European Journal of Molecular & Clinical Medicine

ISSN 2515-8260 Volume 09, Issue 02, 2022

Comparative study of intubating condition and duration of action after administration of rocuronium bromide and vecuronium bromide in abdominal surgery using train of four

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Abstract

Background: Rocuronium Bromide, an intermediate acting amino steroid NMDR, is five to seven times less potent than Vecuronium used in this study was to compare time of onset, conditions of tracheal intubation, duration of action and hemodynamic parametres, either of the drugs are used to produce muscular paralysis.
Materials & Methods: Study was carried out by taking 60 adult patients, undergoing different elective abdominal surgery under general anaesthesia, in age group of 15-60 years with ASA physical status I or II,30 patients received 0.6 mg/kg of Rocuronium bromide as Intubating dose and the other 30 patients received 0.1 mg/kg of Vecuronium bromide. Then neuromuscular blockade, endotracheal intubation of two non-depolarizing muscle relaxants were evaluated using a TOF in adductor pollicis muscles.
Results: In both the groups intubating conditions were either excellent or good. Intubating conditions with Rocuronium group were excellent in 86.67% and good in 13.33% patients while in Vecuronium group, intubating condition were excellent in 80% and good in 20% patients, which were comparable and statistically not significant (p=0.488). The onset of action of Rocuronium was found to be rapid compared to Vecuronium group with high statistical significance. (p=0.000).
Conclusion: Rocuronium, with its early onset of action, along with good to excellent intubating conditions and the cardiovascular stability, makes this neuromuscular relaxant a safe and desirable choice for tracheal intubation in surgical procedures requiring general Anaesthesia.

Keywords: Rocuronium, vecuronium, TOF, NMDR, ETT, neuromuscular blockade

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I. Introduction

The ideal neuromuscular blocking agent for intubation should have a rapid onset, brief duration of action, free from hemodynamic changes, devoid of residual paralysis and provide excellent intubating conditions like fully relaxed jaw, widely open vocal cord and absence of intubation-response. Both are intermediate acting NDMRs; provide a faster onset, rapid and measurable recovery with little dependence on the kidneys for elimination and great haemodynamic stability. But neither of these agents have been demonstrated to have significantly shorter onset time as needed for rapid tracheal intubation. Rocuronium Bromide (1990s), intermediate acting aminosteroid NMDR, chemically 2-morphine, 3-diacetyl, 16-N-allylpyrollidone derivative of Vecuronium, is five to seven times less potent than Vecuronium. It is cardiostable and has a rapid onset of action, which would render it the muscle relaxant of choice for facilitation of both routine and crash intubation. Its introduction is considered as an added advantage over Vecuronium. In clinical practice Neuromuscular blockers were monitored by assessing the response of muscles by stimulating a particular nerve observing Train of Four with a Neuromuscular monitor. It provides ideal operating conditions with optimal doses of muscle relaxant and helps to minimize side effects like unwanted movements, prolonged paralysis and delayed recovery.

II. Aims and Objectives

1. To compare time of onset, conditions of tracheal intubation, duration of action-between two non-depolarizing muscle relaxants: Vecuronium bromide and Rocuronium bromide; using TOF on adductor pollicis muscles.
2. To compare hemodynamic parameters in the patients under anaesthesia where either of the drugs are used to produce muscular paralysis.

III. Material and Methods

The admitted patients in the surgery wards scheduled for various types of elective abdominal surgical procedures were included in our study. After obtaining approval from ethical committee, the study was done.

Inclusion criteria

Pts. with ASA physical status class-I and II.
Age-15-60 years, Mallampati-I&II.

Exclusion criteria

Hepatic, renal or neuromuscular disease.
Asthma, COPD, heavy smoker.
Cardiovascular disease, hypertensive patients
H/O or Anticipated difficult intubation (e.g. obesity, Pregnancy, mallampati III or IV and thyromental distance < 6 cm).
H/o known allergy to drugs under study.
Those taking anticonvulsants, amino glycosides or any.
Other medications which may affect action of NDMRs.
60 Patients of either sex aged 15-60 years of ASA physical status I & II were selected for the purpose of study.

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Gr-A:-(30 patients): Intubating dose of rocuronium 0.6mg/kg IV.
Gr-B:-(30 patients): Intubating dose of vecuronium 0.1mg/kg IV.

The patients were preoxygenated with 100% oxygen for 3 minutes. Muscle relaxants were given prior to induction with thiopentone sodium. Then induction was done with thiopentone sodium (2.5%) 5mg/kg till the loss of eyelash reflex. The TOF stimulus was given prior to the injection of muscle relaxants. [The supramaximal stimulus of duration 0.2 ms and frequency 2 Hz was delivered in a train-of-four (TOF) stimulation to the ulnar nerve at the wrist via surface electrodes and the resultant four twitches of adductor pollicis muscle were observed visually].
Muscle relaxants were given according to the following schedule.
Intubating dose-Rocuronium (0.6mg/kg iv), Vecuronium (0.1mg/kg iv) The onset time of the muscle relaxant was determined by measuring the time from injection of muscle relaxant to abolition of all four responses to train of four stimulus.
Endotracheal intubation was carried out once maximum block achieved (i.e. all four responses are ablated) and mechanical intermittent positive pressure ventilation instituted with N_2O:O_2 (2:1).
Intubating conditions were scored as excellent [8-9], good [6-7], fair [3-5] and poor [0-2] according to the cooper scoring system.

Table 1: Cooper Scoring System

Score	jaw relaxation	vocal cords	Response to intubation
0	Poor (impossible to open)	Closed	severe coughing/bucking
1	Moderate (opens with difficulty)	Closing	Mild coughing
2	Moderate opening	Moving	Slight diaphragmatic movement
3	Easy opening	Open (relaxed)	No movement

Observation: In the present study, 60 patients aged between 15 and 60 years belonging to ASA grade I and II were randomly divided into two groups, each group consisting of 30 patients.
Group A: Patients received Inj. Rocuronium as the non-depolarizing muscle relaxant in a dose of 0.6mg/kg for intubation and 0.15 mg/kg for maintenance of muscle relaxation.
Group B: Patients received Inj. Vecuronium as the non-depolarizing muscle relaxant in a dose 0.1 mg/kg for intubation and 0.025 mg/kg for maintenance of muscle relaxation.

Statistical methods

The observed results were analysed statistically using chi-square test for qualitative data & students "t" test for quantitative data. An intergro comparison was made using the unpaired t-test and intragroup comparison was made using paired t-test. Microsoft excel was used for analysis of the data. Microsoft word and Microsoft excel were used to generate graphs and table. The inferences based on 'p' value were made as follows:
$p>0.05$-Not significant $p<0.05$-Significant $p<0.01$-Highly significant.

Table 2

Parameters	Rocuronium	Vecuronium	P Value
No. of Patients	30	30	
Age (Yrs)			
Mean	34.83	35.13	0.899
SD	8.66	9.54	
Range	20-50	20-53	

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Weight (KGS)			
Mean	52.87	52.77	0.941
SD	4.94	5.51	
Range	42-62	44-66	
Sex			
Female	15	16	0.796
Male	15	14	

This table shows the distribution of patients according to age, body weight, and sex. The patients were demographically similar in both groups.

Table 3: Types of Operation Conducted in Two Groups

Operation	Rocuronium Gr. A		Vecuronium Gr. B	
	No. of cases	Percentage (%)	No. of cases	Percentage (%)
LAP. Cholecystectomy (LCH)	9	30	8	26.67
Open Cholecystectomy (OCH)	7	23.33	8	26.67
Splenectomy(SP)	3	10	3	10
Truncal Vagotomy + Gastrojejunostomy (TV+GJ)	3	10	3	10
Partial Gastrectomy (PG)	2	6.67	3	10
Lap. Appendisectomy (LA)	6	20	5	16.66

This table shows different types of elective operative procedure conducted in the two groups.

Table 4: Comparison of Mean Time for Onset of Action between Two Groups

Groups	Time for Onset of Action (SEC) Mean + SD	t Value	P Value
Rocuronium (GR A)	98.60±7.578	-14.145	0.000
Vecuronium (GR B)	154.80± 20.400		

This table shows the time required for onset of action of two groups.
The mean (SD) onset of action in group A (Rocuronium) was 98.60(7.578) sec and group B (Vecuronium) was 154.80(20.400) sec, which was statistically highly significant (t value-14.145 and P value 0.000).

Table 5: Profile of Intubating Conditions between Two Groups

Group	Excellent (8-9)		Good (6-7)		Fair (3-5)		Poor (0-2)	
	No. of Cases	%	No. of Cases	%	No. of Cases	%	No. of Cases	%
Rocuronium (Group A)	26	86.67	4	13.33	0	0	0	0
Vecuronium (Group B)	24	80	6	20	0	0	0	0

The table shows the condition for intubation according to Cooper scoring system.

IV. Discussion

The ideal neuromuscular blocking agent for intubation should have following properties like,
1. Rapid onset of action.
2. Short duration of action.
3. Rapid recovery.
4. Non-cumulative.
5. No cardiovascular side effects.
6. No histamine release.

7. Reversible by cholinesterase inhibitors.
8. Pharmacologically inactive metabolites.
9. High potency
10. Availability of specific antidote

In our study we used neuromuscular monitoring by Train of four because the response of neuromuscular blocking drugs is not predictable in all patients so the monitoring of neuromuscular function provides more predictable and rational approach to the use of muscle relaxants and better and faster Recovery of the patients by optimizing the doses, hence provide better patient care.

Onset of action

In the present study the onset of action was considered as the time taken from Injection of muscle relaxant to abolition of all four responses to train of four stimuli.

Table 6: Previous Studies for Onset Time of Action

Author	Onset of action (in seconds)	
	Rocuronium	**Vecuronium**
Booth MG *et al*. [1]	60 sec	96 sec
Magorian T *et al*. [44]	89 sec	144 sec
Scheiber G *et al*. [53]	92sec	112 sec
Chatrath V *et al*. [74]	109.44 sec	254.44 sec
Sathe V *et al*. [75]	95 sec	168 sec
Patel DD *et al*. [83]	75.66 sec	116 sec
SomaniM *et al*. [89]	99.97sec	150.7 sec

In present study, the mean (SD) time for onset of action for group A (Rocuronium group) was 98.60(7.578) sec and group B (Vecuronium group) was 154.80(20.400) sec and onset of action in group A (Rocuronium) was rapid compared to group B (Vecuronium) with high statistical significance ($p<0.001$).

The present study concurs with the findings of the studies of Magorian T *et al*. [44], Sathe V *et al*. [75], Somani M *et al*. [89] who have also reported the onset time similar to our present study. All the previous studies showed that time for onset of action of Rocuronium was faster than Vecuronium with high statistical significance which is similar with our result. Intubating conditions were either excellent or good in both the group in our study. Intubating conditions with Rocuronium were excellent in 86.67% and good in 13.33% patients while in the Vecuronium group, intubating condition were excellent in 80% and good in 20% patients, which were comparable and without statistical significant difference.

Lee HK *et al*. [73] (2009), Suresh SN and Singh NG [76] (2010) found excellent Intubating condition of Rocuronium in 87%, 87.5% respectively in adductor pollicis muscle by using TOF. Our study finding coincides with their results.

A study by Somani *et al*. [89] with $2ED_{95}$ of Rocuronium and Vecuronium using TOF guard monitor at AP showed significantly early onset of action in Rocuronium group without significant difference in intubation scores. A study by Sathe V *et al*. [75] also found that Rocuronium produced excellent and good Intubating condition much earlier than Vecuronium and our study show similar result as these two studies.

The Rocuronium provides clinically excellent or good Intubating conditions much earlier than vecuronium. The reason for this rapid onset of neuromuscular block has been suggested to be low potency of Rocuronium, entailing the presence of more relaxant molecules in the blood stream which results in a large concentration gradient towards the bio phase at pre and

post synaptic receptor sites at neuromuscular junction. Another possible explanation is that plasma protein binding of Rocuronium is less than vecuronium.

V. Conclusion

Rocuronium has a more rapid onset of action and provides excellent and good intubating conditions more rapid than Vecuronium. Both the drugs have similar cardiovascular stability and intermediate duration of action without any adverse effects.Thus the advantage of Rocuronium, with its early onset of action, along with good to excellent intubating conditions and the cardiovascular stability, makes this neuromuscular relaxant a safe and desirablechoice for tracheal intubation in surgical procedures requiring general anaesthesia when there is no anticipated difficulty in intubation.

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