



Double blind Comparison of Rocuronium and Succinylcholine for endotracheal intubation in adult patients for elective surgeries

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ABSTRACT

Background: A Double blind Randomized Control Trial was done to compare Rocuronium and Succinylcholine for endotracheal intubation for elective surgeries in adult patients done under general anesthesia.

Materials & Methods: 80 patients were divided into 2 groups of 40 each. Group A received Rocuronium at 0.9 mg/kg and Group B received Succinylcholine at 2mg/kg dose.

Statistical Analysis used: The statistical difference in the age, weight, height of the study subjects, onset of action of relaxant, intubation conditions, time taken to intubate, and duration of action were compared using analysis of variance and unpaired t-test.

Results: Comparison between Rocuronium at 0.9mg/kg and Succinylcholine at 2mg/kg for elective endotracheal intubation revealed that the onset time, time taken to intubate and the duration of action was significantly higher in the Rocuronium group. However the intubation conditions were found to be comparable and without statistical difference between the two groups

Conclusion: In the setting of a rapid sequence induction of anesthesia where succinylcholine may be contraindicated, Rocuronium at a dose of 0.9mg/kg is found to produce comparable intubation conditions and thus may be used as a suitable alternative in such situations.

Keywords: Anesthesia-general, neuromuscular blockade, intubating time, rocuronium, succinylcholine.

INTRODUCTION

Patients who need tracheal intubation in the emergency department often require a rapid sequence induction technique to protect against aspiration of gastric contents or to facilitate urgent airway protection in cases of imminent airway closure, haemodynamic instability, failing gas exchange and surgical emergencies¹. The rapid sequence intubation technique involves the prompt sequential administration of a

predetermined dose of hypnotic agent and muscle relaxant followed by tracheal intubation within 1 min of giving the muscle relaxant².

Succinylcholine, introduced by Thesleff and Foldes and colleagues in 1952, changed anesthetic practice drastically. Its rapid onset of effect and ultra short duration of action permitted rapid endotracheal intubation. In 1994, a new drug became available called rocuronium, an intermediate-acting non depolarizing blocker with

lesser potency but a rapid onset of effect. Succinylcholine, the drug traditionally used to facilitate endotracheal intubation has, in many situations, been replaced by Rocuronium. Rocuronium has the most rapid onset of the currently available non depolarising neuromuscular blocking drugs³. The rapid onset of action of rocuronium is believed to be primarily due to its low potency^{4,5}. Rocuronium was found to have no obvious side effects⁶. In this study the effects of rocuronium at 0.9mg/kg (3xED95) will be compared with that of succinylcholine (2mg/kg) when used for endotracheal intubation in adult patients for elective surgeries under general anaesthesia.

METHODS

The study has taken place at Government Medical college Hospital, Alappuzha. Adult male patients aged 40 years or less, ASA grade I/II, with Malampatti score of upto Class II undergoing elective surgery under general anaesthesia were eligible. Exclusion criteria included hyperkalemia, neurological disorders, burns, familial history of malignant hyperthermia, known or anticipated difficult intubation, known history of allergy to the drugs being used and serious co-morbidities like hypertension, diabetes, bronchial asthma, epilepsy.

Sample Size Calculation

Among the parameters measured, the most important one in our study is the intubation score. Thus expecting a 15% difference in the intubation score between the two groups, a 95% confidence interval, power of 85% and a population variance of 500, the sample size calculated for each arm was 40.

Design of study

A double blinded randomised control trial with a sample size of 80 allocated into two groups of 40 each is performed. Group A receives Rocuronium at 0.9mg/kg and Group B receives Succinylcholine at 2mg/kg. Two anaesthesiologists assisted by an experienced anesthesia assistant are present throughout the procedure. This study involves the

blinding of the drug administrator and anaesthesiologist performing the intubation.

A thorough history and clinical examination of the patient is conducted. All solid and liquid foods are restricted for upto 6 hours before surgery. Oral premedication of Tab Pantoprazole 40mg and Tab Diazepam 10mg are given at 10pm the day before surgery and 2 hours before on the day of surgery.

The anaesthesia machine is checked. The intubation cart with all emergency intubation equipment is kept ready. The drug cart is kept ready. The patient vitals are checked.

An intravenous access is obtained with Normal Saline using 18 gauge IV canula. ECG, pulse oximeter, peripheral nerve stimulator, end tidal CO₂ monitor and non invasive blood pressure monitors are attached. A ring of height 10cm is placed under the head to obtain the ideal intubation position. Vitals are checked and noted at five minute intervals. The patient is pre-oxygenated for 3 minutes with 100% oxygen. Inj Glycopyrrolate 0.2 mg IV, Inj Midazolam 1mg IV, Inj Pentazocine 0.3mg/kg IV, Inj 2% preservative free Lignocaine 1mg/kg IV, Inj Propofol 2mg/kg IV following which muscle relaxant to be studied, that is either Drug A or Drug B is administered in that order. Intubation is performed when 'Train of Four count' is zero. Endotracheal intubation is performed using a Macintosh size 4 blade and an endotracheal tube of size 8.0 mm ID. The intubation conditions is evaluated on the basis of the Cooper scoring system.

COOPER SCORING SYSTEM

Criteria	Score 3	Score 2	Score 1
1. Laryngoscopy Jaw relaxation Resistance to blade	Relaxed None	Acceptable relaxation Slight resistance	Poor relaxation Active resistance
2. Vocal cords Position Movement	Abducted None	Intermediate Moving	Closed Closing
3. Intubation response Limb movement Coughing	None None	Slight Diaphragmatic	Vigorous Severe coughing or bucking

The time duration from administration of muscle relaxant up to the complete disappearance of the train of four count was noted down as the time of onset. The time duration from the complete disappearance of train of four count up to successful endotracheal intubation is noted down as the time taken to intubate. Successful endotracheal intubation is confirmed with the appearance of end tidal CO₂ on the monitor. After endotracheal intubation, the cuff is inflated and controlled ventilation is started.

Immediately after tracheal intubation and every 5 min thereafter, the number of tactile responses to TOF stimulation was recorded. The duration of action of rocuronium was the time from injection until the return of the first tactile TOF response. After tracheal intubation, anaesthesia was maintained with propofol as an infusion and supplementation of muscle relaxant bolus doses as required.

OBSERVATION AND ANALYSIS

Eighty patients are segregated into two different groups of 40 each labelled as Group A Rocuronium 0.9 mg/kg, Group B Succinylcholine 2 mg/kg. To compare statistical difference in the age, weight, height and the observational variants of the study subjects between the two groups, the unpaired *t*-test was used.

Baseline characteristics

Table[1] Demographic profile

Parameter	Group A Mean (SD)	Group B Mean (SD)	P value	t value
Age (years)	31.48 (6.75)	33.6 (6.83)	0.1656	1.3997
Height (cm)	159.90 (5.26)	158.53 (9.40)	0.4219	0.8075
Weight (kg)	58.15 (6.76)	58.63 (6.20)	0.7442	0.3275

The mean of patients' age, weight and height were calculated between the two groups and were tabulated as shown above. To determine whether there is any statistical difference in the age of the study subjects between the different groups, the unpaired *t* test is done. The age, height and weight distribution between the two groups is computed and *p* value is calculated. This being >0.05 for all three parameters, hence is considered statistically

insignificant. Thus, it was concluded on the basis of the *p* value, that the distribution of age, height and weight among the two groups were comparable and these factors did not have any influence on outcome.

Time of Onset

The onset time was assessed by the complete disappearance of all four twitches of adductor pollicis muscle to the Train of four stimuli at the ulnar nerve.

Table [2] Comparison of Time of Onset between Groups A and B

Groups	Mean(seconds)	SD	P value
A	74.25	5.38	< 0.001
B	52.25	8.62	

The mean time of onset between the two groups is compared and charted as shown above. The mean score of Group A was 74.25 seconds and Group B was 52.25 seconds. With unpaired *t* test, a *p* value of <0.001 was obtained indicating that the difference was statistically significant.

Time to intubate

The time taken to intubate is taken as the time from the attainment of a zero train of four count up to successful endotracheal intubation.

Table [3] Comparison of Time to Intubate between Groups A, B and C

Groups	Mean(seconds)	SD	P value
A	14.85	3.37	< 0.001
B	12.33	2.27	

The mean time to intubate between the two groups is compared and charted as shown above. The mean score of Group A was 14.85 seconds and of Group B was 12.33 seconds. With unpaired *t* test, a *p* value of <0.001 was obtained indicating that the difference was statistically significant.

Intubation Score

The intubation score was calculated on a 6 point basis, each point being given a maximum score of three and a minimum score of one. Thus the cumulative score adds up to a maximum of 18 being the best score and a minimum of 6, being the worst score.

Table [4] Comparison of Intubation Score between Groups A and B

Groups	Mean	SD	P value
A	17.83	0.45	0.1951
B	17.68	0.57	

The mean intubation score between the two groups is compared and charted as shown above. The mean score of Group A was 17.83 and of Group B was 17.68. With unpaired test, a p value of 0.1951 was obtained indicating that the difference was not statistically significant.

Duration of Action

The duration of action is taken from administration of muscle relaxant up to appearance of the first response of Train of four count.

Table VII A Comparison of Duration of Action between Groups A and B

Groups	Mean(minutes)	SD	P value
A	43.975	7.468	<0.001
B	5.613	1.910	

The mean duration of action between the two groups is compared and charted as shown above. The mean score of Group A was 43.975 min and of Group B was 5.613. With unpaired t test, a p value of <0.001 was obtained indicating that the difference was statistically significant.

DISCUSSION

Succinylcholine with its rapid onset (40–60 s) and short duration of action (6–10 min) have advantages that have to be balanced against the risk of hyperkalemia, variable increases in intracranial pressure⁷ and, to a lesser extent, intra-ocular pressure⁸. As a result, succinylcholine is contra-indicated in major burns or crush injuries, severe abdominal sepsis, denervation syndromes, muscular dystrophy, malignant hyperthermia or in the presence of a previous allergic reaction to succinylcholine^{9,10}.

Rocuronium is a steroid-based non-depolarising muscle relaxant. Due to its rapid onset of action, it has been used to create intubating conditions comparable to those of succinylcholine. The duration of action is longer (37–72 min) with standard doses¹¹. The only absolute contra-indication to rocuronium is allergy. Care must be taken with people who have myasthenia gravis or myasthenic syndrome, hepatic disease, neuromuscular disease, carcinomatosis, or severe cachexia, as the duration of action may be profoundly increased.

There have been many studies comparing rocuronium and succinylcholine; these have produced conflicting outcomes. It has been suggested that variation in the use of opioids, the hypnotic agent used (propofol, thiopental, etomidate), or the dose of rocuronium given may have accounted for these differences. The intention of this article is to determine whether rocuronium creates intubating conditions comparable to those of succinylcholine.

This article summarises that succinylcholine creates better intubation circumstances than rocuronium. However, if an alternative agent is required, rocuronium 0.9 mg/kg can be used to create acceptable intubation conditions but should only be used as a second-line treatment because paralysis will be significantly prolonged. The introduction of sugammadex to facilitate reversal of rocuronium allows this problem to be overcome, but this drug is not currently widely available¹².

The dose of rocuronium has been thought to be important in creating intubation conditions equivalent to succinylcholine. Succinylcholine created significantly more excellent intubation conditions than rocuronium at doses of 0.6mg/kg¹³. There was no statistically significant difference for the 0.9 to 1.0 mg/kg or 1.2 mg/kg groups, reaffirming the current practice of using 1 mg/kg of rocuronium for rapid sequence intubation when succinylcholine is not clinically indicated¹⁴.

Multiple factors that include airway management, ability to ventilate and oxygenate, anaphylaxis, unanticipated difficult airway, and possible need for assisted or mechanical ventilation are taken into consideration while making a choice between rocuronium and succinylcholine for intubation. A “can’t ventilate, can’t intubate” scenario may be prolonged when rocuronium is administered^{15,16}.

Rocuronium may be used as an alternative choice to succinylcholine when the latter is contraindicated, a rapid onset is desired, and a longer period of recovery from neuromuscular blockade is appropriate¹⁷. If rocuronium is used

in place of succinylcholine, for intubation at doses of 0.9 mg/kg IV, airway management supplies and equipment should be available to secure the airway and provide prolonged ventilation support until the rocuronium induced neuromuscular blockade has worn out.

This study recapitulates that even though the onset time, time taken to intubate and duration of neuromuscular block were significantly more in the Rocuronium group, endotracheal intubation conditions were not statistically different between succinylcholine and rocuronium approximately 60 s after the injection of the neuromuscular relaxant.

CONCLUSION

The distribution of age, weight and height amongst the two groups is even and they do not have any influence on the outcome. Rocuronium at 0.9 mg/kg has an onset time longer (74.25s) than succinylcholine (52.25s). The time taken to intubate is the shortest with succinylcholine. The time taken to intubate with rocuronium at a dose of 0.9mg/kg was prolonged (14.85) as compared with that of succinylcholine (12.33). The intubation score of rocuronium at a dose of 0.9mg/kg was the best (17.83). The duration of neuromuscular block is shortest with succinylcholine (5.613 min). Rocuronium at 0.9 mg/kg has a longer duration of action(43.975 min).

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