IOSR Journal of Dental and Medical Sciences (IOSR-JDMS)
e-ISSN: 2279-0853, p-ISSN: 2279-0861.Volume 16, Issue 1 Ver. X (January. 2017), PP 01-05
www.iosrjournals.org

Comparative Study of Succinylcholine with Different Doses of Rocuronium Bromide for Tracheal Intubation during General Anaesthesia

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Abstract:
Background and objective: *Tracheal intubation is one of the best methods of securing a patient airway. Though many non-depolarising muscle relaxants (NDMRs) like atracurium besylate, vecuronium bromide and mivacurium chloride were introduced, they however have not matched the timing and intubating conditions produced by succinylcholine. The new NDMR drug rocuronium bromide became the first competitor for succinylcholine as it produces excellent cardiovascular stabilityand is devoid of the adverse effects that are seen with succinylcholine. Hence, the present study was undertaken to compare the intubating conditions, hemodynamic changes and adverse effects of using injection succinylcholine 1 mg/kg with two doses of injection rocuronium bromide 0.6 mg/kg and 1 mg/kg body weight during general anaesthesia in adult patients.*
Methodology*: The study population consisted of 90 patients aged between 18-60 years posted for various elective surgeries requiring general anaesthesia. Study population was randomly divided into 3 groups with 30 patients in each sub group. Group A received injection succinylcholine 1mg/kg body weight and intubation, group B received injection rocuronium bromide 0.6 mg/kg body weight and group C received injection rocuronium bromide 1mg/kg body weight and intubation attempted at 60 seconds. Intubating conditions were assessed at 60 seconds based on the scale adopted by Toni Magorian et al. 1993.*
Results: *It was found that succinylcholine 1mg/kg body weight and rocuronium bromide 1mg/kg body weight produced excellent intubating condition in 96.7% and 93.3% of the patients, respectively whereas rocuronium bromide 0.6mg/kg produced excellent intubating condition in only 50% of the patients and the difference was statistically significant. Rocuronium bromide 0.6 mg/kg produced significant increase in heart rate, systolic blood pressure, diastolic blood pressure from baseline as compared to succinylcholine 1mg/kg and rocuronium bromide 1 mg/kg, post induction.*
Conclusion*: Thus, from the present study, it is clear that Rocuronium is a safe, haemodynamically stable and good alternative for succinylcholine for endotracheal intubation at 60 seconds and can be used for safe intubation, if there is no anticipation of difficult intubation.*
Keywords*: Anaesthesia, Rocuronium bromide, Succinylcholine, Tracheal intubation*

I. Introduction

The primary role of anaesthesiologists is to secure and maintain a patent airway. Tracheal intubation is one of the best methods of securing a patient airway.

Succinylcholine (Sch), a depolarising agent was introduced by Thesleff and Foldes in 1952, which changed anaesthetic practice drastically and was considered the gold standard for tracheal intubation.[1,2,3] Its rapid onset of effect and ultrashort duration of action permitted rapid endotracheal intubation.[4] But all did not go well for succinylcholine when its adverse effects started surfacing especially fasciculations[5], hyperkalemia[6,7], post-operative muscle pains[8], rise in intragastric, intracranial and intraocular pressure.[9]

The aim of research on neuromuscular drugs was to have a nondepolarising muscle relaxant (NDMR), which is like succinylcholine but without its side effects.[10] Though many non-depolarising muscle relaxants (NDMRs) like atracurium besylate, vecuronium bromide and mivacurium chloride were introduced, they however have not matched the timing and intubating conditions produced by succinylcholine.[10] The new NDMR drug rocuronium bromide introduced in 1994 became the first competitor for succinylcholine.[11] Rocuronium bromide when given in two to three times the ED_{95} (effective dose), is said to produce excellent to good intubating conditions in 60 seconds similar to those obtained with succinylcholine but with excellent cardiovascular stability.[10] Further rocuronium bromide being a nondepolarising agent is devoid of the adverse effects that are seen with succinylcholine.[10]

Hence, the present study was undertaken to compare the intubating conditions, hemodynamic changes and adverse effects of using injection succinylcholine 1 mg/kg with two doses of injection rocuronium bromide 0.6 mg/kg and 1 mg/kg body weight during general anaesthesia in adult patients.

II. Materials And Methods

The study was a prospective randomized double-blind controlled trial conducted among all the patients undergoing general anaesthesia fulfilling the inclusion criteria which was ASA grade I/II, either sex, age group between 18-60 years and Mallampatti grade I and II. Patients with ASA grade III/IV, Mallampatti grade III/IV, increased risk of aspiration, having contraindications to suxamethonium and rocuronium, history of drug and alcohol abuse, hepatic and renal impairment, neuromuscular diseases, BMI>30 and anticipated difficult intubation were excluded from the study. A sample size of 26 in each group was determined and it was rounded to 30 patients in each group. Patients were randomly allocated to three groups with equal number of patients in each group according to computer generated randomization list.

Group A received injection succinylcholine 1mg/kg body weight and intubation, group B received injection rocuronium bromide 0.6 mg/kg body weight and group C received injection rocuronium bromide 1mg/kg body weight and intubation attempted at 60 seconds. Assesment of intubating conditions was done according to a qualitative scoring system described by Cooper et al.[12] Table 1 shows criteria and score of intubating conditions assigned to the patients.

Table 1. Criteria and score of intubating conditions

Jaw relaxation	Vocal Cords	Response to intubation
Poor (impossible) = 0	Closed = 0	Severe coughing = 0
Minimal (difficult) = 1	Closing = 1	Mild coughing = 1
Moderate (fair) = 2	Moving = 2	Slight diaphragm movement = 2
Good(easy) = 3	Open = 3	None = 3

Intubating conditions in all the patients were graded as excellent, good, fair, poor after calculating scores of jaw relaxation, vocal cords and response to intubation as shown in Table 2.

Table 2. Grading of intubation

Intubating condition	Score
Excellent	8-9
Good	6-7
Fair	3-5
Poor	0-2

The excellent and good intubating conditions were taken as acceptable where as the fair and poor intubating condition were considered as unacceptable. In the perioperative period, side-effects and complications, if any was noted in all patients.

Preanaesthetic evaluation was done in all patients scheduled for elective surgeries. Detailed history, physical examination and basic investigation were performed in all patients. On arrival in the operation theatre, electro-cardiography, non-invasive blood pressure, pulse oximetry, capnography were monitored. A 20-gauge intravenous catheter was placed for administration of intravenous fluids and drugs.

All drugs were prepared by an anaesthetiologist not involved in the study to keep the study investigation blinded. Pre-oxygenation using a tight-fitting mask was performed for 3 min with 100% oxygen. Just before induction every patient were premedicated with injection glycopyrolate 0.2 mg intravenously. Anaesthesia was induced with inj. propofol 3 mg/kg till the eyelash reflex is lost and then administration of the designated dose of study drug was done. Laryngoscopy was attempted for facilitation of endotracheal intubation 60 seconds after the administration of either of the respective drug.

Blood pressure (BP), heart rate (HR) and peripheral oxygen saturation (SpO2) were recorded before induction of anaesthesia, at induction and post-induction (1 min after tracheal intubation). In the event of bradycardia (HR< 50 beats per min), inj atropine was administered. In the event of a decrease in mean arterial pressure (MAP) >25%, mephentermine was administered in 3 mg increments. Adverse events such as laryngospasm, bronchospasm, masseter spasm or muscle rigidity were recorded. After tracheal intubation, anaesthesia was maintained with balanced technique of using nitrous oxide, oxygen, isoflurane and systemic analgesics.

The collected data were entered and analyzed in SPSS (IBM) version 21. Summarization of data for frequency distribution of variables of interest were carried out by using descriptive statistics such as mean,

standard deviation and percentages. Chi-square test, Fisher's exact test and ANOVA with post hoc analysis were used to test the association. P-value of less than 0.05 was taken as statistically significant.

Ethical approval was obtained from the Institutional Ethics Committee, RIMS, Imphal before the beginning of the study. Written informed consent were taken from the participants and their participation was completely voluntary and the right for refusal to participate in the study was respected.

III. Results

Patients in all the five groups were comparable with respect to age, weight, and ASA physical status (Tables 3).

Table 3. Background characteristics of the patients

Background characteristics	Group A	Group B	Group C	p-value
Age in yrs (mean ± SD)	41.5 ± 10.6	34.7 ±10.3	38.3 ± 10.6	0.302
Body weight in kg (mean ± SD)	56.9 ± 5.9	57.8 ± 5.3	57.2 ± 5.1	0.807
Male n(%)	6 (20.0)	7 (23.3)	5 (16.7)	0.812
Female n (%)	24 (80.0)	23 (76.7)	25 (83.3)	
ASA grade I (%)	16 (53.3)	15(50.0)	12 (40.0)	0.561
ASA grade II (%)	14 (46.7)	15 (50.0)	18 (60.0)	
Mallampati grade I (%)	16 (53.3)	11(36.7)	12 (40.0)	0.387
Mallampati grade II (%)	14 (46.7)	19 (63.3)	18 (60.0)	

Succinylcholine 1mg/kg body weight and rocuronium bromide 1mg/kg body weight produced excellent intubating condition in 96.7% and 93.3% of the patients, respectively whereas rocuronium bromide 0.6mg/kg produced excellent intubating condition in only 50% of the patients and the difference was statistically significant (Table 4).

Table 4. Distribution of patients in relation to their Intubating condition score

Intubating condition Score	Group A n (%)	Group B n (%)	Group C n (%)	p-value
Excellent	29 (96.7)	15 (50.0)	28 (93.3)	0.000
Good	1 (3.3)	13 (43.3)	2 (6.7)	
Fair	0	2(6.7)	0	

Rocuronium bromide 0.6 mg/kg produced significant increase in heart rate, systolic blood pressure, diastolic blood pressure from baseline as compared to succinylcholine 1mg/kg and rocuronium bromide 1 mg/kg, post induction (Table 5).

Table 5. Heart rate, systolic blood pressure, diastolic blood pressure and SpO_2 in three groups pre-induction and post-induction

Groups	Pre-induction Mean ± SD	Post-induction Mean ± SD	Increase	Percentage increase	p-value
Heart rate (beats/min)					
Group A	79.4 ± 4.4	112.5 ± 6.1	33.1	41.6	0.02
Group B	78.2 ± 3.2	116.1 ± 7.4	37.9	48.4	
Group C	77.3 ± 3.1	111.6 ± 5.8	34.3	44.3	
Systolic blood pressure (mm of Hg)					
Group A	121.67 ± 3.1	131.13 ± 2.7	9.46	7.7	0.000
Group B	121.60 ± 3.4	134.87 ± 3.2	13.27	10.9	
Group C	121.53 ± 3.2	131.40 ± 2.6	9.87	8.1	
Diastolic blood pressure (mm of Hg)					
Group A	78.3 ± 2.4	84.4 ± 2.8	6.1	7.7	0.001
Group B	78.0 ± 2.2	87.2 ± 2.6	9.2	11.8	
Group C	78.1 ± 2.8	85.5 ± 3.0	7.4	9.5	
SpO_2 (%)					
Group A	98.9 ± 1.2	99.5 ± 0.5	0.6	0.6	0.878
Group B	98.7 ± 1.2	99.5 ± 0.6	0.8	0.8	
Group C	99.0 ± 1.1	99.6 ± 0.5	0.6	0.6	

Adverse effects of the drugs noticed during the study were muscle fasciculation and sore throat and hoarseness of voice (Table 6). There was significantly more side effects in succinylcholine group as compared to rocuronium group as shown in Table 7.

Table 6: Reported adverse effects

Adverse effects	Group A n (%)	Group B n (%)	Group C n (%)
Muscle fasciculation	9 (30.0)	0	0
Sore throat and hoarseness of voice	1 (3.3)	2 (6.6)	1 (3.3)

Table 7. Comparison of side effect between succinylcholine and rocuronium group*

Side effects	Succinylcholine group N (%)	Rocuronium group N (%)	p-value
Yes	10 (33.3)	3 (5.0)	0.001
No	20 (66.7)	57 (95.0)	

* Group B and C clubbed

IV. Discussion

4.1 Intubating conditions

In the present study involving comparison of succinylcholine 1mg/kg body weight with rocuronium bromide 0.6 mg/kg body weight and 1mg/kg body weight for endotracheal intubation in adult patients. It was noted that succinylcholine 1mg/kg body weight and rocuronium 0.9 mg/kg produced excellent intubating conditions in 96.7% and 93.3% of the patients, respectively while rocuronium bromide 0.6 mg/kg body weight produced excellent intubating conditions in only 50% of cases. The present study was comparable with study of Penchalaiah C et al.[13] Thus increasing the dose of rocuronium bromide from 0.6 mg/kg to 1mg/kg body weight increased the incidence of excellent intubating conditions. The study results were comparable to Toni Magorian et al,[14] Cooper et al[15] and Puhringer et al[16] and K. C. McCourt et al.[17]

4.2 Cardiovascular changes

There was a rise in mean heart rate by 41.6%, 48.4% and 44.3% following administration of succinylcholine 1 mg/kg body weight, rocuronium 0.6 mg/ kg body weight and 1 mg/ kg body weight, one minute following intubation, respectively. There was significant increase in heart rate from baseline after 1 minute in rocuronium 0.6 mg/kg group than rocuronium 1mg/kg and succinylcholine 1 mg/kg group. These findings were similar to those observed by Misra M et al,[18] Bhale P et al,[19] Gupta et al,[20] Somani M et al.[21]

There was increase in systolic blood pressure by 7.7%, 10.9% and 8.1% from pre induction value following administration of succinylcholine 1 mg/kg body weight, rocuronium 0.6 mg/kg and 1 mg/kg body weight one minute following intubation, respectively. There was significant increase in systolic blood pressure from baseline after 1 minute in rocuronium 0.6 mg/kg group than in rocuronium 1 mg/kg and succinylcholine group. There was a similar increase in diastolic blood pressure by 7.7%, 11.8 % and 9.3% from pre induction value following administration of succinylcholine 1mg/kg body weight, rocuronium 0.6 mg/kg and 1 mg/kg body weight one minute following intubation, respectively. Similar findings were observed by Misra M et al,[18] Bhale P et al,[19] Gupta S et al[20] and Somani M et al.[21]

There was significant increase in diastolic blood pressure from baseline after 1 minutes in rocuronium 0.6 mg/kg group than rocuronium 1 mg/kg and succinylcholine 1 mg/kg group. Similar findings were observed by Misra M et al[18] and Somani M.[21] There was no significant difference seen in mean saturation of oxygen from baseline to post induction in the groups which is comparable to Marsch A.[22]

4.3 Side effects

Muscle fasciculations were seen in succinylcholine group (30%). Shukla A et al[23] had also reported only muscle fasciculations in succinylcholine group in 95% of patients. Sore throat and hoarseness of voice were reported in succinylcholine 1 mg/kg group (3.3%), rocuronium 0.6 mg/kg group (6.6%) and rocuronium 1 mg/kg group (3.3%). No patient in succinylcholine and rocuronium group had any signs of histamine release (e.g. flushing, rash, bronchospasm).

V. Conclusion

Rocuronium 1 mg/kg is a safe, haemodynamically stable and good alternative for succinylcholine 1 mg/kg for endotracheal intubation at 60 seconds and can be used for safe intubation, if there is no anticipation of difficult intubation. There was increase in heart rate, systolic blood pressure and diastolic blood pressure after 60 seconds of administration of drugs in all the three groups but the maximum increase was with rocuronium 0.6 mg/kg and least increase with succinylcholine 1 mg/kg. The most common side effects of the drugs in this study were muscle fasciculation in succinylcholine group and sore throat and hoarseness of voice in all the three groups but these were mild and safe-limiting in nature.

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