

IS I-GEL A NEW REVOLUTION AMONG SUPRAGLOTTIC AIRWAY DEVICES?

- A Comparative Evaluation -

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Summary

In an attempt to reduce the pressor responses subsequent to laryngoscopy and intubation in normotensive anesthetized paralysed patients, the hemodynamic effects of three supraglottic devices were compared: I-gel, SLIPA, and LMA, The I-gel produced the least hemodynamic changes.

Keywords: LMA, I-gel, SLIPA, Hemodynamic changes.

Introduction

Discovery of endotracheal intubation has not only made administration and maintenance of anesthesia easy, but has also helped in saving several lives. Endotracheal intubation is usually carried out under direct vision made possible by direct laryngoscopy, which in healthy patient, may not lead to serious complications.

Laryngoscopic stimulation of oropharyngolaryngeal structures may be an important factor in the hemodynamic stress response associated with tracheal intubation^{1,2}. The sudden rise in blood pressure may cause left ventricular failure, myocardial ischemia or cerebral hemorrhage in the presence of coronary or cerebral atheroma or hypertension. In these conditions it can even become life threatening³.

Attempts to prevent the pressor response to laryngoscopy and intubation are being made. By using alternative guiding devices such as fiberoptic scope⁴, light wand⁵ or laryngeal mask airway⁶ (LMA), the incidence pressor response may be reduced⁷.

In recent years, the I-gel, another supraglottic airway device with some distinctive features, has been devised that sets it apart from other competitors⁸. The I-gel is competing to be the easiest and simplest device.

The aim and objectives of the present study is to evaluate and compare the hemodynamic changes during insertion of supraglottic devices LMA, SLIPA or I-gel and to report on the technic of airway instrumentation that is less likely to produce hemodynamic changes in patients undergoing elective surgery.

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Materials and Methods

The study was conducted in the Department of Anaesthesiology & ICU, HIMS, Dehradun from October 1, 2007 to March 31, 2008. Following approval of the Hospital Committee and the fully informed consent of patients, a prospective study was conducted on 75 patients of either sex, 20-70 years, ASA I and II, scheduled to undergo elective surgical procedures under general anesthesia. Exclusion criteria consisted of patients with ASA III, IV, blood pressure $\geq 150/100$ mmHg, history of sore throat within the previous 10 days, full stomach, patients scheduled for head, neck surgery and patients with potential difficult airway, MP grade IV.

After a detailed history, general and systemic examinations and airway assessment (using MP classification), opening a sealed envelop, the 75 patients were divided into three equal groups (25 each) to receive either one of three supraglottic devices: I-gel (Group I), SLIPA (Group II) or LMA (Group III).

All patients were kept fasting for 8 hours before surgery and all received diazepam tab. 10 mg at night and 5 mg at 6 am in the morning of surgery.

After confirming consent and fasting status, an iv line was established with 18G cannula and ringer lactate was started. All the monitors were placed and baseline reading of HR, BP, SpO₂, ECG were noted. The patient was in supine position and head was placed on a pillow 7 cm in height.

Following, preoxygenation with 100% oxygen, patients were induced with propofol 1.5-2.5 mg/kg slowly and vecuronium 0.1 mg/kg facilitate intubation. All three supraglottic devices were introduced using the standard techniques by a single anesthesiologist who is noted to possess considerable experience in all three techniques (approximate number of uses, I-gel >150; SLIPA >150; and LMA >200).

Maintenance of anesthesia was done with 66% N₂O in oxygen, muscle relaxant vecuronium 0.015 mg/kg and morphine 0.1 mg/kg. Surgeons were requested not to clean, drape or position patient till 5 minutes after placement of supraglottic devices so as to avoid any stimuli likely to interfere with the findings.

The following data were collected by an blinded observer:

(a) number of intubation attempts

(b) intubation time (time from insertion of the intubating device into the mouth, to time of confirmation by mechanical ventilation)

(c) mucosal trauma (blood detected on the intubation device after use)

(d) lip or dental injury

(e) episodes of hypoxia during intubation (SpO₂ <95%)

(f) serial heart rate, arterial pressure, SpO₂ and ECG recording were done at the time of insertion, 1, 3 and 5 minutes following insertion thereafter at the time of removal and then 1 min after removal.

At end of surgery neuromuscular block was reversed with neostigmine 50 µg/kg and gentle assisted ventilation was done to allow patient to breathe spontaneously considering the extubation criteria. When reflexes were restored and the patient was able to open mouth on command, the devices were removed. Oral suctioning was done and the airway patency and respiratory depth were confirmed.

Statistical analysis was done using two sample 't' test and by chi-square test.

Results

There were no differences in demographic and airway assessment data among the three groups. The number of intubation attempts was similar among groups, but intubation time was significantly longer in the LMA group (Table 1).

Table 1
Patients' Characteristics, Airway Assessment,
and Intubation Data

	Group I (I-gel)	Group II (SLIPA)	Group III (LMA)
Age: Mean \pm SD	38.52 \pm 8.89	38.04 \pm 8.71	38.24 \pm 9.76
Range	22-53	26-57	20-53
Sex			
Male: Female:	13:12	14:11	14:11
ASA Grade I:II	19:06	20:05	20:05
MP Grade I:II	13:12	17:08	16:09
No. of Attempts I:II	24:1 (96%: 4%)	21:4	23:2
Duration of intubation Mean \pm SD	3.48 \pm 1.41	5.16 \pm 0.68	7.68 \pm 69

The Hemodynamic changes

Heart Rate

No significant change in heart rate in group (I-gel) was observed. In group II (SLIPA) there were significant changes during removal and 1 min after removal when compared to baseline. On comparing group I to group II there was no significant change in heart rate at any time. On comparing group II (SLIPA) with group III (LMA), there were significant changes at the time of insertion and 1 min after insertion (Fig 1).

Systolic Blood Pressure

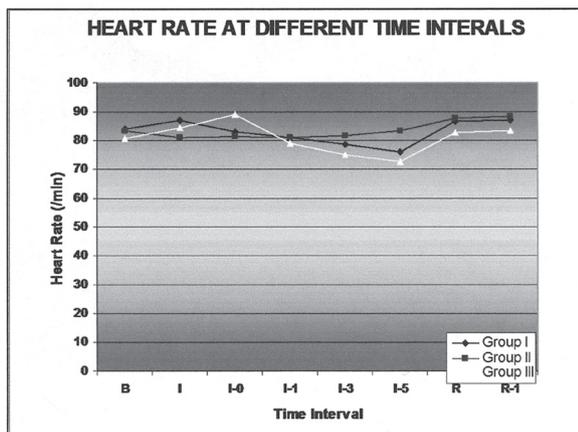
In all three groups, there was significant difference in systolic blood pressure from baseline till 5 min after insertion and highly significant difference at the time of removal in group I. On comparing group I and II and group II with group III there was significant difference at 1, 3, 5 min after insertion and at removal (Fig. 2).

Diastolic Blood Pressure

In Group I, significant difference in diastolic blood pressure (DBP) was seen from 1 min after insertion to 5 min after insertion. Group I & II showed no significant difference in DBP at 3 & 5 minutes after insertion. On comparing Group I & III and Group II & III there was significant difference from insertion to 5 min after insertion (Fig. 3).

Fig 1

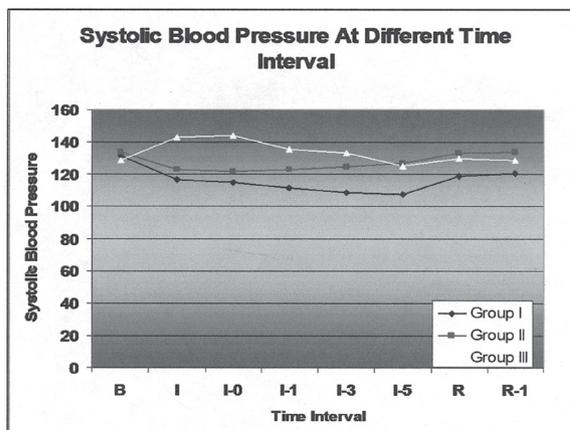
Heart rate changes at different time intervals after insertion and removal of supraglottic devices in various groups. Group I: I-gel, Group II: SLIPA, Group III: LMA



B: Baseline, I: Induction, I-0: Insertion, I-1: 1 min after insertion, I-3: 3 min after insertion, I-5: 5 min after insertion, R: removal, R-1: 1 min after removal.

Fig 2

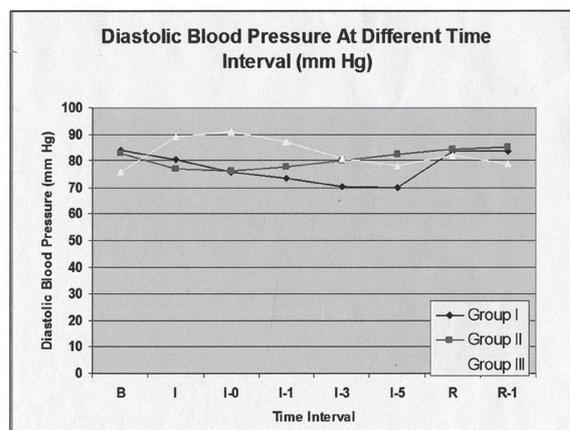
Systolic blood pressure changes at different time interval. after insertion and removal of supraglottic devices in various groups. Group I: I-gel, Group II: SLIPA, Group III: LMA



B: Baseline, I: Induction, I-0: Insertion, I-1: 1 min after insertion, I-3: 3 min after insertion, I-5: 5 min after insertion, R: removal, R-1: 1 min after removal.

Fig 3

Diastolic blood pressure changes at different time interval after insertion and removal of supraglottic devices in various groups. Group I: I-gel, Group II: SLIPA, Group III: LMA



B: Baseline, I: Induction, I-0: Insertion, I-1: 1 min after insertion, I-3: 3 min after insertion, I-5: 5 min after insertion, R: removal, R-1: 1 min after removal.

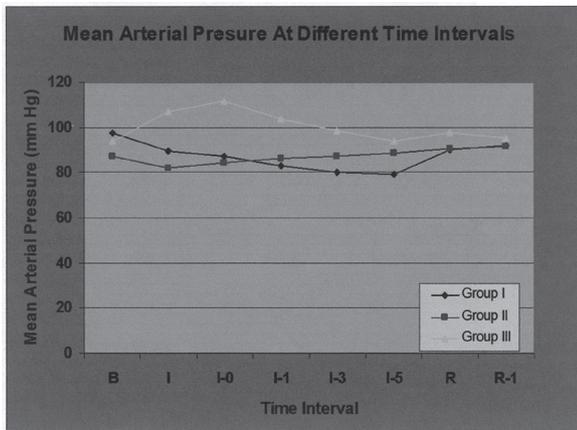
Mean Arterial Pressure

In Group I there was significant difference in MAP from baseline.

On comparing Group I & II and Group I & III, there was significant difference in MAP at 3 and 5 minutes after insertion (Fig. 4).

Fig 4

Mean arterial pressure changes at different time intervals after insertion and removal of supraglottic devices in various groups. Group I: I-gel, Group II: SLIPA, Group III: LMA



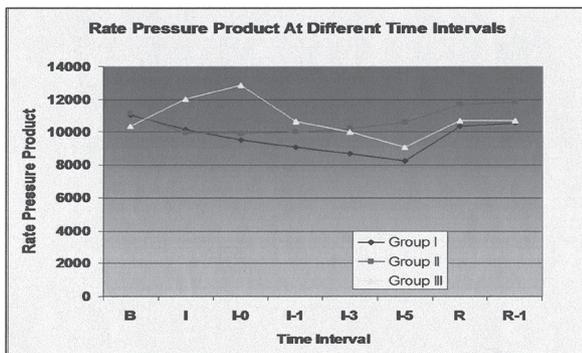
B: Baseline, I: Induction, I-0: Insertion, I-1: 1 min after insertion, I-3: 3 min after insertion, I-5: 5 min after insertion, R: removal, R-1: 1 min after removal.

Rate Pressure Product

In Group I there was significant difference in RPP at 1, 3 & 5 minutes after insertion. On comparing Group II & III, significant difference in RPP was seen at 1 & 3 minutes after insertion (Fig. 5).

Fig 5

Rate pressure product changes at different time intervals after insertion and removal of supraglottic devices in various groups. Group I: I-gel, Group II: SLIPA, Group III: LMA



B: Baseline, I: Induction, I-0: Insertion, I-1: 1 min after insertion, I-3: 3 min after insertion, I-5: 5 min after insertion, R: removal, R-1: 1 min after removal.

It was observed in this study that the hemodynamic changes were least in group I (I-gel) and maximum changes in group III (LMA) (Table 2).

Table 2

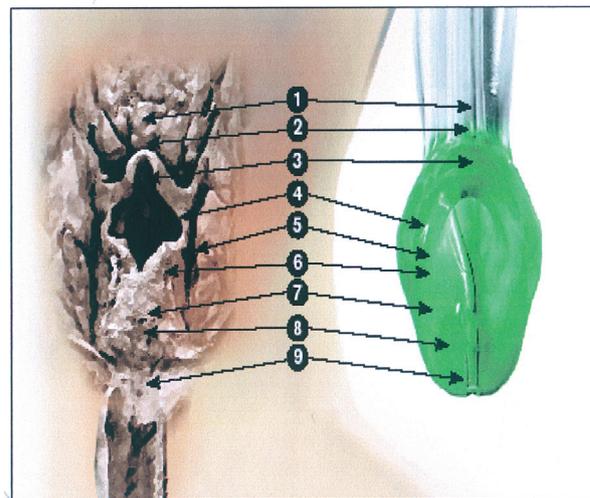
Comparison various hemodynamic parameters among all groups

	I-gel (Group I)	SLIPA (Group II)	LMA (Group III)
HR	2.4% ↓ at I-0 9.5% ↓ at I-5	2.4% ↓ at I-0	11.2% ↑ at I-0 10% ↓ at I-5
SBP	12.2% ↓ at I-0	8.27% ↓ at I-0	12.5% ↑ at I-0
DBP	16.7% ↓ at I-5	7.31% ↓ at I-5	20% ↑ at I-5
MAP	10.5% ↓ at I-0 18.5% ↓ at I-3	3.44% ↓ at I-0	19.3% ↑ at I-0
RPP	13.7% ↓ at I-0 25% ↓ at I-5	12.3% ↓ at I-5	3.4% ↓ at I-5

At time of insertion, there was no fall in saturation, dental and mucosal trauma or ECG changes, in any of the groups.

Fig 6

View of the I-gel cuff in relation to the laryngeal framework



1. Tongue
2. Base of tongue
3. Epiglottis
4. Aryepiglottic folds
5. Piriform fossa
6. Posterior cartilages
7. Thyroid Cartilage
8. Cricoid cartilage
9. Upper oesophageal opening

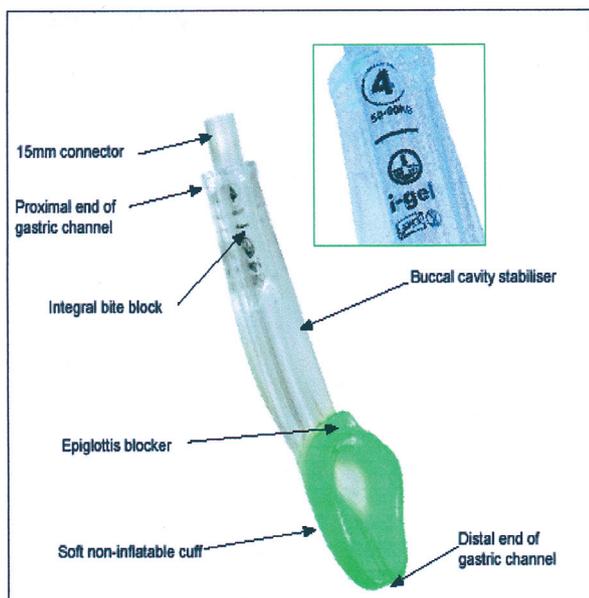
Courtesy I-gel user manual (intersurgical)

Discussion

The I-gel is a new single-use, noninflatable supraglottic airway for use in anesthesia during spontaneous or intermittent positive pressure ventilation⁹. The I-gel airway an anatomically designed mask made of a gel-like thermoplastic elastomer

called SEBS (Styrene Ethylene Butadiene Styrene)¹⁰. The soft, non-inflatable cuff fits snugly onto the perilaryngeal framework, mirroring the shape of the epiglottis, aryepiglottic folds, piriform fossae, perithyroid, peri-cricoid, posterior cartilages and spaces. Thus each structure receives an impression fit, thus supporting the seal by enveloping the laryngeal inlet. The seal created is sufficient for both spontaneously breathing patients and for IPPV¹¹ (Figs 6,7).

Fig 7
I-gel its key components. Courtesy I-gel user manual (intersurgical)



In a study on 100 patient by Gabbot DA et al⁹ it was observed that the seal pressures by I-gel were good. Peak airway pressures above 30 cm H₂O were possible in the vast majority of patients (mean and median 32 cm H₂O). The mean and median leak on sustained pressure (with the circle gas flows of 4 L min⁻¹ and the APL valve closed) was 24 cm H₂O. They compared this finding with the previous findings of 18-21 cm H₂O for the cLMA and 29 cm H₂O for the Proseal LMA. They also observed that the seal pressure appeared to improve over time in a number of patients and postulated that this might be due to the thermoplastic properties of the gel cuff which may form a more efficient seal around the larynx after warming to body temperature⁹.

It has been mentioned that insertion of the I-gel does not require any maneuver but in our cases we had to depress the tongue by a finger for easy insertion¹¹.

I-gel is available in three sizes size 3, 4, 5. An endotracheal tube (CETT) can be passed through the device. When correctly inserted, the tip of the I-gel will be located into the upper esophageal opening, providing a conduit via the gastric channel to the esophagus and stomach. This then allows for suctioning, passing of a nasogastric tube and can facilitate venting.

The maximum size of cuffed ETT and nasogastric tube that can be passed through each size of I-gel is as follows^{9,11}.

Size 3 I-gel- Maximum size of CETT 6.0 mm	- 12G nasogastric tube
Size 4 I-gel- Maximum size of CETT 7.0 mm	- 12G nasogastric tube
Size 5 I-gel- Maximum size of CETT 8.0 mm	- 14G nasogastric tube

In our study, it was observed that I-gel produced less hemodynamic changes than SLIPA which is also a non inflatable supraglottic device. This difference could be because SLIPA, is made of moulded plastic (polypropylene) that does not conform to anatomic structures^{12,13,14}.

The tensile properties of the I-gel bowl, along with its shape and the ridge at its proximal end, contribute to the stability of the device upon insertion. Upon sliding beneath the pharyngo-epiglottic folds it becomes narrower and longer, creating an outward force against the tissues. The ridge at the proximal bowl catches the base of the tongue, also keeping the device from moving upwards out of position (and the tip from moving out of the upper esophagus)¹⁵.

I-gel does not have any epiglottic/aperture bars like some other supraglottic devices¹⁶. I-gel has an artificial epiglottis called the 'epiglottis blocker' which prevents epiglottis from down-folding. But in case epiglottis does down-fold, the airway channel exits so deeply into the bowl of the cuff that there is no danger of the epiglottis interfering with the fresh gas flow^{9,12}.

During the insertion of LMA, pressor response (i.e. increase in heart rate and arterial pressure), may be induced by the passage of the LMA through the oral and pharyngeal spaces, pressure produced in the larynx and the pharynx by the inflated cuff and the dome of the LMA. The signals are transmitted to the brain through the trigeminal, glossopharyngeal and the vagus nerve. These nerves carry the afferent

impulses to the vasomotor centre which in turn activate sympathoadrenal system to release catecholamine resulting in increase of increased cardiac output, rather than increased systemic vascular resistance. The cardiovascular response is maximum during the stimulation of epipharynx whereas those arising from the stimulation of tracheobronchial tree are least marked¹⁷. During removal of LMA the hemodynamic response is probably triggered by pharyngeal stimulation during reverse rotation of the cuff¹⁸.

There are limitations to our study. First, insertions were done in patients with normal airway (MP grade, I, II) and normotensive patients. Our results may not apply to patients with difficult airways and hypertensive patients. Second, our results are specific to the anesthetic administered and might not apply for other anesthesia regimes such as the use of large-dose narcotics.

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Conclusion: I-gel effectively conforms to the perilaryngeal anatomy despite the lack of an inflatable cuff, it **consistently achieves proper positioning** for supraglottic ventilation and causes **less hemodynamic changes** as compared to other supraglottic airway devices.

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