

COMPARATIVE EVALUATION OF AIRWAY EVENTS AND RECOVERY PROFILES IN I GEL VS ENDOTRACHEAL INTUBATION IN VITREORETINAL SURGERIES: AN INSTITUTIONAL BASED STUDY

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ABSTRACT

Background: Airway management during vitreoretinal surgery under general anesthesia should ensure adequate ventilation, hemodynamic stability, minimal airway-related complications, and smooth recovery. Endotracheal intubation is commonly used, but it may be associated with greater airway stimulation, hemodynamic stress response, and postoperative throat discomfort. The I-gel, a second-generation supraglottic airway device, has emerged as a less invasive alternative with the potential advantages of easier insertion, reduced airway trauma, and improved recovery characteristics. **Aim:** To comparatively evaluate airway events and recovery profiles in I gel vs endotracheal intubation in vitreoretinal surgeries. **Materials and Methods:** This hospital-based comparative study was conducted on total of 78 adult patients scheduled for elective vitreoretinal surgery under general anesthesia and allocated into two groups of 39 patients each. Group I underwent airway management with I-gel, while Group II underwent endotracheal intubation. Demographic data, airway placement characteristics, number of attempts, ease of insertion, airway manipulations, intraoperative airway events, hemodynamic parameters, recovery times, and postoperative complications were recorded. Statistical analysis was performed using SPSS version 26.0. Quantitative variables were expressed as mean \pm standard deviation and qualitative variables as frequency and percentage. A p value of less than 0.05 was considered statistically significant. **Results:** Both groups were comparable with respect to age, sex, body weight, ASA status, and baseline hemodynamic parameters ($p > 0.05$). The time for airway placement was significantly shorter in the I-gel group than in the endotracheal intubation group (16.84 ± 3.21 seconds vs 28.63 ± 5.14 seconds; $p < 0.001$). Easy insertion and fewer airway manipulations were observed more frequently with I-gel. Coughing and blood staining on the device were significantly higher in the endotracheal intubation group. Hemodynamic responses after airway insertion, including heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure, were significantly greater in the endotracheal group. Recovery was faster in the I-gel group, with shorter times to spontaneous breathing, eye opening, response to verbal commands, and shorter recovery room stay. Postoperative sore throat, hoarseness of voice, and throat discomfort were also significantly lower in the I-gel group. **Conclusion:** I-gel is a safe and effective alternative to endotracheal intubation for vitreoretinal surgery under general anesthesia. It provides easier and faster airway placement, attenuated hemodynamic response, fewer airway-related complications, and smoother postoperative recovery. I-gel may therefore be considered a preferable airway device in selected patients undergoing vitreoretinal procedures.

INTRODUCTION

Vitreoretinal surgery comprises a group of delicate intraocular procedures performed for disorders such as retinal detachment, vitreous hemorrhage, macular pathology, endophthalmitis, and complex proliferative vitreoretinopathy. Although many posterior segment procedures can be completed under regional techniques, general anesthesia continues to play an important role in selected patients, particularly those with poor cooperation, anxiety, prolonged operative time, anticipated movement, communication difficulty, or contraindications to local blocks. In such cases, the anesthetic technique must provide immobility, optimal oxygenation and ventilation, stable hemodynamics, smooth emergence, and minimal postoperative morbidity. Because the operative field is confined and the surgeon works in close proximity to the face and airway tubing, airway choice becomes especially relevant in ophthalmic surgery. Supraglottic airway devices have therefore attracted growing interest as alternatives to endotracheal intubation, provided that they do not encroach on the surgical field and can maintain effective ventilation throughout the procedure.^[1] Among supraglottic airway devices, the I-gel has gained popularity because of its non-inflatable cuff, anatomically shaped bowl, ease of insertion, gastric drainage channel, and potential to produce less stimulation during placement and removal. In contrast, endotracheal intubation remains the conventional standard when a more definitive airway is desired, but laryngoscopy and tracheal instrumentation are well known to produce sympathetic responses, airway irritation, and postoperative throat symptoms. The balance between these two approaches is clinically important in eye surgery, where coughing, straining, and abrupt hemodynamic surges may adversely affect intraocular dynamics and surgical conditions. The AIRWAYS-2 cluster randomized controlled trial, although conducted in a different clinical setting, reinforced the broader practical distinction between supraglottic airway placement and tracheal intubation by evaluating I-gel-based supraglottic airway management against tracheal intubation in a large population, underscoring the continuing relevance of this comparison in modern anesthetic practice.^[2]

A major reason for interest in I-gel is the expectation of simpler and faster airway establishment with less technical demand than tracheal intubation. Rapid insertion, high first-pass success, and reduced need for airway manipulation are desirable in all anesthetic practice, but they are particularly attractive in short to moderate duration procedures where minimizing airway instrumentation can improve workflow and reduce stimulation. Real-world evidence from a natural experiment during the COVID-19 period showed that the I-gel supraglottic airway achieved higher first-pass success and shorter placement times

than endotracheal intubation in prehospital advanced airway management. Although the environment differs from the elective operating room, these findings support the general concept that I-gel is a practical, efficiently deployable airway device. In elective vitreoretinal surgery, where an uncomplicated induction and atraumatic airway placement are preferred, such performance characteristics may translate into meaningful perioperative advantages.^[3] Another important consideration is perioperative airway morbidity. Even when oxygenation and ventilation are adequate, airway devices differ in the degree of pharyngolaryngeal irritation they produce. Postoperative sore throat, hoarseness, cough, and swallowing discomfort are among the most common airway-related complaints after general anesthesia and may influence patient satisfaction and early recovery. Although supraglottic devices are generally perceived as less traumatic than endotracheal tubes, they are not entirely free from such complications.^[4] The clinical significance of postoperative airway symptoms has been emphasized further by more recent interventional work. In a randomized controlled trial, superior laryngeal nerve block after I-gel use reduced postoperative sore throat, swallowing discomfort, and cough, indirectly demonstrating that these symptoms are frequent enough to warrant active preventive strategies. This has implications for comparative airway research, because any device that inherently reduces pharyngolaryngeal irritation may offer a meaningful postoperative advantage without requiring additional interventions. In ophthalmic surgery, where postoperative comfort, low agitation, minimal coughing, and reduced nausea are particularly valuable, the airway device may influence not only intraoperative conduct but also the quality of recovery in the post-anesthesia period. Thus, assessment of sore throat, hoarseness, and throat discomfort should be regarded as integral endpoints when evaluating I-gel against endotracheal intubation.^[5] Vitreoretinal surgery also presents specific anesthetic concerns that make recovery characteristics especially important. General anesthesia is still required in selected retinal cases, and perioperative events such as hemodynamic instability, postoperative pain, rescue opioid requirement, and postoperative nausea and vomiting may affect overall outcomes and patient safety.^[6]

MATERIALS AND METHODS

This hospital-based comparative study was designed to evaluate airway events and recovery profiles in I gel vs endotracheal intubation in vitreoretinal surgeries. A total of 78 patients scheduled for elective vitreoretinal surgery under general anesthesia were included in the study. Patients were allocated into two groups of 39 each. Group I received airway management with I-gel, while Group II underwent

endotracheal intubation. Adult patients of either sex who were considered suitable for general anesthesia and vitreoretinal surgical procedures were included in the study. Patients with anticipated difficult airway, increased risk of aspiration, severe cardiopulmonary disease, active upper respiratory tract infection, obesity of significant degree, or any contraindication to supraglottic airway device placement were excluded.

Methodology

Pre-anesthetic Evaluation: All patients underwent detailed pre-anesthetic assessment before surgery. This included recording demographic data such as age, sex, body weight, and American Society of Anesthesiologists (ASA) physical status. A thorough clinical examination was carried out, including airway assessment, systemic examination, and relevant laboratory investigations as per institutional protocol. Standard fasting guidelines were followed, and written informed consent was obtained from all participants.

Grouping and Airway Intervention: The enrolled patients were divided into two groups according to the airway device used during surgery. In the I-gel group, an appropriately sized I-gel was inserted after induction of anesthesia. In the endotracheal intubation group, direct laryngoscopy followed by placement of a cuffed endotracheal tube of appropriate size was performed. Correct positioning of the airway device in both groups was confirmed clinically by bilateral chest expansion, auscultation, and capnographic tracing.

Anesthetic Technique: On arrival in the operating room, standard monitoring was instituted for all patients, including electrocardiography, non-invasive blood pressure, pulse oximetry, respiratory rate, and end-tidal carbon dioxide monitoring. Baseline values were recorded before induction. Intravenous access was secured, and all patients were preoxygenated with 100% oxygen. General anesthesia was induced using standard intravenous agents as per institutional practice. After adequate depth of anesthesia was achieved, the assigned airway device was inserted. Anesthesia was maintained with oxygen, nitrous oxide or air, inhalational anesthetic agents, and intermittent or continuous administration of muscle relaxants and analgesics as required. Ventilation was adjusted to maintain adequate oxygenation and normocapnia throughout the procedure.

Study Parameters: The primary outcome measures were airway-related events and recovery profile in both groups. Airway events observed included ease of insertion, number of insertion attempts, time taken for airway device placement, adequacy of airway seal, oxygen desaturation, coughing, laryngospasm, bronchospasm, airway obstruction, gastric insufflation, regurgitation or aspiration, blood staining on the device, and postoperative sore throat. Hemodynamic parameters including heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure, and oxygen saturation were recorded at baseline, after induction, immediately

after airway placement, and at regular intraoperative intervals. Recovery parameters included time to spontaneous breathing, time to removal of airway device, time to eye opening on command, time to response to verbal commands, and duration of stay in the recovery room. Postoperative complications such as nausea, vomiting, throat discomfort, hoarseness of voice, and any respiratory adverse event were also noted.

Assessment of Airway and Recovery Outcomes:

Ease of insertion was assessed by the attending anesthesiologist and categorized based on resistance encountered and requirement of additional maneuvers. The number of attempts required for successful placement of the airway device was documented. Airway manipulations such as jaw thrust, repositioning, or reinsertion were recorded. Recovery was assessed after completion of surgery and discontinuation of anesthetic agents. Patients were observed for return of protective airway reflexes, adequacy of spontaneous ventilation, orientation, and ability to obey commands. Recovery characteristics were compared between the two groups to determine the relative suitability of each airway device in vitreoretinal surgery.

Statistical Analysis: The collected data were entered into Microsoft Excel and analyzed using Statistical Package for the Social Sciences (SPSS) version 26.0. Quantitative variables were expressed as mean and standard deviation, while qualitative variables were presented as frequency and percentage. Comparison of continuous variables between the two groups was performed using the independent samples t-test. Categorical variables were analyzed using the chi-square test or Fisher's exact test wherever applicable. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 78 patients undergoing vitreoretinal surgery under general anesthesia were included in the study. The patients were randomly allocated into two equal groups, with 39 patients in the I-gel group (Group I) and 39 patients in the endotracheal intubation group (Group II).

Demographic and Baseline Characteristics

Table 1 shows the demographic profile and baseline physiological parameters of patients in both study groups. The mean age of patients in the I-gel group was 52.41 ± 11.26 years, while in the endotracheal intubation group it was 53.08 ± 10.94 years. The difference between the two groups was not statistically significant ($p = 0.781$), indicating comparable age distribution. With respect to gender distribution, the I-gel group consisted of 22 males (56.41%) and 17 females (43.59%), whereas the endotracheal intubation group included 21 males (53.85%) and 18 females (46.15%). The difference was not statistically significant ($p = 0.823$). The mean body weight was also comparable between the groups, with 64.72 ± 8.54 kg in the I-gel group and

65.13 ± 9.01 kg in the endotracheal intubation group (p = 0.842). Regarding ASA physical status, 23 patients (58.97%) in the I-gel group and 21 patients (53.85%) in the endotracheal intubation group were classified as ASA I, while 16 patients (41.03%) and 18 patients (46.15%) respectively belonged to ASA II, showing no statistically significant difference (p = 0.651). Baseline hemodynamic parameters were also comparable between the groups. The baseline heart rate was 78.63 ± 7.04 beats/min in the I-gel group and 79.21 ± 6.92 beats/min in the endotracheal intubation group (p = 0.708). Similarly, baseline systolic blood pressure, diastolic blood pressure, and oxygen saturation showed no significant difference (p > 0.05).

Airway Device Insertion Characteristics

Table 2 presents the airway insertion characteristics of both airway devices. The mean time required for airway placement was significantly shorter in the I-gel group (16.84 ± 3.21 seconds) compared with the endotracheal intubation group (28.63 ± 5.14 seconds), and this difference was highly statistically significant (p < 0.001). The first-attempt success rate was higher in the I-gel group (37 patients; 94.87%) compared to the endotracheal intubation group (33 patients; 84.62%), although the difference was not statistically significant (p = 0.135). The need for a second attempt was observed in 2 patients (5.13%) in the I-gel group and 6 patients (15.38%) in the endotracheal intubation group. Regarding ease of insertion, 36 patients (92.31%) in the I-gel group experienced easy insertion, compared with 30 patients (76.92%) in the endotracheal intubation group. Difficult insertion occurred in 3 patients (7.69%) and 9 patients (23.08%), respectively, showing a statistically significant difference (p = 0.047). Additional airway manipulations were also more frequently required in the endotracheal intubation group. Airway manipulation was required in 11 patients (28.21%) in the endotracheal group, compared to 3 patients (7.69%) in the I-gel group (p = 0.018). Similarly, jaw thrust and repositioning of the airway device were more common with endotracheal intubation, although these differences were not statistically significant. An adequate airway seal was achieved in 38 patients (97.44%) in the I-gel group and all 39 patients (100.00%) in the endotracheal group, indicating effective airway maintenance with both devices.

Intraoperative Airway-Related Events

Table 3 compares the incidence of intraoperative airway-related complications between the two groups. Coughing during airway instrumentation was observed in 1 patient (2.56%) in the I-gel group, compared to 6 patients (15.38%) in the endotracheal intubation group, which was statistically significant (p = 0.048). Laryngospasm occurred in 2 patients (5.13%) in the endotracheal intubation group, whereas no cases were reported in the I-gel group, though the difference was not statistically significant (p = 0.153). Similarly, bronchospasm occurred in 1 patient (2.56%) in the endotracheal group, while no

such event occurred in the I-gel group. Episodes of oxygen desaturation were slightly higher in the endotracheal intubation group (3 patients; 7.69%) compared to the I-gel group (1 patient; 2.56%), although the difference was not statistically significant. Airway obstruction occurred in 1 patient (2.56%) in the I-gel group and 2 patients (5.13%) in the endotracheal group, while gastric insufflation was noted in 2 patients (5.13%) in the I-gel group and 1 patient (2.56%) in the endotracheal group. Importantly, blood staining on the airway device, indicating airway trauma, was significantly higher in the endotracheal intubation group (7 patients; 17.95%) compared to the I-gel group (1 patient; 2.56%) with statistical significance (p = 0.023). No cases of regurgitation or aspiration were observed in either group.

Hemodynamic Changes During Airway Placement

Table 4 shows the hemodynamic responses associated with airway instrumentation. The heart rate immediately after airway insertion was significantly higher in the endotracheal intubation group (91.54 ± 8.21 beats/min) compared with the I-gel group (82.46 ± 7.18 beats/min), with high statistical significance (p < 0.001). Similarly, the heart rate at 5 minutes after insertion remained higher in the endotracheal group (86.47 ± 7.54 beats/min) compared to the I-gel group (80.63 ± 6.92 beats/min, p = 0.001). The systolic blood pressure after airway insertion was also significantly elevated in the endotracheal group (136.19 ± 12.34 mmHg) compared to the I-gel group (124.28 ± 10.62 mmHg, p < 0.001). A similar trend was observed for systolic blood pressure at 5 minutes, diastolic blood pressure, and mean arterial pressure, all of which were significantly higher in the endotracheal intubation group. However, oxygen saturation (SpO₂) and end-tidal CO₂ levels remained comparable between the groups with no statistically significant difference (p > 0.05), indicating adequate ventilation and oxygenation in both groups.

Recovery Profile and Postoperative Complications

Table 5 compares the recovery characteristics and postoperative complications between the two groups. The time to spontaneous breathing was significantly shorter in the I-gel group (5.84 ± 1.32 minutes) compared to the endotracheal group (7.46 ± 1.58 minutes, p < 0.001). Similarly, the time to removal of the airway device, time to eye opening, and time to response to verbal commands were all significantly shorter in the I-gel group compared with the endotracheal intubation group (p < 0.001 for all comparisons). Patients in the I-gel group also demonstrated a shorter duration of stay in the recovery room (28.46 ± 5.92 minutes) compared with the endotracheal group (34.13 ± 6.47 minutes, p = 0.001). Regarding postoperative airway complications, sore throat occurred in 2 patients (5.13%) in the I-gel group, compared with 9 patients (23.08%) in the endotracheal group, which was

statistically significant ($p = 0.018$). Hoarseness of voice was also significantly more common in the endotracheal group (15.38% vs 2.56%, $p = 0.048$). Although postoperative nausea and vomiting occurred slightly more frequently in the endotracheal

group (10.26% vs 7.69%), the difference was not statistically significant ($p = 0.688$). Throat discomfort was also significantly higher in the endotracheal intubation group (20.51%) compared with the I-gel group (5.13%, $p = 0.041$).

Table 1: Demographic and Baseline Characteristics of Patients

Variable	I-gel Group (n=39)	Endotracheal Intubation Group (n=39)	p value
Age (years) Mean \pm SD	52.41 \pm 11.26	53.08 \pm 10.94	0.781
Male	22 (56.41%)	21 (53.85%)	0.823
Female	17 (43.59%)	18 (46.15%)	
Weight (kg) Mean \pm SD	64.72 \pm 8.54	65.13 \pm 9.01	0.842
ASA I	23 (58.97%)	21 (53.85%)	0.651
ASA II	16 (41.03%)	18 (46.15%)	
Baseline Heart Rate (beats/min)	78.63 \pm 7.04	79.21 \pm 6.92	0.708
Baseline Systolic BP (mmHg)	121.54 \pm 10.16	122.31 \pm 9.84	0.724
Baseline Diastolic BP (mmHg)	74.13 \pm 7.42	75.08 \pm 7.16	0.561
Baseline SpO ₂ (%)	99.23 \pm 0.64	99.18 \pm 0.69	0.732

Table 2: Airway Device Insertion Characteristics

Parameter	I-gel Group (n=39)	Endotracheal Intubation Group (n=39)	p value
Time for airway placement (seconds) Mean \pm SD	16.84 \pm 3.21	28.63 \pm 5.14	<0.001
First attempt success	37 (94.87%)	33 (84.62%)	0.135
Second attempt required	2 (5.13%)	6 (15.38%)	
Ease of insertion – Easy	36 (92.31%)	30 (76.92%)	0.047
Ease of insertion – Difficult	3 (7.69%)	9 (23.08%)	
Airway manipulation required	3 (7.69%)	11 (28.21%)	0.018
Jaw thrust required	2 (5.13%)	6 (15.38%)	0.135
Repositioning of device	1 (2.56%)	5 (12.82%)	0.089
Adequate airway seal achieved	38 (97.44%)	39 (100.00%)	0.315

Table 3: Intraoperative Airway-Related Events

Airway Event	I-gel Group (n=39)	Endotracheal Intubation Group (n=39)	p value
Coughing	1 (2.56%)	6 (15.38%)	0.048
Laryngospasm	0 (0.00%)	2 (5.13%)	0.153
Bronchospasm	0 (0.00%)	1 (2.56%)	0.313
Oxygen desaturation	1 (2.56%)	3 (7.69%)	0.301
Airway obstruction	1 (2.56%)	2 (5.13%)	0.556
Gastric insufflation	2 (5.13%)	1 (2.56%)	0.556
Regurgitation/Aspiration	0 (0.00%)	0 (0.00%)	–
Blood staining on device	1 (2.56%)	7 (17.95%)	0.023

Table 4: Hemodynamic Changes During Airway Placement

Parameter	I-gel Group (Mean \pm SD)	Endotracheal Intubation Group (Mean \pm SD)	p value
Heart rate after airway insertion (beats/min)	82.46 \pm 7.18	91.54 \pm 8.21	<0.001
Heart rate at 5 min (beats/min)	80.63 \pm 6.92	86.47 \pm 7.54	0.001
Systolic BP after airway insertion (mmHg)	124.28 \pm 10.62	136.19 \pm 12.34	<0.001
Systolic BP at 5 min (mmHg)	122.36 \pm 9.41	131.21 \pm 11.02	<0.001
Diastolic BP after airway insertion (mmHg)	76.15 \pm 8.03	83.72 \pm 9.41	0.001
Mean arterial pressure (mmHg)	92.19 \pm 7.64	101.21 \pm 8.83	<0.001
SpO ₂ (%)	99.21 \pm 0.68	98.97 \pm 0.71	0.142
End-tidal CO ₂ (mmHg)	35.72 \pm 2.14	36.03 \pm 2.21	0.541

Table 5: Recovery Profile and Postoperative Complications

Parameter	I-gel Group (n=39)	Endotracheal Intubation Group (n=39)	p value
Time to spontaneous breathing (min) Mean \pm SD	5.84 \pm 1.32	7.46 \pm 1.58	<0.001
Time to removal of airway device (min)	6.21 \pm 1.48	8.19 \pm 1.76	<0.001
Time to eye opening (min)	7.21 \pm 1.67	9.63 \pm 2.04	<0.001
Time to response to verbal commands (min)	8.36 \pm 1.84	10.81 \pm 2.29	<0.001
Duration of stay in recovery room (min)	28.46 \pm 5.92	34.13 \pm 6.47	0.001
Postoperative sore throat	2 (5.13%)	9 (23.08%)	0.018
Hoarseness of voice	1 (2.56%)	6 (15.38%)	0.048
Nausea/Vomiting	3 (7.69%)	4 (10.26%)	0.688
Throat discomfort	2 (5.13%)	8 (20.51%)	0.041

DISCUSSION

The two study groups in the present series were well matched at baseline, which strengthens the internal validity of the comparison. The mean age was 52.41 ± 11.26 years in the I-gel group and 53.08 ± 10.94 years in the endotracheal intubation group, with comparable sex distribution, body weight, ASA grade, baseline heart rate, blood pressure, and oxygen saturation. This suggests that the subsequent differences observed in airway events and recovery were more likely related to the airway device rather than preoperative imbalance. A similar baseline comparability was reported by Ahirwar et al (2023), who found no significant intergroup difference in age, weight, height, or sex distribution between their endotracheal tube and I-gel groups undergoing laparoscopic cholecystectomy; their mean age was 44.47 ± 8.56 years in the endotracheal group and 40.40 ± 7.40 years in the I-gel group, and mean weight was 65.37 ± 5.71 kg versus 63.77 ± 6.67 kg, respectively.^[7]

The present study showed that I-gel was associated with favorable insertion characteristics. Time for airway placement was markedly shorter with I-gel than with endotracheal intubation (16.84 ± 3.21 seconds vs 28.63 ± 5.14 seconds; $p < 0.001$), and first-attempt success was also numerically higher (94.87% vs 84.62%). Easy insertion was achieved in 92.31% of I-gel cases, while only 7.69% were categorized as difficult. These findings are in line with the early clinical experience of Kannaujia et al (2009), who reported a 90.00% first-attempt success rate with I-gel, a median insertion time of 11 seconds, second-attempt requirement in 10.00% of patients, and only limited need for additional maneuvers, namely increased depth of insertion in 8.00% and jaw thrust/chin lift in 4.00%. The slight difference in absolute insertion times between the two studies may reflect differences in study population, anesthetic technique, operator experience, and the fact that our comparison was against endotracheal intubation rather than isolated evaluation of I-gel performance; however, the overall message remains consistent that I-gel is a rapidly insertable supraglottic device.^[8]

The superiority of I-gel with respect to insertion speed in the present study also compares well with direct head-to-head trials against endotracheal intubation. In our study, airway placement time was reduced by nearly 12 seconds with I-gel, and the need for a second attempt was lower (5.13% vs 15.38%), with fewer cases requiring difficult placement. Badheka et al (2015) similarly observed significantly faster insertion with I-gel than with endotracheal tube in adult laparoscopic surgeries, with mean insertion times of 11.28 ± 2.91 seconds and 14.33 ± 1.56 seconds, respectively. They also reported first-attempt I-gel placement in 25 of 30 patients (83.40%), while the remaining 16.60% required a second attempt. Although the absolute intubation time in our endotracheal group was longer than in the Badheka study, likely due to differences in case type

and methodology, both studies consistently demonstrate that I-gel insertion is quicker and operationally simpler than endotracheal intubation.^[9] Ease of insertion and the need for airway manipulation further favored I-gel in the present study. Airway manipulation was required in only 7.69% of I-gel cases compared with 28.21% of endotracheal intubations, and jaw thrust or repositioning was also less common in the I-gel group. Adequate airway seal was achieved in 97.44% of I-gel patients, showing that easier placement did not compromise functional airway maintenance. Panneer et al (2017), in patients undergoing elective cesarean section under general anesthesia, also found easier airway management with I-gel and noted that 8 of 40 patients in the endotracheal group had difficult intubation, while insertion times and ventilation were otherwise comparable. Importantly, they concluded that I-gel offered easier insertion with less hemodynamic disturbance and a lower incidence of airway morbidity. Taken together with our results, these findings suggest that I-gel can provide a practical advantage in routine elective surgery, including ophthalmic procedures, where repeated manipulations and sympathetic stimulation are undesirable.^[10]

With respect to intraoperative airway-related events, the present study showed a lower incidence of coughing in the I-gel group (2.56% vs 15.38%; $p = 0.048$), no laryngospasm or bronchospasm in the I-gel arm, and less blood staining on the device (2.56% vs 17.95%; $p = 0.023$), indicating less airway irritation and trauma. These findings are clinically important in vitreoretinal surgery, where coughing and straining can adversely affect intraocular conditions. Guerrier et al (2016), in a randomized trial of keratoplasty under general anesthesia, observed an even more striking difference in coughing at extubation and after extubation, with coughing occurring in 3 of 55 patients (5.00%) in the I-gel group versus 40 of 55 patients (73.00%) in the tracheal tube group ($p < 0.001$). Although the absolute cough incidence in our endotracheal group was lower than in keratoplasty patients, both studies point in the same direction: I-gel is associated with smoother emergence and less airway stimulation than tracheal intubation, which is particularly desirable in ocular surgery.^[11]

Postoperative pharyngolaryngeal morbidity in the present study also favored I-gel. Sore throat occurred in 5.13% of patients with I-gel compared with 23.08% after endotracheal intubation, hoarseness of voice in 2.56% versus 15.38%, and throat discomfort in 5.13% versus 20.51%, all indicating less postoperative airway irritation with I-gel. Ning et al (2022), in patients undergoing thyroid surgery, reported that postoperative sore throat itself was not significantly reduced with I-gel compared with endotracheal tube at 1, 6, 24, and 48 hours; for example, sore throat at 1 hour was 61.20% in the I-gel group and 51.00% in the endotracheal group, and at 6 hours it was 75.50% versus 83.70%. However,

the same study found postoperative hoarseness to be significantly lower with I-gel, being 30.60% versus 69.40% at 1 hour and 63.30% versus 83.70% at 6 hours.^[12] A major finding of the present study was the significantly attenuated hemodynamic response associated with I-gel. Immediately after airway insertion, heart rate was 82.46 ± 7.18 beats/min in the I-gel group versus 91.54 ± 8.21 beats/min in the endotracheal group, and systolic blood pressure was 124.28 ± 10.62 mmHg versus 136.19 ± 12.34 mmHg. At 5 minutes, heart rate and systolic blood pressure remained significantly lower in the I-gel group, and mean arterial pressure was also lower (92.19 ± 7.64 mmHg vs 101.21 ± 8.83 mmHg). These results are strongly supported by Ismail et al (2011), who demonstrated that i-gel insertion did not increase intraocular pressure, whereas endotracheal tube insertion increased intraocular pressure from 11.6 ± 1.6 to 16.5 ± 1.7 mmHg ($p < 0.001$), along with significant rises in heart rate, systolic blood pressure, and diastolic blood pressure.^[13]

The ophthalmic relevance of these findings is reinforced by studies performed specifically in eye surgery. In our patients undergoing vitreoretinal procedures, oxygen saturation and end-tidal carbon dioxide were maintained equally well in both groups, but the I-gel group had less hemodynamic stress and a trend toward fewer postoperative nausea and vomiting episodes (7.69% vs 10.26%), although this difference was not significant. Allahyari et al (2021), in children undergoing strabismus surgery, similarly reported that I-gel had less impact on stress responses than both endotracheal tube and laryngeal mask airway, and no patient in the I-gel group experienced postoperative nausea and vomiting, whereas 5 patients in the endotracheal tube group did, though the difference was not statistically significant. Their study also showed that mean arterial pressure, intraocular pressure, and heart rate were more stable in the I-gel group during the post-insertion period.^[14] Recovery was clearly faster with I-gel in the present study, as shown by shorter times to spontaneous breathing, airway device removal, eye opening, response to verbal commands, and a shorter stay in the recovery room (28.46 ± 5.92 minutes vs 34.13 ± 6.47 minutes). These findings indicate a smoother and quicker emergence profile with less airway stimulation. A related observation was reported by Lai et al (2017), who found comparable ventilation between I-gel and endotracheal tube during laparoscopic pneumoperitoneum and Trendelenburg position, with similar leak fractions in the operative position (6.20% vs 6.38%, $p = 0.883$), no aspiration in either group, and significantly less postoperative sore throat in the I-gel group (3 patients vs 9 patients, $p = 0.038$).^[15]

CONCLUSION

In conclusion, I-gel proved to be a safe and effective alternative to endotracheal intubation for airway

management in patients undergoing vitreoretinal surgery under general anesthesia. It was associated with easier and faster insertion, fewer airway-related complications, reduced hemodynamic stress response, and smoother postoperative recovery. Patients managed with I-gel also experienced lower incidences of sore throat, hoarseness, and throat discomfort. Therefore, I-gel may be considered a preferable airway device in selected vitreoretinal surgical patients where stable intraoperative conditions and rapid recovery are desired.

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