Section: Anaesthesiology

Original Research Article

COMPARISON OF TIME FOR ONSET OF ACTION AND INTUBATING CONDITIONS USING 4 TIMES ED95 DOSE OF ROCURONIUM VERSUS VECURONIUM DURING ENDOTRACHEAL INTUBATION-A PROSPECTIVE RANDOMIZED DOUBLE-BLIND STUDY

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Received *: 10/06/2025*
Received in revised form *: 25/07/2025*
Accepted *: 16/08/2025*

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DOI: 10.70034/ijmedph.2025.3.602

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

Int J Med Pub Health
2025; 15 (3); 3287-3291

ABSTRACT

Background: Rapid sequence induction and tracheal intubation is an established technique in patients at risk for aspiration of gastric contents. Increasing the dosage of rocuronium or vecuronium shortens the onset time of neuromuscular block. With this background, in the present study we compared the onset time and intubating conditions by using high doses (4 times ED95) of rocuronium and vecuronium.

Materials and Methods: In a prospective randomized double-blind study, 60 patients were randomly allocated into two groups. Group R-30 patients received rocuronium 1.22mg/kg body weight and group V-30 patients received vecuronium 0.172mg/kg body weight. After administration of study drug, onset of neuromuscular block was assessed with train of four stimulation (TOF) until loss of twitch response (TOF-0) of adductor pollicis muscle to stimulation of ulnar nerve. Intubating conditions at the time of intubation were monitored with copenhagen consensus conference scoring system and documented on a predesigned proforma.

Results: Mean onset time of action in group R was 70.7±7.6 seconds and in group V was 162.2±32.7 seconds. There was statistically significant difference (p-value<0.001) between group R and group V for onset time of action. Excellent intubating conditions were seen in 18 patients and good intubating conditions were seen in 12 patients in group R. Excellent intubating conditions were seen in 7 patients and good intubating conditions were seen in 23 patients in group V. There was statistically significant difference for intubating conditions (p-value-0.004) between group-R and group-V.

Conclusion: At equipotent doses, rocuronium produces early onset time of intubating conditions compared to vecuronium. Rocuronium produces more number of excellent intubating conditions compared to vecuronium. Though rocuronium produces more number of excellent intubating conditions compared to vecuronium, both rocuronium and vecuronium produces clinically acceptable intubating conditions.

Keywords: Rocuronium, Vecuronium, Endotracheal Intubation.

INTRODUCTION

Rapid sequence induction and tracheal intubation is an established technique in patients considered to be at risk for aspiration of gastric contents. The goal of rapid sequence induction is to secure the patients airway smoothly and quickly, thereby minimizing the chances of regurgitation and aspiration of gastric contents.

An ideal neuromuscular blocking agent for intubation should have a rapid onset, brief duration of action, provide excellent intubation conditions and should be free from side-effects. So far suxamethonium has been the neuromuscular blocking drug of choice in rapid sequence induction and intubation technique, yet its use is associated with innumerable side effects like fasciculations, myalgia, hyperkalaemia, bradyarrhythmia, raised intraocular pressure, intracranial pressure, intragastric pressure, anaphylaxis, malignant hyperthermia and masseter spasm Rocuronium produces faster neuromuscular blockade compared with other neuromuscular blocking drugs. It produces comparable intubating conditions to that of succinylcholine, but does not have the short intubation time of the latter. The onset of action of nondepolarizing neuromuscular blocking drugs (NMBD) can be accelerated by certain techniques like priming technique and large dose technique.[1-3] In large dose regimen, large doses of NMBDs will be given to enhance the onset of action With this background, in the present study we compared the time for onset of action and intubating conditions by using high doses (4 times ED95) of rocuronium and vecuronium.

Aims & Objectives

Aim of this study is to compare the time for onset of action and intubating conditions

During endotracheal intubation using 4 times ed95 dose of rocuronium and Vecuronium.

Objectives

1. To compare the time for onset of action by objectively assessing the absence of twitch response to train of four (TOF) stimulation.
2. To compare the intubating conditions during endotracheal intubation using copenhagen consensus conference scoring system.

MATERIALS AND METHODS

Study Design: This was a prospective, randomized, double blind study.

Place of Study: GGH, RIMS. Kadapa.

This study was conducted after obtaining approval from institutional ethical committee (ACAD./E3B2023-2024) clearance and registered in CTRI with registration no.CTRI/2025/03/083133,informed written consent from all patients included in the study

Study Period: This study was done from MAR 2025 to MAY 2025.

Sample Size: In the previous study,[4] the mean onset time was 83.6 seconds with 41.7 seconds standard deviation and 116.6 seconds with 55.3 seconds standard deviation in rocuronium and vecuronium groups respectively. The required sample size with equal allocation to achieve an 85% power (β error=0.15) at alpha error =0.05 (two sided) was 40 patients in each group.

Further considering a potential dropout rate of 5% the estimated sample size was 42 in each group. Due to the logistic, we enrolled 30 per group. Formula used for calculating sample size was as

$$n \geq \frac{\left(Z_{1-\alpha/2} + Z_{1-\beta}\right)^2 \left(\sigma_1^2 + \sigma_2^2 / r\right)}{\left(\mu_1 - \mu_2\right)^2}$$

Study participants

Inclusion Criteria

The following category of patients were included in this study such as;

1. Patients aged 18-65 years.
2. Patients of either gender.
3. Patients with Mallampati grade (MPG) I/II.[5]
4. Patients of American Society of Anesthesiologists physical status (ASA PS) I, II, III.[6]
5. Patients scheduled to undergo elective surgical procedures requiring general endotracheal anaesthesia with neuromuscular paralysis.

Exclusion Criteria

The following category of patients were excluded from study such as:

1. Obese patients (BMI> 30kg/m2) (Annexure-4).[7]
2. Pregnant and lactating mother.
3. Patients allergic to study drugs.
4. Patients with hepatic or renal impairment or neuromuscular disorders.
5. Patients who were not willing to participate in the study.

Group Allocation: Sixty patients were allocated using random number tables into group R and group V comprising of 30 patients in each group.

Group R patients received rocuronium 1.22mg/kg body weight (4 times ED95).

Group V patients received vecuronium 0.172mg/kg body weight (4 times ED95).

Study Procedure: All the patients of this study were thoroughly evaluated on the day before surgery and details were documented in the anaesthesia chart. All the participants were explained in detail about the study drugs during pre-anaesthetic check-up and written informed consent was obtained from all the study participants. All the patients were premedicated with Tab.alprazolam 0.5mg night before surgery. All patients were kept nil per oral 6 hours for solids and 2 hours for clear liquids prior to induction of anaesthesia.

After shifting to OT, standard ASA monitoring such as ECG, noninvasive blood pressure (NIBP), oxygen saturation (SpO2) and capnography (ETCO2) were connected. A good peripheral IV line was secured with 18 gauge cannula. All the patients were preoxygenated with 100% oxygen for 3 min. TOF-Watch ® SX electrodes were placed over the ulnar nerve on the volar side of the wrist to observe the TOF response of adductor pollicis muscle.[8] Standard general anaesthesia induction protocol was followed for all study participants. Train of four of 4 pulse each of 0.5 sec duration at 2 Hz frequency was applied

before administering study drug over 2 sec to the ulnar nerve and the resultant twitches of adductor pollicis muscle was observed objectively using TOF-Watch ®SX.

After confirming the adequacy of mask ventilation, the study drug comprising of either rocuronium or vecuronium in a calculated dose was given intravenously as a bolus in group R or group V as per their random group allocation. After administration of study drug, all patients were maintained with sevoflurane 2% with intermittent mask ventilation using 100% O2. Onset of neuromuscular block was assessed with TOF stimulus every 15 seconds until loss of twitch response (TOF-0) of adductor pollicis muscle to stimulation of ulnar nerve. Onset time was considered from the time of administration of muscle relaxant to the loss of twitch response (TOF-0) of adductor pollicis muscle to nerve stimulus. After achieving maximal neuromuscular block (TOF-0), endotracheal intubation was done within 10 seconds by single anaesthesiologist who was blinded to the study. Intubating conditions at the time of intubation were observed and documented in a predesigned proforma by using "intubation scoring system of consensus conference on good clinical research practice in pharmacodynamic studies of neuromuscular blocking agents, Copenhagen consensus conference" (9). Endotracheal tube position was confirmed by using 5 point auscultation and endotracheal tube was fixed. At this point of time, study was concluded and rest of the anaesthetic management was guided by the concerned anaesthesiology team who was posted in that particular operation theatre.

Statistical Analysis

All the collected data was double checked to exclude any clerical errors. Data collected was evaluated for normality using the Shapirowilk test. Continuous data was analyzed using unpaired student "t" test and was expressed as mean±SD. Categorical data was analyzed using chi-square test or Fisher's exact test as appropriate and was expressed as number (%). $p<0.05$ was considered statistically significant. Statistical package for social sciences (SPSS) version 24.0 was used to do the analysis.

RESULTS

Gender distribution: Out of 30 patients in each group (group-R versus group-V), females (16 versus 23) outnumbered males (14 versus 7). There was no statistically significant difference between two groups (p-value-0.058). [Figure 1 2].

Gender	Group-R	Group-V	p-value
Male	14(46.7%)	7(23.3%)	0.058
Female	16(53.3%)	23(76.7%)	

Group-R-Rocuronium; Group-V-Vecuronium

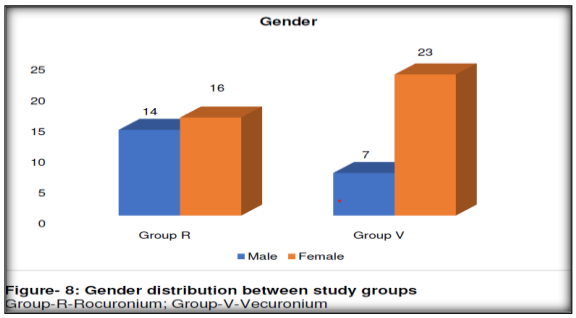

Figure- 8: Gender distribution between study groups
Group-R-Rocuronium; Group-V-Vecuronium

Figure 1 & 2: Gender distribution between study groups.

Comparison of Mallampati grading: Out of 30 patients in each group, 8 patients belong to MPG I, 22 patients belong to MPG II in group-R, whereas in group-V, 4 patients belong to MPG I and 26 patients belong to MPG II. There was no statistically significant difference between both study groups (p-value-0.197).

Variable		Group-R	Group-V	p-value
MPG	I	8	4	0.197
	II	22	26	

MPG -Mallampati grading; Group-R-Rocuronium; Group-V-Vecuronium

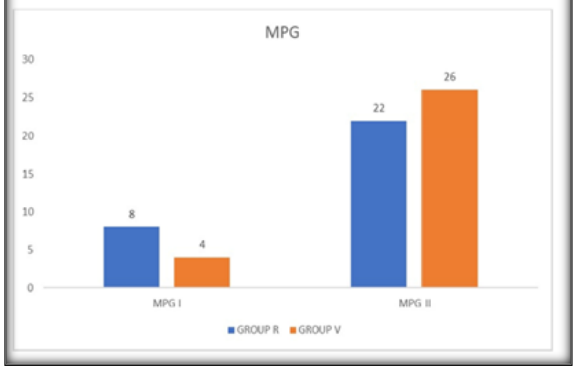

Figure 3: Comparison of MPG(85) between study groups MPG-Mallampati grading; Group-R-Rocuronium; Group-V-Vecuronium

Comparison of Cormack Lehane grading: Out of 30 patients in each group, in group-R 8 patients had grade-I , 21 patients had grade-II,1 patient had grade-III, whereas in group-V, 4 patients had grade-I, 26 patients had grade-II. There was no statistically significant difference between study groups (p-value-0.239). [Figure 4].

Comparison of time for onset of action: Onset of neuromuscular block was assessed with TOF stimulus every 15 seconds until loss of twitch response (TOF-0) of adductor pollicis muscle to stimulation of ulnar nerve.

Onset time was considered from the time of administration of muscle relaxant to the loss of twitch response (TOF-0) of adductor pollicis muscle to nerve stimulus. The mean onset time of action in group- R was 70.7±7.6 seconds and in group -V was 162.3±32.7 seconds with p-value (<0.001) which was

statistically significant. This implies group-R who received rocuronium had earlier onset time of action than group-V who received vecuronium. [Figure 5]

Variable		Group-R	Group-V	p-value
Cormack Lehane grade	I	8	4	0.239
	II	21	26	
	III	1	0	

Group-R-Rocuronium; Group-V-Vecuronium

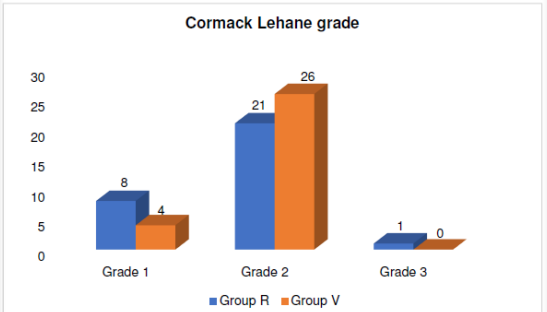

Figure 4: Comparison of Cormack Lehane grading(89) between studygroups

Variable	Group R	Group V	p-value
Onset time of action (sec)	70.7±7.6	162.3±32.7	<0.001

Group-R-Rocuronium; Group-V-Vecuronium; sec-seconds

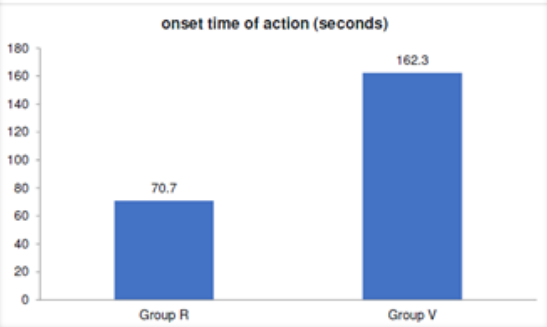

Figure 5: Onset time of action between Group R and Group V Group-R-Rocuronium; Group-V-Vecuronium; sec-seconds

Comparison of intubating conditions: Out of 30 patients in each group,in group- R, 18 patients had excellent intubating conditions and 12 patients had good intubating conditions ,whereas in group -V, 7 patients had excellent itubating conditions and 23 patients had good intubating condition with p-value (0.004) which was statistically significant. None of the patients in group-R and group-V had poor intubating conditions. As per scoring system based on quality of intubating conditions more number of patients in group-R had excellent intubating conditions than group-V patients (18 in group-R versus 7 in group-V), but both excellent and good intubating conditions were clinically acceptable for intubation.In patients who received rocuronium had earlier onset of clinically acceptable intubating conditions compared to patients who received vecuronium. [Figure 6].

Variable		Group R	Group V	p-value
Intubation condition	Good	12	23	0.004
	Excellent	18	7	

Group-R-Rocuronium; Group-V-Vecuronium

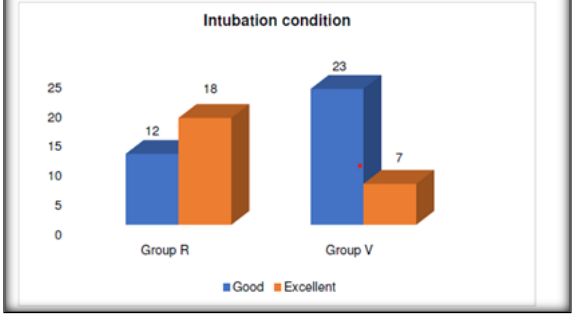

Figure-6: Intubation conditions between study groups Group-R-Rocuronium; Group-V-Vecuronium

DISCUSSION

In our present study, we compared the onset time of action and intubation conditions in 60 patients of ASA PS grade I-III with 30 patients in each group. Group-R patients received 4 times ED95 doses of rocuronium (1.22mg/kg body wt) and group-V patients received 4 times ED95 doses ofvecuronium (0.17mg/kg body wt).

A study by Smith et al,[10] compared the intubating conditions using 2 times ED95 of rocuronium and vecuronium. They concluded that rocuronium provided earlier onset of better intubating conditions than vecuronium. They judged the timing of intubation by clinical criteria which was based on the ease of ventilation, jaw and upper airway tone and intubating conditions by krieg score.[11] In our study onset time was taken from the administration of NMBD to loss of twitch response (TOF-0) to adductor pollicis muscle. Group- R patients who received rocuronium had onset time of 70.7±7.6 seconds and group-V patients who received vecuronium had onset time of 162.3±32.7 seconds. Our study had earlier onset of clinically acceptable intubating conditions compared to their study as we used 4 times ED95 dose of rocuronium and vecuronium.

A study done by Misra MN et al,[12] using 2 times ED95 dose of rocuronium 0.6mg/kg and vecuronium 0.1 mg/kg compared onset time and intubating conditions between two groups. In their study onset time was taken from the completion of injection of NMBD to the cessation of respiration and intubating conditions were assessed by cooper scoring system.[13] In their study onset time of action was 53.6±11.8 seconds in patients who received rocuronium and 78.2±14.8 seconds in patients who received vecuronium. In their study, in rocuronium group, 90% of cases had acceptable intubating

conditions at 60 seconds out of which 70% were excellent and at 90 seconds all patients had acceptable intubating conditions. In vecuronium group only 13.3% cases had acceptable intubating conditions. None of the cases had poor intubating conditions. Contrary to their study, in our study, onset time was taken from the administration of NMBD to loss of twitch response (TOF-0) to adductor pollicis muscle.

A study done by Patel DD et al,[14] in 60 patients, aged 18-60 years, of ASA PS I-II of either gender, who were scheduled to undergo various surgeries under general anaesthesia. Patients were divided into two groups. Group-R received 2 times ED95 dose of rocuronium 0.6mg/kg intravenously and group-V received 2 times ED95 dose of vecuronium 0.1 mg/kg intravenously. The mean onset time was earlier in Group-R 75.6+11.7 seconds as compared to group-V 116.6+10.9 seconds. Overall intubating conditions were excellent in 83.33% patients in Group R as compared to 46.66% patients in Group V ($p<0.01$). They concluded that rocuronium provides clinically acceptable intubating conditions earlier than vecuronium. In our study group-R patients had onset time of 70.7±7.6 seconds and group-V patients had onset time of 162.3±32.7 seconds.

Study by Somani et al,[15] using 2ED95 of rocuronium (0.6mg/kg) and vecuronium (0.1mg/kg) compared onset time and intubating conditions found that rocuronium group (group-R) had earlier onset time of 99.9±10.8 seconds than vecuronium group (group-V) with onset time of 150.7±11.8 seconds. In our study, group-R patients had onset time of 70.7±7.6 seconds and group-V patients had onset time of 162.3±32.7 seconds. In patients who received rocuronium had earlier onset clinically acceptable intubating conditions compared to patients who received vecuronium.

CONCLUSION

At equipotent doses, rocuronium produces early onset time of intubating conditions compared to vecuronium. Rocuronium produces more number of excellent intubating conditions compared to vecuronium. Though rocuronium produces more number of excellent intubating conditions compared to vecuronium, both rocuronium and vecuronium produces clinically acceptable intubating conditions.

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