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A Prospective Randomized Comparison of Standard, Rotational, and Triple Airway Maneuvers for I-Gel Insertion in Anaesthetized, Paralyzed Adults

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Abstract | **Background:** This study was conducted to compare the success rates of three different techniques of i-gel insertion standard, rotational, and triple airway maneuver in anaesthetized, paralyzed adult patients. **Materials and Methods:** This prospective randomized trial included 150 patients and was conducted in the Department of Anaesthesia, Dr. R.P.G.M.C., Kangra at Tanda during the study period. Patients were randomly allocated into three groups (n = 50 each): Group A (standard technique), Group B (rotational technique), and Group C (triple airway maneuver). The primary outcome measure was the first-attempt success rate of i-gel insertion. Secondary outcomes included insertion time and the number of insertion attempts. **Results:** In Group A, the first-attempt success rate was 86%, with 14% of patients requiring a second attempt. In Group B, the first-attempt success rate was 96%, while 4% required a second attempt. In Group C, the first-attempt success rate was 94%, with 6% requiring a second attempt. Although the success rate was higher in the rotational and triple airway maneuver groups compared to the standard group, the difference was not statistically significant ($p = 0.149$), indicating that all three techniques were comparable in terms of first-attempt success. The mean number of insertion attempts was significantly higher in the standard group compared to the rotational group (1.30±0.46 vs. 1.04±0.19; $p<0.0001$) and the triple airway maneuver group (1.30±0.46 vs. 1.06±0.24; $p = 0.001$). The mean insertion time was 11.76±4.92 seconds in the standard group, 10.42±2.89 seconds in the rotational group, and 8.50±2.44 seconds in the triple airway maneuver group. Insertion time was significantly shorter in the triple airway maneuver group compared to the standard group ($p<0.0001$) and the rotational group ($p = 0.027$). **Conclusion:** The triple airway maneuver technique showed a higher first-attempt success rate, shorter insertion time, and fewer insertion attempts compared to the standard and rotational techniques for i-gel insertion in anaesthetized, paralyzed adult patients.

Key Words I-gel insertion, Success rate, Standard technique, Rotational technique, Triple airway maneuver, Anaesthetized paralyzed adults

INTRODUCTION

The i-gel is a well-established alternative to tracheal intubation in patients undergoing elective surgical procedures and is also widely used as an effective device for emergency airway management. Proper positioning of the device is crucial to ensure adequate oxygenation and effective ventilation.

Supraglottic airway devices (SADs) are commonly classified into first-generation and second-generation devices. First-generation SADs are simple airway tubes that lack specific design features to minimize the risk of pulmonary aspiration of gastric contents. In contrast, second-generation SADs incorporate additional features that enhance positive pressure ventilation (PPV) and reduce the risk of aspiration [1].

The i-gel (Intersurgical, Wokingham, UK) is a novel second-generation supraglottic airway device. It is characterized by a soft, anatomically shaped cuff that

provides an effective airway seal without the need for cuff inflation. The device is considered easy to insert due to its low coefficient of friction when adequately lubricated and the absence of an inflatable cuff. An increasing number of studies have evaluated the clinical performance of the i-gel, with most reporting favorable outcomes. First-attempt insertion success rates exceed 85% and approach nearly 100% after three attempts [2].

Previous studies have reported that the first-attempt success rate of i-gel insertion ranges from 78% to 93%, with overall success rates after two attempts varying between 84% and 100% [3]. It has also been demonstrated that the rotational technique yields a higher first-attempt success rate with less pharyngeal mucosal trauma compared to the standard insertion technique for ProSeal™ laryngeal mask airway (LMA) insertion [4]. Furthermore, in paralyzed patients, insertion of LMA using the triple airway maneuver has been shown to provide a wider pharyngeal space and reduce the incidence of epiglottic downfolding compared with the standard insertion method [5].

To date, no studies have evaluated the efficacy of rotational and triple airway maneuver techniques specifically for i-gel insertion based on available web-based literature. The present study hypothesizes that the rotational and triple airway maneuver techniques reduce tongue folding by minimizing resistance between the device and the tongue, thereby facilitating smooth advancement of the i-gel into the posterior hypopharynx when compared with the standard technique. Therefore, it is clinically relevant to compare the effectiveness of these three insertion techniques in terms of success rate, insertion time, and number of attempts.

Aim and Objectives

To compare the success rate of three different techniques of i-gel insertion—standard, rotational, and triple airway maneuver—in anaesthetized, paralyzed adult patients.

MATERIALS AND METHODS

Study Area

The study was conducted in the Department of Anaesthesiology, Dr. R.P.G.M.C., Kangra at Tanda, Himachal Pradesh.

Study Population

After obtaining approval from the Institutional Ethics Committee, this prospective randomized study was carried out on 150 patients scheduled to undergo surgery under general anaesthesia with i-gel used as the primary airway device. Patients were equally allocated into three groups, with 50 patients in each group.

Study Duration

Following approval from the Institutional Ethics Committee (IEC), the study was conducted over a period of 12 months, which included data collection, organization, analysis, interpretation, and presentation.

Sample Size

All patients fulfilling the inclusion criteria during the study period were enrolled. A total of 150 patients were evaluated after randomization, with 50 patients in each of the three study groups.

Inclusion Criteria

- Patients aged between 18 and 65 years
- American Society of Anesthesiologists (ASA) physical status I and II
- Body mass index (BMI) between 18.5 and 29.9 kg/m^2

Exclusion Criteria

- Duration of surgery exceeding 4 hours
- Mouth opening less than 2.5 cm
- Presence of sore throat
- Any contraindication to supraglottic airway device placement (e.g., facial trauma or deformity)
- Pregnancy
- Patients at risk of aspiration (e.g., gastroesophageal reflux disease, previous history of postoperative nausea and vomiting, hiatus hernia)
- Refusal to provide informed consent

Study Design

The study commenced after approval from the institutional scientific review committee and ethics committee. This was a prospective randomized study. Patients were randomly allocated into three groups using computer-generated random numbers: Group A (standard technique, n = 50), Group B (rotational technique, n = 50), and Group C (triple airway maneuver technique, n = 50). The randomization sequence was concealed in opaque sealed envelopes, which were opened at the time of induction of general anaesthesia by an individual not involved in the study and subsequently handed over to the anaesthesia team.

Methodology

Standard ASA fasting guidelines were followed for all patients. Premedication consisted of oral alprazolam 0.25 mg administered the night before surgery. Upon arrival in the operating room, standard monitoring including electrocardiography (ECG), non-invasive blood pressure (NIBP), and pulse oximetry (SpO_2) was applied.

Following preoxygenation with 100% oxygen for three minutes, anaesthesia was induced using intravenous propofol (2 mg/kg), fentanyl (2 µg/kg), and atracurium (0.5 mg/kg). I-gel insertion was performed four minutes after administration of atracurium using one of the three study techniques. The size of the i-gel was selected based on patient body weight: size 3 for 30–60 kg, size 4 for 50–90 kg, and size 5 for patients weighing more than 90 kg.

Group A (Standard Technique)

In Group A (n = 50), the i-gel was inserted using the standard technique as described by Brain.

Group B (Rotational Technique)
In Group B (n = 50), the i-gel was inserted using the rotational technique. The device was introduced back-to-front, similar to a Guedel airway, and then rotated counterclockwise through 180° while advancing into the hypopharynx.

Group C (Triple Airway Maneuver Technique)
In Group C (n = 50), the i-gel was inserted using the triple airway maneuver technique as described by Kuvaki *et al*., which involved the following steps:

- Holding the i-gel at the middle third between the index finger and thumb of the dominant hand
- Performing the triple airway maneuver comprising head extension, mouth opening, and jaw thrust
- Pressing the i-gel directly against the hard palate and advancing it along the posterior palatopharyngeal curve using the index finger and thumb
- Adjusting the index finger position to apply upward traction on the lower surface of the tube when reaching the oral cavity
- Advancing the i-gel into its final position while holding the shaft

After i-gel insertion, anaesthesia was maintained using isoflurane in a mixture of oxygen and nitrous oxide. All insertions were performed by an anaesthesiologist with experience of at least 50 prior i-gel insertions using the standard technique. Correct placement of the i-gel was confirmed by the presence of a square-wave capnography trace and absence of an audible air leak at peak airway pressures ≥ 10 cm H_2O during manual ventilation. If an air leak occurred at peak airway pressures<10 cm H_2O, the attempt was considered a failure, and reinsertion was performed using the same technique. The number of insertion attempts was recorded.

Insertion time was defined as the time from picking up the i-gel until the initiation of mechanical ventilation. A maximum of two insertion attempts were permitted, with 60 seconds allowed for each attempt. The interval between attempts was included in the total insertion time.

At the end of the procedure, neuromuscular blockade was reversed with neostigmine (0.05 mg/kg) and glycopyrrolate (0.01 mg/kg). The i-gel was removed once the patient regained spontaneous breathing and was able to open their eyes on verbal command.

The primary outcome measure was the first-attempt insertion success rate. Secondary outcome measures included insertion time and number of insertion attempts.

Statistical Analysis
Data were recorded in Microsoft® Excel 2019 and analyzed using SPSS version 21.0 (IBM, USA). Categorical variables were expressed as frequencies and percentages and analyzed using the Chi-square test. Continuous variables were expressed as mean±standard deviation and compared using one-way analysis of variance (ANOVA). A p-value<0.05 was considered statistically significant.

RESULTS

The present study compared the success rates of three different i-gel insertion techniques—standard, rotational, and triple airway maneuver—in anaesthetized, paralyzed adult patients. A total of 150 patients were enrolled from the Department of Anaesthesiology, Dr. R.P.G.M.C., Kangra at Tanda, and were equally distributed into three groups with 50 patients each: Group A (standard technique), Group B (rotational technique), and Group C (triple airway maneuver).

There was no statistically significant difference in mean age among the three groups (p = 0.422). The male-to-female ratio was 0.4:1 in the standard group, 0.7:1 in the rotational group, and 0.6:1 in the triple airway maneuver group, with no significant difference in gender distribution between the groups (p = 0.466). Similarly, no significant differences were observed in body weight (p = 0.395), height (p = 0.321), or body mass index (BMI) (p = 0.660) among the three groups (Table 1).

Regarding airway assessment, 70% of patients in the standard group had Modified Mallampati Score (MPS) class I, 20% class II, 6% class III, and 4% class IV. In the rotational group, 62% of patients had MPS class I, 34% class II, and 4% class III. In the triple airway maneuver group, 68% of patients had MPS class I, 26% class II, 4% class III, and 2% class IV. There was no statistically significant difference in MPS distribution among the three groups (p = 0.623).

In the standard group, 86% of patients belonged to ASA physical status I and 14% to ASA II. Similarly, in the rotational group, 74% were ASA I and 26% were ASA II, while in the triple airway maneuver group, 76% were ASA I and 24% were ASA II. The distribution of ASA physical status was comparable among the three groups, with no statistically significant difference (p = 0.292) (Table 2).

The first-attempt success rate of i-gel insertion was 86% in the standard group, 96% in the rotational group, and 94% in the triple airway maneuver group. Second-attempt success rates were 14%, 4%, and 6% in the standard, rotational, and triple airway maneuver groups, respectively. Although higher first-attempt success rates were observed in the rotational and triple airway maneuver groups compared to the standard group, the difference in success rate distribution among the three groups was not statistically significant (p = 0.149). Therefore, all three techniques were comparable in terms of first-attempt insertion success rate.

Among the 12 patients who required a second insertion attempt, 58% belonged to the standard group, 17% to the rotational group, and 25% to the triple airway maneuver group, indicating a higher incidence of second-attempt insertion in the standard technique compared to the other two techniques (Table 3).

Table 1: Distribution of Participants According to Socio-Demographic Variables

Variables	Group-A (n = 50)	Group-B (n = 50)	Group-C (n = 50)	p-value#
Age (Years)	40.24±12.54	42.18±13.02	43.54±12.16	0.422
Gender				
Male	16 (32%)	22 (44%)	19 (38%)	0.466
Female	34 (68%)	28 (56%)	31 (62%)	
Anthropometric Characteristics				
Weight (kg)	60.62±7.45	61.84±7.08	62.46±5.90	0.395
Height (cm)	154.96±6.52	157.04±7.85	156.58±7.21	0.321
BMI (kg/m^2)	25.20±2.55	25.09±2.44	25.53±2.49	0.660

Table-2: Distribution of Participants According to Mallampati Score and ASA Class

Variables	Group-A (n = 50)	Group-B (n = 50)	Group-C (n = 50)	p-value#
MPs Grade				
MPS-1	35 (70%)	31 (62%)	34 (68%)	0.623
MPS-2	10 (20%)	17 (34%)	13 (26%)	
MPS-3	3 (6%)	2 (4%)	2 (4%)	
MPS-4	2 (4%)	0	1 (2%)	
ASA Class				
Class-1	43 (86%)	37 (74%)	38 (76%)	0.292
Class-2	7 (14%)	13 (26%)	12 (24%)	

Table 3: Success Rate in First Attempt Of I-Gel Insertion

Success Rate	Group-A (n = 50)	Group-B (n = 50)	Group-C (n = 50)	p-value#
First attempt	43 (86%)	48 (96%)	47 (94%)	0.149
Second attempt	7 (14%)	2 (4%)	3 (6%)	
Number of attempts	1.3±0.46	1.04±0.19	1.06±0.24	<0.0001
Insertion time (sec)	11.76±4.92	10.42±2.89	8.50±2.44	<0.0001

DISCUSSION

Though tracheal intubation is the gold standard method for maintaining a patent airway during anaesthesia, the I-Gel is a useful alternative to tracheal intubation. It has been used for routine elective anaesthesia and has also been effective in pre-hospital emergency airway management [6].

Insertion of supraglottic airways using the standard technique is not always successful. Previous studies have reported varied success rates for the first attempt at inserting supraglottic airways [7]. Various techniques have been described to ensure a high successful insertion rate. Among the alternative methods, the rotation technique derived from the back-to-front insertion technique of the Guedel airway and consists of inserting the device with a 90- or 180-degree rotation and then rotating it to the final position as it enters the hypopharynx. There are very few studies that have shown improvement in successful placement of I-Gel by rotational or triple airway manoeuvre technique. But no randomised controlled trial comparing all three techniques is conducted till now.

These three groups were compared with respect to primary outcome of success rate in first attempt of I-Gel insertion and secondary outcome that were insertion time and number of insertion attempts.

In this study, the differences in age, gender, weight, height and BMI among all three groups were statistically not significant. Hence these three groups were comparable with respect to demographic profile. In our study, these three groups were comparable in terms of ASA and MPS as the difference was statistically insignificant.

In our study, in standard group first attempt success rate was 86 % and second attempt success rate was 14%. In rotational group, first attempt success rate was 96% and 4% in second attempt and lastly triple airway manoeuvre group first attempt success rate was 94% and 6% in second attempt. Though success rate was higher in rotational and triple airway group than standard group, there was no significant difference of success rate distribution between three groups (p = 0.149). Hence, all the three groups were comparable for first attempt success rate. We also found that out of 12 patients with second attempt, 58% were in standard group, 17% in rotational group and 25% in triple airway group, showing rate of second attempt was higher in the standard group.

In the study by Bhardwaj *et al.*, first attempt success rate was 82.2%, 89% and 84.4% with standard, reverse and rotational technique of I-Gel insertion in anaesthetised adults, which was statistically not significant (p-value = 0.07) [8]. In the study by Baran *et al.*, successful insertion at the first attempt was 78% and 92% for the standard and triple airway group respectively, which was statistically not significant (p = 0.092) [9]. In the study conducted by Eglen *et al.*, they compared three different insertion techniques of the LMA-Unique in adults [5]. Patients were randomly allocated to the standard, rotational and triple airway manoeuvre (triple) group. Successful insertion at the first attempt was 88.3%, 78.3% and 88.3% for the standard, the rotational and the triple group. All the three groups were comparable in first attempt success rate (p-value = 0.2) [5]. In the study done by Sharda *et al.*, they hypothesized that the I-Gel can be inserted with

relative ease in a reversed manner just like a Guedel's airway in comparison to standard technique of I-Gel insertion. Better success rate of the first attempt insertion was achieved using the reversed technique in comparison to standard technique (96% vs. 86%), but it was not statistically significant (p = 0.08) [10].

Our study had similar results like the studies of Bhardwaj *et al.* [8], Baran *et al.* [9], Eglen *et al.* [5] and Sharda *et al.* [10], showing first attempt success rate was statistically not significant and was comparable in all the three groups.

In our study, number of insertion attempts were significantly higher in standard group in comparison to rotational group (1.3±0.46 vs. 1.04±0.19; p-value<0.0001) and triple airway manoeuvre group (1.3±0.46 vs. 1.06±0.24; p-value = 0.001).

In the study conducted by Muneer *et al.*, they compared standard and rotational technique of I-Gel insertion, number of attempts in standard group (1.28±0.5) was significantly higher than rotational group (1.1±0.3) (p-value = 0.04) [11].

Our study had similar results to this study, showing number of attempts were significantly higher in standard group than both the groups. This might be because of obstruction of passage from the oral cavity to the pharynx due to folding of tongue and due to increase resistance in between I-Gel and pharyngeal wall in standard technique.

In our study, insertion time in standard group was 11.76±4.92 sec, in rotational group it was 10.42±2.89 sec and 8.50±2.44 sec in triple airway manoeuvre group. On comparison, insertion time was significantly shorter in triple airway manoeuvre group in comparison to standard group (8.50±2.44 sec vs 11.76±4.92 sec; p-value <0.0001) and significantly shorter in comparison with rotational group (8.50±2.44 sec vs 10.42±2.89 sec; p-value = 0.027).

Bhardwaj *et al.* compared standard (group I), reverse (group II) and rotational (group III) techniques of I-Gel placement in terms of insertion characteristics and success rate. Mean time of insertion was 18.04±5.65 s, 15.00±5.72 s and 16.12±5.84 s for groups I, II and III respectively. Time taken for insertion was shortest and significantly lower (p-value = 0.048) for group II compared to group I. Insertion time was comparable between rest of groups [8]. Baran *et al.* compared the standard technique with the triple airway manoeuvre technique of I-Gel insertion in terms of successful device insertion time and first-attempt success. Time for successful insertion was significantly shorter in the triple group (20±7 s) than with the standard group (32±11 s; p-value <0.001) [9]. In the study conducted by Eglen *et al.*, they compared standard, rotational and triple airway manoeuvre technique for LMA insertion, they concluded that the time for successful insertion was significantly shorter in triple airway manoeuvre group (8.63s) when compared with standard technique (11.78 s) (p-value = 0.0001) and rotational technique (11.57 s) (p-value = 0.001). Standard and rotational technique groups did not differ from each other (p-value>0.05) [5]. In the study conducted by Kim *et al.*, they compared two techniques for I-Gel insertion- standard group and rotational group. The mean (SD) insertion time was longer in standard group than rotational group, but it was statistically insignificant 26.9 (14.5) s vs. 22.4 (10.2) s (p-value = 0.016) [12]. In the meta-analysis by Park *et al.*, they compared the rotational and standard techniques for inserting supraglottic airways. Device insertion was completed faster with the rotation technique in comparison to standard technique (mean difference: -4.6 seconds; 95% CI: -7.37 to -1.74; p-value = 0.002) [13].

Our study had results similar to the study done by Baran *et al.* and Eglen *et al.* showing insertion time was significantly shorter in triple airway manoeuvre technique in comparison to standard and rotational technique [5,9]. This might be due to wider pharyngeal space and decrease in the incidence of epiglottic downfolding leading to smooth advancement of I-Gel in triple airway maneuver technique.

CONCLUSION

To conclude, this study demonstrated that the triple airway maneuver and the rotational technique both are acceptable alternative to standard technique of I-Gel insertion in adults. Considering the possibility of infection and trauma to the operator due to intraoral manipulation, triple airway technique and rotational technique are advantageous. The triple airway maneuver technique shows higher overall success rate in first attempt of insertion, shorter insertion time, lesser insertion attempts in comparison to rotational and standard techniques of I-Gel insertion.

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