International Journal of Medical and Pharmaceutical Research

Online ISSN-2958-3683 | Print ISSN-2958-3675
Frequency: Bi-Monthly
Available online on: https://ijmpr.in/

Original Article

Comparative Study of Intubating Conditions and Cardiovascular Effects Following Succinylcholine and Rocuronium in Adult Elective Surgical Patients

Dr. Srishti Yadav[1], Dr. Surender[2], Dr. Bilal Ahmad[3], Aradhana Yadav[4], Dr. Akshat Upadhyay[5]

[1]*Junior Resident-3, Department of Anaesthesiology & Critical Care, Muzaffarnagar Medical College & Hospital, Muzaffarnagar, U.P.*
[2]*Associate Professor, Department of Anaesthesiology & Critical Care, Muzaffarnagar Medical College & Hospital, Muzaffarnagar, U.P.*
[3]*Associate Professor, Department of Anaesthesiology & Critical Care, Muzaffarnagar Medical College & Hospital, Muzaffarnagar, U.P.*
[4]*Research scholar, Department of Pharmacology (School of Pharmaceutical Education and Research) and the Department of Pharmacology (Jamia Hamdard University)*
[5]*Junior Resident-3, Department of Anaesthesiology & Critical Care, Muzaffarnagar Medical College & Hospital, Muzaffarnagar, U.P.*

OPEN ACCESS

Corresponding Author:

Dr. Surender
Associate Professor, Department of Anaesthesiology & Critical Care, Muzaffarnagar Medical College & Hospital, Muzaffarnagar, U.P.

Received: 02-06-2026
Accepted: 20-06-2026
Available online: 05-07-2026

ABSTRACT

Background: Endotracheal intubation is a critical component of general anaesthesia, requiring optimal intubating conditions and minimal hemodynamic disturbance. Succinylcholine is widely used due to its rapid onset, but is associated with several adverse effects. Rocuronium, a non-depolarizing agent, is considered a potential alternative with a favorable safety profile. **Aim & Objectives:** To compare succinylcholine and rocuronium with respect to intubating conditions, hemodynamic response, and incidence of complications in adult elective surgical patients. **Methodology:** This hospital-based interventional study was conducted on 60 patients (18–60 years, ASA I–II), randomly divided into two groups: Group A received succinylcholine (1.5 mg/kg) and Group B received rocuronium (0.6 mg/kg). Intubating conditions were assessed clinically, and hemodynamic parameters (HR, SBP, DBP, SpO_2, respiratory rate) were recorded at baseline and at predefined intervals. Data were analyzed using SPSS v30, with $p<0.05$ considered significant. **Results:** Both groups showed comparable demographic profiles. Excellent intubating conditions were observed in 76.67% (Group A) and 83.33% (Group B). A transient rise in heart rate and blood pressure was noted at 1 minute post-intubation in both groups, with no significant intergroup differences ($p>0.05$). SpO_2 and respiratory rate remained stable throughout. Complications were fewer in Group B, with absence of fasciculations and myalgia. **Conclusion:** Both drugs provided satisfactory intubating conditions with similar hemodynamic responses; however, rocuronium demonstrated a better safety profile and can be considered an effective alternative to succinylcholine.

Keywords: *Succinylcholine, Rocuronium, Intubating conditions, Hemodynamic response, Neuromuscular blockers, Endotracheal intubation.*

INTRODUCTION

Endotracheal intubation is an important part of administration of anaesthesia during surgery requiring general anaesthesia.[1] Rapid and safe tracheal intubation is of paramount importance for the airway maintenance in general anaesthesia.[2] Neuromuscular blocking agents play an important role in establishing airway control by providing adequate laryngopharyngeal relaxation and also provide muscle relaxation during surgery.[3] Good intubating conditions minimize the risk of trauma to airway. The ideal neuromuscular blocking agent for intubation should have a quick onset, brief duration of action, provide profound relaxation, no histamine release, no anaphylaxis and be free from hemodynamic changes.[4] Depolarizing NMBAs (eg, succinylcholine) act on receptors at the motor endplate of the neuromuscular junction (NMJ), causing depolarization of the membrane; this induces a refractory period.[5] Succinylcholine, or suxamethonium, is the only depolarizing NMBA used clinically.[6] Non- depolarizing NMDAs prevent acetylcholine from binding to the motor plate at the NMJ by competing for the ACh binding site on α subunit of nicotinic receptors.[7] For precise dosing, providers should refer to the FDA-approved labelling for each medication and carefully assess the patient's clinical situation. This approach ensures the safe and tailored administration of drugs, aligning with best healthcare practices.

- Succinylcholine: 1-2 mg/kg
- Rocuronium: Intubation (RSI): 0.45 to 0.9 mg/kg [6]

Succinylcholine is preferably given via the IV route, though it can be given IM. When given IV, the onset of action is 30 to 60 seconds, with duration of action 8 to 15 minutes. [14] It has a rapid onset of action and induces profound relaxation, making intubation simple, easy and non-traumatic. Due to its potentially dangerous side effects, such as bradycardia and other dysrhythmias, an increase in serum potassium, postoperative myalgia, and an increase in intra-ocular, intra-gastric, and intracranial pressure, it falls short of being an ideal muscle relaxant. Furthermore, it is contraindicated in burns and certain neurological diseases.[9] Unfortunately, succinylcholine chloride has many side effects such as an increase in intra-gastric, intracranial, and intraocular pressure, rhabdomyolysis with hyperkalaemia, changes in cardiac rhythm including bradycardia and cardiac arrest, malignant hyperthermia in susceptible individuals and also life-threatening increase in serum potassium levels are noticed in patients with burns, trauma, injuries, or upper motor neuron lesion.[10,11]

Rocuronium is a non-depolarizing muscle relaxant with fast onset of action producing good muscle relaxation without the side effects of succinylcholine. [12] Rocuronium onset is about 1 to 2 minutes after IV administration, and duration of action is 30 to 60 minutes. [8] Rocuronium in doses of 0.9-1.2mg/kg has proven to be as effective as succinylcholine for rapid tracheal intubation. [13] The only absolute contraindication to rocuronium is allergy. Care must be taken with patients who have myasthenia gravis or myasthenic syndrome, hepatic disease, neuromuscular disease, carcinomatosis or severe cachexia as the duration of action may be profoundly increased. [14]

The importance of this study lies in its potential to significantly enhance clinical practice in airway management and anesthesia. Although succinylcholine has historically been the drug of choice for rapid sequence induction due to its rapid onset and short duration, it is associated with several limitations, including adverse effects such as hyperkalemia, malignant hyperthermia, and postoperative myalgia. These concerns necessitate the exploration of alternative agents like rocuronium, which offers a similar rapid onset and prolonged duration with potentially fewer adverse effects, making it a valuable option in various clinical scenarios. By systematically comparing these two agents, this research will provide valuable insights that can aid anaesthesiologists in selecting the most appropriate neuromuscular blocker tailored to individual patient needs, thereby improving safety, efficacy, and overall perioperative outcomes.

AIM & OBJECTIVES

1. To compare rocuronium with succinylcholine with regard to intubating conditions and onset of endotracheal intubation and intubation conditions.
2. To compare rocuronium with succinylcholine with regard to duration of action, hemodynamic response and incidence of postoperative sore throat.

MATERIAL AND METHODS

The present hospital-based interventional study was conducted in the Department of Anesthesiology and Critical Care, Muzaffarnagar Medical College, over a period of 18 months (12 months data collection and 6 months analysis) to compare intubating conditions and cardiovascular effects of succinylcholine and rocuronium in adult elective surgical patients. A total of 60 patients aged 18–60 years (ASA I–II, Mallampati I–II) were enrolled using purposive sampling and randomly allocated into two groups (n=30 each): Group A received succinylcholine (1.5 mg/kg) and Group B received rocuronium (0.6 mg/kg). All patients underwent standard pre-anaesthetic evaluation, fasting, and premedication, followed by induction with fentanyl and propofol under routine monitoring (ECG, BP, SpO_2). Endotracheal intubation was performed 60 seconds after muscle relaxant administration and assessed using Cormack–Lehane grading and clinical parameters (laryngoscopy, vocal cord position, and response to intubation). Hemodynamic parameters (HR, SBP, DBP, MAP, SpO_2) were recorded at baseline, after induction, and at 1, 2, 3, and 5 minutes post-intubation. Data were analyzed using SPSS version 30, with quantitative variables compared using Student's t-test and qualitative variables using Chi-square test; $p<0.05$ was considered statistically significant. Ethical approval and written informed consent were obtained prior to the study.

Inclusion criteria: Patients fulfilling the following criteria were included:

- Age between 18 and 60 years
- Either gender
- ASA physical status I or II
- Modified Mallampati class I or II
- Patients scheduled for elective surgeries under general anaesthesia
- Patients without significant systemic comorbidities

- Patients who provided written informed consent

Exclusion criteria: Patients were excluded if they had:

- Refusal to participate
- Anticipated difficult airway
- Modified Mallampati class III or IV
- Age <18 years or >60 years
- Neuromuscular disorders
- History of cardiac, renal, hepatic disease or intracranial space-occupying lesions
- Conditions such as hyperkalemia, uncontrolled diabetes mellitus, hypertension, obesity, bronchial asthma, epilepsy
- Pregnancy
- History of allergy to study drugs
- Requirement for rapid sequence induction
- Patients receiving drugs affecting neuromuscular transmission (e.g., aminoglycosides)

RESULTS

In **Table 1**, the demographic characteristics of both groups were comparable for most variables. The mean age in Group A (35.23 ± 11.57 years) and Group B (35.73 ± 12.52 years) was similar (p=0.90). Gender distribution was also comparable (p=0.79), with a slight female predominance in both groups. No statistically significant difference was observed in height (p=0.19), ASA physical status (p=0.79), or Modified Mallampati class distribution (p=0.79), indicating good baseline matching between the groups. However, a statistically significant difference was found in weight, with Group B (67.27 ± 7.97 kg) having higher mean weight compared to Group A (61.37 ± 7.58 kg) (p=0.004).

In **Table 2**, the comparison of mean heart rate at different time intervals between Group A and Group B showed no statistically significant difference at any point. Following intubation, a rise in heart rate was observed at 1 minute in both groups; however, the difference remained statistically insignificant (p=0.83). Subsequently, heart rate values gradually returned towards baseline at 10, 15, 30, and 45 minutes, with no significant intergroup differences (p>0.05 at all intervals).

Table 3 compares mean systolic blood pressure (SBP) between Group A and Group B at different time intervals showed no statistically significant difference at any point. Baseline SBP was comparable between both groups (p=0.57). A transient rise in SBP was observed at 1 minute post-intubation in both groups, but the difference remained statistically insignificant (p=0.78). Thereafter, SBP gradually returned towards baseline at 10, 15, 30, and 45 minutes, with no significant intergroup variation (p>0.05 at all intervals).

In **Table 4**, the comparison of mean diastolic blood pressure (DBP) between Group A and Group B at different time intervals showed no statistically significant difference at any point. A transient increase in DBP was observed at 1 minute post-intubation in both groups; however, the difference was not statistically significant (p=0.79). Subsequently, DBP values gradually returned towards baseline at 10, 15, 30, and 45 minutes, with no significant intergroup variation (p>0.05 at all intervals).

Table 5 compares mean SpO_2 between Group A and Group B at different time intervals showed no statistically significant difference at any point. Baseline SpO_2 was identical in both groups (p=1.00). At 1 minute post-intubation, a slight increase in SpO_2 was observed in both groups, but the difference remained statistically insignificant (p=0.52). SpO_2 values remained stable and within normal limits at 10, 15, 30, and 45 minutes, with no significant intergroup variation (p>0.05 at all intervals).

Table 6 compares mean respiratory rate between Group A and Group B at different time intervals showed no statistically significant difference at any point. A slight increase in respiratory rate was observed at 1 minute post-intubation in both groups; however, the difference remained statistically insignificant (p=0.32). Subsequently, respiratory rate values remained stable and near baseline at 10, 15, 30, and 45 minutes, with no significant intergroup variation (p>0.05 at all intervals).

Figure 1 shows the distribution of patients according to overall intubating conditions. In Group A, excellent intubating conditions were observed in 76.67% of patients, followed by good conditions in 20.00%, and poor conditions in 3.33%. In Group B, excellent conditions were seen in a higher proportion, i.e., 83.33%, while good conditions were noted in 16.67% of patients, and no patient (0.00%) had poor intubating conditions.

Figure 2 shows the distribution of patients according to complications. In Group A, no complications were observed in 73.33% of patients, while mild fasciculations were seen in 10.00%, mild myalgia in 6.67%, mild soreness in 6.67%, and transient bradycardia in 3.33% of patients. In Group B, a higher proportion of patients (90.00%) had no complications. Mild soreness was observed in 6.67%, and transient bradycardia in 3.33%, while no cases of fasciculations or myalgia (0.00%) were reported.

Table 1: Demographic profile of Study Participants: (N = 60)

	Group A	Group B	p value
Age (years)	35.23 ± 11.57	35.73 ± 12.52	0.90
Gender (M/F)	12/18	11/19	0.79
Height (cm)	166.7 ± 9.09	163.67 ± 7.68	0.19
Weight (kg)	61.37 ± 7.58	67.27 ± 7.97	**0.004**
ASA (I/II)	13/17	14/16	0.79
MCL Grade	16/14	15/15	0.79

Table 2- Comparison of mean Heart Rate at different time intervals between two groups:

Heart Rate(beats/min)	Group A		Group B		p value
	Mean	Std Dev.	Mean	Std Dev.	
Baseline	77.4	3.57	76.9	4.38	0.63
1 min	102.07	5.15	101.77	5.45	0.83
10 min	76.8	4.23	76.4	4.45	0.69
15 min	76.93	4.83	76.1	4.53	0.44
30 min	76.77	4.22	76.3	4.49	0.61
45 min	77.23	4.13	76.37	4.57	0.37

Table 3- Comparison of mean Systolic Blood Pressure at different time intervals between the groups:

SBP (mm Hg)	Group A		Group B		p value
	Mean	Std Dev.	Mean	Std. Dev	
Baseline	120.03	5.64	118.87	6.24	0.57
1 min	138.93	6.76	138.53	6.60	0.78
10 min	119.27	6.25	118.13	5.83	0.62
15 min	118.8	6.38	117.17	6.05	0.43
30 min	118.97	6.72	117.33	6.33	0.50
45 min	118.47	6.19	117.93	6.18	0.68

Table 4- Comparison of mean Diastolic Blood Pressure at different time intervals between the groups:

DBP (mm Hg)	Group A		Group B		p value
	Mean	Std Dev.	Mean	Std Dev	
Baseline	77.9	4.26	77.67	4.50	0.73
1 min	90.67	4.50	90.3	4.53	0.79
10 min	78.27	5.45	77.17	5.60	0.57
15 min	78.63	5.85	77.03	6.27	0.48
30 min	78.13	5.08	77.83	5.60	0.62
45 min	78.27	5.42	77	5.52	0.52

Table 5- Comparison of mean SpO_2 at different time intervals between the groups:

Mean SpO_2 (%)	Group A		Group B		P Value
	Mean	Std Dev.	Mean	Std Dev	
Baseline	98.5	0.51	98.5	0.51	1.00
1 min	99.03	0.72	98.9	0.71	0.52
10 min	98.97	0.76	99.1	0.71	0.63
15 min	98.93	0.69	98.87	0.73	0.84
30 min	99	0.83	99	0.69	0.97
45 min	98.93	0.64	98.9	0.80	0.79

Table 6- Comparison of mean Respiratory Rate at different time intervals between two groups:

Respiratory Rate(breaths/min)	Group A		Group B		P Value
	Mean	Std Dev.	Mean	Std Dev.	
Baseline	13.87	1.38	14.2	1.37	0.41
1 min	14.37	1.85	14.9	1.69	0.32
10 min	13.87	1.70	14.27	1.41	0.46
15 min	13.7	1.58	14.23	1.54	0.37
30 min	13.93	1.55	14.1	1.65	0.49
45 min	13.83	1.82	14.4	1.83	0.40

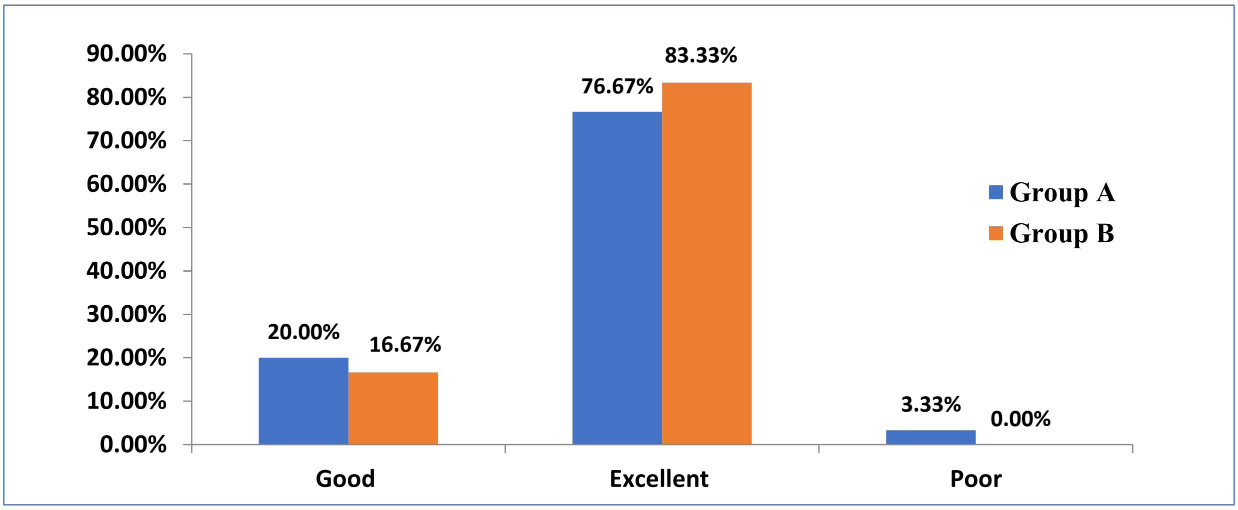

Figure 1- Distribution of patients according to overall intubating condition (N=60)

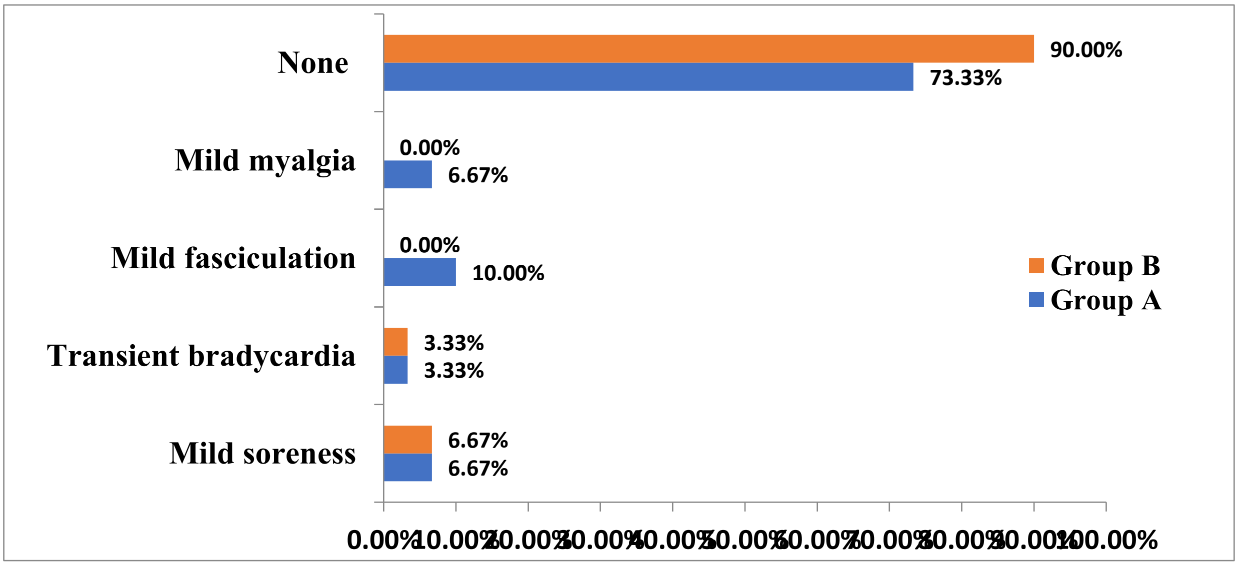

Figure 2- Distribution of patients according to complications

DISCUSSION

In the present study, the two study groups were well matched at baseline, which is essential to ensure that subsequent differences are attributable to the study drugs rather than confounders. The mean age was comparable (Group A: 35.23 ± 11.57 years vs Group B: 35.73 ± 12.52 years; p = 0.90). Gender distribution was similar (M/F: 12/18vs11/19; p = 0.79), as were height (166.7 ± 9.09 cm vs 163.67 ± 7.68 cm; p = 0.19), ASA physical status (I/II: 13/17vs14/16; p = 0.79), and Modified Cormack–Lehane grades (16/14vs15/15; p = 0.79). A statistically significant difference was observed only in weight (Group A: 61.37 ± 7.58 kg vs Group B: 67.27 ± 7.97 kg; p = 0.004). Similar baseline comparability has been reported by **Pauline A et al. (2016)**, where age, sex, ASA status and airway grades were comparable between rocuronium and succinylcholine groups. [15] The age distribution in the present study is also comparable to that reported by **Kumar A et al. (2015)** and **Heisnam I et al. (2017),** all of whom included adult patients predominantly belonging to ASA physical status I and II. [16,17]

In the present study, the baseline mean heart rate in Group A was 77.4 ± 3.57 beats/min, Following this, heart rate values showed a progressive decline by 10 minutes (76.8 ± 4.23 beats/min; p = 0.52) and remaining stable at 15 minutes (76.93 ± 4.83; p = 0.58), 30 minutes (76.77 ± 4.22; p = 0.49), and 45 minutes (77.23 ± 4.13; p = 0.77). Comparable observations have been reported by **Hassan SM et al (2016),** where both succinylcholine and rocuronium groups showed significant tachycardia immediately after intubation with no sustained difference at later intervals.[18] These findings are also consistent with **HeisnamI et al. (2017)**, who reported a transient increase in heart rate immediately after intubation, returning to baseline within 5–10 minutes.[17]

In the present study, both groups showed a significant rise in systolic blood pressure at 1 minute post-intubation (Group A: 120.03 ± 5.64 to 138.93 ± 6.76 mm Hg; Group B: 118.87 ± 6.24 to 138.53 ± 6.60 mm Hg; $p < 0.0001$). Similar haemodynamic trends were reported by **Kumar A et al. (2015)**, who observed a significant increase in SBP immediately after intubation with both succinylcholine and rocuronium, followed by normalization within 5 minutes. [16] **Heisnam I et al. (2017)** also documented a transient SBP rise in both groups, with no clinically significant difference between succinylcholine and rocuronium beyond the immediate post-intubation period. [17]

In present study, a significant rise in DBP was observed at 1 minute post-intubation in both groups (Group A: 90.67 ± 4.50 mmHg; Group B: 90.3 ± 4.53 mmHg; $p<0.0001$), reflecting a transient sympathetic response. **Pauline PA et al. (2016)** similarly observed transient DBP elevations that resolved rapidly, emphasizing that airway manipulation is the primary driver of this response. [15] These findings also correlate well with those of **Kanvee MVania et al (2019)**, who reported a significant but transient rise in DBP following intubation with both succinylcholine and rocuronium, returning to baseline within 5 minutes. [19]

In present study, mean respiratory rate was comparable between Group A (13.87 ± 1.38 breaths/min) and Group B (14.20 ± 1.37 breaths/min), with no statistically significant difference (p = 0.41). These findings are in agreement with **Kumar A et al. (2015),** who demonstrated no statistically significant changes in respiratory rate or other respiratory parameters following the administration of either succinylcholine or rocuronium once controlled ventilation was established. [16] Similarly, **Heisnam I et al. (2017)** reported stable respiratory patterns in both groups, with no episodes of respiratory compromise attributable to the choice of neuromuscular blocking agent.[17]

Throughout the study, SpO_2 remained within normal limits (≥98%) in both groups, with no statistically significant difference at any time point. These observations are consistent with the findings of **Kumar A et al. (2015),** who reported stable oxygen saturation throughout induction and intubation with both succinylcholine and rocuronium, without any episodes of desaturation. [16] Similarly, **Heisnam I et al. (2017)** demonstrated no statistically significant difference in SpO_2 values between the two groups, with oxygen saturation consistently maintained above 97% in all patients.[17]

Excellent intubating conditions predominated in both groups: 76.67% in Group A and 83.33% in Group B; good conditions were seen in 20%vs16.67%, respectively, while poor conditions were rare (3.33% in Group A; 0% in Group B). These findings closely align with **Hassan SM et al (2016)**, who reported 93.33% excellent intubating conditions with succinylcholine and 53.33–96.67% excellent with rocuronium depending on dose. [18] **Pauline A et al (2016)** observed 88–100% excellent conditions with both agents.[15] These findings were also comparable to the observations of **Kumar A et al. (2015)**, who reported excellent intubating conditions in 87.5% of patients receiving succinylcholine and 57.5% of patients receiving rocuronium 0.6 mg/kg, with good conditions in the remaining patients. [16]

In the present study, most patients did not experience complications, with 73.33% in Group A and 90% in Group B showing no adverse effects. Mild soreness was observed equally in both groups (6.67%), and transient bradycardia occurred in 3.33% of patients in each group. However, mild fasciculations (10%) and myalgia (6.67%) were seen only in Group A. These findings are consistent with **Kumar A et al. (2015)**, who reported no serious adverse effects with either succinylcholine or rocuronium, and noted that haemodynamic fluctuations observed were transient and related to laryngoscopy rather than drug toxicity. [16] Similarly, **HeisnamI et al. (2017)** did not observe any significant complications in either group, concluding that both agents are safe when used for rapid sequence induction in controlled settings. [17]

CONCLUSION

The present study concludes that both succinylcholine and rocuronium provide comparable and satisfactory intubating conditions with similar hemodynamic responses during endotracheal intubation. Although both agents demonstrated a transient rise in heart rate and blood pressure immediately after intubation, values returned to baseline without significant intergroup differences. Rocuronium showed a slightly better safety profile with fewer complications, particularly absence of fasciculations and myalgia. Therefore, rocuronium can be considered a safe and effective alternative to succinylcholine for endotracheal intubation in adult elective surgical patients.

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