

# Clinical Assessment of Cardiovascular Effects and Intubating Conditions with Rocuronium, Vecuronium, and Suxamethonium

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## Abstract

**Background:** Achieving muscle relaxation during endotracheal intubation is a vital requirement and needs drugs safer than suxamethonium that is early-onset, long duration, stable hemodynamic parameter, minimum side effects, and good intubating conditions. The aim of the present study was to evaluate cardiovascular effects and intubating conditions of drug rocuronium compared to vecuronium and suxamethonium. **Subjects and Methods:** A total of 120 subjects were randomly divided into 3 groups of 40 subjects each depending on muscle relaxant given during intubation as Group I with 0.6 mg/kg rocuronium, Group II with 1.5 mg/kg suxamethonium, and Group III with 0.08 mg/kg vecuronium. Premedication was done with 0.2 mg glycopyrrolate and the anesthetic agent used was 4-5 mg/kg thiopentone sodium 2.5% along with the intermittent injection of vecuronium. Parameters assessed were fasciculations, cardiovascular response, limb movement, coughing, vocal cord movement and position, jaw relaxation, and apnoea onset. **Results:** For Group I, onset was longer compared to Group II, however, it was lesser than Group III. No fasciculation was seen in Group I and III but was seen in Group II. Better intubating conditions were seen in Group III. No complication was seen in any subject from any group. **Conclusion:** The present study concludes that rocuronium is an effective and safer alternative to suxamethonium in tracheal intubation cases in subjects not needing rapid spontaneous respiration return. Hence, it can act as a filler between non-depolarizing neuromuscular blocking agents and suxamethonium and can be considered as the ideal neuromuscular agent.

**Keywords:** Anaesthesia, Endotracheal Intubation, Rocuronium, Suxamethonium, Vecuronium.

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## Introduction

The anesthesia was primitive around 50 years back compared to today. There was prevalent use of local infiltration agents, i.v agents, and volatile agents along with a few nerve blocks by the anesthetists. Tracheal intubation was not prevalent before neuroblocking agents making intubation difficult. After the introduction of neuromuscular blocking agents in anesthesia, tracheal intubation has become vital. It has the advantage of maintaining airway safely with gaining popularity in routine use in recent anesthesia practice.<sup>[1]</sup>

In 1952, succinylcholine was introduced by Thesleff and Foldes which revolutionized the anesthesia by inducing effective neuromuscular block of very short duration and rapid onset easing the tracheal intubation. Although, suxamethonium has few side effects including increased intracranial pressures, intragastric pressures, and intraocular pressures, hyperkalemia, post-operative myalgia, and muscle fasciculations. It

also has cardiovascular effects like cardiac arrhythmias and asystole. Prolonged apnoea can also be seen in subjects with atypical pseudo-cholinesterase leading to lethal conditions like myoglobinuria and malignant hyperthermia making suxamethonium a non-ideal agent as a muscle relaxant despite its rapid recovery and action. This alarms a need for having a rapid non-depolarizing neuromuscular blocking agent as a substitute to suxamethonium.<sup>[2]</sup>

An ideal neuromuscular blocking agent should have high potency, pharmacologically inactive metabolites, reversible by cholinesterase inhibitors, no histamine release, no cardiovascular effect, non-cumulative effect, rapid recovery, short duration of action, rapid onset, and non-depolarizing mechanism of action. The need for these properties led to the development of nondepolarizing neuromuscular blocking drugs which are developed recently having an intermediate duration.<sup>[3]</sup> They include atracurium and vecuronium, which are largely exempted from various adverse effects of suxamethonium.

However, they have slow onset which can be shortened with a high initial bolus dose, whereas, prolonged duration of these agents is still concerning and undesirable. One newer agent to this group is rocuronium bromide having lesser side-effects and rapid onset with an intermediate duration of action making it an almost ideal agent.<sup>[4]</sup>

Rocuronium has been close to the ideal agent used at 0.6 mg/kg dose with 60-90 sec as onset time, and a dose of (0.6-1.2 mg/kg is considered favorable for tracheal intubation. This new agent has fewer adverse effects than suxamethonium with no histamine release and no autonomic ganglia effect with stable hemodynamic parameters and cardiovascular profile. Considering the advantages and disadvantages of various neuromuscular blocking agents and their efficacy during tracheal intubation in subjects where suxamethonium is contraindicated, rocuronium can be a suitable alternative.<sup>[5]</sup> Hence, the present study was conducted to assess and compare cardiovascular effects and intubating conditions of rocuronium to vecuronium and suxamethonium.

## Subjects and Methods

The present study was conducted to assess and compare cardiovascular effects and intubating conditions of rocuronium to vecuronium and suxamethonium. The study was carried out at Department of Anaesthesiology, Maharajah's Institute of Medical Sciences, Nellimarla, Vizianagaram, Andhra Pradesh, India after obtaining clearance from the concerned Ethical committee. The study population was comprised of the subjects visiting the Department of Anesthesiology of the Institute and were scheduled for elective surgical procedures under general anesthesia. The study included 120 subjects from both genders and within the age range of 20 years to 62 years with ASA I and ASA II grades. The exclusion criteria for the study were subjects having the neuromuscular disorder, paralysis, other systemic disorders, or cardiovascular disease, and impaired liver or kidney functions.

After final inclusion, detailed history was recorded with general, systemic, and pre-anesthetic evaluation followed by routine investigations and specific investigations if warranted. A written, as well as verbal informed consent, was taken. The subjects were divided into 3 groups of 40 subjects each where Group I with 0.6 mg/kg rocuronium, Group II with 1.5 mg/kg suxamethonium, and Group III with 0.08 mg/kg vecuronium. Vitals were assessed and monitored during the whole study period. Premedication was done with 0.2 mg glycopyrrolate in all the subjects and 100% oxygen for 3 minutes was given before anesthesia induction. Thiopentone sodium 2.5% along with the intermitted injection of rocuronium. Following the disappearance of eyelash reflex, i.v muscle relaxant was given and the time was recorded along with the time from relaxant administration to apnoea onset.

This was followed by laryngoscopy to assess intubating conditions following the 'Copenhagen consensus conference rating scale'. Intubation was then performed using an endotracheal tube with a cuff of adequate size and positive pressure ventilation. Immediately after the following ventilation, vitals were recorded following regular assessment at each 10 minutes interval. Time was noted for first respiratory excursions in reservoir bag and apnoea return of first respiratory excursion giving action duration for the relaxant used.

All subjects were maintained at an oxygen and nitrous oxide mixture of (33.3% and 66.6%) with the intermitted injection of vecuronium. Halothane and analgesics were given as required. IPVV was given by Bain circuit. After completion of the surgery, reversal was done by glycopyrrolate and neostigmine. Extubation was done after adequate respiration return and spontaneous eye-opening with upper airway reflexes. Subjects were then shifted to the recovery room.

Parameters assessed during the perioperative period are onset of action by apnoea onset along with intubation conditions like Vocal cord movement, Vocal cord position, and Jaw relaxation. Intubation response was evaluated concerning Coughing Limb Movement, and cardiovascular response in terms of oxygen saturation (SpO<sub>2</sub>), blood pressure, and pulse rate recorded immediately following and 10 minutes after intubation. Fasciculation-like duration of action was noted as assessed by time from apnoea onset to first respiratory effort return. Intubation conditions were graded as excellent, good, and poor using 'Copenhagen Consensus Rating Scale'. Laryngoscopy was also judged using the 'Copenhagen Consensus Rating Scale' as easy, fair, and difficult.

## Results

The present study was conducted to assess and compare cardiovascular effects and intubating conditions of rocuronium to vecuronium and suxamethonium. The subjects were divided into 3 groups of 40 subjects each where Group I with 0.6 mg/kg rocuronium, Group II with 1.5 mg/kg suxamethonium, and Group III with 0.08 mg/kg vecuronium. Vitals were assessed and monitored during the whole study period. Premedication was done with 0.2 mg glycopyrrolate in all the subjects and 100% oxygen for 3 minutes was given before anesthesia induction. Thiopentone sodium 2.5% along with the intermitted injection of veculash rocuronium. Following the disappearance of eyelash reflex, i.v muscle relaxant was given and the time was recorded along with the time from relaxant administration to apnoea onset

For Group I, onset was longer compared to Group II, however, it was lesser than Group III. No fasciculation was seen in Group I and III but was seen in Group II. Better intubating conditions were seen in Group III. No complication was seen

in any subject from any group.

**Table 1: Demographic characteristics of the study subjects**

Age	Group I		Group II		Group III	
	n	%	n	%	n	%
20-30	20	50	26	65	19	47.5
31-40	8	20	6	15	13	33.5
41-50	10	25	5	12.5	8	20
51-62	2	5	3	7.5		
Total	40		40		40	
Mean	32.7		32.6		32.9	

## Discussion

The present study was conducted to assess and compare cardiovascular effects and intubating conditions of rocuronium to vecuronium and suxamethonium. The subjects were divided into 3 groups of 40 subjects each where Group I with 0.6 mg/kg rocuronium, Group II with 1.5 mg/kg suxamethonium, and Group III with 0.08 mg/kg vecuronium. Vitals were assessed and monitored during the whole study period. Premedication was done with 0.2 mg glycopyrrolate in all the subjects. The study included 120 subjects from both genders and within the age range of 20 years to 62 years with ASA I and ASA II grades and was scheduled for elective surgical procedures under general anesthesia. The demographic characteristics are listed in [Table 1]. Maximum subjects were in the age group of 20-40 years and weight range of 40-50 kgs.<sup>[6]</sup>

The majority of the study subjects had to undergo tonsillectomy and other procedures related to ENT followed by gynecologic surgical procedures. Concerning pulse rate, immediately the following intubation and 10 minutes after intubation, mean pulse rate variation were noted with significant rise immediately following intubation and non-significant rise 10 minutes after intubation which returned to baseline in 10 minutes in all 3 groups. As these changes were common, this can be attributed to presser response during laryngoscopy and intubation and not the drugs. SpO<sub>2</sub> was stable during the whole procedure. These findings were comparable to the studies by Levy et al 1994 and W.M. Schramm, K. Strasser et al in 1996 where authors concluded no significant change in blood pressure and heart rate following vecuronium and rocuronium.<sup>[7,8]</sup>

In Group I, the mean onset of action using apnoea onset was 55.13±8.53 sec, in Group II, it was 48.43±6.97 sec, and for Group III, it was 131.43±21.43 sec. The apnoea onset was earlier in Group II followed by Group I, and then Group III. The onset of apnoea was slightly higher in Group III than in Groups I and II. These findings were consistent with the studies of Sunila Sharma et al in 2001 and R. Cooper et al

in 1992. The development rate of neuromuscular block and action onset action was fast with rocuronium compared to vecuronium and other drugs as rocuronium is 6-8 times more potent.<sup>[9,10]</sup>

Rocuronium has a short onset time, however, it has a longer time than suxamethonium which has the smallest onset time which was similar to Roopa Sharma in 2002 and Toni Magorian et al in 1993.<sup>[11]</sup> From apnoea onset to first respiratory excursion return gave the duration of action for drugs used. The mean duration of action for Group I, Group II, and Group III was 21.32±5.03, 4.79±1.07, and 22.67±4.78 respectively. These values were not statistically significant. This was also comparable to Stoddart in 1998 and Fuchs-Buder in 1996 where the duration reported was 24.2±6.6.<sup>[12,13]</sup>

Fasciculations were also noted in the study subjects of Group II, but not in Group I and Group III. Fasciculations are attributed to depolarizing nature of suxamethonium, especially in young subjects. Intubating conditions are governed by anesthetic choices like inhalational agents, lidocaine, sedatives, and narcotics. A standardized "Copenhagen consensus conference rating scale" was used for assessing intubation parameters in the study subjects.

## Conclusion

Within its limitations, the present study concluded that rocuronium can act as a suitable alternative to suxamethonium in cases with tracheal intubation in cases where rapid and spontaneous return to respiration is not needed. Hence, the present study fills the gap of suxamethonium and other neuromuscular blocking agents making it an ideal neuromuscular blocking agent. The study had few limitations as smaller sample size, short monitoring period, single institutional study, single geographical area, and hence, this study could not depict the overall picture. More prospective clinical trials with larger sample sizes and longer monitoring periods are required.

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