ORIGINAL ARTICLE

A Study on Neuromuscular Blocking Effect Of Rocuronium Bromide in Anesthesia In A Tertiary Care Hospital

Hardik Z Patel[1], Avruti R Kacha[2]

[1]Assistant Professor, Dept. Of Anesthesia, GMERS Medical College Valsad, Gujarat, India.
[2]Consultant, Dept. Of Anesthesia & critical care , Baby memorial Hospital, Calicut, Kerala India.

ABSTRACT

BACKGROUND AND OBJECTIVES: Rocuronium bromide is a non-depolarizing muscle relaxant, with a short onset time, an intermediate duration of action and rapid recovery characteristics coupled with cardiovascular stability, with no histamine release or other side effects. The present study was conducted with an objective to study onset of action (time of maximum depression of T1), duration of action, pharmacodynamic effects and recovery profile of rocuronium bromide. **METHODS:** The present study is cross-sectional study conducted on patients posted for general surgeries and ENT surgeries of intermediate duration. The time to achieve maximum blockade and the clinical duration of action were also noted by twitch stimulation using biometer accelograph. **RESULTS:** In our study 18% of the patients showed maximum depression of T1 at 60 seconds when laryngoscopy was done and 42% of the patients showed maximum depression of T1 at 80 seconds, the time by which the endotracheal intubation was completed. In 12% of patients it took more than 100 seconds for the maximal depression of T1. The mean $\pm$SD for maximum depression of T1 is 78.80$\pm$20.76 which indicates the onset time of rocuronium bromide with the dose of 0.6 mg kg^{-1}. **CONCLUSION:** Rocuronium in the dose of 0.6 mgkg-1 for induction of anaesthesia and 0.15 mg kg^{-1}IV for maintainace of anaesthesia can be used as a part of rapid sequence induction, provided there is no anticipated difficulty in intubation.

Keywords: Neuromuscular blockade, rocuronium, accelerograph

INTRODUCTION

Neuromuscular blockers (NMB) have become essential parts of the anesthetist armamentarium. They aid endotracheal intubation, mechanical ventilation, reduce anesthetic requirements, prevent patient movement without voluntary or reflex muscle movement, facilitate surgery, and decrease oxygen consumption. In the development of new neuromuscular blocking drugs, the anesthesiologist is now provided with drugs that are almost free of unwanted effects, have a time course of action that allows great control of their activity and, in most cases, allows the anesthesiologist to substitute them for succinylcholine.[1]

Corresponding Author:
Dr. Hardik Patel,
Anesthesia Department,
GMERS Medical College, Valsad.
M: 9879061174,
Email: djhearty@gmail.com

In selecting a neuromuscular blocking agent, an anesthetist strives to achieve three competing goals: rapid adequate muscle relaxation, hemodynamic stability, and predictable complete return of skeletal muscle function. Rocuronium bromide is a non-depolarizing muscle relaxant, with a short onset time, an intermediate duration of action and rapid recovery characteristics coupled with cardiovascular stability, with no histamine release or other side effects. [2]
Acceleromyography is a simple method of analyzing neuromuscular function. One requirement is that the muscle be able to move freely. During a nondepolarizing neuromuscular blockade, good correlation exists between the TOF ratio measured by this method and the TOF ratio measured with a force displacement transducer.[3] Also the precision of acceleromyography seems to be comparable to that of mechanical measurement.[4]
The present study was conducted with an objective to study onset of action (time of maximum depression of T1), duration of action (Time of recovery of T1 to 25% of

control value), pharmacodynamic (cardiovascular) effects and recovery profile (Time of recovery of T1 to 75% of control value) of rocuronium bromide.

MATERIALS AND METHODS

The present study is cross-sectional study conducted on patients posted for general surgeries and ENT surgeries of intermediate duration were studied. After getting an approval from ethical committee present study was conducted. 50 patients in the age group of 15-60 years of either sex who belongs to ASA physical status I or II were included in the study. Children, pregnant females and patients with anticipated difficult airway, neuromuscular disease, and increased risk of pulmonary aspiration were excluded from the study.

Preanaesthetic examination in the form of thorough history taking, general examination, systemic examination and airway examination was done on the day before the surgery. All the patients were kept nil per oral for 8 hours before the surgery. On the day of surgery written and informed consent was taken and patients were explained about the procedure.

In the operating room iv lines were secured with 18 gauge iv cannula in the upper limbs of the patients. Monitors were applied in the form of ECG, NIBP, SPO2, EtCO2 baseline parameters were noted. NMT monitor acceleromyograph was applied on the ulnar nerve with the help of two surface electrodes. Premedication was given in the form of inj. glycopyrrolate 0.04 mg kg^{-1} iv, inj. fentanyl citrate 1-2 ug kg^{-1} iv, inj. midazolam hydrochloride 0.02 mg kg^{-1} iv and inj. ondansetron hydrochloride 10-15 ug kg^{-1} iv. Ulnar nerve was stimulated by supramaximal stimulus 2Hz at every 2 seconds and baseline TOF count was noted.

Induction of anaesthesia was done with inj. thiopentone sodium 5-7 mg kg^{-1} iv and neuromuscular blockade was achieved immediately with inj. rocuronium bromide 0.6 mg kg^{-1} iv. Time for maximal depression of T1 was noted. TOF count was measured at every 20 seconds for initial 180 secondsand at every 5 minutes for next 15 minutes. Laryngoscopy was done at 60 seconds followed by endotracheal intubation and TOF count was noted at that time. Intubating conditions were assessed by using clinical criteria and DOMOAOL scoring system was used for the same. Hemodynamic parameters were noted at the time of laryngoscopy and intubation.

DOMOAOL Scoring system

Score	1	2	3	4
Laryngoscopy	Easy	Regular	Difficult	Impossible
Vocal cords	Open	Moving	Closing	Closing
Masseters	Relaxed	Regular relaxation	Poor relaxation	Contraction
Rejection of tube	None	Diaphragm	Evident	Severe

Anaesthesia was maintained with O2(50%) / N2O(50%) / Sevoflurane (0.6-2.5%) / Isoflurane (0.4-1.5%). Neuromuscular blockade was maintained with 0.15 mg kg^{-1} of rocuronium bromide. Incremental dose of rocuronium bromide was given after assessment of clinical parameter like movement on reservoir bag or when T1 returned to 25% of the control value. After initial 15 minutes TOF count was monitored at every 15 minutes till the end of the surgery. Peri operative monitoring for temperature, pulse, SBP,DBP, MBP,SPO2, EtCO2, urine output and intravenous fluid was done at every 5 minutes for initial 15 minutes and at every 15 minutes till the end of the surgery. Patients were monitored for intra operative complications like hypo/hyper tension, tachycardia/bradycardia and were managed accordingly. Once the surgery got over the patients were reversed with inj. glycopyrrolate 8 ug kg^{-1} iv and inj neostigmine methylsulphate 0.05 mg kg^{-1} iv. The reversal was started after recovery of T1 to 25% of control value and bag movement was present at the same the time. Patients were extubated when they had regular, smooth respiration with adequate tidal volume on reservoir bag and 75% recovery of T1 on NMT monitor. Patients were shifted to post operative ward where they were monitored for hypoxia, inadequate reversal of neuromuscular block, hypo/hyper tension,

tachy/bradycardia if any and were treated accordingly.

RESULTS

The present study included 50 patients of 15 to 60 years of age, weighing 30 to 75 kg of either sex, belonged to ASA physical status I or II were included. The patients were admitted for ENT surgeries like septoplasty, FESS, DCR, tonsillectomy and general surgeries like laproscopic appendicectomy, diagnostic laproscopy were included in the study. These surgeries were of intermediate duration.

DOMOAOL scoring system was used for the assessment of intubating conditions at 60 seconds of the administration of rocuronium bromide. Total score is 16. Intubating conditions were evaluated 4-5 as excellent, 6-8 as good, 9-12 as regular and 13-16 as bad intubating conditions. In our study 100% of the patients had excellent to good intubating conditions.

In our study 18% of the patients showed maximum depression of T1 at 60 seconds when laryngoscopy was done and 42% of the patients showed maximum depression of T1 at 80 seconds, the time by which the endotracheal intubation was completed. In 12% of patients it took more than 100 seconds for the maximal depression of T1. The mean ±SD for maximum depression of T1 is 78.80±20.76 which indicates the onset time of rocuronium bromide with the dose of 0.6 mg kg^{-1}.

Table 3: Distribution of subjects according to TOF ratio at the time of intubation

TOF ratio at the time of intubation	No. of patients	Percentage
0.5-0.4	11	22
0.39-0.3	02	04
0.29-0.2	10	20
0.19-0.1	16	32
<0.1	11	22

TOF ratio (T4/T1) was observed at the time of intubation. It is inversely proportional to the degree of neuro muscular blockadge and so to the intubating conditions. Maximum TOF ratio is 1. In our study TOF ratio was < 0.5 for 100% of the patients and < 0.2 in 54% of the patients. This indicates excellent to good intubating conditions in 100% of the patients. Mean±SD for TOF ratio was 0.23±014.

Table no. 4 shows that time of return of T1 to 25% of control/flickers on reservoir bag in minutes observed that by giving loading dose to 1st incremental dose was around 43.66 +_ 7.42 minutes. While 3rd incremnetal dose of rocuronium bromide administered it was found that 16.66+-2.43 minutes.

Table 4: According to time of return of T1 to 25% of control/ flickers on reservoir bag (mins).

Time interval	Mean±SD (minutes)
Loading dose to 1st incremental dose/reversal	43.66±7.42
1st incremental dose to 2nd incremental dose/reversal	21.86±4.32
2nd incremental dose to 3rd incremental dose/reversal	20.20±3.37
3rd incremental dose to reversal	16.66±2.43

Table 5: Time of return of T1 to 75% of control value/presence of spontaneous respiration (sec)

Time of return of T1 to 75% of control value (sec)	No. of patients	% of the patients
100-139	1	2
140-179	23	46
180-219	17	34
220-259	6	12
260-299	2	4
300-339	0	0
339-375	1	2

Table no 5 shows that time of return from T1 to 75% of control value/presence of spontaneous respiration in which majority of patients return within 140 to 179 sec followed by 180 to 219 sec. Only 2 % of patients return within 100 to 139 seconds.

DISCUSSION

In our study the onset time of rocuronium bromide evaluated by maximum depression of T1 is 78.80±20.76 seconds. H. J. Spaar et al[5] studied the influence of induction technique on intubating conditions after administration of rocuronium in adults comparing it with rapid sequence induction using suxamethonium and thiopentone and observed that intubation time was similar in all four groups with a mean value of 55.0 ±3.4s and tube could be passed from open vocal cords within 70s. In rocuronium group with either thiopentone or propofol as an induction agent and

without alfentanil as a premedication agent, intubating conditions were excellent only in 40% and 32%, good in 40% and 60% and fair in 20% and 8% of patients respectively ($p<0.0001$ vs control) compared to excellent in 88% and good in 12% of the patients in suxamethonium group irrespective of premedication and induction agent. In 10% of the patients in rocuronium group the tube was placed after 60s because of problems with laryngoscopy or closed and mobile vocal cords. They assessed that after rocuronium the response of the diaphragm to intubation was more pronounced in the two groups of patients not receiving alfentanil ($p<0.0001$).

Madhavi Barve and Roopa Sharma[6] evaluated the intubating conditions using Cooper scoring system (total score 18) and concluded thatwith intubating dose of rocuronium, 65% patients could be intubated at 60 s and 100% at 90s; while with the succinylcholine 100% patients could be intubated at 60s. In both groups intubating conditions were clinically acceptable and comparable at the time of intubation. Singh Ajeet et al[7] noted intubating conditions and scored them according to a modification of the method described by Krieg et al with total score of 18. Total intubation score achieved at 60 s was 7.37±2.07 and 7.79±1.27 in suxamethonium and rocuronium groups respectively.

Passavanti MB[8] observed that 40% of adult group A0.5 showed excellent intubabation conditions versus 60% of A0.9 ($p<0.05$); elderly patients did not show any significant difference in the intubation procedure after two different doses of rocuronium bromide. Cooper et al score was used for the grading of the intubating conditions.

In our study mean±SD for TOF ratio (T4/T1) at the time of intubation was 0.23±0.14. Woolf Rex L et al[9] showed the duration of neuromuscular block after rocuronium increased when the dose was increased. The time to 25% recovery after 1.2 mg kg^{-1} of rocuronium (41±13 min) was approximately 50% greater than that after 0.8 mg kg^{-1} (27±06 min) ($p<0.01$) and eight times greater than that after succinylcholine (5.2±1.9 min) ($p<0.001$). Madhavi Barve and Roopa Sharma[6] noted that clinical duration of the intubating dose of succinylcholine was significantly lesser (4.20±0.93 min) than that of rocuronium (15.36±3.03 min) ($p<0.001$). Singh Ajeet et al[7] demonstrated duration of action of suxamethonium as 318±60 sec and rocuronium as 1705±132 sec ($p<0.001$). Anand Tippanna Talikoti and G.S.Venkatesh found the mean duration of action of succinylcholine at a dose of 1 mg kg^{-1} 4.77±0.99 minutes, mean duration of action of rocuronium 0.6 mg kg^{-1} as 27.4±2.14 minutes and mean duration of action of rocuronium 0.9 mg kg^{-1} as 45.33±3.73 minutes by using clinical criteria. Passavanti MB et al[8] calculated the mean duration of action of rocuronium with two different doses by estimation of recovery of T1 to 25% of normal value. The results were 36.3±2.1 min in A0.5 group, 46.8±3.5 min in E0.5 group, 41.4±2.2 min in A0.9 group and 47.7±1.9 min in E0.9 group.

Ashraf Mounir Amin et al[10] in their comparative study of neuromuscular blocking and hemodynamic effects of rocuronium and cisatracurium under sevoflurane or total IV anaesthesia. They showed mean duration of action of these two neuromuscular blockers by observing return of twitch height to 25% as 18±4.8 min in group I (rocuronium and sevoflurane), 19±4.5 min in group II (cisatracurium and sevoflurane), 15±3.3 min in group III (rocuronium and propofol) and 16±6.3 min in group IV (cisatracurium and propofol).

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