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COMPARATIVE EVALUATION OF INTUBATING CONDITIONS AFTER SUCCINYLCHOLINE AND DIFFERENT DOSES OF ROCURONIUM

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ABSTRACT: BACKGROUND: Succinylcholine is widely used to facilitate intubation but it is contraindicated and hazardous in some medical conditions and Rocuronium is safer alternative. Aim: To study the intubating conditions obtained after different doses of Rocuronium and to compare with succinylcholine. **SETTING AND DESIGN:** Randomized and prospective study. **METHODS:** 100 adult patients posted for major surgeries under general anaesthesia divided into four groups of 25 each depending on dose and muscle relaxant given. Intubating conditions were assessed using standard scoring system, results were tabulated and analysed. **STATISTICAL ANALYSIS:** Results were analysed using chi-square test and unpaired t test. **RESULTS:** Intubating conditions after Rocuronium 0.6 mg/kg body weight at 90 seconds and Rocuronium 0.9 mg/kg body weight at 60 seconds are clinically acceptable in 100% of the patients and are equivalent to succinylcholine 1.5 mg/kg BW. **CONCLUSION:** Rocuronium is alternative and safer choice of succinylcholine in the conditions where succinylcholine is contraindicated and hazardous.

KEYWORDS: Rocuronium, Succinylcholine, Intubating condition.

INTRODUCTION: In modern anaesthesia practice endotracheal intubation is performed after induction and adequate muscle relaxation, different type of complication are met during induction and intubation. These complication may be life threatening in certain group of patients. Therefore the aim is to have intubation fast, smooth and stable haemodynamics.

Succinylcholine since its introduction in clinical practice in 1951 is the drug of choice for tracheal intubation, owing to its rapid onset. However the use of this drug is associated with fasciculation's, myalgia, bradycardia, increased plasma potassium concentration, raised intraocular and intra-abdominal pressure. It is also hazardous to use succinylcholine in hyperkalemic state such as burn, massive tissue trauma, tetanus, paraplegia and multiple sclerosis these side effects were constant cause for promoting the use of non-depolarizing agents. But the slow onset and inadequate intubating condition restrict the use of non-depolarizing agents amongst the currently available non depolarizing agents Rocuronium has the most rapid onset, intermediate duration of action minimal cardiovascular side effects and no histamine release. Therefore Rocuronium almost fulfilling the criteria for ideal neuromuscular blocking agents for endotracheal intubation.

The results from different studies regarding acceptable Intubating conditions after Rocuronium 0.6 mg/kg at 60 seconds are variable. K.C McCourt et al (1998)¹ found acceptable Intubating conditions in 75% subjects while R. Cooper et al (1992)² found acceptable intubating condition in 95 % of the subjects.

S. C. Marsh 2011,³ Toni Magorian et al (1995)⁴ and J. I Andrews⁵ have reported uniformly excellent Intubating condition with Rocuronium 0.9mg/kg or more. However larger doses of Rocuronium would be associated with longer duration of action.

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Observation of above studies inspired us to conduct the study to assess the intubating condition using Rocuronium 0.6mg/kg BW at 60, 90 seconds and Rocuronium 0.9 mg/kg BW at 60 seconds and to compare with standard dose of Succinylcholine i.e. 1.5 mg/kg BW.

MATERIAL METHODS: Study was conducted in 100 adult patients of ASA grade I-II and mallampatti grade I-II posted for major surgeries done under general anaesthesia. Patients were randomly divided into four groups of 25 each depending on the type, dose of relaxant and time of intubation.

Group I Succinylcholine 1.5 mg/kg BW assessed at 60 sec.

Group II Rocuronium 0.6 mg/kg BW assessed at 60 sec.

Group III Rocuronium 0.6 mg/kg BW assessed at 90 sec.

Group IV Rocuronium 0.9mg/kg BW assessed at 60 sec.

Written consent was taken from all the patients and were kept on fasting for at least six hours in the operation theatre patients were pre medicated with injection atropine 0.6mg I.V., Injection pentazocine 0.5mg/kg BW I.V and Inj midazolam 0.05mg/kg BW I.V before induction all the patients were uniformly pre oxygenated for 3mins and were induced with Inj. Thiopentone followed by calculated dose of relaxant to be studied. Laryngoscopy and intubation was performed at 60 and 90 seconds depending on the group and intubating conditions were assessed using standard scoring system.

In present study the intubating conditions are graded using a method described by R. Cooper et al (1992). This takes into consideration the ease of laryngoscopy, condition of vocal cords, and response to tracheal intubation. These are scored on four point scale (0-3) and total score added together to give an overall intubating score for each patient. If intubation was not possible, it was reattempted after 30 seconds, but for all practical purposes the Intubating conditions at first attempt were recorded

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

Table 1: Grading of Intubating Condition

A score of 8-9 was considered excellent, 6-7 as good, 3-5 as fair and 0-2 as poor. Good and Excellent Intubating condition were taken as clinically acceptable.

Anaesthesia was maintained on Oxygen, Nitrous Oxide, Halothane and intermittent doses of Attracurium. At the end of surgery residual neuromuscular blockade was reversed with intravenous Neostigmine 0.05mg/kg BW and glycopyrolate 0.08mg/kg BW.

Hemodynamic profile was recorded in the form of pulse rate and blood pressure. These were recorded before induction, after induction and every one minute after intubation up to 5 min. other parameters like spo2, ET co2, urine output, blood loss monitored throughout the surgery.

Statistical Analysis: unpaired t test to compare age, weight between two groups and chi-square test to compare the distribution of sex, jaw relaxation, cord relaxation, reaction to intubation and Intubating conditions at 60 and 90 seconds.

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Changes in PR, BP, in between groups at various stages were compared by using unpaired t test.

OBSERVATION AND RESULT:

Jaw Relaxation	Group I		Group II		Group III		Group IV	
	No.	%	No.	%	No.	%	No.	%
Poor (impossible)	-	-	-	-	-	-	-	-
Minimal (difficult)	-	-	2	8%	-	-	-	-
Moderate (fair)	2	8%	15	60%	6	24%	3	12%
Good (easy)	23	92%	8	32%	19	76%	22	88%

Table 2: Condition of Jaw Relaxation (laryngoscopy)

Vocal Cords	Group I		Group II		Group III		Group IV	
	No.	%	No.	%	No.	%	No.	%
Closed	-	-	-	-	-	-	-	-
Closing	-	-	4	16%	-	-	-	-
Moving	3	12%	11	44%	4	16%	2	8%
Open	22	88%	10	40%	21	84%	23	92%

Table 3: Condition of Vocal Cords

Response	Group I		Group II		Group III		Group IV	
	No.	%	No.	%	No.	%	No.	%
Severe coughing or bucking	-	-	-	-	-	-	-	-
Mild coughing	-	-	4	16%	-	-	-	-
Slight diaphragmatic movement	3	12%	15	60%	6	24%	3	12%
None	22	88%	6	24%	19	76%	22	88%

Table 4: Response to Intubation

Intubating Condition	Group I		Group II		Group III		Group IV	
	No.	%	No.	%	No.	%	No.	%
Excellent (8-9)	23	92	7	28	19	76	22	88
Good (6-7)	2	8	13	52	6	24	3	12
Fair (3-5)	-	-	5	20	-	-	-	-
Poor (0-2)	-	-	-	-	-	-	-	-

Table 5: Overall Intubating Condition

Above table shows the Overall Intubating condition, which was excellent in 23 patients of group I, 7 of group II, 19 of group III and 22 of group IV.

Good Intubating conditions was present in 2 patients of group I, 13 of group II, 6 of group III and 3 of group IV.

Overall intubating condition was fair in 5 patients of group II only.

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Group Compared	X2 value	P value	Significance
I vs II	21.33	<0.001	Highly significant
I vs III	2.38	>0.05	Not Significant
I vs IV	0.22	>0.05	Not Significant
II vs III	21.54	<0.001	Highly significant
II vs IV	18.47	<0.001	Highly significant
III vs IV	1.22	>0.05	Not Significant

Table 6: Intergroup relationship of overall Excellent Intubating Conditions

Above table shows the comparison of Excellent Intubating conditions of all the four group. The difference is statistically highly significant in group I (Succinylcholine 1.5mg/kg BW at 60 seconds) vs II (Rocuronium 0.6mg/kg at 60 seconds), group II (Rocuronium 0.6mg/kg at 60 seconds) vs III (Rocuronium 0.6mg/kg at 90 seconds), and group II(Rocuronium 0.6mg/kg at 60 seconds) vs IV (Rocuronium 0.9mg/kg at 60 seconds) and Not Significant between I vs III, I vs IV and III vs IV.

Group Compared	X2 value	P value	Significance
I vs II	11.52	<0.001	Highly significant
I vs III	2.38	>0.05	Not Significant
I vs IV	0.22	>0.05	Not Significant
II vs III	4.16	<0.05	significant
II vs IV	9.19	<0.05	significant
III vs IV	1.22	>0.05	Not Significant

Table 7: Intergroup relationship of overall Good Intubating Conditions

Above table shows the comparison of Good Intubating conditions of all the four groups. The difference is statistically highly significant in group I (Succinylcholine 1.5mg/kg BW at 60 seconds) vs group II (Rocuronium 0.6mg/kg at 60 seconds), and significant between group II (Rocuronium 0.6mg/kg at 60 seconds) vs III (Rocuronium 0.6mg/kg at 90 seconds), and group II(Rocuronium 0.6mg/kg at 60 seconds) vs IV (Rocuronium 0.9mg/kg at 60 seconds) and Not Significant between I vs III, I vs IV and III vs IV.

Group Compared	X2 value	P value	Significance
I vs II	5.56	<0.05	significant
I vs III	5.56	<0.05	Significant
II vs IV	5.56	<0.05	Significant

Table 8: Intergroup relationship of overall fair Intubating conditions

Above table shows the comparison of fair Intubating conditions which are found only after Rocuronium 0.6 mg/kg at 60 seconds (i.e. group II). The difference is statistically significant after Rocuronium 0.6mg at 60 seconds in relation to group I, III, IV.

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Pulse rate	Group I	Group II	Group III	Group IV
Just before Induction				
Mean +/-SD	92.24 +/-10.77	88.96+/-9.78	91.52+/-11.46	92.40+/-11.46
Just after induction				
Mean +/-SD	93.12+/-10.06	89.92+/-10.09	93.52+/-10.69	94.32+/-10.93
T value	0.30	0.34	0.64	0.60
P value	>0.05	>0.05	>0.05	>0.05
After Induction				
Mean +/-SD	100.88+/-9.68	98.48+/-9.13	98.16+/-11.48	103.20+/-10.13
T value	2.98	3.56	2.05	3.50
P value	<0.05	<0.001	<0.05	<0.001
5 minutes after Induction				
Mean +/-SD	97.76+/-9.29	91.84+/-10.06	94.72+/-12.08	95.20+/-10.31
T value	1.94	1.03	0.96	0.90
P value	>0.05	>0.05	>0.05	>0.05

Table 9: Change in Pulse Rate

Pulse rate	Group I	Group II	Group III	Group IV
Just before Induction				
Mean +/-SD	95.04+/-6.00	94.72+/-5.80	92.88+/-6.23	92.96+/-6.69
Just after Induction				
Mean +/-SD	95.12+/-5.96	95.16+/-5.85	93.64+/-6.00	94.80+/-6.31
T value	0.05	0.27	0.44	1.0
P value	>0.05	>0.05	>0.05	>0.05
After Induction				
Mean +/-SD	97.56+/-5.81	98.00+/-5.88	95.96+/-6.24	97.88+/-5.76
T value	1.51	1.99	1.75	2.79
P value	>0.05	>0.05	>0.05	>0.05
5 minutes after Induction				
Mean +/-SD	95.80+/-5.88	95.48+/-5.67	94.76+/-6.16	95.88+/-5.99
T value	0.45	0.47	1.07	1.63
P value	>0.05	>0.05	>0.05	>0.05

Table 10: Change in Mean Arterial Pressure

Hemodynamic state of all the groups patients are within the clinically acceptable range.

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Side Effects	Group I	Group II	Group III	Group IV
Fasciculation	20	-	-	-
Erythema	-	-	-	-
Flushing	-	-	-	-
Hypotension	-	-	-	-
Bronchospasm	-	-	-	-

Table 11: Side Effects

Above table shows that the fasciculation was present in 20 patients of group I only. No other side effects were observed in any other group.

DISCUSSION: It is generally agreed that time interval between induction and development of satisfactory intubating condition should be as short as possible.

Succinylcholine since its introduction due to its shortest onset has been the drug of choice for endotracheal intubation but the side effects associated with the Succinylcholine were fasciculation, myalgia, bradycardia, raised potassium concentration in plasma, increased intraocular pressure and increase intra-abdominal pressure.

These side effects were constant cause for promoting the use of non-depolarizing agents for endotracheal intubation, but the slow onset of action and inadequate intubating conditions with the usual dose restricted the use of these drugs.

Amongst the currently available non-depolarizing neuromuscular blocking drugs Rocuronium has the most rapid onset of action, taking about 60-90 seconds for the complete block to develop with doses of 2-3 x ED 95 (0.6-0.9mg/kg).

Rocuronium is the 2-morpholino, 3-desacetyl, 16-N-allyl-pyrrolidino derivative of Vecuronium with mainly post – junctional effect and high degree of selectivity for the receptors at the neuromuscular junction. Muscle paralysis is produced by competitive antagonism of the nicotinic cholinergic receptors of skeletal muscle. Its potency is about 15-20% of Vecuronium. Rocuronium does not produce block of autonomic ganglia. It has fast onset, an intermediate duration of action, rapid recovery and shows minimal cumulation. Being an aminosteroidal based neuromuscular blocking agent it has low tendency to release histamine.

In present study, jaw relaxation after administration of muscle relaxant is good in 23 patients, in group-I, 8 in group-II, 19 in group-III, 22 in group-IV. Vocal cords are completely open in 22 patients of group-I, 10 of group-II, 21 of group – III, and 23 of group-IV.

There is no response to intubation in 22 patients of group-I, 6 of group-II, 19 of group-III, and 22 of group-IV. Slight diaphragmatic movement is visible in 3 patients of group-I, 15 patients of group-II, 6 of group-III and three of group-IV. In four patients of group-II i.e. after Rocuronium 0.06mg/kg at 60 seconds mild coughing has occurred during intubation.

In our study over all Intubating conditions are excellent in 23 patients in group-I (Succinylcholine 1.5mg/kg at 60 seconds), 7 in group –II (Rocuronium 0.6mg/kg at 60 seconds), 19 in group-III (Rocuronium 0.6 mg/kg at 90 seconds) and 22 patients in group-IV (Rocuronium 0.9mg/kg at 90 seconds). Number of patients having excellent Intubating condition are higher in group –I, group-II and group-IV as compared to Rocuronium 0.6mg/kg at 60 seconds i.e group-II (statistically highly significant, $p < 0.001$), but there is no significant difference between group –I, III and IV. ($p > 0.05$).

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Good intubating condition are presented in 2 patients after Succinyl choline 1.5 mg/kg at 60 seconds (group-I) 13 patient after Rocuronium 0.6mg/kg at 60 seconds (group-II) and 6 patients after rocuronium 0.6mg/kg at 90 seconds (group-III) and 3 patients after Rocuronium 0.9mg/kg at 60 seconds (group-IV). Difference in the number of patients having Good Intubating conditions are statistically significant ($p < 0.05$) between group-II and III, group -II and group-IV, and statistically highly significant ($p < 0.001$) between group-I and II.

Clinically acceptable Intubating conditions (excellent +good) are found in 80% of patient after administration of Rocuronium 0.6mg/kg at 60 seconds, with excellent Intubating condition in 28% of patients.

As in our study similar observation were also recorded by K.C. McCourt et al (1998).¹ They found clinically acceptable intubating conditions in 75% of patients with excellent condition in 28%.

J. I Andrews (1999)⁵ found clinically acceptable intubating conditions in 77% of patients with excellent condition in 40% Shukla et al⁶ reported clinically acceptable intubating condition in 80% of patients with excellent intubating condition in 30%.

However Puhlinger et al (1992)⁷ observed clinically acceptable condition in 100% patients with excellent condition 85% after rocuronium 0.6mg/kg at 60 seconds. R. Cooper et al 1992,² also found clinically acceptable condition in more than 95% of the patients with excellent condition 65%.

In these studies patients were given alfentanil/ fentanyl and nitrous oxide for more than ten minutes before induction

In our study Intubating condition were clinically acceptable in all the patients after Rocuronium 0.6mg/kg at 90 seconds with excellent condition in 76% patients. The results of our study are in accordance with them.

In our study intubating condition were clinically acceptable in all the patient after Rocuronium 0.9mg/kg at 60 seconds with excellent condition in 88% patients. The similar observations were also recorded by De Mey et al 1994,⁸ Patel. N. K⁹ and Samboonviboon¹⁰ et al 2000.

The reason for this rapid onset of this Rocuronium has been suggested to be relatively low potency of the drug. This ensures the presence of more relaxant molecule in the blood stream and results in large concentration gradient towards the biophase.

Another possible explanation could be the earlier occurrence of the block at the adductor muscle of larynx than the adductor pollicis, it appears that the intubation can be performed before complete block is obtained and measured in the thumb.

In the patients of group-I after administration of succinyl choline 1.5mg/kg intubating condition are clinically acceptable in all the patient with excellent in 95% which is consistent with the clinical practice various previous studies and the studies conducted by R. Cooper 1992,² Toney Magorian⁴ et al 1993, Tyrba M.¹¹ 1994, Patel⁹ N. K 1995, Shukla,⁶ reported the same findings.

Therefore to obtain parallel intubating condition as that after Succinyl choline 1.5mg/kg either waits for 90 seconds after Rocuronium 0.6 mg/kg or increase the dose of Rocuronium 0.9 mg/kg.

There was no significant difference in heart rate and blood pressure in all the four groups at different time interval the results are in accordance with the previous studies. The studies conducted by Cooper et al,² Nitschmann et al,¹² and Levy et al¹³ show similar results.

In our study no signs of histamine release were observed in any patients in all the four groups and similar observation were also reported by A. C. T. Huizinga¹⁴ et al 1992, Meyer et al 1992.

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CONCLUSION: From the forgoing discussion it can be concluded that Rocuronium 0.9mg/kg provide clinically acceptable and equivalent intubating conditions as that after succinyl choline 1.5 mg/kg after 60 seconds, there are no clinically significant cardiovascular effects and side effects are observed after Rocuronium 0.9mg/kg.

Thus Rocuronium can replace succinyl choline for rapid sequence intubation like burns certain neurological disease, increased serum potassium concentration, raised intraocular and intra-abdominal pressure where use of succinyl choline were hazardous and contraindicated. Also being free from fasciculation, myalgia and histamine release Rocuronium has an added advantage. Mild vagolytic effect as seen in Rocuronium may help in prevention of intraoperative bradycardia with certain anaesthetic agents.

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