INTUBATING CONDITIONS WITH ROCURONIUM BROMIDE AND SUXAMETHONIUM IN ELECTIVE SURGERIES: A RANDOMIZED COMPARATIVE STUDY

Kanchan Prakash Paudyal,[1] Pawan Puspa Baral,[2] Laxmi Pathak[2]

ABSTRACT

INTRODUCTION

Adequate intubating condition is required to avoid airway trauma and adverse sympathetic responses. Though, Succinylcholine is considered as ideal drug, it has many contraindications. In search of alternative, rocuronium is found to have similar responses in higher doses. Therefore, our aim was to compare the effect of different dosages of rocuronium with sucinylcholine for tracheal intubation and the haemodynamic variables.

MATERIAL AND METHODS

A prospective randomized comparative study was conducted in Universal College of Medical Sciences (UCMS-TH) in 90 (American Society of Anaesthesiologists Physical Status I and II) patients with age between 18 to 60 years scheduled for elective surgeries under general anesthesia. They were divided into 3 groups of 30 each using lottery system. Groups 1 and 2 received intravenous rocuronium 0.6mg/kg and 1mg/kg respectively whereas patients in group 3 received intravenous succinylcholine 1.5mg/kg. Under continuous monitoring, tracheal intubation attempt was done at 60 seconds after the administration of drug and intubating conditions were assessed according to Cooper et al four point scale.

RESULTS

Only 26.7% of patients in group 1 exhibited excellent intubating condition whereas in groups 2 and 3, excellent intubating condition was exhibited in 100% when muscle relaxant was administered at 60 seconds with highly significant statistical difference between groups 1 and 3 with p value <0.001 without any adverse effects in any of these patients.

CONCLUSION

This study concluded that intubating response with inj. succinylcholine 1.5mg/kg is similar to rocuronium 1.0mg/kg and is superior to inj rocuronium 0.6mg/kg, for intubating condition at 60 seconds following the drug administration while using Cooper et al. Score.

KEY WORDS Rocuronium, succinylcholine, tracheal intubating condition

1. Sagarmatha Choudhary Eye Hospital, Lahan-3, Siraha, Nepal.

2. Department of Anesthesiology, Universal College of Medical Sciences, Bhairahawa, Rupandehi, Nepal.

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For Correspondence:
Dr. Kanchan Prakash Paudyal
Department of Anaesthesiology
Sagarmatha Choudhary Eye Hospital
Siraha, Nepal
Email:paudyalp@gmail.com

INTRODUCTION

Tracheal intubation is the best method for securing a patient's airway.[1] Good intubating conditions minimize the risk of trauma to airway. The ideal neuromuscular blocking agent for intubation should have a quick onset, brief duration of action, provide profound relaxation, no histamine release, no anaphylaxis and be free from hemodynamic changes.[2]

Though succinylcholine has rapid onset and exhibits good intubating conditions, it has potentially hazardous side effects. It is contraindicated in patients with major burns, crush injuries, severe abdominal sepsis, denervation syndromes, nerve or spinal cord injuries, also with a history of malignant hyperthermia or previous allergic reaction to it.[3] Rocuronium is proposed to create intubating condition similar to that of succinylcholine. Its onset of action is more rapid at the diaphragm and adductor laryngeal muscles than at the adductor pollicis muscle and has longer duration of action. Its absolute contraindication is allergy and "can't intubate, can't ventilate"situation.[4]

As succinylcholine is proven drug for good intubating conditions, we choose this drug to compare with another in different doses to find its best alternative to use when contraindicated. This study aimed to compare different doses of rocuronium i.e. 0.6mg/kg and 1mg/kg body weight with succinylcholine 1.5mg/kg body weight for tracheal intubation. The present study compares the intubating conditions of rocuronium and succinylcholine and evaluates the cardiovascular effects like pulse rate, systolic and diastolic blood pressures and oxygen saturation of these agents in elective surgeries.

MATERIAL AND METHODS

This prospective randomized comparative study was conducted at UCMS-TH for a period of 18 months from March 2014 to August 2015. 90 indoor patients undergoing different elective surgical procedures under general anaesthesia with endotracheal intubation were selected after obtaining ethical committee clearance, institutional approval and written informed consent from the patients.

Inclusion criteria

All patients aged 18 to 60 years of age with ASA-PS I and II

Exclusion criteria

1. Pregnancy and morbidly obese or at increased risk of pulmonary aspiration
2. Patients with contraindication to succinylcholine and propofol
3. Patients with Mallampatti grade III and IV, anticipated difficult airway, neuromuscular diseases or on medication known to influence neuromuscular function, susceptible to malignant hyperthermia

Patients were randomly divided into 3 groups, each with 30 patients using a lottery system. Sample size was calculated based on previous year data. Patients in group 1 received rocuronium 0.6mg/kg, group 2 received rocuronium 1mg/kg and group 3 received succinylcholine 1.5mg/kg intravenously. Patients were kept nil per oral after ingestion of tablet diazepam 5 mg the night before surgery. Baseline vitals including heart rate (HR), ECG, systolic and diastolic blood presssure, SPO_2 were recorded. Anesthetic nurse from another operation theatre prepared the study drug and diluted with distilled water to make total volume of 5 ml and kept ready. Intravenous fentanyl 1mcg/kg was given 90 seconds after starting pre-oxygenation. After a minute, propofol 1.5mg/kg intravenously over a period of 15 seconds was given. As patient became unconscious, neuromuscular blocking drug either rocuronium or suxamethonium was injected rapidly by the anesthesia nurse and endotracheal intubation using conventional laryngoscope and machintosh blade size 3 was attempted after 60 seconds by the anaesthesiologist. Blinding was done for the patient, drug administrator and the anesthesiologist who intubated the patient. Intubating condition was assessed according to the four point scale after Cooper et al[5] (Table1). A total score of 8-9 was considered excellent intubating condition, 6-7 was considered as good intubating condition, 3-5 was considered as fair intubating condition and 0-2 was considered as poor intubating condition.

Table 1. Showing Cooper et al Criteria

Score	Jaw relaxation	Vocal Cord Position	Response to Intubation
0	Poor (impossible)	Closed	Severe bucking or coughing
1	Minimal (difficult)	Closing	Mild coughing
2	Moderate (fair)	Moving	Slight diaphragmatic movement
3	Good (early)	Open	None

Vitals were monitored continuously in perioperative period and recorded at 1 (immediately before intubation), 3, 5 and 10 minutes after administration of muscle relaxant. Changes in heart rate and blood pressure after injection of muscle relaxant was noted. After tracheal intubation, anaesthesia was maintained with isoflurane 0.5-1.0 volume % and oxygen.

Vecuronium bromide 0.04 mg/kg was used as muscle relaxant when wave for spontaneous respiration was seen in capnography. Neostigmine 0.05-0.07mg/kg and glycopyrrolate 0.01- 0.02 mg/kg was used as reversal agent. Clinical side effects of histamine release with administration of rocuronium and succinylcholine was noted. Following points were observed:

1. Signs of bronchospasm - wheeze, slowly increasing wave on capnograph, decreased exhaled tidal volume.
2. Development of rashes

3. Bradycardia - Heart rate (HR) less than 50/min or HR decreased by 20% of baseline.

4. Tachycardia - Heart rate more than 100/min or HR increased by 20% of baseline

5. Hypotension - Systolic blood pressure falls by more than 30% of baseline (with lower limit of <90 mm of Hg).

6. Hypertension - Increase in systolic blood pressure by more than 30% from the base line

Statistical analysis:

Data was entered into Microsoft Excel Software 2007 and analyzed in SPSS 16 version. Chi square test and student t-test was used. P value of <0.05 was considered statistically significant.

RESULTS

All 90 patients were enrolled. Those who received rocuronium 0.6mg/kg were listed as group 1, those who received rocuronium 1mg/kg were listed as group 2 and those who received succinylcholine 1.5mg/kg were listed as group 3.

There was no any statistical significant difference in age, weight, male/female, ASA-PS and hemodynamic parameters when compared among groups (Table 2, Figure 1-3)

Table 2. Demographic variables

Parameters	GROUP 1 Mean± SD	GROUP 2 Mean± SD	GROUP 3 Mean± SD	P Value Group 1 Vs. 3	P Value Group 2 Vs. 3
Age (years)	34.30 ± 13.01	35.73 ± 13.18	39.30 ± 15.37	0.17	0.33
Weight (Kg)	56.06 ± 4.28	55.80 ± 5.18	54.36 ± 3.99	0.11	0.23
Male : Female	18:12	15:15	12:18	0.12	0.43
ASA PS I : II	22 : 8	24 : 6	19 : 11	0.40	0.15

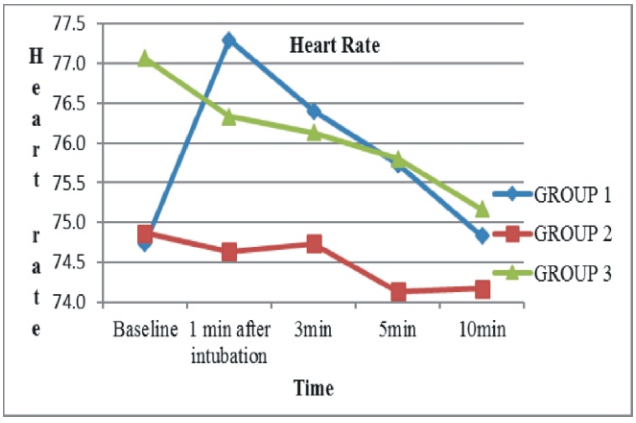

Figure 1. Comparison of heart rate among three groups

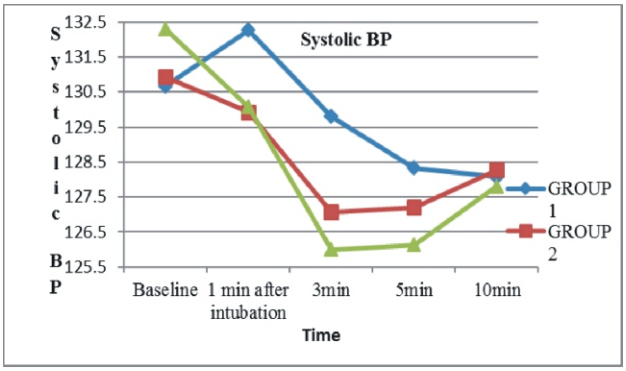

Figure 2. Comparison of systolic blood pressure among three groups

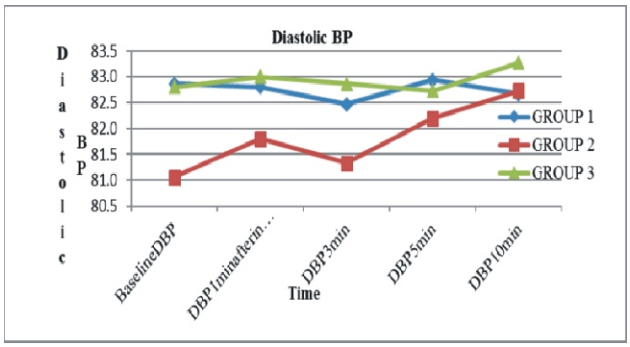

Figure 3. Comparison of diastolic blood pressure among three groups

Intubating condition was assessed using Cooper et al and was classified as excellent, good, fair and poor. There was statistical significant difference on comparison of intubation Response between group 1 and group 3 while group 2 and group 3 have no statistical significant difference on comparison (Table 3, 4).

Table 3. Scores as per Cooper et al.

TOTAL SCORE	GROUP 1 (n=30)	GROUP 2 (n=30)	GROUP 3 (n=30)	P Value Group 1 Vs. 3	P Value Group 2 Vs. 3
6	3 (10.0%)	0 (0%)	0 (0%)	<0.001	0.739
7	19 (63.3%)	0 (0%)	0 (0%)		
8	8 (26.7%)	6 (20.0%)	5 (16.7%)		
9	0 (0%)	24 (80.0%)	25 (83.3%)		

Table 4. Comparison of intubation response among three groups as per Cooper et al.

Grading	GROUP 1 (n=30)	GROUP 2 (n=30)	GROUP 3 (n=30)	P value Group 1 Vs. 3	P value Group 2 Vs. 3
Excellent	8	30	30	<0.001	Non significant
	26.7%	100.0%	100.0%		
Good	22	0	0		
	73.3%	0%	0%		
Total	30	30	30		

No any clinical side effects related to histamine release were noted with the use of different doses of rocuronium bromide and succinylcholine chloride.

DISCUSSION

Obstruction of the airway was a poorly understood phenomenon prior to 1874. Opening the mouth with a wooden screw and drawing the tongue forward with forceps or steel gloved finger was height of airway management. Sir Ivan Magill and Stanley Row Botham are credited with the initial development of modern tracheal intubation.[6] Suxamethonium, introduced by Thesleff and Foldes et al in 1952, provides rapid intense neuromuscular blockade with ultra-short duration. As an alternative to succinylcholine, rocuronium is the only non-depolarizing neuromuscular blocking drug when rapid onset is needed and when succinylcholine is contraindicated. The onset of larger dose of rocuronium will resemble succinylcholine at adductor pollicis but will be delayed compared with succinylcholine at laryngeal abductor. As with other non-depolarizing neuromuscular blocking drugs, the laryngeal adductor muscle and diaphragm are more resistant to rocuronium than adductor pollicis muscle.[7] Our result showed no any statistical significant differences in age, weight, gender, ASA PS and cardiovascular effects like in various studies[5,8-14] but study done by Robertson et al and Sparr et al. showed significant increase in mean arterial pressure and heart rate following intubation after administering different doses of rocuronium.[15,16]

Naguib et al studied intubating conditions and pharma codynamics of suxamethonium, rocuronium, mivacurium or rocuronium-mivacurium combinations in children at various doses. The result of their study showed that suxamethonium 1mg/kg had better intubating condition than rocuronium with 0.6 mg/kg at 60 seconds after drug administration like in our study.[8]

Cooper et al observed that intubating conditions after 600 mcg/kg Org 9426 at 60 seconds was found to be clinically acceptable as good or excellent only in 95% of patients whereas it was 100% when attempted at 90 seconds. suxamethonium 1 mg/kg showed acceptable intubating condition in all patients at both times. The average time for the onset of block following Org 9426 at this dose was 89 seconds and concluded that 1mg/kg suxamethonium has better intubating condition than 0.6mg/kg rocuronium while 0.9mg/kg rocuronium has similar intubating condition at 90 sec.[5] Tracheal intubating conditions during RSI was compared by Mc Court et al. using 0.6mg/kg or 1mg/kg rocuronium and 1.0mg/kg suxamethonium at 60 seconds, assessed with Viby-Mogensen et al grading and found that intubating conditions at 60 seconds was acceptable in 75% of subjects with 0.6mg/kg rocuronium whereas around 96% with 1.0mg/kg rocuronium and 1.0mg/kg suxamethonium, showing 1mg/kg suxamethonium is superior to 0.6mg/kg rocuronium at 60 seconds.[17]

A meta-analysis conducted by Perry J.J. et al used Goldberg Scale of intubation and found that 1mg/kg succinylcholine exhibited excellent intubation conditions more reliably than 0.6mg/kg rocuronium at 60 seconds of drugs administration. They also mentioned that succinylcholine should be used as the first-line muscle relaxant for rapid-sequence intubations and rocuronium when used with propofol, may be the alternative agent to exhibit similar intubating condition.[18] Also, Andrews et al concluded that 1.0mg/kg rocuronium given along with propofol in a rapid-sequence induction of anaesthesia contributes to the quality of the intubating conditions and is clinically equivalent to succinylcholine 1.0 mg/kg for this purpose.[19]

We used rocuronium at doses 0.6 mg/kg and 1 mg/kg and compared with suxamethonium 1.5mg/kg intravenously as boluses. The result showed 100% excellent intubating condition in both groups with higher dose of rocuronium and suxamethonium, while only 26.7% excellent and 73.3% good intubating condition in group with 0.6mg/kg rocuronium at 60 seconds of drug administration. There was high statistical significant difference between these two doses of rocuronim with p value of <0.001.

In contrary to our study, Puhringer et al did a study with 1mg/kg succinylcholine and 0.6 mg/kg rocuronium bromide for intubation at 60 seconds after drugs administration and Steward Score was used. Intubating conditions was rated excellent or good in all patients except one with poor intubating conditions. They concluded stating rocuronium resembles succinylcholine in exhibiting good to excellent intubating conditions approximately 1 min after its administration.[10] Shukla et al also suggested that it would be prudent to wait for 90 seconds if rocuronium bromide is to be used at a dose of 0.6mg/kg body weight to achieve similar intubating condition as suxamethonium.[12]

A randomized clinical study was conducted by Parikh et al using 1.5mg/kg suxamethonium and 0.6 mg/kg rocuronium to assess intubating condition clinically at 60 and 90 seconds. The mean onset time at 60 seconds for suxamethonium was 46.66 ± 5.54 seconds, for rocuronium was 76.33 ± 10.33 sec and at 90 seconds for rocuronium was 78.33 ± 9.4 sec.[20] Also, comparative clinical evaluative study was conducted by Kumar et al in 2015 to prove rocuronium as a safe alternative to succinylcholine for endotracheal intubation.[21] Both these study concluded that rocuronium bromide is a safe, haemodynamically stable and good alternative for suxamethonium for endotracheal intubation where it is contraindicated or its use is hazardious.

Brijesh et al in 2017 compared two doses of rocuronium 0.6 mg/kg and 0.9mg/kg for rapid sequence intubation in 60 patients. It was observed that 0.9 mg/kg dose provide good to excellent intubating condition whereas 0.6 mg/kg produces adequate intubating conditions for RSI at 60 seconds. They concluded that lower doses of rocuronium can be used when

succinylcholine is contraindicated and a shorter duration of neuromuscular blockade is preferred.[22]

SG Chavan et al compared two different doses of rocuronium that is 0.6 mg/kg and 0.9 mg/kg with 2mg/kg succinylcholine for endotracheal intubations in 30 adult patients in each group and found that intubation score of rocuronium 0.9 mg/kg was the best but the time taken to intubate was prolonged by 20% and increase duration by 7.5 times when compared to succinylcholine suggesting larger dose of rocuronium as an alternative to succinylcholine to achieve perfect intubating condition.[23]

Like in many studies, our study concluded that at 60 seconds after the administration of muscle relaxant the clinically acceptable intubating conditions are similar in both succinylcholine 1.5 mg/kg and rocuronium 1.0 mg/kg (100% and 100% respectively). There was no any significant change in hemodynamic and demographic variables. Limitation, we realized is that use of neuromuscular monitoring would have a better judgment for time to tracheal intubation as clinical judgment and inter personnel skills can have various impact on the laryngoscopy and intubation response. Though study was blinded, the fasciculation by succinylcholine can no longer be hidden here.

CONCLUSION

This study concluded that intubating response after 60 seconds following inj. suxamethonium 1.5mg/kg is similar to inj. rocuronium 1.0 mg/kg body weight while using Cooper et al score; thereby can be the alternative to the succinylcholine in conditions where it is contraindicated.

CONFLICT OF INTERESTS

None.

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