

**Research article****COMPARISON OF INDUCTION, INTUBATION AND RECOVERY CHARACTERISTICS OF HALOTHANE + PROPOFOL V/S SEVOFLURANE + PROPOFOL IN CHILDREN UNDERGOING ADENOTONSILLECTOMY**

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ABSTRACT

Purpose: General anaesthesia for oral surgeries in paediatric patients is always challenging for an anaesthesiologist. Aim was to compare halothane+propofol and sevoflurane+propofol in paediatric patients undergoing adenotonsillectomy without muscle relaxant. **Method:** In a double blind manner, eighty patients of 3-10 years were premedicated with inj. Atropine and randomly divided into two groups of forty each. In Group A, priming was done with 50% oxygen+50% nitrous oxide+4% halothane for 1 minute, after loss of eye lash reflex and centralisation of pupil intravenous cannulation done. Inj. midazolom, lignocaine and Propofol were given and trachea was intubated. Maintenance was done with 1-2% halothane+ nitrous oxide+ oxygen and continuous propofol infusion. Similar technique was used in group B except for priming done with sevoflurane 7% and maintenance with 2-3%. Both groups were compared for induction, intubating conditions, haemodynamics and emergence characteristics. **Results:** Induction was rapid in group B as time for loss of eye lash reflex and centralisation of pupil was less in group B (21.88±12.6 & 114.40±28.8 seconds) as compared to group A (33.05±4.0 & 140.05±12.1 sec) p<0.001. Intubating conditions were excellent but mean intubation time was less in group B as compared to group A p<0.001. Heart rate and blood pressure remained on lower side in group A. Emergence was significantly rapid in group B. No side effect or complications were noted. **Conclusion:** Both groups provided excellent intubating conditions but sevoflurane+propofol group was better as it provided faster induction and rapid recovery from anaesthesia with more stable haemodynamics as compared to Halothane+propofol group.

Keywords: General anaesthesia, Paediatric, Halothane, Sevoflurane, Propofol.

INTRODUCTION

General anaesthesia for adeno-tonsillectomy in paediatric patients is always challenging for an anaesthesiologist as there is sharing of the airway with the surgeon, limited access and risk of soiling the airway with blood. Children with adenotonsillar hypertrophy can have nasal obstruction, reactive airways and sometimes obstructive sleep apnoea.^[1] They are at increased risk of desaturation, laryngospasm and airway obstruction during induction of anaesthesia.^[2] Hence induction in these patients is preferred with potent inhalational agents,

which can be used as an alternative to muscle relaxants to facilitate tracheal intubation and to further avoid the potential side effects of muscle relaxants like myalgias, hyperkalemia, masseter spasm or malignant hyperthermia.^[3,4] Halothane with its sweet odour and minimal effects on airway reactivity makes it a suitable agent for paediatric anaesthesia, despite its propensity to cause bradycardia, hypotension and arrhythmias.^[5] Sevoflurane has nonpungent odour, provides rapid onset and emergence from anaesthesia and has less

cardiovascular side effects, which makes it an attractive alternative for paediatric anaesthesia.^[6] Induction, recovery characteristics and haemodynamics of Halothane and Sevoflurane in paediatric patients have been compared previously also. But in most of the studies, either muscle relaxants were used for intubation ^[7,8] or where muscle relaxants were omitted, perfect intubating conditions were not obtained.^[9,10,11] Propofol an intravenous induction agent, can be considered as an alternative to muscle relaxants as it attenuates laryngeal and pharyngeal reflexes, provides better jaw relaxation ^[3] and also decreases the extubation related complications.^[12] With these considerations in mind, the present study was done to compare induction characteristics, intubating conditions, haemodynamics and recovery profile of Halothane + propofol and Sevoflurane + propofol without muscle relaxants in paediatric patients undergoing adenotonsillectomy.

Aim and objectives

- Induction characteristics and intubating conditions.
- Haemodynamic parameters
- Recovery characteristics.
- Side effects and complications of halothane+propofol and sevoflurane+propofol in paediatric patients.

MATERIAL AND METHODS

After approval from the institutional ethics committee, this double blind randomised study was conducted on eighty patients of American Society of Anaesthesiologist (ASA) grade I and II in the age group of 3 to 10 years undergoing adenotonsillectomy under general anaesthesia. Patients with history of acute upper respiratory tract infection, Hematocrit < 25%, bleeding disorders, hepatic or renal dysfunction, congenital anomalies, exposure to general anaesthetic agents in previous seven days, any contraindication for using study drugs or personal or family history of malignant hyperthermia were excluded from the study. A well informed written consent was taken from the parents or guardians of the patients included in the study. A day before surgery, a detailed preanaesthetic checkup was done. General physical examination and systemic examination was done. Mallampatti grading was done to assess the airway. Routine investigations were

noted and if needed special investigations were ordered. Weight of each patient was recorded. Patients were randomly divided in to two groups of forty each, Group A: (Halothane + propofol) and Group B (Sevoflurane + propofol) is using a computer-generated randomization technique. On the day of surgery, patients were reassessed preoperatively and after confirming overnight fasting, patients were shifted to operating room and multipara monitor was attached to monitor baseline heart rate, respiratory rate, systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial blood pressure (MAP), SPO₂ and electrocardiograph (ECG). Continuous monitoring of vitals was then started.

In group a (halothane + propofol), priming of circuit was done with 4% halothane + 50%: 50% of oxygen and nitrous oxide for one minute. In group B (sevoflurane + propofol), priming of the circuit was done with 7% sevoflurane + 50%: 50% of oxygen and nitrous oxide for one minute. Face mask of appropriate size was kept on the face of spontaneously breathing patient and time taken to loss of eyelash reflex as a sign of loss of consciousness was noted. Time taken to complete induction (centralisation of pupil, no gross bodily movements) was also recorded. Induction was done by a senior anaesthesiologist who was unaware of the inhalation agent used as the vapourisers were concealed by a screen and dial settings were adjusted by a separate anaesthesiologist. The anaesthesiologist doing the induction also recorded all the variables. After centralisation of pupils, intra venous cannulation was done and infusion of Isolyte P was started. Any bodily movements occurring at the time of cannulation were noted. Injection midazolam 0.04 milligram per kilogram body weight, injection lignocaine 1 milligram per kilogram body weight followed by bolus dose of Injection propofol 3 mg/kg body weight intravenously was given. After giving propofol concentration of halothane was reduced to 2% in group A and Sevoflurane was reduced to 4% in group B. Bag and mask ventilation was started and when adequate jaw relaxation was obtained, trachea was intubated with appropriate sized endotracheal tube without using any muscle relaxant. Care was taken that endotracheal tube does not touch the carina. Injection Atropine sulphate was given only if indicated to decrease secretions. The quality of

intubating conditions was assessed by using scoring system devised by Helbo-Hansen, Ravio and Trap-Anderson^[13] and revised by Styne and colleagues.^[14] Following parameters were noted: Jaw relaxation, Ease of laryngoscopy, Vocal cord positioning, Coughing on laryngoscopy or intubation and any Limb movements. For all variables, score of 1-4 was taken, where score of 1 was taken as ideal conditions, therefore total score of five was taken as best possible score for all parameters. Other variables like laryngospasm, struggling, oxygen desaturation and hemodynamic changes occurring during induction and intubation were also recorded. Immediately after intubation, paracetamol suppository (20mg/kg body weight) per rectum was given for analgesia. Maintenance of anaesthesia was done with 40% oxygen: 60% nitrous oxide + either 1-2 % halothane in group A or 2-4% sevoflurane in group B. After intubation, Continuous intravenous infusion of propofol was started at the rate of 5-7 milligram per kilogram body weight per hour. Any of the patients requiring muscle relaxant during surgery were excluded from the study. Continuous monitoring of respiratory rate, systolic and diastolic blood pressure, mean arterial pressure, heart rate, SPO₂, electrocardiogram was done at 1st minute, 3rd minute, 5th minute and then at every 5 minute interval till the completion of surgery. If the heart rate or blood pressure varies more or less than 20% of the baseline value, then the concentration of inhalational agent was increased or decreased accordingly. At the completion of surgery, oropharyngeal and endotracheal suctioning was done in deep plane of anaesthesia. Nitrous oxide and inhalational agents were stopped and 100% oxygen was given. Intravenous infusion of propofol was continued till the spontaneous respiration was considered adequate and patients were extubated. During recovery, emergence time (time taken from stoppage of all anaesthetic agent to that when patient responds to verbal commands) and time taken to shift the patient to recovery room (time taken from the time when patient start responding to verbal commands to the time when patient regained full consciousness) was noted. Any coughing, laryngospasm and struggling on emergence were noted. Mental state assessment (alert, awake, agitated or Drowsy) was done during shifting the patient to recovery. Any post operative nausea and vomiting was also noted. In the post

operative period, syrup Ibuprofen + paracetamol were given as rescue analgesia. Syrup ondansetron was given for managing postoperative nausea and vomiting. All patients were observed for any side effect or complications of the procedure. **Statistical analysis:** The data from the present study was systematically collected, compiled and analysed using SPSS 19.0 evaluation version. Data was expressed as mean and standard deviation. The patients characteristics (non parametric data) were analysed by using the 'Chi - Square' tests while the inter group comparison of the parametric data was done by using unpaired "t" test. The p value was determined finally to evaluate the levels of significance. The p value of > 0.05 was considered not significant; p value of 0.01 to 0.05 was considered significant and p value < 0.01 was considered highly significant. Power analysis was done to calculate the power of study by taking error at 0.05. Effect size was calculated and power was above 90%.

RESULTS

In the present study both groups were comparable with respect to age, sex ratio, weight, duration of surgery and baseline haemodynamic parameters as shown in table: 1. During induction, time taken for loss of eye lash reflex and centralisation of pupil was significantly less in group B as compared to group A (P=0.00). Mean time taken from induction of anaesthesia to intubation of trachea (intubation time) was also significantly less in group B as compared to group A. (table: 2). However intubating conditions were excellent and comparable in both the groups. There was complete jaw relaxation, open vocal cords on laryngoscopy with no coughing, no laryngospasm, no limb movements or struggling during intubation in both the groups. None of the patient had oxygen desaturation in both groups during induction and intubation. During maintenance of anaesthesia, none of the patient required non depolarising muscle relaxant in both the groups. Total amount of propofol required during maintenance of anaesthesia in group A (88.112 ± 34.54 milligram) and group B (98.187 ± 34.02milligram) was also comparable (P=0.193). Mean heart rate remained on lower side in group A as compared to group B at all measured intervals from 2nd to 60th minutes and the difference between the two groups was highly significant (p=0.00). But after 60 minutes, heart rate remained

stable and comparable in both the groups as shown in fig: 1. The maximum percentage fall in heart rate was observed at third minute and that too was significantly more in group A (21.55% fall) as compared to group B(9.93% fall) ($p < 0.01$). Mean systolic blood pressure (SBP) remained stable and comparable in the two groups during first two minutes ($p > 0.05$), after that SBP was significantly on lower side in group A as compared to group B at 3rd, 4th and 5th minute ($p < 0.001$). After 5th minute, mean SBP was comparable in both groups ($p > 0.05$) at all measured intervals upto 60 minutes.(fig: 2). However maximum percentage fall in SBP was significantly more in group A ($20.49 \pm 2.64\%$) as compared to group B ($13.65 \pm 2.85\%$) at third minute and the difference was highly significant ($p < 0.001$). Mean diastolic blood pressure (DBP) remained comparable ($p > 0.05$) in both groups at all measured intervals from 0-60 minutes.(fig: 2). Maximum percentage fall in DBP was also more in group A ($20.45 \pm 4.20\%$) as compared to group B ($18 \pm 3.5\%$) and that too at third minute but the difference was non significant. Mean arterial pressure (MAP) also remained comparable in both groups ($p > 0.05$) at all measured intervals. (Fig: 2). Difference in the percentage fall in MAP was statistically non-significant at first five minutes with

maximum fall noticed at third minute which was $20.45 \pm 4.20\%$ in group A and $18.00 \pm 3.5\%$ in group B. Later on MAP remained stable in both groups as shown in fig: 3. Mean heart rate, Systolic blood pressure, Diastolic blood pressure and mean arterial pressure remained stable and comparable in both groups from 60 minutes onwards till the end of study. Mean Respiratory rate and saturation of O₂ in peripheral blood remained stable and comparable in both groups at all measured intervals till the end of study. None of the patient had any ECG changes from induction to recovery in both the groups. After completion of surgery, emergence from anaesthesia was significantly more rapid in group B (15.78 ± 3.886 minutes) as compared to group A (19.08 ± 4.492 minutes) ($p = 0.001$). But the mean time taken to shift the patients to recovery room was comparable in both groups ($p = 0.233$) as shown in Table: 2. None of the patient had coughing, laryngospasm, oxygen desaturation or struggling during emergence from anaesthesia in both the groups. Patients in both the groups were drowsy but were responding to verbal commands at the time of shifting to the recovery room. None of the patient developed nausea and vomiting in both the groups during immediate postoperative period.

Table1: Demographic profile of patients in Group A and Group B.

Parameters		Group A (Halothane +propofol)	Group B(Sevoflurane+ propofol)	p value	Significance
No. of patients		40	40	-	-
Age in years		6.80 ± 2.235	7.175 ± 2.312	0.445	NS
Weight in kg		16.68 ± 5.622	18.93 ± 6.439	0.100	NS
Sex ratio	Male	21(52.5%)	22 (55%)	0.823	NS
	Female	19 (47.5%)	18 (45%)		
Duration of surgery		52.23 ± 8.163	51.85 ± 5.304	0.808	NS
Baseline Heart rate		118.35 ± 6.747	122.85 ± 9.638	0.068	NS
Baseline Systolic blood pressure		117.08 ± 8.337	113.23 ± 9.449	0.058	NS
Baseline Diastolic blood pressure		72.85 ± 5.811	71.73 ± 8.608	0.495	NS

Values are expressed as mean and standard deviation or number and percentage. $P > 0.05$ is no significant (NS). Number of patient in both group were comparable. Mean age, mean weight, sex ratio and duration of surgery in minutes was comparable in both groups ($p > 0.05$). Inter group comparison of age,

weight and duration of surgery was done with unpaired "t" test and sex ratio was compared with Chi- Square test. Mean baseline heart rate per minute, systolic blood pressure and diastolic blood pressure in mm of Hg were also comparable in both the groups

while using unpaired “t” test for statistical analysis. (p>0.05).

Table2: Induction, Intubating and Emergence parameters in Group A and Group B.

Parameters	Group A (Halothane+ propofol) n=40	Group B(Sevoflurane+ propofol) n=40	p value	Significance
Loss of eye lash reflex in seconds	33.05± 4.015	21.88± 12.652	0.000	HS
Centralisation of pupil in seconds	140.05± 12.106	114.40± 28.811	0.000	HS
Mean Intubation time in seconds	211.88±11.305	189.30±33.087	0.000	HS
Quality of induction	No cyanosis No pain on I/v access No laryngospasm No body movement	No cyanosis No pain on i/v access No laryngospasm No body movement	---	---
Intubation parameters (total score)	Jaw relaxation complete – 1 Vocal cord position open – 1 No Cough- 1 No limb movement – 1 No laryngospasm – 1 Total score – 5	Jaw relaxation complete – 1 Vocal cord position open – 1 No Cough- 1 No limb movement – 1 No laryngospasm – 1 Total score – 5	---	---
Emergence time in minutes	19.08±4.492	15.78±3.886	0.001	S
Mean time taken to shift patient to recovery room in minutes	11.78±2.516	10.75±4.776	0.233	NS

Values are expressed as mean and standard deviation. P>0.05 is non significant (NS), p<0.01 is significant (S), p<0.001 is highly significant. In group B (sevoflurane +propofol) loss of eye lash reflex, centralisation of pupil and intubation time was significantly less as compared to group A (halothane +propofol) p<0.001. However quality of induction and intubating conditions were comparable in both groups. Emergence was also earlier in group B as compared to group A. P<0.001. Time taken to shift the patient to recovery room was again comparable in both groups.(p>0.05) Statistical analysis was performed for various parameters of induction and recovery using unpaired “t” test.

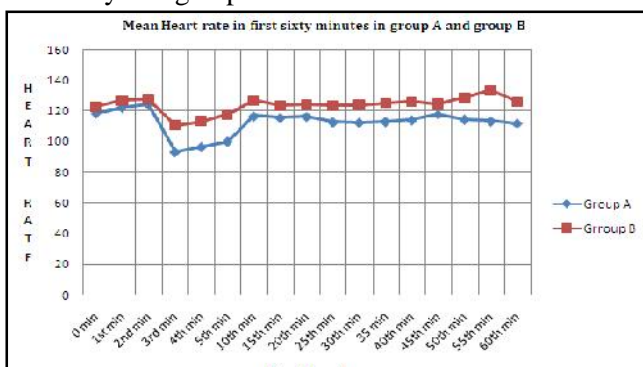
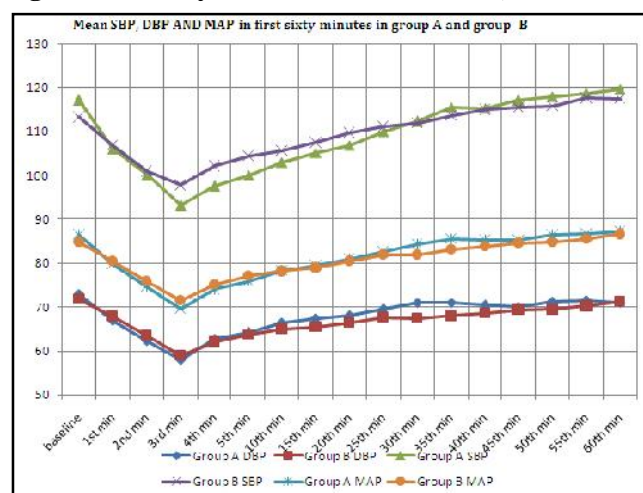


Fig1: Mean Heart Rate in group A (Halothane+propofol) and group B (Sevoflurane+propofol) at various time intervals. Line diagram showing comparison of Mean heart rate at various time intervals in both groups. It remained on lower side in group A from 3rd to 60th minute of

induction as compared to group B. Maximum fall in heart rate was at 4th, 5th, 6th minute of induction in both group and that too was more in group A as compared to group B when unpaired “t” test was applied. (P<0.001)

Fig2: Mean Systolic Blood Pressure, Diastolic



Blood Pressure and Mean Arterial Pressure at various time intervals in Group A (Halothane+propofol) and Group B (Sevoflurane+propofol).

Line diagram showing the comparison of systolic blood pressure (SBP), Diastolic blood pressure (DBP) and mean arterial pressure (MAP) from first minute to 60 minute of induction in group A and group B. There was maximum fall in SBP, DBP and MAP in both groups at 2, 3 and 4 minute of induction. SBP remained on lower side in group A as compared to Group B. DBP and MAP remained comparable in

both groups. Unpaired “t” test was used for intergroup comparison of MAP, SBP and DBP.

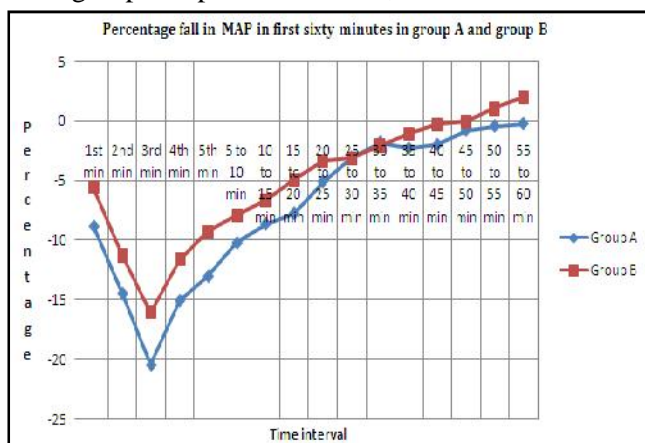


Fig3: Line diagram showing percentage changes in mean arterial pressure (MAP) in group A (Halothane+propofol) and group B (sevoflurane+propofol) at various time intervals.

Line diagram showing percentage change in mean arterial pressure (MAP) in both groups. Percentage fall in MAP was more in group A as compared to group B from second to fifth minute. P was less than 0.001 on applying unpaired “t” test.

DISCUSSION

Goals of anaesthesia for paediatric patients are fast emergence and short recovery with low incidence of post operative side effects, permitting a rapid and safe discharge.^[13] Continuous research for an ideal inhalation agent which has all the induction properties of halothane but with minimal cardiac side effects led to the introduction of sevoflurane. It provides rapid induction and emergence due to its low blood gas solubility.^[14] With the advent of potent and short acting intravenous induction agent “Propofol”, intubating the trachea without using muscle relaxant has been under evaluation. Propofol has faster onset, provides good intubating conditions by decreasing muscle tone and depressing airway reflexes, allows smooth transition to emergence and rapid recovery from anaesthesia.^[15] In the present study, both groups were comparable with respect to demographic profile and duration of surgery. Induction of anaesthesia was more rapid in sevoflurane group, as the time taken to loss of eye lash reflex and centralisation of pupil was significantly less in sevoflurane group as compared to halothane group (p<0.01). Previous studies also reported that time taken for loss of eye lash reflex and

centralisation of pupil was less with sevoflurane than with halothane induction, but in these studies induction time was slightly more than the present study.^[6,7,9,16,17] This difference might be due to fact that either no priming of the circuit was done^[6,16] or step wise increased concentration technique, starting with low concentration of inhalational agent was used for induction in these studies.^[7,9,17] However in the present study, quality of induction was good and comparable in both the groups as none of the patient had any cyanosis, laryngospasm, breath holding or pain during intravenous cannulation. Batra Y K et al^[10] used graded inhalational technique for bronchoscopic removal of foreign body in children. Induction was done with either Halothane or sevoflurane in oxygen only. Slight incidence of coughing, breath holding, laryngospasm and excitement was observed during induction in both groups. In a study done by Abdel-Halem et al^[16] induction was done with either 5% halothane or 8% sevoflurane in oxygen only. Struggling, bodily movements and laryngospasm during induction was observed in both the groups. In the present study, use of nitrous oxide during priming of the circuit for induction might be helpful for smooth induction. Addition of nitrous oxide to oxygen, decreases the MAC of sevoflurane and halothane^[18] and also minimises the adverse airway reactions and struggling associated with use of high concentration of inhalational agents.^[19] Similarly time taken for intubation was significantly less in sevoflurane group as compared to halothane group but intubating conditions were excellent in both groups. Less intubation time taken during sevoflurane induction was documented by previous studies also.^[18,20] O’Brien et al^[11], in their study observed coughing, vocal cord movements, laryngospasm and oxygen desaturation during intubation, when halothane and sevoflurane was used with O₂ and N₂O for induction without using muscle relaxants. In the present study, I/V lignocaine and propofol^[15] given just before intubation might have improved the intubating conditions. I/V lignocaine abolish the injection pain of propofol, improve intubation scores by its antitussive effects and also attenuate the pressor response to tracheal intubation.^[21] In Halothane + propofol group, mean heart rate remained on lower side as compared to sevoflurane + propofol group from first minute to sixty minutes and the maximum

fall at third minute was also more in halothane group. Previous studies also observed that heart rate remained on lower side in halothane group and it remained on higher side in sevoflurane group during induction and maintenance of anaesthesia.^[5,17,18,20] In the present study, heart rate did not increased from baseline values in sevoflurane group at all measured intervals and no stress response was noted in either of the two groups at the time of intubation as reported by Paris S T et al^[17] and Dedhia KN and Kudalkar A. Intravenous lignocaine^[21] and propofol^[15] given just before intubation, effectively attenuates the haemodynamic stress response to intubation. Blood pressure remained on lower side and maximum fall in blood pressure was also more in halothane + propofol group as compared to sevoflurane + propofol group. Both sevoflurane and halothane decreases myocardial contractility, but effect of halothane is more. In stable conditions, blood pressure is better maintained with sevoflurane than with halothane as documented by Piat V et al^[20], Dedhia KN and Kudalkar A^[5] and Paris S T et al.^[17] After completion of surgery, emergence was significantly faster in Group B as compared to Group A. Emergence from anaesthesia depends on the blood gas solubility of inhalational agents. Blood gas- partition coefficient of sevoflurane is low, hence provides rapid emergence.^[18] Previous studies also reported faster emergence with sevoflurane as compared to halothane.^[9,10,16,17,20] In the present study, none of the patient had cough, laryngospasm, struggling or oxygen desaturation during extubation and emergence from anaesthesia. Children were drowsy but were responding to verbal commands at the time of shifting to recovery room, in both the groups. No emergence agitation was noted in both groups and the time taken for shifting the patients to recovery room was comparable. In the postoperative period none of patient developed nausea and vomiting. Propofol depresses the airway reflexes and thus decreases the incidence of coughing and laryngospasm during extubation.^[12] Previous studies found that rapid emergence from sevoflurane as compared to halothane was associated with increased incidence of struggling and excitement.^[7,8,10,17] Moore JK et al^[22] concluded that emergence agitation was observed more when sevoflurane alone was used for maintenance and addition of propofol decreases the emergence agitation. Propofol also decreases the

incidence of postoperative nausea and vomiting if used for maintenance of anaesthesia.^[22,23]

CONCLUSION

Hence it was concluded that both groups provided excellent intubating conditions without using muscle relaxants, with no stress response. But Sevoflurane + propofol group was better as it provided faster induction and rapid recovery from anaesthesia with more stable haemodynamics as compared to Halothane + propofol group.

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Conflict of Interest: Nil

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