

A Comparative Study of Intubating Conditions for Rapid Sequence Induction Between a Single Dose of Vecuronium and Rocuronium

Viraj Namshikar¹, Pabitra Ghoshal², Abhinav Pai³, Esha Nilekani⁴, Shradha Manjrekar⁵

¹Assistant Professor, Department of Anaesthesiology, Goa Medical College, Bambolim, Goa.

²Lecturer, Department of Anaesthesiology, Goa Medical College, Bambolim, Goa.

³Senior Resident, Department of Anaesthesiology, Goa Medical College, Bambolim, Goa.

⁴Senior Resident, Department of Anaesthesiology, Goa Medical College, Bambolim, Goa.

⁵Senior Resident, Department of Anaesthesiology, Goa Medical College, Bambolim, Goa.

ABSTRACT

BACKGROUND

Rapid sequence induction is performed in patients at risk of aspiration with a short onset muscle relaxant which reduces the time of gastric insufflation before surgery, along with helping in the rapid control of the airway with adequate intubating conditions. Succinylcholine has been most commonly used, alternatively replaced by rocuronium (non-depolarizing muscle relaxant) which has a similar onset of action of one minute. However, succinylcholine cannot be used in all patients because of its various side effects, and rocuronium isn't available in all centres; in addition to requiring the use of TOF monitoring for muscle paralysis and reversal of the drug. Vecuronium is an intermediate acting non-depolarizing muscle relaxant, with cardio-stable properties, more economical than rocuronium, with an equal potency and in previous studies has been used at a single higher dose to intubate patients in one minute of administration.

METHODS

A prospective randomized comparative study was conducted in 100 patients scheduled for surgeries under general anaesthesia in the emergency and routine hours of American Society of Anaesthesiologist physical status I and II patients and was divided into two groups of 50 each. Group A received Inj. Vecuronium (0.3 mg/kg) and Group B received Inj. Rocuronium (1.2 mg/Kg) administered as the muscle relaxant after intravenous induction, and the patients were intubated at one minute. Vitals and TOF monitoring were done from preinduction up to 5 minutes after intubation. Intubating conditions were compared using an intubation score, and haemodynamic stability and any side effects were noted along with any significant delay in reversal of the patient at the end of the surgery. Student t test was utilized to compare demographic data, hemodynamic variables and ANOVA was used to evaluate the intubation condition scores and the TOF ratios at 0- and 1-minute intervals.

RESULTS

The intubating conditions were found favourable and similar in both groups, and TOF values at 1 minute were also similar. Haemodynamic variables were comparable in both groups and no significant side effects were found in either group.

CONCLUSIONS

Vecuronium can be used as a muscle relaxant for rapid sequence intubations.

KEYWORDS

Vecuronium, Rocuronium, Rapid Sequence Intubation, TOF, One-Minute Intubation

Corresponding Author:

*Dr. Pabitra Ghoshal,
#301a, Ruturaj Residency,
Opp. Radhakrishna Temple, Khorlim,
Mapusa- 403507, Goa.
E-mail: pabi1984@yahoo.com
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BACKGROUND

Rapid sequence induction is performed in patients at risk of aspiration requiring general anaesthesia for surgery. It is used for emergency tracheal intubation to protect the airway against gastric aspiration, facilitate intubation and also control raised intracranial pressures.¹ Succinylcholine is a depolarizing muscle relaxant which is an agent of choice, alternatively replaced by rocuronium (non-depolarizing muscle relaxant) which has a similar onset of action of one minute.² However succinylcholine cannot be used in all patients because of its serious side effects due to its membrane depolarizing effect and extracellular release of potassium.¹ rocuronium is the alternate drug of choice for rapid sequence intubations due to its rapid onset action, excellent intubating conditions however isn't available in all centres, and requires TOF monitoring to reverse the drug and muscle paralysis.³ vecuronium is an intermediate acting non depolarizing muscle relaxant, with cardio-stable properties, more economical than rocuronium, with an equal potency and in previous studies has been used a single higher dose to intubate patients in one minute of administration. In one study where rapid sequence induction was compared with a large dose of vecuronium (0.3 mg/kg) with or without priming they found at this dose the clinical duration to be long and unpredictable a longest intubation time of 140 seconds and longest onset of 200 seconds, some patients also required additional reversal at the end of surgery, however no change in hemodynamic was noted.⁴ In another study higher doses of vecuronium were found safe to us with no dose related change in heart rate, blood pressure or histamine release, and could safely increase the speed of block onset, but was noted to have a significantly prolonged duration of action.^{5,6} This study therefore is undertaken to compare the intubating conditions by both rocuronium and vecuronium as a single dose muscle relaxant at one minute after administration for rapid sequence induction.

METHODS

This prospective randomized control study was undertaken in a group of 100 patients presenting for surgeries under general anaesthesia in a tertiary care hospital. It was conducted after approval of the institutional medical ethical committee. The population under study were between the ages of 18-60 years and of American Society Physical Status class I and II, of both sexes, scheduled for surgeries during emergency and routine hours which required general anaesthesia with endotracheal intubation who were adequately nil by mouth. Patients were explained the study and informed consents were taken. Those who refused consent, had altered hepatic or renal parameters, were anticipated difficult airways (Mallampati III or IV) or were at risk of aspiration were excluded from the study. Randomization was achieved by a double blinded technique into two groups. Both patients were preoxygenated with 100% oxygen for 5 minutes before induction following which

intravenous access was established and total intravenous anaesthesia with Intravenous midazolam (0.05mg/kg), Fentanyl 2mcg/kg) and Propofol 2.5 mg/kg was given. After confirming loss of consciousness and bag mask ventilation, Group A received Injection vecuronium 0.3 mg/kg and Group B received rocuronium 1.2 mg/kg as the muscle relaxant. Vitals like Pulse, Blood pressure and oxygen saturation were monitored for five minutes after induction. TOF ratios were attained with a peripheral nerve stimulator at zero and the one minute after the muscle relaxant was administered, after which in both groups the patients were intubated after direct laryngoscopy. Person conducting the intubation was a conventionally trained anaesthesiologist with three years' experience, was blinded to both the drug and the TOF scores at one minute. Intubating conditions were compared using a intubation score by Cooper et al. (Table 1.1) and were then summated as poor (0-2), Fair (3-5), good (6-7) and excellent (8-9).

| Score | Jaw Relaxation | Vocal Cords | Response to Intubation |
|-------|---------------------|-------------|-------------------------------|
| 0 | Poor (impossible) | Closed | Severe Coughing/Bucking |
| 1 | Minimal (Difficult) | Closing | Mild Coughing/bucking |
| 2 | Moderate (Fair) | Moving | Slight Diaphragmatic Movement |
| 3 | Good (Easy) | Open | None |

Table 1.1 Intubation Score

The peripheral nerve stimulator (TOF Watch SX) to monitor was placed on the hand opposite to the arm with intravenous line, using the thumb and adductor pollicis to measure the TOF. After calibration it was measured at one minute, following which irrespective of the value, the patient was intubated. TOF was taken at induction, then at one minute before intubation. Hemodynamic variables like pulse, blood pressure, SpO₂ were taken preinduction then at induction, one, three and five minutes after induction. Complications such as hypotension (defined as Blood pressure less than 20% of baseline values was treated with fluids and ephedrine bolus 5 mg), Bradycardia (defined as heart rate less than 20% baseline was to be treated with IV atropine 0.6 mg/kg), anaphylaxis and any difficulties in intubation were noted. General anaesthesia was then maintained on oxygen air mixtures of 50:50 ratios along with sevoflurane. Muscle relaxation was continued with boluses of the same relaxant used for induction as required and analgesia was continued with Fentanyl boluses and Diclofenac 2 mg/kg intravenously and any significant delay in reversal of the patient at end of surgery was also noted. The data was analysed using the software SPSS 14 for windows. ANOVA and Student t tests were used for statistical data analysis, Student-T tests were utilized for the demographic data and the Hemodynamic variables, whereas the ANOVA multivariate analysis for used for assessing the intubating scores and the TOF scores at zero and one minute. P value of >0.05 was considered statistically insignificant and P values <0.05 were of statistical significance.

RESULTS

A total of 100 patients were enrolled in the study, where Group A received vecuronium and Group B received rocuronium (n=50 in each group). Both the groups were found comparable in terms of demographic data i.e. Age, gender, weight ASA grades as seen in table 1.2. Intubation scores were found to be similar in both groups with a p value of 0.8666, most scores were found to be excellent to good. TOF scores at zero and one minute were also found to be similar as mentioned in Table 1.3

| Parameters | Group A (n=) vecuronium | Group B (n=) rocuronium | p-Value |
|---------------------------|-------------------------|-------------------------|---------|
| Age in years (Mean ± SD) | 39.8±12.93 | 42.07±11.62 | 0.7331 |
| Gender (male/Female) | 13/37 | 18/32 | 0.4453 |
| Weight in kgs (Mean ± SD) | 56.12±11.84 | 59.33±10.48 | 0.8887 |
| ASA Grades (I/II) | 37/13 | 38/12 | 0.8352 |

Table 1.2

| | Group A (n=) vecuronium | Group B (n=) rocuronium | p-Value |
|---------------------------------|-------------------------|-------------------------|---------|
| TOF (zero) | 102 | 109 | 0.9478 |
| TOF (one minute) | 3 | 2 | 0.9802 |
| Intubation scores at one minute | 9 | 8 | 0.8666 |

Table 1.3

No complications were noted in either group. All the patients recovered in time out of anaesthesia and the muscle paralysis with no postoperative complication.

DISCUSSION

Rapid sequence induction is still considered a preferred method of securing the airway in patients who present in emergency situations for rapid airway control, to prevent aspiration, provide controlled ventilation. It gets administered with intravenous induction agents for sedation, hypnosis and amnesia and a drug with a short onset of action for muscle paralysis.

Good intubating conditions have been considered with succinylcholine and rocuronium. Succinylcholine falls short with its adverse responses to hyperkalaemia, post intubation muscle cramps, succinylcholine apnoea, risk of potential malignant hyperthermia and arrhythmia in patients with certain pre-existing co morbidities. Rocuronium is then considered the ideal drug; with its quick reversal with sugammadex in case of a difficult airway. But it is unfortunately not used in many developing countries due to its high cost.

Vecuronium belongs to the same group as rocuronium as an intermediate acting depolarizing muscle relaxant. When routinely administered it provides standard intubating conditions at its ED95 dose 3 minutes after it is administered. However some studies have used it at a higher single dose (3 times ED95) which was seen to produce the same relaxation as that at three minutes.^{6,7,8,9} It is easily available, economical and has known cardio stable properties and hence we used it to compare its intubating

conditions at one minute at a higher dose with rocuronium to compare the intubating conditions produced.

In our study all 100 patients were included in the study population, and the demographic parameters were found comparable in both groups similar to previous studies.

Intubating scores were similar in both groups. TOF at zero and one minute were similar in both groups. No complications noted in either group, neither was any delay in recovery noted in the patients under study. However, at one minute tearing was noted in a few patients, but that could be deputed to quick metabolism of the intravenous agents as sometimes seen with rapid sequence induction, however no change in hemodynamic was simultaneously noted. The vocal cords were adequately relaxed but diaphragmatic movement was noted in some of the patients.

Limitations

Few patients still had inadequate peripheral muscle relaxation, although the vocal cords were adequately relaxed, this could be attributed to the mechanism of action of a non-depolarizing muscle relaxant which acts delayed at peripheral neuromuscular junctions.

CONCLUSIONS

This study provided comparable intubation scores and conditions when vecuronium was used at a higher single dose, and hence it may be used for rapid sequence intubations.

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