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Research Article

# LARYNGEAL MASK AIRWAY INSERTION: COMPARISON OF SEVOFLURANE WITH PROPOFOL IN ADULTS

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**ABSTRACT**

**Objectives:** The objectives of the study were to evaluate and compare sevoflurane in one vital capacity breath with propofol in dose of 2 mg/kg for ease of laryngeal mask airway (LMA) insertion in adults.

**Methods:** A cross-sectional observational study was conducted on patients scheduled for vascular, reconstructive, gynaecological, and day care surgeries for whom propofol (P) and sevoflurane (S) were used as induction agent for LMA insertion. All patients who fulfilled the inclusion and exclusion criteria and had given propofol or sevoflurane at various departments during the specified duration were included in the study and data were collected using pre-defined protocol. A total of 100 consecutive patients (50 patients in each group) were included in the study.

**Results:** The mean age for sevoflurane (S) group and propofol (P) group was 35.30, standard deviation (SD) 8.74 and 34.88, SD 9.37, respectively. Heart rate (HR) at 2 min, 3 min, and 4 min after induction showed a fall with propofol which was statistically significant. There was statistically significant difference in systolic blood pressure at on 1 min, 2 min, 3 min, and 4 min when compared between the two groups. A statistically significant fall in the systolic blood pressure in Group P was noted when compared to Group S. There was statistically significant difference in diastolic blood pressure at 4 min when compared between the two groups. A fall in the diastolic blood pressure in Group P was noted when compared to Group S at 4 min. There was fall in blood pressure in Group P when compared with Group S and this was significant. Fall in oxygen saturation in 3 and 4 min was significant. However, this fall was not clinically significant, as the values remained above 94%. There was increase in end-tidal carbon dioxide in 1, 2, 3, and 4 min and was statistically significant between the two groups. Sevoflurane took longer time for induction and LMA insertion. Loss of eye lash reflex, jaw relaxation, and LMA insertion were lost earlier with propofol and were statistically significant. The overall LMA insertion was excellent with propofol in 50 patients and with sevoflurane 48 patients had excellent condition and two were satisfactory.

**Conclusion:** In our study, sevoflurane was associated with good hemodynamic stability, but quality of anesthesia provided with propofol was superior. Delayed jaw relaxation with sevoflurane when compared to propofol delayed LMA insertion. The overall insertion was excellent with propofol with all 50 patients as compared to sevoflurane.

**Keywords:** Laryngeal mask airway, Sevoflurane, Propofol.

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## INTRODUCTION

The laryngeal mask airway (LMA) has gained widespread popularity for airway management during surgery. The LMA is an ingenious supraglottic airway device that is designed to provide and maintain a seal around the laryngeal inlet for spontaneous ventilation and allow controlled ventilation at modest levels (<15 cm of H2O) of positive pressure [1]. LMA has been used in millions of patients and is accepted as a safe technique, in variety of surgical procedures. It ensures a better control of airway than the facemask, leaving the anesthesiologists hands free and avoids the disadvantages of endotracheal tube-like pressure response during intubation and sore throat, croup, and hoarseness postoperatively. Laryngeal mask also provides an effective and simple solution to many problems of difficult intubation. With the use of LMA, muscle relaxation is unnecessary, laryngoscopy is avoided, and hemodynamic changes are minimized during insertion [2].

The ideal induction agent for LMA insertion would provide loss of consciousness, jaw relaxation, and absence of upper airway reflexes rapidly without cardiorespiratory compromise. Most currently available induction agents have been used for LMA insertion, but propofol is probably the best intravenous agent and sevoflurane is the best volatile agent [3]. Propofol has the advantages of rapid onset and short duration of action, easy titration, and favorable profile for side effects. Sevoflurane is a volatile anesthetic agent, which combines rapid, smooth inhalational induction of anesthesia with rapid recovery, making it particularly suitable for day case anesthesia. IV propofol with or without opioid is the induction agent of choice for LMA insertion. Because of its favorable recovery profile and low incidence of side effects, propofol has become the drug of choice for insertion of LMA but is associated with pain on injection and cardiovascular and respiratory depression [4].

Sevoflurane, a halogenated, volatile anesthetic agent, is non-irritating to the airways, and mask induction with this agent is associated with a very low incidence of breath holding, coughing, and laryngospasm. In addition, low lipid solubility allows a fast, smooth induction, and a predictably short recovery. Induction technique using a high inspired concentration of sevoflurane and vital capacity breaths (VCBs) provides good conditions for the insertion of LMA [5]. It combines rapid, smooth inhalational induction of anesthesia with rapid recovery, making it particularly suitable for day case anesthesia [6]. Sevoflurane is halogenated ether, which has rapid induction due to low blood: Gas partition (blood: Gas partition coefficient of 0.65 and fat: Blood solubility 48) at 37°C [7,8]. Induction of anesthesia with sevoflurane is generally well-received and causes less hypotension and apnea compared to propofol [9]. Sevoflurane has several properties which make it potentially useful for day case anesthetic. When compared, induction of anesthesia with sevoflurane is faster as compared to

propofol, however, subsequent recovery and discharge are generally similar for both of agents. Satisfactory insertion of the LMA after induction of anesthesia requires sufficient depth for suppression of airway reflexes [10].

Recently, VCB inhaled induction of anesthesia with sevoflurane has been used as an alternative to IV induction in adults. This method is rapid, with little excitatory phenomena, high patient acceptance, and good hemodynamic stability [11]. Rapid insertion of LMA after VCB induction may allow the use of sevoflurane as a single drug for the induction and maintenance of anesthesia, which would ease the transition period and lead to cost saving [7]. With this above background, we conducted this study to evaluate and compare sevoflurane in one VCB with propofol in dose of 2 mg/kg for ease of LMA insertion in adults.

## METHODS

A cross-sectional observational study was conducted on patients scheduled for vascular, reconstructive, gynecological, and day care surgeries for whom propofol (P) and sevoflurane (S) were used as induction agent for LMA insertion. All patients who fulfilled the inclusion and exclusion criteria and had given propofol or sevoflurane at various departments during the specified duration were included in the study and data were collected using pre-defined protocol. Thus, a total of 100 consecutive patients (50 patients in each group) were included in the study. Hospital ethical clearance was taken from the committee and written informed consent was taken from all enrolled patients. The Excel and SPSS (SPSS Inc., Chicago) software packages were used for data entry and analysis.

### Inclusion criteria

The following criteria were included in the study:

1. Patients 18–65 years of age
2. American Society of Anesthesiologists (ASA) physical status I and II
3. Patients weighing 40–70 kg
4. Patients undergoing elective vascular, reconstructive, gynecological, and day care surgeries.

### Exclusion criteria

The following criteria were excluded from the study:

1. Unwillingness
2. Known hypersensitivity to any drug being used (propofol or sevoflurane)
3. ASA III and above
4. Neonates and pediatric
5. Age less than 18 years and more than 65 years
6. Patients with a history of heavy smoking (>20 cigarettes per day), and any drugs that influence the induction anesthesia.

## RESULTS

The mean age for sevoflurane (S) group and propofol (P) group was 35.30, standard deviation (SD) 8.74 and 34.88, SD 9.37, respectively (Table 1). About 80% of participants were female in S group and 84% in P group (Table 2). There was no statistically significant difference in age and sex distribution among groups. Majority were from obstetrics and gynecology department (81%) (Table 3). Comparison of important vital parameters between two groups is shown in Tables 4 and 5. The heart rate (HR) at baseline and at the time of induction was not statistically significant. However, HR at 2 min, 3 min, and 4 min after induction showed a fall with propofol which was statistically significant. However, no significance was noted at 1 min. There was no significant difference in systolic blood pressure during induction. However, there was statistically significant difference in systolic blood pressure at 1 min, 2 min, 3 min, and 4 min when compared between the two groups. A statistically significant fall in the systolic blood pressure in Group P was noted when compared to Group S. There was no significant difference in diastolic blood pressure during induction, 1 min, and 2 min but there was statistically significant difference in diastolic blood pressure at 4 min when compared between the two groups. A fall in the diastolic blood pressure in Group P was noted when compared to Group S at 4 min. There was no statistically significant different in mean arterial blood pressure in both the groups at the time of induction when compared with two groups but there was fall in blood pressure in Group P when compared with Group S and this was significant. There was no statistically significance noted in fall in oxygen saturation in 1 and 2 min but was significant in 3 and 4 min. However, this fall was not clinically significant, as the values remained above 94%. There was increase in end-tidal carbon dioxide in 1, 2, 3, and 4 min and was statistically significant between the two groups. Sevoflurane took longer time for induction and LMA insertion. Loss of eye lash reflex, jaw relaxation, and LMA insertion were lost earlier with propofol and were statistically significant. The number of attempts for LMA insertion was compared using Student's t-test and was not significant. Occurrence of complications such as post-operative sore throat and apnea during induction and LMA insertion did not reach statistical significance in our study. The overall LMA insertion was excellent with propofol in 50 patients and with sevoflurane 48 patients had excellent condition and two were satisfactory.

## DISCUSSION

Satisfactory insertion of LMA after induction of anesthesia requires sufficient depth of anesthesia [12]. Propofol is an intravenous anesthetic agent commonly used for LMA insertion because of its greater depressant effect on airway reflexes [13]. Sevoflurane is suitable for inhalational induction technique even in high concentrations because of its low blood gas solubility and minimal respiratory irritant effect. The vital capacity induction technique with sevoflurane was used to make the technique similar to that of intravenous bolus injection of propofol [14]. Injection fentanyl was used as a coinduction agent because of known synergistic effect of opioid with both sevoflurane and propofol [15]. Propofol is a known induction agent for insertion of LMA with excellent jaw relaxation and allowed easy insertion of LMA. However, it is not ideal as it has been associated with several adverse effects including hypotension, apnea, and pain on injection. Recently, single breath VCB inhaled induction of anesthesia with sevoflurane has been used as an alternative to IV induction in adults. This is associated with high patient acceptance and good hemodynamic stability [16]. In this study, we compared the quality and speed of LMA insertion in adult patients after sevoflurane VCB inhaled induction and propofol intravenous induction of anesthesia.

Patients were randomly divided into two groups of 50 each: Group P (propofol) and Group S (sevoflurane). Patient's response to LMA insertion was assessed and post-operative sore throat, apnea, jaw relaxation, and ease of LMA insertion were noted. For assessing hemodynamic status – pulse rate, systolic and diastolic blood pressures were recorded, at induction, 1 min, 2 min 3min, and 4 min after LMA insertion.

### Timing of laryngeal mask airway insertion

In our study, mean time taken from induction to successful laryngeal mask insertion was significantly shorter in as propofol compared with sevoflurane. With the sevoflurane group, the LMA insertion took

**Table 1: Mean age (years) distribution of the study group**

| Groups | n | Mean age±SD | Minimum | Maximum | t | p | Significance |
|---|---|---|---|---|---|---|---|
| Sevoflurane | 50 | 35.30±8.74 | 24 | 60 | 0.232 | 0.82 | Not significant |
| Propofol | 50 | 34.88±9.37 | 21 | 67 | | | |

SD: Standard deviation

123.50 s while propofol has taken 103.76 s. Jaw relaxation has taken a longer time in the sevoflurane group with p=0.0001. This is highly significant. Priya *et al*., in their study, noted that propofol is known to depress laryngeal reflexes facilitating LMA insertion. They concluded that propofol is better than sevoflurane for LMA insertion using the loss of eyelash reflex as the end point of induction probably due to better jaw relaxation [17]. In our study, propofol took (74.02 s) for induction in comparison with sevoflurane (82.02 s). Thwaites *et al.,* in their study, observed that induction with sevoflurane was significantly slower when compared with propofol (mean 84 [SD24] sec vs. 57 [SD11] sec) but was associated with lower incidence of apnea and shorter time to establish spontaneous ventilation [18]. In contrast, Ravikumar *et al*., in their study, they noted that verbal contact and eyelash reflex with sevoflurane were lost earlier when compared to propofol. However, both propofol and sevoflurane took similar times to jaw relaxation (Group S 98 ± 10.34) versus Group P (93.75 ± 16.34 s) and subsequent LMA insertion (Group S 137 ± 0.0517.42 versus Group P 140.16 ± 21.67 s) [4]. Ti *et al*., in their study, achieved insertion of LMA with sevoflurane in 127 s almost similar to the time taken in our study (123.5 s). They concluded that prolonged jaw tightness after sevoflurane induction of anesthesia may delay LMA insertion [19]. Muzi *et al*., in their study, reported jaw tightness after sevoflurane anesthetic induction and this resulted in failure to insert the LMA in several patients [20].

**Table 2: Sex distribution in between two groups**

| Group | Sex | | Total (%) | p |
|---|---|---|---|---|
| | Male (%) | Female (%) | | |
| Sevoflurane | 10 (20) | 40 (80) | 50 (100) | 0.6027 |
| Propofol | 8 (16) | 42 (84) | 50 (100) | |
| Total | 18 (18) | 82 (82) | 100 (100) | |

**Table 3: Comparison of patients in various departments**

| Groups | Departments (%) | | | | Total (%) |
|---|---|---|---|---|---|
| | OBG | RSC | Vascular | URO | |
| Sevoflurane | 40 (80) | 5 (10) | 3 (6) | 2 (4) | 50 (100) |
| Propofol | 41 (82) | 4 (8) | 2 (4) | 3 (6) | 50 (100) |
| Total | 81 (81) | 9 (9) | 5 (5) | 5 (5) | 100 (100) |

OBG: Obstetrics & Gynaecology, RSC: Reconstructive Surgery, URO: Urology

**Hemodynamic changes while inserting laryngeal mask airway**

HR at 2 min, 3 min, and 4 min after induction showed a fall in the propofol group compared to sevoflurane which was statistically significant with p=0.011, 0.0005, and 0.0018, respectively, and these were statistically significant. The fall in systolic blood pressure between the two groups was statistically significant at 1, 2, 3, and 4 min. A significant fall in the systolic blood pressure in Group P was noted when compared to Group S.

The fall in mean arterial blood pressure was in Group P when compared with Group S and this was significant. Fredman *et al*., in their study, comparing the induction by sevoflurane versus propofol detected a decrease in mean arterial pressure (MAP) and HR after induction in comparison to pre-induction values, the study also detected that the decrease in HR in the sevoflurane group was more significant than that in the propofol group [21]. Jellish *et al*. detected significant decrease in MAP after propofol induction compared to sevoflurane induction in adult patients. The present study suggested that there was significant decrease in MAP in the patients induced by propofol compared to those induced by sevoflurane [22]. Thwaites *et al*., while comparing the hemodynamic parameters noted induction of anesthesia with propofol, were associated with decrease of approximately 20 mmHg in MAP which occurred within 2 min and persisted for at least 5 min of anesthesia. In contrast, they noted that decrease with MAP with sevoflurane was only 10 mm Hg. Almost similar results were noted in our study [18].

**Analysis of condition for laryngeal mask airway insertion and patient's response**

In our study, inadequate jaw relaxation was found in two patients in the sevoflurane group [Table 6]. In the same patients, ease of LMA insertion was difficult requiring third or fourth attempt. All patients in the propofol group had LMA inserted in the first or second attempt. In the sevoflurane group, two patients had LMA inserted in the fourth attempt, probably due to inadequate jaw relaxation. The overall condition of LMA insertion was an excellent in 49 patients and one was

**Table 4: Comparison of important vital parameters between two groups**

| Vital parameters | Sevoflurane | | Propofol | | t | p |
|---|---|---|---|---|---|---|
| | n | Mean±SD | n | Mean±SD | | |
| Pulse rate | | | | | | |
| At the time of induction | 50 | 86.91±6.85 | 50 | 85.12±6.86 | 1.23 | 0.22 |
| 1 min | 50 | 83.66±7.78 | 50 | 82.92±7.34 | 0.516 | 0.61 |
| 2 min | 50 | 85.88±8.96 | 50 | 81.46±7.92 | 2.60 | 0.011 |
| 3 min | 50 | 84.92±10.2 | 50 | 78.82±6.93 | 3.60 | 0.0005 |
| 4 min | 50 | 83.88±10.8 | 50 | 77.98±8.16 | 3.22 | 0.0018 |
| Systolic BP | | | | | | |
| At the time of induction | 50 | 121±10.8 | 50 | 122±11.2 | −0.590 | 0.56 |
| 1 min | 50 | 126±11.6 | 50 | 121±8.64 | 2.39 | 0.019 |
| 2 min | 50 | 120±11.2 | 50 | 112±8.22 | 4.41 | 0.0001 |
| 3 min | 50 | 115±9.81 | 50 | 104±8.76 | 5.83 | 0.0001 |
| 4 min | 50 | 110±12.5 | 50 | 96.9±8.01 | 6.00 | 0.0001 |
| Diastolic BP | | | | | | |
| At the time of induction | 50 | 76.84±8.88 | 50 | 76.86±8.22 | 0.199 | 0.84 |
| 1 min | 50 | 80.12±9.27 | 50 | 77.75±4.92 | 1.89 | 0.062 |
| 2 min | 50 | 75.98±7.40 | 50 | 74.57±5.94 | 1.18 | 0.24 |
| 3 min | 50 | 73.64±7.28 | 50 | 73.18±5.22 | 0.347 | 0.73 |
| 4 min | 50 | 72.46±8.15 | 50 | 67.59±9.89 | 2.75 | 0.0071 |
| MAP | | | | | | |
| At the time of induction | 50 | 91.7±6.21 | 50 | 90±6.17 | 1.82 | 0.072 |
| 1 min | 50 | 95.8±11.1 | 50 | 92.1±4.98 | 2.17 | 0.033 |
| 2 min | 50 | 90.6±7.89 | 50 | 87±5.34 | 2.65 | 0.0093 |
| 3 min | 50 | 87.5±7.74 | 50 | 83.6±3.90 | 2.77 | 0.0067 |
| 4 min | 50 | 84.8±12.5 | 50 | 77.5±5.85 | 4.17 | 0.0001 |

SD: Standard deviation, BP: Blood pressure, MAP: Mean arterial pressure

**Table 5: Comparison of oxygen saturation, end-tidal carbon dioxide, and time for laryngeal mask airway insertion between two groups**

| Variables | Sevoflurane | | Propofol | | t | p |
|---|---|---|---|---|---|---|
| | n | Mean±SD | n | Mean±SD | | |
| SpO2 | | | | | | |
| 1 min | 50 | 98.3±0.872 | 50 | 98.54±0.762 | −1.22 | 0.22 |
| 2 min | 50 | 97.72±0.730 | 50 | 97.64±0.851 | 0.505 | 0.62 |
| 3 min | 50 | 97.76±0.822 | 50 | 96.54±2.70 | 3.06 | 0.0029 |
| 4 min | 50 | 97.26±0.981 | 50 | 96.10±1.05 | 5.60 | 0.0001 |
| EtCO2 | | | | | | |
| 1 min | 50 | 38.20±1.73 | 50 | 39.76±1.29 | −5.17 | 0.0001 |
| 2 min | 50 | 37.90±1.43 | 50 | 39.22±1.42 | −4.57 | 0.0001 |
| 3 min | 50 | 37.64±1.29 | 50 | 38.90±1.59 | −4.28 | 0.0001 |
| 4 min | 50 | 37.36±1.41 | 50 | 38.68±1.75 | −4.21 | 0.0001 |
| Time for LMA insertion | | | | | | |
| Time to loss of eye lash reflex | 50 | 82.24±9.77 | 50 | 74.02±12.9 | 3.71 | 0.0003 |
| Time to jaw relaxation | 50 | 105.54±13.2 | 50 | 90.78±15.1 | 5.28 | 0.0001 |
| Time successful LMA insertion | 50 | 123.5±15.7 | 50 | 103.76±15.3 | 6.28 | 0.0001 |

EtCO2: End-tidal carbon dioxide, LMA: Laryngeal mask airway, SpO2: Oxygen saturation, SD: Standard deviation

**Table 6: Conditions for laryngeal mask airway insertion**

| Parameters | Description | Group | |
|---|---|---|---|
| | | Sevoflurane (n=50) | Propofol (n=50) |
| Jaw relaxation | Full | 48 | 50 |
| | Partial | 2 | 0 |
| | Difficult | 0 | 0 |
| Ease of LMA insertion | Easy | 48 | 50 |
| | Difficult | 2 | 0 |
| | Impossible | 0 | 0 |
| Apnea | Present | 0 | 5 |
| | Absent | 50 | 45 |
| Post-operative sore throat | Nil | 48 | 50 |
| | Transient | 2 | 0 |
| | Persistent | 0 | 0 |

LMA: Laryngeal mask airway

**Table 7 : Comparison of number of attempts at laryngeal mask airway insertion for successful placement**

| Group | *n* | Mean attempts±SD | Minimum | Maximum | t | p |
|---|---|---|---|---|---|---|
| Sevoflurane | 50 | 1.40±0.756 | 1 | 4 | 1.65 | 0.10 |
| Propofol | 50 | 1.20±0.404 | 1 | 2 | | |

SD: Standard deviation

satisfactory belonging to the propofol group. Forty-eight patients in the sevoflurane group had excellent conditions and two were in satisfactory condition. Muzi *et al*. encountered difficulty in jaw opening in 30% of patients induced by sevoflurane [20] as well as in other study of Ti *et al*. who encountered difficulty in jaw opening in 45% with sevoflurane and in 21% of patients induced by propofol. LMA was inserted after 1.2 (0.6) attempts with propofol and in 1.6 (0.7) attempts with sevoflurane and detected significant difference between the two groups [19]. In our study, it is done in 1.4 (0.75) attempts in the sevoflurane and 1.2 (0.40) attempts in the propofol group [Table 7]. In the study done by Fleischmann, *et al*., LMA was inserted from the first attempt with propofol in 85% of patients and in 75% with sevoflurane. This difference in the results may be explained by the different doses and concentrations of propofol and sevoflurane used by the investigators [23]. In a similar study conducted by Priya *et al*., features such as coughing, gagging, and patient movements did not reach statistical significance. In their study, they noted that jaw relaxation with propofol was much better. With sevoflurane, they noted that induction took longer time because sevoflurane has less relaxation properties when compared to propofol [18]. Koppula *et al*., in their study, found that both sevoflurane and propofol had similar quality for insertion of LMA and concluded that sevoflurane is a good alternative to propofol for LMA insertion [4]. Ti *et al*., in their study, found that more attempts at insertion of LMA were required in patients in the sevoflurane group versus those in the propofol group; they suggested that this was primarily because of incidence of initially impossible mouth opening [19]. Philip *et al*., in their study, noted more airway-related events (cough and hiccough) in the sevoflurane group and more hemodynamic events in the propofol group [24]. The airway-related incidents in our study were more in the sevoflurane group when compared to the propofol group but were not of any statistical significance. In our study, we showed that post-operative sore throat was present in two patients in Group S but none in Group P. Propofol induction was associated with frequent and more prolonged time of apnea. Apnea occurred in 10% of patients in Group P as compared with none in Group S.

## CONCLUSION

In our study, sevoflurane was associated with good hemodynamic stability, but quality of anesthesia provided with propofol was superior. Delayed jaw relaxation with sevoflurane when compared to propofol delayed LMA insertion. None of the patients had trauma during insertion as noticed by the absence of blood in LMA after removal in both groups. Patients who received propofol complained of pain while injection but had the advantage of inducing anesthesia rapidly and depressing upper airway reflexes. Patients who received sevoflurane complained of odor while mask was held. Sevoflurane took longer time for induction and LMA insertion. Loss of eye lash reflex, jaw relaxation, and LMA insertion were earlier with propofol and this was statistically significant. Occurrence of complications such as post-operative sore throat and apnea during induction and LMA insertion did not reach statistical significance in our study. The overall insertion was excellent with propofol with all 50 patients as compared to sevoflurane.

## CONFLICTS OF INTEREST

Nil.

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Nil.

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