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Original Research Article

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

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Abstract

Introduction: Endotracheal intubation is an essential component of general anaesthesia but is often associated with sympathetic stimulation leading to tachycardia and hypertension. Succinylcholine has been the gold standard neuromuscular blocking drug for rapid sequence induction but is associated with adverse effects such as fasciculations and postoperative myalgia. Rocuronium, a non-depolarizing neuromuscular blocker, has been proposed as a safer alternative with comparable intubating conditions and fewer side effects. The study aimed to compare intubating conditions and cardiovascular responses following administration of succinylcholine and rocuronium in adult elective surgical patients.

Materials and Methods: This prospective, randomized, comparative study was conducted at Mamata Medical College, Khammam, from January 2024 to June 2025, on 60 ASA I–II adult patients scheduled for elective surgeries under general anaesthesia. Participants were randomly assigned to receive either succinylcholine (2 mg/kg) or rocuronium (0.6 mg/kg). Intubating conditions were assessed at 60 seconds using standard clinical criteria. Hemodynamic parameters—heart rate, systolic, diastolic, and mean arterial pressure—were recorded at baseline, post-induction, post-muscle relaxant, and up to 5 minutes after intubation. Adverse events including fasciculations, myalgia, sore throat, hypotension, and bradycardia were documented. Data were analyzed using Student's t-test and Chi-square test, with $p < 0.05$ considered significant.

Results: Both groups achieved comparable excellent intubating conditions (>85%). Rocuronium group showed significantly lower heart rate and mean arterial pressure in the first 1–2 minutes post-intubation. Fasciculations were observed only in the succinylcholine group (90%).

Conclusion: Rocuronium provides intubating conditions equivalent to succinylcholine with superior hemodynamic stability and absence of fasciculations, making it a suitable alternative, especially in patients where succinylcholine is contraindicated.

Keywords: Rocuronium, Succinylcholine, Intubating Conditions.

Introduction

Endotracheal intubation is a fundamental step in securing the airway during general anaesthesia [1]. It facilitates controlled ventilation, prevents aspiration, and ensures adequate oxygenation during surgery [2]. However, the process of laryngoscopy and intubation is associated with significant sympathetic stimulation, leading to transient tachycardia, hypertension, and increased

myocardial oxygen consumption [3,4]. These hemodynamic changes, though generally well tolerated in healthy individuals, can pose a risk in patients with cardiovascular comorbidities and necessitate careful choice of anaesthetic agents to minimize stress response [5].

Succinylcholine has long been considered the gold standard neuromuscular blocking agent for rapid sequence induction due to its rapid onset, short duration of action, and reliable intubating conditions [6,7]. Despite its advantages, succinylcholine is associated with several adverse effects including muscle fasciculations, postoperative myalgia, hyperkalemia, and potential risk of malignant hyperthermia [8,9]. These limitations have prompted the search for safer alternatives that provide comparable intubating conditions without undesirable side effects.

Rocuronium, a non-depolarizing neuromuscular blocking drug, has emerged as a promising alternative to succinylcholine [10]. At doses of 0.6–1.2 mg/kg, it produces a rapid onset of neuromuscular blockade, often within 60 seconds, allowing satisfactory intubating conditions [11]. Its hemodynamic stability and absence of muscle fasciculations make it suitable for patients where succinylcholine is contraindicated [12]. However, its comparatively longer duration of action may limit its use in short procedures unless reversal agents such as Sugammadex are available [13].

Given these considerations, a direct comparison between succinylcholine and rocuronium is warranted to evaluate not only the quality of intubating conditions but also their cardiovascular effects in adult patients undergoing elective surgery.

The aim of the present study was to compare the intubating conditions and hemodynamic responses following administration of succinylcholine and rocuronium in adult elective surgical patients.

Materials and Methods

This prospective, randomized, comparative study was conducted at Mamata Medical College and associated teaching hospitals, Khammam, over a period of 18 months from January 2024 to June 2025, after obtaining approval from the Institutional Ethics Committee and written informed consent from all participants. Adult patients of either sex, aged 18–60 years, belonging to the American Society of Anaesthesiologists (ASA) physical status I or II, and scheduled for elective surgical procedures under general anaesthesia requiring endotracheal intubation were enrolled in the study.

A total of 60 patients were included and randomly allocated into two equal groups (n=30 each) using a computer-generated randomization list. Patients in Group R received rocuronium (0.6 mg/kg) as the neuromuscular blocking agent, while those in Group S received succinylcholine (2 mg/kg).

All patients were premedicated with standard institutional protocol including anticholinergics, sedatives, and analgesics. Induction of anaesthesia was achieved with intravenous propofol in titrated doses followed by administration of the study drug according to group allocation. Laryngoscopy and endotracheal intubation were performed by an experienced anaesthesiologist blinded to the group allocation, 60 seconds after drug administration.

Intubating conditions were assessed using standard parameters including ease of laryngoscopy, vocal cord position and movement, and patient response to intubation, which were then graded as excellent or good based on predefined scoring criteria. Hemodynamic parameters such as heart rate, systolic blood pressure, diastolic blood pressure, and mean arterial pressure were recorded at baseline (pre-induction), post-induction, post-muscle relaxant, immediately after intubation (0 min), and at 1, 2, and 5 minutes following intubation. Any adverse events including fasciculations, myalgia, sore throat, hypotension, and bradycardia within the first 24 hours were also documented.

Data were entered in Microsoft Excel and analyzed using SPSS version 27. Continuous variables were expressed as mean ± standard deviation (SD) and compared between groups using Student's unpaired t-test. Categorical variables were presented as frequency and percentage and analyzed using the Chi-square test. A p-value < 0.05 was considered statistically significant.

Results

The demographic and clinical characteristics were comparable between the two groups. The mean age was 37.2 ± 10.5 years in the rocuronium group and 36.4 ± 9.8 years in the succinylcholine group. The male-to-female distribution, mean weight, and ASA physical status were similar with no statistically significant difference, ensuring homogeneity between groups for further comparison (Table 1).

Table 1: Baseline Demographic and Clinical Characteristics of Study Participants

Parameter	Rocuronium (n=30)	Succinylcholine (n=30)	p-value
Age (years)	37.2 ± 10.5	36.4 ± 9.8	0.68
Sex (Male/Female)	18 / 12	17 / 13	0.79
Weight (kg)	64.7 ± 7.3	63.9 ± 7.1	0.54
ASA Physical Status (I/II)	20 / 10	21 / 9	0.79

The assessment of intubating conditions revealed that ease of laryngoscopy was high in both groups, with 93.3% in the rocuronium group and 96.7% in the succinylcholine group being classified as "easy."

Vocal cord position and movement were comparable, with a majority showing abducted cords and no movement in both groups. The response to intubation was minimal, and overall intubating conditions were rated as "excellent" in more than 85% of patients in each group, with no statistically significant difference, indicating that rocuronium provided intubating conditions comparable to succinylcholine (Table 2).

Table 2: Comparison of Intubating Conditions between Study Groups

Intubating Parameter	Rocuronium (n=30)	Succinylcholine (n=30)	p-value
Ease of Laryngoscopy			
Easy	28 (93.3%)	29 (96.7%)	0.55
Difficult	2 (6.7%)	1 (3.3%)	
Vocal Cord Position			
Open/Abducted	27 (90.0%)	28 (93.3%)	0.64
Partially Open	3 (10.0%)	2 (6.7%)	
Vocal Cord Movement			
None	26 (86.7%)	27 (90.0%)	0.73
Slight Movement	4 (13.3%)	3 (10.0%)	
Response to Intubation			
No Response	25 (83.3%)	26 (86.7%)	0.74
Cough/Diaphragmatic Movement	5 (16.7%)	4 (13.3%)	
Overall Intubating Conditions			
Excellent	26 (86.7%)	27 (90.0%)	0.71
Good	4 (13.3%)	3 (10.0%)	

Heart rate analysis demonstrated a significant increase in the succinylcholine group at multiple intervals. Post-induction, post-muscle relaxant, and at 0 min and 1 min after intubation, heart rate was significantly higher in the succinylcholine group compared to the rocuronium group ($p < 0.05$). Although values gradually trended toward baseline by 5 min, the rocuronium group consistently maintained more stable heart rate responses throughout the peri-intubation period (Table 3).

Table 3: Heart Rate (beats/min) at Various Intervals

Time Interval	Rocuronium (Mean ± SD)	Succinylcholine (Mean ± SD)	p-value
Pre-induction	77.3 ± 11.2	76.9 ± 11.5	0.68
Post-induction	74.8 ± 10.4	78.9 ± 10.7	0.04
Post-muscle relaxant	74.1 ± 10.1	79.7 ± 10.3	0.03
0 min (after intubation)	75.6 ± 9.8	80.8 ± 9.9	0.02
1 min	74.7 ± 9.3	79.9 ± 9.5	0.01
2 min	75.4 ± 8.6	78.3 ± 8.4	0.08
5 min	74.9 ± 9.0	77.6 ± 9.4	0.19

Systolic blood pressure showed a statistically significant rise in the succinylcholine group following induction, after muscle relaxant administration, and at 1 min post-intubation. The rocuronium group demonstrated relatively stable systolic pressure with a more gradual return toward baseline values.

Differences at 2 min and 5 min were not statistically significant, indicating that hemodynamic changes were transient (Table 4).

Table 4: Systolic Blood Pressure (mmHg)

Time Interval	Rocuronium (Mean ± SD)	Succinylcholine (Mean ± SD)	p-value
Pre-induction	120.5 ± 7.9	121.1 ± 6.7	0.62
Post-induction	118.8 ± 6.4	123.3 ± 6.1	0.01
Post-muscle relaxant	117.9 ± 6.1	125.5 ± 6.0	<0.001
0 min	125.9 ± 7.1	126.8 ± 5.9	0.42
1 min	124.1 ± 6.5	127.9 ± 4.8	0.01
2 min	123.3 ± 6.4	126.2 ± 5.0	0.07
5 min	121.7 ± 6.3	124.5 ± 4.3	0.09

Diastolic blood pressure remained comparable between groups at most intervals except post-muscle relaxant, where a significant rise was observed in the succinylcholine group ($p = 0.02$). At other time points including immediately after intubation and at 1, 2, and 5 min, values were similar, again indicating only a transient effect (Table 5).

Table 5: Diastolic Blood Pressure (mmHg)

Time Interval	Rocuronium (Mean ± SD)	Succinylcholine (Mean ± SD)	p-value
Pre-induction	65.5 ± 8.5	64.8 ± 8.3	0.58
Post-induction	65.8 ± 8.6	67.4 ± 8.9	0.23
Post-muscle relaxant	64.7 ± 8.5	69.0 ± 7.8	0.02
0 min	70.2 ± 8.0	68.0 ± 8.5	0.09
1 min	69.3 ± 7.3	68.2 ± 7.5	0.34
2 min	68.1 ± 7.2	69.6 ± 7.7	0.28
5 min	67.5 ± 8.1	67.9 ± 8.4	0.77

Mean arterial pressure showed a significant rise in the succinylcholine group after muscle relaxant administration and at 1 min post-intubation, reflecting the sympathoadrenal stimulation associated with succinylcholine. No significant difference was seen at other intervals, with both groups showing near-baseline MAP by 5 min (Table 6).

Table 6: Mean Arterial Pressure (mmHg)

Time Interval	Rocuronium (Mean ± SD)	Succinylcholine (Mean ± SD)	p-value
Pre-induction	83.8 ± 7.5	82.9 ± 7.1	0.59
Post-induction	83.5 ± 6.9	85.1 ± 6.4	0.18
Post-muscle relaxant	82.2 ± 6.6	87.7 ± 6.1	0.01
0 min	88.1 ± 6.9	87.4 ± 6.3	0.53
1 min	87.5 ± 6.5	88.5 ± 6.2	0.04
2 min	86.3 ± 6.2	88.1 ± 6.5	0.11
5 min	85.5 ± 7.0	86.7 ± 7.1	0.33

Adverse event analysis revealed a significantly higher incidence of fasciculations in the succinylcholine group (90%) compared to none in the rocuronium group ($p < 0.001$). Myalgia was more frequent with succinylcholine (16.7% vs. 3.3%), though this difference was not statistically significant.

Other complications such as sore throat, hypotension, and bradycardia occurred infrequently and were comparable between groups (Table 7).

Table 7: Adverse Events Observed

Adverse Event	Rocuronium (n=30)	Succinylcholine (n=30)	p-value
Fasciculations	0 (0%)	27 (90.0%)	<0.001
Myalgia	1 (3.3%)	5 (16.7%)	0.07
Post-intubation Sore Throat	2 (6.7%)	3 (10.0%)	0.64
Hypotension	2 (6.7%)	3 (10.0%)	0.64
Bradycardia	1 (3.3%)	1 (3.3%)	1.00

Discussion

In our study, clinical assessment of intubating conditions at 60 seconds after administration of the muscle relaxant using criteria such as jaw relaxation, vocal cord movement, and diaphragmatic response showed that succinylcholine produced "excellent" intubating conditions in about 83.3% of patients, which closely aligns with findings by Shareef SM et al.

[14]. This concurs with the general pattern in similar trials: while non-depolarizing agents like rocuronium have sometimes lagged behind believability in "excellent" scores, when used at sufficient doses (e.g. 0.9 mg/kg), their intubating conditions become nearly comparable to those of succinylcholine.

For example, Jose AE in a randomized study of rocuronium 0.9 mg/kg vs. succinylcholine 2 mg/kg found well-to-excellent conditions in 100% of cases, with "excellent" in about 83.4% for rocuronium, showing minimal difference [15]. The hemodynamic responses in our study showed transient increases in heart rate (HR) and mean arterial pressure (MAP) following laryngoscopy and intubation, especially with succinylcholine are consistent with what other studies have observed. For example, Shukla et al. and Shaik Mira Shareef et al. also reported no significant long-term hemodynamic changes beyond 5 minutes post-intubation with both rocuronium and succinylcholine, despite early rises [14,16]. Similarly, in the study by Jose AE rocuronium 0.9 mg/kg was compared with succinylcholine 2 mg/kg, they observed that although there were transient hemodynamic boosts, by 5 minutes all parameters returned close to baseline [15].

Our findings also reinforce the notion, supported in the literature, that using train-of-four (TOF) monitoring at the adductor pollicis may not reflect the actual status of laryngeal or diaphragmatic muscles when non-depolarizing blocks are used. Because onset of paralysis occurs earlier in laryngeal muscles than in adductor pollicis, relying solely on TOF there might underestimate readiness for intubation. Studies like the one by Magorian et al. and numerous RCTs included in the Cochrane meta-analysis also emphasized that timing (60 seconds or sometimes longer) and clinical scoring systems are critical to assess intubating conditions accurately [12,15,17].

A limitation of our study is that although rocuronium demonstrated statistically significant attenuation of early hemodynamic responses reflected by lower heart rate and a smaller rise in mean arterial pressure during the first 1-2 minutes these effects were modest and transient, with parameters returning to baseline by 5 minutes. Similar findings have been reported by Shukla A et al. and Jose et al., who also observed that the sympathetic response to laryngoscopy and intubation is largely unavoidable, regardless of the neuromuscular blocking agent used, though its intensity and duration may differ [15,16].

Therefore, while succinylcholine appears to elicit a slightly greater immediate hemodynamic surge, the overall clinical relevance of these differences beyond the immediate post-intubation period remains limited.

Conclusion

Both succinylcholine and rocuronium provided comparable and clinically acceptable intubating conditions in adult patients undergoing elective surgery. Rocuronium was associated with significantly attenuated early hemodynamic responses, with lower heart rate and less rise in mean arterial pressure during the first 1–2 minutes after intubation, although these differences were transient and returned to baseline by 5 minutes. Additionally, rocuronium was devoid of fasciculations and showed a lower incidence of myalgia, highlighting its favourable safety profile. These findings suggest that rocuronium can serve as a reliable alternative to succinylcholine, particularly in patients where succinylcholine is contraindicated or where avoidance of fasciculations and greater hemodynamic stability is desired.

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