

Comparison of intubating conditions during rapid tracheal intubation between Rocuronium and combination of Rocuronium with Vecuronium

Roshan Piya

Patan Academy of Health Sciences

ABSTRACT

Introduction: Rapid sequence induction (RSI) is usually indicated during emergency surgical procedure in the presence of full stomach and other conditions with an increased risk of aspiration. The use of succinylcholine has been the gold standard for RSI because of its rapid onset and short duration of action in spite of its adverse effects and contraindications in many conditions. Because of these side effects of succinylcholine many techniques have been attempted and published to replace succinylcholine when it is contraindicated. Aim of the study was to compare the quality of intubation conditions during tracheal intubation in 60 seconds after administration of thrice ED₉₅ dose (0.9mg/kg) of rocuronium and combination of one & half times ED₉₅ dose (0.45mg/kg) of rocuronium and one & half times ED₉₅ dose (0.075mg/kg) of vecuronium.

Methods: Sixty patients scheduled for elective surgery requiring tracheal intubation, age ranges from 18-65 years were chosen after informed consent. Prospective, Randomized, double blind study was conducted in the Department of Anaesthesiology, Tribhuvan University Teaching Hospital.

Results: The intubating conditions obtained with the combination groups were comparable with that of rocuronium alone. Most of the patients had excellent intubating condition and few had good intubating condition. The combination of one & half ED₉₅ dose of rocuronium & one & half ED₉₅ dose of vecuronium produced either excellent or good intubating condition during RSI.

Conclusion: Thus the combination of this drug with above dose can be an alternative to succinylcholine and rocuronium for RSI.

Key Words: Rapid sequence induction, rocuronium, succinylcholine, vecuronium.

CORRESPONDENCE

Dr. Roshan Piya

Department of Anaesthesiology

Patan Academy of Health Sciences (PAHS)

Email: piyaroshan@hotmail.com

INTRODUCTION

Control of ventilation has always been a key issue during anesthesia. To enable mechanical ventilation, an endotracheal tube is often used, although there are alternative devices such as facemasks or laryngeal mask airway.

Rapid Sequence Induction (RSI) is a quicker form of intubation used to induce a state of general anesthesia. Till now, Succinylcholine is the drug of choice for RSI. However, succinylcholine has some serious side effects it is contraindicated in such conditions.³ For the substitute of Succinylcholine, different drugs: Rocuronium, Vecuronium and different techniques were used using non-depolarizing muscle relaxants for RSI; But these techniques also have some side effects and difficulty for the patient.

Aim of the study was to compare the quality of intubation conditions during tracheal intubation in 60 seconds after administration of thrice ED₉₅ dose (0.9mg/kg) of rocuronium and combination of one & half times ED₉₅ dose (0.45mg/kg) of rocuronium and one & half times ED₉₅ dose (0.075mg/kg) of vecuronium. And also to compare between the groups: the ease of laryngoscopy, condition of the vocal cords, coughing at the time of intubation of the trachea.

METHODS

Prospective, Randomized, double blind study was conducted in the Department of Anaesthesiology, Tribhuvan University Teaching Hospital after approval of Ethical Committee and Department of Anaesthesiology. Patient scheduled for elective surgery requiring tracheal intubation and patients of American Society of Anaesthesiology Physical Status (ASA PS) I & II grading were included in the study. Duration of

the study was four months. Sixty patients undergoing elective surgery of either sex, age ranges from 18-65 years were chosen after their informed consent.

Each group consisted of 30 patients. Patients were randomly assigned to one of the two study groups by sealed envelope method. The patients in Group I received rocuronium 0.9mg/kg (thrice ED₉₅) & group II received the mixture of rocuronium 0.45mg/kg (one & half times ED₉₅) with vecuronium 0.075mg/kg (one & half times ED₉₅) for tracheal intubation.

All the patients were premedicated with tablet diazepam 0.2mg/kg per oral night before operation and two hours before the day of operation in the morning. On arrival to the anesthetic preparatory room intravenous access obtained with 18 gauge cannula. In the operating theatre, an ECG, blood pressure cuff and pulse oximeter were applied and vital signs were recorded. Preoxygenation was done for three minutes with 100% oxygen. For analgesia injection pethidine 0.75mg/kg IV was given and anesthesia was induced with injection of sodium thiopentone 5mg/kg IV. After loss of eyelash reflex patients were paralyzed with either of the following study drugs:

Group I: Rocuronium 0.9mg/kg (10ml)

Group II: Rocuronium 0.45mg/kg and Vecuronium 0.075mg/kg (10ml).

Injection time of the study drug was noted. Following assisted ventilation with 100% oxygen for sixty seconds after the end of injection of muscle relaxant intubation was attempted by investigator, who was blinded for the administration of muscle relaxant.

The intubating conditions were evaluated and scoring was done as follows:

Table 1: - Intubating conditions scale as described by Krieg²⁴

Vocal cords	Coughing	Laryngoscopy	Points
Open	None	Easy	1
Moving	With Diaphragm	Fair	2
Closing	Clear	Difficult	3
Closed	Severe	Impossible	4

Score	Intubating Condition
3 – 4	Excellent
5 – 7	Good
8 – 10	Poor
11 – 12	Bad

If intubation was not successful at the first attempt, assisted ventilation was done and reintubated once the favorable condition was achieved after 2 minutes. Maintenance of muscle relaxation was done with vecuronium 0.01mg/kg. BP, ECG, pulse oximeters were monitored throughout the operation. Anaesthesia was maintained with halothane 1% and 100% oxygen. At the end of the operation muscle relaxation was reversed with 0.05mg/kg neostigmine + 0.02mg/kg atropine and patients were extubated. The patients were monitored in the recovery room till patients become stable and transferred to postoperative ward.

Data were recorded and analyzed by using the statistical programmed SPSS 15.0. Two groups were compared in terms of proportion and mean (SD). Statistical significance was compared using Chi-square test for the proportion and student T – test for the means. p value of <0.05 was considered to indicate a statistically significant differences.

RESULTS

All sixty patients (thirty in each group) who gave informed written consents were included in the study. Distribution of the cases among the groups was comparable. Sex distribution of the cases showed a greater number of females as compared to male. There were 22 male patients and 38 female patients. The distributions between the groups were not significant (p value = 0.108). All adult patients (18 to 65 yrs old) were included in the study. The mean age was 39.17 +/- 13.049 in group I; 29.57 +/- 9.008 in group II. The distributions between the ages were significant (p value = 0.002). The mean weight was 53.83 +/- 9.549 in group I; 52.23 +/- 7.347 in group II. The distributions between the weights were not significant (p value = 0.470). ASA I & II patients were also evenly distributed among the groups. Distribution of patients of ASA I & II between the groups were also not significant (p value = 0.085) Table 1.

Table 2: Distribution of the cases

	Group I (n=30)	Group II (n=30)	p value
Male (%)	8 (26.7)	14 (46.7)	0.108
Female (%)	22 (73.3)	16 (53.3)	
Total (%)	30 (100)	30 (100)	
Age (yrs)	39.17 (13.049)	29.57 (9.008)	0.002
Weight (kg)	53.83 (9.549)	52.23 (7.347)	0.470
ASA I (%)	25 (83.3)	29 (96.7)	0.085
ASA II (%)	5 (16.7)	1 (3.3)	

Ease of laryngoscopy:

The majority of the patients in both groups had easy laryngoscopy, 28 patients (93.33%) in each Group I & Group II. Two patients (6.67%) had fair laryngoscopy in each group. None of the patients

in both groups had difficult and impossible laryngoscopy. Laryngoscopy in both groups was similar and statistically not significant (Table 2).

Table 3: Distribution of ease of laryngoscopy between the two groups:

	Rocuronium	Rocuronium with Vecuronium	P value
	N (%)	N (%)	1.000
Easy	28 (93.3)	28 (93.3)	
Fair	2 (6.7)	2 (6.7)	
Total	30 (100)	30 (100)	

Conditions of the vocal cords were similar in both groups and statistically not significant (Table 3).

Table 4: Distribution of vocal cord condition between the two groups:

	Rocuronium	Rocuronium with Vecuronium	P value
	N (%)	N (%)	1.000
Open	27 (90.0)	27 (90.0)	
Moving	3 (10.0)	3 (10.0)	
Total	30 (100)	30 (100)	

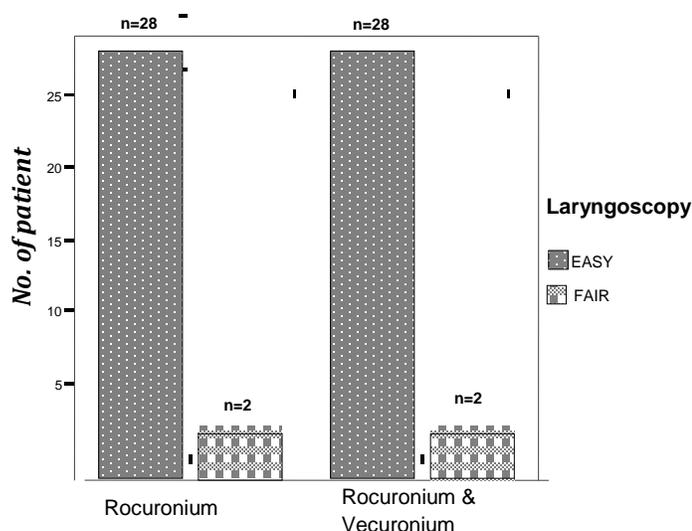


Figure 1: Distribution of ease of laryngoscopy between the two groups.

Condition of Vocal Cords:

The majority of the patients in two groups had open vocal cord, 27 patients (90%) in both Groups I and II. Three patients (10%) in each group had moving vocal cord. None of the patients had closing and closed vocal cords.

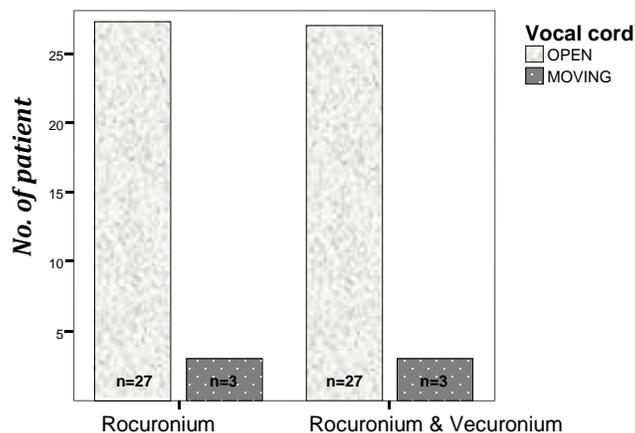


Figure 2. Distribution of vocal cord condition between two groups

Coughing during intubation:

The majority of the patients in both groups had no cough, 19 (63.33%) in Group I & 18 (60%) in Group II. 8 patients (26.67%) in Group I & 9 patients (30%) in Group II had coughing with diaphragm. 2 patients (6.67%) in Group I and 3 (10%) patients in Group II had clear cough. 1 patient (3.33%) in Group I had severe cough which was not seen in Group II. Even though the

number of patient were different in both groups but the value were statistically not significant (Table 4).

Table 5: Distribution of coughing between the two groups:

	Rocuronium	Rocuronium with Vecuronium	P value
	N (%)	N (%)	0.732
None	19 (63.3)	18 (60.0)	
With Diaphragm	8 (26.7)	9 (30.0)	
Clear	2 (6.7)	3 (10.0)	
Severe	1 (3.3)	0 (0)	
Total	30 (100)	30 (100)	

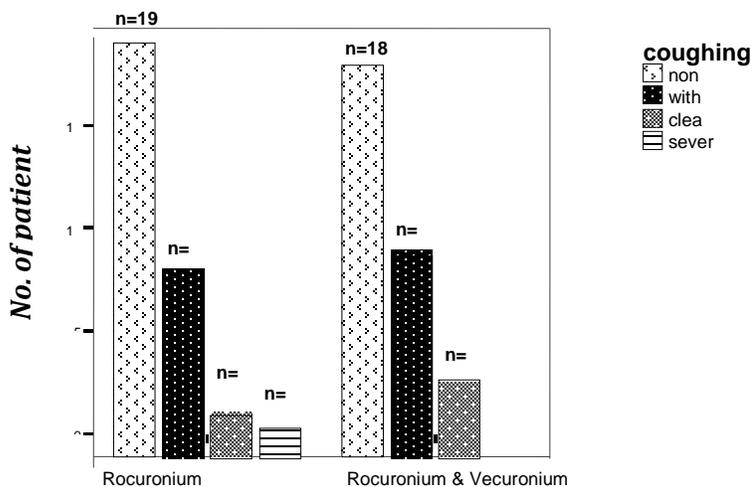
Figure 3. Distribution of coughing between two groups

Intubation Condition:

Among the patients, 26 patients (86.67%) from Group I & 25 patients (83.33%) from Group II had excellent intubation condition. 4 patients (13.33%) in Group I and 5 patients (16.67%) in Group II had good intubation condition. None of the patient from any of the groups had poor and bad intubation condition. The intubation conditions obtained in two groups were similar and were not significant (Table 5).

Table 6. Intubating Conditions:

Intubation condition	Group I (n = 30)	Group II (n = 30)	p- value
Excellent (%)	26 (86.7)	25 (83.3)	0.718
Good (%)	4 (13.3)	5 (16.7)	
Bad	0	0	
Poor	0	0	
Total	30	30	



Thus Combination of Rocuronium with Vecuronium provided good to excellent intubation condition similar to that obtained after the use of Rocuronium alone.

There are too many tables

Complications:

Few complications were seen during procedure. 7 patients out of sixty developed Ventricular Premature Contraction (VPC), 3 patients in Group I and 4 patients in Group II. 1 patient with VPC treated with Injection lidocaine 1.5mg/kg IV in group I and other patients resolved with ventilating 100% oxygen.

DISCUSSION

The rationale behind RSI of anesthesia is to create an environment in which the trachea can be intubated as quickly and little difficulty as possible. It is used where there is a greater than usual risk of regurgitation and aspiration of stomach contents.¹⁶ Usually succinylcholine has been used for rapid tracheal intubation. When succinylcholine is contraindicated, rocuronium can be used. Many studies have been done in order to replace succinylcholine for rapid tracheal intubation with different technique and using different drugs.

It has been found that intubating condition provided by succinylcholine and rocuronium are similar and develop at the same rate in spite of pharmacodynamic differences.^{2,11,12,15,17,18} Eventhough rocuronium has been found as an alternative for succinylcholine, the studies were done on the combination of drugs for the assessment of intubating condition in order to reduce the dose requirement of the either drugs, preventing side effects and to decrease costs of the drugs. It has been shown that the combination of the drugs have synergistic effect thus providing rapid intubation time as well as effective intubating condition as that of rocuronium and succinylcholine alone.^{7,8,10,14,19,21,22,23} Studies had shown that the mixture of rocuronium and mivacurium not only provide synergistic effect but also provide the duration that is similar to mivacurium in young adults.¹⁴

Most of the studies were performed between rocuronium and other non-depolarizing agents. It has been found that rocuronium may act synergistically with other non depolarizing agents during onset of blockade, but that when a steady state is reached the early synergistic

effect is overwhelmed by an alternative mechanism of action which results in an additive effect with other non-depolarizing drugs. It also implies that the quality of tracheal intubation conditions achieved after 1 min might be enhanced by using an equipotent mixture of rocuronium with another non-depolarizing drug.⁷

In the present study rocuronium as Group I and combination of rocuronium with vecuronium as Group II with the aim that combination is similar or better than rocuronium alone for intubating conditions during rapid tracheal intubation were used. Among 30 patients who received rocuronium alone showed 86.7% excellent intubating condition and 13.3% good intubating condition. The intubating conditions in mixture of rocuronium with vecuronium showed 83.3% excellent and 16.7 % good intubating condition. There were no poor or impossible intubation conditions. From the above result it is clear that synergism of vecuronium can be due to rocuronium because standard intubation time for vecuronium is 3 to 4 minutes. Synergism of mixtures of rocuronium and vecuronium was also observed by other study.

In the study performed by AJ England et al⁷, 96.6% who receive rocuronium and 90% who receive the mixture of rocuronium and vecuronium achieved good or excellent intubation conditions after 60 seconds. But excellent intubation conditions were 57% of the rocuronium group, 70% of the mixture group. As compare to this study excellent intubation conditions were in lesser percentage. This result may be due to the drug dose, as they used lower dose. The present study used three times ED₉₅ dose of rocuronium (0.9mg/kg) while they used

only two times ED₉₅ (0.6mg/kg). And only 19 patients (62.7%) who received vecuronium alone had good or excellent intubation conditions after 1min. But excellent intubation conditions were seen in only 26.4 % of the patient who received vecuronium alone. Poor or impossible conditions for intubation at 60 seconds were reported in 11 patients (36.3%) receiving vecuronium alone, one patient (3.3%) who received rocuronium alone and 3 patients (10%) who received a mixture of rocuronium and vecuronium. Intubation conditions were similar for rocuronium groups and mixture groups ($p > 0.4$). Intubation conditions in rocuronium groups were significantly better than those in vecuronium group ($p < 0.05$) and conditions in mixture groups were significantly better than those in vecuronium group ($p < 0.002$). As compared to the present study, intubation conditions (good and excellent) were seen to be better but poor or impossible intubation conditions were none in the study.

Many other studies showed that 0.6mg/kg dose of rocuronium doesn't achieve intubation conditions similar to succinylcholine in 60 seconds.^{14, 21} It has been said that it is prudent to wait for 90 seconds to achieve intubating condition similar to succinylcholine.¹⁷ Studies had found that the administration of 0.9 to 1.2mg/kg is an acceptable alternative to succinylcholine for RSI of anesthesia.^{11, 18, 25}

Thus, 3 times ED₉₅ doses of Rocuronium (0.9mg/kg) in Group I and equipotent doses in Group II ie 1.5times ED₉₅ doses of Rocuronium (0.45mg/kg) and 1.5times ED₉₅ of Vecuronium (0.075mg/kg) were chosen in this study. Maknija Neeti et al⁸ used almost similar doses of the drug. They found 86.7 % excellent intubation conditions in rocuronium group, 80% in mixture

of rocuronium and vecuronium group. 13.3 % good intubations in rocuronium group, 13.3 % in mixture rocuronium and vecuronium group.

The excellent intubating condition obtained in mixture group in present study in 60 seconds probably may be due to synergistic action of vecuronium with rocuronium as the dose of rocuronium alone in mixture is not sufficient (1.5 times ED₉₅) to cause excellent intubating condition as shown by many studies.^{17, 18} The result of the study clearly indicates that a mixture of rocuronium with vecuronium act synergistically to produce neuromuscular blockade. The drug combination can provide clinically comparable condition for tracheal intubation as compared with rocuronium alone. The present study supports the fact that the combination of rocuronium with vecuronium can be an economic alternative for rapid sequence intubation in surgical patients as vecuronium is cheaper than the rocuronium.

Complications associated with the procedure were less. In the present study 7 patients had complications though such complications were not mentioned or reported in other studies. The complication noted was VPC's and the complications were seen in both the groups. But, the mixture of rocuronium & vecuronium does not place the patients at any increased risk of complication as compared with other technique of rapid tracheal intubation.

CONCLUSION

The combination of rocuronium and vecuronium at the doses of 0.45mg/kg and 0.075mg/kg respectively can be an alternative technique for rapid tracheal intubation when succinylcholine is contraindicated.

REFERENCES

1. Thomas J. Gal. Airway Management in Miller's Anesthesia. Miller's Anesthesia. 6th edition. India: Natasha Andjelkovic, 2005; 1635.
2. Perry JJ, Lee J, Wells G. Are Intubation Conditions Using Rocuronium Equivalent to Those Using Succinylcholine? Academic Emergency Medicine, 2002; Volume 9(8), 813-23.
3. Sluga M, Ummenhofer W, Studer W, Siegemund M, Marsch SC. Rocuronium Versus Succinylcholine for Rapid Sequence Induction of Anesthesia and Endotracheal Intubation: A Prospective, Randomized Trial in Emergent Cases. Anesth Analg, 2005; 101:1356-61.
4. Koh, Kwong F, Chen, Fun Gee. Rapid tracheal intubation with atracurium: the timing principle. Canadian Journal of Anaesthesia, 1994; 41: 688-93.
5. Naguib M, Lein AC. Pharmacology of Muscle Relaxants and their Antagonists. Miller's Anesthesia. 6th edition. India: Natasha Andjelkovic, 2005: 481
6. Morgan, Mikhail, Murray. Clinical Anesthesiology. 4th edition. McGraw-Hill Companies, Inc. 2006; 224
7. England AJ, Margaron MP, Feldman SA. Tracheal intubation conditions after one minute: rocuronium and vecuronium, alone and in combination. Anaesthesia, 1997; 52: 336-40.
8. Maknija N, Saxena N, Kiran U, Choudhary M; Hemodynamic effects and intubation conditions following rocuronium and its combination with vecuronium and pancuronium in elective paediatric cardiac patient. Indian journal Anesthesia 2006; 50 (4): 295-99.
9. Sota Omoigui. Anesthesia Drugs Handbook. 3rd edition. India: Panther Publishers Private Limited; 2000;
10. Naguib M. Neuromuscular effect of rocuronium bromide and mivacurium chloride administered alone and in combination. Anesthesiology, 1994 Aug; 81 (2): 388-95.
11. Toni M, K. BF, Miller, Ronald. Comparison of rocuronium, succinylcholine and vecuronium for rapid sequence induction of anesthesia in adult patient. Anesthesiology, 1993 Nov; 79(5): 913-918.
12. Puhringr FK, Khuenl-Brandy KS, Koller J and Mitterschiffthaler. Evaluation of the entotracheal intubating conditions of rocuronium and succinylcholine in outpatient surgery. Anesthesia and analgesia, 1992; Vol 75, 37 – 40.
13. Weiss JH, Gratz I, Goldberg ME, Afshar M, Insinga F, Larijani G. Double blind comparison of two doses of rocuronium and succinylcholine for rapid sequence intubation. J Clin Anesth 1997 Aug; 9 (5): 379 – 82.
14. Motamed C. and Donati F. Intubating conditions and blockade after mivacurium, rocuronium and their combination in young and elderly adults. Canadian Journal of Anesthesia 2000; 47: 225-231.
15. Andrews JI, Kumar N, Van Den Brom RHG. A large simple randomized trial of rocuronium versus succinylcholine in rapid sequence induction of anesthesia along with propofol. Acta Anaesthesiol Scand 1999; 43: 4 – 8.
16. Smith I, Saad RSG. Comparison of intubating conditions after rocuronium

- or vecuronium when the timing of intubation is judged by clinical criteria. *British Journal of Anaesthesia* 1998; 80: 235–37.
17. Aparna S, Dubey KP, Sharma M. Comparative evaluation of hemodynamic effects and intubating conditions after the administration of ORG 9426 (Rocuronium) and Succinylcholine. *Indian J. Anaesth.* 2004; 48 (6): 473–79.
 18. Cheng C. Comparison of Rocuronium and suxamethonium for rapid tracheal intubation in children. *Pediatric Anaesthesia* 2002; 12 (2): 140–45.
 19. Man TT, Cheng JK, Wong KL. Tracheal intubation condition – a comparison between one minute after rocuronium alone, one minute after rocuronium combined with atracurium and one minute after atracurium with rocuronium at one minute priming interval. *Acta Anaesthesiol Sin.* 2002 Dec; 40 (4): 179 – 83.
 20. Mirakhur R, Gibson F and Ferres C. Vecuronium and d- Tubocurarine combination potentiation of effect. *Anesth Analg* 1985; 64: 711–14.
 21. Naguib M, Samarkandi A, Ammar A, Turkistani A. Comparison of suxamethonium and different combinations of rocuronium and mivacurium for rapid tracheal intubation in children. *British Journal of Anaesthesia.* Vol 79 (4): 450–55.
 22. Stevens JB, Shepherd Jm, Vories PA. A mixture of mivacurium and rocuronium is comparable in clinical onset to succinylcholine. *Journal Clin. Anesth.*, 1996 Sept; 8 (6): 486–90.
 23. Kim KS, Chun YS, Chon SU. Neuromuscular interaction between cisatracurium and mivacurium, atracurium, vecuronium administered in combination. *Anaesthesia* 1998; 53: 872–78.
 24. Krieg N, Mazur L, Booij LHDJ, Curull JF. Intubating conditions and reversibility of a new non-depolarizing neuromuscular blocking agent, Org – NC45. *Acta Anaesthesiol Scand* 1980; 24:423-5.
 25. Engbek J, Mogensen JV. Can Rocuronium replace succinylcholine in rapid sequence induction? *Acta Anaesthesiol Scand* 1999; 43:1-3.