



COMPARISON OF INTUBATING CONDITIONS AND HAEMODYNAMIC CHANGES USING ROCURONIUM AND VECURONIUM BROMIDE DURING ENDOTRACHEAL INTUBATION

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ABSTRACT

Background and Aims: Use of suxamethonium as muscle relaxant is associated with various side effects, some of which are inconvenient while others may be potentially harmful. Considering various side effects of succamethonium the present study was undertaken to compare the onset of action, intubating conditions and hemodynamic parameters using vecuronium and rocuronium for laryngoscopy. **Methods:** Sixty patients scheduled for different surgical speciality posted for various elective procedures under general anaesthesia were randomly divided into two groups. Thirty patients in Group A and Group B were given intubating dose of rocuronium 0.6mg/kg and vecuronium 0.1 mg/kg

respectively Primary outcome measures were the onset of action whereas secondary outcome measure were intubating conditions and hemodynamic parameters using vecuronium and rocuronium for laryngoscopy. Comparison of quantitative and qualitative variables between groups was done using unpaired student's "t" test and chi-square test respectively using statistical package for social sciences. **Results:** Onset of action of rocuronium [59.2(± 4.0) seconds] was significantly shorter than v ecuronium [136.6(± 6.6) seconds] with p value 0.001. The duration of action of vecuronium [45.3(±3.1) minutes] of was slight longer than rocuronium [41.1(±4.4) minutes]with p value 0.001. There was no statistically significant difference in intubating conditions. **Conclusion:** Rocuronium can be used as a muscle relaxant for laryngoscopy and intubation over v ecuronium.

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INTRODUCTION

Use of a muscle relaxant revolutionized anaesthesia practice by providing intense neuromuscular blockade of very rapid onset and ultra short duration, thereby greatly easing the maneuver of tracheal intubation. Since then, it has been widely used as a muscle relaxant of choice for most of the patients. But, its use is associated with various side effects, some of which are inconvenient while others may be potentially harmful. In addition, its use may be contraindicated in some situations.

The unwanted side-effects which may be encountered with suxamethonium include muscle fasciculations, post-operative myalgia, hyperkalemia, increased intraocular, intragastric and intracranial pressures, and cardiac arrhythmias. In addition to these potential problems, prolonged apnea may be encountered in individuals with atypical pseudocholinesterase. It may also induce malignant hyperthermia and myoglobinuria, a grave situation in susceptible patients. Thus, it falls short of an ideal muscle relaxant due to its potentially hazardous side effects, in spite of having the advantages of rapid action and quick recovery. Thus, the need for a rapid acting non-depolarizing neuromuscular blocking agent to replace suxamethonium for rapid sequence induction of anaesthesia has therefore been obvious for many years.

The search for better drugs to meet the properties of an ideal neuromuscular blocking agent, led to the development of new non-depolarizing neuromuscular blocking drugs. Recently, developed drugs of intermediate duration include vecuronium and atracurium which are, to a major extent, free from various side effects encountered with suxamethonium. However, even after intubating doses, onset time is relatively slow as compared with suxamethonium that of for rapid tracheal intubation. The use of high initial bolus dose of either atracurium or vecuronium shortens the onset time, but at the expense of a prolonged duration of action, which may be undesirable in certain situations.

The new addition in the list of neuromuscular blocking agents is rocuronium bromide, which fills the gap for an agent, with rapid onset while lacking the potentially adverse features associated with suxamethonium, retaining a medium duration of action and meeting most of the requirements of an ideal neuromuscular blocking agent.

Work carried out by various workers has confirmed the long held belief, that a rapid onset of action can be produced by compounds of relatively low potency. This concept was in part the basis for the development of rocuronium bromide. Rocuronium is an aminosteriod non depolarizing neuro muscular blocking agent used in modern anaesthesia, to facilitate endotracheal intubation and to provide skeletal muscle relaxation during surgery or mechanical intubation. Introduced in 1994, rocuronium has rapid onset, and intermediate duration of action. The intubating dose of rocuronium is 0.6 mg/kg.^[1] Vecuronium bromide is a muscle relaxant in the category of non-depolarizing blocking agents. Vecuronium bromide is indicated as an adjunct to general anaesthesia, to facilitate endotracheal intubation and to provide skeletal muscle relaxation during surgery or mechanical ventilation. The intubating dose for vecuronium bromide is 0.1 mg/kg.^[2]

Considering the various side effects of succamethonium the present study was undertaken to compare the onset of action, intubating conditions and hemodynamic parameters using vecuronium and rocuronium for laryngoscopy.

MATERIAL AND METHODS

This prospective, randomised double-blind controlled study was conducted between October 2015 and December 2016. After scientific advisory committee and institutional ethics committee approval, written informed consent was obtained from all patients. Patients aged 18 to 60 years of either sex scheduled different surgical speciality posted for various elective procedures under general anaesthesia, and American Society of Anaesthesiologist (ASA) grade I and II were included. Pregnant or lactating women, patients having pre-existing problem of difficult intubation, paralysis or neuromuscular disorder, h/o drug intake that might affect neuromuscular blocking agent, and impaired renal or hepatic function were excluded from this study.

Out of 65 patients assessed for eligibility, after exclusion 60 patients were randomly divided into two equal groups of 30 each, using computer generated randomization code (Fig 1). We used website <https://www.sealedenvelope.com/simple-randomiser/v1/lists> for creating a randomization list with block size four. Group A patients and Group B patients were given intubating dose of rocuronium 0.6mg/kg and vecuronium 0.1 mg/kg respectively. An operation theatre nurse prepared syringes with rocuronium or vecuronium and put them into concealed envelopes according to the allocation orders. This was done under the supervision of senior anaesthesiologist. Researcher and patients were blind as to group assignment.

Pre-anaesthesia checkup was done one day prior to surgery. The patients were evaluated for any systemic diseases and laboratory investigations were recorded. Details of the procedure was explained to the patients. In operation theatre, adequate intravenous (IV) access was confirmed. Standard monitors were attached. Noninvasive blood pressure, pulse-oximeter, electrocardiogram, end tidal CO₂ (ET CO₂) were monitored after intubation. Before induction of anaesthesia, all patients were given IV glycopyrrolate 0.004 mg/kg, IV ondansetron 75 microgram/kg, and IV ranitidine 50 mg. The patients were pre-oxygenated with 100% oxygen for three minutes before induction. In all patients, anaesthesia was induced with IV fentanyl 2 µg / kg, IV propofol 2-2.5 mg / kg. After abolition of eye reflex, intubating dose of muscle relaxant of either inj. rocuronium (0.6 mg/kg) or inj. Vecuronium (0.1mg/kg) as selected by randomization was given. The time of administration of relaxant was noted. Time in seconds from injection of study drug till train of four (TOF) score 0 was measured by intermittently noting response to TOF.

The degree of muscle relaxation was monitored with the help of TOF machine. Direct laryngoscopy was performed when TOF was 0 and the intubating conditions were observed according to “Copenhagen consensus rating scale”. The time interval from the administration of the relaxant to the time at which TOF showed 0 was noted. The patient was then intubated with adequate size cuffed endotracheal tube and intermittent positive pressure ventilation was started with N₂O and O₂ mixture through Bain circuit. All patients were maintained on nitrous oxide and oxygen mixture (2:1) and intermittent injection of rocuronium or vecuronium. Analgesics and sevoflurane were given as per requirement. Onset of action (assessed by TOF machine), intubating conditions such as laryngoscopy (jaw relaxation), vocal cord (position and movement), response to intubation (coughing and limb movement), cardiovascular response (pulse rate, blood pressure, and SPO₂) were observed and recorded at baseline, immediately after intubation and 10 minutes later. Intubating conditions were assessed as excellent, good or poor using Copenhagen consensus rating scale.

Copenhagen Consensus rating scale.

Intubating condition variables	Clinically acceptable		Clinically unacceptable
	Excellent	Good	Poor
Laryngoscopy	Easy	Fair	Difficult
Vocal cords Position Movement	Abducted None	Intermediate Moving	Closed Closing
Response to intubation Movement of limbs Coughing	None None	Slight Diaphragmatic	Vigorous Sustained (>10s)

At the end of surgery, reversal was done with inj. neostigmine 50 microgram/kg and inj. glycopyrrolate 40 microgram/kg. After return of adequate respiratory effort and upper airway reflexes along with spontaneous eye opening, extubation was done. The patient was shifted to recovery.

Laryngoscopy was defined as easy if jaw was relaxed, no resistance to blade in the course of laryngoscope, fair if the jaw relaxed, slight resistance to the blade and difficult if poor jaw relaxation, active resistance of the patient to laryngoscopy. Intubating conditions were defined as excellent if all variable listed under 'excellent' were present, good if only variable listed under 'excellent' or 'good' was present and poor if the presence of any variable listed under 'poor' was present.

Primary outcome measures were the onset of action whereas secondary outcome measure were intubating conditions and hemodynamic parameters using vecuronium and rocuronium for laryngoscopy.

On the basis of previously published study,^[3] a sample size of 30 patients in each group was calculated by a formula^[4] with 80 % power and 5 % probability of Type I error to reject null hypothesis. Data collected were entered in the Excel 2007 and analysis of data was done using Statistical Package for Social Sciences (SPSS) version 20, IBM, USA. The comparison of quantitative variables between the groups such as mean age, mean weight, mean heart rate, mean systolic BP, mean diastolic BP, mean SPO₂, mean train of monitoring and mean duration of action was done using unpaired student's "t" test, whereas comparison of qualitative variables such as age group, gender, ASA grade, laryngoscopy status, vocal cord status and response to intubation was done by using chi-square test or Fisher's exact test. The confidence limit for significance was fixed at 95% level with p-value < 0.05.

RESULTS

Out of 65 patients assessed for eligibility, 5 were excluded because of impaired renal function (2), impaired hepatic function (1), refused to participate (2). Sixty patients were randomly allotted, 30 patients in each group and were analyzed and compared (Fig.1).

Both groups were comparable with respect to mean age, age groups, sex distribution, mean weight, and ASA physical status (Table 1). As depicted in table 2, mean heart rate 10 minutes after intubation was significantly higher in vecuronium group but there was no statistically

significant difference in other hemodynamic parameters between the two groups. As shown in table 3, onset of action of rocuronium was significantly shorter than vecuronium whereas the duration of action of vecuronium was slightly longer than rocuronium. There was no statistically significant difference in intubating conditions such as laryngoscopy status, vocal cord status and response to intubation.

Table 1: Demographic profile.

Demographic characteristic	Group A (N = 30)	Group B (N = 30)	p value
Mean age in years(SD)	37.2 (± 6.6)	36.4 (± 7.1)	0.500
Age in years (%)			
< 30	5(16.7)	5(16.7)	0.993
30 <40	15(50.0)	16(53.3)	
40 < 50	9(30.0)	8(26.7)	
>50	1(3.3)	1(3.3)	
Gender, no (%)			
Male	15 (50.0)	14 (46.7)	0.796
Female	15 (50.0)	16 (53.3)	
Mean weight in kg (SD)	60.7 (± 5.6)	60.3 (± 7.0)	0.809
ASA Grade (%)			
I	19 (63.3)	21(70.0)	0.584
II	11(36.7)	9(30.0)	

Table 2: Comparison of vital parameters.

Vital parameters	Group A (N = 30)	Group B (N = 30)	p value
Heart rate / minute (SD)			
Baseline	81.7(± 4.4)	83.5(± 5.3)	0.156
Immediate after intubation	91.5(± 5.4)	93.5(± 4.7)	0.131
After 10 minutes	80.6(± 4.1)	83.2(± 5.2)	0.039
Systolic BP (SD)			
Baseline	126.9(± 5.0)	127.9(± 5.0)	0.427
Immediate after intubation	144.7(± 5.4)	146.7(± 5.5)	0.161
After 10 minutes	126.8(± 4.0)	128.6(± 5.4)	0.143
Diastolic BP (SD)			
Baseline	75.2(± 4.7)	77.9(± 5.6)	0.181
Immediate after intubation	87.9(± 4.7)	88.1(± 5.8)	0.922
After 10 minutes	75.7(± 4.9)	76.8(± 5.5)	0.387
SPO₂(SD)	100(0.0)	100(0.0)	0.999

Table 3: Intra operative comparison.

Parameters	Group A (N = 30)	Group B (N = 30)	p value
Train of four monitoring in seconds (SD)	59.2(± 4.0)	136.6(± 6.6)	0.001
Duration of action in minutes (SD)	41.1(±4.4)	45.3(±3.1)	0.001
Laryngoscopy status (%)			
Easy	30(100.0)	30(100.0)	0.999
Difficult	0(0.0)	0(0.0)	
Vocal cord status (%)			
Abducted position	30(100.0)	30(100.0)	0.999
No movement	30(100.0)	30(100.0)	0.999
Response to intubation (%)			
No limb movement	30(100.0)	30(100.0)	0.999
No cough	30(100.0)	30(100.0)	0.999

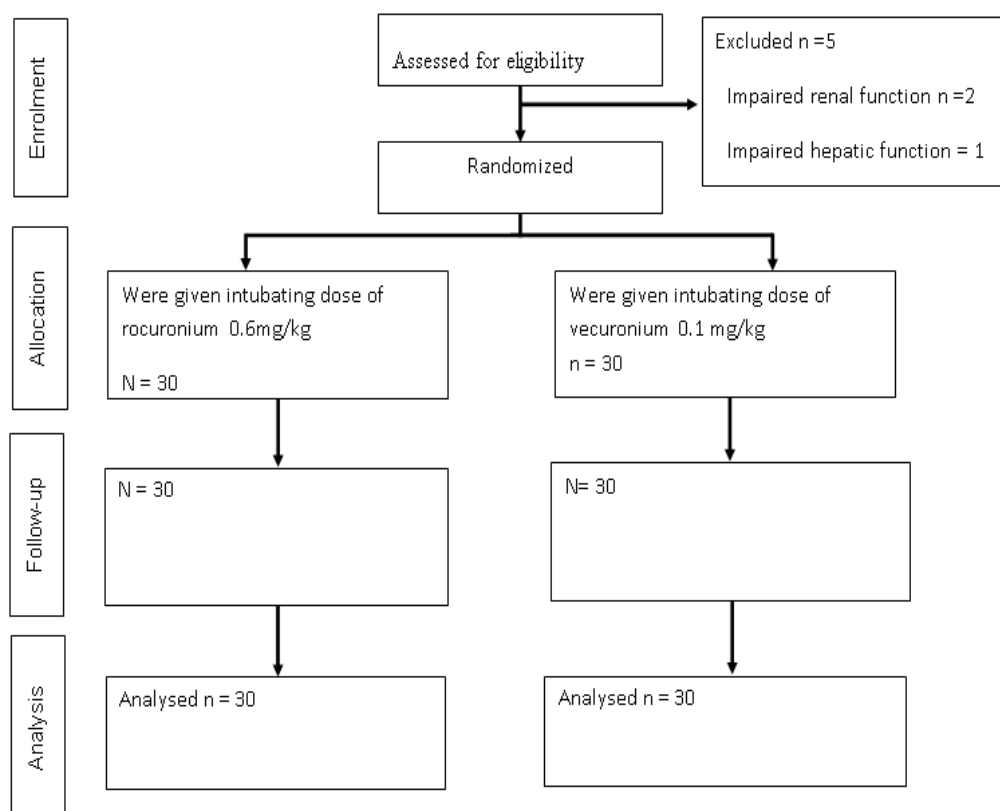


Fig 1: CONSORT Diagram.

DISCUSSION

In the present randomized controlled study onset of action, intubating conditions and hemodynamic parameters using vecuronium and rocuronium for laryngoscopy were compared in 60 patients, between 18 and 60 years of age scheduled for various elective surgeries under general anaesthesia. Onset of action of rocuronium was significantly shorter than vecuronium whereas the duration of action of vecuronium was slightly longer than rocuronium in the present study.

The studies conducted by J.M.K. H. Wierda *et al*^[5], Bartkowski RR *et al*^[6] and Robertson EN *et al*^[7] reported that rocuronium provided clinically acceptable intubating conditions in shorter time with least side effects as compared to succinylcholine and vecuronium. The results of the above studies are comparable with our research. W.M. Schramm *et al*^[8] reported that there was no significant changes in the mean arterial blood pressure after rocuronium(0.6 mg/kg) and vecuronium (0.1 mg/kg). Our study substantiated the findings. Lewy *et al*^[9] reported that in doses upto 1.2 mg/kg rocuronium has minimal cardiovascular side effects both in healthy patients and those with cardiovascular disease. These results were consistent with findings of the present study. J.M.K. Wierda *et al*^[5] and Neeraja Bharti *et al*^[10] reported that the rate of development of neuromuscular block and hence the onset of action was faster with rocuronium than vecuronium. Their findings are consistent with our study. Study conducted by Lin *et al*^[11] observed that clinical durations of action were 44.2 +/- 13.2 min in rocuronium group and 42.5 +/- 9.1 min in vecuronium group respectively. In the present study, although duration of action of rocuronium was slightly but significantly less than that of vecuronium. Man TT *et al*^[12] and Lin PL *et al*^[11] reported that both rocuronium and vecuronium provided good to excellent intubating conditions. In our studies also we got same results. There are certain limitations in the present research such as propofol used can depress the laryngeal reflexes and thus can act as a confounding factor, sample size was small and TOF machine may produce some technical errors. Further studies with large sample sizes are required to firmly establish efficacy and safety of drugs used in this study.

CONCLUSIONS

Onset of action of rocuronium was significantly shorter than vecuronium. The duration of action of vecuronium was slightly longer than rocuronium. There was no statistically significant difference in intubating conditions. Mean heart rate 10 minutes after intubation was significantly higher in vecuronium group but there was no statistically significant difference in other hemodynamic parameters between the two groups.

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