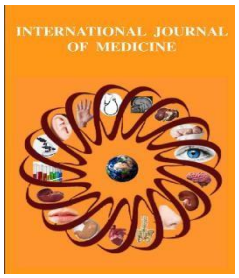

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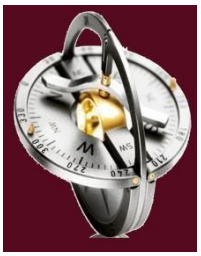

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Review Article

Incidence of airway trauma and postoperative pharyngolaryngeal morbidity with different LMA devices

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Abstract

Background: Laryngeal mask airways (LMAs) are widely used supraglottic airway devices that offer effective airway management with fewer complications than endotracheal intubation. However, postoperative pharyngolaryngeal morbidity and airway trauma remain common concerns. Newer LMA designs aim to improve airway seal and reduce tissue injury. This study compared airway trauma and postoperative pharyngolaryngeal morbidity associated with Classic LMA, ProSeal LMA, and I-gel in elective surgical patients. ***Methods***: This prospective, randomized comparative study included 90 adult patients (ASA physical status I–II) undergoing elective surgeries under general anesthesia. Patients were randomly allocated into three groups (n = 30 each): Group A (Classic LMA), Group B (ProSeal LMA), and Group C (I-gel). Insertion characteristics, oropharyngeal leak pressure (OLP), and evidence of airway trauma were recorded intraoperatively. Postoperative pharyngolaryngeal morbidity—sore throat, dysphonia, dysphagia, and visible trauma—was assessed at 1, 6, and 24 hours postoperatively. Statistical analysis was performed using ANOVA and Chi-square tests, with $p < 0.05$ considered significant. ***Results***: Demographic characteristics and surgical duration were comparable among groups. The I-gel demonstrated significantly shorter insertion time (21.4 ± 4.8 s; $p = 0.001$) and the lowest incidence of postoperative sore throat at 1 and 6 hours ($p < 0.05$). ProSeal LMA achi eved the highest OLP (26.5 ± 4.1 cm H_2O; $p = 0.002$), indicating superior airway seal. Airway trauma, evidenced by blood staining and postoperative symptoms, was least frequent with I-gel, though differences were not statistically significant for all parameters. ***Conclusion***: I-gel is associated with faster insertion, minimal airway trauma, and significantly lower postoperative pharyngolaryngeal morbidity compared to Classic and ProSeal LMAs. ProSeal LMA provides superior airway sealing and is preferable when higher airway pressures are anticipated. Second-generation LMAs offer clear advantages over Classic LMA in elective anesthesia practice.

Keywords: Laryngeal mask airway, I-gel, ProSeal LMA, postoperative sore throat, airway trauma, supraglottic airway devices.

Introduction:

Securing and maintaining a patent airway is a cornerstone of safe anesthesia practice. The laryngeal mask airway (LMA), introduced by Dr. Archie Brain in 1983, revolutionized airway management by bridging the gap between the face mask and the endotracheal tube. Since its introduction, the LMA has become an essential tool in both elective and emergency airway management due to its ease of insertion, hemodynamic stability, and reduced incidence of airway-related complications compared to tracheal intubation.

However, despite its advantages, the use of LMA is not devoid of complications. Pharyngolaryngeal morbidity–including sore throat, dysphonia, and dysphagia–remains a frequent postoperative concern. Airway trauma, evidenced by blood staining on the device or visible mucosal injury, may also occur during insertion, removal, or due to excessive cuff pressure. The incidence of these complications varies widely, depending on the type of LMA used, insertion technique, lubrication method, cuff design, and the experience of the anesthesiologist.1,2

Over the years, several modifications of the classical LMA have been developed, such as the LMA ProSeal, LMA Supreme, LMA Unique, and I-gel. These newer devices incorporate design changes aimed at improving the seal pressure, facilitating gastric access, and reducing mucosal trauma. The I-gel, for instance, uses a non-inflatable cuff made of a soft thermoplastic elastomer that conforms anatomically to the perilaryngeal structures, potentially minimizing compression-related injury. Conversely, inflatable-cuff LMAs such as ProSeal and Supreme may cause higher pharyngolaryngeal pressure, particularly when overinflated.

Postoperative sore throat (POST) remains one of the most common minor complications after LMA use, with reported incidences ranging from 5% to 40%. 3,4 While these symptoms are generally self-limiting, they can impact patient satisfaction and recovery, particularly in day-care surgeries. Comparative studies evaluating the incidence of airway trauma and postoperative morbidity between different LMA designs have yielded inconsistent results, necessitating further research to establish device-specific risk profiles.

The present study aims to evaluate and compare the incidence of airway trauma and postoperative pharyngolaryngeal morbidity associated with different LMA devices used during elective surgeries under general anesthesia. By analyzing the relationship between device design and postoperative airway outcomes, this study seeks to contribute to safer and more comfortable airway management practices..

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MATERIALS AND METHODS

A prospective, randomized, comparative study was conducted in the Department of Anesthesiology at [Name of Institution], over a period of six months. The study aimed to evaluate and compare the incidence of airway trauma and postoperative pharyngolaryngeal morbidity associated with different laryngeal mask airway (LMA) devices used during elective surgical procedures under general anesthesia.

Study Population

The study included 90 adult patients (aged 18-60 years) of either sex, belonging to American Society of Anesthesiologists (ASA) physical status I and II, scheduled for elective surgeries of duration less than two hours requiring general anesthesia with spontaneous or controlled ventilation.

Inclusion Criteria

Adult patients aged between 18 and 60 years.
ASA Grade I or II.
Patients undergoing elective surgical procedures under general anesthesia.
Patients with no anticipated difficult airway.

Exclusion Criteria

Known or anticipated difficult airway (Mallampati Grade III or IV).
Upper respiratory tract infection or sore throat within the preceding 7 days.
Patients with restricted mouth opening or upper airway pathology.
History of gastroesophageal reflux disease (GERD) or increased risk of aspiration.
Pregnant women, obese patients (BMI > 30 kg/m²), and those with cervical spine instability.

Grouping and Randomization

Patients were randomly allocated into three groups (n = 30 in each group) using a computer-generated randomization chart:

Group A: Classic LMA (LMA-Classic™)
Group B: LMA ProSeal™
Group C: I-gel™

Allocation concealment was maintained using sealed opaque envelopes opened just before induction of anesthesia.

Anesthetic Technique

All patients were fasted overnight and premedicated with oral alprazolam (0.25 mg) on the night prior to surgery. Standard monitors (ECG, NIBP, SpO_2 , and $EtCO_2$) were attached in the operating room.
Anesthesia was induced with intravenous propofol (2 mg/kg) and fentanyl (2 µg/kg). Once adequate depth of anesthesia was achieved, muscle relaxation was obtained using succinylcholine (1.5 mg/kg) for ease of insertion.

The selected LMA device (as per group allocation) was lubricated with water-based jelly and inserted by an experienced anesthesiologist (>3 years of experience) following manufacturer's instructions.
The cuff was inflated with air until an adequate seal was achieved, ensuring cuff pressure was maintained below 60 cm H_2 O using a handheld manometer. Correct placement was confirmed by bilateral chest rise, capnography, and absence of air leak during manual ventilation.

Intraoperative Monitoring
Parameters recorded intraoperatively included:

Number of insertion attempts.
Time taken for successful insertion (in seconds).
Oropharyngeal leak pressure (OLP) measured by closing the expiratory valve and noting the airway pressure at which an audible leak occurred.
Any visible blood staining on the device upon removal.
Hemodynamic changes (heart rate and mean arterial pressure) recorded at baseline, insertion, and 5 minutes post-insertion.

Postoperative Assessment

Postoperative pharyngolaryngeal morbidity was evaluated at 1 hour, 6 hours, and 24 hours after removal of the airway device by an independent observer blinded to group allocation.
Symptoms assessed included:

Sore throat (graded as mild, moderate, or severe).
Dysphonia (change in voice quality).
Dysphagia (difficulty in swallowing).
Presence of visible oral or pharyngeal trauma (blood-stained saliva or mucosal abrasion).

Pain and discomfort were graded on a 3-point scale (0 = none, 1 = mild, 2 = moderate/severe).

Statistical Analysis

Data were compiled and analyzed using SPSS version 25.0 (IBM Corp, USA).
Continuous variables were expressed as mean ± standard deviation (SD) and analyzed using ANOVA.
Categorical variables were compared using the Chi-square test or Fisher's exact test as appropriate.
A p-value < 0.05 was considered statistically significant.

Ethical Considerations

The study protocol was approved by the Institutional Ethics Committee. Written informed consent was obtained from all participants after explaining the procedure and possible complications. Confidentiality was maintained throughout the study.

RESULTS

A total of 90 patients were included in the study, with 30 patients in each group — Group A (Classic LMA), Group B (ProSeal LMA), and Group C (I-gel). All patients completed the study, and no case was excluded due to insertion failure or anesthesia-related complications.

Table 1. Demographic and Clinical Characteristics

Parameter	Group A (Classic LMA)	Group B (ProSeal LMA)	Group C (I-gel) | p-value	p-value
Mean Age (years)	40.8 ± 9.3	41.2 ± 8.6	42.1 ± 9.1	0.78
Sex (M/F)	12 / 18	10 / 20	14 / 16	0.64
Mean BMI (kg/m²)	24.6 ± 2.1	25.0 ± 2.5	24.4 ± 2.3	0.72
ASA I / II	20 / 10	22 / 8	21 / 9	0.83
Mean Duration of Surgery (min)	76.2 ± 15.3	74.1 ± 14.7	72.5 ± 13.9	0.66

The three groups were comparable in terms of demographic characteristics and surgical duration, with no statistically significant differences (p > 0.05).

Table 2. Insertion Characteristics and Intraoperative Parameters

Parameter	Group A (Classic LMA)	Group B (ProSeal LMA)	Group C (I-gel) | p-value	p-value
Mean insertion time (sec)	26.8 ± 5.4	28.1 ± 5.7	21.4 ± 4.8	0.001
First attempt success (%)	86.7%	83.3%	96.7%	0.12
Oropharyngeal leak pressure (cm H_2 O)	20.2 ± 3.8	26.5 ± 4.1	23.1 ± 3.5	0.002

Blood staining on device (%)	16.7%	13.3%	3.3%	0.18

The I-gel group showed the shortest mean insertion time, with significantly faster placement compared to Classic and ProSeal LMA (p = 0.001).
ProSeal LMA achieved the highest oropharyngeal leak pressure, indicating superior airway sealing.
Minor blood staining was observed more frequently with Classic LMA but did not reach statistical significance.

Table 3. Postoperative Pharyngolaryngeal Morbidity

Complication	Group A (Classic LMA)	Group B (ProSeal LMA)	Group C (I-gel) | p-value	p-value
Sore throat (1 hr)	9 (30%)	7 (23.3%)	2 (6.7%)	0.03
Sore throat (6 hrs)	7 (23.3%)	5 (16.7%)	1 (3.3%)	0.04
Dysphonia	4 (13.3%)	3 (10%)	1 (3.3%)	0.32
Dysphagia	5 (16.7%)	4 (13.3%)	1 (3.3%)	0.29
Visible oropharyngeal trauma	5 (16.7%)	3 (10%)	1 (3.3%)	0.25

|Postoperative sore throat was significantly less common in the I-gel group compared to Classic and ProSeal LMAs, especially in the early postoperative period ($p < 0.05$).
Other pharyngolaryngeal complications such as dysphonia, dysphagia, and visible trauma were lower in the I-gel group, though not statistically significant.

Table 4. Overall Comparison of Airway Trauma and Morbidity

Outcome	Group A (Classic LMA)	Group B (ProSeal LMA)	Group C (I-gel) | p-value	Trend
Mean Insertion Time	↑	↑	↓	I-gel fastest
Leak Pressure	↓	↑	Moderate	ProSeal best seal
Airway Trauma	↑	Moderate	↓	I-gel least trauma
Postoperative Sore Throat	↑	Moderate	↓	I-gel best tolerated

DISCUSSION

The present study compared the incidence of airway trauma and postoperative pharyngolaryngeal morbidity among patients using three supraglottic airway devices — Classic LMA, ProSeal LMA, and I-gel. The findings demonstrated that the I-gel provided the least postoperative morbidity, faster insertion time, and minimal mucosal trauma, while the ProSeal LMA achieved higher oropharyngeal leak pressure, reflecting superior airway seal integrity.

In this study, the mean insertion time was shortest with I-gel (21.4 ± 4.8 sec), followed by Classic LMA (26.8 ± 5.4 sec) and ProSeal LMA (28.1 ± 5.7 sec). The results are consistent with the observations made by Park et al. 4(2015), who reported that the non-inflatable cuff design and gel-like thermoplastic elastomer material of I-gel facilitate easy insertion without cuff inflation, thereby reducing insertion time and minimizing airway manipulation.

Similarly, Levitan and Kinkle 5(2005) found that I-gel conforms anatomically to the perilaryngeal structures, ensuring rapid placement and effective seal without the need for cuff pressure adjustment.

The oropharyngeal leak pressure (OLP) was significantly higher in the ProSeal LMA group (26.5 ± 4.1 cm H_2 O) compared to I-gel and Classic LMA. This agrees with findings by Brimacombe et al. 2(2000) and Sharma et al. 6(2010), who demonstrated that the presence of a dorsal cuff and drain tube in the ProSeal LMA enhances airway sealing, particularly during positive pressure ventilation. The moderately high OLP observed with I-gel in the present study (23.1 ± 3.5 cm H_2 O) indicates its suitability for both spontaneous and controlled ventilation, corroborating findings by Jindal et al. 7(2009).

Visible blood staining, indicating mucosal trauma, was observed in 16.7% of Classic LMA insertions compared to 13.3% with ProSeal and only 3.3% with I-gel. This lower rate with I-gel parallels results from Alexiev et al. 8(2013), who attributed the reduced trauma to the soft, non-inflatable cuff design that minimizes mucosal compression and vascular compromise. Bhandari et al. 9(2018) also reported significantly less airway trauma with I-gel compared to inflatable LMAs, supporting its advantage in terms of tissue safety.

The incidence of sore throat within the first 6 hours postoperatively was lowest with I-gel (3.3%) compared to Classic LMA (30%) and ProSeal LMA (23.3%). Similar findings were reported by Sood et al.10 (2012) and Raveendran et al.11 (2017), who found that cuff inflation in LMAs contributes to mucosal pressure, leading to postoperative pharyngolaryngeal discomfort. In contrast, I-gel's cuffless design allows for a secure fit without exerting excess pressure, explaining the lower morbidity observed. The incidence of dysphonia and dysphagia was also minimal in the I-gel group, consistent with results by Rai et al.12 (2015), who concluded that the I-gel is associated with significantly fewer airway complications compared to other supraglottic devices.

The overall findings of this study are in agreement with Madhuri et al.13 (2019), who observed that I-gel offers an optimal balance between ease of use, minimal tissue trauma, and sufficient airway seal for short and intermediate-duration procedures. Furthermore, Cook and Howes 14(2011) highlighted the clinical safety of I-gel in terms of insertion stability, reduced trauma, and low incidence of postoperative sore throat in large cohort analyses.

The higher OLP of ProSeal LMA corroborates earlier studies by Brimacombe and Keller (2002), 15suggesting that it remains advantageous in cases requiring controlled ventilation and higher airway pressures.

The choice of an LMA device must balance between ease of insertion, airway seal adequacy, and patient comfort. Based on the results, I-gel appears superior for short elective surgeries, especially where minimal airway morbidity is desired, whereas ProSeal LMA is preferable for procedures requiring better airway sealing and gastric drainage.

Classic LMA, although still widely used, may contribute to higher rates of postoperative sore throat due to cuff-induced mucosal compression, making it less favorable when newer alternatives are available.

Limitations

The present study was limited by its sample size and single-center design. Fiberoptic assessment of laryngeal positioning was not performed, which could have provided objective data on anatomical fit. Long-term complications beyond 24 hours postoperatively were also not evaluated. Future multicentric trials with larger sample sizes and inclusion of varied surgical durations are recommended.

Conclusion:

In conclusion, the I-gel demonstrated the lowest incidence of postoperative pharyngolaryngeal morbidity and minimal airway trauma, while the ProSeal LMA provided the highest oropharyngeal leak pressure and better seal during controlled ventilation. Both devices showed distinct advantages over the Classic LMA, reaffirming the role of second-generation LMAs as safer and more efficient alternatives in airway management.

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