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ORIGINAL ARTICLE

A COMPARATIVE CLINICAL EVALUATION OF INTUBATING CONDITIONS AND HAEMODYNAMIC EFFECTS AFTER ADMINISTRATION OF SUCCINYL CHOLINE & ROCURONIUM BROMIDE

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ABSTRACT: BACKGROUND: Rapid and safe endotracheal intubation is of paramount importance in practice of general anesthesia. Succinylcholine chloride, a depolarizing muscle relaxant due to its quick onset of action and excellent intubating conditions has remained a muscle relaxant of choice. Rocuronium was proved to be safe alternative to Succinylcholine for endotracheal intubation. **AIMS:** Study was conducted to evaluate & compare the onset time, clinical duration and intubating condition of Succinylcholine and Rocuronium Bromide and Haemodynamic changes caused by these agents. **METHODS & MATERIALS:** 80 patients were randomly divided into two groups. Group-1, Succinylcholine (1. 5mg/kg) and group-2 Rocuronium Bromide (0.6mg/kg). After 60 sec of administration of muscle relaxant, intubating conditions were judged according to scoring system by Cooper et al.[1] Onset time and duration of action was noted. Hemodynamic parameters (Heart rate, Systolic Blood Pressure, Diastolic Blood Pressure, Mean Atrial pressure and SPO_2) were monitored before intubation, during intubation and just after intubation at 1, 2 and 5 minutes. **RESULTS:** The mean onset time and duration of action was significantly longer for Rocuronium (95.15±9.47 seconds) than Succinylcholine (59.80±14.30 seconds) and Rocuronium (42.60±13.15 minutes) than Succinylcholine (5.10±2.35 minutes). Intubating conditions was excellent in 35(87%) and good in 5(12.5%) patients in succinylcholine whereas, in Rocuronium produced excellent intubation in only 23(57.5%) patients and good intubation in 14(35%) patients. The heart rate increased significantly after induction (maximum at 1 minute) with both Rocuronium (98.75±15.53) and Succinylcholine (112.75±15.89). But it gradually declined towards normal and change in heart rate with either drug was not significant at 5 minutes. The mean blood pressure increased significantly after induction (maximum at 1 minute) with both Succinylcholine (100.52±8.11) and Rocuronium (100.61±7.83). But it gradually declined towards normal in 5 minutes after induction. **CONCLUSION:** Rocuronium bromide is a safe, haemodynamically stable and good alternative for Suxamethonium for endotracheal intubation and can be used for safe induction and intubation, if there is no prediction of difficult intubation.

KEYWORDS: Rocuronium, Succinyl Choline, Tracheal Intubation, Hemodynamic Changes.

INTRODUCTION: BACKGROUND: Rapid and safe endotracheal intubation is of paramount importance in practice of general anesthesia. In emergency situations, Rapid sequence intubation is often chosen over other intubation techniques because simultaneous onset of deep sedation and paralysis, followed by securing patient's airway smoothly and quickly minimizes the chances of regurgitation and aspiration of gastric contents. The ideal neuro-muscular blocking agent for rapid sequence intubation should have a fast onset, brief duration of action, provide profound relaxation and be free from haemodynamic changes.

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Succinylcholine chloride is a short acting depolarizing muscle relaxant, allows early establishment of patient airway and reduces risk of aspiration, thereby increasing safety. However, it has side effects like bradycardia, nodal rhythm and other ventricular dysrhythmias, hyperkalemia, rise in intraocular, intragastric and intracranial pressure, postoperative myalgia, and prolonged recovery in patients with pseudo – cholinesterase deficiency and triggering of malignant hyperthermia etc.

Rocuronium bromide is a newer, low potency non-depolarizing drug with rapid onset time, an intermediate duration of action and rapid recovery with cardiovascular stability and no significant histamine release. Rocuronium bromide has been shown to produce intubating conditions and hemodynamic changes similar to those produced by Succinylcholine, whereas, side effects of Suxamethonium are not observed with Rocuronium bromide. In the previous studies, Rocuronium has given promising results in rapid sequence intubation, but its availability and cost, has limited its routine use.

Keeping these properties in mind it was decided to compare the two drugs for tracheal intubation while studying the onset of action, clinical duration intubating conditions and hemodynamic changes in elective, otherwise healthy adult population.

AIMS: The study was conducted to evaluate & compare the: Onset time, clinical duration and intubating condition of Succinylcholine and Rocuronium Bromide & Haemodynamic changes caused by these agents.

METHODS: Following Institutional Ethical Committee clearance and written consent for surgery and general anaesthesia, 80 haemodynamically stable patients of (ASA) grade I & II, of either sex in 18-60 years age group undergoing various surgical procedures were enrolled for this study. All the patients were subjected to thorough pre-anaesthetic evaluation and relevant laboratory investigations. A standard anaesthetic protocol was used in both the groups of patients. Patients with known allergy to the pre-treatment, with history of atypical plasma cholinesterase, hyperkalaemia, raised intracranial pressure, intra-ocular hypertension, malignant hyperthermia, with neuromuscular disorders, with anticipated difficult airway intubation and with known systemic disorders like cardiovascular, pulmonary, hepatorenal, or metabolic diseases were excluded from study. All patients were equally divided into two groups of 40 patients each.

In operation theatre, all monitors such as NIBP, pulse oximeter, and electrocardiogram (ECG) were connected to the patient. Intravenous line was secured using 18 G i. v. cannula and slow i. v. infusion of normal saline was started. Base line vital parameters namely pulse rate (PR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and SPO_2 were recorded. All patients were pre-oxygenated with 100% O_2 for 3 minutes. After pretreatment, patients were pre-medicated with Injection Glycopyrrolate (0.005mg/kg), Injection Ondansetron (4 mg), Injection Ranitidine (50 mg), Injection Fentanyl (2µg/kg) and Injection Midazolam 1 mg intravenously. Induction of general anesthesia was done with Injection Propofol (2mg/kg) intravenously, till the loss of eye lash reflex. In group-1, Succinylcholine (1.5mg/kg) and group-2 Rocuronium Bromide (0.6mg/kg) was given intravenously. It was followed by oro-tracheal intubation using well lubricated endotracheal tube of appropriate size after 60 sec of administration of muscle relaxant. Intubating conditions were graded and assessed according to scoring of endotracheal intubating conditions by Cooper et al.[1]

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The time taken to obtain zero response to train-of-four stimulation was noted in each case using Nerve Stimulator. Hemodynamic parameters (Heart rate, Systolic Blood Pressure, Diastolic Blood Pressure, Mean Atrial pressure and SPO_2) were monitored before intubation, during intubation and just after intubation at 1, 2 and 5 minutes.

Anesthesia was maintained with 66% nitrous oxide (N_2O) with 33% oxygen (O_2) mixture plus variable concentration (1-2%) isoflurane as required in Bain's breathing system and volume controlled ventilation with intermittent doses of Rocuronium bromide and Vecuronium as and when required. During operation, SPO_2, Pulse rate, ECG, NIBP – SBP, DBP, MAP were monitored continuously.

Duration of surgery was noted and at the end of surgery residual effects of neuromuscular blockade were reversed with inj. Neostigmine 0. 05 mg/kg and inj. Glycopyrrolate 0. 008 mg/kg body weight.

Thorough oral suctioning was done and patients were extubated after getting spontaneous respiration, confirming spontaneous eye opening and intact deglutinating reflexes and patient was shifted to postoperative recovery ward and any adverse reactions noted.

STATISTICAL ANALYSIS: The analysis of the data and application of various statistical tests was carried out with help of SPSS (16th version). Data was compiled, analyzed and presented as frequency, proportions, mean, standard deviation, percentages, Pearson Chi-Square test, Independent Samples Test, Mann-Whitney Test & T-Test. A 'p' value less than 0.05 considered as significant. Finally the results in the two groups were compared to draw the conclusion.

RESULTS: The study was conducted during the period of 2012-14 and involved 80 patients undergoing elective surgery under general anaesthesia. They were randomly divided into two groups. Group 1 received succinylcholine as the muscle relaxant and Group 2 received Rocuronium bromide. The intubating conditions were assessed according to system proposed by the Cooper et al and were classified as excellent, good, fair and poor. The hemodynamic changes were observed during induction, 1, 2 & 5 minutes after induction.

Demographically both the groups were similar in respect to age, gender, weight distribution and BMI of the population (Table 1).

	Group 1	**Group 2**
Mean age ± SD	38.62 ± 9.75	39.35 ± 10.96
Male: female	1.67	1.85
Mean weight ± SD	56.275 ± 8.16	56.125 ± 9.07
Mean BMI ± SD	21.96 ± 2.62	21.29 ± 2.16

TABLE 1: Demographics

The mean onset time of complete neuromuscular blockade was significantly longer for Rocuronium (95.15±9.47 seconds) than Succinylcholine (59.80±14.30 seconds) (p=0.00). The duration of action was significantly longer for Rocuronium (42.60±13.15 minutes) than Succinylcholine (5.10±2.35 minutes) (p=0.00). (Table 2).

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	Succinylcholine	Rocuronium	p Value
Mean onset time± SD	59.80±14.30	95.15±9.47	0.000000
Mean Duration of Action ± SD	5.10±2.35	42.60±13.15	0.000000

TABLE 2: Time course of action

Intubating conditions were graded as excellent in 35(87.5%) and good in 5(12.5%) patients of group 1 (succinylcholine), whereas, in group 2, Rocuronium produced excellent intubation in only 23(57.5%) patients and good intubation in 14(35%) patients, which was statistically significant ($p<0.05$). (Table 3 & Fig. 1).

Scores	Group 1 (n = 40)	%	Group 2 (n = 40)	%	Chi-Square Tests	p-value
Excellent	35	87.5	23	57.5	9.746	0.008
Good	5	12.5	14	35		
Fair	0	0	3	7. 5		
Poor	0	0	0	0		

TABLE 3: Intubation Score

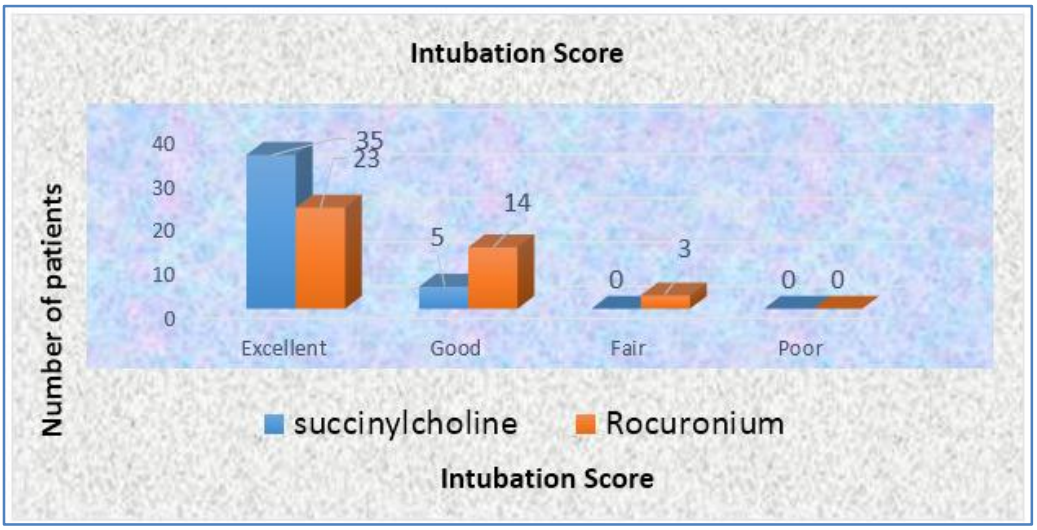

Fig. 1

The heart rate increased significantly after induction (maximum at 1 minute) with both Rocuronium (98.75±15.53) and Succinylcholine (112.75±15.89). But it gradually declined towards normal and change in heart rate with either drug was not significant at 5 minutes. On comparing, there was significant increase in heart rate from baseline after 1 minute and 2 minute in Rocuronium group than Succinylcholine group (p value <0.05). (Table 4 & Fig. 2).

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	Group 1 (Succinylcholine) (Mean± SD)	Group 2 (Rocuronium bromide) (Mean ± SD)	t-test for Equality of Means	
			t value	p value
Pre induction	86.47±14.61	87.72±14.08	0.390	0.698 (NS)
During Induction	95.25±16.70	97.57±15.72	0.641	0.523 (NS)
1 minute after Induction	98.75±15.53	112.75±15.89	3.984	0.000 (S)
2 minute after Induction	89.15±24.47	111.72±16.97	4.803	0.000 (S)
5 minute after Induction	86.97±13.82	89.02±12.23	2.416	0.018 (NS)

TABLE 4: Mean Heart rate (Beats/Min)

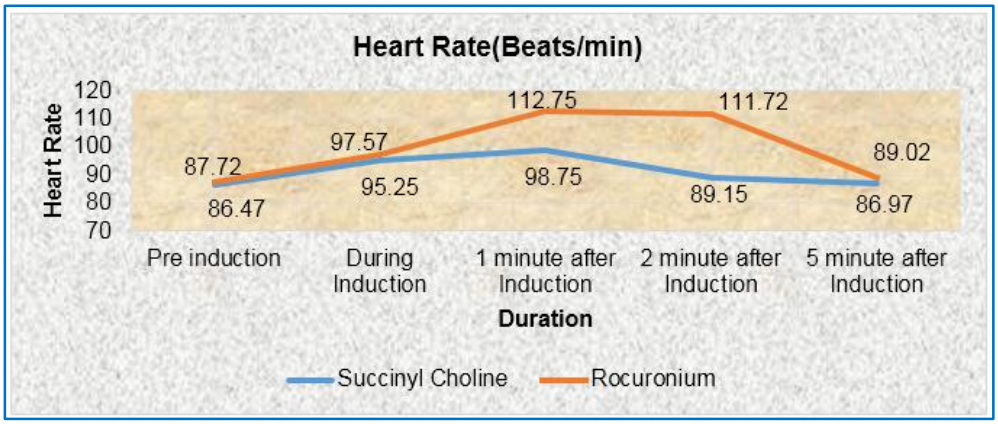

Fig. 2

The systolic blood pressure increased significantly after induction (maximum at 1 minute) with both Succinylcholine (133.22±13.85) and Rocuronium (130.40±14.59). But it gradually declined towards normal in 5 minute after induction (p value>0.05). On comparing both the groups, there was significant increase in systolic blood pressure from baseline after 2 minutes in Rocuronium group than in Succinylcholine group (p value<0. 05). (Table 5 & Fig. 3).

	Group 1 (Succinylcholine) (Mean ± SD)	Group 2 (Rocuronium bromide) (Mean ± SD)	t-test for Equality of Means	
			t value	Sig. (2-tailed) p value
Pre induction	124.40±14.89	121.77±12.15	0.923	0.362 NS
During Induction	126.32±16.68	127.47±14.71	0.387	0.701 NS
1 minute after Induction	133.22±13.85	130.40±14. 59	1.017	0.315 NS

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2 minute after Induction	123.32±12.20	130. 00±16. 5	2.850	0.007 S
5 minute after Induction	117.75±14.11	119.25±10.56	0.578	0.567 NS

TABLE 5: Systolic Blood Pressure (mmHg)

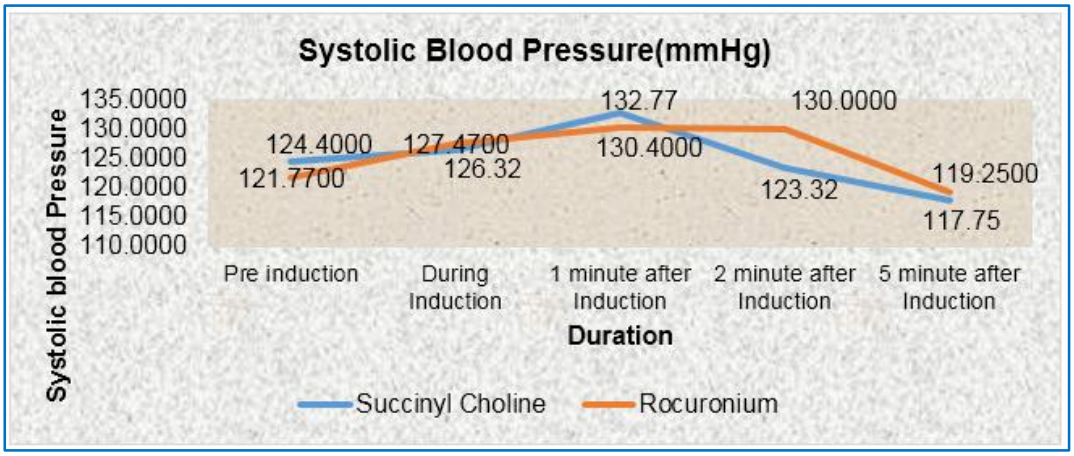

Fig. 3

The diastolic blood pressure increased significantly after induction (maximum at 1 minute) with both Succinylcholine (84.17±7.34) and Rocuronium (85.72±6.94). But it gradually declined towards normal in 5 minute after induction. On comparing, there was significant increase in diastolic blood pressure from baseline after 2 minute in Rocuronium group than in Succinylcholine group (p value <0.05). (Table 6 & Fig. 4).

	Group 1 (Succinylcholine) Mean ± SD	**Group 2 (Rocuronium bromide) Mean ± SD**	**t-test for Equality of Means**	
			t value	**Sig. (2-tailed) p value**
Pre induction	77.82±9.32	77.17±8.49	0.344	0.733 NS
During Induction	82.00±9.41	79.20±8.27	1. 389	0.173 NS
1 minute after Induction	84.17±7.34	85.72±6.94	1.050	0.300 NS
2 minute after Induction	77.27±10.69	82.22±7.48	2.540	0.015 S
5 minute after Induction	76.37±11.11	77.50±6.48	0.533	0.597 NS

TABLE 6: Diastolic Blood Pressure

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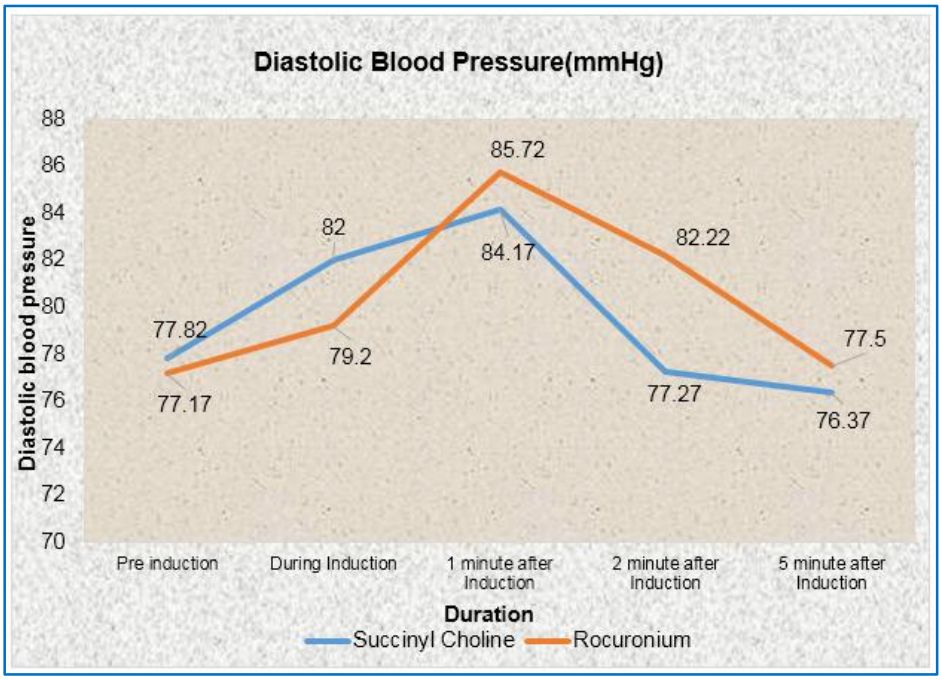

Fig. 4

The mean blood pressure increased significantly after induction (maximum at 1 minute) with both Succinylcholine (100.52±8.11) and Rocuronium (100.61±7.83). But it gradually declined towards normal in 5 minutes after induction. On comparing both the groups, there was significant increase in mean blood pressure from baseline after 2 minute in Rocuronium group than in Succinylcholine group (p value <0. 05). (Table 7 & Fig. 5).

	Group 1 (Succinylcholine chloride) Mean ± SD	**Group 2 (Rocuronium bromide) Mean ± SD**	**t-test for Equality of Means**	
			t value	Sig. (2-tailed) p value
Pre induction	93. 35±10.66	92.04±8.41	0.670	0.507 NS
During Induction	96.77±11.00	95.29±9.68	0.681	0.500 NS
1 minute after Induction	100.52±8.11	100.61±7.83	0.058	0.954 NS
2 minute after Induction	92.62±10.41	98.15±8.98	3.168	0.003 S
5 minute after Induction	90.16±11.39	91.41±7.19	0.587	0.561 NS

TABLE 7: Mean Blood Pressure

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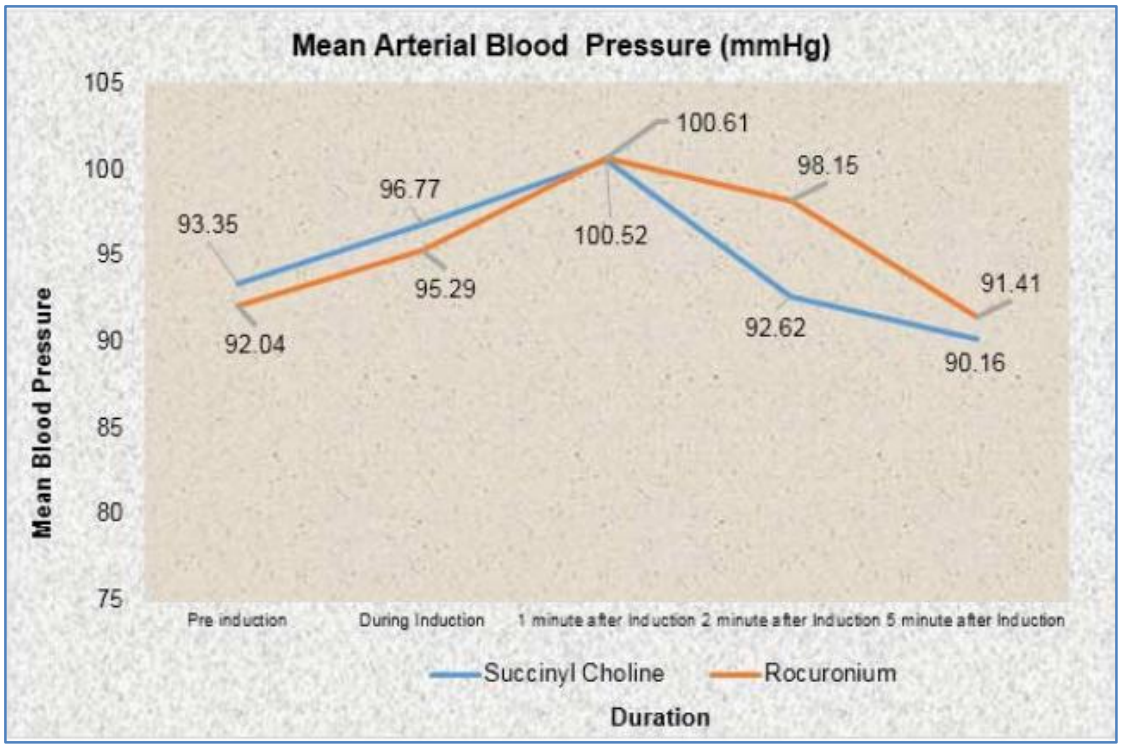

Fig. 5

On comparing both the groups, there wasno significant difference seen in mean saturation of oxygen from baselineto pre induction, during induction, 1 or 2 minute in Succinylcholine and Rocuronium groups (p value>1. 00). (Table 8 & Fig 6).

	Group 1 (Succinylcholine chloride) Mean ± SD	**Group 2 (Rocuronium bromide) Mean ± SD**	**t-test for Equality of Means**	
			t value	Sig. (2-tailed) p value
Pre induction	99.97±0.15	99.90±0.37	1.355	0.421 NS
During Induction	99.95±0.31	99.90±0.37	0.813	0.421 NS
1 minute after Induction	99.95±0.31	99.87±0.56	1.000	0.323 NS
2 minute after Induction	99.97±0.15	99.97±0.15	0.000	1.000 NS
5 minute after Induction	100.00±0.00	99.97±0.15	1.000	0.323 NS

TABLE 8: Mean Saturation of Oxygen (SPO_2)

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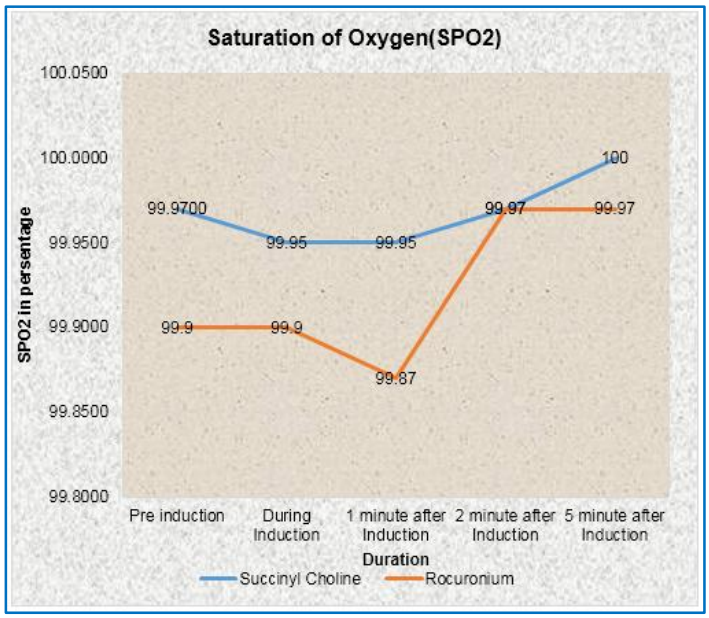

Fig. 6

DISCUSSION: Endotracheal intubation offers safe conduct of general anaesthesia. Succinylcholine, since its introduction in 1952[2,3] was considered to be the best drug for providing ideal intubating conditions for surgical procedures requiring general anaesthesia and rapid sequence induction because of its quick onset of action. However, its usefulness is limited due to side effects like bradycardia and other dysrhythmias, hyperkalemia, rise in intraocular, intragastric and intracranial pressure and postoperative myalgia. Many drugs like Vecuronium, Atracurium and Mivacurium were introduced into clinical practice. But none could challenge Succinylcholine in terms of onset time. Further, they were associated with side effects like histamine releasing property of Mivacurium. Rocuronium bromide introduced into 1994 became the first drug to challenge the onset time of succinylcholine, in that it produces good to excellent intubating conditions in 60 seconds. In addition to this, Rocuronium bromide is devoid of adverse effects of succinylcholine.

In view of this, the present study was undertaken to evaluate & compare onset time, clinical duration and intubating condition of Succinylcholine with that of Rocuronium bromide at 60 seconds. Haemodynamic changes caused by these agents were also evaluated and compared.

In this study, patients were given inj. Succinylcholine 1.5mg/kg in group 1 and inj. Rocuronium Bromide 0. 6mg/kg in group 2.

There were no statistically significant differences in patient's age, sex, weight, height and BMI between the groups. (P>0.05) (Table no. 1)

Selecting the time for intubation can be either by neuromuscular monitoring or by clinical method. However, with non-depolarizing muscle relaxants like Rocuronium, it has been found that the onset of paralysis at laryngeal muscles preceded that at adductor pollicis and hence monitoring of train of four at adductor pollicis may not give the correct picture of intubating conditions.[4,5,6] So, intubating conditions are usually assessed using clinical criteria such as jaw relaxation, vocal cord movements and diaphragmatic relaxation. Hence in the present study, clinical criteria as adopted by Cooper R. A. et al[1] were used for scaling intubating conditions at 60 seconds.

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In present study, Succinylcholine chloride 1.5 mg/kg produced excellent intubating conditions in 87.5% cases and good intubating conditionsin 12.5% cases which is comparable with Misra M. N et al (2005)[7] and Ali A. Sheikh et al (2008).[8] Similarly, Rocuronium bromide 0. 6 mg/kg produced excellent intubating conditions in 57.5% and good intubating conditions in 35% of patients which is comparable with Aparna Shukla et al (2004)[9] and Misra M. N. et al (2005).[7]

The onset time of complete neuromuscular blockade was significantly longer for Rocuronium (95.15±9.47 seconds) seconds which is comparable to Aparna Shukla et al.[9] than Succinylcholine (59.80±14.30 seconds) with a p value of 0. 00 which is comparable to PramodBhaleet al.[10]

In the present study, the duration of action of bolus dose of Succinylcholine was found to be having mean 5.10±2.35 minutes. This finding is comparable to Kusuma Parikh, Dixit B Modh, Mahendra R Upadhyay (2014).[11]In the present study, the duration of action of bolus dose of Rocuronium was found to be having mean 42.60±13.15 minutes. The finding is comparable to Darshna D Patel et al (2013).[12]

The heart rate increased significantly after induction (maximum at 1 minute) with both Rocuronium (98.75±15.53) and Succinylcholine (112.75±15.89). There was significant increase in heart rate from baseline after 1 minute and 2 minute in Rocuronium group than Succinylcholine group. (p value<0.05) But it gradually declined towards normal and change in heart rate with either drug was not significant at 5 minutes. These findings were similar to those observed by Misra M. et al,[7] PramodBhale, Narender Bhandari, SelvaKumaran P, Rashmee Joshi,[10] Shobhana Gupta and R. Kirubahar,[13] M. Somani, P. Sharma, S. Sachdev, V. Mathur, S. Chaturvedi.[14]

The systolic blood pressure increased significantly after induction (maximum at 1 minute) with both Succinylcholine (133.22±13.85) and Rocuronium (130.40±14.59). There was significant increase in systolic blood pressure from baseline after 2 minute in Rocuronium group than in Succinylcholine group. (p value <0.05) But it gradually declined towards normal in 5 minute after induction (p value >0. 05). Overall, the changes in mean systolic blood pressure were insignificant.

The diastolic blood pressure increased significantly after induction (maximum at 1 minute) with both succinylcholine (84.17±7.34) and Rocuronium (85.72±6.94). There was significant increase in diastolic blood pressure from baseline after 2 minutes in Rocuronium group than Succinylcholine group. (p value<0.05). But it gradually declined towards normal in 5 minutes after induction. Overall, the changes in mean diastolic blood pressure were insignificant.

The mean arterial blood pressure increased significantly after induction (maximum at 1 minute) with both Succinylcholine (100.52±8.11) and Rocuronium (100.61±7.83). There was significant increase in mean blood pressure from baseline after 2 minutes in Rocuronium group than in Succinylcholine group (p value<0.05). But it gradually declined towards normal in 5 minute after induction. Hence, in the present study, insignificant changes were seen in mean arterial pressure in both groups. Similar findings were observed by Misra M. et al[7] and M. Somani, P. Sharma, S. Sachdev, V. Mathur, S. Chaturvedi.[14]

There wasno significant difference seen in mean saturation of oxygen from baselineto pre induction, during induction, 1, 2 & 5 minutes after induction in both the groups (p value >1. 00) which is comparable to Marsch et al (2011).[15]

CONCLUSION: Thus, Rocuronium bromide 0.6 mg/kg is a safe, haemodynamically stable and good alternative for Suxamethonium 1.5 mg/kg for endotracheal intubation at 60 seconds and can be used for safe induction and intubation, if there is no prediction of difficult intubation.

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