Original Research Article

A study to compare the action of rocuronium versus vecuronium for tracheal intubation and maintenance of anesthesia using train of four monitor

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Abstract

Background and Objectives: Adequate maintenance of airway in patients undergoing surgeries under general anaesthesia is through proper intubation. Some of the drugs currently used are vecuronium, atracurium, pancuronium and rocuronium. Rocuronium bromide and vecuronium are monoquaternary aminosteroid compounds. Rocuronium has been considered "nearideal" muscle relaxant except for high potency. **Aims and objectives:** To evaluate onset time, tracheal intubation conditions, duration of action and maintenance of anaesthesia using two non depolarizing muscle relaxants vecuronium and rocuronium using a Train of four monitor (TOF).Methods:80 patients of either sex, aged 20 – 60 years, of ASA I and II undergoing elective orthopedic and urological surgeries under general anaesthesia were randomly allocated into Groups A and B of 40 each. Group A received Inj Vecuronium 0.1mg/kg as induction dose and 0.025mg/kg as maintenance dose .Group B received Inj Rocuronium 0.6mg/kg as induction dose and 0.15mg/kg as maintenance dose .Onset of action, duration and intubation conditions were assessed. Adverse effects if any were recorded. **Results:** The age, weight distribution and gender were comparable in both groups. The onset time was significantly shorter in Group B (104.70 ± 18.43sec) compared to Group A (184.80± 30.72 sec) with P<0.001.Intubation conditions were better in Group B compared to Group A with P<0.001. The duration of action of the induction dose was significantly longer in Group B (34.38±3.5 minutes) compared to Group A (27.50± 4.94minutes) with P<0.001. There were no significant changes in haemodynamic variables between the two groups. No adverse reactions were found. **Conclusion:** Rocuronium provides rapid onset of action than Vecuronium. Rocuronium is an intermediate-acting muscle relaxant as Vecuronium with excellent intubation condition. Both the drugs provide cardiovascular stability with no side effects.

Key Words: Rocuronium; Vecuronium; Tracheal intubation condition; TOF.

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INTRODUCTION

Maintenance of patent airway is a basic and essential component of general anaesthesia, regardless of technique selected. Endotracheal intubation is one of the means available for doing so in clinical practice. Muscle relaxants are useful in providing adequate relaxation and enable laryngoscopy and intubation. The introduction of neuromuscular blocking drugs into clinical practice represents one of the most significant advances in the development of anesthesiology and has revolutionized the practice of anesthesia. The use of neuromuscular blocking drugs has increased the safety and improved the results of many established surgical procedures as well as many

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new ones. An ideal neuromuscular blocking agent for intubation should have a rapid onset, brief duration of action, provide excellent intubation conditions and should be free from side-effects. For several decades, suxamethonium was the gold standard relaxant for rapid sequence intubation. However, the unintended side-effects such as muscle fasiculations, hyperkalemia, rise in intracranial and intraocular pressure led to the search of newer relaxants[1].Though vecuronium and atracurium were found to have a shorter onset times than the older nondepolarising muscle relaxants, they did not serve the purpose of rapid sequence intubation[2,3] Rocuronium bromide a mono quaternary amino-steroid became available in 1994[4]. Rocuronium is similar in structure and properties to Vecuronium but had an added advantage of greater lipophillicity, decreased potency and faster onset of action and excellent tracheal intubating conditions when compared to vecuronium[5].Neuromuscular monitoring helps to balance adequate surgical relaxation with safe restoration of neuromuscular function at the end of the procedure. 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. In the light of the above observations ,Rocuronium was compared with Vecuronium as relaxants for surgeries using peripheral nerve stimulator in the study.

METHODOLOGY

A prospective comparative randomized double-blind study was done in the Department of Anesthesiology, Sri Satya Sai Institute of higher medical sciences, Prashantigram from April 2016 to December 2017. Sample size was calculated by taking into consideration the study done Mrunalini Parasa *et al* wherein they Compared equipotent doses of Rocuronium and Vecuronium for onset of action as the primary outcome as a reference. Power of study as 80% (probability of detecting a significance difference between two groups) and 2 sided 95% confidence level. The mean onset time of rocuronium was 83.66 $\pm$ 41.73 sec and mean onset time of vecuronium was 116.66 $\pm$ 55.37 sec from previous study and sample size is derived as n $=(1.96+0.84)^2(2)(2353)^2/ (33)^2$ n = 34 in each group 40 in each group were selected to outnumber the dropouts from the study. The Adult patients aged 20-60 years belonging to physical status ASA I and II scheduled to undergo elective orthopedic and urological surgeries under general anesthesia. The Patients were categorized into each group based on the number which were generated by randomization technique in computer.

INCLUSION CRITERIA

- Patients with ASA physical status I and II.
- Patients aged between 20 to 60 years.
- Patients with Mallampati class 1 or 2.
- Patients who are willing to give consent to participate in the study.
- Those patients scheduled to undergo elective upper extremity, or urological surgeries under general anaesthesia.

EXCLUSION CRITERIA

- Patients with gastroesophageal reflux disease
- Patients with history of allergy to any of these drugs or constituents.
- Patients with cardiac,pulmonary,hepatic or renal disorders.
- BMI>25% .
- Heavy smokers.
- Patients with neuromuscular disorders or medications known to influence neuromuscular functions.

After obtaining the approval of scientific ethics committee and written informed consent, a total of 80 patients undergoing elective orthopedic or urological surgeries under general anaesthesia were selected. Pre-anesthetic assessment was done the evening prior to the day of surgery. A detailed history was taken; examination and investigation were reviewed. Informed consent was obtained after explaining the procedure to the patients. Tab. Diazepam 5 mg and Tab. Ranitidine 150 mg was given night before the surgery and on morning of the day of surgery 1 ½ hours prior to the time of surgery. All the patients were Nil per oral for at least 6 hours before surgery. Patients were randomized into one of the two groups by computer generated tables, Group A and Group B of 40 each for induction and maintenance of anaesthesia. Investigator A prepared the drugs, who loaded Inj Vecuronium at the dose of 0.1mg/kg and Rocuronium at the dose of 0.6mg/kg body weight according to the study group and labelled as Drug X and Drug Y respectively. Group A recieved Inj Vecuronium 0.1mg/kg and Group B Inj Rocuronium 0.6mg/kg. Investigator B who was blinded to the study group did direct laryngoscopy for all patients and assesed the intubation conditions as per Cooper score. Data regarding intubation conditions, onset and clinical durations were collected in predefined proforma and was subjected to statistical analysis comparing Group A and Group B. The identity of the drug was revealed to the investigator only after the statistical study was completed. Patients were reviewed on the morning of surgery and shifted to operation theatre. Non-invasive monitors like Electrocardiogram (ECG), Non-invasive BP, and pulse oximetry were connected to the patient. Intravenous access was established with 18G IV cannula and infusion of crystalloids like ringer lactate solution 10ml/kg was

commenced. Prior to the induction of anaesthesia, patients in both groups were premedicated with Midazolam 0.025mg/kg, inj Glycopylorate 5mcg/kg and Fentanyl 1mcg/kg intravenously. Patients were pre oxygenated with 100% oxygen for a period of three minutes followed by which patients were induced with Inj Thiopentone 4mg/kg intravenously. At this point the train of four stimulus was given by the operator and its basal reading was noted. Train of four stimulus (TOF) of 4 pulses each of 0.2 ms duration at 2 Hz frequency was applied over 2 s to the temporal branch of facial nerve and the resultant twitches of Corrugator supercilii (CS) muscle were observed visually. Patients in Group A received Vecuronium 0.1mg/kg and those in Group B received Rocuronium 0.6mg/kg. Four supramaximal stimulus were given every 12 seconds after the drug had been administered. Each stimulus in the train caused the muscles to contract and fade of response provided the basis of evaluation .Onset of neuromuscular block was assesed with TOF stimulus every 12 sec until the loss of visual response to nerve stimuli was seen. Onset time was the time from administration of muscle relaxant to the loss of visual response to the nerve stimulus. At this point direct laryngoscopy was performed and patients were intubated by a senior Anesthesiologist using a suitable size portex endotracheal tube who was blinded of the drug and Intubating condition was scored as excellent [8-9], good [6-7], fair [3-5], and poor [0-2] according to a system described by Cooper. Haemodynamic parameters like systolic, diastolic blood pressure and Heart Rate were recorded at baseline followed by every 2 mins upto 10mins and then every 15mins after intubation till the end of the surgery. Results obtained on continuous measurements are presented on Mean ± SD (Min-Max) and results on categorical measurements are presented in Number (%). Significance is assessed at 5 % level of significance. Student t test (two tailed, independent) is used to find the significance of study parameters on continuous scale between two groups Chi-square/ Fisher Exact test are used to find the significance of study parameters on categorical scale between two or more groups.

RESULTS

In the present study, 80 patients aged between 20 and 60 years belonging to ASA grade I and II were randomly divided into two groups, Group A and B each group consisting of 40 patients. The Age distribution in Group A and B was comparable and not statistically significant with p=0.13.The Weight distribution in Group A and B was comparable and not statistically significant with p=0.79.The Height distribution in Group A and B was comparable and not statistically significant with p=0.43.The study comprised of 41 males and 39 females. Group A comprised of 50% (20) males and 50% (20) females whereas Group B comprised of 52.5% (21) males and 47.5 % (19) females. Sex distribution was comparable in both groups with p=1.00.

Table 1: Comparison of Age, weight and Height among both the groups

	Group	N	Mean	SD	Mean Difference (95% CI)	t	df	p-value
Age	A	40	37.08	11.24	-3.88 (-8.94, 1.19)	-1.52	78	0.13(NS)
	B	40	40.95	11.50				
Weight	A	40	58.83	8.40	-0.50 (-4.23, 3.23)	-0.27	78	0.79(NS)
	B	40	59.33	8.34				
Height	A	40	158.63	6.27	-1.10 (-3.88, 1.68)	-0.79	78	0.43(NS)
	B	40	159.73	6.21				
BMI	A	40	23.34	2.55	0.15 (-0.92, 1.21)	0.28	78	0.78(NS)
	B	40	23.19	2.22				

The mean onset of action in Group A was 184.8± 30.72 sec and in Group B was104.7 ±18.43sec.Onset of action in Group B was faster than Group A with p< 0.001. The mean duration of action in Group A is 27.5±4.94mins and Group B is 34.38±3.95mins.Group B has longer duration of action than Group A which was statistically significant with p<0.001.

Table 2: Comparison Of Onset Of Action, Duration Of Action And Cooper Score

	Group	N	Mean	SD	Mean Difference (95% CI)	t	df	p-value
Onset (in sec)	A	40	184.80	30.72	80.10 (68.82, 91.38)	14.14	78	<0.001*
	B	40	104.70	18.43				
Coopers	A	40	7.43	0.81	-1.28 (-1.57, -0.98)	-8.61	78	<0.001*
	B	40	8.70	0.46				
Duration (in min)	A	40	27.50	4.94	-6.88 (-8.87, -4.89)	-6.88	78	<0.001*
	B	40	34.38	3.95				

Intubation conditions were excellent in 100% of patients in Group B as compared to 42.5% in Group A. Intubation conditions were good in 57.5% of pateints in Group A. The mean Cooper score in Group A was 7.43±0.81 and Group B was 8.7±0.46. Group B had better intubation condition compared to Group A with P<0.001.

Table 3: Comparison Of Cooper Score in both the groups

COOPERS	Group		TOTAL
	A	B	
Excellent	17(42.5%)	40(100%)	57(71.25%)
Good	23(57.5%)	0(0%)	23(28.75%)
Total	40	40	80
Chi square test	Chi square value(1) = 32.28, p<0.001*		

DISCUSSION

The introduction of neuromuscular blocking drugs into clinical practice represents one of the most significant advances in the development of anesthesiology and has revolutionized the practice of anesthesia. The use of neuromuscular blocking drugs has increased the safety and improved the results of many established surgical procedures as well as many new ones. As stated by Foldes and co-authors "the first use of muscle relaxants not only revolutionized the practice of anesthesia but also started the modern era of surgery and made possible the explosive development of cardiothoracic, neurological and organ transplant surgery". Vecuronium and Rocuronium has been used intravenously in various doses for tracheal intubation and maintenance of anesthesia. Sanjula virmani *et al*[6] and Lin PL *et al*[7] compared neuromuscular action of Vecuronium 0.1 mg / kg and Rocuronium 0.6 mg / kg. Sanjula virmani *et al* [6] found that Vecuronium provides best intubation conditions at the dose of 0.1mg/kg. Schram *et al*[8] found that there are no hemodynamic changes with Vecuronium in the dose of 0.1mg/kg. Lin PL *et al*[7] found there were no adverse effects with Vecuronium 0.1mg/kg. Russo R *et al*[9] determined the onset time and duration of action of neuromuscular block induced by increasing doses of Vecuronium bromide (upto 0.150 mg/kg) and concluded that increased doses did not shorten significantly the onset time. So we chose Vecuronium 0.1mg/kg IV as induction dose. Schultz P *et al* [10], compared Rocuronium in the dose of 0.6mg/kg, 0.9mg/kg and 1.2mg/kg and found that there was no further improvement in intubation conditions at 60 s by increasing the rocuronium dose from 0.9 mg/kg to 1.2 mg/kg. Brijesh savidhan *et al*[11] compared the intubation conditions with 0.6mg/kg and 0.9mg/kg of Rocuronium bromide for rapid sequence intubation. They concluded that Rocuronium at 0.6mg/kg provided adequate intubation conditions at 60sec and shorter duration of action whereas Rocuronium at 0.9mg/kg provided good to excellent intubation conditions at 60sec but at the cost of prolonged duration of action. In the present study onset of neuromuscular block was assessed at Corrugator Supercili muscle with TOF stimulus every 12s to temporal branch of facial nerve. Onset of action was considered as the time taken from complete injection of the muscle relaxant to the abolition of visual response to train of four stimulus. Lee H J *et al*, [12] Mrunalini parasa *et al* [13], chose Corrugator supercilii (CS) to assess the onset of neuromuscular block . Lee HJ *et al* [12] Compared adductor pollicis, orbicularis oculi, and corrugator supercilii as indicators of adequacy of muscle relaxation for tracheal intubation. They concluded that twitch monitoring at the Orbicularis Oculi allows a faster intubation but is associated with inadequate intubating conditions. Excellent intubating conditions are observed most frequently with Adductor Pollicis monitoring but with the longest delay before intubation is attempted. Monitoring of the Corugator Supercilii allows intubation earlier than that of Adductor Pollicis with patients having adequate intubating conditions. In the present study the mean onset of action in Group A (Vecuronium group) was 184.80 seconds(SD±30.78) . This correlates approximately with the study of Schramm *et al*,[8] and Sanjula virmani *et al*[6] who used 0.1 mg/kg of vecuronium for intubation and onset of action of the drug was around 192±64 seconds and 144.8±46.1 seconds respectively in their study. Conversly , Booth M G *et al* [14] used Vecuroinum 0.1mg/kg for induction but the onset of action of the drug in their study was 96 sec. The mean onset of action in Group B (Rocuronium group) was 104.7 seconds(SD±18.43). The present study correlates with the findings of Madhavi Bhare *et al* [15] used Rocuronium in the dose of 0.6mg/kg for intubation and the onset of action of the drug in their study was 101.5± 29.47 sec. In a study conducted by Lee H J *et al* [12] rocuronium 0.6mg/kg was used for intubation and onset of action was assesed at CS muscle and they found onset of action was 1.70±0.68 min (i.e 102±40.8sec) which is in correlation with our study. Conversly in study conducted by Booth *et al* [14] the onset of action of Rocuronium 0.6mg/kg was 60seconds.Onset of action in Group B (Rocuronium) was rapid compared to Group A (Vecuronium) which was statistically significant with P<0.001. The present study is in agreement with the studies conducted by Booth MG *et al*[14] , Lin PL *et al*[7] and Parasa M *et al* [16] who compared the onset of action of equipotent doses of Rocuronium and Vecuronium and found that Rocuronium had rapid onset of action compared to Vecuronium with P=0.0001, P<0.05 and P=0.011 respectively. In the present study intubation conditions were assesed using Cooper score. Mrunalini Parasa *et al* assesed intubation conditions with Cooper

score and graded as Excellent, good, fair and poor. In our study Intubation conditions were excellent in 100% of patients in Group B as compared to 42.5% in Group A. Intubation conditions were good in 57.5% of patients in Group A. Intubation conditions were better in Group B as compared to Group A with P<0.001. The present study correlates with the study conducted by Mrunalini parasa *et al*,[13] who compared intubation conditions of equipotent doses of Rocuronium and Vecuronium and found that overall intubation conditions were excellent in 100% of patients in Rocronium group as compared to 70% in Vecuronium group. In a study conducted by Van den broek L *et al*[17] they concluded that intubation conditions are better in rocuronium group in comparison with Vecuronium group.

CONCLUSION AND RECOMMENDATION

Rocuronium provides rapid onset of action than Vecuronium. Rocuronium is an intermediate-acting muscle relaxant as vecuronium with excellent intubation condition. Both the drugs provide cardiovascular stability with no side effects. Therefore, inspite of its high cost and limited availability, Rocuronium appears to be a better alternative to Vecuronium for tracheal intubation.

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