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Original Research Article

Propofol vs Sevoflurane for Laryngeal Mask Airway Insertion: A Comparative Analysis in Minor Elective Surgeries

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Abstract

Background: Propofol, commonly used for induction, induces alterations in blood pressure and heart rate (HR) during laryngeal mask airway (LMA) insertion. Sevoflurane, however, presents a promising alternative as an induction agent. This study compares the effectiveness of propofol and sevoflurane for facilitating LMA insertion in adult patients undergoing minor surgeries. The main aim of the study was to assess and compare the ease of LMA insertion and related characteristics in adult patients undergoing minor elective surgeries with intravenous propofol versus inhalational sevoflurane.

Materials and Methods: This prospective, observational study included a total of 145 patients using consecutive sampling and divided into two groups: group A (propofol) and group B (sevoflurane). Key variables, such as anesthesia induction time, jaw relaxation time, and LMA insertion time, were recorded. LMA insertion conditions were evaluated using a 3-point scale across six variables, with a total score calculated for each group. Hemodynamic responses and induction-related complications were also documented.

Results: There were no significant differences between the groups in terms of demographic data, American Society of Anesthesiologists classification, Modified Mallampati Grading, or LMA size. The LMA insertion times were comparable between both groups. Regarding complications, while there were no cases of coughing, minor gagging and laryngospasm were observed exclusively in the sevoflurane group. Final score evaluation indicated excellent insertion conditions for propofol and sevoflurane, with no statistically significant difference between them.

Conclusion: Sevoflurane can be considered a viable alternative to intravenous propofol for LMA insertion in adult patients undergoing minor elective surgeries.

Keywords: Propofol; Sevoflurane; Induction Agent; Laryngeal Mask Airway.

Introduction

Effective airway management requires a thorough understanding of airway anatomy, anesthesia techniques, and the various devices used, as well as their associated complications. The introduction of the endotracheal tube was a significant advancement in airway management. However, both endotracheal intubation and laryngoscopy disrupt the patient's natural airway reflexes, leading to potential soft-tissue injury. This process also triggers sympathetic overactivity, resulting in increased heart rate (HR) and blood pressure. Supraglottic airway devices facilitate ventilation without needing to pass through the vocal cords. The development of the laryngeal mask airway (LMA) by in 1981 marked a turning point by shifting the emphasis from intubation to ensuring proper oxygenation and ventilation. The LMA can be used across various age groups during surgical procedures, offering a minimally invasive and low-trauma alternative. Its insertion does not require laryngoscopy or muscle relaxants [1-3]. The resulting airway irritation is minimal, leading to reduced hemodynamic fluctuations, decreased agitation and coughing during recovery from anesthesia, and a lower incidence of post-operative sore throat. This makes the LMA a preferred choice for ambulatory surgeries and minor day-care procedures, while also serving as an effective option for emergency and difficult airway management [4,5]. LMA insertion is typically performed after the administration of induction agents. These agents are used to achieve the necessary depth of anesthesia and to suppress airway reflexes. Among intravenous (IV) induction agents, propofol is frequently favored due to its smooth induction process, ability to suppress

airway reflexes, bronchodilatory effects, and ease of LMA insertion, with a lower incidence of side effects such as gagging, throat irritation, and laryngospasm [4,5]. However, propofol is more expensive and may cause injection site pain, thrombophlebitis, and cardio-respiratory depression [6]. Sevoflurane, a halogenated volatile anesthetic with a pleasant odor, is non-irritating to the airways and also exhibits bronchodilatory properties. Its low lipid solubility allows for rapid and smooth induction, easy adjustments in anesthetic depth, quick elimination, stable hemodynamics, and predictably faster recovery, making it ideal for outpatient anesthesia. Adverse reactions to sevoflurane may include coughing, laryngospasm, and breath-holding episodes [7-9].

Although several studies have compared the effectiveness of sevoflurane and propofol in LMA insertion, most utilized closed circuits or Bain's circuits, while Magill's circuit—often considered the most physiologically appropriate for spontaneous induction—has been less frequently studied. Furthermore, research on the use of LMA in minor surgical procedures remains limited, particularly in India. Therefore, additional studies are necessary to fill this gap. The primary goal of this study was to evaluate the ease of LMA insertion and its associated characteristics in adults undergoing minor elective surgeries, comparing the use of intravenous propofol with inhalational sevoflurane. Secondary objectives included assessing induction time, the actual time of LMA insertion, and the number of attempts, jaw relaxation time, LMA insertion time, apnea duration, hemodynamic monitoring, and the incidence of complications.

Material and Methods

This prospective, observational study included a total of 145 participants were through consecutive sampling, adhering to the guidelines of the American Society of Anesthesiologists (ASA). Inclusion criteria comprised ASA Grade I or II patients, aged between 18 and 60 years, of either sex, with a Modified Mallampati Grading (MMPG) of I or II, undergoing elective minor surgical procedures.

Patients were excluded if they were undergoing emergency surgery, had ASA Grade III or higher, MMPG Grades III or IV, restricted mouth opening (<2 finger breadths), upper airway obstruction or disruption, pulmonary fibrosis, morbid obesity, a known difficult airway, were at risk of aspiration, or were pregnant.

All participants underwent a pre-anesthetic check-up and received oral clobazam (0.5 mg) the night before surgery for anxiolysis. The participants were divided into two groups: Group A received intravenous propofol (2.5 mg/kg, administered at 40 mg/10 s), and Group B was induced with 8% sevoflurane in an air/O2 mixture (1:1, at 8 L/min) for 30 seconds using the Vital Capacity Breath (VCB) technique. Both groups received pre-oxygenation with 100% oxygen at 8 L/min for 3 minutes via a Magill circuit. Group S patients were preoxygenated using a separate anesthesia machine, while a second machine primed with 8% sevoflurane was used for induction. All patients were trained in the VCB technique prior to the procedure. Loss of consciousness was determined by the absence of the eyelash reflex in both groups.

Jaw relaxation was assessed before attempting LMA insertion, and in cases where insertion failed, spontaneous or assisted ventilation with 8% sevoflurane in 8 L of oxygen was provided. Repeated insertion attempts were made at 30-second intervals, with up to four attempts allowed. In Group P, if jaw relaxation was insufficient, additional propofol boluses (0.5 mg/kg) were administered at 30-second intervals, up to a maximum of four doses.

A trained anesthesiologist performed the LMA insertion after sufficient jaw relaxation. Study parameters included (1) induction time, (2) jaw relaxation time, (3) LMA insertion time, (4) success on the first attempt, (5) apnea duration, and (6) LMA insertion conditions. These conditions were assessed using a 3-point scale across six variables: jaw relaxation, patient movement, ease of insertion, cough reflex, gagging, and laryngospasm.

The total score was categorized as excellent (18), satisfactory (16-17), or poor (<16). Hemodynamic parameters, including heart rate (HR) and mean blood pressure (MBP), were recorded at induction, LMA insertion, and at 1, 3, and 5 minutes post-insertion. Induction-related complications, such as patient movement, coughing, gagging, laryngospasm, or events requiring termination or pharmacologic intervention, were also documented. The study concluded 5 minutes after successful LMA insertion, and the surgical case proceeded as per routine care. Data were recorded and organized using Microsoft Excel. Results were presented as means and standard deviations. The Chi-square test and Mann–Whitney U test were used to compare variables between the two groups. Statistical analysis was conducted using SPSS software (version 21), with a P-value < 0.05 considered statistically significant.

Results

Table 1 shows comparable LMA insertion conditions between Group A and Group B across all parameters demonstrating no significant difference.

Table 1: Scoring for LMA Insertion Conditions

Parameters	Group A; n=73 (%)	Group B; n=72 (%)	P-value
Jaw Relaxation			0.91
Full (3)	70 (48.28)	68 (46.9)	
Partial (2)	3 (2.07)	4 (2.76)	
Nil (1)	0 (0)	0 (0)	
Ease of Insertion			0.32
Easy (3)	71 (48.97)	67 (46.21)	
Difficult (2)	2 (13.33)	5 (33.33)	
Impossible (1)	0 (0)	0 (0)	
Patient Movement			0.72
Nil (3)	67 (46.21)	70 (48.28)	
Moderate (2)	6 (4.14)	2 (13.33)	
Vigorous (1)	0 (0)	0 (0)	
Incidence of Coughing			0.97
Nil (3)	73 (50.34)	72 (49.66)	
Minor (2)	0 (0)	0 (0)	
Severe (1)	0 (0)	0 (0)	
Gagging			0.52
Nil (3)	73 (50.34)	70 (48.28)	
Minor (2)	0 (0)	2 (13.33)	
Severe (1)	0 (0)	0 (0)	
Laryngospasm			0.28
Nil (3)	73 (50.34)	68 (46.9)	
Minor (2)	0 (0)	4 (2.76)	
Severe (1)	0 (0)	0 (0)	
Final Scoring			0.49
Excellent (18)	68 (46.9)	61 (42.07)	
Satisfactory (16-17)	5 (33.33)	11 (7.59)	
Poor (<16)	0 (0)	0 (0)	
Mean Score	17.88 ± 0.31	17.71 ± 0.56	0.11

Both groups had similar demographic characteristics. The mean age in Group A was 38.51 ± 9.49 years, while in Group B, it was 39.55 ± 9.34 years (p = 0.91). There were no significant differences in gender distribution or weight between the two groups. ASA classification and MMPG grading were also comparable. LMA size distribution showed no significant difference between groups (p = 0.25), although Group B had a higher number of participants with LMA size 5 (Table 2).

Table 2: Demographic and LMA size details in study participants

Parameters	Group A (n=73)	Group B (n=72)	P-value
Age (years)	38.51 ± 9.49	39.55 ± 9.34	0.91
Male	42	39	0.81
Female	31	33	
Weight (kg)	67.47 ± 7.45	66.37 ± 6.33	0.45
ASA I	53	50	0.97
ASA II	20	22	
MMPG I	32	39	0.67
MMPG II	41	33	
LMA Size 3	1	0	0.25
LMA Size 4	38	29	
LMA Size 5	34	43	

Significant differences were observed between the groups regarding induction characteristics. Group A had a shorter induction time (38.92 ± 2.60 seconds) compared to Group B (46.26 ± 2.51 seconds), with a p-value < 0.01. Similarly, jaw relaxation occurred more quickly in Group A (62.25 ± 2.46 seconds) than in Group B (90.00 ± 3.26 seconds, p < 0.01). Apnea time was longer in Group A (33.41 ± 6.52 seconds) than in Group B (25.90 ± 2.95 seconds), also with a p-value < 0.01.

However, LMA insertion time did not differ significantly between the groups (Table 3).

Table 3: Induction characteristics in study participants

Parameter	Group A (Mean ± SD)	Group B (Mean ± SD)	P-value
Induction Time (s)	38.92 ± 2.60	46.26 ± 2.51	< 0.01
Jaw Relaxation (s)	62.25 ± 2.46	90.00 ± 3.26	< 0.01
Apnea Time (s)	33.41 ± 6.52	25.90 ± 2.95	< 0.01
LMA insertion Time (s)	9.42 ± 1.35	10.45 ± 1.52	0.86

Heart rate changes were more pronounced in Group B during the procedure. Post-LMA heart rate was significantly higher in Group B (89.72 ± 1.58 bpm) than in Group A (85.48 ± 1.25 bpm), with a p-value < 0.05. Similarly, at 1 minute, 3 minutes, and 5 minutes after LMA insertion, Group B exhibited significantly higher heart rates (p-values < 0.05) (Table 4).

Table 4: Heart rate at different time in study participants

Parameter	Group A (Mean ± SD)	Group B (Mean ± SD)	P Value
Baseline	84.13 ± 1.52	85.27 ± 1.44	0.85
At Induction	88.24 ± 1.36	90.11 ± 1.65	0.61
Post LMA	85.48 ± 1.25	89.72 ± 1.58	<0.05
At 1 min	75.35 ± 1.83	83.47 ± 1.76	<0.05
At 3 min	73.82 ± 1.69	80.19 ± 1.65	<0.05
At 5 min	77.68 ± 1.74	83.91 ± 1.59	<0.05

Group B demonstrated higher mean arterial pressure (MAP) than Group A at multiple time points. Post-LMA, Group B had a MAP of 95.82 ± 1.92 mmHg compared to 92.50 ± 1.64 mmHg in Group A (p < 0.01). This trend continued at 1 minute, 3 minutes, and 5 minutes after LMA insertion, where Group B consistently showed higher MAP values, all with p-values < 0.01 (Table 5).

Table 5: MAP at different time in study participants

Parameter	Group A (Mean ± SD)	Group B (Mean ± SD)	P Value
Baseline	85.34 ± 1.54	85.90 ± 1.67	0.33
At Induction	90.28 ± 1.72	91.57 ± 1.83	0.13
Post LMA	92.50 ± 1.64	95.82 ± 1.92	< 0.01
At 1 min	78.64 ± 1.77	88.75 ± 1.65	< 0.01
At 3 min	74.28 ± 1.60	86.48 ± 1.74	< 0.01
At 5 min	71.39 ± 1.55	84.91 ± 1.59	< 0.01

Discussion

For LMA insertion, propofol is widely recognized as an effective induction agent, though it is associated with certain unavoidable side effects. Inhalational agents like sevoflurane are considered a more reliable alternative, with some studies even demonstrating their superiority over propofol [11,12].

Various studies have compared propofol and sevoflurane, but most utilized Bain's circuit or circle systems, which are unsuitable for spontaneous ventilation. In comparing the tidal volume method of sevoflurane induction to the breath technique [13-15], the latter was found to be faster, more hemodynamically stable, and preferred by patients [16]. Research by Sivalingam et al. [13] and Sarkar et al. [17] confirmed that sevoflurane provided faster induction, though LMA insertion times were similar for both agents, unlike findings in other studies. The administration of opioids prior to LMA insertion enhances the effects of both agents [18]. Gupta et al. [13] and Dharmalingam et al. [18] reported mean induction times for sevoflurane using the tidal volume breathing method as 145.93 ± 53.07 s and 120 ± 30 s, respectively. In contrast, our study found significantly faster induction with propofol (39.92 ± 2.74 s) compared to sevoflurane (47.64 ± 2.64 s), a statistically significant difference, consistent with the findings of Udaybhaskar et al. [19]. The mean LMA insertion times for both Group A (propofol) and Group B (sevoflurane) in our study were comparable, though the difference was not statistically significant. Similar results were observed by Sarkar et al. [16] and Prakash et al. [20]. In contrast, Siddik-Sayyed et al. [21] reported significantly faster LMA insertion with propofol, but their study used a higher propofol dose (3 mg/kg). In our study, LMA insertion was successful in all patients, with the mean number of attempts being nearly identical between the two groups (P = 0.51). Dharmalingam et al. [18] and Prakash et al. [20] also found similar results,

though their studies reported a higher number of attempts in the sevoflurane group, possibly due to the use of lignocaine with propofol and the absence of opioid administration.

We compared both groups based on various insertion criteria (jaw relaxation, ease of insertion, etc.) and complications (gagging, coughing, laryngospasm, and body movements), scoring these on a scale of 1 to 3. Our results were consistent with studies by Udaybhaskar et al. [19] and Priya et al. [22]. Priya et al. [22] found partial jaw opening in 28% of the propofol group and 56% of the sevoflurane group, while our study showed excellent jaw relaxation in the majority of patients. These findings aligned with the results of Udaybhaskar et al. [19] and Prakash et al. [20]. The subjective ease of LMA insertion was similar between the two groups, corroborating the results of Udaybhaskar et al. [19] and Prakash et al. [20].

None of the patients in either group experienced coughing, though gagging was reported in Group B patients. Sivalingam et al. [11] found coughing in 12% of the propofol group and 20% of the sevoflurane group, while Prakash et al. [20] reported no such incidences, similar to our findings. No life-threatening laryngospasm occurred in either group, consistent with Prakash et al. [20], though some Group B patients experienced minor laryngospasm, which is comparable to the findings of Siddik-Sayyed et al. [21] and Priya et al. [22], where the incidence was 8% and 12%, respectively, in the sevoflurane group. In terms of hemodynamic stability, sevoflurane was found to be more stable than propofol. Overall, LMA insertion conditions were comparable between the two groups, a result similar to Prakash et al. [20] but differing from Priya et al. [22], where conditions in the propofol group were significantly more favorable.

Conclusion

Prolonged induction and jaw relaxation times may potentially delay LMA insertion when using sevoflurane.

However, the overall insertion characteristics of LMA were found to be comparable between propofol and sevoflurane. There was no significant difference between the two agents in terms of complications, including coughing, gagging, patient movements, or laryngospasm. Notably, sevoflurane demonstrated superior hemodynamic stability, suggesting it may be advantageous in cases where the use of propofol is contraindicated. In conclusion, inhalational sevoflurane (8%) may be considered a feasible alternative to intravenous propofol (2.5 mg/kg) for LMA insertion in patients undergoing minor elective surgeries.

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