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A comparative study between combination of sevoflurane and propofol with propofol alone for intubating condition and hemodynamic response

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Abstract

Background: Neuromuscular blocking agents are routinely used to facilitate tracheal intubation. In some patients, however, avoiding these drugs may be desirable because of their adverse effects and the possibility of residual neuromuscular blockade. Combining sevoflurane with a lower dose of propofol may be one way of achieving adequate anesthetic depth while limiting the cardiovascular effects of a larger propofol dose.

Objectives: We compared combination of sevoflurane and propofol induction with propofol alone for intubation without a neuromuscular blocking agent. Intubating conditions, induction time, adverse events, and hemodynamic changes were assessed.

Methods: In this prospective randomized comparative study, 60 adults with American Society of Anesthesiologists physical status I or II who were scheduled for elective surgery were assigned to two groups. Group A received sevoflurane 4% and propofol 1.5 mg/kg, whereas Group B received propofol 3 mg/kg. Tracheal intubation was attempted 240 seconds after induction. Intubating conditions were graded with the Copenhagen Consensus Conference score, and heart rate and blood pressure variables were recorded serially.

Results: Acceptable intubating conditions were observed in 28 of 30 participants (93.3%) in Group A and 23 of 30 participants (76.7%) in Group B ($p < 0.01$). Combination of sevoflurane and propofol induction was associated with easier laryngoscopy, less coughing, fewer limb movements, and better preservation of systolic blood pressure and mean arterial pressure. Mean induction time was longer for combination of sevoflurane and propofol induction (185.60 ± 13.45 vs. 79.96 ± 10.17 seconds; $p < 0.001$), while the frequency of recorded induction-related adverse events did not differ significantly.

Conclusion: Sevoflurane 4% with propofol 1.5 mg/kg provided better intubating conditions and better preservation of early blood pressure than propofol 3 mg/kg alone in these elective surgical patients. The benefit was accompanied by a longer induction time.

Keywords: Sevoflurane, Propofol, Tracheal intubation, Muscle relaxant–free anesthesia.

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1. Introduction

Securing the airway by tracheal intubation remains an important part of general anesthesia. Good intubating conditions depend on several factors, particularly the skill of the operator, the depth of anesthesia, and adequate relaxation of the jaw and upper airway.[1]

Muscle relaxants make intubation easier and more predictable, but they are not required for every patient or every procedure. In selected situations, intubation without neuromuscular blockade may therefore be useful.

Succinylcholine is valued for its rapid onset, although its adverse effects include myalgia, hyperkalemia, bradyarrhythmia, malignant hyperthermia, prolonged apnea, and increases in intraocular or intracranial

pressure. Non-depolarizing drugs avoid some of these problems, but prolonged paralysis and the need for reversal remain concerns. These issues have led to continued interest in techniques that allow tracheal intubation without giving a muscle relaxant.[2-13]

Propofol is particularly useful in this setting because it depresses pharyngeal and laryngeal reflexes. When used with a short-acting opioid, satisfactory intubation has been reported without neuromuscular blockade.[13,14] The drawback is that increasing the propofol dose can also increase hypotension, apnea, pain on injection, and involuntary movements.[15-17]

Sevoflurane offers another way of increasing anesthetic depth. It has low blood-gas solubility and causes relatively little airway irritation, properties that make it suitable for inhalational induction. Previous studies have examined sevoflurane for airway-device insertion and tracheal intubation.[25-42]

We considered that using the two agents together might be clinically useful. Sevoflurane could contribute to anesthetic depth and suppression of airway reflexes, while a smaller dose of propofol could provide rapid hypnosis with less cardiovascular depression.

However, the usefulness of such a technique depends on more than whether the tracheal tube can be placed. Coughing, limb movement, the number of attempts, the need for rescue muscle relaxation, induction time, and the hemodynamic response are also relevant at the bedside.

We therefore compared 4% sevoflurane with propofol 1.5 mg/kg against propofol 3 mg/kg alone in adults aged 20-55 years undergoing elective surgery. Intubation was performed without a neuromuscular blocking agent, and we assessed intubating conditions, induction characteristics, adverse events, and hemodynamic changes.

2. Materials and Methods

2.1. Study design and ethics

This prospective randomized comparative study was performed at Government Medical College and the attached group of hospitals in Kota, Rajasthan, from June 2020 to June 2021. Approval was granted by the Institutional Ethics Committee (File No. F.3 Acad/Ethical Clearance/2020/07; June 19, 2020), and written informed consent was obtained before enrollment.

The study enrolled 60 adults aged 20-55 years with American Society of Anesthesiologists physical status I or II who were scheduled for elective surgery under general anesthesia.

2.2. Inclusion criteria

1. ASA physical status I–II
2. Mallampati class I–II
3. Elective surgical procedures lasting 1–3 hours

2.3. Exclusion criteria

1. Anticipated difficult airway
2. Obesity (BMI > 1.5 × normal)
3. History of malignant hyperthermia
4. Allergy to study drugs
5. Use of monoamine oxidase inhibitors

After enrollment, participants were assigned in a 1:1 ratio using the sealed-envelope method. The envelopes were opened only after written consent and enrollment to prevent prior knowledge of the upcoming assignment. Each study group contained 30 participants.

1. Group A received inhaled sevoflurane, increased to 4% in oxygen, together with intravenous propofol 1.5 mg/kg.
2. Group B received intravenous propofol 3 mg/kg with oxygen.

Five minutes before induction, all participants received fentanyl 2 µg/kg, midazolam 1 mg, and glycopyrrolate 0.2 mg intravenously. In Group A, sevoflurane was introduced through a face mask and increased from 0.5% to 4% at a fresh gas flow of 8 L/min; propofol 1.5 mg/kg was administered over 15 seconds. Group B received propofol 3 mg/kg over 30 seconds. Direct laryngoscopy was undertaken 240 seconds after induction began.

The primary outcome was the proportion of participants with clinically acceptable intubating conditions, defined as an overall Copenhagen Consensus Conference rating of excellent or good. The component assessments were ease of laryngoscopy, vocal-cord position and movement, limb movement, and coughing. Secondary outcomes included induction time, induction-related adverse events, number of intubation attempts, rescue succinylcholine, and serial heart rate and blood pressure measurements.

2.4. Statistical analysis

Data were analyzed with IBM SPSS Statistics for Windows, version 21.0 (IBM Corp., Armonk, NY, USA). Continuous variables are reported as mean ± standard deviation and were compared using the unpaired Student t-test. Categorical variables are presented as numbers and percentages and were evaluated using the chi-square test, as appropriate. Statistical significance was defined as $p < 0.05$.

3. Results

3.1. Demographic data

The groups were similar in mean age and ASA physical status at baseline (Table 1).

Table 1: Baseline demographic and clinical characteristics

Variable	Group A (n=30)	Group B (n=30)	p-value
Age (years, mean ± SD)	35.4 ± 10.6	33.4 ± 10.3	0.45
Male/Female	18/12	9/21	0.99
ASA I/II	21/9	25/5	0.99

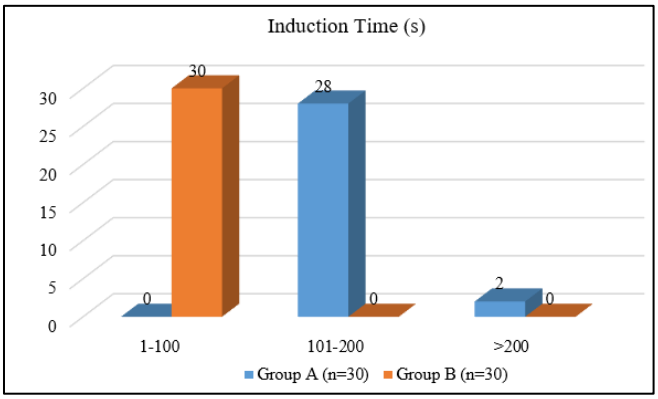


Figure 1: Distribution of induction time by study group

Mean induction time was 185.60 ± 13.45 seconds in Group A and 79.96 ± 10.17 seconds in Group B, a difference of 105.64 seconds ($p < 0.001$; Figure 1).

Induction-related events were uncommon in both groups, with no statistically significant differences in the recorded events (Table 2).

Table 2: Induction-related adverse events

Induction side effects	Group A (n=30)	%	Group B (n=30)	%	p-value
Breath holding	0	0	2	6.67%	0.5
Cough	3	10%	4	13.33%	0.0903
Excitatory Movements	2	6.67%	4	13.33%	0.2048
Laryngospasm	0	0	0	0	0
Other	0	0	0	0	0

Table 3: Components of the copenhagen consensus conference intubation score

CCC endotracheal Intubation score	Criteria	Group A (n=30)	Group B (n=30)	p-value
Laryngoscopy	Easy Fair Difficult	26 (86.67%) 4 (13.33%) 0	17 (56.67 10 (33.33%) 3 (10%)	0.0241
Vocal cords Position	Abducted Intermediate Closed	26 (86.67%) 4 (13.33%) 0	18 (60%) 9 (30%) 3 (10%)	0.0412
Vocal cords movement	None Moving Closing	26 (86.67%) 4 (13.33%) 0	18 (60%) 9 (30%) 3 (10%)	0.0412
Limb movement	None Slight Vigorous	27 (90%) 2 (6.67%) 1 (3.33%)	14 (46.67%) 9 (30%) 7 (23.33%)	0.0014
Coughing	None Diaphragmatic movement Severe coughing	27 (90%) 2 (6.67%) 1 (3.33%)	18 (60%) 8 (26.67%) 4 (13.33%)	0.0273
Quality of intubation	Excellent Good Poor	22 (73.33%) 6 (20%) 2 (6.67%)	14 (46.67%) 9 (30%) 7 (23.33%)	0.0759

Easy laryngoscopy was recorded in 26 participants (86.67%) in Group A and 17 (56.67%) in Group B (p = 0.0241; Table 3).

Abducted vocal cords were observed in 26 participants (86.67%) in Group A and 18 (60.00%) in Group B. The distribution of vocal-cord position differed between groups (p = 0.0412).

Absence of vocal-cord movement was documented in 26 participants (86.67%) in Group A and 18 (60.00%) in Group B; the overall distribution of movement categories differed significantly (p = 0.0412).

Limb movement was absent in 27 participants (90.00%) in Group A and 14 (46.67%) in Group B. Vigorous movement occurred in one participant (3.33%) and seven participants (23.33%), respectively (p = 0.0014).

No coughing occurred in 27 participants (90.00%) in Group A compared with 18 (60.00%) in Group B. Severe coughing occurred in one participant (3.33%) and four participants (13.33%), respectively (p = 0.0273).

Overall, these individual components consistently favored the sevoflurane-propofol group.

Table 4: Overall intubating conditions

Condition	Group A (%)	Group B (%)
Acceptable	93.3	76.7
Unacceptable	6.7	23.3

Clinically acceptable conditions were present in 28 of 30 participants (93.33%) in Group A and 23 of 30 (76.67%) in Group B (p < 0.0102; Table 4).

Table 5. Number of intubation attempts

Number of attempts	Group A (n=30)	%	Group B (n=30)	%
1	29	96.67	22	73.33
2	1	3.33	6	20
3	0	0	2	6.67

Intubation was completed on the first attempt in 29 participants (96.67%) in Group A and 22 (73.33%) in Group B. More than one attempt was required in one participant (3.33%) and eight participants (26.67%), respectively (p = 0.0382; Table 5).

Rescue succinylcholine was not required in Group A; five participants (16.67%) in Group B received it (reported p = 0.522; Table 6).

Table 5: Requirement for rescue succinylcholine

Tracheal intubation supplemented with succinylcholine	Group A (n=30)	%	Group B (n=30)	%
No	30	100	25	83.33
Yes	0	0	5	16.66

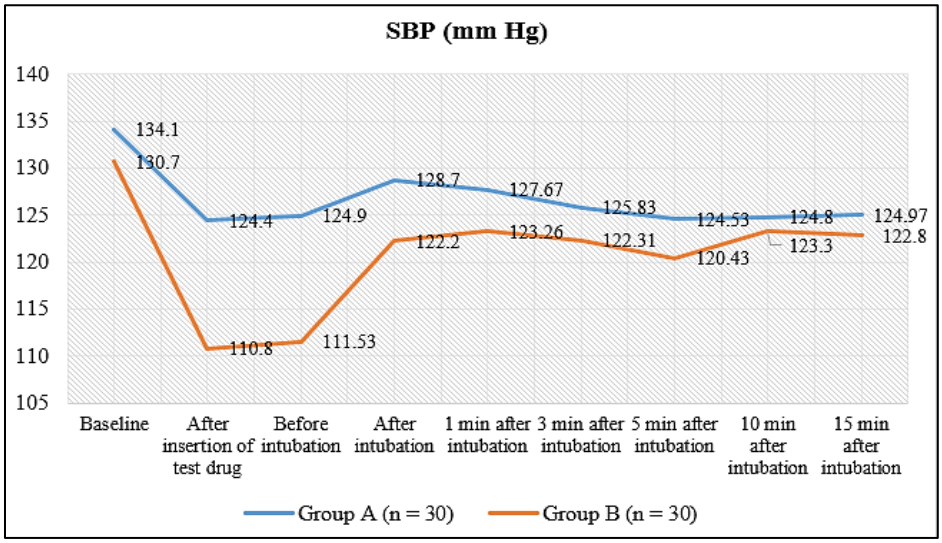


Figure 2: Changes in systolic blood pressure over time

Systolic blood pressure was higher in Group A after administration of the study drugs, before intubation, immediately after intubation, and at one, three, and five minutes (all reported $p < 0.05$). The groups were not significantly different at 10 or 15 minutes (Figure 2).

Diastolic blood pressure was similar between groups at most observations. A significant intergroup difference was reported only immediately before intubation ($p = 0.0397$; Figure 3).

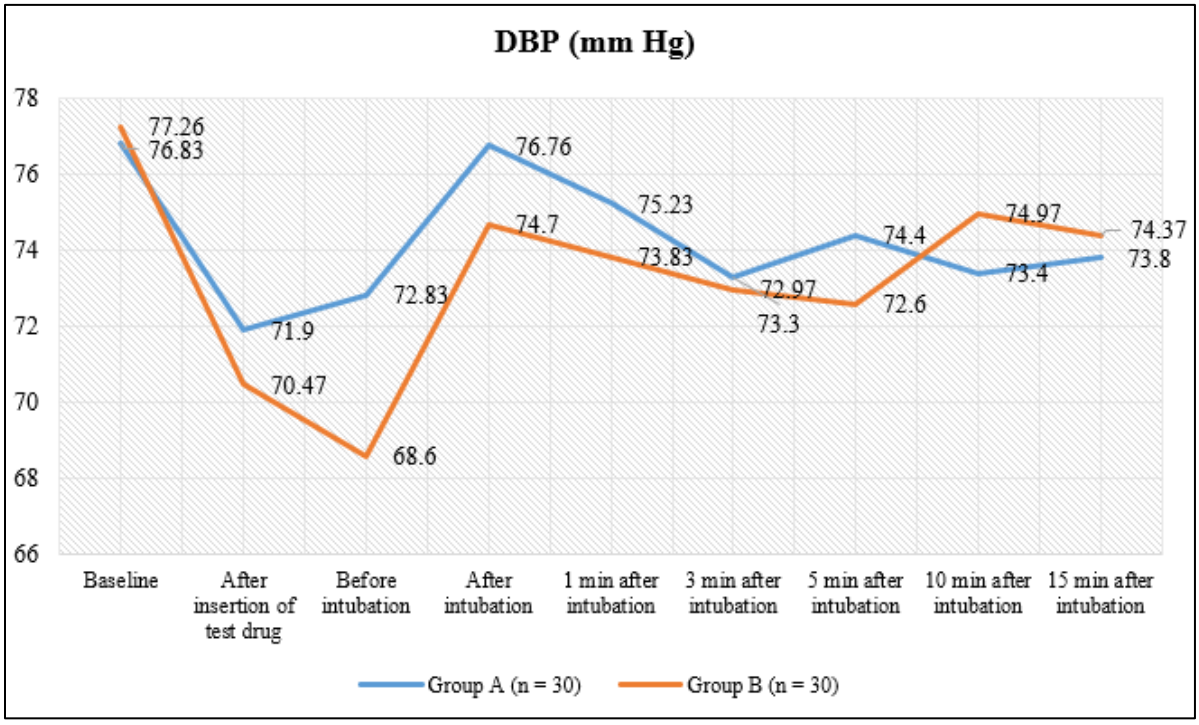


Figure 3: Changes in diastolic blood pressure over time

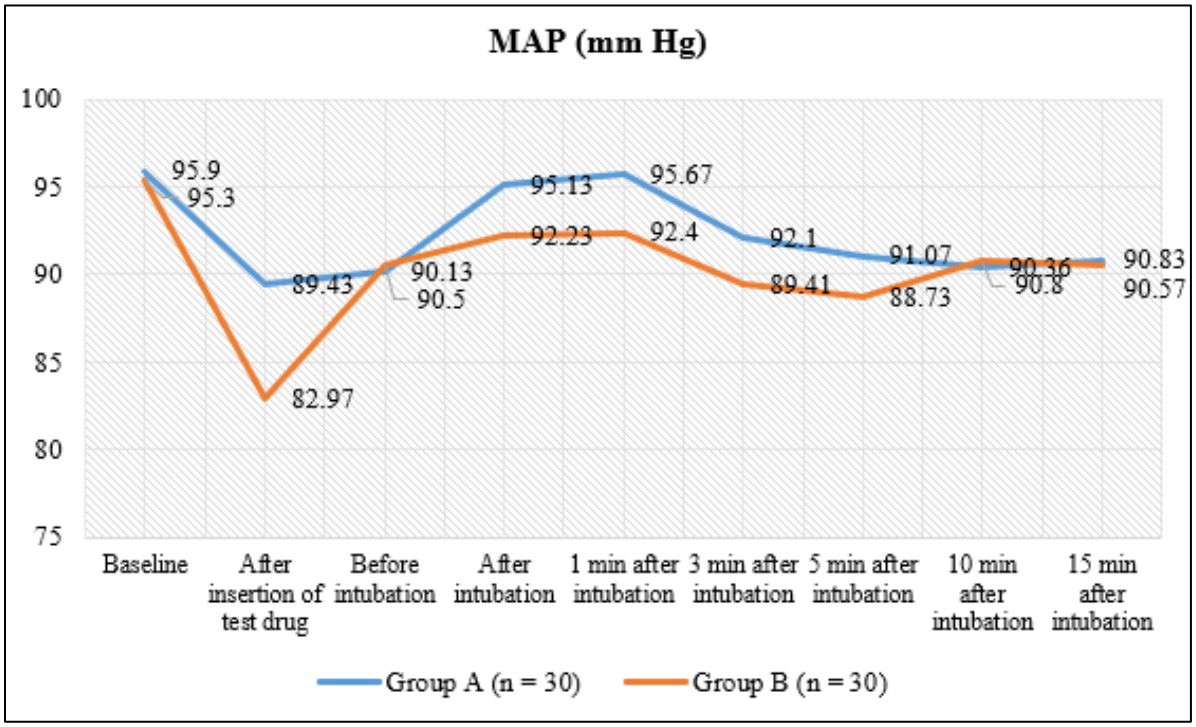


Figure 4: Changes in mean arterial pressure over time

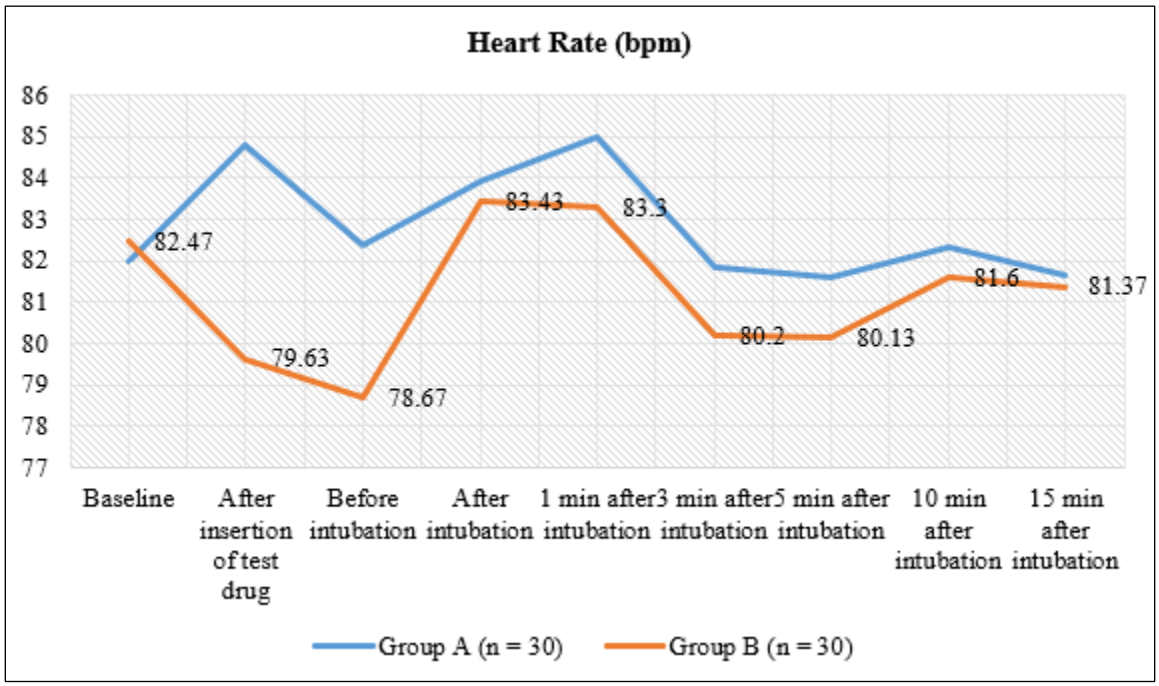


Figure 5: Changes in heart rate over time

Heart rate was comparable between groups across most observations. The only statistically significant difference was recorded after study-drug administration ($p = 0.0267$; Figure 5).

4. Discussion

Clinically acceptable intubating conditions were achieved in 93.3% of patients receiving combination of sevoflurane and propofol induction compared with 76.7% in the propofol only group. The improvement was evident across multiple components of the Copenhagen Consensus Conference scoring system, including ease of laryngoscopy, vocal cord position, and suppression of coughing and limb movement.

The conclusion of this study was the combination of sevoflurane and a lower propofol dose produced acceptable intubating conditions more often than propofol alone. This was also reflected in easier laryngoscopy, less coughing and limb movement, and a higher first-attempt intubation rate.

Acceptable intubating conditions were achieved in 93.3% of patients in the co-induction group and 76.7% in the propofol group. This difference is clinically relevant because the Copenhagen score reflects several parts of the intubation process, not simply the laryngoscopic view.

There is a reasonable pharmacologic explanation for this observation. Propofol is effective at suppressing upper airway reflexes, while sevoflurane allows anesthetic depth to increase without marked airway irritation.[13-17,24,34] In combination, these effects may have allowed satisfactory intubation despite reducing the propofol dose from 3 mg/kg to 1.5 mg/kg.

The difference was especially apparent in coughing and limb movement. Both responses were less frequent in Group A, suggesting that the combined technique provided better suppression of the response to laryngoscopy and passage of the tracheal tube.

Sevoflurane is relatively stable cardiovascular profile likely contributed to this observation. By reducing the required propofol dose, combination of sevoflurane and propofol induction attenuated the magnitude of hypotension without compromising intubating conditions.

The blood-pressure findings are also worth noting. Patients who received propofol alone had a greater early fall in systolic pressure, and mean arterial pressure was lower at several early measurements. A simple explanation is the larger propofol dose used in Group B.

Heart rate and diastolic pressure were similar at most time points. Thus, the hemodynamic advantage seen with combination of sevoflurane and propofol induction was mainly related to systolic pressure and mean arterial pressure rather than a consistent difference across every cardiovascular variable.

The better intubating conditions came at the cost of a slower induction. On average, induction took about 106

seconds longer in Group A. This is an important practical limitation and means that the technique would not be appropriate when rapid control of the airway is required.

5. Conclusion

In this group of adults undergoing elective surgery, sevoflurane 4% combined with propofol 1.5 mg/kg after fentanyl premedication produced acceptable intubating conditions more often than propofol 3 mg/kg alone when no neuromuscular blocking agent was given.

The combined technique was associated with less coughing and limb movement, more first-attempt intubations, and better preservation of early systolic and mean arterial pressure. Its main disadvantage was a substantially longer induction time. On the basis of these results, the technique may be considered in selected elective patients when neuromuscular blockade is undesirable, but the findings should not be extrapolated to rapid-sequence or difficult-airway situations.

Author Contributions

Suman Kumari Dabi: Conceptualization, study design, data collection, data analysis, literature review, manuscript drafting, critical revision, and final approval of the manuscript.

Insha Rafia: Study supervision, clinical management, data interpretation, manuscript review, critical revision, and final approval of the manuscript.

Abbreviations

ASA: American Society of Anesthesiologists; BMI: Body mass index; CCC: Copenhagen Consensus Conference; DBP: Diastolic blood pressure; HR: Heart rate; IV: Intravenous; MAP: Mean arterial pressure; SBP: Systolic blood pressure; SD: Standard deviation.

Ethical Approval

Approved by the Institutional Ethics Committee (File No. F.3 Acad/Ethical Clearance/2020/07; June 19, 2020). Written informed consent was obtained from all participants.

Financial Support and Sponsorship

None.

Conflict of Interest

None.

Use of Artificial Intelligence (AI)

The authors declare that no artificial intelligence (AI) tools were used in the generation, analysis, interpretation, or writing of this manuscript.

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