Comparative study of intubating conditions after rocuronium bromide and succinylcholine: A randomised controlled double blinded study

Kanvee M Vania^{1*}, Vandana S Parmar²

¹Associate professor, Department of Anaesthesiology, GMERS Medical College, Junagadh, Gujarat, India.zip code-362001. ²Professor and Head, Department of anasthesiology, PDU Medical college, Rajkot, INDIA. **Email:** <u>drkanvee@rediffmail.com</u>, <u>kanveevania@gmail.com</u>

Abstract

Background and Aims: Succinylcholine is most commonly used muscle relaxant to facilitate rapid sequence endotrachealintubation. When Succinvlcholine is undesirable or contraindicated, we have to use non-depolarizing muscle relaxants for this purpose¹. The Aim of this study was to compare intubation conditions and onset of action after Rocuronium bromide and Succinylcholine following induction with Sodium thiopentone as a sole anaesthetic agent in elective otherwise healthy adult population. Materials and Methods: Eighty adult patients undergoing elective surgery, requiring general anaesthesia were selected and divided randomly in to group A and group B. Group A patients given Inj. Rocuronium Bromide 0.6 mg/kg and group B patientsgiven Inj .Succinylcholine 1.5 mg/kg after induction with Inj. Sodium thiopentone. Intubating conditions were assessed using scoring system based on criteria of cooper et al.²Time of intubation was recorded as onset of action of muscle relaxant.. Hemodynamic were recorded preoperatively, after muscle relaxant, after intubation, 5 min, 10 min 15 min after intubation. Results: Intubating conditions were excellent in 37 patients in and good in 3 patients in group A and excellent in all 40 patients in group B.Onset of action was 60-90 secs in group A and 60 secs in group B. Hemodynamic changes were comparable in both groups. Pulse rate, systolic and diastolic blood pressure were increased after intubation but reached baseline value within 5 mins. Conclusion: Rocuronium bromide is new non depolarizing muscle relaxant which can be used as an alternative to Succinylcholine for rapid sequence induction as it has rapid onset of action as compared to other non depolarising muscle relaxants. Key Word: Rocuronium bromide, Succinylcholine, muscle relaxant, rapid sequence induction (RSI), intubating conditions.

*Address for Correspondence:

Dr. Kanvee M Vania, Mangalam Ortho Care, Opp Chanakya Appartment, Nr Sardarbaug, Junagadh, INDIA. **Email:** drkanvee@rediffmail.com kanveevania@gmail.com Received Date: 21/11/2018 Revised Date: 10/12/2018 Accepted Date: 02/01/2019 DOI: https://doi.org/10.26611/10159111

Access this article online			
Quick Response Code:	Website		
	www.medpulse.in		
	Accessed Date: 13 January 2019		

INTRODUCTION

Endotracheal intubation is an important part of administration of anaesthesia during surgery requiring general anaesthesia. Rapid sequence induction(RSI) is require in patients with full stomach and require emergency surgery under general anaesthesia to protect

against gastric aspiration, to facilitate intubation, or to protect against increased intracranial pressure. Muscle relaxant for RSI should have rapid onset of action, short duration of action, minimal hemodynamic and systemic effects. Succinvlcholine is muscle relaxant of choice to facilitate endotracheal intubation due to its properties like rapid onset and short duration of action. But it has many adverse effects like fasciculations, bradycardia and dysrrhythmias, rise in serum potassium, post - operative myalgia, rise in intraocular, intragastric and intracranial pressure, incidences of prolonged recovery in patients with pseudo - cholinesterase deficiency and it can also trigger malignant hyperthermia. Most of these side effects of Succinylcholine are due to its depolarizing mechanism of action. Therefore research for ideal muscle relaxant for RSI focused on non-depolarizing muscle relaxants which has rapid onset time and clinically acceptable intubating conditions, as rapidly as Succinylcholine and which lacks

How to site this article: Kanvee M Vania, Vandana S Parmar. Comparative study of intubating conditions after rocuronium bromide and succinylcholine: A randomised controlled double blinded study. *MedPulse International Journal of Anesthesiology*. January 2019; 9(1): 46-51. http://medpulse.in/Anesthesiology/index.php

the above mentioned adverse effects. Rocuronium bromide a newer amino - steroidal compound is a derivative of Vecuronium; is fastest acting nondepolarizing muscle relaxant among currently available non-depolarizing muscle relaxants has rapid recovery, good cardiovascular stability, no significant histamine release³.Onset of action of Rocuronium 0.6 mg/kg is observed to be 1 to 1.5 minute^{4,5,6} and intubating conditions at 60 second are similar to those observed with Succinylcholine^{2,4,7,8,9,10}.Due to properties these Rocuronium is being used at many places to facilitate endotracheal intubation in elective as well as in emergency situations requiring rapid sequence intubation. So, with these properties in mind it was decided to study two important properties i.e. onset of action and intubating conditions after Succinylcholine -a time tested popular short acting depolarizing muscle relaxant and Rocuronium bromide -recently introduced fast acting non depolarizing muscle relaxant, using Inj. Sodium thiopentone, as the sole anaesthetic agent in 80 healthy adult patients undergoing elective surgery.

MATERIALS ANDMETHODS

In present study, after taking approval from institutional ethics committee, eighty healthy adult patients were selected randomly from routine operation lists of Pandit Dindayal Upadhyay Hospital, Rajkot, aged between 11 and 60 years, ASA physical status I or II for the study. The patients were divided randomly into two groups, group A and group B, each group consisting of 40 patients, accordingly they received muscle relaxant either Rocuronium bromide or Succinylcholine.

Group A: Rocuronium bromide, 0.6 mg/ kg (n = 40) **Group B:** Succinylcholine chloride, 1.5 mg /kg (n = 40) The criteria for selection of patients were:

- **I.** Healthy having nosystemic or metabolic disorder or any other major illness.
- **II.** Patients with neuromuscular disease or receiving medications known to influence neuromuscular function were excluded from study.
- **III.** Undergoing laparoscopic surgeries, ear surgery, renal surgery, thyroid surgery and other surgeries with less than two hours duration.

Thorough preoperative assessment was done of all patients and a detailed history was noted. History suggestive of major illness or major surgery and drug therapy was asked. On general examination average built, nutritional status, pallor, clubbing, cyanosis, lymphadenopathy, icterus, teeth and spine were examined. Mouth opening was assessed and recorded according to mallampatti grading. Systemic examination of respiratory system, cardiovascular system, digestive system, central and peripheral nervous system were carried out to rule out any major systemic disorder. Vital data like temperature, pulse rate per minute, blood pressure, Spo2 and respiratory rate were noted. Routine investigations like Hemoglobin estimation, urine for routine and microscopic examinations, random blood sugar, blood urea, serum creatinine, chest x-ray, and electrocardiogram were done in all cases. Patients were kept nil by mouth from 10:00 pm on the day before surgery. On the arrival in operation theatre peripheral venous line was secured, chest leads of ECG were attached. After attaching the monitor, vitals like pulse rate, blood pressure, spo2 were recorded as baseline vital data. For premedication Inj. Glycopyrrolate 4µg / kg; Inj. Ranitidine 1 mg / kg; Inj. Ondansetron 80 μ g / kg; Inj. Diclofenac Na 1.5 mg /kg given in all patients. All patients were pre-oxygenated with 100% O2 with face mask for 3 minutes. all patients were induced with Inj. Sodium thiopentone intravenously. Patients of group A were given Inj. Rocuronium bromide 0.6 mg/ kg IV and patients of group were given Inj. Succinylcholine 1.5 mg/ kg. Time recording started along with all vital data for considering onset of action of muscle relaxant by another anaesthetist. Intermittent positive pressure ventilation started with 100% oxygen. Jaw relaxation was assessed for atraumatic laryngoscopy at 60 seconds or if needed at 75 seconds and then at 90 seconds. Score recorded for criteria of jaw relaxation. Laryngoscopy performed after moderate to good jaw relaxation. Intubation perfomed with proper sized endotracheal tube and condition of vocal cords and response of diaphragm to intubation was recorded. From the time of giving muscle relaxant to time of intubation is recorded as the onset of action of muscle relaxant. For the assessment of intubating conditions criteria of Cooper et al² used. Each of the following criteria were given 4 points:

- **1.** Jaw relaxation (for ease of laryngoscopy)
- **2.** Condition of vocal cords during laryngoscopy

3. Response of the diaphragm to tracheal intubation Scores of individual criteria were recorded then added for total score of a maximum of 9.According to total score intubating conditions were rated as excellent, good, fair or poor as per follows.

- A total score of
- 8 9 excellent
- 6 7 good.
- 3 5 Fair and
- 0 2 is rated as poor intubating conditions.

Good and excellent intubating conditions were taken to be "clinically acceptable" by Cooper *et al*². Pulse rate, systolic and diastolic blood pressure were recorded immediately after muscle relaxant, immediately after intubation and from the time of intubation (time = 0 minute) every 5 minutes up to 30 minute and then every 10 minutes.ECG and Spo2 were observed continuously for any changes. Anesthesia was maintained with 50% N₂O, 50% 0₂, isoflurane and non depolarising muscle relaxant, with use of closed circuit with circle absorber with controlled ventilation. At the end of surgery, Inj. Neostigmine 0.05 mg/ kg and Inj. Glycopyrrolate 0.08 μ g/ kg intravenously used for reversal of neuromuscular blockade. After adequate recovery of consciousness, respiration and muscle tone and power, patients were extubated. During post operative period patients were observed for nausea, vomiting, bradycardia, tachycardia, hypotension, respiratory obstruction.

Statistics: In present study, significance of difference 'p' value for qualitative data was calculated by using chi-square test. Mean and standard deviation calculated and then t-test applied for calculating significance of difference between means of two different groups in the case of quantitative data. This test is also called student's t test¹¹ as it was designed by W.S. Gossett whose pen name was student.

RESULTS

Demographic criteria for both groups are as shown in the TABLE I. The TABLE I shows that the age of patients were ranged from 11-60 years in both Group A and Group B. Mean of age is 30.22 in Group A and 28.22 in Group B. The male to female ratio in Group A was 15:25 and in Group B it was 17:23. It shows further that 26 patients of Group A belonged to ASA physical status

grade I and 14 belonged to grade II. In Group B, 20 patients were of ASA status I and 20 of II. Mallampatti grade was I in all patients of both groups. Jaw relaxation was good in 32 patients and moderate in 8 patients in group and good in 37 patients and moderate in 3 patients in group B [Table II]Vocal cords were open and immobile in 35 patients and moving in 5 patients at 60 sec after administration of Rocuronium . They were open and immobile at 60 sec in 39 patients and moving in 1 patient after administration of Suxamethonium. [Table II] No diaphragmatic movements were observed in 30 patients and slight diaphragmatic movements observed in group A. No diaphragmatic movements was observed in all 40 patients group B.[Table II] As per shown in Table III and fig 1 intubation conditions were excellent in 37 patients (92.5%) and good in 3 patients (7.5%) in group A patients and excellent in 40 patients (100%) in group B patients. Onset of action of muscle relaxant was 60 secs in 36 patients, 75 secs in 2 patients and 90 secs in 2 patients in group A. It was 60 secs in all 40 patients in group B[Table IV]. Hemodynamic changes were comparable in both groups with respect to baseline pulse rate, systolic and diastolic blood pressure There was significant rise in hemodynamics after intubation in both groups which returns to baseline within 5 minutes. The difference between two groups was statistically insignificant (p value >0.05) [fig.2,3 and 4]. No any changes observed in ECG or Spo2.

Table	1: Demogra	aphic data i	in two	groups
-------	------------	--------------	--------	--------

	Group A	Group B	P value
Age (years)	30.22(11-60)	28.82(12-52)	>0.05
Sex (M:F)	15:25	17:23	>0.05
ASA physical status I/II	26(65%)/14(35%)	20(50%)/20(50%)	>0.05
Mallampatti grade I/II	40(100%)/0	40(100%)/0	>0.05
(Significant P < 0.05)	-		

Table 2: Showing ease of jaw relaxation condition of	the vocal cord, response to intubation	in group A (Inj. Rocuronium bromide) and group
	D (Int. Cupation data a line)	

No.			Group A	Group B	P Value
		Good (Easy).	32	37	>0.05
1	Jaw Relaxation	Moderate (fair).	08	03	>0.05
I	(Ease of Laryngoscopy)	Minimal (Difficult)	00	00	>0.05
		Poor (Impossible)	00	00	>0.05
		Open	35	39	>0.05
C	Condition of vocal cords	Moving	05	01	>0.05
Z	condition of vocal colus	Closing	00	00	>0.05
		Closed	00	00	>0.05
		None	30	40	>0.05
2	Designed to be the best of	Slight diaphragmatic	10	00	>0.05
3	Response to intubation	movement	00	00	>0.05
		Severe coughing	00	00	>0.05

(significant P<0.05)

MedPulse International Journal of Anesthesiology, Print ISSN: 2579-0900, Online ISSN: 2636-4654, Volume 9, Issue 1, January 2019 pp 46-51

Intubating condition	Group-A No. of patients (%)	Group-B No. of patients (%)	P value
Excellent	37(92.5%)	40(100%)	>0.05
Good	03(7.5%)	00	>0.05
Poor	00	00	>0.05
Inadequate	00	00	>0.05
(Significant P < 0.05)			

Table 3: Intubating conditions after Rocuronium bromide (group A) and Succinylcholine (group B)

Table 4: Onset of action (time of intubation) of Rocuronium (group A) and Succinylcholine(group B)

	No or patr	
6	40	>0.05
	0	>0.05
	0	>0.05
	6	6 40 0 0



Figure1: distribution of total scoring of intubating conditions in group a (rocuronium) and group b(succinylcholine). Figure2:changes in mean pulse rate after rocuronium (group-a) and succinylcholine(group b) Figure 3: changes in systolic blood pressure (mm of hg) after rocuronium (group a) and succinylcholine (group b) Figure 4: changes in diastolic blood pressure (mm of hg) after rocuronium (group a) and succinylcholine (group b).

DISCUSSION

Various animal studies demonstrated that Rocuroniumis a low potency compound and associated with rapid onset of effect when compared with other compounds such as Pancuronium and Vecuronium. Thereafter many clinical studies carried out to prove that the onset of action of Rocuronium is significantly faster when compared to equipotent dosage of Atracurium and Vecuromium. And now Rocuronium is emerging as the first non depolarizing muscle relaxant having an onset time as short as that of Succinylcholine without significant Rocuronium adverse effects⁷. (ORG 9426) is aminosteroidal muscle relaxant is chemically 2morpholino, 3-desacetyl,16-N-allyl pyrrolidino derivative of Vecuronium, differing from it at 3 positions on steroid

nucleus. That's why we have decided to compare intubating conditions and onset time of action of Rocuronium bromide and Succinylcholine in the present study. The choice of the anaesthesia induction agent, the use of adjuvant drugs such as narcotics, sedatives or lidocaine¹² can also influence intubating conditions by enhancing muscle relaxation. Induction agents like Propofol and Etomidate depress pharyngeal and laryngeal reactivity more than Sodium Thiopentone^{13,14}. In present study we have selected Sodium Thiopentoneto minimize enhancement of muscular relaxation. The intubating conditions would expected to be improved^{13,14} if Propofol or Etomidate used as an induction agent. In studies, where opioids were used during induction or used for premedication, intubating condition at 60seconds after Rocuronium 0.6 mg/ kg were similar to those after Succinylcholine^{2,4,7,8}. Wolfgang Ummenhofer *et al.*¹⁵ studied that to determine whether the intubation conditions created by Rocuronium are equivalent to those of Succinylcholine during rapid-sequence induction (RSI). They observed that intubation conditions are excellent and more reliable after Succinvlcholine. But when Rocuronium is used with Propofol intubation conditions are equivalent to those with Succinylcholine. Many studies are carried out to specifically compare the intubating conditions after Rocuronium bromide and Succinylcholine^{2,4,8}.In one of such studies by Mc Court et al.¹⁶ tracheal intubating conditions were compared during rapid sequence induction of anaesthesia using 0.6 mg/kg Rocuronium or 1 mg/kg Succinylcholine and conditions were scored at 60 secs. Intubating conditions were found to be equally acceptable (96% and 97% respectively) in both groups. The incidence of excellent grade of intubation was however significantly higher with Succinylcholine (80% vs. 65%; p=0.02).

Timing of endotracheal intubation can be determined by following methods:

- 1. Clinical judgement
- 2. Neuromuscular monitoring by TOF on nerve stimulator
- 3. Predetermined time after muscle relaxant(60 secs,75 secs, 90 secs etc).

The method of clinical judgement alone is relatively insensitive. In neuromuscular monitoring onset time is influenced by nerve stimulation rates used. Onset time for Rocuronium 0.6 mg/kg was found to be 90 sec by 0.1 Hz stimulation and 58 sec using TOF stimulation by Cooper et al^5 . So a predetermined time for tracheal intubation is more reliable method. So, we used this method. It has been advocated by various workers that higher dose of Rocuronium can improve intubating conditions during rapid sequence intubation and cut short the onset time below 60 seconds. But doses larger than 0.6 mg/kg Rocuronium bromide prolong the duration action which may not be desirable in many situations. A prospective randomized trial conducted by Mathias Sluga et al.¹⁷ for comparison of Rocuronium and Succinylcholine for rapid sequence induction of anesthesia and endotracheal intubation in 180 emergency cases. It has been observed that when Propofol is used as an induction agent intubation conditions did not differ statistically after administration of Succinvlcholine and Rocuronium. The result of the study by Perry J et al.¹⁸ supported the contention that 0.6mg/kg of Rocuronium bromide can be a suitable alternative to Succinylcholine for rapid sequence induction of anaesthesia and endotracheal intubation in 60 Sec in elective cases. Although, Rocuronium was not fully interchangeable with

Succinylcholine, as intubating conditions were observed excellent uniformly, after the administration of Succinylcholine (100%) but not with Rocuronium (92.5%) using Thiopentone as a sole anaesthetic agent. In present study intubation conditions are similar clinically acceptable (excellent or good) in both Rocuronium and Succinylcholine groups. We have also compared the individual parameters i.e. jaw relaxation, condition of vocal cords and response to intubation by quantitative score rated on a 0 to 3 scale to avoid confusion for describing intubation conditions. Factors like skill and experience of anaesthesiologist, patient's anatomy, history of smoking or bronchospastic diseases and may influence intubation conditions. There was slight diaphragmatic movement following endotracheal intubation in 10 patients who received Rocuronium whereas no diaphragmatic movement seen in any patients who received Succinylcholine. These findings are supported by some investigations which states that the laryngeal adductor muscles and the diaphragm are more resistant to the effects of Rocuronium. Hemodynamic changes are observed in both groups are similar. The rise in pulse rate, systolic and diastolic blood pressure in response to endotracheal intubation is due to increase in sympathetic and sympathoadrenal activity in response to oropharyngeal, laryngeal and tracheal stimulation¹⁹. Similar results were observed by other investigators also in their studies.

CONCLUSION

It is concluded from this study that Rocuronium bromide, a new non-depolarising muscle relaxant can be used instead of Succinylcholine for endotracheal intubation in elective as well as rapid sequence induction during emergency because it provides good to excellent conditions at 60-90 seconds, even after induction with Thiopentone as the sole anesthetic agent. Rocuronium is the drug of choice for excellent and RSI intubation technique to protect against gastric aspiration, to protect against increased intracranial pressure and to facilitate intubation without side effects of depolarizing muscle relaxant.

REFERENCES

- Mehta MP, Choi W W, Gorcis SD *et al.* Facilitation of rapid endotracheal intubations with devided doses of nondepolarizing neuromuscular blocking drugs,J Anesthesiology 1985; 62:392-95.
- Cooper. R, Mirakhur RK, Clarke RST *et al.* Comparison of intubating conditions after administration of ORG 9426 (rocuronium) and succinylcholine. Br J Anaesth 1992; 69: 269-73.
- John J. Savarese, James E. Caldwell and Millar RD. Pharmacology of muscle relaxants and their antagonist. In:

MedPulse International Journal of Anesthesiology, Print ISSN: 2579-0900, Online ISSN: 2636-4654, Volume 9, Issue 1, January 2019 pp 46-51

Ronald D. Millar, Editor. Anesthesia. California: Churchill living stone. 2000: 412-90.

- Puhringer FK, khuenl Brady KS and Mitterschiffthaler G. Evaluation of the endotracheal intubating conditions of rocuronium (org. 9426) and succinylcholine in out patient surgery. Anaesth analg 1992; 75: 37-40.
- Cooper RA, Mirakhur RK, Maddineni VR. Neuromuscular effects of Rocuronium bromide (ORG, 9426) during fentanyl and halothane anesthesia. Anesthesia 1993; 48: 103-5.
- 6. Foldes FF, Nagashima H, Nguyen HD *et al.* The neuromuscular effects of ORG 9426 in patients receiving balanced Anesthesia. Anesthesiology 1991; 75: 191-6.
- Magorian T, Flannery KB, Miller RD. Comparision of Rocuronium, succinylcholine induction of anesthesia in adult patients. Anesthesiology 1993; 79: 913-8.
- Huizinga ACT, Vandnbrom RHG, Wierda JMKH *et al.* Intubating conditions and onset of neuromuscular block, of rocuronium (ORG 9426) a comparison with suxamethonium. Acta Anesthesiol Scand 1992; 36: 463-8.
- **9.** Sparr. HJ, Luger TJ, Herdegger T *et al.* Comparision of intubating conditions after rocuronium and suxamethonium following 'rapid- sequence- induction with Thiopentone in elective cases. Acta Anaesthesiol scand 1996; 40: 425-30.
- Tryba M, Zorn A and Zeng M. rapid sequence orotracheal intubation with rocuronium; a randomized double-blind comparison with suxamethonium preliminary communication. Euo J Anesthesiol 1994; 9(suppl.): 44-8.

- 11. B.K. Mahajan, Methods in Biostatistics 6th Ed., 1997; 141-52
- 12. Stevens JB, Vescow MV, Harris KE *et al.* Tracheal intubation using alfentanil and no muscle relaxant : is the choice of hyphotic important and Anaesth Analg 1997 ; 84, 1222-6.
- 13. Fuchs Buder T, Sparr HJ, Ziegenfuss T. Thiopental or etomidate for rapid sequence induction with rocuronium Br. J. Anaesth 1998; 80: 504-6.
- 14. Mc Keating K, Bali JM Dundee JW. The effects of Thiopentone and propofol on upper airway integrity Anaesthesia 1988; 3: 638-40.
- Wolfgang Ummenhofer, MD, Wolfgang Studer, MD, Martin Siegemund, MD, and Stephan C. Marsch, MD, Dphil Anesth Analg 2005;101:1356-61.
- **16.** Mc Court K C, Salmela L, Mirakhur R K *et al.* Comparision of rocuronium and suxamethonium for use duringrapid sequence induction of anaesthesia: Anaesthesia 1998;53; 867-71.
- 17. Mathias Sluga, Wolfgang Ummenhope, Wolfgang Studer, Martin Siegemund, Steph C. Marsch. Rocuronium verses succinylcholine for rapid sequence induction of anesthesia and endotracheal intubation: A prospective randomized trail in Emergent cases. Anesth Analg 2005; 101: 1356-61.
- **18.** Perry J,Lee J,Wells G. Rocuronium versus succinylcholine for rapid sequence induction intubation. Cochrane Database of Systematic Reviews 2003, Issue 1.
- **19.** Gibb JM, The effect of endotracheal intubation on cardiac rate and rhythm. NZ Med J 1967; 66: 465-9.

Source of Support: None Declared Conflict of Interest: None Declared