Original Article

A comparative evaluation of ProSeal laryngeal mask airway, I-gel and Supreme laryngeal mask airway in adult patients undergoing elective surgery: A randomised trial

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Access this article online

Website: www.ijaweb.org

DOI: 10.4103/ija.IJA_153_18

Quick response code

ABSTRACT

Background and Aims: Second-generation supraglottic airway devices are widely used in current anaesthesia practice. This randomised study was undertaken to evaluate and compare laryngeal mask airway: ProSeal laryngeal mask airway (PLMA), Supreme laryngeal mask airway (SLMA) and I-gel. **Methods:** Eighty-four adult patients undergoing elective surgery were randomly allocated to three groups: group P (PLMA), group I (I-gel) and group S (SLMA) of 28 patients each. Insertion times, number of insertion attempts, haemodynamic response to insertion, ease of insertion of airway device and gastric tube, oropharyngeal leak pressure (OLP) and pharyngolaryngeal morbidity were assessed. The primary outcome measure was the OLP after successful device insertion. Statistical analysis was performed using Statistical Package for the Social Sciences version 18.0 software using Chi-squared/Fisher's exact test (categorical data) and analysis of variance (continuous data) tests. $P < 0.05$ was considered statistically significant. **Results:** The demographic profile of patients was comparable. OLP measured after insertion, 30 minutes later and at the end of surgery differed significantly between the three groups ($P < 0.001$). The mean OLP was 32.64 ± 4.14 cm·H_2O in group P and 29.79 ± 3.70 cm·H_2O in group S. In group I, the mean OLP after insertion was 26.71 ± 3.45 cm H_2O, which increased to 27.36 ± 3.22 cm H_2O at 30 minutes and to 27.50 ± 3.24 cm H_2O towards the end of surgery. However, these increases were not statistically significant ($P = 0.641$). Device insertion time was longest for group P ($P = 0.001$) and gastric tube insertion time was longest for group I ($P = 0.001$). Haemodynamic response to insertion and pharyngolaryngeal morbidity were similar with all three devices. **Conclusion:** PLMA provides better sealing pressure but takes longer to insert. I-gel and SLMA have similar sealing pressures. I-gel insertion time is quicker.

Key words: Anaesthesia, laryngeal mask, time, ventilation

INTRODUCTION

The endotracheal tube remains the gold standard airway device. However, laryngoscopy and endotracheal intubation may be associated with considerable morbidities ranging from minor side effects such as sore throat to more serious complications such as autonomic stimulation and difficult or failed intubation. Supraglottic airways (SGAs) offer distinct advantages including an increased speed and ease of placement, maintenance of haemodynamic stability during induction and emergence,[1] better oxygenation during emergence and lesser postoperative sore throat and voice alteration.[2] The second-generation SGAs have additional features to reduce the risk of aspiration and provide an improved pharyngeal seal making them more efficient and reliable in their performance. The

How to cite this article: Singh A, Bhalotra AR, Anand R. A comparative evaluation of ProSeal laryngeal mask airway, I-gel and Supreme laryngeal mask airway in adult patients undergoing elective surgery: A randomised trial. Indian J Anaesth 2018;62:858-64.

ProSeal laryngeal mask airway (PLMA)[3] is a reusable SGA with a modified cuff made of silicone and a double tube arrangement. The I-gel[4] is a disposable SGA made of a soft, gel-like thermoplastic elastomer with a noninflatable cuff and is easier and faster to insert than other SGAs. The Supreme laryngeal mask airway (SLMA)[5] is an advanced form of the PLMA made of polyvinylchloride (PVC). There is paucity of literature comparing these three second-generation SGAs in a single study. This study was designed to compare the efficacy of PLMA, I-gel and SLMA as ventilatory devices during general anaesthesia with respect to insertion characteristics, haemodynamic response, oropharyngeal leak pressure (OLP) and pharyngolaryngeal morbidity.

METHODS

After obtaining Institutional Ethical Committee approval and informed consent from patients, 84 adult patients of either sex admitted for various elective surgical procedures of less than 2-hour duration were included in the study. This randomised controlled trial was conducted in a tertiary care hospital in Delhi from September 2015 to September 2016 (CTRI/2017/08/009534). A detailed preoperative and airway assessment was done. Patients included in the study were of American Society of Anesthesiologists physical status I/II aged 18–60 years. Patients at an increased risk of aspiration (pregnancy, gastro-oesophageal reflux disease, hiatus hernia) and those undergoing head and neck surgery or procedures not performed in supine position were excluded from the study as were those with a known or predicted difficult airway, acute or chronic lung disease and obesity.

Eighty-four patients were randomly allocated into three groups: group P (n = 28) in whom PLMA was used to secure the airway, group I (n = 28) in which I-gel was used and group S (n = 28) in which SLMA was used. Randomisation was by computer-generated numbers and allocation into groups was done by the supervisor opening a sealed opaque envelope just prior to surgery. Patients were blinded to their group allocation. All device insertions were supervised by senior anaesthesiologists and performed by anaesthesia trainees with a prior experience of at least 20 successful insertions of each of the devices. Selection of size of the device was as per manufacturer's guidelines based on the patient's weight. For I-gel, size 3 was used in patients weighing 30–60 kg; size 4 in 50–90 kg and size 5 in patients weighing >90 kg. For PLMA and SLMA, size 3 was used in patients weighing 30–50 kg; size 4 in 50–70 kg and size 5 in 70–100 kg.

All patients were fasted overnight and received the tablet alprazolam 0.25 mg on the night before and 2 hours before surgery. In the operation theatre, intravenous (iv) access was secured and monitoring instituted consisting of electrocardiogram, capnogram ($ETCO_2$), pulse oximeter (SpO_2), non-invasive blood pressure (NIBP) and neuromuscular junction monitoring. The patients were placed supine with the head in sniffing position using a 7-cm high firm pillow and administered iv fentanyl 2 μg/kg, 5 minutes before induction. After preoxygenation for 3 minutes, general anaesthesia was induced with iv propofol 1.5–2 mg/kg and muscle relaxation facilitated by iv rocuronium 0.6 mg/kg. The lungs were manually ventilated with a facemask with 1–1.5% isoflurane in oxygen and nitrous oxide (1:2) for 3 minutes. Although complete neuromuscular block is not mandatory for insertion of these airway devices, neuromuscular blockade was confirmed using train-of-four (TOF) stimulation using TOF-Watch® SX monitoring software and the airway device inserted once TOF count was zero in order to ensure comparable conditions for device insertion in the three study groups.

All the devices were checked, prepared, inserted and secured according to the corresponding manufacturer's recommendations. The PLMA and SLMA were deflated fully before insertion. Insertion of the PLMA was performed using the introducer tool as this is the method recommended by the manufacturer and also converts the device into a preformed device for better comparison with the other two preformed devices. Insertion time was recorded as the time from picking up the device until the appearance of first square wave capnogram. If satisfactory placement was not achieved, the device was removed and reinserted. The number of insertion attempts was recorded. A failed attempt was defined as removal of the device after insertion. A maximum of two attempts were permitted before the device was considered a failure. Each 'attempt' was defined as reinsertion of the airway device into the mouth, and respective times were taken as T1 and T2. Effective airway time was calculated by adding T1 and T2. If, at any time, SpO_2 fell below 90%, the patients were mask ventilated with 100% oxygen till optimal SpO_2 level was reached (>95%) and this time of ventilation was not included in effective airway time. A satisfactory placement was

defined by the presence of normal thoracoabdominal movement and a square wave capnograph trace. After insertion, the cuffs of the SLMA and PLMA were inflated to an intracuff pressure of 60 cm·H_2O and maintained at that pressure throughout surgery using an automatic cuff controller (VBM Medizintechnik, Germany). The ease of insertion of the SGA was assessed on a 3-point scale as 1 = easy, 2 = some difficulty during insertion or 3 = impossible, by the anaesthesiologist inserting the device. If ventilation was inadequate, the following manipulations were allowed in the following order: adjusting of head and neck position or depth of insertion, chin lift, jaw thrust, and finally by changing the size of the device. In all three groups, an appropriate size (as suggested by the manufacturer) lubricated nasogastric tube was inserted through the gastric drain channel. Ease of insertion of the gastric tube was also assessed by the anaesthesiologist inserting the device on a 3-point scale as 1 = easy, 2 = some difficulty during insertion and 3 = impossible to pass. Proper placement was confirmed by auscultation of injected air over the epigastrium and aspiration of gastric contents. The time taken to pass the gastric tube was recorded. All times were recorded by an anaesthesiologist separate from the investigator inserting the device.

The patients were ventilated to maintain end-tidal carbon dioxide ($EtCO_2$) between 35 and 40 mm Hg. Intraoperative heart rate (HR), NIBP (systolic, diastolic, mean), oxygen saturation and $EtCO_2$ were recorded before induction (baseline), before device insertion (T0), every minute for the first 5 minutes after SGA insertion and henceforth every 5 minutes for the duration of surgery. OLP was recorded using the manometer stability test. The fresh gas flow was set at 3 l/minute of oxygen and the adjustable pressure limiting valve of the circle system was closed. The aneroid manometer dial was observed as the pressure from the breathing system increased and the airway pressure at which the dial reached stability was noted as OLP. A maximum pressure of 40 cm H_2O was allowed during the test. Three measurements of OLP were taken: OLP1 (after successful insertion of SGA), OLP2 (10 minutes later) and OLP3 (at tend of surgery). Also, the patients in the study underwent various surgical procedures and the type of surgery was not standardised and included both laparoscopic and nonlaparoscopic procedures. However, in those patients who were undergoing laparoscopy, positioning and gas insufflation were not allowed for the first 10 minutes until haemodynamics and OLP2 had been recorded and OLP3 was recorded at the end after desufflation of pneumoperitoneum and once patient was supine to avoid any bias.

Anaesthesia was maintained with isoflurane in oxygen and nitrous oxide (1:2) and intermittent boluses of rocuronium when TOF count was >2. At the end of surgery, residual muscle paralysis was reversed, with iv glycopyrrolate and neostigmine. The SGA was removed once the patient was awake. The presence of any visible blood on the device was documented. Pharyngolaryngeal morbidity was evaluated in the recovery room and 24 hours later by an anaesthesiologist not involved in the study and unaware of the airway device used. Hoarseness of voice was defined as a change in voice tone or painful phonation. Sore throat was defined as soreness of the throat. Dysphagia was defined as pain triggered by swallowing of saliva.

The primary outcome variable was the difference in OLP1. Secondary outcome variables included the time for insertion of the device, success of first attempt insertion, use of any manipulations, OLP2, OLP3, ease and time of gastric tube insertion, haemodynamic response to insertion, and incidence of visible blood on device and pharyngolaryngeal morbidity.

The sample size was calculated to be 28 in each group with an α error of 0.05 and power of 80%, considering at least 20% difference in the oropharyngeal leak pressure relative to the expected mean between the devices.[3] All data were statistically analysed using Statistical Package for the Social Sciences (SPSS) statistical software, Version 18. The quantitative data (OLP, times for insertion of SGA and gastric tube) were analysed using the one-way analysis of variance test and Bonferroni *post hoc* multiple comparison test. Qualitative data (ease of insertion of SGA and gastric tube, first attempt insertion success rate, number of insertion attempts and any complications) were compared using Chi-squared or Fisher's exact test. A P value of <0.05 was considered significant.

RESULTS

The demographic data and surgery details were comparable in all the groups [Table 1]. OLP was significantly different among the three groups ($P < 0.001$) at all times [Table 2]. The mean OLP1 was highest in group P (32.64 ± 4.14 cm·H_2O). In group S, the mean OLP1 was 29.79 ± 3.70 cm·H_2O. With PLMA and SLMA there was no change in OLP

over time. However, in the I-gel group, the mean OLP1 was 26.71 ± 3.45 cm·H_2O, which increased to 27.36 ± 3.22 cm·H_2O at 10 minutes and to 27.50 ± 3.24 cm·H_2O towards the end of surgery. This increase was not statistically significant ($P = 0.641$). Further intergroup comparison revealed the OLP to be significantly higher in the PLMA group compared to I-gel and SLMA groups at all times ($P < 0.001$). Although OLP1 was significantly higher with SLMA compared to I-gel, OLP2 and OLP3 were comparable [Table 3].

In all three groups, insertion of the SGA was found to be easy and the device was placed successfully in the first attempt. Insertion time was significantly different among the three groups ($P < 0.001$). While the insertion time was similar in groups I and S ($P = 1.000$), there was a significant difference between groups P and I and groups P and S ($P < 0.001$). Insertion times were significantly longer with PLMA compared to SLMA and I-gel. The only manipulation required to facilitate successful insertion in all groups was jaw thrust. In group I, as many as 53.6% of patients required jaw thrust for easy placement but this was not significant when compared with other groups ($P = 0.052$).

In all three groups, insertion of Ryle's tube was easy. In PLMA and SLMA groups, a 14 F Ryle's tube was placed, whereas 12 F Ryle's tube were placed in the I-gel group. The time taken for gastric tube insertion was significantly different among all three groups ($P < 0.001$). Insertion time was longer in group I vs group P ($P < 0.001$) and in group I vs group S ($P = 0.001$), but no significant difference was found in group P vs group S ($P = 1.000$). Insertion of nasogastric tube was significantly longer with I-gel [Table 4].

The HR, diastolic blood pressure and mean arterial pressure were comparable in all three groups upto 10 minutes after device insertion ($P > 0.05$) [Table 5]. Systolic blood pressure (SBP) was also comparable among the three groups during first 5 minutes. However, 10 minutes after device insertion, the SBP was higher in group S compared to group I ($P = 0.028$) and similar in group I vs group P and group P vs group S. Pharyngolaryngeal morbidity was similar with all three devices [Table 6].

Table 1: Demographic characteristics

Parameter (mean±SD)	Group P	Group I	Group S	*P*
Age (years)	36.04±11.33	30.71±8.05	31.25±11.06	0.108
Sex				
Male	12 (42.9%)	12 (42.9%)	13 (46.4%)	0.953
Female	16 (57%)	16 (57%)	15 (53.6%)	
Weight (kg)	54.07±8.69	52.39±8.68	55.64±8.73	0.381
Height (cm)	153.68±6.72	154.32±3.44	156.04±7.06	0.317
MMP class I/II	25/3	18/10	19/9	0.072
ASA grade				
I	26 (92.9%)	27 (96.4%)	26 (92.9%)	0.814
II	2 (7.1%)	1 (3.6%)	2 (7.1%)	
Type of surgery				0.071
Open hernioplasty	12 (42.8%)	13 (46.4%)	11 (39.2%)	
Laparoscopic cholecystectomy	8 (28.5%)	9 (32.1%)	8 (28.5%)	
Tubal ligation	5 (17.8%)	4 (14.2%)	6 (21.4%)	
Skin grafting	3 (10.7%)	2 (7.1%)	3 (10.7%)	

SD – Standard deviation; MMP – Modified Mallampati Score; ASA – American Society of Anesthesiologists

Table 2: OLP (cm·H_2O) using manometer stability method

OLP (cm·H_2O)	Group P	Group I	Group S	*P*
OLP1 (mean±SD)	32.64±4.14	26.71±3.45	29.79±3.70	<0.001
OLP2 (mean±SD)	32.64±4.14	27.36±3.22	29.79±3.70	<0.001
OLP3 (mean±SD)	32.64±4.14	27.50±3.24	29.79±3.70	<0.001

SD – Standard deviation; OLP – Oropharyngeal leak pressure

Table 3: Intergroup comparison of OLP using manometer stability test

OLP	Group P vs group I	Group P vs group S	Group I vs group S
OLP1	<0.001	0.018	0.010
OLP2	<0.001	0.015	0.050
OLP3	<0.001	0.015	0.07

OLP – Oropharyngeal leak pressure

Table 4: Insertion characteristics

	Group P	Group I	Group S	*P*
Number of attempts	1 (28)	1 (28)	1 (28)	0.072
Ease of insertion of device	Easy (28)	Easy (28)	Easy (28)	0.084
Insertion time device (seconds) (mean±SD)	23.0±2.58	13.50±4.41	14.50±4.71	<0.001
Use of jaw thrust	7	15	8	0.052
Ease of insertion of Ryle's tube	Easy (28)	Easy (28)	Easy (28)	0.076
Insertion time NG tube (seconds) (mean±SD)	8.89±2.58	12.21±3.82	9.0±2.78	<0.001

NS – Not significant; SD – Standard deviation; NG – Nasogastric

DISCUSSION

SGAs have undergone a remarkable evolution since the introduction of the classic LMA. The PLMA, I-gel and SLMA have previously been evaluated alone or in pairwise comparisons but under different study designs, which makes it difficult to compare the results. To the best of our knowledge, there is a paucity of studies comparing these devices in a single study setting using controlled ventilation. In this study, 84 patients were taken and randomly allocated into

Table 5: Haemodynamic response to insertion

Time	Parameters	Group P	Group I	Group S	*P*
Baseline	HR	81.89±16.53	94.67±9.27	93.71±10.58	0.931
	SBP	124.78±11.40	122.17±9.32	122.28±11.10	0.587
	DBP	79.57±11.53	81.28±8.64	79.71±9.31	0.773
	MAP	93.89±10.58	94.67±9.27	93.71±10.58	0.931
T0	HR	92.0±11.51	93.71±9.63	91.92±11.62	0.789
	SBP	121.42±13.36	119.89±11.62	119.75±11.84	0.852
	DBP	76.25±11.91	80.92±9.32	77.21±11.51	0.248
	MAP	92.0±11.51	93.71±9.63	91.92±11.62	0.789
T1	HR	90.82±11.72	87.32±12.12	86.75±12.67	0.404
	SBP	119.50±12.22	114.21±12.31	113.96±13.53	0.190
	DBP	77.50±12.55	75.21±11.46	72.14±13.22	0.276
	MAP	90.82±11.72	87.32±12.12	86.75±12.67	0.404
T2	HR	85.14±12.79	84.28±14.17	80.67±11.70	0.395
	SBP	113.96±12.66	109.07±14.93	105.64±13.49	0.081
	DBP	71.07±11.00	72.17±13.78	67.0±11.35	0.248
	MAP	85.14±12.79	84.28±14.17	80.67±11.7	0.395
T3	HR	79.67±10.76	81.14±14.19	80.53±10.53	0.899
	SBP	109.82±11.80	106.89±15.94	105.89±11.48	0.516
	DBP	66.53±10.11	68.28±13.77	66.96±10.49	0.841
	MAP	79.67±10.76	81.14±14.19	80.53±10.53	0.899
T4	HR	77.57±11.46	80.14±12.41	82.14±11.09	0.345
	SBP	105.89±11.56	105.10±12.03	108.10±11.81	0.617
	DBP	64.75±10.54	67.78±11.81	69.10±11.75	0.345
	MAP	77.57±11.46	80.14±12.41	82.14±11.09	0.345
T5	HR	78.60±10.34	79.14±9.81	82.96±9.81	0.212
	SBP	104.53±10.82	102.96±9.19	109.0±10.23	0.074
	DBP	67.25±9.86	67.10±10.41	69.14±11.32	0.724
	MAP	78.60±10.34	79.14±9.81	82.96±9.81	0.212
T10	HR	80.50±11.18	81.07±11.42	86.35±13.37	0.140
	SBP	107.28±10.97	105.78±10.27	113.89±2.83	0.022
	DBP	68.50±10.89	68.39±11.35	72.39±13.51	0.367
	MAP	80.50±11.18	81.07±11.42	86.35±13.37	0.140

T0 – Time just before insertion, T1, 2, 3, 4, 5, 6, 7, 8, 9, 10 minutes post insertion respectively; HR – Heart rate; SBP – Systolic blood pressure; DBP – Diastolic blood pressure; MAP – Mean arterial pressure

Table 6: Pharyngolaryngeal morbidity: immediate postoperatively and 24 hours later

	Group P	Group I	Group S	*P*
Blood on device removal	0/28	2/28 (7.2%)	1/28 (3.6%)	0.363
Hoarseness				
Immediate	0/28	1/28 (3.6%)	0/28	0.372
24 hours later	0/28	0/28	0/28	-
Dysphagia				
Immediate	0/28	1/28 (3.6%)	0/28	0.372
24 hours later	0/28	0/28	0/28	-
Sore throat				
Immediate	0/28	2/28 (7.2%)	1/28 (3.6%)	0.372
24 hours later	0/28	0/28	0/28	-

three groups of 28 patients. Device insertion was successful in all patients, that is, 100% first attempt success rate was achieved which was similar to another study[6] in which first time success rates were 80% (I-gel), 84% (PLMA) and 100% (SLMA). One major study[7] also found the overall insertion success rate of I-gel to be 97% irrespective of the anaesthesiologist's previous experience of using the device.

All the SGAs were easy to insert in our study, which is also similar to other investigators.[6,7] There was no trauma during insertion in any patient which is in contrast to another comparison by Eschertzhuber *et al.*[8] who reported a 4% incidence of trauma with insertion of PLMA and SLMA. A better acquaintance with SGAs, training on mannequins, proper patient positioning and device manipulations during insertion probably minimised airway trauma in our instance.

In our study, the insertion times for I-gel (13.5 ± 4.41 seconds) and SLMA (14.5 ± 4.71 seconds) were similar (P = 1.00) but significantly longer with PLMA (23 ± 2.58 seconds). This may be attributed to the additional time taken for removal of the introducer followed by inflation of the cuff of the PLMA. Both I-gel

and SLMA are preformed devices and insertion does not require the use of an introducer. Various studies have found that insertion of I-gel is quicker due to the absence of an inflatable cuff. Bamgbade *et al.*[9] evaluated 300 I-gel insertions in 290 patients and reported an insertion time of 5 seconds, but they did not define insertion time. On the other hand, Teoh *et al.*[10] found similar insertion times for I-gel (15.4 ± 7.3 seconds) and SLMA (14.3 ± 4.7 seconds) which are similar to our study but they had defined them as time from insertion of airway device into patient's mouth to the first end-tidal carbon dioxide trace which differs from our definition.

To facilitate insertion of the SGA, the only manipulation required was jaw thrust. It is our impression that the use of a jaw thrust facilitates insertion of an I-gel and we used this in 15 (53.6%) of our study cases. We used jaw thrust in 7 patients in group P and 8 patients in group S. The jaw thrust for I-gel has been recommended by the manufacturer if there is early resistance to insertion. Change in device size was not required in any patient. There is an overlap in the weight criteria of the manufacturer's recommendations for I-gel, that is, size 3 for 30–60 kg and size 4 for 50–90 kg. If the patient weighed between 50 and 60 kg, then size selection was left to the discretion of the conducting anaesthesiologist. Gatward *et al.*[11] have demonstrated the suitability of the size 4 I-gel in 100 nonparalysed patients weighing 42–113 kg.

In our study, insertion of a gastric tube was easy in all patients but took significantly longer in group I (12.21 ± 3.82 seconds). This is similar to the findings of Teoh *et al.*[10] who found gastric tube insertion times to be longer for I-gel (15 ± 7.3 seconds) compared to SLMA (9 ± 2.5 seconds). They suggested that the longer time to insert a gastric tube in the I-gel group can be attributed to the smaller aperture of the gastric port in the device which may increase the time to insert the leading edge of the tube into the gastric port aperture. The longer time to insert a gastric tube in the I-gel has been reported in earlier studies.[12] It seems likely that the suggestion of Teoh *et al.* may be a reasonable explanation for this longer gastric tube insertion time in our study too.

The haemodynamic response to laryngoscopy and intubation is a reflection of an increase in sympathoadrenal activity due to oropharyngeal and laryngotracheal stimulation.[13] There is a lesser cardiovascular response to insertion of an SGA compared to an endotracheal tube. In our study, haemodynamic response to insertion was similar in all the groups apart from the SBP at 10 minutes which was significantly lower in group I. In contrast to our findings, Teoh *et al.*[10] reported a comparable haemodynamic response to insertion with I-gel and SLMA. A likely cause for the lower SBP in the I-gel group could be the absence of an inflatable cuff in I gel which may provoke lesser pharyngolaryngeal stimulation when compared to the larger PVC cuff of the LMA supreme.

We found the OLP to be significantly higher in group P (32.64 ± 4.41 cm·H_2O) compared to group S (29.50 ± 3.70 cm·H_2O). This remained same for all three readings, that is, OLP1, OLP2 and OLP3. The higher OLP with PLMA may be attributed to the double cuff made of silicone rubber which conforms to the anatomy of the hypopharynx more favourably than the single larger cuff of the SLMA made of PVC.

The seal pressure or OLP of I-gel is expected to improve with time as the cuff is made up of medical grade thermoplastic elastomer which is soft, gel like and fits anatomically to perilaryngeal structures. Due to the thermoplastic nature of the cuff, the seal improves as the cuff attains body temperature and fits more snugly over perilaryngeal tissues. Hence we decided to assess OLP at three times. In our study, the OLP increased with time in the I-gel group, that is, OLP1 (26.71 ± 3.45 cm·H_2O) < OLP2 (27.36 ± 3.22 cm·H_2O) < OLP3 (27.50 ± 3.24 cm·H_2O). This increase was, however, statistically insignificant. Mukadder *et al.*[14] had also reported that OLP of I-gel improved with time which is similar to our results.

Our results showed the highest mean OLP with the use of PLMA, similar to Van Zundert *et al.*[6] who found the mean OLP to be 33 ± 7 cm·H_2O with PLMA, 32 ± 6 cm·H_2O with SLMA and 30 ± 11 cm·H_2O with I-gel. Shin *et al.*[15] compared I-gel, PLMA and classical LMA and reported an OLP 27 cm·H_2O for I-gel and 29.8 cm·H_2O for PLMA in paralyzed patients. In a recent study on the comparison of the clinical performance of I-gel, LMA Supreme and LMA ProSeal in elective surgery, Liew *et al.*[16] found highest OLP with I-gel (27.31 cm·H_2O). However, in this study, patients were allowed to breathe spontaneously and the researchers modified weight-based size selection of I-gel.

In our study, pharyngolaryngeal morbidity was assessed immediately postoperatively and 24 hours later and was similar in all three groups. In contrast,

Teoh *et al*.[10] found that two patients had blood on the device and four had a sore throat after use of SLMA, while only one patient in the I-gel group had blood on the device and a sore throat. However, in this study, intracuff pressure was not kept constant. In our study, the cuff pressure was maintained below 60 cm·H_2O which may explain the comparable pharyngolaryngeal morbidity of PLMA and SLMA vs an uncuffed device like the I-gel.

Our study does have some limitations. In order to maintain the usual surgical turnover rate, we did not assess the anatomical position of the SGA in relation to the vocal cords using fibreoptic bronchoscopy. Also, there is evidence to suggest that checking the placement by fibre optic bronchoscopy does not have much clinical correlation and has not been suggested as a preuse check by the manufacturers. Another limitation is that the airway operator could not be blinded to the device being used and insertion data were collected by an unblinded investigator. This may introduce a potential for bias. Also, all device insertions were performed by a single experienced anaesthesiologist and these results may not be applicable to inexperienced users, although there is evidence to suggest that these devices can be inserted by inexperienced operators with a high rate of first attempt successful insertion.[17] Our study included only nonobese patients with normal airways and these results cannot be directly extrapolated to obese patients or those with a difficult airway. In our study, device insertion was done after administration of a muscle relaxant and it has been reported that the use of neuromuscular blockade can affect laryngeal mask airway seal pressure resulting in lower values of OLP.[18] Also, airway pressures and intra-abdominal pressures were not recorded in the laparoscopy cases to maintain uniformity in the methodology.

CONCLUSION

ProSeal LMA, I-gel and Supreme LMA were easy to insert with a 100% first attempt insertion success rate and similar pharyngolaryngeal morbidity. The PLMA provided a significantly higher OLP compared to the other two devices and can be suggested as the device of choice to be used in those patients and situations where a high OLP is required.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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