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A randomized controlled trial on comparison of sevoflurane induction to propofol induction for insertion of laryngeal mask airway in adults

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Abstract

Background: The laryngeal mask airway is a popular supraglottic airway device, with intravenous propofol being the agent of choice for its insertion. Sevoflurane is a volatile anaesthetic agent, which combines rapid, smooth inhalational induction of anaesthesia with rapid recovery, making it ideal for day care anaesthesia.

Objective: To compare conditions for LMA insertion following induction with intravenous propofol and inhalational induction with sevoflurane (viz., jaw opening, ease of insertion, coughing, gagging, laryngospasm and patient movement) and number of attempts for insertion of Laryngeal Mask Airway.

Study design: A randomized single blinded clinical trial.

Methods: After obtaining the institutional ethical committee approval, fifty adults patients were allocated randomly into two groups of 25 each; group P (Propofol group) and group S (Sevoflurane group). Patients in group P were induced with 2.5 mg/kg intravenous Propofol. In group S, after priming the Bain's circuit with Sevoflurane 8% in 50% N2O and O2 (flow rate – 8 litre/minute) for 30 seconds, patients were asked to take vital capacity breaths via the face mask connected to primed circuit. The LMA insertion was attempted afterloss of eyelash reflex and assessing the jaw relaxation. Scoring system was used to grade the conditions for the LMA insertion.

Results: The mean time required for induction with propofol was 34.08 secs and with sevoflurane it was 46.96 secs. The mean time required for LMA insertion with propofol was 63.04±3.75ssecs and in sevoflurane group it was 87.48±15.14ssecs. In both the groups excellent conditions for LMA insertion were obtained. Complications while inserting LMA were not significant in both the groups.

Conclusion: The observation of this study shows that propofol produces a much faster induction and good jaw relaxation for insertion of LMA than induction with sevoflurane. The insertional characteristics like coughing, gagging, laryngospasm, ease of insertion, patient movements and haemodynamic stability are comparable between the two groups. Prolonged time to jaw relaxation with Sevoflurane when compared to Propofol may delay laryngeal mask airway insertion.

Keywords: Propofol; Sevoflurane; Vital capacity breath induction; Laryngeal Mask Airway.

Introduction

Securing the airway and maintaining adequate ventilation and oxygenation is an integral part of General Anaesthesia. For decades, bag and mask ventilation was the mainstay of airway management. Airway management has come a long way since the development of Endotracheal tube by William Macewan in 1880.[1]

In 1981 Dr Archie IJ Brain, a British Anaesthesiologist at London Royal Hospital developed a novel device the Laryngeal Mask Airway.[2] It fills the gap in airway management between tracheal intubation and face mask. The increasing emphasis on day care anaesthesia has led to the greater use of LMA as an alternative to the face mask and in some cases to tracheal intubation. It ensures a better control of airway than the face mask, leaving the anaesthesiologist hands free and avoids the disadvantages of endotracheal tube like pressor response during intubation and sore throat, croup, hoarseness postoperatively. Laryngeal mask airway can also be used to manage difficult intubations.[3] Muscle relaxation is unnecessary when using an LMA. It allows the administration of inhaled anaesthetics through a minimally stimulating airway.[5]

Since its introduction, various induction agents namely thiopentone,[6] propofol,[7-11] halothane,[12] sevoflurane[13,14] have been used for induction of anaesthesia for laryngeal mask airway placement. Satisfactory insertion of the laryngeal mask airway after induction of anaesthesia requires sufficient depth for suppression of airway reflexes.

An ideal induction agent for LMA insertion would provide rapid loss of consciousness, jaw relaxation, absence of upper airway reflexes without cardio respiratory compromise. Propofol is probably the best intravenous agent and sevoflurane is the best volatile agent, though neither is ideal.

Intravenous Propofol with or without an opioid has been the induction agent of choice for LMA insertion, as it provides better pharyngeal and laryngeal relaxation, depressing the upper airway reflexes.[15] It has a favorable recovery profile with low incidence of side effects like pain on injection and cardiovascular and respiratory depression (hypotension, apnoea).[7-11,15]

Sevoflurane, a halogenated volatile anaesthetic agent is non-irritant to the airways and is suitable for inhalation induction in both children and adults. It is associated with a very low incidence of breath holding, coughing, and laryngospasm.[13,14,16] It has a low lipid

solubility which allows a rapid and smooth induction, quick adjustments of anaesthetic depth, rapid elimination, good haemodynamic stability, and a predictably short recovery.

Inhalational induction with 8% Sevoflurane has been used as an alternative to propofol in patients undergoing ambulatory surgeries.[14] Faster induction time, haemodynamic stability and satisfactory patient recovery characteristics of sevoflurane induction and attenuation of airway reflexes can be of advantage in LMA insertion.[14] Sevoflurane when used for induction can be used as a single drug for the induction as well as maintenance of anesthesia, which would ease the transition period.[16]

In this study we are comparing the induction characteristics, ease of LMA insertion, haemodynamic changes and any complications occurring during LMA insertion with propofol to that of sevoflurane.

Methods

After obtaining the institutional ethical committee approval, 50 patients (aged between 18 and 55 years) of either sex admitted to SRM medical college Hospital and Research Centre, scheduled for various elective procedures under general anaesthesia lasting less than 60 minutes, assessed under ASA PS class I and II were included in the study.

A pilot study was done and the power analysis showed a 90% power with a sample size of 24 (alpha error 5%).

Patients were randomly allocated into two groups of 25 each; group P, Propofol group (n=25), and group S, Sevoflurane group(n=25) based on computer generated random numbers. Patients with ASA grade > III, Mallampati grade III and IV, morbidly obese patients and patients at risk of aspiration (previous upper gastrointestinal tract surgeries, known or symptomatic hiatus hernia, oesophageal reflux) were excluded from the study.

Preparation

All patients included in the study were premedicated with Tab.Alprazolam 0.25 mg, Tab. Ranitidine 150 mg and Tab. Metoclopromide 10mg orally the night before surgery and in the morning on the day of surgery. Standard NPO guidelines were followed.

After shifting the patients inside the operation theatre vital monitors, which included the NIBP, SpO2, ECG were connected and an intravenous access was obtained and an infusion of normal saline was started. Prior to induction, patients in both the groups were premedicated with Inj. Glycopyrolate 0.005mg/kg i.v, Inj. Midazolam 0.1mg/kg i.v, Inj.Fentanyl 2mcg/kg i.v. Inj. lidocaine 0.3mg/kg All the patients were preoxygenated with 100% O2 at 8L/minute using an additional Bain's circuit (Mapelson-D) with a 2liter reservoir bag for 3 minutes.

The patients were randomly assigned, based on computer generated random numbers to:

Group – P (Propofol): Patients were induced with Inj.Propofol 2.5mg/kg i.v. over 30 seconds. Following induction of anaesthesia (confirmed by loss of eyelashreflex), jaw relaxation was assessed(by noting the loss of motor response to forward jaw thrust)After jaw relaxation was attained, LMA insertion done with the standard technique.The time taken for the loss of eyelash reflex, time to jaw relaxation were noted. The time to LMA insertion and number of attempts required for successful insertion were noted. If unsuccessful, spontaneous or assisted ventilation with N_2O 50% and O_2 50% was done, jaw relaxation was assessed and if adequate enough LMA insertion repeated, up to maximum of three attempts. Each time preceded by boluses of 0.5 mg/kg i.v propofol.

Group – S (Sevoflurane): The anaesthesia circuit was primed with 8% Sevoflurane in N_2O 50% and O_2 50% at 8litres/minute for 30 seconds.

The patient was asked to exhale fully and then inhale fully(vital capacity breath). At the end of expiration, the mask connected to primed circuit from the anaesthesia machine was placed on the patient. The patients were asked to perform the vital capacity breaths. The time of induction (loss of eye lash reflex) was noted and assisted mask ventilation continued.jaw relaxation was assessed and if adequate, LMA placement attempted. If unsuccessful, patients were continued on assisted ventilation with Sevoflurane 8% in N_2O 50% and O_2 50% and the jaw relaxation was assessed and if adequate LMA insertion was repeated, up to maximum of three attempts.

In both the groups' failure of insertion of LMA after three attempts, LMA insertion was facilitated by giving Inj.Succinylcholine 25 mg i.v.

A Classic LMA (LMA size #3 will be used for<70 kg and size #4 for >70 kg) lubricated with lignocaine jelly on posterior surface was inserted using the method described by Brain.

The correct placement of the LMA was confirmed by Capnography and 5 point auscultation.

Definition of parameters observed

Loss of consciousness is defined as loss of eyelash reflex and is considered as the end point of induction. Time of induction is defined as the interval from the beginning of induction to the loss of eyelash reflex. Time for laryngeal mask airway insertion (in seconds) taken from the time to loss of eyelash reflex to successful insertion of laryngeal mask airway.

The attenuation of laryngeal reflex is graded as follows

- Grade I (Full) -when, laryngeal mask airway is inserted smoothly.
- Grade II (Partial) -when insertion is accompanied by gagging coughing or involuntary movements.

- Grade III (Poor) -when laryngeal mask airway insertion is not possible.

Success of laryngeal mask airway insertion is defined as ability to insert laryngeal mask airway for oxygenation and ventilation without the need for other rescue methods. Failure of insertion is defined as failure to insert laryngeal mask airway after three attempts.

Induction complications is defined as presence of oxygen desaturation (less than 90%), coughing, laryngospasm, patients movements, and any other events that requires termination of induction techniques or requiring any other pharmacological interventions.

- Apnoea is defined as cessation of respiration for more than 30 seconds after insertion of LMA.

Grading of LMA insertion

		Grade	Score
Introduction to LMA	Jaw opening	3	Full
		2	Partial
		1	Nil
	Ease of insertion	3	Easy
		2	Difficult
		1	Impossible
Patient response	coughing	3	Nil
		2	Minor
		1	Severe
	gagging	3	Nil
		2	Minor
		1	Severe
	laryngospasm	3	Nil
		2	Partial
		1	Total
	Patient movements	3	Nil
		2	Moderate
		1	Vigorous

Results

All data were collected, tabulated and expressed as Mean ± Standard deviation. Statistical analysis was done using SPSS 17 (Statistical Package for the Social Sciences) software for windows. All quantitative data were compared using Independent t-test and all qualitative data were compared using Chi-Square test. P-values were calculated for all the tests. A p-value < 0.05 was considered significant (S) and p-value < 0.01 was considered highly significant (HS).

There were no significant differences between the two groups in demographic data. The mean age in group P is 32.44 years and in group S is 36.68 years. The mean weight in group P is 54.48 kg and in group S is 55.56 kg.

The induction time in Group P was much less(34.08±5.49s) when compared to that in Group S(46.96±10.29s), and is highly statistically significant (p value 0.001).The time to jaw relaxation was faster in Group P(60.84±13.75s) when compared to Group S(76.84±20.87s)with a p-value 0.000 which was highly statistically significant. The time to LMA insertion was much faster inGroup P(63.04±3.75s) when compared to Group S(87.48±15.14s)with p-value 0.000 which is highly statistically significant.

The insertion was successful by the 1st attempt in all the patients of the propofol group. Whereas in group S, LMA insertion at first attempt was successful in 24 cases, the remaining 1 in the second attempt. But this is not statistically significant.

There were 2 patients who had movements during induction in the propofol group and sevofluranegroup. There was one incident of gagging and laryngospasm in group S.

No statistically significant difference was found between both the groups with respect to the insertional characteristics.

Grading of conditions for LMA insertion

	Grade	Group P	Group S	p-value
Jaw opening	3	25	25	
	2	0	0	
	1	0	0	
Ease of insertion	3	23	23	1.000
	2	2	2	
	1	0	0	
Coughing	3	25	25	
	2	0	0	
	1	0	0	
Gagging	3	25	24	0.312
	2	0	1	
	1	0	0	
Laryngospasm	3	25	24	0.312
	2	0	1	
	1	0	0	
Patient movements	3	23	23	1.000
	2	2	2	
	1	0	0	

The overall LMA insertion conditions in group P and group S were comparable and there was no statistically significant difference (p-value 0.440).

Overall conditions for LMA insertion

Scoring	Group - P		Group - S		p-value
18 (Excellent)	22	88.0%	20	80.0%	0.440 (NS)
16-17 (Satisfactory)	3	12.0%	5	20.0%	
<16 (Poor)	0	0.0%	0	0.0%	

Group P had an increase in heart rate at insertion and at 2 min from the basal value which was statistically significant (p-value 0.048 and 0.031). Similarly in Group S there was an increase in heart rate at insertion and at 2min from the basal value which was statistically significant (p-value 0.001 and 0.002). When both the groups were analyzed together there was no statistically significant difference in heart rate from basal to 8 min (the lowest p-value being 0.096).

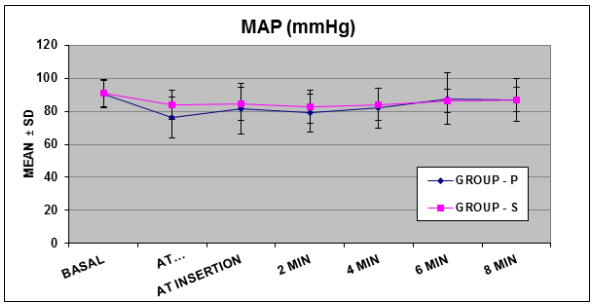
Comparison of heart rate between the two groups

Heart Rate (bpm)	Group - P	Group - S	p-value
	Mean±SD		
Basal	80.16±9.95	78.36±9.15	0.509
At Induction	82.96±10.22	78.32±9.04	0.096
At Insertion	85.72±11.34	85.12±9.93	0.843
2 Min	85.04±9.89	84.56±9.95	0.865
4 Min	84.12±10.33	81.12±8.87	0.276
6 Min	84.32±9.28	81.32±8.31	0.235
8 Min	82.32±8.15	79.64±8.06	0.248

When comparing both the groups there was a statistically significant fall in MAP at induction (p-value 0.017). Whereas when both the groups were statistically analyzed separately, in Group P, there was a highly significant fall in MAP at induction, at insertion, at 2min and at 4minafter which the MAP gradually returned to baseline. Similarly in Group S there was a highly significant fall in MAP from basal till 4minafter which the MAP gradually returned to baseline.

Comparison of mean arterial pressure between the two groups

MAP	Group - P	Group - S	p-value
	Mean ± SD		
Basal	90.52±8.13	90.76±8.27	0.918
At Induction	76.24±12.63	83.88±8.91	0.017
At Insertion	81.52±15.43	84.44±10.23	0.434
2 Min	78.92±11.68	82.68±9.98	0.227
4 Min	82.00±12.19	84.20±9.91	0.487
6 Min	87.68±15.53	86.24±7.35	0.677
8 Min	86.88±13.00	86.96±7.46	0.979



Discussion

Laryngeal mask airway insertion requires deep plane of anaesthesia and suppression of respiratory reflexes for which Propofol is the drug that provides ideal conditions. In our study, Sevoflurane also produces smoother induction and successful LMA insertion, which correlates with most of the corresponding studies.

There is a statistically significant faster induction with propofol than with sevoflurane in our study, which concurs with the results of Priya V et al.,[8] Hall JE et al.,[13] Thwaites A et al.,[16] Saravanan Ravi et al.[18] In contrast Ravikumar Koppula and Anitha Shenoy et al.,[17] in their study noted that the time to loss of eyelash reflex and verbal contact was faster with sevoflurane when compared to propofol.

In our study mean insertion time was significantly lower in group P(60.84±13.74s) than in group S(76.84±13.74s). This correlates well with the study conducted by Lian et al.,[7] Sahar M Siddik-Sayyid et al,[10] Zhang Guohua et al.[11]

In our study adequate jaw opening was present in all the patients (100%) in both the groups. However the ease of insertion was difficult in two patients in both the group, but the LMA was inserted in the first attempt itself in those two patients in both the groups. Hall et al[13] stated that jaw opening takes longer with sevoflurane than propofol. Partial jaw opening was noted in the study by Shivalingamet al.[9] (24% in propofolgroup, 40% in sevoflurane group), Priya et al.[8] (28% partial jaw opening in propofol group and 56% in sevofluranegroup). The ease of insertion of LMA was better in our study probably due to our method of waiting for adequate jaw relaxation.

In our study, the overall conditions for LMA insertion were excellent in 88% patients and satisfactory in 12% patients in Group P, whereas in Group S it was excellent in 80% and satisfactory in 20% patients. Priya et al.,[8] in their study, obtained excellent conditions for LMA insertion in a significantly greater number of patients in propofol group (64%) than in sevoflurane group (32%) (p-value 0.002).

In our study we did not encounter any coughing but [one patient in Group S had gagging which was statistically not significant.

In our study there were movements in 8% of patients in both the groups. It was statistically not significant (p-value 1.000). Other investigators noticed occurrence of movements in their studies, Siddik-Sayyid et al.[10] (50% in propofol group, 19% in sevoflurane group), Lian Ti et al[7] (propofol group - 52%), Priya et al.[8] (12% in propofol group and 28% in sevoflurane group).

In our study, laryngospasm occurred in one patient in Sevofluranegroup. Laryngospasm was also noted in studies done by Priyaet al.[8] and Siddik Sayyid et al.,[10] in the sevoflurane group.

Propofol is known to depress the laryngeal reflexes, thus facilitating LMA insertion. This feature could also explain the absence of laryngospasm in Propofol group. Inj.Fentanyl and Inj.Lignocane, which also have a role in the attenuation of laryngeal reflexes, have been used in the study. However, their doses have been standardized and were common to both group of patients.

In our study LMA was inserted in the first attempt in 25 patients (100%) in propofol group and in 24 patients (96%) in sevoflurane group. There was no statistically significant difference between the two groups. LianKah Ti et al.,[7] and Siddique Sayyid et al.[10] noted that LMA insertion required fewer attempts with Propofol when compared to Sevoflurane.

In our study in Group P, a maximum increase of HR of 5 bpm occurred during LMA insertion and stabilized after a few minutes, whereas in Group S there was an increase of HR to 7 bpm from the basal during insertion, which also stabilized after a few minutes. There was no statistically significant difference between the two groups. In our study when comparing the MAP between both the groups, there was a statistically significant fall in MAP at induction (p-value 0.017). Whereas when both the groups were statistically analyzed separately, in Group P, there was a highly significant fall in MAP at induction, at insertion, at 2min and at 4min after which the MAP gradually returned to baseline. In Group S there was a highly significant fall in MAP from basal till 4 min.

A. Thwaites, S. Edmends and I. Smith et al.[16], while comparing the hemodynamic parameters noted induction of anesthesia with propofol was associated with decrease of approximately 20 mmHg in MAP which occurred within 2 min and persisted for atleast 5 min, whereas with sevoflurane the decrease in MAP was only 10mmHg.

Conclusion

Hence we conclude that induction with Propofol is better than induction with Sevoflurane for insertion of LMA in adults with respect to the induction time, the time required for LMA insertion, the response of the patient to LMA insertion including the presence or absence of gagging, coughing, patient movements, laryngospasm and haemodynamic parameters. The ease of insertion and jaw relaxation were comparable in both the groups.

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