

# Comparative Study of Rocuronium Bromide and Succinylcholine Chloride for Endotracheal Intubation During General Anesthesia

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## ABSTRACT

**Introduction:** Rocuronium has a rapid onset of neuromuscular blockade like succinylcholine without the latter's adverse effects and can substitute succinylcholine. Aim is to compare intubating conditions and haemodynamic effects of rocuronium bromide and succinylcholine chloride.

**Material and Method:** It was a prospective, randomized, double blind study. Methods: Sixty patients were divided into two groups. Group I (n = 30) was intubated with rocuronium bromide 1.2 mg kg<sup>-1</sup> and Group II (n = 30) received succinylcholine chloride 1.5 mg kg<sup>-1</sup>. The intubating condition was graded using score adopted by Cooper et al. Statistical tests used were analysis of variance (ANOVA), Chi-Square test.

**Results:** In Group I the mean onset time was 76.09 seconds and in Group II the mean onset time was 56.13 seconds. In group I, 28 patients out of 30 had excellent intubating conditions with 2 patients having good intubating conditions. In group II patients, 27 patients had excellent intubating conditions with 3 patients having good intubating conditions. The mean duration of action in group I was 66.79 minutes and group II was 5.83 minutes.

**Conclusion:** Our study showed that intubating conditions and onset time of rocuronium 1.2 mg/kg were comparable to those with succinylcholine 1.5 mg/kg. Rocuronium may be a suitable alternative for succinylcholine during rapid sequence induction of anesthesia.

**Key words:** Intubating conditions, onset time, rocuronium, succinylcholine

## INTRODUCTION

Suxamethonium has always been a drug of choice to facilitate endotracheal intubation due to its distinct advantages.<sup>1-5</sup> However the drug has deleterious side effects which evoked a quest to search an ideal muscle relaxant. Rocuronium (org 9426), a new nondepolarising aminosteroidal muscle relaxant is chemically 2-morpholino, 3-desacetyl, 16-N-allylpyrrolidino derivative of vecuronium, differing from it at 3 positions on steroid nucleus. It has the onset time comparable to succinylcholine<sup>6,10</sup> and offers good to excellent intubation conditions, as rapidly as suxamethonium. It is devoid of side effects that are commonly seen with succinylcholine. By virtue of this property it can be safely used for rapid sequence induction whenever suxamethonium is contraindicated. The present study was undertaken to evaluate whether the nondepolarising muscle relaxant rocuronium bromide can be a substitute for succinylcholine chloride for endotracheal intubation.

Aim of the study was to study intubating conditions and haemodynamic effects after administration of Rocuronium bromide and succinylcholine chloride.

Objectives of the research were to compare the intubating

conditions of rocuronium bromide and succinylcholine chloride at 60 seconds, to study the onset time of rocuronium bromide and succinylcholine chloride and to study the haemodynamic effects during laryngoscopy and intubation, using the above drugs and comparing them.

## MATERIALS AND METHODS

After obtaining institutional and Ethical committee clearance, sixty adult patients of ASA grade I and II of either sex in the age group of 18-50 years requiring intubation for various surgeries were selected and were randomly divided into two groups

Group I received 1.2mg/kg of rocuronium bromide intravenously to facilitate endotracheal intubation.

Group II received 1.5 mg/kg of succinylcholine intravenously to facilitate endotracheal intubation.

**Inclusion criteria:** ASA Grade 1 and 2 patients of both the sexes posted for various elective surgeries under general anaesthesia in age group of 18-50 yrs with mallampati Grade 1 and 2

**Exclusion criteria:** Airway abnormalities and past history of difficult intubation, Pregnancy, Obesity and Neuromuscular disorders, Cardiac, Hepatic and Renal disease, Medication with drugs that interact with neuromuscular transmission viz Aminoglycosides, Calcium channel blockers, History of drug allergy, Mallampati grading III and above, Patients without consent, Emergency surgeries.

A thorough pre anaesthetic evaluation was done a day before surgery and all the necessary investigations were done. Tab Alprazolam 5 µg/kg and Tab Ranitidine 150 mg was given to all patients on the night before the surgery. Patients were maintained nil by mouth for about 8 hrs prior to the surgery. On the day of surgery, in pre operative room, an 18 G iv cannula was inserted. Baseline heart rate(HR), systolic blood pressure (BP), diastolic BP, mean arterial pressure, SpO<sub>2</sub> was measured. On shifting to operation room, multiparameter monitor was connected which included noninvasive blood pressure (NIBP), pulseoximeter and electrocardiogram

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Score	Jaw relaxation (laryngoscopy)	Vocal cords	Response to intubation
0	Poor	Closed	Severe coughing or bucking
1	Minimal (difficult)	Closing	Mild coughing
2	Moderate (fair)	Moving	Slight diaphragmatic movement
3	Good (easy)	Open	none
Total score of 8-9 =Excellent 6-7= Good 3-5=Fair 0-2=Poor			
<b>Table-1: Cooper intubation scale</b>			

Onset time (seconds)	Group I (n = 30)	Group II (n = 30)
41-50	0	2
51-60	1	26
61-70	12	2
71-80	5	0
81-90	12	0
Mean $\pm$ SD	76.09 $\pm$ 9.15	56.13 $\pm$ 3.76
Range	60-89	48-62
p<0.0001, a significant difference was present		
<b>Table-2: Comparison of onset time</b>		

	Group I (n =30)	%	Group II (n = 30)	%
Excellent	28	94%	27	90%
Good	2	6%	3	10%
Fair	-	-	-	-
Poor	-	-	-	-
<b>Table-3: Comparison of intubating conditions of two groups</b>				

(ECG). Neuromuscular monitoring was done with neuromuscular monitor. Neuromuscular electrodes were placed along the ulnar aspect of the distal forearm. IV fentanyl 1 $\mu$ g/kg and midazolam 0.05 mg/kg iv was given to all patient 5 minutes prior to the administration of induction agent. All the patients were preoxygenated with 100% oxygen for three minutes and were induced with iv thiopentone 5mg/kg. After induction height of single twitch response to supramaximal stimulus was determined with neuromuscular monitor.

In Group I iv rocuronium 1.2 mg/kg.

In Group II iv succinylcholine 1.5 mg/kg.

Neuromuscular monitoring was done immediately after the injection of neuromuscular blocking drug. Nerve stimulator delivered supramaximal single twitch stimulus after every 6 second. Intubation was attempted at 60 seconds and the intubating condition was graded using score adopted by Cooper et al (1992). The time interval from injection of the neuromuscular blocking drug to the caesation of visible motor response of adductor pollices to single twitch nerve stimulation of ulnar nerve was recorded.

Intubation score based on the scale adopted by Cooper et al (1992 as shown in Table 1.

Haemodynamic parameters ie.pulse rate,systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), continuous ECG and SPO<sub>2</sub> was recorded after giving premedication, before intubation,immediately after intubation and every 2 mins for 15 mins and every 15 mins upto the surgery is completed. The patients were

ventilated with 100% oxygen with intermittent positive pressure ventilation on mask. Patient was intubated with proper sized endotracheal tube and anesthesia was proceeded with O<sub>2</sub>, N<sub>2</sub>O, isoflurane 0.5% and further doses of muscle relaxant. After completion of surgery, reversal of neuromuscular blockade was done with iv neostigmine 0.05 mg kg<sup>-1</sup> and iv glycopyrrolate 0.01 mg/kg. After satisfactory recovery, patients were extubated. Post operatively all vital data i.e. pulse rate, blood pressure, respiratory rate was monitored, and patient was observed for nausea, vomiting, bradycardia, tachycardia, hypotension, respiratory obstruction. The haemodynamic parameters in the present study were compared statistically using p value obtained from student t-test.

## RESULT

The gender wise and weight wise distribution of patients in both groups were comparable.

### Comparison of onset time

The age distribution of the patients in Group I: the mean age was 34.87 years. and in Group II was 33.50 years.

Onset time of the drug was taken as a time interval from administration of the neuromuscular blocking drug to the cessation of visible motor response of adductor pollicis muscle to single twitch nerve stimulation of ulnar nerve. The results were as depicted in Table 2. In Group I the mean onset time was 76.09 $\pm$ 9.15 seconds and in Group II the mean onset time was 56.13 $\pm$ 3.76 seconds. p<0.0001, a significant difference was present.

### Intubating conditions

The Table 3 shows the intubating conditions in both the groups based on score adopted by Cooper et al (1992). Group I patients who received rocuronium 1.2 mg/kg body weight, 28 patients out of 30 had excellent intubating conditions with 2 patients having good intubating conditions. In group II patients, who received succinylcholine 1.5 mg/kg body weight, 27 patients had excellent intubating conditions with 3 patients having good intubating conditions

### Clinical duration of action of two groups

Clinical duration of action was taken as the time between the administration of neuromuscular blocking drug and first attempt at respiration. As shown in the Table 4, the clinical duration of action of rocuronium (1.2mg/kg body wt) ranged from 60 to 75 minutes with mean duration of 66.79 $\pm$  3.38 minutes. The clinical duration of action of succinylcholine (1-5mg/kg body wt) ranged from 4 to 8 minutes with mean duration of 5.83 $\pm$  1.06 minutes. p<0.0001 very highly significant difference was observed.

## DISCUSSION

Rapid and safe endotracheal intubation is of paramount importance in practice of general anaesthesia. Securing patients airway smoothly and quickly, minimises the chances of re-gurgitation and aspiration of gastric contents. The ease with which endotracheal intubation is performed depends upon the degree of muscle relaxation and depth of anaesthesia. Succinylcholine chloride introduced in 1951 was unparalleled in terms of its onset and duration of action. The type of relaxation obtained with this drug was so good that even today it is used as a gold standard and other drugs are compared with it. But with time the adverse effects of Succinylcholine chloride, like bradycardia, nodal and junctional rhythms, rise in intraocular, intracranial pressure were observed and development of Phase 2 block after large dose or continuous infusion, also duration of succinylcholine was prolonged in patients with pseudocholinesterase deficiency. Rocuronium is the first nondepolarizing muscle relaxant having an onset time as short as that of succinylcholine without adverse side effects. The speed of onset is inversely proportional to the potency of nondepolarizing neuromuscular blockers. Rocuronium has a molar potency of ED<sub>95</sub> 0.54 μM/kg, that is about 13% that of the vecuronium and only 9% of cisatracurium. Intubating dose; The dose of relaxant needed for endotracheal intubation is usually employed in multiples of ED<sub>95</sub> dose. The ED<sub>95</sub> of Rocuronium is 0.3 mg/kg body weight. In the present study the dose used is four times the ED<sub>95</sub> i.e. 1.2 mg/kg body weight. It has been shown to provide good to excellent intubating condition at 60 sec by Kusuma Parikh.<sup>11</sup> (2014) The goal of general anaesthesia is securing airway non traumatically at the earliest i.e. within 60 sec. The time for intubation can be determined either by neuromuscular monitoring or by clinical methods. In this study we chose to measure both single twitch response and intubation score to combine reproducible quantitative criteria with qualitative clinical criteria as employed in studies by Aparna Shukla<sup>12</sup> et al. In the present study a clinical criterion were used for scaling intubating condition at 60 sec and along with onset time defined as cessation of visual response of adductor pollices muscle to single twitch nerve stimulus of 1 Hz was also recorded.

Comparison of the intubating conditions with succinylcholine chloride 1.5 mg kg<sup>-1</sup> at 60 seconds with other study are shown in Table 5. It was noted that with succinylcholine 1.5 mg/kg body weight, Aparna Shukla<sup>12</sup> et al have obtained excellent intubating condition in 95%. In the present study succinylcholine 1.5 mg/kg body weight produced excellent intubating conditions in 94% (n=30) of cases which is comparable with that of Aparna Shukla<sup>12</sup> et al (2004).

Comparison of onset time with rocuronium bromide and succinylcholine in various authors and present study is shown in Table 6 With rocuronium bromide 1.2mg/kg body wt, Aparna Shukla<sup>12</sup> et al (2004) noted onset time of 80±5sec, Kusuma Parikh<sup>11</sup> et al (2014) noted onset time of 76 ± 10sec. In our study, the minimum onset time was 60 sec and maximum onset time was 89 sec and mean onset time was 76±9 seconds which is consistent with the studies of Aparna Shukla<sup>12</sup> et al and Kusuma Parikh<sup>11</sup> et al. The onset time with succinylcholine 1.5mg/kg body wt in present study was 56±3.7sec

which was comparable with the studies of Aparna Shukla<sup>12</sup> et al 46 ± 5sec and Kusuma Parikh<sup>11</sup> et al 46 ± 5sec. Thus we can conclude that the onset time of rocuronium (1.2mg/kg body weight) is shorter than that of other nondepolarizing muscle relaxant and is comparable to that of succinylcholine (1.5mg/kg body weight). The various authors who have studied rocuronium bromide and succinylcholine chloride have utilized the recovery of twitch height to 25% of baseline as the clinical duration of action. However in the present study the time between the administration of neuromuscular blocking drug and first attempt at respiration was taken as the clinical duration of action.

Duration of action of rocuronium bromide in various authors and present study is shown in Table 7 With rocuronium bromide 1.2 mg /kg body weight, Toni Magorian<sup>13</sup> et al. (1993) noted a clinical duration of action of 73 ± 32 minutes and C. Wright<sup>14</sup> et al. (1994) noted clinical duration of 67 ± 25 minute. In the present study, the minimum duration of action for rocuronium bromide 1.2 mg/ kg was 60 minutes, maximum duration was 75 minutes with a mean of 66.79 ± 3.38 minutes which was consistent with studies of Toni Magorian<sup>13</sup> et al. (1993) and C. Wright et al.<sup>14</sup> (1994).

Duration of action of succinylcholine chloride in various authors and present study is shown in Table 8, The clinical duration of action of succinylcholine chloride 1.5 mg/kg body weight in the present study was found to range between a minimum of 4 minutes to a maximum of 8 minutes with a mean duration of action of 5.83 ± 1.06 minutes which was consistent with studies of J Aleksandra<sup>15</sup> et al 1998 (5.8 ± 3.3).

Duration (minutes)	Group I (n = 30)	Group II (n = 30)
Mean ± SD	66.79 ± 3.38	5.83 ± 1.06
Range	60-75	4-8
p<0.0001 very highly significant difference.		

**Table-4:** Comparison of clinical duration of action

Authors	Excellent	Good	Fair	Poor
Aparna Shukla et al(2004) (n=20)	19(95%)	1(5%)	–	–
Present study (n= 30)	28 (94%)	2(6%)	–	–

**Table-5:** Comparison of the intubating conditions with succinylcholine chloride at 60 seconds

Authors	Onset time (secs)	Onset time (secs)
	Group I	Group II
Aparna Shukla et al (2004)	80 ± 5	46 ± 4
Kusuma Parikh et al (2014)	76 ± 10	46 ± 5
Present study (N=30)	76±9	56±3.7

**Table-6:** Comparison of onset time with rocuronium bromide and succinylcholine

Authors	Duration of action (minutes)
	Group I
Tony Magorian et al (1993)	73 ± 32
C. Wright et al(1994)	67 ± 25
Present study (n=30)	66.79 ± 3.38

**Table-7:** Duration of action of rocuronium bromide in various authors and present study

Authors	Duration of action (minutes) Group II
J Aleksandra et al (1998)	5.8 ± 3.3
Present study (n=30)	5.83 ± 1.06

**Table-8:** Duration of action of succinylcholine chloride in various authors and present study

Authors	Excellent	Good	Fair	Poor
Aleksandra J et al. 1998 (n=13)	7 (54%)	5 (40%)	1 (6%)	–
Present study (n = 30)	27 (90%)	3(10%)	–	–

**Table-9:** Comparison of the intubating conditions with rocuronium bromide at 60 seconds

Comparison of intubating conditions with rocuronium bromide 1.2 mg kg<sup>-1</sup> body weight with other study is shown in Table 9. In our study, we found that intubating conditions were considered excellent or good in most patients in both groups. The reason for a good, rather than an excellent, score was usually vocal cord movement. Thus we can conclude that intubating conditions with rocuronium 1.2mg/kg are comparable with that of succinylcholine 1.5mg/kg at 60 seconds. The various authors have taken the onset time as time between administration of neuromuscular blocking drug and maximum twitch depression. In present study time interval from administration of neuromuscular blocking drug to cessation of visible motor response of adductor pollicis to single twitch ulnar nerve stimulation of 1 Hz was taken.

## CONCLUSION

Rocuronium bromide is a safe alternative to succinylcholine chloride for rapid sequence induction in adult patients in situations where succinylcholine is contraindicated and in whom there is no anticipated difficult airway. Rocuronium bromide 1.2 mg kg<sup>-1</sup> body weight produces good to excellent intubating conditions in all the patients at 60 seconds with mean onset time of 76.09±9.15 seconds as compared with iv succinylcholine (1.5 mg kg<sup>-1</sup>) 56.13±3.76 seconds. The prolonged clinical duration of action with rocuronium 1.2mg/kg body weight (66 minutes) may be a disadvantage but this can be overcome with the advent of sugammadex in near future.

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