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A Clinical Study of Comparison of Combination of Sevoflurane and Propofol with Propofol Alone for Induction and Intubation

KEYWORDS: General Anaesthetic, Sevoflurane,Propofol, Laryngoscopy, Endotracheal intubation, Haemodynamics.

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ABSTRACT *Endotracheal intubation is the most important and crucial step during administration of general anaesthesia. Propofol is a hypnotic agent, obtunds airway reflexes, and allows laryngoscopy and intubation. Sevoflurane is a newer volatile induction agent with low blood-gas solubility and has a pleasant smell, low airway irritability and better haemodynamic characters. The study was done in 60 ASA PS I and II, aged 20-40 yearspatients, were randomly divided into two groups and monitored heart rate (HR), blood pressure(BP), Oxygen saturation (SPO2) and Electrocardiogram (ECG) in both groups. In group B patients (93%) had significantly better and acceptable intubation conditions than group A (73%) with P value of < 0.001.*

INTRODUCTION

Endotracheal intubation is the most and crucial step during administration of general anaesthesia. It helps in maintaining the airway patency, makes procedure safe and also protects the lungs from aspiration. The ease with which endotracheal intubation is achieved depends on technique of proficiency, depth of anaesthesia and degree of muscle relaxation. Intubation in anaesthesia using short acting hypnotic agent is frequently facilitated by the simultaneous administration of a short acting muscle relaxant. However, Succinylcholine administration may associated with side effects such as prolonged paralysis (Scoline apnea), postoperative myalgia, triggering of malignant hyperthermia, masseter spasm, histamine release, hyperkalemia, cardiac arrhythmias, cardiac arrest, increase in intracranial and intraocular pressure, and anaphylaxis. Even use of nondepolarizing muscle relaxants may be associated with undesirable side effects such as prolonged muscle paralysis, the need to reverse neuromuscular blockade, or the inability to reverse the paralysis quickly if airway management via mask or tracheal intubation is not possible.

MATERIALS AND METHODS

The study population of 60 ASA PS I and II, non obese adult patients, aged between 20 to 40 years, posted for elective surgical procedures under general endotracheal anaesthesia and had Mallampatti class I airway. Patients were grouped into two groups with 30 patients in each group. The baseline heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure parameters were recorded.

All patients were premeditated with intravenous fentanyl at a dose of 2 µg/kg, midazolam 1mg, glycopyrrolate 0.2 mg. All patients were preoxygenated with 100% oxygen for 3 minutes. Anaesthesia was induced in **Group A** patients by oxygen, nitrous oxide (66%) and intravenous propofol at a dose of 3 mg/kg over a period of 30 seconds. **Group B** patients were induced by facemask with sevoflurane at 4% inhaled concentration with nitrous oxide (66%) and oxygen and intravenous propofol at a dose of 1.5 mg/kg injected over a period of 30 seconds. Tracheal intubation was attempted at 240 seconds after the start of induction. Lidocaine 0.2 mg/kg added to propofol to prevent pain on injection.

The heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure before and after induction and post intubation at 1, 3, 5 minutes were recorded. Time to induction in seconds (start of anaesthetic until loss of eye lash reflex), induction side effects like breath holding, coughing, excitatory movements, laryngospasm, and others (Bradycardia, hypoxia, hyperthermia, hypothermia, and injection site pain) were noted

Tracheal intubation was performed using appropriate sized endotracheal tube. Intubating conditions were assessed by anaesthesiologist who performed intubation using Copenhagen Consensus Conference (CCC) Score.

OBSERVATIONS: - The following parameters were studied during procedure

1 Time to induction (seconds),
2 Induction side effects,
3 Quality of endotracheal intubation,
4 Number attempts taken for successful endotracheal intubation,
5 Supplementation of endotracheal intubation with suxamethonium,
6 Changes in vital parameters - HR, SBP, DBP, and MAP

Table1: Copenhagen Consensus Conference (CCC) Intubation Score

Laryngoscopy	Easy	Fair	Difficult
Vocal cords position	Abducted	Intermediate	Closed
Vocal cords movement	None	Moving	Closing
Limb movements	None	Slight	Vigorous
Coughing	None	Diaphragmatic movement	Severe coughing
Quality of intubation	Excellent	Good	Poor

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Excellent - all scores excellent; Good - All scores good; Poor - Any score poor. Excellent and good scores are clinically acceptable, poor scores are not clinically acceptable.

Inclusion criteria

1. Patients belonging to ASA grade I and II undergoing elective surgical procedures of 1 to 3 hours
2. Patients of either sex, between the age group of 20 to 40 years

Exclusion criteria`

1. Patient refusal
2. Patients with history or evidence of difficult airway
3. Patients on MAO inhibitors
4. Patients had a history of malignant hyperthermia
5. Patients with previous history of allergy to volatile agents or propofol
6. Patients with body mass index more than 1.5 times normal

Table-1: Age Distribution Of Patients

Age in years	Group A	Group B
20-24	09 (30%)	09 (30%)
25-29	11 (36.7%)	10 (33.4%)
30-34	07 (23.3%)	04 (13.3%)
35-40	03 (10.0%)	07 (23.3%)
TOTAL	30 (100%)	30 (100%)
Mean ±SD	27.23±05.22	28.67±05.99

Samples are age matched with P - 0.327

Table-2: Gender Distribution of Patients

Gender	Group A	Group B
Male	14 (46.7%)	11 (36.7%)
Female	16 (53.3%)	19 (63.3%)
Total	30 (100%)	30 (100%)

Samples are matched with P - 0.402

Table -3: Weight distribution

Weight in Kilograms	Group A	Group B
38-50	13 (43.3%	11 (36.7%)
51-60	11 (36.7)	16 (53.3%)
61-70	06 (20%)	03 (10.0%)
Total	30 (100%)	30 (100%)
Mean ± SD	52.53 ±7.30	53.10 ± 7.56

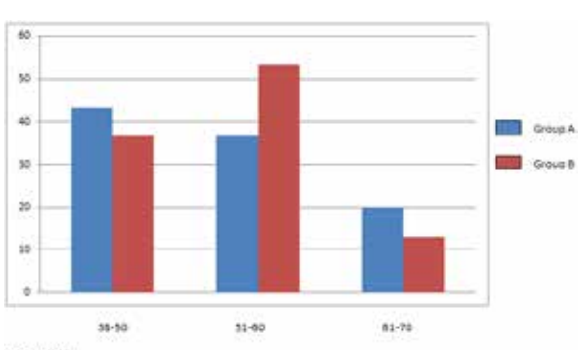

Table-4: ASA Grade

ASA Grade	Group A	Group B
I	26 (86.7%)	27 (90.0%)
II	04 (13.3%)	03 (10.0%)

ASA grade is statistically similar between two groups with P – 0.688.

Table-5: Time to Induction (Seconds)

Time to induction (seconds)	Group A	Group B
001-100	30 (100%)	00
101-200	00	29 (96.7%)
>200	00	01 (03.3%)
TOTAL	30 (100%)	30 (100%)
Mean ±SD	39.80±8.10	156.07±21.58
INFERENCE	Time to induction in seconds is significantly less in Group A (39.80 vs 156.07) with t – 27.629; P is less than 0.001	

Induction time is significantly less in group A patients (39.80±8.10) when compared with group B patients (156.07±21.580

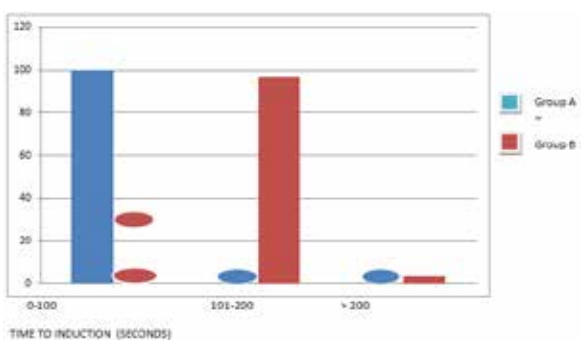

Table-6: Induction Side Effects

INDUCTION SIDE EFFECTS	GROUP A	GROUP B	P-VALUE
Breath holding	3 (10%)	0	0.237
Cough	6 (20%)	2 (6.7%)	0.254
Excitatory movements	3 (10%)	1 (3.3)	0.612
Laryngospasm	0	0	-
Others	0	0	-

Both groups were found to be statistically similar with respect to breath holding, cough, excitatory movements, laryngospasm, and other induction side effects.

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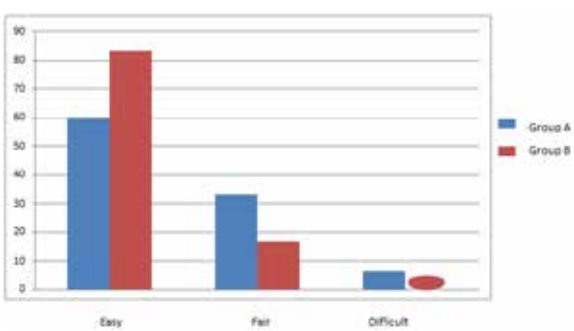
Table-7: Inter Group Comparison of Laryngospasm, Vocal cords position, Vocal cords movements, Limb Movements and Cough.

COPENHAGEN CONSENSUS CONFERENCE (CCC) INTUBATION SCORE

CCC ENDOTRACHEAL INTUBATION SCORE	Criteria	Group A	Group B	P value
Laryngoscopy	Easy	18 (60%)	25 (83.3%)	0.103
	Fair	10 (33.3%)	05 (16.7%)	
	Difficult	02 (6.7%)	00 (00%)	
Vocal cords position	Abducted	20 (66.7%)	25 (83.3%)	0.202
	Intermediate	08 (26.6%)	05 (16.7%)	
	Closed	02 (6.7%)	00 (00%)	
Vocal cords movements	None	20 (66.7%)	25 (83.3%)	0.201
	Moving	07 (23.3%)	05 (16.7%)	
	Closing	03 (10%)	00 (00%)	
Limb movements	None	15 (50%)	26 (86.7%)	0.010
	Slight	08 (26.7%)	03 (10%)	
	Vigorous	07 (23.3%)	01 (3.3%)	
Coughing	None	17 (56.7%)	26 (86.7%)	0.037
	Moderate	09 (30%)	03 (10%)	
	Severe	04 (13.3%)	01 (3.3%)	
Quality of intubation	Excellent	13 (43.3%)	25 (83.3%)	0.006
	Good	09 (30%)	03 (10%)	
	Poor	08 (26.7%)	02 (6.7%)	

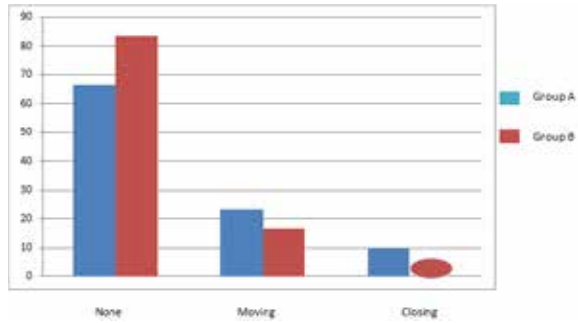
Laryngoscopy was easy in 60% of patients in group A and 83% in group B. The two groups were comparable with respect to laryngoscopy. P value is 0.103 and is not significant.



LARYNGOSCOPY

Regarding position of vocal cords, they were abducted in 66.7% of patients, intermediate in 26.7% of patients, and closed in 6.7% of patients in group A. In group B, vocal cords were abducted in 83.3% and moving in 16.7% of patients. The groups were comparable with respect to vocal cords position. P value is 0.202 and is not significant.

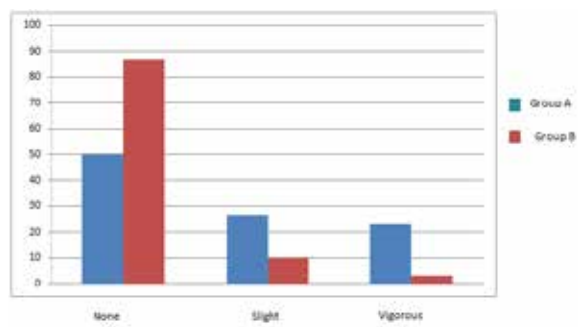
Vocal cords were not moving in 66.7%, moving in 23.3%, and closing in 10% of patients in group A. In group B, vocal cords were not moving in 83.3% and moving in 16.7% 0f patients. The two groups were comparable with respect to vocal cords movements. P value is 0.201 and not significant.



VOCAL CORDS

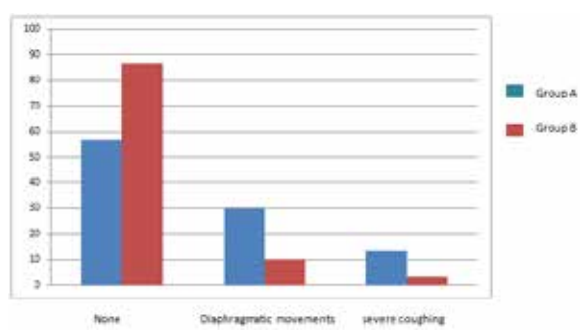
Limb movement were absent in 50%, slight in 26.7%, vigorous in 23.3% patients in group A. In group B 86.7% patients did not move, 10% slightly moved, remaining 3.3% had vigorous movements.

Patients in group A had more limb movements than in group B which is significant (P - 001)



LIMB MOVEMENTS

No cough was present in 56.7% in group A, while 30% patients had diaphragmatic movements and 13.3% had severe coughing after intubation. Group B patients had no coughing in 86.7%, diaphragmatic movements in 10% and severe coughing in 3.3%. Patients in group A had more coughing than in group B which is significant (P-0.037).



COUGHING

DISCUSSION

Laryngoscopy and tracheal intubation are essential skills associated with practice of anaesthesia. It is said that for successful intubation it requires patient to be deeply anaesthetized, paralyzed or anesthesiologists stronger than patient[1]. Usually a combination of hypnotic agent, opioid, and a muscle relaxant is used for intubation.

Propofol is most commonly using relatively newer intravenous hypnotic agent. It is short acting and has fast re-

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covery of consciousness, possesses antiemetic action and reduces incidences of airway complications. It attenuates laryngeal reflex as well as pressure response to laryngoscopy and tracheal intubation [2].

Although, Succinylcholine is the gold standard to provide adequate relaxation because of its rapid onset within 30 to 60 seconds and fast metabolism by pseudocholinesterase, usually indicated for difficult airway management and rapid sequence intubation. It has many associated side effects like myalgia, cardiac dysarrhythmias, elevated intracranial and intraocular pressures, hyperkalemia, and initiation of malignant hyperthermia in susceptible individuals and sometimes causes apnea called "scoline apnea"[3,4]. To avoid complications associated with use of Succinylcholine, short acting nodepolarizing skeletal muscle relaxants are used. They can produce awareness, allergy, failed intubation, residual paralysis [1].

Sevoflurane is newer volatile inhalational induction agent with low blood-gas solubility and a relatively pleasant smell and produces rapid induction and recovery. It causes less significant myocardial depression and cardiac dysarrhythmias than that of halothane [5, 6].

Newer potent short acting opioids such as fentanyl, Alfentanil, Sufentanil, or remifentanil produce intense analgesia and attenuate the pressor response and facilitate smooth laryngoscopy and intubation when given along with propofol.

Lidocaine has been used as an adjuvant in adult and paediatric patients at a dose of 1 to 1.5 mg/kg body weight. It has been shown that it attenuates the pressor response to laryngoscopy and tracheal intubation. It also suppresses cough reflex and is important as it improves intubation scores. This is evident in a study done by **Davidson et al** [7]. We used lidocaine 0.2 mg/kg to prevent pain on injection with propofol.

The peak effect of propofol from the time of administration was around 90 to 100 seconds**; Mc Keating et al** [8] study showed that it is possible to perform laryngoscopy safely and smoothly at 120 seconds after induction with propofol.

The timing of tracheal intubation is complicated by the lack of reliable end points. Depth of anaesthesia is also difficult to assess clinically, with some anaesthesiologists using clinical features such as constriction and centralization of pupils,[9] and acceptance of face mask, while others have found eye signs unreliable. **Swadia VN et al** [10] and **Bithal et al** [11] had found signicantly greater time for tracheal intubation with sevoflurane i.e. (242.2±52.67 seconds) and (325.93±44.02 seconds) respectively.

Addition of 60% nitrous oxide reduces the MAC value of sevoflurane by 24%,[6] and hastens the onset of induction. 7.5% sevoflurane in nitrous oxide and oxygen (41 seconds) had reduced induction by 15% compared to sevoflurane in oxygen alone (48 seconds) using a single breath technique.[12]

Tracheal intubation was accomplished in 86.7% of patients in group A, only 73.3% of those patients had acceptable intubation conditions and remaining 26.7% of patients had unacceptable intubating conditions. Three factors made the intubating scores unacceptable were vocal cords movements (33.3%), coughing (43.4%), and limb movements (50%).

In group A, Laryngoscopy was easy in 60%, fair in 33.3%, and difficult in 6.7% of patients and vocal cords were moving in 23.4% and closing in 10% of patients which is not significant. 13.3% of patients required Succinylcholine to achieve intubation because of vocal cords movements, coughing, and excessive limb movements. Only 76.7% of patients intubated at first attempt and remaining 23.3% of patients required multiple attempts.

During induction, 10% of patients in group A had breath holding, 20% had cough, 10% had excessive limb movements which is not significant. Induction time in group patients were 39.80±8.10 seconds.

In study by **Erhan E et al** [13] clinically acceptable intubating conditions were found in 93.3%, 66.7%, and 40% in patients receiving propofol, thiopentone, or etomidate respectively. Patients receiving propofol found to have less severe coughing after intubation when compared to thiopentone or etomidate groups

In a study by **Samar I et al**, [14] 80 patients received either Alfentanil (20 µg/kg), lidocaine (1.5 mg/kg) and propofol (3mg/kg) or fentanyl (2µg/kg), lidocaine (1.5 mg/kg) and propofol (3 mg/kg). Excellent intubating conditions found in 95% of receiving Alfentanil when compared with 62.5% of those with fentanyl. Patients who received fentanyl had more coughing and vocal cord movements during intubation.

Davidson et al [7] showed that addition of lidocaine or increasing dose of opioids improved the intubating conditions. 60 ASA PS I or II patients were allocated into four groups. Group A received propofol (2.5 mg/kg), Alfentanil (10 µg/kg), Group B received propofol (2.5 mg/kg), Alfentanil (10 µg/kg), lidocaine (1mg/kg), Group C received propofol (2.5 mg/kg), Alfentanil (20 µg/kg), Group D received propofol (2.5 mg/kg), Alfentanil (20 µg/kg), lidocaine (1 mg/kg). Intubating conditions were acceptable in 20%, 73%, 73% and 93% in group A to group D respectively. The study showed that addition of lidocaine reduces the incidence of coughing on tracheal intubation after receiving propofol-alfentanil regimen. While **MC Neil et al** [15] found that high doses remifentanil and propofol was required to achieve intubating conditions similar to that of Succinylcholine at the cost of cardiovascular depression.

In a study by **Coghlan et al** [2] intubation was successful in 83% of patients receiving alfentanil (20 µg/kg) and propofol (2.5 mg/kg) and in 73% of patients receiving propofol (2.5 mg/kg) only. Coughing was present in 97% of patients after intubation with propofol alone group compared to 63% following propofol and alfentanil group. Similarly 93% of patients had moved in propofol alone group, but only 47% in propofol and alfentianil group.

Taha et al [16] concluded that 84% of patients received lidocaine (1.5 mg/kg), remifentanil (2 µg/kg) and propofol (2 mg/kg) had excellent intubating conditions compared with 50% of patients received lidocaine (1.5 mg/kg), remifentanil (2 µg/kg) and thiopentone.

In our study, tracheal intubation was accomplished in 100% of patients group B, 93.3% of those patients had acceptable intubating conditions when compared with 73.3% in group A which is highly significant (X^2 = 4.320; P- 0.001). In group B, laryngoscopy was easy in 83.3% and fair in 16.7%

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of patients and vocal cords were abducted in 83.3% and moving in 16.7% of patients which is not significant. 86.7% of patients had no cough in group B compared with 56.7% in group A. 10% of patients in group B had diaphragmatic movements and 3.3% had severe cough. Limb movements were absent in 86.7% of patients in group B compared to 50% in group A. None of the patients in group B required Succinylcholine supplementation to achieve intubation. 96.7% of patients were intubated at first attempt in group B when compared with 76.7% in group A.

During induction, 6.7% of patients in group B had cough and 3.3% had excitatory movements. Induction time in group B patients were 156.07±21.58 seconds when compared with group A (39.80±8.10). Induction times were significantly more in group B patients ($t = 27.629$; $p < 0.001$).

In **Thwaites et al** [17] study, all children could successfully be intubated with 8% sevoflurane in oxygen and nitrous oxide at 150 seconds. 91% of children had excellent intubating conditions and 9% had good intubating conditions. In **Swadia et al** [10] study, anaesthesia was induced with 60% nitrous oxide in oxygen and incremental increase in concentration of sevoflurane from 1% to 7%. Time interval from application of facemask to intubation was 242±52.67 seconds. 80% of children had excellent intubating conditions. None had fair or poor conditions. 16% had tachycardia, 8% had Bradycardia, and 80% had hypotension.

In **O'Brien et al** [9] study, 8% sevoflurane with 60% nitrous oxide was compared with 5% halothane with 60% nitrous oxide in oxygen. Intubation was successful in all children at first attempt. Time to reach clinical endpoint was 243.5 seconds for sevoflurane. One patient in sevoflurane had excessive vocal cord movement. Seven out of twenty children had ideal intubating conditions in sevoflurane group.

Iamaroon et al [18] compared sevoflurane 8% and nitrous oxide in oxygen with Thiopentone and Succinylcholine in adults. 16.7% of patients on sevoflurane group had excellent and 76.6% had good intubating conditions.

There was definite reduction in heart rate, systolic blood pressure, diastolic blood pressure in group A patients after induction and intubation when compared with pre-induction values. However, there was no significant difference among parameters when compared with pre-induction values in group B. Thus propofol decreased both heart rate and blood pressure, which indicate there was decrease in cardiac output. So propofol directly attenuated the haemodynamic response to intubation. Similar results were found in other studies also. **Srivastava et al** [19] found significant decrease in heart rate and blood pressure in children given propofol and fentanil.

Steyn et al [3] observed a no change in heart rate but found a significant fall in MAP after induction and following intubation with a dose combination of propofol (3mg/kg) and alfentanil (15 µg/kg) in children. **Coghlan et al** [2] compared propofol with or without alfentanil in healthy adult patients and found propofol (2.5 mg/kg) alone causes significant increase in heart rate and MAP after intubation. The addition of alfentanil (20 µg/kg) produced decrease in MAP and no change in heart. In the study by **Davidson et al** [7] heart rate and MAP were decreased after induction and increased after intubation in all patients. However, propofol, alfentanil, and lidocaine combination attenuated MAP rise after intubation better compared to other groups. **Alexander et al** [20] found a significant reduction in heart rate and MAP in each group after remifentanil. **Mc Neil et al** [15] found that post induction MAP reduced by 21% and 28% with remifentanil 2 µg/kg or 4µg/kg when compared with propofol 2 mg/kg respectively.

There was no significant difference in heart rate after induction and intubation between two groups, except 3 minutes after intubation, where heart rate was significantly low in group A (87.33±7.57) when compared with group B (93,67±13.26) (P-0.027). There was significant in systolic blood pressure after induction and intubation in group A patients when compared with group B patients. However, there was no significant difference in diastolic blood pressure and mean arterial pressure between two groups, except MAP being significantly low in group A following intubation (P-024).

In **Cros et al** [21] study 2.5% sevoflurane produced decrease in heart rate and MAP by 18% and 15% respectively after remifentanil administration and values increased slightly after intubation. **Blair et al** [22] study observed that there was slight increase in heart rate before intubation.

SUMMARY

Sevoflurane is a newer inhalational agent and has pleasant smell, produces minimal cardiovascular and respiratory derangements. Propofol is the most commonly using intravenous induction anaesthetic agent. Propofol produces brief period of hypotension, bradycardia and also causes pain on injection. There was significant fall in heart rate, blood pressure, and mean arterial pressure after induction and intubation in group A when compared with group B. Induction time was significantly less in group group A patients (39.80 ±8.10) when compared with group B patients (156.07± 21.50) (P value - < 0.001). Intubation without muscle relaxant using combination of inhalational sevoflurane 4% with propofol 1.5 mg/kg had more favourable conditions when compared with patients received propofol 3 mg/kg only.

CONCLUSION

A combination of 4% sevoflurane with 67% nitrous oxide in oxygen and propofol 1.5 mg/kg preceded by fentanyl 2 µg/kg without muscle relaxant had more acceptable intubating conditions compared to propofol 3 mg/kg with 67% nitrous oxide in oxygen preceded by fentanyl 2 µg/kg in adult patients undergoing various elective surgical procedures under general anaesthesia and there was no significant change in haemodynamic parameters during induction and intubation with respect to combination of sevoflurane with propofol 1.5 mg/kg. Hence, we conclude that combination of inhalational 4% sevoflurane with intravenous propofol 1.5 mg/kg is superior to intravenous propofol 3 mg/kg with respect to quality of intubation and less significance with respect to haemodynamic response during induction and intubation in adult patients undergoing various elective surgical procedures without muscle relaxants and also this combination is cost effective. This combination can also be attempted for anticipated difficult intubation. The combination can also reduce the doses of each agent.

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