Print ISSN: 2321-6379
Online ISSN: 2321-595X
DOI: 10.17354/ijss/2016/534

Original Article

Comparative Study of Two Different Doses of Rocuronium Bromide with Suxamethonium Chloride for Endotracheal Intubation

Anisha Pauline Paul[1], Chitturi Suriya Prakash[2], Natesan Krishnasamy Sekaran[3], Subbulakshmi Sundaram[4]

[1]Post Graduate, Department of Anaesthesiology, Rajah Muthiah Medical College and Hospital, Annamalai University, Chidambaram, Tamil Nadu, India, [2]Professor, Department of Anaesthesiology, Rajah Muthiah Medical College and Hospital, Annamalai University, Chidambaram, Tamil Nadu, India, [3]Professor and Head, Department of Anaesthesiology, Rajah Muthiah Medical College and Hospital, Annamalai University, Chidambaram, Tamil Nadu, India, [4]Lecturer, Department of Anaesthesiology, Rajah Muthiah Medical College and Hospital, Annamalai University, Chidambaram, Tamil Nadu, India

Abstract

Introduction: Suxamethonium chloride was a time-tested depolarizing muscle relaxant with quick onset of action and produced excellent intubating conditions but it is contraindicated and hazardous in certain situations. Rocuronium bromide had the most rapid onset, intermediate duration of action, minimal cardiovascular side effects, and no histamine release emerged as a good alternative.

Purpose of the Study: To evaluate the efficacy of two different doses of rocuronium bromide in comparison to suxamethonium chloride on the intubating conditions, with emphasis on the duration of action, hemodynamic changes after intubation, and occurrence of any untoward side effects with either drug.

Methods: This was a randomized clinical study conducted at a tertiary care center. 90 patients posted for elective surgeries were divided into groups of 30 each. Depending on the dose of the muscle relaxant Group S received succinylcholine 1.5 mg/kg, Group R6 and R8 received rocuronium bromide 0.6 mg/kg and 0.8 mg/kg, respectively. Laryngoscopy and intubation were done with an appropriate size oral endotracheal tube at 60 s. Relaxation of jaw, vocal cords, and response to intubation were assessed at 60 s and scored using a standard intubation scoring system after injection of the study drug. Results were tabulated and analyzed using mean, standard deviation, and Chi-square test.

Results: We observed excellent intubating conditions in 100% of Group S, 86.66% and 93.33% in Group R6 and R8, respectively. The duration of action of rocuronium 0.6 mg/kg was shorter than 0.8 mg/kg. Thus, increasing the dose led to a longer duration of action. Hemodynamic changes returned to preinduction baseline values by the end of 10 min in all three groups.

Conclusion: Rocuronium at both doses of 0.6 mg/kg and 0.8 mg/kg produced clinically acceptable intubating conditions and can be used as a safer alternative to succinylcholine in situations where it is contraindicated.

Key words: Endotracheal intubation, Intubating conditions, Intubation scoring system, Rocuronium bromide, Suxamethonium chloride

INTRODUCTION

The introduction of muscle relaxant (d-tubocurarine) into clinical practice in 1942 by Griffith HR and Johnson GE) has refined and improved the anesthetic practice and was an important milestone in the history of anesthesia.[1] Before the introduction of muscle relaxants, inhalational agents had to be used for endotracheal (ET) intubation which was associated with inadequate depth of anesthesia. Further to achieve adequate intubating conditions, higher concentrations were needed to be used and were associated with hemodynamic disturbances.[2]

Succinylcholine (also known as suxamethonium chloride – introduced by Thesleff and Foldes in 1952) with its ultrarapid onset and short duration of action has been

Access this article online

www.ijss-sn.com

Month of Submission : 08-2016
Month of Peer Review : 08-2016
Month of Acceptance : 09-2016
Month of Publishing : 10-2016

Corresponding Author: Dr. Anisha Pauline Paul, Ashirvadh, 24 A, 2nd Street, Kamaraj Avenue, Adyar, Chennai - 600 020, Tamil Nadu, India. Phone: +91-9994247287. E-mail: dr.anishapauline@gmail.com

the drug of choice to obtain excellent intubating conditions in less than 60 s for both elective and emergency surgeries. However, the undesired side effects of succinylcholine led to a search for ideal neuromuscular blocking agent among the nondepolarizing type. Rocuronium bromide introduced into clinical practice by Dr. Sleigh and late Dr. Savage in 1990, was the first drug to challenge the onset time of succinylcholine facilitating rapid and safe ET intubation devoid of its side effects.

In this context, the present study was undertaken to compare the intubating conditions of rocuronium bromide with that of succinylcholine along with the clinical duration of action, the hemodynamic changes, and the occurrence of any untoward side effects with either drug.

METHODS

This was a randomized clinical study conducted in the Department of Anesthesiology in the operating rooms of Rajah Muthiah Medical College and Hospital, Chidambaram, during 2014-2016. After getting approval from the Institutional Ethical Committee, the study was conducted on a total of 90 adult patients of either sex, aged between 18 and 60 years, belonging to either ASA Class I or II, posted for elective surgery. Patients were excluded from this study when they refused or if they were on medication that might interact with the study drugs. Those with potential airway problems and suspected difficult intubations were also excluded. Furthermore, those with hyperkalemia, neuromuscular, renal, hepatic, and allergic disorders were excluded. A detailed preanesthetic checkup was done for all patients, and informed consent was taken and procedure of the study was explained to them.

Patients were randomly assigned to any one of the following three groups with 30 patients in each group. Group S patients received intravenous (IV) succinylcholine 1.5 mg/kg, Group R6 and Group R8 patients received IV rocuronium 0.6 mg/kg and 0.8 mg/kg, respectively.

In the operation theater, an IV line was secured with appropriate size IV cannula and IV fluid connected. Monitors including noninvasive blood pressure (BP), electrocardiogram, pulse oximeter, and end-tidal carbon dioxide were connected, and pre-operative data such as baseline heart rate, oxygen saturation, and systolic and diastolic BPs were recorded. Patients were premedicated with injection glycopyrrolate 0.2 mg IV, injection ranitidine 50 mg IV, injection midazolam 0.05 mg/kg IV, and injection fentanyl 1.5 μg/kg IV 5-10 min before surgery.

All patients were preoxygenated with 100% oxygen for 3 min through Bain's circuit followed by standard anesthetic induction with injection thiopentone sodium 5 mg/kg body weight till there was loss of eyelash reflex. The IV line was flushed with running IV fluid, and a bolus dose of the study drug was given. Atraumatic laryngoscopy was done with Macintosh blade, and intubation with oral cuffed ET tube of appropriate size was done at 60 s. The anesthetist who performed laryngoscopy and intubation was blinded by covering the patient with a drape sheet while another anesthetist loaded the muscle relaxant and administered it. The time taken for laryngoscopy was kept within 15 s relaxation of jaw, vocal cords, and response to intubation was assessed and scored by the grading criteria given by Cooper *et al.* 1992[3] (Table 1).

Vital parameters were recorded and monitored immediately after the study drug administration, immediately after intubation, and at 3, 5, 10, and 30 min intervals. If laryngoscopy and intubation failed at 60 s, it was repeated at 90 s and intubating conditions were assessed again. Any side effects such as electrocardiography (ECG) changes, muscle fasciculations, or any untoward effects due to histamine release such as skin flushing and erythema were also recorded if they occurred.

Bilateral air entry was confirmed and ET tube was firmly secured. After connecting the ET tube to Bain's circuit, controlled ventilation was started. Anesthesia was maintained with 33% oxygen, 66% nitrous oxide and sevoflurane. The clinical duration of action of initial bolus doses (from the time of administration of the study drug to the first respiratory attempt) was noted, and subsequently, all groups were maintained with injection vecuronium bromide 0.04 mg/kg till the end of the surgery.

At the end of the surgery, all patients were reversed with after adequate reversal with injection neostigmine 0.05 mg/kg IV and injection glycopyrrolate 0.01 mg/kg IV and were extubated after ascertaining the adequacy of reversal of neuromuscular blockade.

Table 1: Cooper *et al.* Scale (1992)

Score	Jaw relaxation	Vocal cords	Response to intubation
0	Poor (impossible)	Closed	Severe coughing bucking
1	Minimal (difficult)	Closing	Mild coughing
2	Moderate (fair)	Moving	Slight diaphragmatic movement
3	Good (easy)	Open	None
Total score	Excellent 8-9, Good 6-7, Fair 3-5, Poor 0-2		

RESULTS

The results were analyzed using SPSS software version 16 and Epi Info 6th version was used for trend analysis. The mean and standard deviation were calculated and used for calculating the significance of the difference. Qualitative data were analyzed using Chi-square test. $P > 0.05$, $P < 0.05$, and $P < 0.001$ were considered statistically nonsignificant, significant, and highly significant, respectively.

All the three groups did not differ with respect to age weight or gender distribution and were comparable with each other (Table 2). In Group S, all the 30 patients who received had excellent intubating conditions. In Group R6, 26 (86.66%) patients out of 30 had excellent intubating conditions with 4 (13.33%) patients showing good intubating conditions. In Group R8, 28 (93.33%) patients out of 30 had excellent intubating conditions with 2 (6.67%) patients showing good intubating conditions. None of the patients in all three groups had fair or poor intubating conditions. There were no cases of failed intubation at 60 s in any of the groups. Thus, the intubating conditions were comparable and statistically nonsignificant ($P = 0.389$) (Table 3 and Figure 1).

The jaw relaxation in Group S was good compared with Groups R6 and R8 and was statistically significant ($P = 0.0526$) (Table 4). There was no significant difference in the state of vocal cords at intubation between S, R6, and R8 groups ($P = 0.338$) (Table 5). Diaphragmatic movements were seen more in number in Group R6 (33.3%) and were statistically highly significant ($P = 0.0016$) (Table 6).

The duration of action of rocuronium 0.6 mg/kg was shorter than rocuronium 0.8 mg/kg. Thus, increasing the dose led to a longer duration of action. Succinylcholine had the shortest duration of action among the drugs (Figure 2).

There was no significant rise in the mean heart rate after intubation ($P = 0.390$) which declined to the baseline preinduction values by the end of 10 min (Figure 3). The mean systolic BP was found to be more in Group S when compared to Groups R6 and R8, immediately after intubation up to 3 min which was statistically significant ($P = 0.074$). This returned to baseline values by the end of 5 min and became statistically nonsignificant ($P = 0.682$) (Figure 4). It was found that mean diastolic BP was higher in Group S when compared with R6 and R8, immediately after intubation up to 5 min which was statistically significant ($P = 0.097$) (Figure 5). This returned to baseline values by the end of 10 min and became statistically nonsignificant ($P = 0.129$). The rise in mean arterial pressure was more with succinylcholine than with rocuronium and declined to preinduction baseline values by the end of 10 min (Figure 6).

Table 2: Demographic data

Group	Group S	Group R6	Group R8	*P* value with significance
Mean age (years)	32±12 (SD)	29±10 (SD)	32±11 (SD)	0.101 (NS)
Mean weight (kg)	58±11 (SD)	54±9 (SD)	54±9 (SD)	0.667 (NS)
Gender ratio (male/female)	16/14	16/14	14/16	(NS)

SD: Standard deviation, NS: Nonsignificant

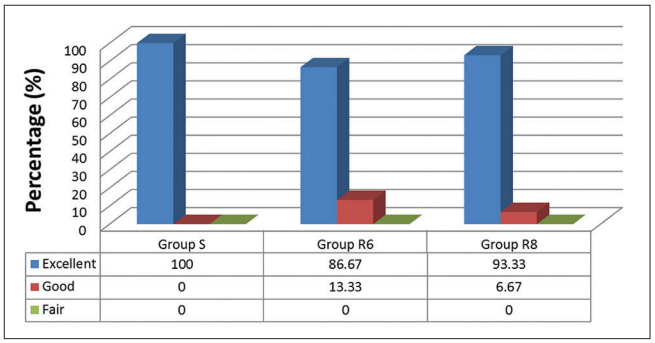


Figure 1: Comparison of the overall intubating conditions

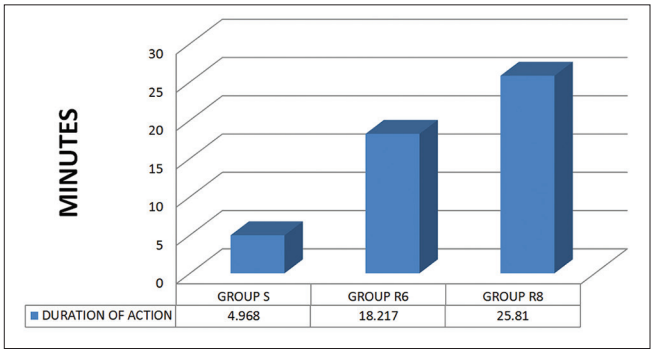


Figure 2: Duration of action

Table 3: Comparison of the overall intubating conditions

Intubating conditions and scores	*n* (%)			Chi-square value	*P* value and significance
	Group S	Group R6	Group R8		
Excellent (8-9)	30 (100)	26 (86.66)	28 (93.33)	0.74	0.389 Not significant
Good (6-7)	0 (0)	4 (13.33)	2 (6.67)		
Fair (3-5)	0 (0)	0 (0)	0 (0)		
Poor (0-2)	0 (0)	0 (0)	0 (0)		
Total	30 (100)	30 (100)	30 (100)		

DISCUSSION

Succinylcholine is the most commonly used muscle relaxant for intubation in both elective and emergency settings but with some adverse effects such as bradycardia, rise in intraocular and intracranial pressures, muscle fasciculations, and post-operative myalgia. It is also not suitable in certain circumstances such as hyperkalemia, musculoskeletal disorders, burns, and central nervous system disorders.

Rocuronium bromide is a low potency, intermediate-acting derivative of vecuronium devoid of cardiovascular side effects[4] and also devoid of histamine release.[5] It was found to have a shorter onset time compared to vecuronium,[6] cisatracurium,[7] and mivacurium.[8] Hence, this study was intended to test the efficacy of rocuronium bromide as a safer alternative to suxamethonium chloride for rapid ET intubation.

Table 4: Comparison of jaw relaxation during intubation

State	*n* (%)			Chi-square value	*P* value with significance
	Group S	Group R6	Group R8		
Good	30 (100)	25 (83.33)	28 (93.33)	5.89	*P*=0.0526 significant
Moderate	0 (0)	5 (16.67)	2 (6.67)		
Poor	0 (0)	0 (0)	0 (0)		
Minimal	0 (0)	0 (0)	0 (0)		
Total	30 (100)	30 (100)	30 (100)		

Table 5: Comparison of vocal cords at intubation

State	*n* (%)			Chi-square value	*P* value with significance
	Group S	Group R6	Group R8		
Open	29 (96.67)	26 (86.67)	28 (93.33)	2.17	*P*=0.338 Not significant
Moving	1 (3.33)	4 (13.33)	2 (6.67)		
Closing	0 (0)	0 (0)	0 (0)		
Closed	0 (0)	0 (0)	0 (0)		
Total	30 (100)	30 (100)	30 (100)		

Selection of Drug Dose[9,10]

The dosage of the neuromuscular blocking drug is usually selected based on the ED95 value. The dose required for ET intubation is employed in multiples of ED95 dose. The ED95 dose of succinylcholine is 0.3 mg/kg body weight. Three times the ED95 that is 1 mg/kg administration results in complete suppression of neuromuscular stimulation in approximately 60 s. Furthermore, there were no advantages when succinylcholine was used in doses larger than 1.5 mg/kg even in a rapid sequence intubation.

Rocuronium has been used in doses two to three times the ED95 dose to obtain clinically acceptable intubating

Table 6: Comparison of response to intubation

State	*n* (%)			Chi-square value	*P* value with significance
	Group S	Group R6	Group R8		
None	30 (100)	20 (66.67)	26 (86.67)	12.86	*P*=0.0016 highly significant
Slight diaphragmatic movement	0 (0)	10 (33.33)	4 (13.33)		
Mild coughing	0 (0)	0 (0)	0 (0)		
Severe coughing/bucking	0 (0)	0 (0)	0 (0)		
Total	30 (100)	30 (100)	30 (100)		

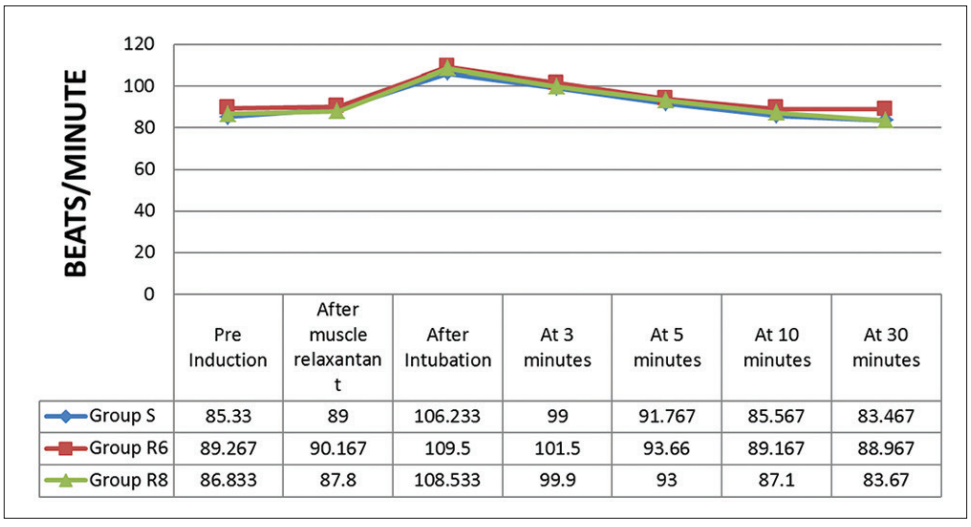
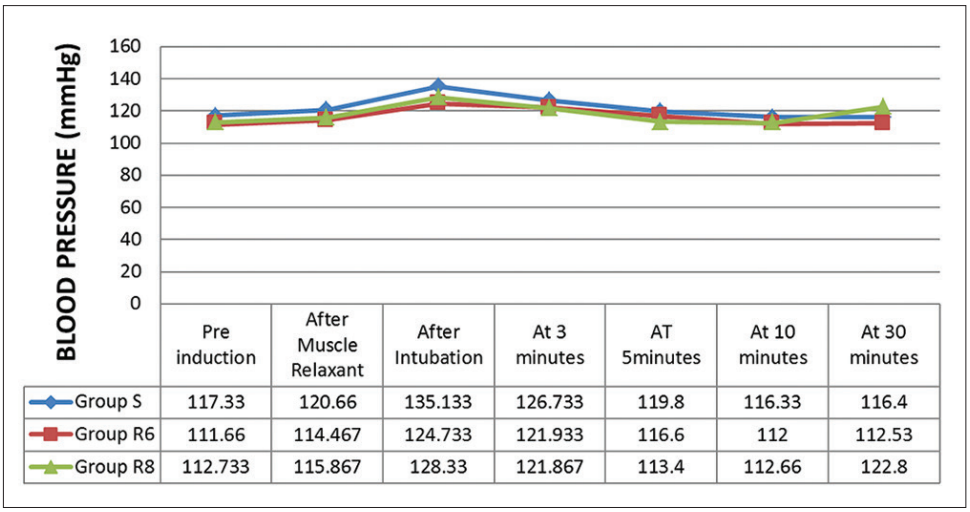
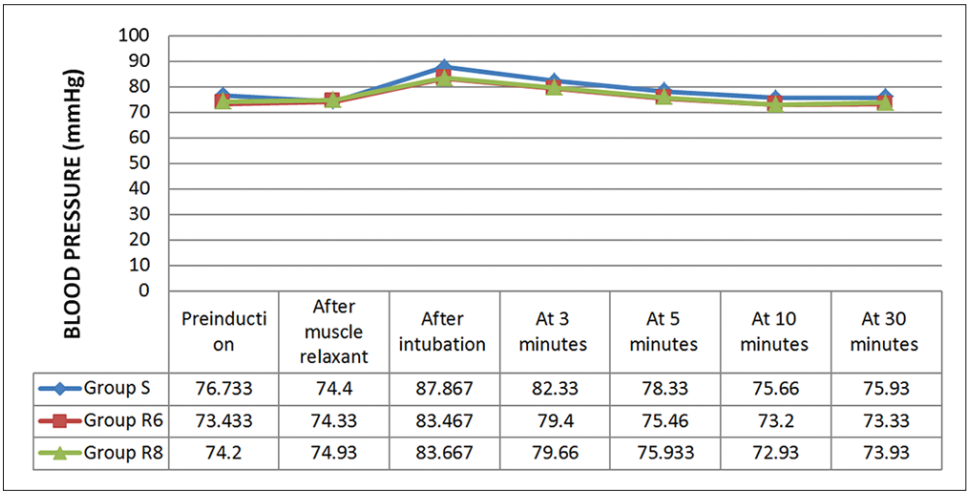


Figure 3: Comparison of heart rate variation



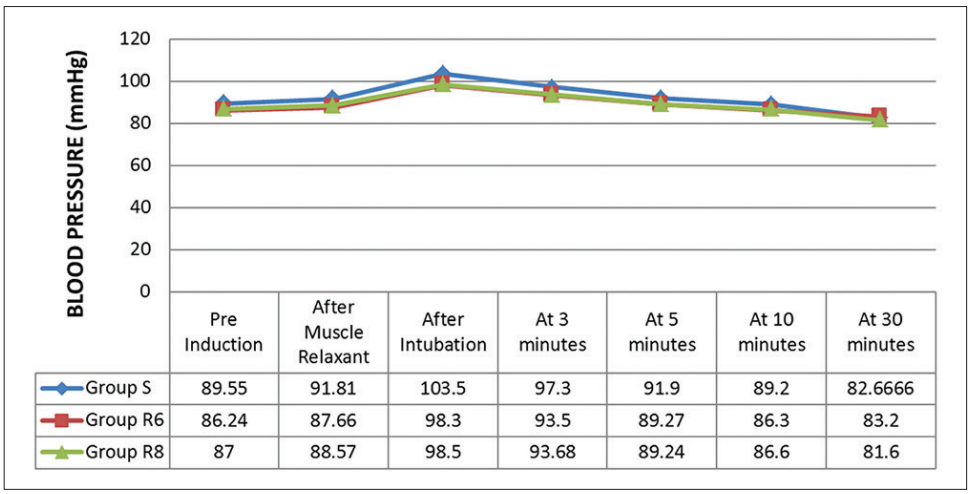
	Pre induction	After Muscle Relaxant	After Intubation	At 3 minutes	AT 5minutes	At 10 minutes	At 30 minutes
Group S	117.33	120.66	135.133	126.733	119.8	116.33	116.4
Group R6	111.66	114.467	124.733	121.933	116.6	112	112.53
Group R8	112.733	115.867	128.33	121.867	113.4	112.66	122.8

Figure 4: Comparison of mean systolic blood pressures



	Preinduction	After muscle relaxant	After intubation	At 3 minutes	At 5 minutes	At 10 minutes	At 30 minutes
Group S	76.733	74.4	87.867	82.33	78.33	75.66	75.93
Group R6	73.433	74.33	83.467	79.4	75.46	73.2	73.33
Group R8	74.2	74.93	83.667	79.66	75.933	72.93	73.93

Figure 5: Comparison of mean diastolic blood pressures



	Pre Induction	After Muscle Relaxant	After Intubation	At 3 minutes	At 5 minutes	At 10 minutes	At 30 minutes
Group S	89.55	91.81	103.5	97.3	91.9	89.2	82.6666
Group R6	86.24	87.66	98.3	93.5	89.27	86.3	83.2
Group R8	87	88.57	98.5	93.68	89.24	86.6	81.6

Figure 6: Comparison of mean arterial pressure variation

conditions. The ED95 dose of rocuronium bromide is 0.305 mg/kg body weight. Two times the ED95 dose of rocuronium bromide is 0.6 mg/kg body weight. Three times the ED95 dose of rocuronium bromide is 0.9 mg/kg body weight has also been shown to provide excellent intubating conditions comparable to

succinylcholine. However, the duration of action was longer.

In our study, succinylcholine and rocuronium bromide has been employed at a dose of 1.5, 0.6 and 0.8 mg/kg body weight to assess the intubating conditions at 60 s.

Selection of Intubation Criteria[11]

In most studies, the appropriate timing of ET intubation has been determined by 3 ways.

1. Clinical criteria such as jaw relaxation, vocal cord movement, and response to intubation were assessed according to a scale or a scoring system
2. Neuromuscular monitoring by twitch suppression (maximum blockade) or train of four (TOF) ratio
3. Predetermined time after administration of neuromuscular blockers, e.g., 60 s, 90 s, and 120 s.

In our study, we have relied on two of the parameters, namely, predetermined time after muscle relaxant administration at 60 s and the clinical criteria given by Cooper *et al.*, which most of the authors followed. We did not use neuromuscular monitoring at adductor pollicis because it was found that the onset of paralysis at the vocal cords and laryngeal muscles were rapid and preceded that of adductor pollicis. Hence, the TOF may give an incorrect picture of the intubating conditions with neuromuscular monitoring as there was significant difference in the onset times and the rate at which the neuromuscular block occurred between the two groups of muscles.[12]

Assessment of Intubating Conditions

In the present study, succinylcholine 1.5 mg/kg produced excellent intubating conditions in 100% of patients. The results were comparable to those studies conducted by Bhati and Parmar (2008),[13] Gupta and Kirbahar (2010),[14] Feroz *et al* (2011),[15] Bhale *et al.* (2013),[16] and Parikh *et al.* (2014).[17]

Rocuronium 0.6 mg/kg produced excellent intubating conditions in 86.67% of patients and good intubating conditions in 13.33% of patients. The results were comparable to those studies conducted by Bhati and Parmar (2008),[13] Gupta and Kirbahar (2010),[14] and Belekar and Khamankar (2013).[18]

Rocuronium 0.8 mg/kg produced excellent intubating conditions in 96.67% of patients and good intubating conditions in 3.33% of patients. The results were comparable to the study conducted by Kurshid *et al.* (2015).[19]

Thus, increasing the dose of rocuronium bromide from 0.6 mg/kg to 0.8 mg/kg body weight not only increased the incidence of excellent intubating conditions but also increased the duration of action.

The reason for the rapid onset time for a neuromuscular block with rocuronium was suggested to be the relative low potency of the drug. This ensured the presence of more relaxant molecular load in the blood stream and neuromuscular junction resulting in the larger concentration gradient toward the biophase. Another explanation could be the earlier occurrence of the block at the adductor muscle of the larynx and intubation can be performed before complete block is obtained at the adductor pollicis muscle.[20]

Although the jaw relaxation was best with succinylcholine (100%), rocuronium was able to provide relatively good relaxation (83.33-93.33%) required for easy atraumatic laryngoscopy which is useful in emergent situations. There was no significant difference in the state of the vocal cords at intubation between the three groups. Open vocal cords without any movement were seen with succinylcholine in 96.66% and rocuronium bromide 86.66-93.33%. Diaphragmatic movements were seen more in those patients who received rocuronium bromide 0.6 mg/kg (33.33%) which was highly significant and may not be acceptable in the patients with a full stomach who are at increased risk of pulmonary aspiration of gastric contents as in emergency.

Clinical Duration of Action

In the present study, the time between the administration of the neuromuscular blocking drug and the first attempt at respiration clinically was taken as the clinical duration of action.

With succinylcholine 1.5 mg/kg, the clinical duration of action in this study was found to be a mean duration of 4.968 min. The minimum duration was 3.33 min, and the maximum was 7.00 min. The results were comparable with the following studies: Shukla *et al.* (2004),[11] Parikh *et al.* (2014),[17] and Kurshid *et al.* (2015).[19]

The clinical duration of action of rocuronium 0.6 mg/kg in the present study was found to be with a minimum duration of 14.03 min and a maximum duration of 25.16 min. The mean duration of action was 18.21 min. This concurred with those studies by Verma *et al.* (2006)[21] and Kurshid *et al.* (2015).[19]

In the present study, we used rocuronium at a dose of 0.8 mg/kg. The minimum duration of action was observed as 16.10 min, and the maximum duration of action was 33.80 min. The mean duration of action was 25.81 min. This was comparable to the study done by Kurshid *et al.* (2015).[19]

Hemodynamic Changes

In our the study, there was an increase in heart rate from baseline values by 24.49%, 12.26%, and 24.99% with succinylcholine 1.5 mg/kg, rocuronium 0.6 mg/kg, and 0.8 mg/kg, respectively, immediately after intubation. This gradually decreased to 7.5%, 4.92%, and 7.10% at the end of 5 min and returned to preinduction values by the end of 10 min.

The rise in systolic BP was 15.17%, 11.70%, and 13.83% in Group S, R6, and R8, respectively immediately after intubation. This declined to 2.13%, 4.42%, and 0.59%, respectively, among the three groups by the end of 5 min and was statistically nonsignificant. Furthermore, there was increase in diastolic BP from preinduction values by 14.50%, 13.65%, and 12.74% in group S, R6, and R8, respectively, postintubation. The diastolic pressures dropped to 2.08%, 2.76%, and 2.33%, respectively, by the end of 5 min.

The increase in mean arterial pressures after intubation was 15.57%, 13.98%, and 13.21% in Group S, R6, and R8, respectively. This gradually declined to 2.62%, 3.51%, and 2.57%, respectively, among the three groups and the return to preinduction values was seen by the end of 10 min in all groups.

These changes concurred with the studies by Bhale *et al.* (2013),[16] Parikh *et al.* (2014),[17] and Kurshid *et al.* (2015).[19] Thus, greater hemodynamic stability was seen with rocuronium than with succinylcholine. The rise in heart rate and mean arterial pressure could be due to the sympathetic stimulation and stress produced by laryngoscopy and intubation. However, succinylcholine caused a greater stimulation of autonomic ganglion than rocuronium which explained the more significant hemodynamic variability in this group.

In our study, no adverse changes in ECG and oxygen saturation were observed. No other untoward side effects such as bradycardia, tachycardia, hypotension, hypertension, bronchospasm, cutaneous flushing, erythema, urticaria, or rashes. Only muscle fasciculations after the administration of suxamethonium chloride were noticed as predicted.

CONCLUSION

Rocuronium bromide at both doses of 0.6 mg/kg and 0.8 mg/kg produced clinically acceptable intubating conditions and can be used as a safer alternative to suxamethonium chloride in situations where suxamethonium chloride is contraindicated.

However, increasing the dose of rocuronium to 0.8 mg/kg produced excellent intubating conditions at 60 s itself, which was comparable with suxamethonium chloride and with lesser diaphragmatic movements that were found to be more useful in emergency situations, although it resulted in a longer duration of action.

ACKNOWLEDGMENTS

We express our sincere thanks to Professor Dr. M. Dhakshinamoorthy, Professor Dr. C. Dhanasekaran, Professor Dr. S. K. Srinivasan, and Professor Dr. R. Gowthaman from the Department of Anaesthesiology, R.M.M.C.H, Annamalai University, Chidambaram, for their timely help and constant encouragement while conducting this study.

REFERENCES

1. Griffith HR, Johnson GE. The use of curare in general anaesthesia. Anesthesiology 1942;3:418-20.
2. Atkinson RS, Rushman GB, Davies NJ. Lee's Synopsis of Anaesthesia. 11th ed. London: The Royal Society of Chemistry; 1998. p. 130-3.
3. Cooper R, Mirakhur RK, Clarke RS, Boules Z. Comparison of intubating conditions after administration of Org 9246 (rocuronium) and suxamethonium. Br J Anaesth 1992;69:269-73.
4. Nitschmann P, Oberkogler W, Hertsig M, Schwarz S. Comparison of haemodynamic effects of rocuronium bromide with those of vecuronium in patients undergoing CABG surgery. Eur J Anaesthesiol Suppl 1994;9:113-5.
5. Levy JH, Davis GK, Duggan J, Szlam F. Determination of the hemodynamics and histamine release of rocuronium (Org 9426) when administered in increased doses under N_2O/O_2-sufentanil anesthesia. Anesth Analg 1994;78:318-21.
6. Misra MN, Agarwal M, Pandey RP, Gupta A. A comparative study of rocuronium, vecuronium and succinylcholine for rapid sequence induction of anaesthesia. Indian J Anaesth 2005;49:469-73.
7. Omera M, Hammad YM, Helmy AM. Rocuronium versus cisatracurium: Onset of action, intubating conditions, efficacy and safety. Alexandria J Anaesth Intens Care 2005;8:27-33.
8. Naguib M, Samarkandi AH, Ammar A, Turkistani A. Comparison of suxamethonium and different combinations of rocuronium and mivacurium for rapid tracheal intubation in children. Br J Anaesth 1997;79:450-5.
9. Miller RD, Cohen NH, Erikkson LI, Fleisher LA, Weiner-Kronish JP, Young WL. Pharmacology of neuromuscular drugs. Blocking Miller's Anesthesia. 8th ed. Philadelphia, PA: Elsevier, National Blood Authority; 2011. p. 970-5.
10. Flood P, Rathmell JP, Shafer S. Neuromuscular blocking drugs and reversal agents. Stoelting's Pharmacology and Physiology in Anesthetic Practice. 5th ed. Philadelphia, PA, USA: Wolters Kluwer Health; 2015. p. 325-9.
11. Shukla A, Dubey KP, Sharma MS. Comparative evaluation of hemodynamic effects and intubating conditions after the administration of ORG 9426 (rocuronium) and succinylcholine. Indian J Anaesth 2004;48:476-9.
12. Wright PM, Caldwell JE, Miller RD. Onset and duration of rocuronium and succinylcholine at the adductor pollicis and laryngeal adductor muscles in anesthetized humans. Anesthesiology 1994;81:1110-5.
13. Bhati K, Parmar V. Comparative study of intubating conditions after rocuronium and suxamethonium (study of 80 cases). Internet J Anesthesiol 2008;20:1-6.
14. Gupta S, Kirubahar R. A comparative study of intubating conditions of rocuronium bromide and suxamethonium in adult patients. Anesth Essays

Res 2010;4:15-9.
15. Feroz SH, Wahid F, Kazi WA, Akhtar F, Al Masalmah BE. Comparative study of intubating conditions after rocuronium and suxamethonium (Study of 50 cases). Pak Armed Forces Med J 2011;1.
16. Bhale P, Bhandari N, Kumaran SP, Joshi R. Comparison of suxamethonium with rocuronium for endotracheal intubation. Int J Rec Trends Sci Technol 2013;9:52-6.
17. Parikh K, Modh DB, Upadhyay MR. Comparison of rocuronium bromide with suxamethonium chloride for tracheal intubation. Int J Med Sci Public Health 2014;3:610-5.
18. Belekar VR, Khamankar S. Rocuronium for tracheal intubation in patients undergoing emergency surgery. Int J Pharmacol Res 2013;3:18-22.
19. Kurshid H, Muneer K, Wani SA. A comparative study of intubating conditions using succinylcholine and two doses of rocuronium. Int J Adv Res 2015;3:1152-9.
20. Dwivedi S, Dwivedi R. Comparative evaluation of intubating conditions after succinylcholine and different doses of rocuoronium. J Evol Med Dent Sci 2015;4:9011-9.
21. Verma R, Goordayal R, Jaiswal S, Sinha G. A comparative study of the intubating conditions and cardiovascular effects following succinylcholine and rocuronium in adult elective surgical patients. Internet J Anesthesiol 2006;14:1-6.

How to cite this article: Paul AP, Prakash CS, Sekaran NK, Sundaram S. Comparative Study of Two Different Doses of Rocuronium Bromide with Suxamethonium Chloride for Endotracheal Intubation. Int J Sci Stud 2016;4(7):92-99.

Source of Support: Nil, **Conflict of Interest:** None declared.