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Comparison of Intubating Conditions of Rocuronium Bromide and Vecuronium Bromide in Thyroid Surgery Using Train of Four

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Abstract
Background & Aim: *Rocuronium and vecuronium are commonly used non depolarising muscle relaxants which are monoquaternary aminosteroid compounds. The aim of this study was to study the onset time, conditions of intubation and duration of action of equipotent doses of rocuronium and vecuronium.*
Methods: *60 patients were divided into two groups of 30 each. Patients allocated to Groups A and B received rocuronium 0.6 mg kg -1 and vecuronium 0.1 mg kg -1 respectively. Tracheas were intubated after train of four count become zero in adductor pollicis muscle. Intubating conditions, onset time and duration of neuromuscular block were assessed both group A and B. Haemodynamic variables were compared at 1,3 and 5 minutes after intubation.*
Results: *The mean onset time was significantly rapid in Group A as compared to Group B.Intubating conditions were excellent in 86% of patients in Group A as compared to 80% in Group B. The mean duration of action and hemodynamic parameters did not show any significant variation between the two groups.*
Conclusion: *In comparison to vecuronium, rocuronium provides earlier acceptable intubation conditions without significant variation in duration of action and hemodynamics.*
Keywords: *rocuronium, train of four, vecuronium, intubation.*

Introduction

Muscle relaxant is used to facilitate endotracheal intubation and provide surgical relaxation.[1] 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.[2,3]

Succinylcholine, which is a depolarizing muscle relaxant, has rapid onset of action and and is useful for rapid sequence intubation.[4,5] However it has several unintended side-effects such as muscle fasciculations, thereby producing postopertive myalgia, hyperkalemia, bradycardia, dysrhythmias, rise in intraocular, intragastric, intracranial pressure, and it also triggers malignant hyperthermia.[6,7,8]. This has led to the search of newer relaxants alternative to succinylcholine with similar parameters like early onset time, excellent intubating conditions but without the side effects of succinylcholine.

Atracurium is a benzyl isoquinoline structure and vecuronium is a mono-quaternary analogue of steroid relaxant pancuronium.[9] 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.[10,11]

Rocuronium Bromide, an intermediate acting aminosteroid NDMR, is five to seven times less potent than vecuronium.[12] It is cardio stable and has a rapid onset of action, which would render it the muscle relaxant of choice for crash intubation.[13] Hence keeping in view of the above facts we have done a comparative study of rocuronium versus vecuronium for endotracheal intubation and maintenance of anesthesia using a train of four guard monitor in thyroid surgery. Our aim was to compare time of onset, conditions of tracheal intubation, duration of action and hemodynamic between two non depolarizing muscle relaxants: rocuronium bromide and recuronium bromide; using TOF on adductor pollicis muscles.

Methods

The present clinical study was performed in the S.C.B Medical College and Hospital, Cuttack during the period from September 2015 to October 2017. Patients scheduled for elective thyroid surgical procedures were included in this study. After obtaining approval from ethical committee (IEC NO-516), the randomised double blind study was done.

Patients with ASA physical status class-I and II, age-15- 60 years, Mallampati- I &II were included in the study. Patients having hepatic, renal or neuromuscular disease, asthma, COPD, heavy smoker and cardiovascular disease were excluded from study.60 Patients were selected for the purpose of study and were randomly allocated into 2 groups of 30 patients each.

Gr-A: (30 patients):- Received intubating dose of rocuronium 0.6mg/kg IV.

Gr-B: (30 patients):- Received intubating dose dose of vecuronium 0.1mg/kg IV.

The purpose and procedure of the study was explained to all patients and informed consent for anaesthesia was obtained and preanesthetic checkup was done.

On arrival into the operating room, non-invasive monitors like electrocardiogram (ECG), non-invasive BP, and pulse oximetry were connected to the patient. Intravenous access was done with an 18G cannula and infusion of crystalloid solution was started. All patients were fasting for at least 6 hr prior to surgery. In premedication, midazolam (0.04mg/kg iv, glycopyrolate (0.005mg/kg iv), and pentazocine (0.5mg/kg iv) was given. The small silver surface electrodes of peripheral nerve stimulator were positioned over ulnar nerve on the volar side of the wrist. 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. The patients were preoxygenated with 100% oxygen for 3 minutes. Then induction was done with inj propofol (2mg/kg) till the loss of verbal contact and loss of eye lash reflex. The TOF stimulus was given prior to the injection of muscle relaxants.

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 (ie all four responses are ablated) and mechanical intermittent positive pressure ventilation instituted with N2O:O2 (2:1). The end-tidal carbon dioxide was maintained in between 30 and 40 mm of Hg. Intubation conditions were assessed using the train of four stimuli. Intubating conditions were scored as excellent [8-9], good [6-7], fair [3-5], and poor [0-2] according to the cooper scoring system.[15]

Table 1: Cooper scoring system

Score	jaw relaxation	vocal cords	Response to intubation
0	Impossible to open	Closed/bucking	severe coughing
1	Opens with difficulty	Closing	Mild coughing
2	Moderate opening	Moving	Slight diaphragmatic movement
3	Easy opening	Open [relaxed]	No movement

Hemodynamic parameters like systolic, diastolic blood pressure and pulse rate were recorded at base line during pre-oxygenation (pre-op) and 1min, 5 min, 10min and 15 minutes after intubation. Anaesthesia was maintained with N2O, O2 and isoflurane. After tracheal intubation, every 5 minutes train of four stimulation was recorded and accordingly muscle relaxants in a maintenance dose of inj. vecuronium 0.025mg/kg and inj. rocuronium 0.15mg/kg was administered and maintained.

The time interval from injection of intubating dose of muscle relaxant to the recovery of the first twitch in the train-of four was taken as the duration of action, which were recorded and compared in two groups. After the end of operative procedure, the reversal was done with inj. Neostigmine and inj. Glycopyrrolate after appearance of all the four twitches of TOF.

Statistical Analysis

The observed results were analysed statistically using chi-square test for qualitative data & students "t" test for quantitative data. An intergroup comparison was made using the unpaired t-test. '*p*' value $p<0.05$ were considered significant:

Results

Table 2 shows the distribution of patients according to age, body weight, and sex. The patients were demographically similar in both groups.

Table-2 Demographic data

Parameters	Group A Rocuronium(n-30)	Group B Vecuronium(n-30)	P Value
Age(yrs)	34.83± 8.66	35.13± 9.54	0.899
Weight(kgs)	52.87 ±4.94	52.77± 5.51	0.941
Sex(M:F)	15: 15	16:14	0.796

Table 3 shows the time required for onset of action of two groups. The mean (SD) onset of action in group A was 98.60 (7.578) sec and group B was 154.80(20.400) sec, which was statistically highly significant (P value 0.001).

Table-3 Comparison of mean time for onset of action)

Groups	Time for onset of action(sec) Mean+SD	P value
Group A Rocuronium	98.60+7.578	0.001
Group B Vecuronium	154.80+ 20.400	

Figure-1 Profile of intubating conditions

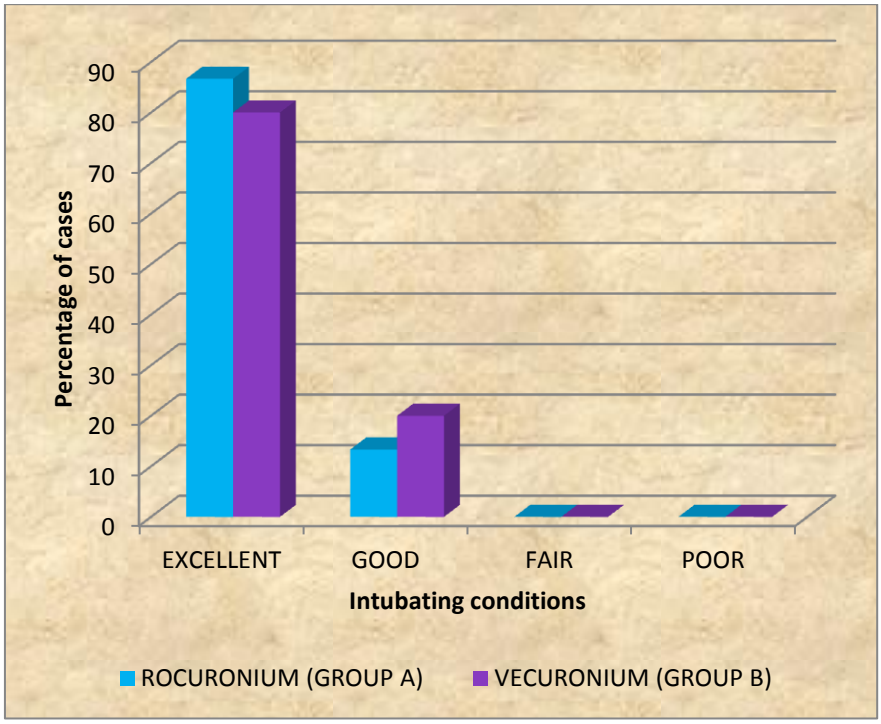

Figure 1 shows the condition for intubation according to Cooper scoring system. In both the groups intubating conditions were either excellent or good. Both group had no fair or poor intubating condition. Intubating conditions with rocuronium were excellent in 26(86.67%) and good in 4(13.33%) patients while in the vecuronium group, intubating condition were excellent in 24(80%) and good in 6(20%) patients, which were comparable and statistically not significant (p=0.488).

Figure-2 Comparison of mean duration of action of intubating dose

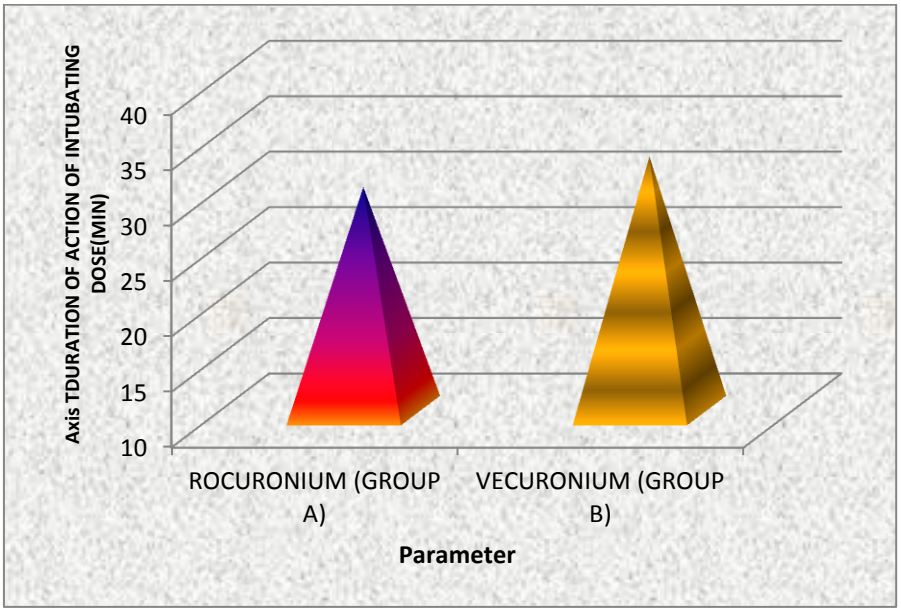

Figure 2 shows the mean duration of action of intubating dose of the two groups. The mean duration of action of intubating dose in group A (rocuronium) was 30.17+5.497 min, and in group B (vecuronium) was 32.90+5.979 minute which was not statistically significant. There were no significant difference in the SBP, DBP and pulse rate between the two groups at various time intervals after intubation.

Discussion

The present study was undertaken to study the neuromuscular properties and cardiovascular effects of rocuronium, the 'near-ideal' muscle relaxant and to compare it with vecuronium.

Singh et al[16] did a comparative evaluation of intubating conditions, onset of action and duration of action of rocuronium bromide and vecuronium bromide. They found that rocuronium provides clinically acceptable intubating conditions much earlier than vecuronium which was similar to our study findings. There have been studies conducted with various doses of these two muscle relaxants for comparison. Rocuronium in the dose of 0.6 mg/kg and vecuronium in a dose of 0.1 mg/kg which are twice their ED95 doses were commonly used for intubation purpose. In the present study, we used 2ED95 doses i.e. rocuronium in the dose of 0.6 mg/kg and compared it with vecuronium in the dose of 0.1 mg / kg as intubating dose. Many other workers like Passavanti et al[17], Sathe V et al [21] and Patel DD et al[22] have also used 2ED95 dose of rocuronium and vecuronium in their study. Study by Parasa M et al.[18] used 3ED95 doses of both drugs in their study which was associated with a longer duration of action and this may be inappropriate in many clinical situations. In our study we used neuromuscular monitoring by Train of four because the response of neuromuscular blocking drugs is not predictable in all patients. Monitoring of neuromuscular function is a rational approach for better and faster recovery of the patients by optimizing the doses, hence provide better patient care.

The demographic table showed the distribution of patients according to age, body weight and sex and there was no statistical significant difference in both groups. Our study shows the time required for onset of action was less in rocuronium group. The mean onset of action in group A was 98.60sec and group B was 154.8sec, which was statistically highly significant. This was similar to findings of Shetty LD et al[19], and Parikh K et al[20] and Dwivedi MB et al[24].

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.

A study by Sathe V et al[21] also found that rocuronium produced excellent and good intubating condition much earlier than vecuronium and our study also show similar result. So rocuronium can provide clinically excellent or good intubating conditions much earlier than vecuronium.

The duration of action of the intubating dose in our study was considered as the time from injection of muscle relaxant to the recovery of the first twitch in the train-of four and maintenance doses were supplemented at the recovery of the first twitch in the train-of-four.

The mean duration of action of intubating dose in group A (rocuronium) was 30.17+5.497 min, and in group B (vecuronium) was 32.90+5.979 minute and which was not statistically significant. In our study there was no significant variation in duration of action between two groups. Such statistical correlation also found in previous studies like Passavanti et al[17] and Patel DD et al[22].

The changes of heart rate, systolic or diastolic blood pressures at the different time intervals after intubation were also comparable in both groups and had no significant difference. This finding is in accordance with the studies of Sathe V et al[21], Patel DD et al[22], Lee H et al[23], and Dwivedi MB et al[24] who have all found no difference in any of the hemodynamic variables between the two groups.

Conclusion

It may be concluded that both the drugs are similar so far as their duration of action, intubating condition and cardiovascular stability is concerned. Both the drugs are free from any significant adverse effects. But onset of action

was significantly quicker with rocuronium in comparison with vecuronium. Hence rocuronium may be accepted as the superior drug between the two, reaching almost all properties of an ideal intubating agent. Use of the Train of four as means to know onset and duration of muscular paralysis is also proved to be the method of choice.

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