

# **A Randomized Comparative Assessment of Intubating Conditions and Hemodynamic Effects after Administration of Rocuronium and Succinylcholine for Endotracheal Intubation in Adult Patients for Elective Surgeries**

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**Received: 25-11-2022 / Revised: 20-12-2022 / Accepted: 10-01-2023**

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**Conflict of interest: Nil**

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**Aim:** To compare rocuronium 0.9mg/kg and succinylcholine 2 mg/kg for tracheal intubation at 60 seconds after the administration of muscle relaxants in patients undergoing elective surgeries.

**Methodology:** A randomized controlled study conducted on Department of Anesthesia, Bhagwan Mahavir institute of Medical Sciences, Pawapuri, Nalanda, Bihar, India for one year. 50 adult patients American society of anesthesiologist grade I and II patients. All patients underwent pre-anesthetic evaluation and relevant investigations one day prior to surgery. All patients underwent pre-anesthetic evaluation prior to surgery and written informed consent was obtained. Oral Pantoprazole 40 mg, Alprazolam 0.25mg were given. Patients were randomly assigned to 2 equal groups R and S (n=25) according to computer generated list. Group S received Succinylcholine 2 mg/kg intravenous. Group R received Rocuronium 0.9 mg/kg intravenous. The pulse rate and blood pressure were recorded before and after induction, after injection of muscle relaxant and at 1-, 2-, 3- and 5-min following intubation.

**Results:** In the present study, based on intubating conditions in Rocuronium group, 16% showed score 7, 44% scored 8 and 40% scored 9. Whereas in Succinylcholine group, score 7 was noted in 16%, score 8 in 52% and score 9 in 32%. There was no statistically significant association observed with relation to intubating conditions between the study groups. A higher SBP was recorded in Succinylcholine group compared to Rocuronium group at Post induction, Post muscle relaxant use, 1 Min, 2 Min, and 5 min. At Post induction, Post muscle relaxant use, 1 min this difference was observed to be statistically significant. A higher DBP was recorded in Succinylcholine group compared to Rocuronium group at Post induction, Post muscle relaxant use, at post muscle relaxant use, this difference was observed to be statistically significant.

**Conclusion:** There was no significant change in hemodynamic variables after the administration of Succinylcholine and Rocuronium. There were significant changes in the heart rate and mean arterial pressure with the use of Rocuronium following one minute after the intubation which became preinduction value after 5 minutes. Hence, rocuronium bromide (0.8 mg/kg) can be used as an alternative to Succinylcholine (1.5 mg/kg) in selected situations.

**Keywords:** Rocuronium, Succinylcholine, Endotracheal Intubation.

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## Introduction

Rapid and safe endotracheal intubation is of paramount importance in the practice of general anaesthesia. The ease with which endotracheal intubation is performed depends upon the degree of muscle relaxation, depth of anaesthesia and skill of anaesthesiologist. Succinylcholine due to its rapid onset time and good intubating conditions is still the drug of choice for rapid endotracheal intubation. However it falls short of the ideal muscle relaxant due to its potentially hazardous side effects [1-4].

Introduction of succinylcholine has been the main neuromuscular blocking agent for the endotracheal intubation with special application in rapid sequence induction and difficult intubation [5]. The succinylcholine has ultrarapid onset and ultra-short duration of action [6]. For these qualities, the succinylcholine still occupies the first position in providing excellent conditions for endotracheal intubations in many conditions.

Rocuronium bromide (ORG 9426) is 2 morpholino 3-disacetyl 16 N-allyl pyrrolidino derivative of vecuronium. Rocuronium has the most rapid onset of action among the currently available nondepolarizing neuromuscular blocking agents [7]. The works carried out by other workers in the past have shown that rocuronium has the onset time comparable to succinylcholine [8,9] and it is free from side effects that are commonly seen with succinylcholine

Rocuronium is a newer non-depolarizing muscle relaxant that is used for rapid sequence induction (RSI) when succinylcholine is contraindicated. Rocuronium has an onset of action comparable to succinylcholine when used in doses > 0.9 mg/kg [10-13]. It has the

shortest onset time of all the non-depolarizing neuromuscular blocking agents currently available [14,15]. Rocuronium has little or no adverse cardiovascular effects, nor does it cause histamine release. For these reasons, it may be preferred over succinylcholine in compromised patients in whom hemodynamic or other changes are to be minimized. Doses of rocuronium usually used for RSI (1 mg/kg) allow rapid paralysis (30 to 60 s) but the duration of action is prolonged (upto 1 h), making it unsuitable in difficult airway scenarios in the unavailability of sugammadex.

Even if available, the benefit of having sugammadex reversing a large dose of rocuronium will come at a cost which will be substantial. For an average 75 kg patient reversal of profound blockade with 4 mg/kg sugammadex requires two 2 mL vials [16]. Also the foreseeable problem of a patient who has recently received sugammadex, who needs a surgery for re-exploration for instance has not been addressed [17]. Our study is designed to compare rocuronium 0.9mg/kg and succinylcholine 2 mg/kg for tracheal intubation at 60 seconds after the administration of muscle relaxants in patients undergoing elective surgeries.

## Materials and Methods

A randomized controlled study conducted on Department of Anesthesia, Bhagwan Mahavir institute of Medical Sciences, Pawapuri, Nalanda, Bihar, India for one year. 50 adult patients American society of anesthesiologist grade I and II patients. All patients underwent pre-anesthetic evaluation and relevant investigations one day prior to surgery. Written informed consent was obtained from all patients.

## Inclusion criteria

1. Age 30-50 years.
2. ASA grade I and II.
3. Malampatti classification 36 up to class 2.
4. Patients undergoing elective surgeries under general anesthesia.

#### Exclusion criteria

1. ASA grade III and IV.
2. Anticipated difficult airway.
3. Conditions like hyperkalemia, uncontrolled diabetic mellitus, hypertension, obesity, bronchial asthma, epilepsy.
4. Patients with neuro-muscular disease, history of cardiac, renal or hepatic disease.
5. History of allergy to the drugs being used.
6. Patients receiving medication known to influence neuromuscular function eg. aminoglycoside antibiotics.

#### Methodology

Following approval from the Institutional Ethics Committee of Patna Medical college and hospital, 50 patients aged 30-50yrs were selected for the study. All patients underwent pre-anesthetic evaluation prior to surgery and written informed consent was obtained. Oral Pantoprazole 40 mg, Alprazolam 0.25mg were given. Patients were randomly assigned to 2 equal groups R and S (n=25) according to computer generated list. The procedure was then double blinded maintaining randomization list. On the day of surgery after shifting the patient to preoperative room, intravenous line was secured with 18G cannula on nondominant hand and ringer lactate 10-15ml/kg was connected and premedicated with Inj. Glycopyrrolate 0.2mg intravenous. ECG leads, Pulse oximeter and NIBP were attached. Baseline pulse rate, systolic and diastolic blood pressure, mean arterial pressure and SpO<sub>2</sub> were recorded. Patients were preoxygenated for 3 minutes with

100% oxygen and Injection Fentanyl 2µg/kg was given 3 minutes before intubation. General anesthesia was induced with intravenous propofol 2mg/kg over 20 seconds. After loss of verbal response, mask ventilation was confirmed.

#### Patients randomly allocated to two groups

**Group S:** Received Succinylcholine 2 mg/kg intravenous.

**Group R:** Received Rocuronium 0.9 mg/kg intravenous.

The intubating anesthesiologist was blinded to the muscle relaxant given. Direct laryngoscopy was performed using a size 3 Macintosh Laryngoscope blade at 60 sec after injection of the muscle relaxant and Cormack Lehane grading was noted. Trachea was intubated with appropriate size, cuffed tracheal tube. Intubating conditions were assessed according to Cooper *et al* grading [18]. Tracheal intubation was not performed until the intubating conditions are excellent or good. Subsequent attempts were noted. The pulse rate and blood pressure were recorded before and after induction, after injection of muscle relaxant and at 1-, 2-, 3- and 5-min following intubation. Our study was concluded at this point. Intubating conditions assessed according to four point scale of Cooper *et al* [19].

#### Results

In the present study, based on intubating conditions in Rocuronium group, 16% showed score 7, 44% scored 8 and 40% scored 9. Whereas in Succinylcholine group, score 7 was noted in 16%, score 8 in 52% and score 9 in 32%. There was no statistically significant association observed with relation to intubating conditions between the study groups as the p value calculated to be > 0.05.

**Table 1: Intubating conditions**

Cooper <i>et al</i> score	Rocuronium		Succinylcholine		Total	
	N	%	N	%	N	%
7	4	16%	4	16%	5	20%
8	11	44%	13	52%	12	48%
9	10	40%	8	32%	8	32%
10	30	100%	30	100%	60	100%

**Table 2: Heart rate**

	Rocuronium	Succinylcholine	P value
	(Mean± SD)	(Mean± SD)	
Pre induction	77.24 ± 12.38	77.23 ± 12.36	0.49
Post induction	74.72 ± 10.37	77.83 ± 10.92	0.39
Post muscle relaxant	73.72 ± 10.28	78.37 ± 10.28	0.31
0 min	75.16 ± 11.11	80.02 ± 10.92	0.32
1 min	74.72 ± 9.23	80.34 ± 9.28	0.13
2 min	75.98 ± 10.32	79.98 ± 8.92	0.03
5 min	74.72 ± 10.18	78.93 ± 9.37	0.31

A higher Heart rate was recorded in Succinylcholine group compared to Rocuronium group at Post induction, Post muscle relaxant use, at 0 minute, 1 minute, 2 minute, and 5 minutes. At Post induction, 0 min, 1 min, 2 min this difference was observed to be statistically significant as the p value calculated was < 0.05.

A higher SBP was recorded in Succinylcholine group compared to Rocuronium group at Post induction, Post muscle relaxant use, 1 Min, 2 Min, and 5

min. At Post induction, Post muscle relaxant use, 1 min this difference was observed to be statistically significant as the p value calculated to be < 0.05. A higher DBP was recorded in Succinylcholine group compared to Rocuronium group at Post induction, Post muscle relaxant use, at post muscle relaxant use, this difference was observed to be statistically significant as the p value was < 0.05.

**Table 3: Systolic Blood Pressure**

	Rocuronium	Succinylcholine	P value
	(Mean± SD)	(Mean± SD)	
Pre induction	120.45 ± 7.37	121.47 ± 7.37	0.20
Post induction	120.27 ± 6.48	123.47 ± 6.23	0.06
Post muscle relaxant	117.25 ± 6.28	126.45 ± 6.38	0.001
0 min	124.28 ± 7.28	125.28 ± 5.63	0.02
1 min	125.38 ± 6.92	127.74 ± 4.37	0.001
2 min	123.38 ± 6.23	126.38 ± 5.37	0.04
5 min	121.82 ± 6.45	126.36 ± 4.38	0.42

**Table 4: Diastolic Blood Pressure**

	Rocuronium	Succinylcholine	P value
	(Mean± SD)	(Mean± SD)	
Pre induction	66.34 ± 8.54	65.53 ± 8.58	0.08
Post induction	66.45 ± 8.84	67.47 ± 8.58	.023
Post muscle relaxant	64.83 ± 8.66	67.97 ± 8.37	0.02
0 min	70.37 ± 8.06	68.76 ± 8.59	0.03

1 min	70.37 ± 7.42	68.15 ± 7.56	0.22
2 min	68.93 ± 7.26	70.43 ± 7.47	0.48
5 min	67.27 ± 8.17	67.35 ± 8.38	0.08

In the present study, a higher MAP was recorded in Succinylcholine group compared to Rocuronium group at Post induction, Post muscle relaxant use, 1 minute, 2 minute, and 5 minutes. At post

muscle relaxant use, this difference was observed to be statistically significant at 1 minute as the p value calculated to be < 0.05 and showed back to baseline after 5 minutes.

**Table 5: Mean Arterial Pressure**

	<b>Rocuronium</b> (Mean± SD)	<b>Succinylcholine</b> (Mean± SD)	<b>P value</b>
Pre induction	83.56 ± 7.37	82.37 ± 7.49	0.07
Post induction	83.37 ± 6.98	84.39 ± 6.49	.0.23
Post muscle relaxant	82.36 ± 6.67	87.47 ± 6.98	0.08
0 min	88.48 ± 6.48	87.48 ± 6.03	0.09
1 min	87.48 ± 6.38	87.20 ± 6.02	0.001
2 min	86.39 ± 6.38	88.29 ± 6.49	0.44
5 min	85.38 ± 7.29	86.40 ± 7.29	0.24

## Discussion

In theory, use of low doses of neuromuscular blocking agents shortens the time for recovery from neuromuscular block and reduces the requirement for anticholinesterase drugs. The ED95 dose of rocuronium is 0.3 mg/kg [20]. But low doses may also compromise the intubating condition. The aim of the study was to compare intubating conditions, onset of neuromuscular blockade and its clinical duration following two doses of rocuronium (0.3 or 0.6 mg/kg) or succinylcholine (1.0 mg/kg) administered in adult patients undergoing elective surgery requiring endotracheal intubation at 60 s and 90 s following administration of rocuronium 0.3 and 0.6 mg/kg and at 60 s following administration of succinylcholine 1.0 mg/kg. Duration of action, hemodynamic response and incidence of postoperative sore throat were also noted.

In the present study, clinical criteria as adopted by Cooper R. A. et al. [19] were used for scaling intubating conditions at 60 seconds. In our study we got excellent intubation conditions with succinylcholine

in 83.3% of patients which concurs with the findings of the studies conducted by Toni Magorian et al. [21] and Shaik Mira Shareef [22]. In our study, we observed no significant change in hemodynamic variables following the administration of rocuronium bromide 5 minutes after induction. There was a change in mean heart rate by 1.9% following administration of rocuronium bromide 0.9 mg/ kg body weight, one minute following intubation. There was a similar increase in mean arterial pressure by 4.38% following the administration of 0.9 mg/ kg body weight one minute following intubation. This was a hemodynamic response to laryngoscopy and endotracheal intubation which subsided to near pre induction values 5 minutes after intubation. Similar trends were seen following the administration of succinylcholine chloride 2 mg / kg body weight.

There was a rise in mean heart rate by 5.2% from pre induction value two minutes after intubation. There was also a rise in mean arterial pressure by 5.66% from pre induction value one minute after intubation. These values returned towards pre induction values 5 minutes following

intubation. There was no significant change in the hemodynamic variables following administration of succinylcholine chloride and rocuronium bromide after 5 minutes of post induction and rise in mean heart rate and blood pressure which returned to the baseline value after 5 minutes was a response to laryngoscopy and intubation.

Eikermann *et al.*'s study on 120 children aged between 2–7 years to define the optimal rocuronium dose that provides a 95% probability of acceptable intubating conditions during inhalational induction with sevoflurane [23] after administering rocuronium in doses 0.1, 0.15, 0.22, 0.3, or 0.6 mg/kg or placebo concluded that during inhalation induction with 8% sevoflurane in 60% nitrous oxide and 40% oxygen, rocuronium 0.29 mg/kg (ED<sub>95</sub>) optimizes intubating conditions for surgery of short duration.

De Miranda *et al.* in their comparative study between one and two effective doses (ED<sub>95</sub>) of Rocuronium for tracheal intubation in adult patients concluded that both doses of Rocuronium, 0.3 mg/kg and 0.6 mg/kg provided clinically satisfactory parameters of tracheal intubation in elective procedures[20] that was again absolutely different to that of our study. Thus, even though previous studies done by different authors concluded that Rocuronium 0.3 mg/kg can be used to provide clinically acceptable intubating conditions, our findings were completely different from those studies. The strikingly different findings could be because of the different induction agents and opioids used in the previous studies, which may lead us to conclude that the same Rocuronium 0.3 mg/kg can give different intubating conditions, depending on the induction methods.

Lam A compared intubating conditions, and the onset and offset times of Rocuronium bromide and succinylcholine [24]. He concluded that Rocuronium at a dose of 0.6 mg/kg (when used with

propofol and fentanyl for induction) provides intubating conditions comparable to succinylcholine 1.0 mg/kg at 60 s, which was a similar finding as that of our study. The actual onset and offset times, however, were significantly longer with rocuronium. The author concluded that Rocuronium is suitable for surgical procedures greater than 30 min eliminating the need for an additional relaxant to succinylcholine. [25]

### Conclusion

There was no significant change in hemodynamic variables after the administration of Succinylcholine and Rocuronium. There were significant changes in the heart rate and mean arterial pressure with the use of Rocuronium following one minute after the intubation which became preinduction value after 5 minutes. Hence, rocuronium bromide (0.8 mg/kg) can be used as an alternative to Succinylcholine (1.5 mg/kg) in selected situations.

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