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# Comparison of Propofol with Sevoflurane for I-GEL Insertion in Adults in day care surgery in tertiary health center.

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We performed a prospective, randomized, controlled trial to compare the quality and ease of I-gel insertion after either IV propofol or rapid inhaled sevoflurane induction of anesthesia. Seventy-six unpre-medicated ASA physical status I or IIpatients were anesthetized with either a single vital capacity breath of sevoflurane 8% or IV propofol 2 mg/kg, which produced equally rapid loss of consciousness (40.5 ± 13.9 vs 37.7 ± 9.9 s; $P > 0.05$). The I-gel was inserted more rapidly in patients in thepropofol group (74 ± 29 vs 127 ± 35 s; $P < 0.01$) and required fewer attempts (1.2 vs 1.6; $P < 0.05$) than the sevoflurane group. There was a greater incidence of initially impossible mouth opening in the sevoflurane group (45% vs 21%; $P < 0.05$). Once mouth opening was possible, the degree of attenuation of laryngeal reflexes was similar. The overall incidence of complications related to I-gel insertion, especially apnea (32% vs 0%);

Insertion of I-gel under deep inhaled anesthesia alone is not commonly performed in adult patients. A popular method of providing anesthesia for LMA insertion is with the use of IV propofol, which has the advantages of inducing anesthesia rapidly and depressing upper airway reflexes (1).However, propofol is not ideal, as it has been associated with various adverse effects which includes hypotension, apnea, and pain on injection (2).

P < 0.01), was more frequent in the propofol group than in sevoflurane group (82% vs 26%; P < 0.01). Both groups had stable hemodynamic profiles. We conclude that sevoflurane vital capacity breath induction compares favorably with IV propofol induction for I-gel insertion in adults. However, prolonged jaw tightness after the sevoflurane induction of anesthesia may delay I-gel insertion. Implications: In this randomized, controlled trial, we compared the ease of insertion of the I-gel in adults after induction of anaesthesia with either a sevoflurane vital capacity breath technique or propofol IV. We conclude that sevoflurane compares favorably with propofol, although prolonged jaw tightness may delay I-gel insertion.

Recently, single vital capacity breath (VCB) inhaled induction of anesthesia with sevoflurane has been used as an alternative to IV induction in adults in day care surgeries. This method is rapid, with high patient acceptance, and better hemodynamic stability (3). Rapid insertion of the I-gel after VCB induction may allow the use of sevoflurane as a single drug for the induction and maintenance of anesthesia, which would make it easy during the transition period and lead to cost-savings (4). Therefore, in this study, we compared the reliability, quality, and speed of I-gel insertion in adult patients posted for day care surgeries after sevoflurane VCB inhaled induction and propofol IV induction of anesthesia.

## I. METHODS

Institutional ethical approval and written informed consent were obtained from all patients. Seventy-six adult ASA physical status I or II patients aged 18 –50 year undergoing day care surgical procedures were recruited. Patients with an allergy or sensitivity to volatile anesthetics or to propofol, known or suspected genetic susceptibility to malignant hyperthermia, heavy smokers (≥20 cigarettes per day), patients with any respiratory diseases and with impaired ability to communicate (e.g., confusion, poor hearing or language barrier) were excluded from the study. The patients were randomized by computer generated numbers into two groups. Patients to the sevoflurane group were taught the VCB technique. The patients were not premedicated. For patients in the sevoflurane group, a circle CO2 absorber circuit with a 2-L reservoir bag was used. The circuit was primed with sevoflurane 8% in a 1:1 ratio of nitrous oxide to oxygen at a fresh gas flow of 10 L/min for 1 min. The patients selected for only sevoflurane induction, were asked to take a deep breath then exhale out to residual volume. The mask with the circuit which

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was already primed was placed firmly over the patient's face. The patients were then instructed to inhale a VCB and hold it as long as they could comfortably. The start of induction was taken as the point at which the patients completed their VCB and was noted.

The loss of consciousness was confirmed by testing for the loss of eyelash reflex. Duration of vital capacity breath-hold was noted. Ninety seconds after the start of induction, the ease of mouth opening was assessed (as possible or impossible). Ninety seconds was chosen because it represents the time at which all patients would have completed their VCB. If mouth opening was impossible, another attempt was made every 30 s up, to a maximum of three tries. An attempt to open the mouth was considered an attempt at insertion. During this time, anesthesia was maintained with sevoflurane at a dial concentration of 8% and nitrous oxide 50% in oxygen. Once mouth opening was possible, insertion of the I-gel was attempted, and the degree of attenuation of laryngeal reflexes of the patients were assessed and classified. This was classified as full when the I-gel was inserted smoothly; partial when insertion was accompanied by gagging, coughing or involuntary movement of limbs or head; or poor when I-gel insertion was impossible. A size 3 or 4 I-gel was used for patients weighing <60 kg or >60 kg, respectively, regardless of the gender.

Patients in the propofol group breathed oxygen for 3 min and were anesthetized with propofol 2 mg/kg IV over 30 seconds . Lidocaine 0.3 mg/kg IV, was given prior to propofol administration. Midway through induction with propofol (at 15 s), the patients wereasked if they felt any pain from the injection. Time to loss of consciouness (LOC) was determined as it had been for the sevoflurane group. Thirty seconds after the completion of IV propofol induction (i.e., 60 s after the start of the propofol injection), ease of mouth opening was assessed. If possible, I-gel insertion was attempted. If impossible, repeat attempts were made every 30 s up to a maximum of three attempts, each time preceded by propofol boluses of 0.5 mg/kg IV. I-gel insertions were performed by the same investigator in both the groups. Once the I-gel was inserted, all patients were given sevoflurane 4.0% in 50% nitrous oxide in oxygen at a fresh gas flowrate of 2 L/min for 3 minutes, before decreasing the dial concentration of sevoflurane to 2% for maintenance of anesthesia. Noninvasive blood pressure (NIBP), electrocardiogram lead II, pulse oximeter, $ETCO_2$, were recorded every minute for 5 min. Any failures of insertion, defined as failure to insert the I-gel after three tries, were rescued with succinylcholine 50 mg IV. No controlled or assisted breaths were given unless the patient suffered oxygen desaturation to a pulse oximetry reading of <90%. The decision not to manually ventilate our patients be- tween I-gel insertions was intended to avoid abolishing their hypercarbic drive, which would prolong the period of apnea. An independent but non blinded observer noted the presence of complications related to anesthetic induction and insertion of the I-gel. These included involuntary movement of limbs and face (excitatory movement or withdrawal from pain of injection), coughing, gagging, apnea (when time to onset of spontaneous respiration after insertion of the I-gel was >30 s) and laryngospasm.

**Table1.** Demographic Data

| | Propofol(*n* = 38) | Sevoflurane(*n* = 38) |
|---|---|---|
| Age (yr) | 30.4 ± 8.1 | 30.0 ± 9.0 |
| Gender (M/F) | 19/19 | 19/19 |
| Smoker (y/n) | 9/29 | 5/33 |
| ASA physical status (I/II) | 37/1 | 34/4 |
| Weight (kg) | 62.2 ± 12.9 | 58.2 ± 10.3 |

Values are mean ± sd or *n*.

At the end of the operation, the I-gels were removed when the were still anesthetized. The presence of blood on the mask, signifying trauma on insertion, was noted. Once fully awake, the patients were interviewed by a blinded investigator who askedwhether they found the induction of anesthesia pleasant and comfortable and whether they had a sore throat after awakening.

All results are expressed as mean ± sd or as group percentages. Student's *t*-tests, with Bonferroni correction where appropriate, were used for the patients' variables and hemodynamic changes. $y^2$ tests, incorporating Fisher's exact test where appropriate, were used for the variables of induction, quality of I-gel insertion, complications, and postoperative assessment. A *P* value <0.05 was

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taken as statistically significant. Statistical calculations were performed using SPSS 8.0.

## II. RESULTS

The patients in both groups were comparable (Table 1). The patients in the sevoflurane group held their VCB for 45.2 ± 16.9 s, resulting in an end-tidal sevoflurane concentration of 4.4% ± 0.7% on release. Sevoflurane and propofol produced equally rapid loss of consciousness (LOC) (40.5 ± 13.9 vs 37.7 ± 9.9 s; P > 0.05). Twelve patients (31%) complained of pain during the injection of propofol even after prior lidocain injection (Table 2). Two patients in the sevoflurane group developed laryngospasm after release of their VCB. However, these complications were self-limiting and did not require any kind of intervention. And the patients did not suffer from oxygen desaturation. The I-gel was inserted more rapidly in patients belonging to the propofol group versus those in the sevoflurane group (74 [60 –150] vs 127 [90 –210] s; P < 0.01). However, there were four insertion failures in the propofol group, but all insertions of the I-gel were successful in the patients belonging to the sevoflurane group (Table 3). The failures were due to the inability to open the patients' mouths within the three tries allowed. All four patients were rescued with succinylcholine (as required by protocol) 150 –210 s after the induction of anesthesia. The data from these patients were included in the analysis of demographic, induction of anesthesia, and overall success of I - gel insertion variables, but they were excluded from analysis of the data pertaining to speed and quality of I-gel insertion, hemodynamic changes, and postoperative interviews of the patient. More attempts at insertion of the LMA were required in patients in the sevoflurane group versus those in the propofol group (1.6 vs 1.2 attempts; P < 0.05) (Figure 1). This was primarily because of a greater incidence of initially impossible mouth openings in the patients belonging to the sevoflurane group (45% vs 21%; P < 0.05). However, once mouth opening of the patient was possible, the degree of attenuation of laryngeal reflexes was similar in both the group of patients. (Table 3). The overall incidence of complications related to the I-gel insertion was higher in the patients belonging to the propofol group (82% vs 26%; P < 0.01). Although more patients had involuntary movement of limbs and face, coughing and gagging in the propofol group, this did not reach significance. Incidence of apnea was more frequent (32% vs 0%; P < 0.01) in the propofol group. In these patients, apnea lasted an average of 69 s. However, none of the patients under study suffered oxygen desaturation. Both groups had stable hemodynamics, although patients in propofol group had a larger decrease in mean blood pressure compared with the sevoflurane group (Table 4). Compared with baseline, the average decrease in mean blood pressure.

During the study period was 18.7% (0%–41%) and 17.0% (2%– 43%) in the propofol and sevoflurane groups respectively. Our patients found both techniques satisfactory, and the incidence of traumatic insertion was similar in both groups.(Table 3).

**Table 2.** Incidence of Complications During the Inductionof Anesthesia and Laryngeal Mask Airway Insertion

| | Propofol ($n$ = 38) | Sevoflurane ($n$ = 38) |
|---|---|---|
| Complications of induction | | |
| Laryngospasm | 0 | 5.2 |
| Cough | 2.6 | 2.6 |
| Involuntary movement | 36.8 | 18.4 |
| Complications of I-gel insertion | | |
| Gagging | 20.6[a] | 10.4 |
| Coughing | 11.8[a] | 2.6 |
| Involuntary movement | 52.9[a] | 36.8 |
| Apnea | 32.4[a] | 0* |

Values are percentages.

* Significantly different from propofol ($P$ < 0.01).

[a] Data from four patients were excluded from analysis because I-gel insertion failed due to inadequate jaw relaxation.

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**Table 3.** Quality of Laryngeal Mask Airway Insertion andPostoperative Interview Results

| | Propofol ($n$ = 34) | Sevoflurane ($n$ = 38) |
|---|---|---|
| Successful LMA insertion | 89.5[a] | 100 |
| Time to I-gel insertion(s) | 74± 29 | 127 ±35* |
| Attempts ($n$) | 1.2 ± 0.6 | 1.6±0.7† |
| Successful initial mouth opening | 78.9 | 55.2† |
| Full attenuation of laryngeal reflexes on first try | 73.5 | 83.5 |
| Pleasant induction | 85.3 | 92.1 |
| Presence of blood on LMA | 14.7 | 7.9 |
| Sore throat | 11.8 | 7.9 |

Values are expressed as mean ± sd or percentages. I-gel
* Significantly different from propofol ($P < 0.01$).
† Significantly different from propofol ($P < 0.05$).
[a] Based on total number of patients in the propofol group ($n$ = 38). I-gel insertion failed in four patients. Their data pertaining to quality of I-gel insertion and postoperative interview were excluded from analysis.

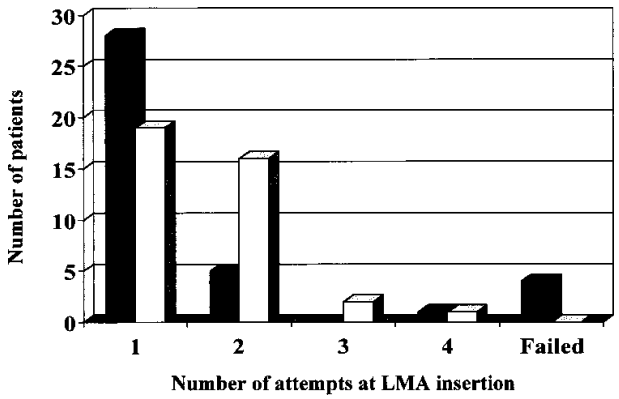


**Figure 1.** Comparison of the number of attempts at laryngeal maskairway (LMA) insertion required for successful placement after the induction of anesthesia with propofol (■) or sevoflurane (□). Fewer attempts were required with propofol (1.2 vs 1.6 attempts; $P < 0.05$).

## III. DISCUSSION

In this study, we demonstrate that sevoflurane single VCB induction compares favorably with propofol for the insertion of I-gel in adults. Both sevoflurane and propofol successfully induced anesthesia in all patients in approximately 40 s. The hemodynamic responses were stable for both groups. Insertion of I-gel after sevoflurane induction was achieved in all patients in that group, compared with three failures in the propofol group. Despite some complications during the induction of anesthesia, there were fewer complications in the sevoflurane group. Acceptibility was good in both groups. But, more attempts at insertion of I-gel were required in the patients belonging to sevoflurane group, and the time to successful I-gel insertion was 53 s longer in this group.

Anesthesia induction and I-gel insertion using sevoflurane have several advantages over propofol IV induction. Sevoflurane allows a smoother transition to the maintenance phase without a period of apnea. Apnea (defined as failure to start spontaneous ventilation within 30 seconds of I-gel insertion) occurred in 32% of the patients in the propofol group but did not occur in the patients of sevoflurane group. The presence of apnea often requires the anesthesiologist to ventilate the patient manually while awaiting the return of spontaneous ventilation, therefore nullifying the benefit of freeing the anesthesiologist's hands afforded by the

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I-gel. Sevoflurane prevents the pain on injection associated with propofol. In this study, 31% of patients complained of pain during propofol induction despite the use of lidocaine. There was less hypotension with sevoflurane, although transient hypotension >20% of baseline was seen in individual patients belonging to both the groups.

In a related study, Muzi et al. (5) achieved insertion of I-gel after sevoflurane induction after 1.7 min, com- pared with the time taken for I-gel insertion in our sevoflurane group (127 s). The shorter time may be related to their use of the less reported triple breath technique, which is associated with a shorter time of induction (6). However, no comparison was made with other techniques. Hall et al. (7) compared I-gel insertion using the single breath technique with sevoflurane 8% with that using IV propofol 2 mg/kg. They showed that the addition of nitrous oxide enhances the safety and speed of sevoflurane induction, but they did not compare the ease and quality of LMA insertion at the earliest opportunity. This resulted in relatively slow times for I-gel insertion (109 and 146 s for the propofol and sevoflurane groups, respectively). Our main difficulty regarding the quality of I-gel insertion when using sevoflurane was that, initially there was difficulty in mouth opening. Muzi et al. (5) also reported jaw tightness after sevoflurane anesthetic induction, which resulted in failure to insert the I-gel in many patients. Similarly, Hall et al. (7) reported longer time to jaw relaxation with sevoflurane compared with patients induced with IV propofol. The likely explanation for the poor mouth opening in our patients is the lag time during which the alveolar concentration of sevoflurane equilibrates with the brain, which results in inadequate anesthesia during the initial attempt at I-gel insertion. This is supported by the fact that the I-gel was eventually inserted in all the patients in both the groups. Relaxation of the jaw muscles sufficient for a jaw thrust may be a reflection of adequate depth of anesthesia (8). However, Inomata and Nishikawa (9) dispute the importance of this lag time. They argue that this is unlikely to be important with sevoflurane because of its low blood- gas partition coefficient. In our patients, the end-tidal concentration of sevoflurane was 4.4% on release of the VCB, which translates into 2.45 minimum alveolar anesthetic concentration (MAC).

**Table 4.** Hemodynamic Data

| Time after start of anesthetic induction (min) | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Mean blood pressure (mm Hg) | | | | | | |
| Propofol[a] | 91 ± 13 | 82 ± 17 | 82 ± 14 | 78 ± 12 | 75 ± 11* | 74 ± 13* |
| Sevoflurane | 94 ± 10 | 84 ± 12 | 78 ± 12 | 80 ± 11 | 91 ± 19 | 87 ± 19 |
| Heart rate (bpm) | | | | | | |
| Propofol[a] | 78 ± 13 | 82 ± 13 | 84 ± 12 | 81 ± 11 | 83 ± 11 | 82 ± 11 |
| Sevoflurane | 79 ± 13 | 76 ± 12 | 81 ± 15 | 93 ± 18 | 100 ± 24 | 93 ± 23 |

Values are mean ± sd.
* Significantly different from sevoflurane ($P < 0.05$).
[a] I-gel insertion failed in four patients. Their data were excluded from analysis.

This is adequate for I-gel insertion because, although a MAC value for insertion of the I-gel in adults is not known, it is likely to approximate 2.00%, the MAC value of sevoflurane for I-gel insertion in children (10).

Another possible explanation for the difference in jaw relaxation between IV propofol and inhalational sevoflurane may be that the propofol group received more anesthetic, as equipotent doses of both drugs could not be determined. This may account for the greater number of patients with apnea in the propofol group. However, the dose of 2 mg/kg was not excessively large for the young unpremedicated patients we studied. A third possibility is related to the anesthetics themselves. Propofol is known to have a relaxant effect on jaw muscles (11), whereas inhaled anesthetics may cause increased muscle tone and spasticity (12). Therefore, for a similar depth of anesthesia, there may be greaterjaw relaxation with propofol.

In contrast to the jaw tightness, there was excellent attenuation of laryngeal reflexes with both sevoflurane and propofol. This resulted in a low incidence of traumatic I-gel insertions in our patients. Although I-gel placement is more closely associated with deglutition and may only require suppression of the less sensitive hypopharynx for successful placement (13), stimulation of the anterior laryngeal structures may occur during

insertion. Therefore, successful attenuation of the laryngeal reflexes was essential to reduce the incidence of respiratory complications during I-gel insertions. This is normal for propofol, as it is known to have depressing properties on laryngeal reflexes and facilitate I-gel insertion (14). However, sevoflurane preserves laryngeal reflexes at values up to 1.8 MAC (15). Its effect on laryngeal reflexes above this value is un- known, but this study suggests that sevoflurane may depress laryngeal reflexes at the higher MAC values achieved in our patients.

The drawback of this study is that the depth of anesthesia between the two groups was not compared. However, it is difficult to compare the depth of anesthesia between inhaled and IV anesthetics. Although adequate depth of anesthesia may be correlated to plasma concentration for propofol (16), the correlation between MAC values and depth of anesthesia for sevoflurane is not clearly defined. This is because MAC refers to a state of equilibrium, which is not achieved during single VCB induction. Furthermore, the presence of a lag time between alveolar and brain concentrations may confound any attempted correlation. The use of electroencephalographic-related technology may provide some answers, as it has been shown to correlate with propofol-induced sedation (17). However, there is no correlation between sevoflurane anesthesia and adequate anesthesia to prevent movement using electroencephalographic derivatives(18). The cost of I-gel insertion with sevoflurane was marginally less than with propofol. We showed that the quality, safety, and reliability of sevoflurane single VCB induction of anesthesia makes it an alternative to IV propofol for the insertion of the LMA in adults. No adjuvant drugs were required. Sevoflurane VCB induction resulted in comparable complication rates and stable hemodynamic profile during the induction of anesthesia but a lower com- plication rate during I-gel insertion. It produced a lower incidence of apnea and allowed a smoother transition to the maintenance phase. However, it may result in a longer time to LMA insertion due to prolonged jaw tightness.

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