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Original Research Article

Comparing Propofol Alone Versus Propofol Combined with Sevoflurane for Induction and Intubation

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Abstract

Background: Various drug combinations, including opioids, intravenous agents, and inhalational agents, are being employed to facilitate endotracheal intubation in the absence of muscle relaxants. Propofol alone versus propofol combined with sevoflurane for induction and intubation.

Methods: Patients meeting the inclusion criteria were eligible for participation. Before the administration of general anesthesia, patients were randomly assigned to two groups using lots. Group I (n=25) received sevoflurane induction, while Group II (n=25) received propofol induction. A thorough pre-anesthetic evaluation was conducted on the day before surgery. Detailed history and cardiorespiratory examination were carried out in all patients. All relevant investigations were done. Nil per oral status for a minimum of 6 hrs was advised. On the day of surgery, after the arrival of the patient to the operation theatre pulse-oxymeter, ECG, and non-invasive blood pressure monitors were connected. The baseline heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure were recorded.

Results: Combining Propofol with Sevoflurane (Group I) achieved faster, and more consistent anesthesia induction compared to Propofol alone (Group II). Both groups had similar mild side effects during induction. Blood pressure decreased in both groups post-induction, with slightly lower values in Group I. However, the differences were small and inconclusive. Group I showed a significantly larger MAP decrease only post-induction, while the heart rate decrease was larger in Group I only at 1-minute post-intubation.

Conclusion: The combination of inhalational 4% sevoflurane with intravenous propofol 1.5mg/kg is superior to intravenous propofol 3mg/kg in terms of intubation quality and has fewer hemodynamic effects during induction and intubation in adult patients undergoing various elective surgical procedures without muscle relaxants. Additionally, this combination is cost-effective and may be considered for cases of anticipated difficult intubation.

Keywords: Propofol, Sevoflurane, Induction, Intubation, Hemodynamic Response.

Introduction

The possibility of performing tracheal intubation without the use of muscle relaxants has long been a subject of debate. Deep inhalational induction for tracheal intubation is commonly practiced in children and in specific clinical scenarios where the administration of neuromuscular blockers is contraindicated, such as cases involving hyperkalemia, plasma cholinesterase deficiency, increased intracranial pressure, malignant hyperthermia, penetrating eye injury, burns, recent spinal cord injury, and known allergic reactions. While some adverse effects associated with succinylcholine can be mitigated by using non-depolarizing muscle relaxants, these agents can also pose risks such as prolonged paralysis or difficulty in reversing the neuromuscular blockade, particularly in "can't ventilate, can't intubate" situations where mask ventilation or tracheal intubation becomes challenging. Neuromuscular disorders like myasthenia gravis can further complicate the clinical pharmacology of muscle relaxants, necessitating tracheal intubation without the use of these agents. [1]

This technique is also advantageous in scenarios where neuromuscular blockade is unnecessary for surgical access, such as in ambulatory surgery or neurosurgical procedures requiring evoked potential monitoring, facial nerve exploration, and certain thyroid surgeries where nerve stimulators are used

for nerve identification and integrity confirmation. [2, 3] Various induction techniques can be employed to achieve tracheal intubation without neuromuscular blockade, including intravenous or inhalational induction. Propofol, administered without concomitant opioids, has been used historically for tracheal intubation, though its use alongside fentanyl has been shown to yield superior intubating conditions. [4] Sevoflurane, particularly at high concentrations, is commonly used for intubation without neuromuscular blockade in children and adults, either alone or in combination with nitrous oxide. Sevoflurane induction, especially when combined with adjuvants like midazolam or fentanyl, has been shown to reduce the time required to achieve optimal intubating conditions in adults. [5] The objective of our study was to compare the efficacy of a sevoflurane-fentanyl combination with that of a propofol-fentanyl combination in providing intubating conditions for tracheal intubation.

Material and methods

This prospective study was carried out at the Department of Anesthesiology, Kakatiya Medical College, and MGM Hospital in Warangal, Telangana. Ethical approval for the study was obtained from the institutional review board. Written consent was obtained from all participants after explaining the study's nature in the local language. Only those who voluntarily agreed to participate were included. Following approval from the institutional ethical committee and obtaining written informed consent from each participant, we enrolled 50 patients classified as ASA physical status I and II, scheduled for elective surgery under general anesthesia. Patients meeting the inclusion criteria were eligible for participation. Before the administration of general anesthesia, patients were randomly assigned to two groups using lots. Group I (n=25) received sevoflurane induction, while Group II (n=25) received propofol induction.

Inclusion criteria

1. Aged 18 years and above
2. ASA I and II
3. Elective surgery under general anesthesia
4. Mallampati scores: I & II
5. Voluntarily willing to participate in the study

Exclusion Criteria

1. Patients posted for emergency surgery
2. Patients with difficult airway
3. Lack of written informed consent
4. Neuromuscular disorders
5. Cervical cord injuries
6. Severe cardiovascular, central nervous system, hepatic, and renal disease
7. Patients with an increased risk of regurgitation
8. Anticipated difficult airway
9. Reactive airway disease and History of drug allergy to the study drugs

A thorough pre-anesthetic evaluation was conducted on the day before surgery. Detailed history and cardiorespiratory examination were carried out in all patients. All relevant investigations were done. Nil per oral status for a minimum of 6 hrs was advised. On the day of surgery, after the arrival of the patient to the operation theatre pulse-oxymeter, ECG, and non-invasive blood pressure monitors were connected. The baseline heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure were recorded.

After doing a thorough cockpit drill of the continuous flow anesthesia machine and the availability of emergency drugs with an $ETCO_2$ monitor, an intravenous line with Ringer's Lactate was secured using either an 18G or 20G intravenous cannula. All patients were per-medicated with IV fentanyl 2µg/kg, IV midazolam 1mg & IV Glycopyrrolate 0.2 mg 5 min before induction. All patients were pre-oxygenated with 100% O_2 for 3 min. Anaesthesia was then induced in Group-I patients by 67% N_2O in O_2 and IV propofol 3mg/kg injected over 30s. Group-II patients were induced by mask with sevoflurane starting at 0.5% and incrementally increased to 4% inhaled concentration with 67% nitrous oxide in oxygen at a total gas flow of 8 liters/min and IV propofol 1.5 mg/kg injected over 15s and tracheal intubation was attempted at 240 s after the start of induction in both groups. Lignocaine 0.2mg/kg was 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, and 5 minutes were recorded. Time to induction in seconds (Start of anesthetic until loss of eyelash reflex), induction side effects like breath holding, cough, excitatory movements, laryngospasm, and others (Bradycardia, hypoxia, hyperthermia, hypothermia, and injection site pain) were noted. Tracheal intubation was performed using the appropriately sized endotracheal tube. Intubating conditions were assessed by an anaesthesiologist who performed intubation using Copenhagen Consensus Conference (CCC) score 19 which graded the quality of tracheal intubation according to ease of laryngoscopy, position of the vocal cords, cough, and movement of the limbs. Supplementation of endotracheal intubation with IV succinylcholine was noted.

Results

A total of n=50 cases were included in the study based on the inclusion and exclusion criteria. Table 1 presents data on the number of patients who reached the anesthetized state within different time intervals: 1-100 seconds: All patients (100%) in Group I reached the state within 100 seconds, while

none (0%) in Group II did. 101-150 seconds: None (0%) in Group I, and 15 patients (60%) in Group II reached the state within this timeframe.151-200 seconds: None (0%) in Group I, and 10 patients (40%) in Group II reached the state within this timeframe. Group I: 39.55 seconds ± 7.57 seconds (faster induction) Group II: 154.33 seconds ± 22.64 seconds (slower induction) Propofol + Sevoflurane: All patients in Group I achieved anesthesia within 100 seconds, suggesting a rapid and consistent induction time. Propofol alone: In Group II, only 60% of patients achieved anesthesia within 150 seconds, and the remaining 40% took even longer. This indicates a slower and more variable induction time compared to Group I. The average induction time (mean ± SD) confirms that Group I had a significantly faster time to anesthesia compared to Group II (P<0.01).

Table 1: shows the time to induction in two groups of cases included in the study

Time to induction in (Sec)	Group I (N=25) Propofol + Sevoflurane induction	Group II (N=25) Propofol alone induction
1 – 100 sec	25(100%)	0
101 – 150 sec	0	15(60%)
151 – 200 sec	0	10(40%)
Total	25(100%)	25(100%)
Mean ± SD	39.55 ± 7.57	154.33 ± 22.64

Table 2 compares the side effects experienced by patients in two groups undergoing anesthesia induction in a study: *Overall:* Both groups experienced a similar number and type of side effects. *Breath holding:* More patients in Group I (2, 8%) experienced breath holding compared to none (0%) in Group II. *Cough*: A similar number of patients experienced coughing in both groups (4 in Group I, 2 in Group II). *Excitatory movements:* Only one patient in each group (1, 4%) experienced excitatory movements. *Laryngospasm:* None of the patients in either group experienced laryngospasm. *Other*: No other side effects were reported in either group. This table suggests that both Propofol and Sevoflurane combined, and Propofol alone, might cause similar types of mild side effects during anesthesia induction.

Table 2: Induction side effects found in the cases of the study

Induction side effects	Group I (N=25) Propofol + Sevoflurane induction	Group II (N=25) Propofol alone induction
Breath holding	2(8.0%)	0(0.00%)
Cough	4(16.0%)	2(8.0%)
Excitatory movements	1(4.0%)	1(4.0%)
Laryngospasm	0(0.00%)	0(0.00%)
Others	0(0.00%)	0(0.00%)

Figure 1 presents the number of attempts required for successful endotracheal intubation in two groups of patients undergoing surgery. *Success rate:* Both groups achieved successful intubation in all patients (25 in each group). The majority of patients in both groups (84% in Group I and 96% in Group II) required only one attempt for successful intubation. Group II showed a slightly higher success rate with one attempt compared to Group I, but with only one patient requiring two attempts in each group, the difference is minimal.

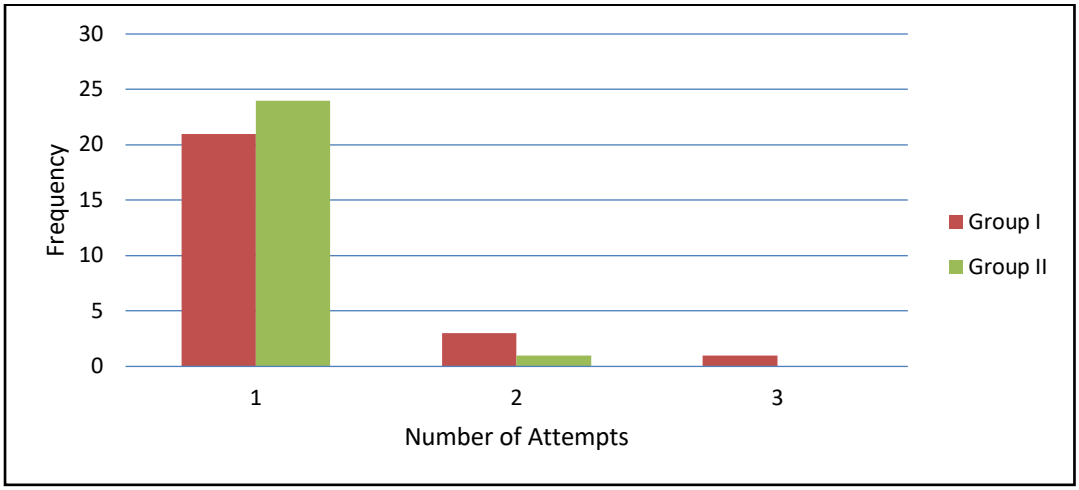

Figure 1: showing the number of attempts at intubation in the study

The Overall use of succinylcholine in the cases of the study showed that a larger proportion of patients in Group I (22, 88%) received succinylcholine to supplement their intubation compared to Group II (0, 0%). All patients in Group II (25, 100%) underwent intubation without the use of succinylcholine.

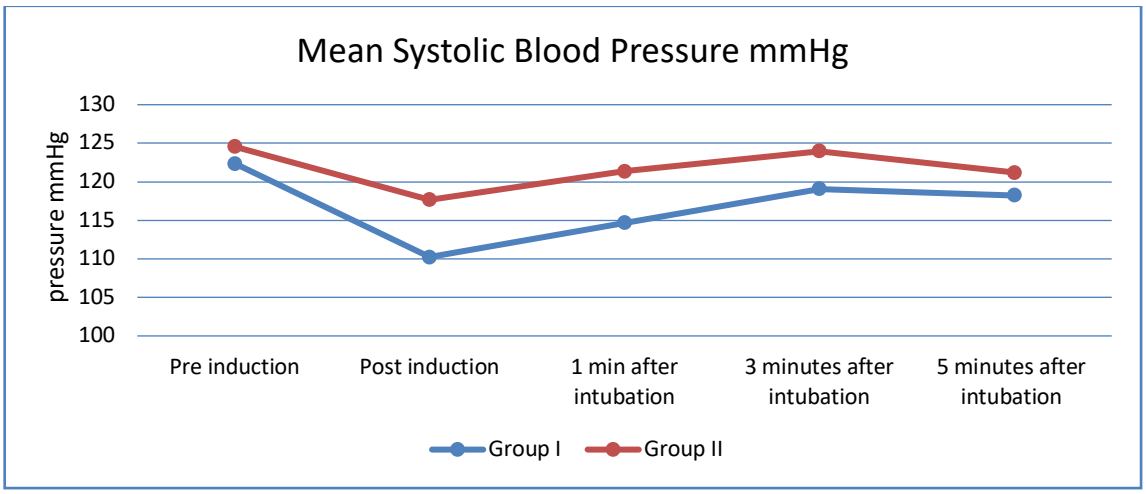

Figure 2: Mean systolic blood pressure at different intervals

Figure 2 shows the Systolic Blood Pressure (SBP) in mmHg measured at different time points for two groups. Baseline (Pre-induction): Group I has a slightly lower SBP (122.37 mmHg) compared to Group II (124.55 mmHg). Post-induction: Both groups experience a decrease in SBP compared to baseline. Group I has a lower SBP (110.24 mmHg) compared to Group II (117.66 mmHg). 1-minute post-intubation: SBP increases slightly in both groups compared to post-induction, with Group I (114.67 mmHg) still lower than Group II (121.34 mmHg). 3 and 5 minutes post-intubation: SBP remains relatively stable in both groups, with Group I, maintaining a slightly lower SBP than Group II at both time points. Both groups experience a decrease in SBP following anesthesia induction, which is a commonly observed effect of some induction agents. Group I has consistently lower SBP compared to Group II at all measured points, but the differences are relatively small.

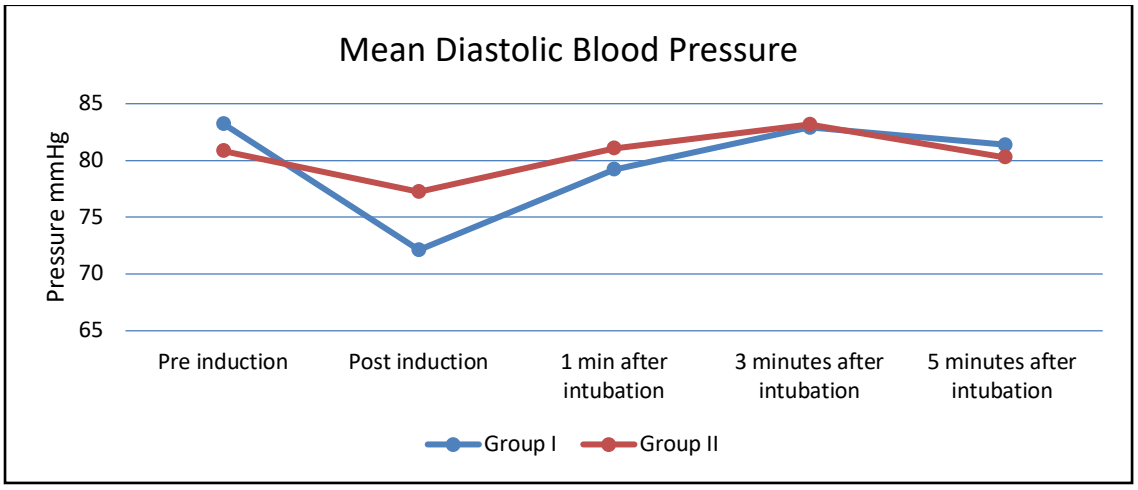

Figure 3: Mean Diastolic blood pressure at different intervals

Figure 3 shows the Diastolic Blood Pressure (DBP) in mmHg measured at different times *Baseline (Pre-induction):* Group I has a slightly higher DBP (83.24 mmHg) compared to Group II (80.83 mmHg). *Post-induction:* Both groups experience a decrease in DBP compared to baseline. Group I has a lower DBP (72.12 mmHg) compared to Group II (77.24 mmHg). *1-minute post-intubation:* DBP increases slightly in both groups compared to post-induction, with Group I (79.22 mmHg) still lower than Group II (81.06 mmHg). *3 and 5 minutes post-intubation:* DBP remains relatively stable in both groups, with Group I, maintaining a slightly lower DBP than Group II at both time points. both groups experience a decrease in DBP following anesthesia induction, which is a commonly observed effect of some

induction agents. Group I has a lower DBP compared to Group II at most measured points, except for the pre-induction baseline. However, the differences are relatively small.

Table 3: Mean Arterial pressure at different intervals

MAP in mmHg	Group I (N=25) Propofol + Sevoflurane induction	Group II (N=25) Propofol alone induction	P value
Pre induction	96.18 ± 7.51	93.55 ± 7.22	0.115
Post induction	86.22 ± 6.18	90.08 ± 7.34	0.020*
1 min after intubation	91.92 ± 5.91	94.65 ± 6.61	0.268
3 minutes after intubation	94.06 ± 7.24	95.11 ± 7.63	0.862
5 minutes after intubation	92.19 ± 6.91	93.27 ± 7.27	0.219

* Significant

Table 3 compares the Mean Arterial Pressure (MAP) in mmHg measured at different time points for two groups (Group I and Group II). Each value represents the average MAP (mean ± standard deviation) for the group at each time point, along with a p-value comparing the groups. Baseline (Pre-induction): Both groups have similar MAP values (Group I: 96.18 mmHg, Group II: 93.55 mmHg), with a p-value of 0.115 indicating no statistically significant difference. Post-induction: Group I has a lower MAP (86.22 mmHg) compared to Group II (90.08 mmHg), with a statistically significant difference (p-value = 0.020). 1-minute post-intubation: Both groups have slightly increased MAP compared to post-induction, with Group I (91.92 mmHg) still lower than Group II (94.65 mmHg), but the difference is not statistically significant (p-value = 0.268). 3 and 5 minutes post-intubation: MAP remains relatively stable in both groups, with similar values and no statistically significant differences (p-values > 0.05). This table suggests that Propofol and Sevoflurane induction (Group I) might lead to a larger initial decrease in MAP compared to Propofol alone induction (Group II), as indicated by the statistically significant difference at the post-induction measurement.

Table 4: Heart rate in bpm at different intervals

MAP in mmHg	Group I (N=25) Propofol + Sevoflurane induction	Group II (N=25) Propofol alone induction	P value
Pre induction	92.22 ± 3.69	89.35 ± 4.55	0.254
Post induction	82.34 ± 7.25	86.64 ± 5.17	0.661
1 min after intubation	87.66 ± 6.71	91.62 ± 6.22	0.011
3 minutes after intubation	87.67 ± 5.51	93.17 ± 4.71	0.332
5 minutes after intubation	87.92 ± 3.64	89.33 ± 3.22	0.156

* Significant

This table compares the Heart Rate (bpm) at different time points for two groups (Group I and Group II) undergoing a medical procedure. Baseline (Pre-induction): Both groups have similar heart rates (Group I: 92.22 bpm, Group II: 89.35 bpm), with a p-value of 0.254 indicating no statistically significant difference. Post-induction: Both groups experience a decrease in heart rate compared to baseline, but the difference between the groups is not statistically significant (p-value = 0.661). Group I has a slightly lower heart rate (82.34 bpm) compared to Group II (86.64 bpm). 1-minute post-intubation: Group I has a lower heart rate (87.66 bpm) compared to Group II (91.62 bpm), with a statistically significant difference (p-value = 0.011). 3 and 5 minutes post-intubation: Heart rate remains relatively stable in both groups, with similar values and no statistically significant differences (p-values > 0.05). This table suggests that Propofol and Sevoflurane induction (Group I) might lead to a larger decrease in heart rate at 1-minute post-intubation compared to Propofol alone induction (Group II), as indicated by the statistically significant difference at that time point.

Discussion

Laryngoscopy and tracheal intubation are critical skills in the practice of anesthesia. The selection of drugs should aim to induce unconsciousness, analgesia, and muscle relaxation while maintaining hemodynamic stability and ensuring optimal intubation conditions. [6] Traditionally, a combination of hypnotic agents, opioids, and neuromuscular blocking agents has been used for this purpose. However, in recent years, several factors have prompted researchers to reconsider the use of neuromuscular blocking agents in tracheal intubation. This shift has been driven by the introduction of agents, such as propofol, short-acting opioids, and sevoflurane, in clinical practice. Propofol offers various advantages, including the suppression of upper airway reflexes, mitigation of the pressure response to intubation, and ensuring swift recovery while reducing airway complications. [7] Succinylcholine, once the

standard, faces skepticism due to potential issues, such as cardiac arrest in children and myalgia. Non-depolarizing agents serve as alternatives but have a slower onset and duration. Sevoflurane, a low-solubility inhalational agent, induces rapid recovery with minimal cardiac depression. We administered fentanyl intravenously before the induction of analgesia and dampened the pressor response. [8] Propofol's peak effect occurs in 90-100 seconds, permitting safe intubation around 120 s post-induction. We adopted a fixed 240-second interval for intubation in Group I, standardizing the technique for objective evaluation. Swadia VN et al. [9] and Bithal PK et al. [10] observed significantly longer durations for tracheal intubation with sevoflurane, specifically 242.2 ± 52.67 seconds and 325.93 ± 44.02 seconds, respectively. This variance was not solely attributable to differing clinical endpoints, but also to variations in the induction technique, wherein sevoflurane concentration was incrementally increased, and manual ventilation was not provided. Erhan et al. [11] reported in their study that clinically acceptable intubation conditions were achieved in 93.3% of patients receiving propofol, compared to 66.7% with thiopental and 40% with etomidate. Moreover, patients administered propofol experienced less severe post-intubation coughing than those administered thiopental or etomidate. In a study by Thwaites et al. [12] all children were successfully intubated using 8% sevoflurane in nitrous oxide and oxygen within 150 s. Of these, 91% exhibited excellent intubation conditions, while 9% demonstrated good intubation conditions. This study demonstrated that 8% sevoflurane combined with nitrous oxide in oxygen could provide satisfactory intubation conditions within 150 seconds.

In our study, tracheal intubation was successfully achieved in 100% of patients in Group II, with 96% of them experiencing acceptable intubation conditions, compared to 75% in Group I, a significant difference ($p<0.01$). Additionally, 84% of patients in Group II did not experience coughing, whereas only 56% of patients in Group I were free from coughing. Coughing was significantly more prevalent in Group I. Limb movements were also significantly more common in Group I than in Group II. None of the patients in Group II required succinylcholine supplementation for successful intubation. Moreover, 96% of the patients in Group II were successfully intubated on the first attempt compared to 84% in Group I. The number of attempts required for intubation was significantly lower in Group II. 84% of the patients in Group I were successfully intubated on the first attempt, while the remaining 16% required multiple attempts. During induction, 8% of patients in Group A experienced breath-holding, 16% had coughing episodes, and 10% exhibited excitatory movements, although these findings were not statistically significant. The induction time for patients in Group B was 154.33 ± 22.64 seconds, significantly longer than that of Group I (39.55 ± 7.57 seconds), indicating a prolonged induction time in Group II patients ($P< 0.05$).

In the study by Swadia et al. [9] anesthesia was initiated using a mixture of 60% nitrous oxide in oxygen, alongside a gradual increase in the concentration of sevoflurane from 1% to 7%. The time taken from the application of the facemask to intubation averaged 242 ± 52.67 seconds. Notably, 80% of the children experienced excellent conditions for intubation. Tachycardia was observed in 16% of the patients, bradycardia in 8%, and hypotension in 80%, with no occurrences of complications such as laryngospasm or bronchospasm. In the present study, Group-I patients exhibited reduced heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure after induction and intubation compared to pre-induction values. However, there was no significant difference in these parameters when compared to pre-induction values in Group II patients. This suggests that propofol led to a decrease in both heart rate and blood pressure, indicating a reduction in cardiac output. Similar findings were reported by other studies, including Srivastava U et al. [13] which observed a significant decrease in heart rate and arterial pressure in children administered propofol and fentanyl, and Steyn et al.26, which noted a significant fall in mean arterial pressure after induction and intubation with a combination of propofol and alfentanil in children. Bithal PK et al. [10] found significantly higher heart rates in the sevoflurane group during post-induction and immediate post-intubation periods, as well as 1-minute post-intubation. Mean arterial pressure also increased slightly from baseline. In our study, there was no significant difference in heart rate after induction and intubation between the two groups, except at 3 minutes post-intubation, where heart rate was significantly lower in Group I (87.66 ± 6.71) compared to Group II (91.62 ± 6.22). There was a significant reduction in systolic blood pressure after induction and intubation in Group I patients compared to Group II patients. However, there was no significant difference in diastolic blood pressure and mean arterial pressure between the two groups, except for mean arterial pressure being lower in Group I, following induction.

Conclusion

In conclusion, we found that the combination of inhalational 4% sevoflurane with intravenous propofol 1.5mg/kg is superior to intravenous propofol 3mg/kg in terms of intubation quality and has fewer hemodynamic effects during induction and intubation in adult patients undergoing various elective surgical procedures without muscle relaxants. Additionally, this combination is cost-effective and may be considered for cases of anticipated difficult intubation.

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