Original Research Paper

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COMPARISON OF ROCURONIUM BROMIDE 0.9 MG/KG AND SUCCINYLCHOLINE 2 MG/KG FOR 90-SECOND INTUBATING CONDITIONS, HAEMODYNAMIC RESPONSE AND PERI-OPERATIVE COMPLICATIONS IN ADULT ELECTIVE SURGERY: A DOUBLE-BLIND RANDOMIZED CONTROLLED TRIAL

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ABSTRACT **Background:** Succinylcholine remains widely used for tracheal intubation because of its rapid onset, but its adverse-effect profile has sustained interest in rocuronium as an alternative. **Objective:** To compare rocuronium bromide 0.9 mg/kg with succinylcholine 2 mg/kg for intubating conditions at 90 seconds, haemodynamic response and peri-operative complications in adult elective surgery. **Methods:** This double-blind randomized controlled trial included 78 ASA I-II adults aged 18-60 years scheduled for elective surgery under general anaesthesia. Patients were allocated to rocuronium 0.9 mg/kg (n=39) or succinylcholine 2 mg/kg (n=39) after standardized induction with midazolam, buprenorphine and propofol. Laryngoscopy was performed at 90 seconds. Cooper score, train-of-four count, serial haemodynamics and complications were recorded. **Results:** Baseline characteristics were comparable. The mean total Cooper score was higher with succinylcholine than rocuronium (8.26 ± 0.68 vs 7.82 ± 1.10; p=0.039). Excellent intubating conditions occurred in 34 (87.2%) and 26 (66.7%) patients, respectively (p=0.060), while all remaining patients had good conditions. TOF count was lower with succinylcholine (0.18 ± 0.39 vs 0.51 ± 0.68; p=0.010). Post-intubation heart rate, systolic pressure and mean arterial pressure were significantly higher with succinylcholine. Fasciculations occurred in 37 (94.9%) patients after succinylcholine and none after rocuronium (p<0.001). **Conclusion:** Rocuronium 0.9 mg/kg produced clinically acceptable intubating conditions in all adults at 90 seconds, with less haemodynamic stimulation and fewer depolarizing adverse effects.

KEYWORDS : Rocuronium; succinylcholine; Cooper score; endotracheal intubation; haemodynamics; neuromuscular blockade

INTRODUCTION

Neuromuscular blocking drugs changed the conduct of general anaesthesia by allowing reliable airway control and surgical relaxation without excessive anaesthetic depth [1]. Succinylcholine has remained the reference agent for rapid tracheal intubation because it produces dense neuromuscular block quickly and has a short duration of action. Its usefulness, however, is limited by fasciculations, postoperative myalgia, bradyarrhythmia, hyperkalaemia, malignant hyperthermia risk and important contraindications [2].

Rocuronium is a non-depolarizing aminosteroid relaxant with a dose-dependent onset. Earlier work with Org 9426 showed clinically acceptable intubating conditions at 90 seconds, and subsequent practice has used higher doses when succinylcholine is undesirable [3]. Contemporary guidance therefore emphasizes individualized selection of muscle relaxants and appropriate reversal strategies rather than routine reliance on a single drug [4].

In elective surgery, where a controlled 90-second interval is feasible, the balance between intubating quality, haemodynamic response and adverse effects is clinically relevant. This trial compared rocuronium bromide 0.9 mg/kg with succinylcholine 2 mg/kg for intubating conditions at 90 seconds, serial haemodynamic changes and peri-operative complications in adult patients undergoing elective procedures under general anaesthesia.

MATERIALS AND METHODS

This double-blind randomized controlled trial was conducted in the Department of Anaesthesiology at a tertiary care teaching hospital. Adult in-patients aged 18-60 years, of either sex, with ASA physical status I or II and scheduled for elective surgery under general anaesthesia were eligible. Patients with anticipated difficult airway (Mallampati grade III or IV), hyperkalaemia, burns, neurological disorders, pregnancy or lactation, and current use of drugs affecting neuromuscular relaxation were excluded. Written informed consent was obtained before enrolment.

A total of 78 patients were enrolled and allocated in a 1:1 ratio to receive either rocuronium bromide 0.9 mg/kg (Group A, n=39) or succinylcholine 2 mg/kg (Group B, n=39). Randomization was performed using a computer-generated random number table/lottery method. Patients and the clinicians assessing outcomes were blinded to allocation. Standard monitoring included electrocardiography, non-invasive blood pressure and pulse oximetry. Train-of-four monitoring was applied over the ulnar nerve, and adductor pollicis response was assessed at 90 seconds.

All patients received intravenous midazolam 1 mg and buprenorphine 2 mcg/kg, followed by induction with propofol 2 mg/kg. After confirmation of mask ventilation, the assigned neuromuscular blocking drug was administered. Laryngoscopy and tracheal intubation were performed at 90 seconds. Intubating conditions were graded using the Cooper scoring system, which assesses jaw relaxation, vocal cord position and response to intubation, with total scores categorized as excellent (8-9), good (6-7), fair (3-5) or poor (0-2) [3].

Heart rate, systolic blood pressure, diastolic blood pressure and mean arterial pressure were recorded at baseline, 60 seconds after study drug administration, immediately after intubation, and at 1, 2, 5 and 10 minutes after intubation. Intra-operative adverse effects and postoperative myalgia were documented. Data were analysed using SPSS version 20.0. Continuous variables were compared using Student's t-test or Mann-Whitney U test, and categorical variables using Pearson's chi-square or Fisher's exact test. A two-tailed p value <0.050 was considered statistically significant.

RESULTS

A total of 78 adult patients were analysed, with 39 patients in each group. The mean age was 40.13 ± 12.02 years in the rocuronium group and 39.31 ± 11.81 years in the succinylcholine group. The two groups were comparable with respect to age distribution, sex, height, weight, body mass index, ASA physical status, Mallampati grade, type of surgery and baseline haemodynamic parameters (Table 1).

Table 1. Baseline profile of study participants by study group (N=78)

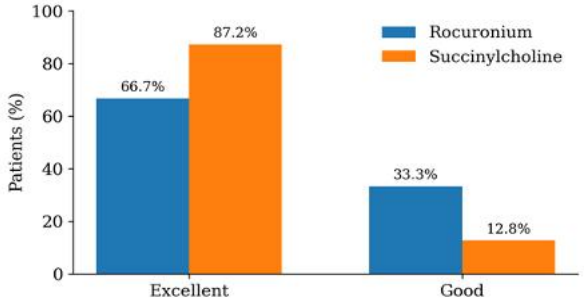
Characteristic	Category	Rocuronium 0.9 mg/kg (n=39)	Succinylcholine 2 mg/kg (n=39)	p value
Age group (years)	18-30	10 (25.6)	9 (23.1)	0.670
	31-40	10 (25.6)	13 (33.3)	
	41-50	8 (20.5)	10 (25.6)	
	51-60	11 (28.2)	7 (17.9)	
Mean age (years)	Mean ± SD	40.13 ± 12.02	39.31±11.81	0.762

Sex	Male	24 (61.5)	22 (56.4)	0.646
	Female	15 (38.5)	17 (43.6)	
Height (cm)	Mean ± SD	165.47 ± 7.63	166.22±7.90	0.676
Weight (kg)	Mean ± SD	66.26 ± 10.12	62.82±0.10	0.141
Body mass index (kg/m²)	Mean ± SD	24.27 ± 3.89	22.82±3.77	0.103
ASA physical status	ASA I	31 (79.5)	25 (64.1)	0.131
	ASA II	8 (20.5)	14 (35.9)	
Mallampati grade	Grade I	25 (64.1)	25 (64.1)	1.000
	Grade II	14 (35.9)	14 (35.9)	
Type of surgery	ENT surgery	22 (56.4)	16 (41.0)	0.174
	General	17 (43.6)	23 (59.0)	
Baseline HR (beats/min)	Mean ± SD	77.23±10.32	76.51±7.64	0.728
Baseline SBP (mmHg)	Mean ± SD	120.05±13.07	121.79±12.86	0.555
Baseline DBP (mmHg)	Mean ± SD	77.74±8.27	74.87 ± 7.88	0.121
Baseline MAP (mmHg)	Mean ± SD	91.90±7.25	90.54 ± 6.36	0.382
Baseline SpO_2 (%)	Mean ± SD	98.87±0.72	98.90 ± 0.68	0.847

Data are presented as number (percentage) or mean ± SD.Percentages are column percentages. p values were rounded to three decimal places; values below 0.001 are shown as <0.001. HR, heart rate; SBP, systolic blood pressure; DBP, diastolic blood pressure; MAP, mean arterial pressure; SpO_2, oxygen saturation.

The individual Cooper score domains were slightly higher with succinylcholine, but jaw relaxation, vocal cord position and response to intubation did not differ significantly between the groups. The total Cooper score was significantly higher with succinylcholine than with rocuronium (8.26 ± 0.68 vs 7.82 ± 1.10; p=0.039). Excellent intubating conditions were observed in 34 (87.2%) patients receiving succinylcholine and 26 (66.7%) receiving rocuronium; this difference did not reach statistical significance (p=0.060). All remaining patients had good intubating conditions, and no fair or poor intubation was recorded (Figure 1; Table 2).

Figure 1. Distribution of intubating condition grades between study groups.



The TOF count at 90 seconds was significantly lower in the succinylcholine group than in the rocuronium group (0.18 ± 0.39 vs 0.51 ± 0.68; p=0.010), indicating a deeper block at the time of laryngoscopy. Despite this difference, clinically acceptable intubation was achieved in every patient in both groups.

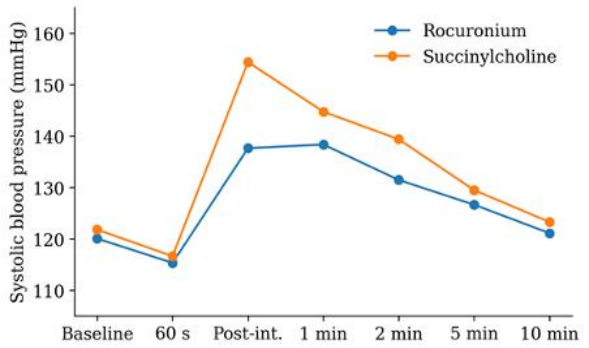
Table 2. Comparison of intubating conditions, haemodynamic response and complications between study groups

Outcome	Rocuronium 0.9 mg/kg (n=39)	Succinylcholine 2 mg/kg (n=39)	p value
Intubating conditions at 90 seconds			
Jaw relaxation score	2.59 ± 0.68	2.69 ± 0.47	0.439
Vocal cord position score	2.64 ± 0.54	2.82 ± 0.39	0.096
Response to intubation score	2.59 ± 0.50	2.74 ± 0.44	0.154
Total Cooper score	7.82 ± 1.10	8.26 ± 0.68	0.039
Excellent intubating condition	26 (66.7)	34 (87.2)	0.060
Good intubating condition	13 (33.3)	5 (12.8)	
TOF count at 90 seconds	0.51 ± 0.68	0.18 ± 0.39	0.010
Haemodynamic response			
HR, post-intubation (beats/min)	92.15 ± 12.49	102.87 ± 9.16	<0.001
HR, 1 min after intubation (beats/min)	89.90 ± 10.78	94.26 ± 8.42	0.050
SBP, post-intubation (mmHg)	137.64 ± 16.19	154.41 ± 15.37	<0.001
SBP, 2 min after intubation (mmHg)	131.46 ± 12.51	139.38 ± 14.60	0.012
DBP, post-intubation (mmHg)	87.44 ± 10.47	87.08 ± 9.72	0.883
MAP, post-intubation (mmHg)	104.08 ± 9.66	109.51 ± 7.65	0.007
Peri-operative complications			
Fasciculations	0 (0.0)	37 (94.9)	<0.001
Bradycardia	1 (2.6)	5 (12.8)	0.200
Hypotension	2 (5.1)	5 (12.8)	0.431
Bronchospasm	0 (0.0)	3 (7.7)	0.240
Postoperative myalgia	2 (5.1)	5 (12.8)	0.431

Data are presented as mean ± SD or number (percentage). Percentages are column percentages. p values were rounded to three decimal places; values below 0.001 are shown as <0.001. TOF, train-of-four; HR, heart rate; SBP, systolic blood pressure; DBP, diastolic blood pressure; MAP, mean arterial pressure.

Baseline haemodynamic variables were similar. After intubation, both groups showed the expected rise in haemodynamic parameters; however, the increase was greater with succinylcholine. Post-intubation heart rate (102.87 ± 9.16 vs 92.15 ± 12.49 beats/min; p<0.001), systolic blood pressure (154.41 ± 15.37 vs 137.64 ± 16.19 mmHg; p<0.001) and mean arterial pressure (109.51 ± 7.65 vs 104.08 ± 9.66 mmHg; p=0.007) were significantly higher with succinylcholine. Systolic pressure remained higher at 2 minutes (p=0.012), while diastolic pressure did not differ at any time point. Values approached baseline by 10 minutes in both groups (Figure 2).

Figure 2. Mean systolic blood pressure trend at different time-points between study groups.



Fasciculations were absent after rocuronium and occurred in 37 (94.9%) patients after succinylcholine (p<0.001). Bradycardia, hypotension and bronchospasm were more frequent in the succinylcholine group, but the differences were not statistically significant. Postoperative myalgia was reported by 2 (5.1%) patients in the rocuronium group and 5 (12.8%) in the succinylcholine group (p=0.431). No serious drug-related adverse event was recorded.

DISCUSSION

The main finding of this trial is that rocuronium 0.9 mg/kg produced clinically acceptable intubating conditions in all patients when intubation was performed at 90 seconds. Succinylcholine produced a higher mean Cooper score and a numerically higher rate of excellent intubation, but the grade distribution did not reach statistical significance. These results are consistent with dose-response observations by Magorian et al. and with the elective-surgery study by Chavan et al., in which rocuronium 0.9 mg/kg approached succinylcholine for intubating quality but retained a longer duration of action [5,6].

The findings also fit the broader evidence base. The Cochrane review found succinylcholine superior overall for excellent and acceptable rapid-sequence intubating conditions, although the difference narrows with higher rocuronium doses and optimized timing [7]. Marsch et al.

reported similar intubation conditions and first-attempt success in critically ill patients, but a shorter intubation sequence with succinylcholine [8]. The present elective setting differs from emergency airway trials; in the out-of-hospital trial by Guihard et al., rocuronium did not meet non-inferiority for first-attempt success [9]. Thus, rocuronium 0.9 mg/kg appears best interpreted as a strong elective alternative when a 90-second interval is acceptable, rather than as a universal substitute in every emergency airway scenario.

Haemodynamic responses favored rocuronium. The greater post-intubation tachycardia, systolic pressure rise and MAP rise after succinylcholine were transient but clinically relevant in patients for whom sympathetic stimulation may be undesirable. Czarnetzki et al. similarly observed that strategies designed to use rocuronium instead of succinylcholine can reduce adverse events without improving intubating conditions beyond succinylcholine [10]. In our cohort, the haemodynamic profile returned toward baseline in both groups, but the immediate response was smoother with rocuronium.

The adverse-effect pattern was mechanistically expected and clinically important. Fasciculations were almost universal with succinylcholine and absent with rocuronium. Myalgia was also more frequent after succinylcholine, although the difference was not significant in this small sample. The association between succinylcholine-induced fasciculation and postoperative myalgia has been repeatedly described, and pharmacological prevention reduces but does not eliminate the problem [11]. Rocuronium also has the practical advantage of being reversible with sugammadex when rapid reversal is required, although availability and cost may influence local practice [12]. Overall, the results support rocuronium 0.9 mg/kg as an effective and better tolerated choice for routine elective intubation when succinylcholine is contraindicated or best avoided.

LIMITATIONS

The study was single-centre and included a modest number of low-risk ASA I-II adults, which limits generalizability to emergency, paediatric, obstetric or critically ill populations. Intubation was assessed only at 90 seconds, so earlier onset differences were not evaluated. TOF response was assessed visually, and rare adverse events could not be reliably detected with this sample size.

CONCLUSION

Rocuronium bromide 0.9 mg/kg provided good-to-excellent intubating conditions in all adult elective surgical patients at 90 seconds. Although succinylcholine 2 mg/kg produced a higher total Cooper score and deeper TOF block, rocuronium offered smoother haemodynamic response and avoided fasciculations. Rocuronium is therefore a safe and effective alternative for elective tracheal intubation, particularly when succinylcholine is contraindicated or undesirable.

DECLARATIONS

Ethical approval: Institutional Ethics Committee approval was obtained before initiation of the study.
Conflict of interest: Nil.
Source of funding: Nil.
Acknowledgement: Nil.

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