Original Article

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A Comparative Study to Evaluate the Intubating Conditions between Propofol-Sevoflurane and Propofol Alone Without Using Neuromuscular Blocking Agents

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Abstract

Background: Endotracheal intubation using an induction agent is usually facilitated by the use of depolarizing neuromuscular blocking agents like succinylcholine however it may be associated with various side effects. Propofol and sevoflurane can be used for endotracheal intubation as both provides adequate intubating conditions but propofol is associated with several adverse effects when used alone. So this study was aimed to compare the intubating conditions, haemodynamic changes and side effects using combination of low dose of propofol and lower concentration of sevoflurane with propofol alone at its usual dose.

Material and Methods: The present study was conducted on sixty patients of ASA grade I or II , aged 20-40 years of either sex scheduled for various elective surgeries under general anaesthesia. The patients were randomly allocated into two groups of 30 each: Patients in Group P were induced with 67% N_2O in O_2 and propofol 3 mg/kg given intravenously over 30 seconds while patients in Group PS were induced with sevoflurane 0.5-4% inhaled concentration with 67% N_2O in O_2 and propofol 1.5mg/kg given intravenously over 15 seconds. Endotracheal intubation was attempted at 4 minutes after the start of induction in both the groups. The intubating conditions, hemodynamic parameters (HR, SBP, DBP, MAP) and any side effects were observed and noted.

Results: Intubating conditions were found to be significantly better in Group PS, ($P<0.001$). Intubating conditions were clinically accepted in 90% of patients in group PS compared to 73.3% in group P, which was highly significant, ($P = 0.028$). In Group P, HR, SBP, DBP and MAP were reduced significantly from their baseline values, ($P<0.05$). No significant difference in side-effects was noted between two groups, ($P>0.05$).

Conclusion: The combination of sevoflurane and propofol seems to be a better alternative to propofol alone for endotracheal intubation in terms of better intubating conditions with minimal haemodynamic changes and side effects.

Keywords: Propofol; Sevoflurane; Intubating Conditions; Haemodynamics; Endotracheal Intubation.

Introduction

The administration of general anaesthesia usually requires endotracheal intubation which is essential to maintain the airway patency along with adequate oxygenation and ventilation during various surgical procedures. The adequate depth of anaesthesia and muscle relaxation are the essential prerequisites for endotracheal intubation [1].

An induction agent followed by administration of a depolarizing muscle relaxant like succinylcholine is frequently used for the placement of an endotracheal tube. However, use of succinylcholine is associated with various undesirable side effects. The nondepolarizing neuromuscular blocking agents are increasingly used for endotracheal intubation nowadays but they are also associated with prolonged neuromuscular blockade, which is undesirable for the surgeries particularly with short duration [2-4]. So to avoid such adverse effects, an alternative method has been searched to provide adequate intubating conditions without the

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use of muscle relaxants. This technique may be of considerable benefit in some particular conditions in which neuromuscular blocking agents have to be avoided or contraindicated [5,6].

Propofol, an intravenous induction agent, may provide adequate conditions for laryngoscopy and endotracheal intubation without the use of neuromuscular blocking agents, as it has the ability to depress pharyngeal and laryngeal reflexes. However, it may be associated with various adverse events including profound hypotension, apnoea, excitatory phenomenon and pain on injection depending on the dosage used [7,8].

Similarly, sevoflurane, a potent inhalational agent, can be used as a sole anaesthetic to facilitate endotracheal intubation as it provides smooth and rapid induction because of its non pungent property, low airway irritability, and low blood- gas coefficient. Sevoflurane is also associated with minimal haemodynamic variations and lesser incidence of apnoea during induction, which is a desirable feature for the facilitation of endotracheal intubation. However it is not cost effective at its usual concentrations used for induction [9,10].

So we hypothesized that a combination of low dose of propofol with a lower concentration of sevoflurane may provide adequate intubating conditions along with minimal haemodynamic changes and adverse events during induction and endotracheal intubation. This may also reduce the various adverse effects associated with the usual doses of propofol and the muscle relaxants.

This prospective randomized study was conducted to compare the intubating conditions, haemodynamic changes and various side effects using a combination of propofol and sevoflurane and propofol alone.

Material and Methods

After obtaining approval from local institutional ethical committee, this prospective randomized comparative study conducted at our institute included sixty adults patients of either sex, aged 20-40 years, American Society of Anesthesiologists (ASA) grade 1 and 2 scheduled for various surgical procedures under general anaesthesia. Patients with ASA grade 3 and above, patients with a history or evidence of a difficult airway (Mallampati Grade 3 and 4), patients with previous history of allergy to any of the drug used in the study and patients with body mass index more than 30 kg/m^2, were excluded from our study.

All the patients were randomly allocated into two groups with 30 patients in each group, using computer generated random number tables, including Group P (Propofol group) and Group PS (Propofol and Sevoflurane group). All patients had undergone routine preanaesthetic evaluation the day before surgery and written and informed consent was taken. After arrival of the patient in operation theatre all standard monitors were attached including pulse oximeter (SpO_2), electrocardiogram (ECG), non invasive blood pressure (NIBP) and an intravenous line was secured using 18G cannula and infusion of ringer's lactate was started. The baseline haemodynamic parameters including heart rate (HR),systolic blood pressure (SBP),diastolic blood pressure (DBP) and mean arterial pressure (MAP) were recorded. In premedication, glycopyrrolate 0.004 mg/kg, midazolam 0.02mg/kg and fentanyl 2 µg/kg were given intravenously 5 min before induction. All the patients were pre-oxygenated with 100% (oxygen) O_2 for 3 min using bain's circuit. The patients in Group P were induced with 67% N_2O in O_2 and propofol 3 mg/kg given intravenously over 30 seconds while in Group PS patients were induced with sevoflurane at 0.5- 4% inhaled concentration increased gradually with 67% N_2O in O_2 and propofol 1.5mg/kg given intravenously over 30 seconds . Endotracheal intubation was attempted at 4 min (240 sec) after the start of induction in both the groups.

Endotracheal intubation was performed using laryngoscope with Macintosh blade and appropriate sized cuffed endotracheal tube. The intubating conditions were assessed by the anaesthesiologist who performed endotracheal intubation using Copenhagen Consensus Conference (CCC) score [9,13] (Table 1). The CCC score grades the quality of tracheal intubation according to different parameters including the ease of laryngoscopy, vocal cords position and movements, coughing and movement of the limbs. Intubation was graded as Excellent, when laryngoscopy was easy, vocal cords abducted and immobile, with no limb movements or coughing; Good, when the laryngoscopy was fair, vocal cords moving and in intermediate position, with slight limb movements and diaphragmatic movements; Poor, when there was difficult laryngoscopy, closed vocal cords, with vigorous limb movements and severe cough. According to the grading of quality of intubation, the excellent and good scores were graded under clinically acceptable intubating conditions while the poor scores were graded under clinically unacceptable intubating conditions. The number of attempts taken for successful endotracheal intubation were also noted.

In some patients where endotracheal intubation could not be done using these techniques, succinylcholine 2 mg/kg was given intravenously to facilitate endotracheal intubation. After confirming the position of the endotracheal tube by chest auscultation and capnography ($EtCO_2$) anaesthesia was maintained using 67% N_2O, 33% O_2, 0.5-2% sevoflurane and vecuronium using closed circuit with controlled ventilation. These patients were excluded from our study.

The haemodynamic parameters including HR, SBP, DBP and MAP were recorded before and after induction and post intubation at 1, 3 and 5 minutes intervals**.** The various side effects during induction including breath holding, cough, excitatory movements, laryngospasm and others (bradycardia, oxygen desaturation, hypo or hyperthermia, and pain at site of injection) were noted.

Statistical Analysis

The sample size was calculated to be 30 patients in each group based on previous studies. Statistical analysis was done using Chi-Square test, Fisher's Exact test and Student's paired and unpaired t- test with windows SPSS version 10.0. All the values were expressed as Mean ± SD (standard deviation). P> 0.05 was considered to be statistically not significant, P< 0.05 was statistically significant and P <0.001 was highly significant.

Results

Both the groups were found to be statistically similar with respect to age, sex , ASA grade and weight distribution (Table 2).

The quality of intubating condition was significantly better in Group PS than in Group P, (P= 0.002). Intubating conditions were clinically acceptable in 73.3% of patients in group P compared to 90% in group PS, which was highly significant, (P = 0.028). Endotracheal intubation was accomplished in 86.7% of patients in Group P, only 73.3% of those patients had acceptable intubating conditions and remaining 26.7% of patients had unacceptable intubating conditions. The factors associated with unacceptable intubating scores were vocal cords movement (36.7%), coughing (50%) and limb movements (53.4%) in Group P (Table 3 and 4).

In Group P, laryngoscopy was easy in 60%, fair in 33.3% and difficult in 6.7% of patients and vocal cords were moving in 26.7% and closing in 10% of patients, which was not statistically significant, (P>0.05). 13.3% of patients required succinylcholine supplementation to achieve intubation because of vocal cords movement, coughing and excessive limb movements. 76.7% of patients intubated in first attempt and remaining 23.3% required multiple attempts. During induction, 13.3% of patients in Group P had breath holding, 20% had cough and 10% had excitatory movements, which was not statistically significant, (P>0.05) (Table 5).

The endotracheal intubation was accomplished in 100% of patients in Group PS, 90% of those patients had acceptable intubating conditions when compared with 73.3% in Group P, which was highly significant,(P< 0.001). In Group PS, laryngoscopy was easy in 80% and fair in 20% of patients and vocal cords were abducted in 73.3% and moving in 16.7% of patients, which was not significant, (P>0.05).

In Group PS, 83.3% of patients had no cough compared with 50% in Group P. Coughing was associated more significantly with Group P, (P=0.007). 13.3% of patients in Group PS had diaphragmatic movements and 3.3% had severe coughing. Limb movements were absent in 80% of patients in Group PS compared to 46.6% in Group P. Limb movements were significantly more in Group P, (P=0.004). 16.6% of patients in Group PS had slight and 3.3% had vigorous limb movements,(P=0.004).

None of the patients in Group PS required succinylcholine supplementation to achieve intubation. The number of attempts required for endotracheal intubation were significantly lesser in Group PS, (P<0.05). Majority of patients in Group PS were intubated in first attempt 29(96.7%) as compared to 23 (76.7%) in Group P while 5 patients required second attempt and 2 patients required third attempt in Group P, which was statistically significant, (P= 0.004) (Table 5).

There was no significant difference in HR after induction and post-intubation between the two groups, (P > 0.05) except 3min after intubation which was significant, (P=0.025) There was a significant difference in SBP after induction and post-intubation at 1, 3 and 5 min between the two groups, (P <0.05). There was no significant difference in DBP and MAP between the two groups following induction and intubation,(P>0.05). However, there was significant reduction in HR, SBP, DBP and MAP were observed from their respective baseline values in Group P,(P<0.05) (Figure 1, 2, 3 and 4).

Both the groups were found to be statistically similar with respect to various side effects during

induction including breath holding, cough, excitatory movements, laryngospasm and others, (P>0.05).

Table 1: Copenhagen Consensus Conference (CCC) intubation score

Laryngoscopy	Easy	Fair	Difficult
Vocal cords position	Abducted	Intermediate	Closed
Vocal cords Movement	None	Moving	Closing
Limb movement	None	Slight	Vigorous
Coughing	None	Diaphragmatic movement	Severe coughing
Quality of Intubation	Excellent*	Good*	Poor**
*Excellent = all scores excellent	Clinically acceptable		
*Good = all scores excellent or good			
**Poor = any score poor	Clinically unacceptable		

Table 2: Demographic data

Variables	Group P (n=30)	Group PS (n=30)
Mean age (years)	27.23±5.22	28.67±5.99
Sex (Male/Female)	14/16	11/19
Mean weight (kgs)	52.53±7.30	53.10±7.56
ASA grade (I/II)	25/5	27/3

Table 3: Copenhagen Consensus Conference (CCC) intubation score in both groups

CCC endotracheal Intubation score	Criteria	Group P (n=30)	Group PS (n=30)	P value
Laryngoscopy	Easy	18(60%)	24(80.0%)	0.094
	Fair	10(33.3%)	6(16.7%)	
	Difficult	2(6.7%)	0(0%)	
Vocal cords position	Abducted	18(60.0%)	22(73.3%)	0.254
	Intermediate	10(33.3%)	8(26.7%)	
	Closed	2(6.7%)	0(0%)	
Vocal cords movement	None	20(66.7%)	25(83.3%)	0.140
	Moving	8(26.7%)	5(16.7%)	
	Closing	2(10%)	0(0%)	
Limb movement	None	14(46.6%)	24(80.0%)	0.004*
	Slight	9(30%)	5(16.7%)	
	Vigorous	7(23.4%)	1(3.3%)	
Coughing	None	15(50.0%)	25(83.3%)	0.007*
	Diaphragmatic movement	10 (33.3%)	4(13.7%)	
	Severe coughing	5(16.4%)	1(3.0%)	
Quality of Intubation	Excellent	12(40%)	24(80%)	0.002*
	Good	10(33.3%)	3(10%)	
	Poor	8(26.7%)	3(10%)	

*Values are expressed as number (percentage)

Table 4: Intubating conditions in both groups

Intubating condition	Group P (n=30)	Group PS (n=30)
Acceptable	22(73.3%)	27(90%)
Unacceptable	8(26.7%)	3(10%)

*Data are expressed as number (percentage)

Table 5: Number of attempts for endotracheal intubation in both groups

Number of attempts	Group P (n=30)	Group PS (n=30)
1	23 (76.7%)	9(96.7%)
2	5(16.7%)	1(3.3%)
3	2(6.6%)	0 (0%)

*Data are expressed as number (percentage)

Table 6: Side effects during induction in both groups

Side effects during induction	Group P (n=30)	Group PS (n=30)	P value
Breath holding	4 (13.3%)	0(0%)	0.112
Cough	6(20.0%)	3(6.7%)	0.473
Excitatory movements	2(10.0%)	1(3.3%)	0.999
Laryngospasm	0(0%)	0(0%)	-
Others	0(0%)	0(0%)	-

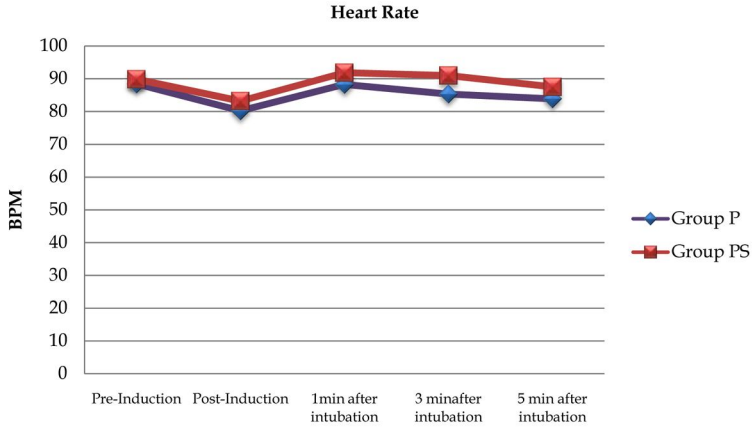

Fig. 1: Comparison of HR (bpm) in both groups

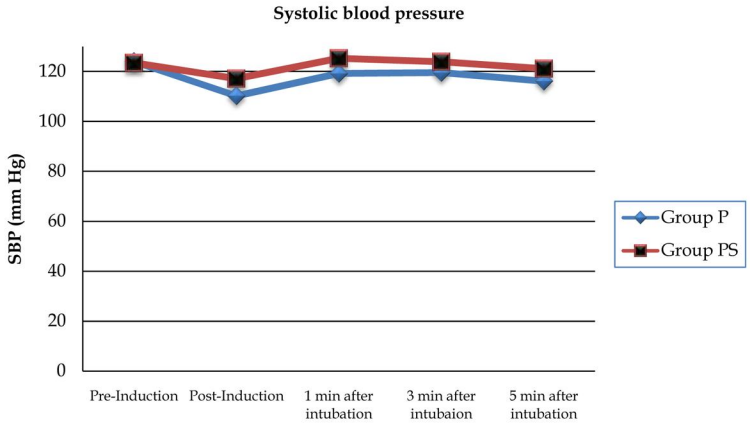

Fig. 2: Comparison of SBP (mm Hg) in both groups

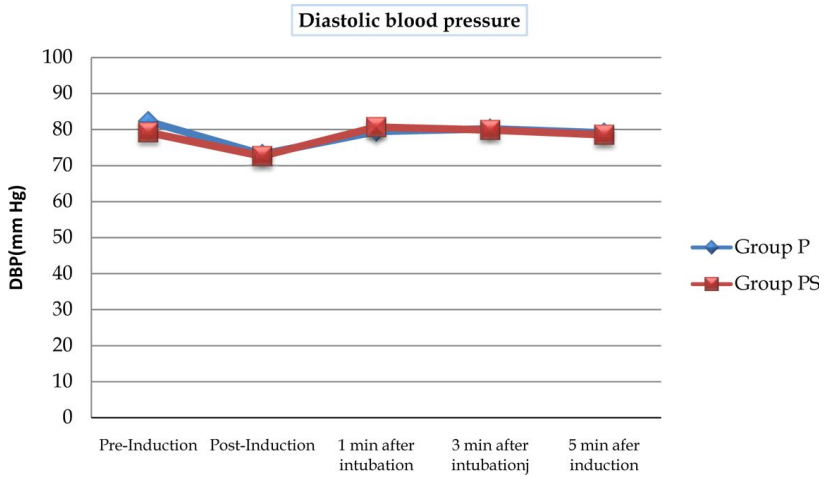

Fig. 3: Comparison of DBP (mm Hg) in both groups

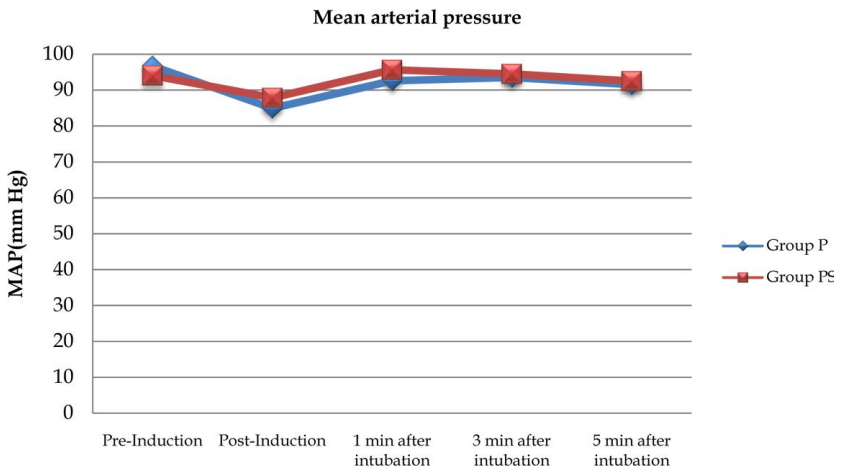

Fig. 4: Comparison of MAP (mmHg) in both groups

Discussion

Propofol has obviated the need of neuromuscular blocking agents for laryngoscopy and intubation in certain situations as it has the advantages of suppressing airway reflexes and blunting the haemodynamic response caused by laryngoscopy and intubation. Propofol also has rapid and smooth induction , rapid recovery and anti emetic properties. Inhalational agents like sevoflurane can be used to facilitate endotracheal intubation. It has low blood gas solubility which provides rapid and smooth induction and also fast recovery with added advantage of decreased chances of cardiac dysarrythmias and cardiac depression as associated with other inhalational agents [10-13]. According to our hypothesis, we have used both propofol and sevoflurane at low dosage and concentrations respectively so as to avoid various adverse effects associated with propofol at its usual dose simultaneously providing adequate intubating conditions in combination with sevoflurane.

In our study, intubating conditions were clinically acceptable in significantly more number of patients in Group PS (90%) as compared to Group P(73.3%), P<0.05. The patients in Group P were associated with significantly more coughing and limb movements. The propofol sevoflurane group had more easy laryngoscopy with better vocal cord position and lesser vocal cord movements according to CCC intubation score. The quality of intubation was also found to be significantly better in group PS as compared to Group P, P <0.05.

Manjunath C et al [3], had found significantly more clinically acceptable intubating conditions in propofol sevoflurane group (93.3%), P<0.001, which concurs with the findings of our study. Similarly they also found significantly lesser incidence of cough and limb movements in propofol sevoflurane group in their study. Raghvendra TR et al [2], found significantly more clinically acceptable intubating conditions in propofol sevoflurane group (93.3%) in their study. However, Erhan et al [6], demonstrated clinically more acceptable intubating condition with propofol (93.3%) compared to thiopentone or etomidate.

The quality of intubation with clinically acceptable intubating conditions were found to be better with combination of low dosage or concentration of propofol and sevoflurane respectively which may be attributed to their favourable properties simultaneously reducing the side effects associated with propofol alone at its usual or higher doses. In our study, we have used fentanyl before induction as it has analgesic action with the added advantage of blunting the pressor response during laryngoscopy and endotracheal intubation which helps in improving the quality of intubation with minimal haemodynamic changes along with reduction in doses of induction agents which is desirable for the placement of endotracheal tube without the use of neuromuscular blocking agents [17,18]. This was demonstrated by the study done by Katoh et al [14], who also reported antitussive effects of fentanyl which might have added advantage during endotracheal intubation.

In our study, the majority of patients were intubated in first attempt in Group PS (96.7%) when compared to Group P (76.7%), P < 0.05. This demonstrated the better quality of intubation with propofol sevoflurane group. The lesser number of attempts with propofol sevoflurane group was attributed to the quality of intubation which depends on vocal cords position and movement during laryngoscopy along with

coughing and limb movements. Since the propofol sevoflurane combination provided better vocal cords position with minimal movements of vocal cords and coughing which is a prerequisite for successful endotracheal intubation in first attempt without the use of muscle relaxant. Thwaites et al [9] and Swadia et al [15] demonstrated excellent intubating conditions with sevoflurane (8%) and nitrous oxide in paediatric patients undergoing various elective surgeries, and no complications were reported. Rajan S et al [18] also reported clinically better acceptable intubating conditions using sevoflurane without the use of muscle relaxants in paediatric patients.

In present study, the significant reduction in HR, SBP, DBP and MAP were observed after induction and intubation in Group P when compared with baseline values, $P<0.05$. However, there was no significant difference among these parameters in Group PS when compared with baseline values, $P>0.05$. Propofol has reduced both heart rate and blood pressure at its usual dose, which demonstrated that there was significant decrease in cardiac output. So propofol effectively attenuated the haemodynamic response to intubation, which is attributed to its action of depressing both pharyngeal and laryngeal reflexes effectively and thereby reducing sympathetic activity or stimulation during laryngoscopy and endotracheal intubation [17].

Manjunath C and Raghvendra TR also reported similar findings in their study [2,3]. Srivastava et al [8], reported significant decrease in HR and MAP from their baseline values with propofol and fentanyl used in paediatric patients. However, Styen et al [16] found no significant change in heart rate but a significant reduction in MAP after induction was observed with propofol and alfentanil in children. In contrary to these studies, Swadia and Bithal PK et al [1] reported significant tachycardia in patients with sevoflurane, during various time intervals which might have due to use of different dose or concentrations of propofol and sevoflurane in their studies [15].

The patients in propofol group alone had significant reduction in HR, SBP and MAP as propofol reduces the sympathetic nervous system stimulation at its usual doses which produces profound hypotension and bradycardia that can be avoided with the use of its lower dosage along with the use of potent inhalational agent like sevoflurane while maintaining the haemodynamic stability of the patient. In Group P, 13.3% patients had breath holding, 20% patients had cough and 10% patients had excitatory movements while none of the patients had any side effects in Group PS, associated with induction, that was also statistically not significant which favours the use of sevoflurane along with propofol during induction as sevoflurane has smooth induction because of its non pungent and non irritant properties.

Conclusion

Thus from our study we concluded that the combination of low dose of propofol (1.5 mg/kg) along with lower concentration of sevoflurane (4%) during induction and endotracheal intubation seems to be better alternative approach as compared to propofol (3 mg/kg) alone with respect to quality of intubation and intubating conditions with minimal haemodynamic variations in patients undergoing various elective surgeries without the use of neuromuscular blocking agents.

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