



Comparison of Sevoflurane and Propofol for Laryngeal Mask Airway Insertion in Children Undergoing Surgical Procedures

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Abstract

We compared patient outcomes for propofol vs sevoflurane induction for ease of laryngeal mask airway (LMA) insertion in sixty children undergoing abdominal or lower limb surgery, were randomly assigned to receive either propofol 3 mg.kg-1 over 20 seconds, or induction with sevoflurane 8%. The following assessments were made induction time, LMA insertion time, number of attempts, insertion conditions, cardio respiratory effects, total drug required in both the group, adverse effect if any were noted. The first-time insertion success rates were similar, but induction time was shorter with propofol (77.1±35.81 p value <0.05). incidence of coughing, patient movement during placement of LMA, were higher in propofol group as compared to sevoflurane group (P < 0.05). There was significant fall in blood pressure in propofol group after 2 min of Lma insertion which was statistically not significant. Total dose of propofol required for endpoint achievement in the group P children was about 3.42 ± 0.36 mg/kg. Thus, we would recommend a higher dose of propofol for LMA insertion in children. We also studied the mean MAC value of sevoflurane for endpoint achievement that was about 2.86±.54 needed for LMA insertion in children aged 3-12 years without causing significant hemodynamic changes. So, we concluded that the techniques described here using propofol and sevoflurane are equally suitable for induction and for LMA insertion in children undergoing surgery below the umbilicus.

Keywords: Volatile Induction, Sevoflurane, propofol, LMA, children.

Introduction

The laryngeal mask airway (LMA), which has wide application in pediatric anesthesia practice, requires induction with either inhalational or intravenous agent to provide enough depth of anesthesia for its satisfactory insertion. Intravenous propofol as an induction agent has the advantage of rapid induction of anesthesia with adequate depression of the airway reflexes but its

bolus injection is associated with several adverse effects like hypotension, apnea, pain on injection and excitatory patient movements.

Sevoflurane is increasingly considered as a superior alternative to propofol as an induction agent in children owing to its pleasant odour, absence of airway irritation and smooth recovery and emergence characteristics. Several studies comparing propofol and sevoflurane as induction

agents have had mixed results. The aim of the present study is to compare the ease of insertion of LMA with propofol and sevoflurane and to compare the hemodynamic changes in children anesthetized with the two techniques.

Materials and Methods

The study included a total of 60 children in the age group of 3 to 12 years who were planned for abdominal or lower limb surgery under general anesthesia. Institutional ethics committee clearance was obtained and written informed consent was taken from parents. Children with anticipated difficult airway, respiratory tract infection and known allergy to egg or soya protein were excluded. The sample size was calculated using an alpha level of 5% and power of 80%.¹

Patients were randomized to two possible groups, Group S and Group P, by sealed envelope technique. An intravenous cannula (20G/22G) was started in the upper limb an hour after application of EMLA cream in the preoperative holding room, Midazolam 0.03 mg/kg i.v. was administered before shifting the patient to the operating room.

In the operating room, Fentanyl 1.5 mcg /kg i.v. 5 minutes before induction. Baseline values of non-invasive blood pressure, heart rate and SpO₂ were noted. These parameters were noted every minute till 5 min after successful LMA insertion.

In Group S, Sevoflurane 8% in 100% O₂ was used for induction. The Jacksonef's modification of Ayer's t piece used was primed with sevoflurane 8% and O₂ 8litres /min for 1minute prior to induction. Induction in Group P was done with propofol 1% intravenously at the rate of 3 mg/Kg over 20 seconds. 1ml of 2% lignocaine was added to 10ml of propofol to reduce the pain of injection.

Absence of motor response to jaw thrust was taken as the end point of induction in our study, and an appropriate sized LMA was inserted.

Successful LMA insertion was indicated by the presence of end tidal CO₂ tracing on monitor, normal breath sounds and normal excursion of the reservoir bag. After the insertion of LMA patient was put on spontaneous ventilation and anesthesia maintained with isoflurane and N₂O.

Unsatisfactory insertion conditions were managed by deepening the plane of anesthesia by continuing sevoflurane inhalation in the sevoflurane group and by an additional dose of Propofol at 0.5mg/kg given over 5 seconds in the propofol group respectively. Assisted ventilation was provided in cases where apnea developed. In case LMA insertion was not satisfactory or the SpO₂ fell to <95%, it was removed, and patient was mask ventilated using with 100% O₂. Failure to reinsert the LMA after three minutes was considered as failure and the child was intubated using an appropriate sized endotracheal tube.

The parameters recorded are defined as given below.

1. Induction time in seconds: From the time of induction, meaning the time of placing mask in sevoflurane and start of injection in propofol, to endpoint achievement
2. Insertion time in seconds: From the time of endpoint achievement to successful LMA insertion as confirmed by capnographic tracing on monitor.
3. Number of attempts for successful LMA insertion
4. Insertion conditions (6 variables 3-point scoring system):

Variables	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
Laryngospasm	Nil	Partial	Total
Patient movements	Nil	Moderate	Vigorous

Total score for insertion conditions was graded as follows

- 16-18 excellent
- 12-15 satisfactory
- <12 poor

5. Hemodynamic parameters: Heart rate, systolic, diastolic and mean arterial pressure and SpO₂ were recorded at baseline, at the end of induction and then every 1 min till 5 min after successful insertion of LMA.
6. Minimum Alveolar Concentration (MAC) of sevoflurane at the endpoint achievement in group S
7. Total dose of propofol needed for endpoint achievement in group P.
8. Adverse events including failure to insert LMA after 2 attempts, desaturation (SpO₂<95%), regurgitation and apnea.

Patient parameters & hemodynamic parameters were studied using Unpaired t test. Changes in hemodynamic parameters within the groups were studied using one way ANOVA. Insertion conditions for LMA were analyzed using Chi-square test, Fischer’s Exact test & Mann Whitney U test and adverse events were studied using Chi square test.

Results

The two groups were similar in age, weight and gender distribution. Boys constituted greater than 80% of all the children included. [Table 1]

Induction time was significantly longer in the Group-S and the insertion time was found to be comparable between the two groups. One patient in each group required a second attempt for insertion of LMA. The median score of insertion using the 6 variables 3 point scoring system was 18 in both the groups and in majority of patients the insertion conditions were excellent. Though the overall median insertion score was similar in the two groups, the individual parameters showed difference. Patients in the Group-P had a significantly higher incidence of cough and patient

movements recorded during induction. More than 90% of patients in both the groups had excellent insertion conditions and in a small proportion the conditions were satisfactory. None of the patients had poor insertions conditions. [Tables 2 and 3] MAC of sevoflurane at the endpoint achievement in 30 patients was noted. The mean MAC value was found to be 2.86 ±.54 %. The total Propofol required for endpoint achievement in the group-P children (mean weight = 16.97 ± 4.32) was noted. The mean dose of propofol required was about 3.42 ± 0.36 mg/kg.

Apnea was observed in 9 out of 30 children in the propofol group and 3 out of 30 in the sevoflurane group. The difference in incidence was not statistically significant (p=0.052). No cases in either group had regurgitation or desaturation to <95%.

Heart rate, Systolic Blood Pressure, Diastolic Blood Pressure, Mean Arterial Pressure and SpO₂ were studied at various time points. Since the baseline hemodynamics in the two groups were not comparable the mean percentage change of each parameter from the basal values were calculated and this mean was compared in both the groups using independent sample t test. There was no significant difference in the mean change of heart rate and oxygen saturation in either of the groups. (Figure 1) While the mean change in systolic blood pressure also was similar in both groups, patients in Group P had a significant fall in their diastolic blood pressure starting from 2 minutes after induction. The resulting change in the mean arterial pressure also was significantly different in the two groups. (Figures 2-4)

Table 1 Demographic characters

	Group S (n=30)	Group P (n=30)	P value
Mean Age (years)	6.5 ± 2.46	6.4 ± 2.37	NS
Mean Weight(kg)	15.9± 4.5	16.9 ± 4.32	NS
Male (%)	26 (86.7%)	24 (80%)	NS
Female (%)	4 (13.33%)	6 (20%)	NS

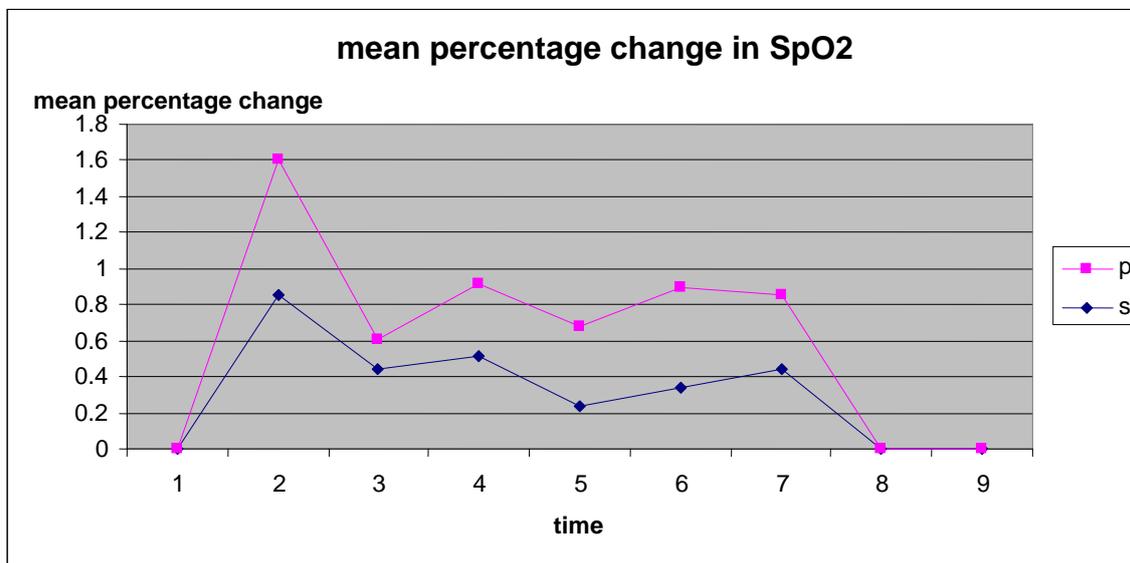
Table 2: Comparison of insertion conditions between the two groups

Parameters	Group S (n=30)	Group P (n=30)	P value
Induction time (Mean ± 2SD, in sec)	119 ± 48.44*	77.1 ± 35.81 *	<0.05
Insertion time (Mean ± 2SD, in sec)	55.77 ±17.53	55.03 ± 17.12	NS
Successful insertion at first attempt (%)	96.7% (29/30)	96.7% (29/30)	NS
Median insertion score	18	18	NS
Insertion grade : Excellent (Score = 16-18) number expressed as percent	96.7%	90%	NS
Insertion grade : Satisfactory (Score = 12-15) number expressed as percent	3.3%	10%	NS

Table 3: Comparison of the individual insertion variable and the patient response between the two groups

	Grading	Group S	Group P	P value
Jaw opening	full	90%	100%	0.11
	partial	10%	-	
Ease of insertion	easy	86.7%	96.7%	0.11
	difficult	13.3%	3.3%	
Coughing	nil	96.7%	80%	0.05
	minor	3.3%	20%	
Gagging	nil	93.4%	90%	0.36
	minor	3.3%	10%	
	severe	3.3%	-	
Laryngospasm	nil	100%	100%	-
	partial	-	-	
Patient movements	nil	83.3%	56.7%	0.02
	moderate	16.7%	43.3%	

Fig 1 Comparison of the mean% change in SpO2 between the two groups



Not statistically significant
 Y axis (time) 1= baseline
 2= at end of induction
 3-8= 1 min interval from LMA insertion

Fig 2. Comparison of mean % change in systolic blood pressure between the two groups

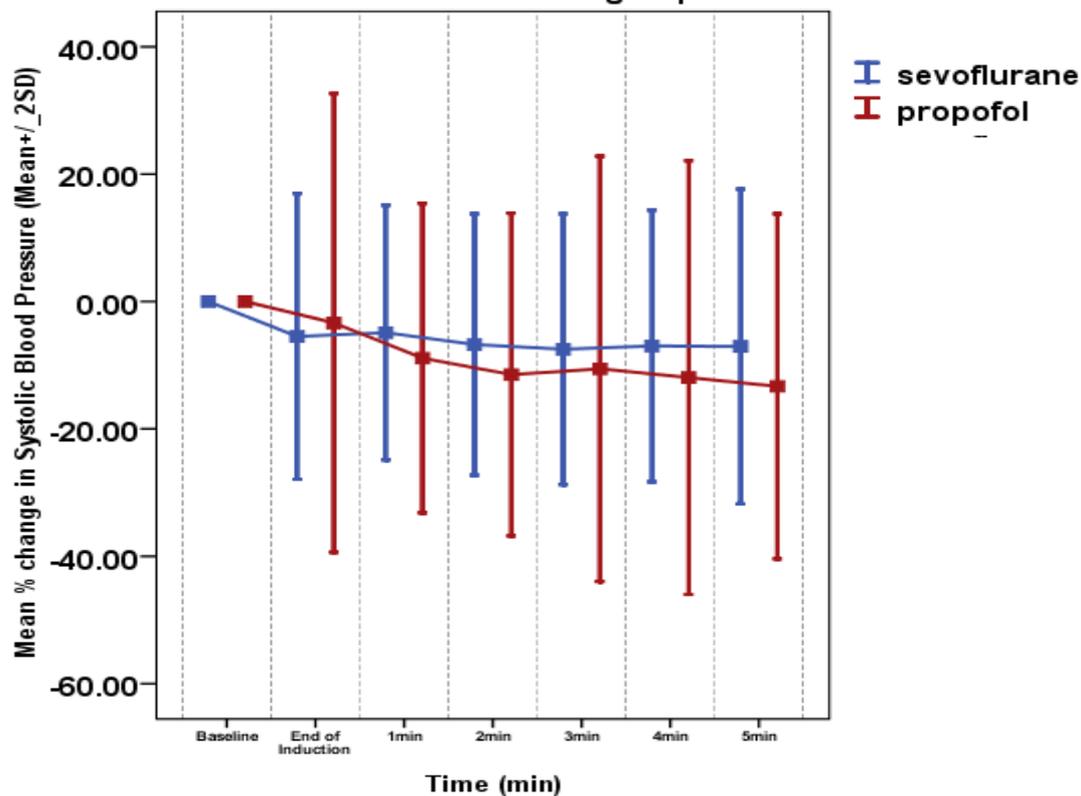


Fig 3. Comparison of mean % change in diastolic blood pressure between the two groups

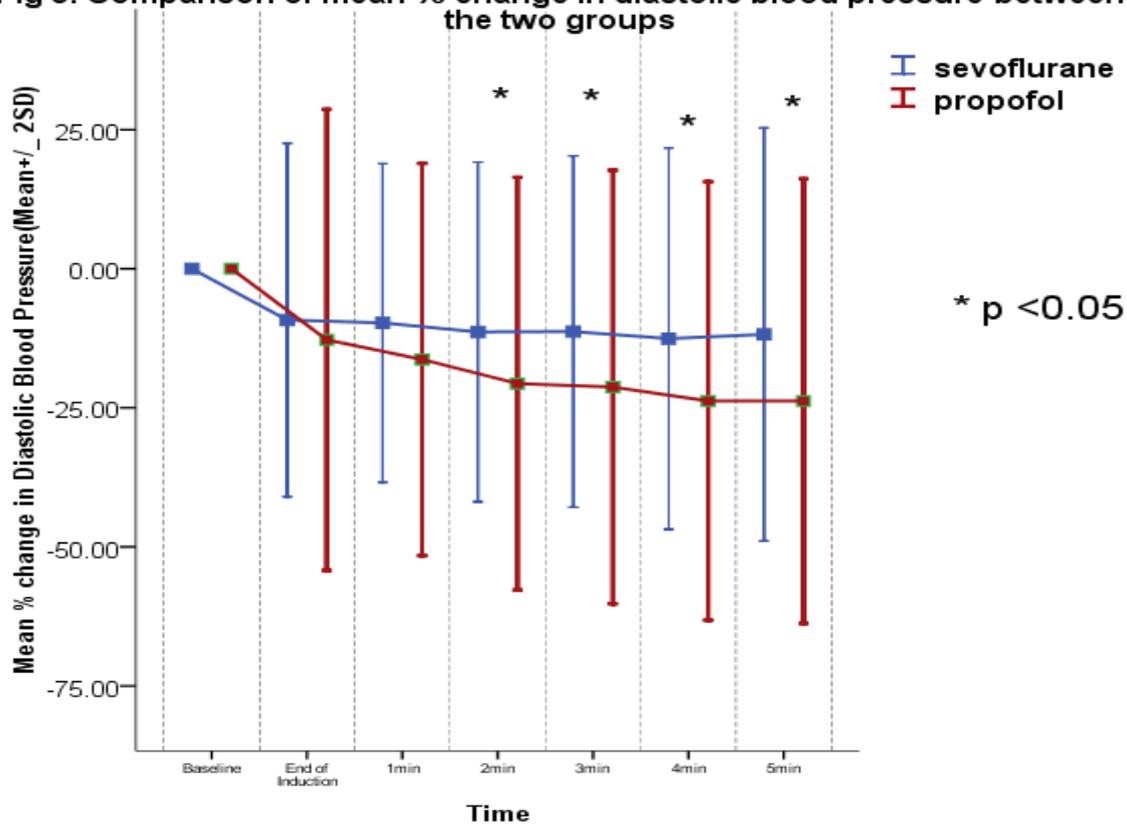
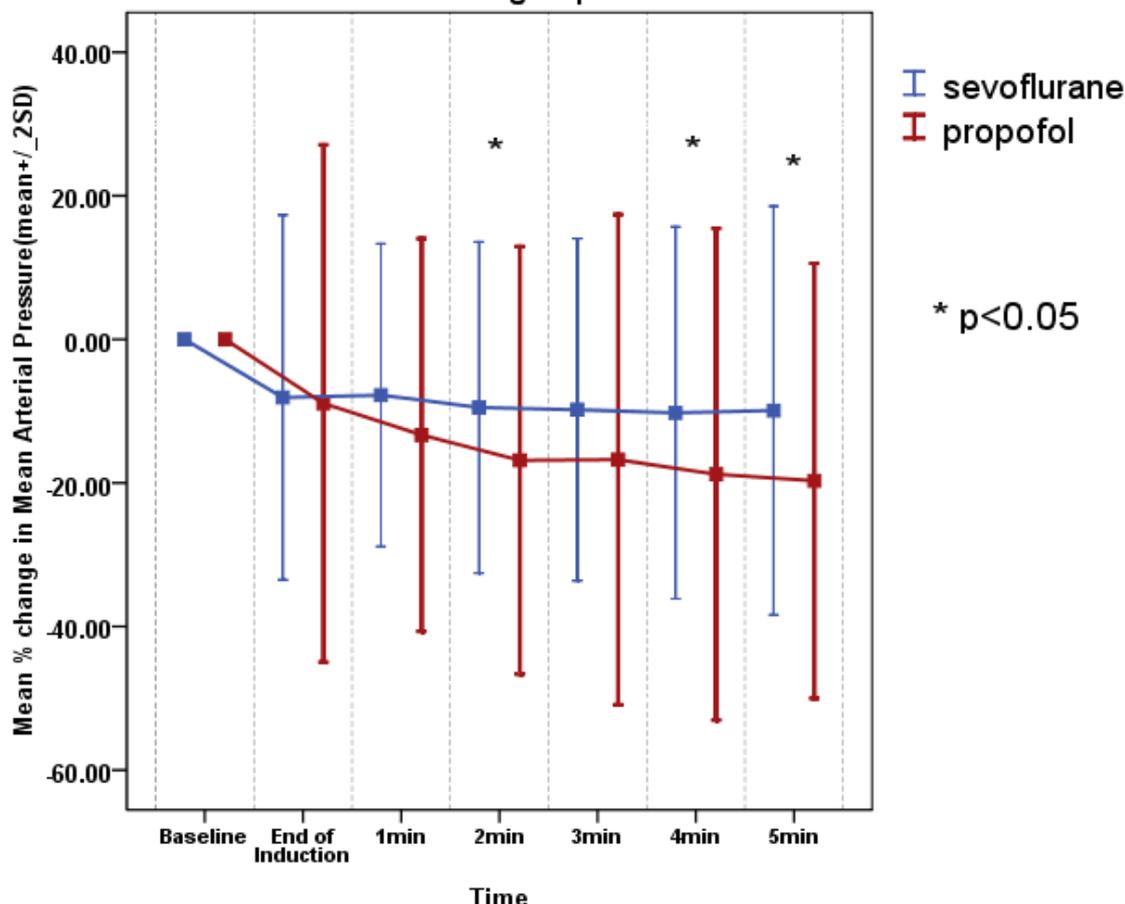


Fig 4. Comparison of mean % change in mean arterial pressure between the two groups



Discussion

The laryngeal mask airway²⁻⁴, is a commonly used airway device in pediatric anesthesia and its insertion can be facilitated either using intravenous or inhalation induction agents. The most common intravenous induction agent in use in children is propofol which is well known for its ability to suppress the upper airway reflexes. Inhalational induction with sevoflurane is the other commonly used technique. The pleasant odour and nonirritant nature of Sevoflurane makes it a favorable choice as an induction agent in children

Our study found that the time taken for induction defined as the start of induction to end point achievement or adequate jaw relaxation We noted in our study that the induction time was significantly prolonged in the sevoflurane group as compared to the propofol group. This could be

due to several factors. Sevoflurane is known to increase the muscle tone and spasticity initially while propofol causes muscle relaxation⁵. Additionally, the lag time during which the alveolar concentration of sevoflurane equilibrates with the brain could also result in inadequate depth during initial jaw thrust maneuver. Propofol being given as a bolus could also explain the faster induction recorded with it. Similar results were found in some studies while some others contradict this^{1,6}. Philip et al demonstrated faster induction with Sevoflurane as opposed to Propofol. The dose of Propofol used was lower at 2mg/Kg, while N2O was used to prime the circuit along with 8%Sevoflurane and O2. Ti et al did not find any difference in induction time between Sevoflurane and Propofol when loss of consciousness was used as the end point of induction⁵.

The insertion conditions as well as the number of attempts taken to achieve satisfactory insertion were comparable between the groups. This could be due to the fact that the depth of anaesthesia was adequate to suppress not only the lesser sensitive hypopharynx needed to prevent complications of LMA insertion but also the laryngeal reflexes⁵. Many studies have found the insertion time to be shorter in the propofol group. This appears to be due to different end points used, lower dose and inadequate time given for sevoflurane induction before attempting LMA insertion^{5,7,8}.

The incidence of coughing (20% vs 3.3%) as well as patient movement (43.3% vs 16.7%) was significantly higher in the propofol group which demanded additional doses of the drug. In contrast to previous studies claiming that doses above 2.5mg/kg do not cause coughing and gagging we found a higher incidence of coughing and gagging at a dose of 3mg/kg^{9, 10}. It is possible that suppression of cough requires a higher dose of Propofol in children

Apnea was observed more in the propofol group than the sevoflurane group, but the difference was not significant. Other studies have noted a significantly higher incidence of apnoea in the propofol group compared to the sevoflurane group^{5, 11}. There was no incidence of desaturation to <95% or regurgitation in any patients in our study.

The total dose of propofol required for endpoint achievement in the group P children (mean weight = 16.97 ± 4.32) was noted. The mean dose of propofol required was about 3.42 ± 0.36 mg/kg. Thus, we would recommend a higher dose of propofol for LMA insertion in children.

We also studied the mean MAC value of sevoflurane for endpoint achievement that was about 2.86±.54. This gave us a rough idea about how much end tidal sevoflurane is approximately needed for LMA insertion in children aged 3-12 years without causing significant hemodynamic changes.

In our study there was no significant difference between the two groups in terms of heart rate and

the mean change in heart rate from the basal was not significant. Statistically significant fall in systolic blood pressure occurred in the propofol group from the 2nd min of LMA insertion but the fall was not clinically significant. Sevoflurane group also recorded a statistically insignificant fall in systolic pressure. When the two groups were compared the mean percentage change in the systolic blood pressure was not significant. In both the groups there was fall in diastolic blood pressure from the 2nd min of LMA insertion and the fall was statistically significant in the propofol group from 2nd min onwards whereas in the sevoflurane group significant fall was there at the 4th and 5th min. When both the groups were compared significant fall was there in the propofol group. Similar changes were seen in the mean arterial pressure.

Diastolic blood pressure is actually, function of the systemic vascular resistance. The profound fall in diastolic blood pressure with propofol may be due to its effect on systemic vascular resistance. Sevoflurane is not known to cause much hemodynamic alterations, but in our study, we got a fall in systolic, diastolic and mean arterial pressure possibly due to the higher concentration of sevoflurane (8%) used. Literature mostly agrees with these findings in terms of hemodynamic changes. Propofol is known to cause reduction in the arterial blood pressure after induction. It causes both arterial and venodilation. It has been suggested that propofol resets or inhibits the baroreflex, thus reducing the tachycardic response to hypotension.¹² (Ref)

The drawback of our study was that the depth of anesthesia with the two techniques of induction were not compared as it was not ideal to compare two different techniques—intravenous and inhalational induction clinically. The depth of anesthesia would be better compared with bispectral index and evoked potentials but since those facilities were not available with us, we could not compare them. Our study also had certain parameters which required grading by the

performer/observer and could be responsible for interobserver variability.

We conclude that sevoflurane inhalation is better than propofol as an induction agent in children as the insertion conditions for LMA with sevoflurane were comparable with propofol while certain insertion variables like patient movements and coughing as well as hemodynamic changes were significantly lesser in the sevoflurane group .

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