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Original Research Article

Comparison of intravenous induction with propofol to vital capacity breath induction with sevoflurane for insertion of laryngeal mask airway

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ABSTRACT

Background: The increasing emphasis on day care anaesthesia has led to the greater use of laryngeal mask airway (LMA) as an alternative to tracheal intubation for short procedure surgeries. Satisfactory insertion of LMA after induction of anaesthesia requires sufficient depth for suppression of airway reflexes. This study was performed to compare intravenous induction with Propofol to vital capacity breath induction with sevoflurane for LMA insertion.
Methods: In this study 100 ASA 1 and ASA 2 patients aged between 20 and 40 years, undergoing short surgical procedures lasting 30 to 60 minutes, were included. The P group received Inj. Propofol 2.5 mg/kg IV whereas the S group received Sevoflurane 8% vital capacity breaths. After the loss of eyelash reflex, which was considered the end point of induction, the LMA insertion was attempted by an anaesthesiologist blinded to the induction technique. The data that was recorded was induction time with both the drugs, characteristics of LMA insertion, hemodynamic responses and complications if any. The number of attempts at insertion was also noted.
Results: Induction time was 60.1±8.98 secs for propofol induction and 72.8±15.86 for sevoflurane vital capacity breath induction which was found statistically significant. The insertion conditions were found excellent in 88% in the propofol group and 90% in the sevoflurane group which was comparable. There was no statistically significant difference found in the time or characteristics of insertion between both the groups. No incidence of complications was found in both groups.
Conclusions: Induction with sevoflurane vital capacity breath inhalation compared equally with induction with intravenous propofol for LMA insertion in patients undergoing short surgical procedures.

Keywords: Laryngeal mask airway, Propofol, Sevoflurane

INTRODUCTION

The development of the laryngeal mask airway (LMA) device has been of significant advantage in airway management. It fills the gap in airway management between use of facemask and tracheal intubation. It allows the administration of inhaled anaesthetics through a minimally stimulating airway. Satisfactory insertion of LMA after induction of anaesthesia requires sufficient depth for suppression of airway reflexes and also to avoid untoward effects due to airway instrumentation.

Intravenous Propofol has been an induction agent of choice for LMA insertion as it provides good pharyngeal and laryngeal relaxation and depresses airway reflexes.[1-3] It has a fast induction rate and a favorable recovery profile too. However it is associated with adverse effects like pain on injection, cardiovascular and respiratory depression like hypotension and apnoea.[2,3]

Sevoflurane, a halogenated inhalational anaesthetic agent with pleasant odour, is non-irritating to the airways and has come up as a suitable inhalational induction agent with excellent recovery.[4-7]

The present study was conducted to compare the induction characteristics, ease of LMA insertion, hemodynamic changes and occurrence of any complications during LMA insertion following induction with intravenous propofol and 8% sevoflurane vital capacity breath induction.

METHODS

The study was undertaken at Jubilee Mission Medical College and Research Institute, Thrissur, Kerala during the period August 2015 to November 2016. One hundred patients of both sexes, aged between 20 and 40 years, were included in the study after obtaining institutional ethical committee approval and informed consent from all patients. They were ASA 1 and ASA 2 patients scheduled for elective surgical procedures of 30 to 60 mins duration. Patients were excluded if they had a mallampatti score of 3 or 4, were heavy smokers, morbidly obese, with history of GI reflux and history of cardiovascular, renal, hypertensive or cerebrovascular disease. Patients who were pregnant, had allergies or had a history of epilepsy were also excluded. Preanaesthetic evaluation was carried out to assess the general condition and examination of the airway, the cardiovascular system and respiratory system. The investigations done were urine for routine examination, blood Hb%, fasting and post prandial blood sugar, renal function tests, 12 lead ECG and X-ray Chest P view.

All patients were premedicated with tab Alprazolam 0.5 mg and tab Ranitidine 150 mg orally the night before surgery. They were kept fasting from 10 pm the previous night. Two anaesthesia machines were utilised for the study to make it double blinded. Prior to induction all patients were preoxygenated for 3 minutes with 100% O_2 at 8 litres/min by bains circuit connected to a 2 litre reservoir bag. Patients in both groups were premedicated with inj. glycopyrollate 0.2 mg, inj Ondensetron 4 mg and inj Midazolam 1 mg intravenously. LMA was chosen as per the weight of each patient. Size 3 was used for patients weighing <70 kg and size 4 for >70 kg.

Group P patients were induced with inj. propofol 2.5 mg/kg IV over 30 seconds, with inj. Lidocaine 0.3 mg/kg to reduce the pain on injection. Induction time was measured from start of injection till the loss of eyelash reflex. In group P, LMA placement was attempted after 1 min following induction, after assessing jaw relaxation. If unsuccessful, spontaneous /assisted ventilation of N_2O 50% and O_2 50% was given and repeat attempts were made every 1 min up to maximum of 4 attempts, each preceded by boluses of IV Propofol 0.5 mg/kg.

Group S patients were preoxygenated using one anaesthesia machine. The second machine was used to deliver 8% sevoflurane in O_2:N_2O ratio of 50:50. The anaesthesia circuit was primed with 8% sevoflurane in N_2O 50% and O_2 50% at 8 litres/min for 30 seconds. The bains circuit reservoir bag was emptied and adjustable pressure limiting valve closed and the patient end of the system sealed by pressing the outlet firmly against the pillow. After giving inj lidocaine, each patient in this group was asked to exhale fully, then inhale fully and hold their breath as long as possible (vital capacity breath). At the end of expiration, the O_2 mask was removed and the mask connected to the primed circuit from the second anaesthesia machine was applied. The patients were encouraged to perform the vital capacity breath maneuver and hold their breath. In this group the mask ventilation was continued for 1 min after the loss of eyelash reflex, before attempting to assess jaw relaxation and LMA placement. If unsuccessful, patients were allowed to continue spontaneous/assisted ventilation on sevoflurane 8% in N_2O 50% and O_2 50%, and repeat attempts were made at every 1 minute up to maximum of 4 attempts. Loss of eyelash reflex was considered as induction of anaesthesia in both the groups. In both groups, observer 1 assessed jaw relaxation 1 min after loss of eye lash reflex and observer 2, who stayed outside the operation theatre during the induction period, was called in. The injection site and the vaporizer were concealed with the help of a screen blinding observer 2 to the technique of induction. Grading of the conditions of LMA insertion was done on the basis of jaw relaxation, ease of insertion, response of the patient like coughing, gagging, movements, laryngospasm and the number of attempts needed. Observer 2 graded the conditions of LMA insertion and scoring was done as per the Table 1.

The overall conditions for insertion were assessed as excellent, satisfactory or poor based on a total score. A maximum score of 18 was excellent, 16-17 satisfactory and <16 poor. After insertion of LMA, anaesthesia was continued as per the discretion of the observer 1 depending on the nature of procedure. Any failure of insertion, in either group was defined as failure to insert the LMA after 4 attempts. They were then given inj succinylcholine 50 mg iv to facilitate LMA insertion. The study ended when patient was considered to reach an adequate depth of anaesthesia as noticed by regular breathing after insertion of LMA.

The observations were statistically evaluated using independent samples t-test and repeated measure ANOVA to compare the two groups. The p value of <0.05 was considered statistically significant.

Table 1: Grading of conditions for LMA insertion.

Criteria	Score		
	3	2	1
Introduction of LMA			
Jaw opening	Full	Partial	Nil
Ease of insertion	Easy	Difficult	Impossible
Patient response			
Coughing	Nil	Minor	Severe
Gagging	Nil	Minor	Severe
Patient movements	Nil	Moderate	Vigorous
Laryngospasm	Nil	Partial	Total
Total score			

RESULTS

There was no significant difference in the demographic parameters between the Groups P and S with respect to age, weight and ASA grade distribution. The mean age in Group P and S were 31.2800±5.32600 and 31.8200±5.87642 respectively as given in Table 2.

Table 2: Age distribution of the patients in both the groups.

Age group (years)	Group P		Group S		P-value
	No of patients	Percent	No of patients	Percent	
20-25	8	16.0%	11	22.0%	0.692
26-30	16	32.0%	15	30.0%	
31-35	14	28.0%	10	20.0%	
36-40	12	24.0%	14	28.0%	
Total	50	100	50	100	
Mean age (in years±SD)	31.2800±5.32600		31.8200±5.87642		
Minimum age in years	21		22		
Maximum age in years	40		40		

Table 3: Induction time.

Propofol		Sevoflurane	
Induction time (sec)	**No. of patients (n=50)**	**Induction time (sec)**	**No. of patients (n=50)**
21-30	4	51-80	26
31-40	7	81-110	2
41-50	16	111-140	13
51-60	23	141-170	4
		171-200	5
Mean: 50.1±8.98		Mean: 72.8±15.86	

The time required for induction with intravenous propofol and vital capacity breath sevoflurane was compared in our study. Induction was more rapid with IV Propofol. The shortest induction time in Group P was 30 secs and the longest was 60 secs (mean time 50.1±8.98 secs), where as in Group S the shortest time was 60 secs and longest time was 180secs (mean time 72.8±15.86 secs). The difference was found statistically significant (P <0.05) as shown in Table 3.

The time taken for successful insertion of LMA (in secs) in intravenous propofol group and vital capacity breath sevoflurane group was studied. The shortest insertion time in propofol group was 68 secs and the maximum time was 130 secs. The mean time in seconds for LMA insertion in Group P was 76.30±12.14 secs. In the sevoflurane group the shortest insertion time was 70 secs and maximum time was 162 secs. The mean time in this group was 75.46±11.82 secs. There was no statistically significant difference in time to LMA insertion between the two groups as presented in Table 4.

Insertion characteristics were assessed in both groups with regard to jaw relaxation and ease of insertion. Partial jaw relaxation was seen in 4 patients in Group P and 3 patients in Group S. Insertion was difficult in 3 patients

in Group P and 2 patients in Group S. These patients had only partial jaw relaxation. There was no statistically significant difference between the two groups with regard to jaw relaxation and ease of insertion as in Table 5.

Table 4: Insertion time.

Propofol group		Sevoflurane group	
Insertion time (sec)	No: of patients (n=50)	Insertion time (sec)	No: of patients (n=50)
61-70	13	61-70	6
71-80	35	71-80	43
>80	2	>80	1

Table 5: Jaw relaxation and ease of insertion.

Parameter	Grade	Description	Group P (n=50)	Group S (n=50)	p-value
Jaw relaxation	3	Full	46	47	1.005
	2	Partial	04	03	
	1	Nil	0	0	
Ease of insertion	3	Easy	47	48	0.588
	2	Difficult	3	2	
	1	Impossible	0	0	

Table 6: Number of attempts for LMA insertion.

	Attempt		p-value
	First	Second	
Group P (n=50)	47	3	0.588
Group S (n=50)	48	2	

Table 7: Patient movements.

Parameter	Grade	Description	Group P (n=50)	Group S (n=50)	p-value
Patient movements	3	Nil	48	48	0.907
	2	Moderate	02	02	
	1	Vigorous	0	0	

Table 8: Complications.

Parameter	Grade	Description	Group P(n=50)	Group S (n=50)
Coughing	3	Nil	50	50
	2	Minor	0	0
	1	Severe	0	0
Gagging	3	Nil	50	50
	2	Minor	0	0
	1	Severe	0	0
Laryngospasm	3	Nil	50	50
	2	Minor	0	0
	1	Severe	0	0

Table 9: Overall conditions for LMA insertion.

Score	Group P (Propofol) (n=50)	Group S (Sevoflurane) (n=50)	p- value
18 (Excellent)	44 (88 %)	45 (90%)	0.848
16-17 (Satisfactory)	6 (12%)	5 (10%)	
<16 (Poor)	-	-	

The number of attempts for successful LMA insertion was studied. LMA could be placed only in the second attempt in 3 patients in the P group and 2 patients in the S group. In the remaining patients of both groups, LMA was placed successfully at the first attempt itself. There was no significant difference between the two groups with respect to the number of attempts at LMA insertion as in Table 6.

Any movement in the patient during the insertion of LMA was also assessed. In the propofol group 2 patients showed moderate movement during insertion. Two patients did in the sevoflurane group too and no statistically significant difference was seen as in Table 7. Complications like coughing, gagging or laryngospasm was not seen in any patient in either group as given in Table 8.

The condition for LMA insertion was compared and scoring as shown in Table 1 was done. Excellent conditions were obtained in 44 patients in group P and 45 patients in Group S. 6 patients in group P and 5 patients in group S showed satisfactory insertion conditions. No patient came under the poor insertion condition category. There was no significant difference between the two groups with respect to overall LMA insertion characteristics as presented in Table 9.

The basal heart rate and heart rate at induction were comparable in both the groups as given in Table 10. The hemodynamic response on LMA insertion in both the groups showed a significant increase in heart rate from basal values at the time of insertion. The mean heart rate came back to basal levels by the 3rd min in the P group but in the S group it did not come down even by the 5th minute. This difference was found to be statistically significant in comparing between the two groups.

The basal mean arterial pressures in both the groups were comparable and presented in Table 11. In group P there was a decrease in mean arterial pressure after induction from basal mean arterial pressure and a further decrease in mean arterial pressure after LMA insertion. Mean arterial pressure decreased after induction in Group S also and a further decrease was noted 1 min after LMA insertion. The decrease in mean arterial pressure 1 min after insertion was statistically significant when compared to basal levels in both Group P and Group S. Statistical evaluation between the two groups also showed that the decrease in mean arterial pressure in Group P was significant in comparison to decrease in Mean arterial pressure in Group S at 2 mins, 3 mins, 4 mins, and 5 mins following LMA insertion.

Table 10: Mean heart rate (BPM) changes in group P and group S.

	Group P (Propofol)	Group S (Sevoflurane)	p-value
Basal	81.28 ± 6.6	77.26+_5.98	0.038
At induction	86.40 ± 6.58	85.01 ± 5.98	0.038
During insertion	92.01 ± 5.86	88.92± 6.72	0.059
1 min	92.08 ± 5.06	91.50 ± 6.34	0.842
2 min	88.11 ± 6.30	95.91 ± 7.20	0.001
3 min	80.98 ± 6.09	93.02 ± 7.30	0.000
4 min	79.63 ± 7.35	94.78 ± 6.73	0.002
5 min	81.78 ± 5.80	89.40 ± 7.23	0.001

Table 11: Mean arterial pressure (mmHg) changes in Group P & Group S.

	Group P (Propofol)	Group S (Sevoflurane)	p-value
Basal	96.98 ± 9.48	98.72 ± 7.50	0.701
At induction	95.10 ± 8.86	92.88 ± 4.14	0.203
During insertion	90.18 ± 8.79	89.12 ± 5.04	0.543
1 min	86.98 ± 8.78	88.24 ± 5.43	0.329
2 min	83.88 ± 7.42	87.12 ± 6.78	0.006
3 min	81.87 ± 6.50	89.02 ± 5.78	0.002
4 min	81.78 ± 5.95	89.65 ± 4.95	0.001
5 min	79.44 ± 6.08	91.32 ± 5.75	0.002

DISCUSSION

Use of LMA for day care procedures has gained popularity in short procedures surgeries. Insertion of LMA needs adequate depth of anaesthesia for easy and successful insertion and proper placement. Intra venous propofol has been widely used because of the advantage of rapid induction, adequate jaw relaxation and suppression of airway reflexes. But it's not without adverse effects like pain on injection, hypersensitivity,

movements, apnoea and hypotension. These have been decreased by adding adjuvants like midazolam, fentanyl, alfentanil and local anaesthetic lignocaine. The addition of benzodiazepines or opioids improves insertion conditions by their sedative effect and abolition of airway reflexes.[8-11]

Sevoflurane has come up as a promising alternative to propofol for LMA insertion because of its pleasant, smooth and rapid induction, hemodynamic stability and good intubating conditions.[4,6] Some workers have found sevoflurane to be better than propofol.[3, 9,12]

Various investigators have used different regimens of propofol dosages.[8,10,12] Different concentrations of sevoflurane using vital capacity breaths with or without adjuvants have also been used.[4,8,10,12] Tidal volume induction with incremental increase in inspired sevoflurane concentration is an acceptable method for

LMA insertion.[3,6] But since induction is slower vital capacity breath technique was adopted in our study. This required prior patient education on the vital capacity maneuver and patient cooperation during induction. This technique has been used successfully by various workers in day care surgery in young patients and the elderly. Loss of eyelash reflex occurs during the early phase of 2nd stage and helps making sure the patient is unconscious. Other studies have used loss of response to verbal commands, dropping of weighted objects and relaxation of jaw muscles for jaw thrust as end points of induction.[7,13] There was statistically significant faster induction time with propofol than vital capacity breath induction with sevoflurane in our study. This was concurring with the results of Hall et al, Thwaith et al, Ti et al but was found to be not clinically significant.[5,7,12] In our study insertion of LMA was attempted 1 min after the loss of eyelash reflex in both groups**.** This was done to wait for the lag time for equilibrium of alveolar concentration with brain concentration with sevoflurane. The mean insertion time in Group P (76.30±12.14 secs) and in Group S (75.46±11.82 secs) were found similar. Siddik-Sayyid et al in their study found that patients in the sevoflurane only group and sevoflurane with propofol group showed longer time to insertion in comparison to the propofol only group.[10] For successful placement of LMA, attenuation of the laryngeal reflexes was required in order to reduce the stimulation of the anterior laryngeal structures during insertion. The insertion characteristics in both the groups were compared based on the criteria of jaw opening, ease of insertion, patient movement, coughing, gagging, laryngospasm and scored on a scale from 1 to 3. Similar grading system was used by Priya et al and Shivalingam et al in their studies.[8,9] In the study by Priya et al, 28% in the propofol group and 56% in the sevoflurane group had partial jaw opening where as in the study by Shivalingam et al, 24% in the propofol group and 40% in the sevoflurane group had partial jaw opening. In our study adequate jaw opening was found in 46 patients in the P group and 47 patients in the S group. Partial jaw opening was seen in 4 patients in P group and 3 patients in S group. The ease of insertion of LMA as graded by a blinded observer showed that in the propofol induction group, insertion of LMA was easy (grade 3) in 47 patients and difficult (grade 2) in 3 patients. No patient had to be graded 1 (impossible). In sevoflurane group 48 patients were grade 3 and 2 patients were grade 2. The LMA could be placed successfully in the first attempt itself in most of the patients in both the groups in our study. Only 3 patients in the propofol group and 2 patients in the sevoflurane group required second attempt for insertion. Shivalingam et al reported coughing in 12% in the propofol group and 20% in the sevoflurane group. Laryngospasm had been seen by Siddik-Sayyid et al in 8% in the sevoflurane group and Priya et al in12% in the sevoflurane group. In the study by Kati et al no significant difference between the groups were noted in terms of complications during LMA insertion.[14] In our study coughing, gagging and laryngospasm was not found in any patient in both the groups. Siddik-Sayyid et al reported occurrence of movement in 50% in the propofol group as compared to 19% in the sevoflurane group. Priya et al found movement in 12% in the propofol group and 28% in the sevoflurane group. Patient movement during insertion was noted in 2 patients in each of the groups in our study.

The hemodynamic responses were stable in both the groups. As comparable with the study by Thwaite et al and Priya et al.[7,8] we also found a significant decrease in MAP in the propofol group 3 mins after induction. In the propofol group in our study the heart rate increased by 10 beats per minute during insertion but returned to basal values by 3rd min. In the sevoflurane group heart rate increased by 11 beats per min during insertion and went up to 17 beats per min by 2nd min. It did not reach baseline levels even at 5 minutes. This is in accordance with the pharmacological effect of propofol which inhibits baroreceptor reflexes and decreases heart rate. Sevoflurane has no effect on baroreceptor reflexes and causes reflex increase in heart rate. The differences in heart rate and mean arterial pressure after LMA insertion was found statistically significant from baseline values. However a stable hemodynamic profile was seen in both the groups with mean arterial pressure being closer to baseline value in sevoflurane group.

In conclusion, we found that induction time with propofol was significantly shorter than that with sevoflurane inhalation. Jaw relaxation and ease of LMA insertion was comparable in the propofol group and sevoflurane group with a high success rate for LMA insertion in the first attempt itself. Complications like coughing, gagging and laryngospasm were not seen in both the groups. Hemodynamic stability was maintained in both the groups. Vital capacity inhalation technique with sevoflurane 8% is comparable with intravenous propofol induction for LMA insertion in adults. It can so be used as an alternative for short surgical procedures needing general anaesthesia.

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