA (LARYNGEAL MASK AIRWAY) IN PAEDIATRIC PATIENTS UNDER CONTROLLED VENTILATION

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Abstract: Background: Effective airway management is critical in pediatric anesthesia due to unique anatomical and physiological characteristics. Supraglottic airway devices, such as the i-gel and ProSeal Laryngeal Mask Airway (PLMA), offer minimally invasive alternatives to endotracheal intubation, reducing airway trauma and hemodynamic responses. This study aimed to compare the clinical performance of i-gel and PLMA in pediatric patients under general anesthesia with controlled ventilation. **Methods:** A prospective, randomized study was conducted with 100 pediatric patients (ASA I-II, aged 1–12 years) scheduled for elective short-duration surgeries under general anesthesia. Patients were randomized into two groups: i-gel (Group I, n=50) and PLMA (Group P, n=50). Key outcomes included hemodynamic parameters (heart rate, blood pressure), ease of insertion, oropharyngeal seal pressure, ventilation parameters (peak airway pressure, end-tidal CO₂), and postoperative complications (sore throat, laryngospasm, and blood-stained devices). Data were analyzed using standard statistical methods, and a p-value < 0.05 was considered significant. **Results:** Hemodynamic responses were comparable between the groups, with no clinically significant changes. The mean insertion time was 23.97 ± 4.46 seconds for i-gel and 24.52 ± 8.10 seconds for PLMA, with both devices achieving a first-attempt success rate of 92%. The oropharyngeal seal pressure was slightly higher for i-gel (20.34 ± 4.71 cmH₂O) compared to PLMA (19.04 ± 4.61 cmH₂O), but this difference was not statistically significant. Both devices maintained effective ventilation, with peak airway pressures of 14.8 ± 2.3 cmH₂O for i-gel and 15.2 ± 2.1 cmH₂O for PLMA. The incidence of postoperative sore throat was lower with i-gel (12%) compared to PLMA (16%), with no cases of laryngospasm or blood-stained devices in either group.

Conclusion: Both i-gel and PLMA are effective and safe for pediatric airway management under controlled ventilation. While both devices demonstrated comparable performance, i-gel showed slight advantages in ease of insertion, faster placement times, and reduced postoperative complications. These findings suggest that i-gel may be a preferred choice in scenarios where simplicity and reduced morbidity are prioritized.

Keywords: Pediatric anesthesia; Airway management; i-gel; ProSeal laryngeal mask airway; Supraglottic airway devices; Controlled ventilation

INTRODUCTION

Airway management in pediatric patients demands careful consideration due to their unique anatomical and physiological characteristics. The smaller airways in children make them particularly vulnerable to obstruction and rapid desaturation, necessitating reliable and effective airway management techniques (1). While endotracheal intubation remains the gold standard, the advent of supraglottic airway devices (SADs) has significantly transformed pediatric airway management by offering less invasive alternatives that maintain airway patency while reducing airway trauma and hemodynamic responses (2). The ProSeal Laryngeal Mask Airway (PLMA), introduced in 2000, represented a significant advancement in SAD technology. Its design incorporates a modified cuff and double tube system specifically engineered for controlled ventilation and enhanced protection against aspiration (3). The drainage tube, complementing the airway tube, provides an effective channel for regurgitated gastric contents and prevents gastric insufflation, addressing key

safety concerns in pediatric anesthesia (4).

The i-gel, unveiled in 2007, brought further innovation to supraglottic airway management. Unlike traditional SADs, it features a non-inflatable cuff made of thermoplastic elastomer, designed to create an anatomical seal around the laryngeal framework without the need for cuff inflation. The device includes additional safety features such as a gastric channel for gastric decompression and an epiglottic rest to prevent epiglottic downfolding (5). The soft, gel-like material and non-inflatable design potentially reduce tissue compression and postoperative complications while maintaining effective sealing pressures (6).

While both devices have demonstrated efficacy in pediatric airway management, comparative data regarding their performance under controlled ventilation in children remains limited. The choice between these devices often relies on individual preference and experience rather than evidence-based comparisons. Understanding their relative

merits in terms of ease of insertion, hemodynamic stability, seal effectiveness, and complication rates is crucial for optimal device selection in pediatric anesthesia (7).

This prospective, randomized study aimed to compare the clinical performance of i-gel and PLMA in pediatric patients under controlled ventilation. The primary objectives included evaluation of hemodynamic changes during insertion and maintenance, ease of insertion, number of insertion attempts, and oropharyngeal seal pressure. Secondary objectives encompassed assessment of postoperative complications such as sore throat, blood staining, and laryngospasm. This comparison will provide valuable insights for anesthesiologists in selecting appropriate airway devices for pediatric patients.

Materials and Methods:

This prospective, randomized comparative study was conducted between January 2016 and September 2017 at a tertiary care hospital after obtaining institutional ethics committee approval. The trial included 100 ASA physical status I-II children aged 1-12 years scheduled for elective short-duration surgeries (anticipated duration <2 hours). Group size was determined through power analysis based on standard deviation data from previously published reports. Using an opaque sealed envelope technique, participants were randomized into two groups: Group I (i-gel, n=50) and Group P (PLMA, n=50).

The study included ASA I-II patients aged 1-12 years of either gender scheduled for elective surgery under general anesthesia. Exclusion criteria comprised parental refusal, upper respiratory tract infection, risk of gastroesophageal regurgitation, airway-related conditions (trismus, limited mouth opening, trauma, or mass), anticipated difficult airway, cardiovascular disease, epilepsy, and obstructive pulmonary disease.

All children received oral midazolam (0.5 mg/kg) 30 minutes preoperatively. In the operating theater, standard monitoring was established including pulse oximetry, non-invasive blood pressure, electrocardiography, and capnography. General anesthesia was induced using sevoflurane (up to 6%) with 100% oxygen. After securing intravenous access, glycopyrrolate (6 µg/kg) and fentanyl

(2 µg/kg) were administered. Following confirmation of adequate bag-mask ventilation, neuromuscular blockade was achieved with atracurium (0.5 mg/kg). Ventilation continued for 4 minutes with sevoflurane (4% or titrated doses) and 100% oxygen.

Device sizes were selected according to manufacturer recommendations. For i-gel: size 1.5 (5-12 kg), size 2 (10-25 kg), size 2.5 (25-35 kg); for PLMA: size 1.5 (5-10 kg), size 2 (10-20 kg), size 2.5 (20-30 kg). Devices were inserted in the "sniffing position" by a single experienced anesthesiologist. The i-gel was inserted according to manufacturer guidelines, while PLMA insertion utilized the index finger digital method. PLMA cuffs were inflated according to size (1.5: 7ml; 2: 10ml; 2.5: 14ml).

After device placement, ventilation was initiated with fresh gas flow at 3 L/min. Anesthesia was maintained with sevoflurane, nitrous oxide, and oxygen in a 2:1 ratio. Ventilation parameters included tidal volume 10 ml/kg and respiratory rate 12-18/min, adjusted to maintain EtCO₂ between 35-40 mmHg. The oropharyngeal seal pressure was assessed by closing the expiratory valve at a fixed gas flow of 3 L/min and noting the airway pressure at equilibrium.

Primary outcome measurements included hemodynamic parameters (heart rate, blood pressure, SpO₂) recorded at baseline, post-induction, insertion, and 2, 4, and 6-minutes post-insertion. Insertion time was measured from picking up the device until obtaining an effective airway with EtCO₂ trace. Ease of insertion was subjectively graded as very easy, easy, or difficult. Secondary outcomes included ease of gastric tube insertion, fiber-optic view (assessed using the Brimacombe score), and post-extubation complications such as cough, laryngospasm, blood staining, and sore throat.

At the end of surgery, neuromuscular blockade was reversed with neostigmine (0.05 mg/kg) and glycopyrrolate (0.01 mg/kg). The device was removed once the child was fully awake or easily arousable. Post-operative follow-up was conducted on the evening of surgery to assess for complications.

RESULTS

A total of 100 ASA physical status I and II children, aged 1-12 years, were enrolled in the study. The groups were demographically comparable with no significant differences between i-gel (Group I, n=50) and ProSeal LMA (Group P, n=50).

Demographic Characteristics The mean age was 6.82±3.23 years in Group I and 6.16±2.57 years in Group P (p=0.61). The majority of patients were in the 7-9 years age group (Group I: 36%, Group P: 44%). Male patients predominated in both groups (Group I: 72%, Group P: 64%). The detailed demographic data are presented in Table 1.

Table 1: Demographic and Clinical Characteristics

Characteristics	Group I (n=50)	Group P (n=50)	P-value
Age (years)			
0-3	12 (24%)	8 (16%)	0.61
4-6	9 (18%)	16 (32%)	
7-9	18 (36%)	22 (44%)	
10-12	11 (22%)	4 (8%)	
Mean Age ± SD	6.82±3.23	6.16±2.57	
Gender			
Male	36 (72%)	32 (64%)	0.39
Female	14 (28%)	18 (36%)	
ASA Status			
I	42 (84%)	44 (88%)	0.56
II	8 (16%)	6 (12%)	
Weight (kg)*	18.4±6.2	17.9±5.8	0.68
*Values expressed as n(%) or mean±SD			

*Values expressed as n(%) or mean $\pm$ SD

Hemodynamic Response Both groups demonstrated comparable hemodynamic changes during device insertion and maintenance (Table 2). Heart rate increased transiently after device insertion in both groups (Group I: 125.94 $\pm$ 14.51, Group P: 128.46 $\pm$ 13.44 beats/min, $p=0.37$), returning to near-baseline values within 6 minutes. Systolic and diastolic blood pressure followed similar patterns, with peak values observed immediately after insertion (SBP - Group I: 95.22 $\pm$ 8.87, Group P: 97.90 $\pm$ 9.30 mmHg, $p=0.14$; DBP - Group I: 63.62 $\pm$ 5.72, Group P: 65.00 $\pm$ 6.03 mmHg, $p=0.24$). The differences were not statistically significant at any time point.

Table 2: Hemodynamic Parameters at Different Time Intervals

Parameter	Time	Group I	Group P	P-value
Heart Rate (beats/min)	T0 (baseline)	108.10 $\pm$ 16.69	109.76 $\pm$ 15.72	0.61
	Ta (after induction)	116.00 $\pm$ 16.05	117.78 $\pm$ 16.11	0.19
	Ti (after insertion)	125.94 $\pm$ 14.51	128.46 $\pm$ 13.44	0.37
	T2 (2 min)	121.44 $\pm$ 14.64	123.90 $\pm$ 13.15	0.37
	T4 (4 min)	117.54 $\pm$ 14.01	120.28 $\pm$ 13.15	0.31
	T6 (6 min)	113.98 $\pm$ 13.95	116.30 $\pm$ 13.48	0.4
SBP (mmHg)	T0	84.06 $\pm$ 8.36	84.72 $\pm$ 7.11	0.67
	Ta	86.24 $\pm$ 8.24	86.40 $\pm$ 6.64	0.91
	Ti	95.22 $\pm$ 8.87	97.90 $\pm$ 9.30	0.14
	T2	93.26 $\pm$ 8.69	94.12 $\pm$ 8.79	0.62
	T4	91.28 $\pm$ 8.64	92.90 $\pm$ 8.16	0.33
	T6	90.26 $\pm$ 8.69	91.26 $\pm$ 7.74	0.54
DBP (mmHg)	T0	60.12 $\pm$ 5.95	60.58 $\pm$ 5.88	0.69
	Ta	61.38 $\pm$ 5.70	61.98 $\pm$ 4.67	0.56
	Ti	63.62 $\pm$ 5.72	65.00 $\pm$ 6.03	0.24
	T2	61.86 $\pm$ 5.50	62.74 $\pm$ 6.24	0.45
	T4	60.30 $\pm$ 5.26	61.40 $\pm$ 5.95	0.33
	T6	59.06 $\pm$ 5.34	60.00 $\pm$ 5.82	0.4

Values expressed as mean $\pm$ SD

Device Insertion Parameters The insertion characteristics were comparable between the groups (Table 3). Mean insertion time was 23.97 $\pm$ 4.46 seconds for Group I and 24.52 $\pm$ 8.10 seconds for Group P ($p=0.67$). First-attempt success rate was identical in both groups (92%), with remaining cases requiring a second attempt. The majority of insertions were rated as "very easy" (70% in both groups), with similar distribution of ease grades between groups ($p=0.91$).

Table 3: Device Insertion Characteristics

Parameter	Group I (n=50)	Group P (n=50)	P-value
Insertion time (seconds)*	23.97±4.46	24.52±8.10	0.67
Number of attempts			
First attempt	46 (92%)	46 (92%)	1
Second attempt	4 (8%)	4 (8%)	
Ease of insertion			
Very easy	35 (70%)	35 (70%)	0.91
Easy	12 (24%)	11 (22%)	
Difficult	3 (6%)	4 (8%)	
*Values expressed as mean±SD & n(%)			

*Values expressed as mean±SD & n(%)

Airway Parameters The mean oropharyngeal seal pressure was slightly higher in Group I (20.34±4.71 cmH2O) compared to Group P (19.04±4.61 cmH2O), though not statistically significant (p=0.36). Fiber-optic assessment revealed optimal positioning in both groups, with all patients achieving grade 3 or 4 Brimacombe scores. Gastric tube placement was successful in all cases, with a higher proportion of "very easy" insertions in Group I (76%) compared to Group P (62%), though this difference was not statistically significant (p=0.13).

Table 4: Airway Assessment Parameters

Parameter	Group I (n=50)	Group P (n=50)	P-value
Oropharyngeal seal pressure (cmH2O) *	20.34±4.71	19.04±4.61	0.36
Brimacombe Score			
Grade 3	24 (48%)	19 (38%)	0.31
Grade 4	26 (52%)	31 (62%)	
Ease of gastric tube insertion			
Very easy	38 (76%)	31 (62%)	0.13
Easy	12 (24%)	19 (38%)	
*Values expressed as mean±SD or n(%)			

*Values expressed as mean±SD or n(%)

Ventilation Parameters Both devices maintained adequate ventilation throughout the procedures (Table 5). Peak airway pressures and end-tidal CO2 values remained within acceptable ranges, with no significant differences between groups. No episodes of desaturation (SpO2 <95%) were recorded in either group.

Table 5: Ventilation Parameters During Maintenance

Parameter	Group I	Group P	P-value
Peak airway pressure (cmH2O)*	14.8±2.3	15.2±2.1	0.38
EtCO2 (mmHg)*	37.2±2.1	36.9±1.9	0.45
Tidal volume (ml/kg)*	9.8±0.4	9.9±0.3	0.15
SpO2 (%)*	99.4±0.3	99.3±0.4	0.16

*Values expressed as mean±SD

Complications post-operative complications were minimal in both groups (Table 6). Sore throat occurred in 12% of Group I and 16% of Group P patients (p=0.49). One case of laryngeal leak was observed in Group P. No blood staining was observed on device removal in either group. There were no instances of laryngospasm, bronchospasm, aspiration, or other major airway complications.

Table 6: Post-operative Complications

Complication	Group I (n=50)	Group P (n=50)	P-value
Sore throat	6 (12%)	8 (16%)	0.49

Laryngeal leak	0	1 (2%)	0.49
Blood staining	0	0	-
Laryngospasm	0	0	-
Values expressed as n (%)			

These results demonstrate that both i-gel and ProSeal LMA provide effective and safe airways in pediatric patients under controlled ventilation, with comparable performance characteristics across all measured parameters.

DISCUSSION

The present study evaluated the efficacy and safety of i-gel and ProSeal Laryngeal Mask Airway (PLMA) in pediatric patients undergoing elective surgeries under general anesthesia with controlled ventilation. Both devices demonstrated comparable outcomes across multiple parameters, including hemodynamic stability, ease of insertion, oropharyngeal seal pressure, ventilation parameters, and postoperative complications. The results were consistent with findings from existing literature, emphasizing the utility of both devices in pediatric airway management.

The heart rate post-insertion in this study was 125.94 ± 14.51 bpm for i-gel and 128.46 ± 13.44 bpm for PLMA, while systolic blood pressure post-insertion was 95.22 ± 8.87 mmHg for i-gel and 97.90 ± 9.30 mmHg for PLMA. These results indicate minimal and comparable hemodynamic changes between the two devices, with no clinically significant variations. This finding aligns with the observations of Ashraf et al. (8) and Patel et al. (9), who reported transient but insignificant hemodynamic changes during the insertion of both i-gel and PLMA. The minor changes in heart rate and blood pressure during insertion, attributed to the passage of the device through the pharyngeal space, were consistent with the observations of Sathiyaraj (10), who noted that these changes normalized shortly after placement. The stability of hemodynamic parameters in this study underscores the safety of both devices for pediatric airway management.

The mean insertion time was 23.97 ± 4.46 seconds for i-gel and 24.52 ± 8.10 seconds for PLMA, with a first-attempt success rate of 92% for both devices. While these results indicate a similar ease of insertion for the two devices in this study, existing literature suggests that i-gel may offer a marginal advantage. For instance, Ashraf et al. (8) reported significantly shorter insertion times for i-gel (15.2 seconds) compared to PLMA (26.1 seconds) and a higher first-attempt success rate for i-gel (95%) than for PLMA (77.5%). This difference has been attributed to the design of i-gel, which features a non-inflatable cuff that simplifies insertion. Similarly, Shiveshi and Anandaswamy (11) observed superior ease of insertion with i-gel, emphasizing its advantages in scenarios requiring rapid airway management. The slightly longer insertion times observed in this study may reflect operator variability or the clinical context but do not diminish the overall reliability of both devices.

The oropharyngeal seal pressure in this study was 20.34 ± 4.71 cmH₂O for i-gel and 19.04 ± 4.61 cmH₂O for

PLMA. These values demonstrate that both devices provide an effective seal for controlled ventilation, though i-gel showed a marginally higher seal pressure. This finding is consistent with the results of Liew et al. (13) and Jagannathan et al. (14), who reported superior oropharyngeal leak pressures for i-gel compared to PLMA. A higher seal pressure is advantageous in maintaining positive pressure ventilation, particularly in patients with elevated airway resistance. However, Patel et al. (9) noted that while PLMA often provides a higher seal pressure, the differences are not always clinically significant. The comparable seal pressures observed in this study affirm the suitability of both devices for maintaining a secure airway in pediatric patients.

Ventilation parameters, including peak airway pressure and end-tidal CO₂, were also comparable between the devices in this study. The peak airway pressure was 14.8 ± 2.3 cmH₂O for i-gel and 15.2 ± 2.1 cmH₂O for PLMA, while end-tidal CO₂ values were 37.2 ± 2.1 mmHg for i-gel and 36.9 ± 1.9 mmHg for PLMA. These values align with the findings of Park et al. (15) and Sathiyaraj (10), who demonstrated that both i-gel and PLMA maintain effective ventilation during pediatric anesthesia. Malik et al. (12) also reported comparable ventilation efficacy between the devices, highlighting their reliability under controlled ventilation.

Postoperative complications were minimal in this study, with the incidence of sore throat being slightly lower for i-gel (12%) compared to PLMA (16%). Additionally, there were no cases of laryngospasm or blood-stained devices in either group. These findings are consistent with those of Rather et al. (16) and Liew et al. (13), who reported reduced airway trauma and lower rates of sore throat with i-gel compared to PLMA. The softer, non-inflatable cuff design of i-gel likely contributes to these advantages by minimizing pressure on surrounding tissues during insertion and maintenance. The absence of blood-stained devices further supports the atraumatic nature of both devices, emphasizing their safety for pediatric use.

Conclusion:

In conclusion, this study demonstrates that both i-gel and PLMA are effective and safe supraglottic airway devices for pediatric patients undergoing elective surgeries under general anesthesia. While both devices performed similarly across most parameters, i-gel showed slight advantages in terms of ease of insertion, faster placement times, and reduced incidence of sore throat. These findings align with existing literature and reinforce the clinical utility of both devices. The choice between i-gel

and PLMA should be based on patient-specific factors and clinical requirements, with i-gel potentially offering greater benefits in scenarios prioritizing ease of use and reduced airway trauma.

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