

A clinical comparative study of succinylcholine versus rocuronium in various doses for pediatric intubation

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Introduction

Endotracheal intubation is the most important procedure involved in general anaesthesia for the purpose of airway maintenance and anaesthesia.

Succinylcholine has stood the test of time and is the most common muscle relaxant used for the intubation because of its fast onset and short duration of action. It is a nicotinic acetylcholine receptor agonist and acts as a depolarizing neuromuscular blocker. Although succinylcholine is the most commonly used drug for endotracheal intubation, it is contraindicated in some clinical settings owing to various complications like bradycardia, asystole, hyperkalemia, malignant hyperthermia, raised intra ocular pressure, myalgia and non-metabolism in patients with atypical pseudocholinesterase (vyshya community) etc.⁽¹⁾

Many trials were conducted to replace succinylcholine with non-depolarizing muscle relaxants like vecuronium, mivacurium and atracurium. These drugs had the disadvantage of slower onset of action, thus limiting their use in emergency situations where securing airway at the earliest was of prime importance. Hence a newer muscle relaxant Rocuronium was discovered.

Rocuronium is a steroidal, non-depolarizing muscle relaxant. It acts by competing for cholinergic receptors at the muscle end plate and it is antagonised by anti-cholinesterase inhibitors. The rapid onset of action is believed to be primarily due to its low potency and has an intermediate duration of action. This property of Rocuronium makes it the most suitable non depolarising muscle relaxant for endotracheal intubation. The introduction of Rocuronium considerably improved the flexibility in clinical administration.⁽²⁾

This study compares the intubating conditions, duration of action, haemodynamic variations and complications of Succinylcholine and different doses of Rocuronium in pediatric patients.

Methods

After institutional ethical committee clearance, 180 children aged between 2-10 years, undergoing elective surgeries under general anaesthesia in hospital attached to JJM Medical College were selected. A detailed pre anesthetic check up was done. Informed consent was obtained from children's parents/guardians. Following children were excluded from the study

- Children aged <2 years and >10 years.
- ASA grade 3 and 4.
- Children undergoing emergency surgeries.

180 children were randomly divided into 3 groups with 60 patients in each group namely "S", "R₁" and "R₂". All patients were pre-medicated 20 minutes prior to surgery with oral midazolam 0.05mg/kg. On arrival in the operation theatre, SpO₂, ECG and NIBP monitors attached, induced with Sevoflurane, IV. line was secured, Propofol 1mg/kg iv +glycopyrolate 0.01mg/kg iv was given. Analgesia was facilitated by fentanyl 2mcg/kg iv. Check ventilation was done. Children under the group S received Succinylcholine 1.5mg/kg, R₁ received 0.9mg/kg of Rocuronium and R₂ received Rocuronium 1.2mg/kg. Following parameters were noted and monitored:

- Intubating conditions at 60 seconds.
- Hemodynamic parameters- heart rate, systolic, diastolic and mean blood pressure. (at 0, 1, 5 and 10 min)
- Duration of action of the muscle relaxant.

After the above observations children were maintained on OXYGEN+NITROUS OXIDE+HALOTHANE+ROCURONIUM+IPPV till the end of the surgery. At the end of the surgery, all children were reversed with Neostigmine 0.5mg/kg and Glycopyrolate 0.01mg/kg. Children were extubated after adequate respiratory effort was noted.

The intubating conditions were assessed according to the scoring system proposed by Krieg et al(1980), modified by Cooper et al(1992).⁽³⁾

Table 1: Scoring of intubating conditions⁽⁴⁾

Score	Jaw relaxation	Vocal cords	Response to intubation
0	Impossible to open	Closed (adducted)	Severe coughing or bucking
1	Opens with difficulty	Closing	Mild coughing
2	Moderate opening	Moving	Slight diaphragmatic movement
3	Easy opening	Open (relaxed)	No movement

Scores were graded as follows-

8-9= excellent 6-7= good 3-5= fair 0-2= poor

Table 2: Demographic data

	Group S	Group R ₁	Group R ₂	P value
Age (in years)	6.12 ± 1.98	6.27 ± 2.94	6.67 ± 2.65	>0.05
Sex (M:F)	39:21	36:24	32:28	>0.05
Weight (kg)	14.57 ± 6.57	16 ± 6.06	16.77 ± 5.54	>0.05
ASA Grading (I:II)	40:20	42:18	41:19	>0.05

Table 3: Intubating conditions

	Excellent	Good	Duration of action (min)
Group S	58 (96.7%)	2 (3.3%)	5.7 +/- 1.114
Group R ₁	50 (83.3%)	10 (16.7%)	28.47 +/- 4.06
Group R ₂	58 (96.7%)	2 (3.3%)	39.85 +/- 4.875
Chi square test (between group S & R ₁) p=0.015			
Chi square test (between group S & R ₂) p=0			

Table 4: Duration of action

	Min value (in minutes)	Max value (in minutes)	Mean+/- SD
Group S	4	9	5.7 +/- 1.114
Group R ₁	21	36	28.47 +/- 4.06
Group R ₂	28	49	39.85 +/- 4.875
ANOVA test p value < 0.001			

**Fig. 1: Intubating conditions**

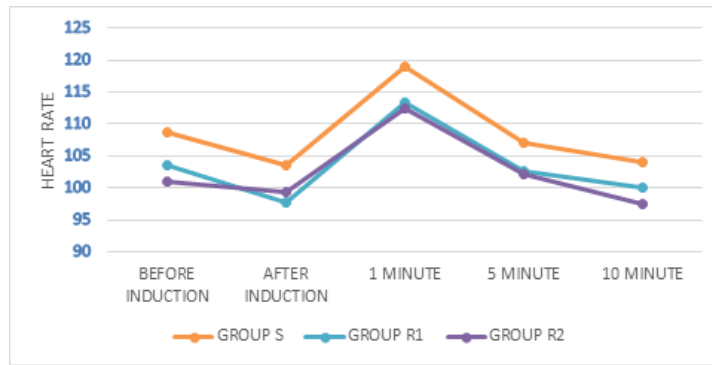


Fig. 2: Heart Rate Variation

ANOVA test p value >0.05 before induction, at 0, 1, 5, 10 minutes

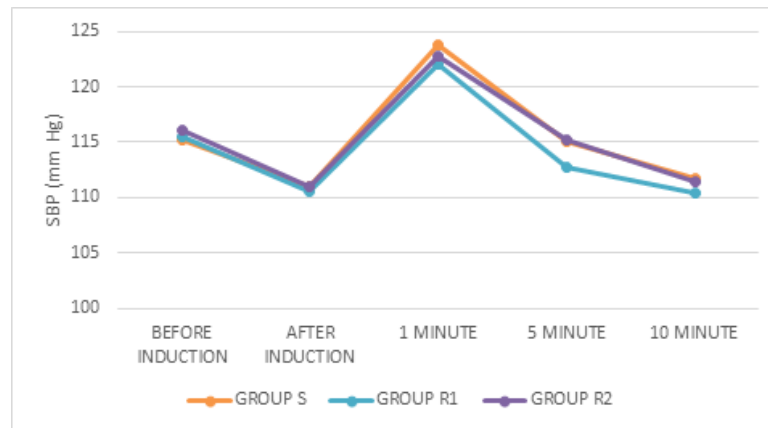


Fig. 3: SBP Variations

ANOVA test p value >0.05 before induction, at 0, 1, 5, 10 minutes

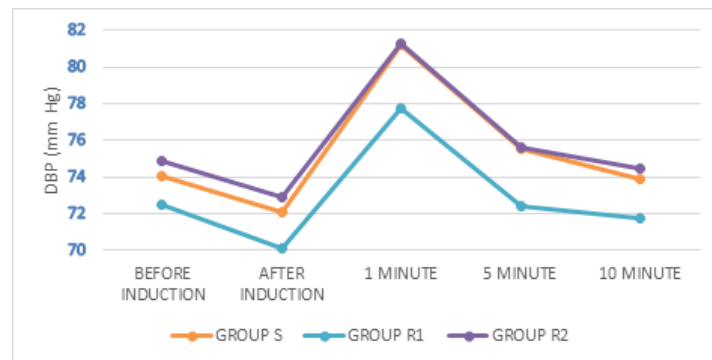


Fig. 4: DBP Variations

ANOVA test p value >0.05 before induction, at 0, 1, 5, 10 minutes

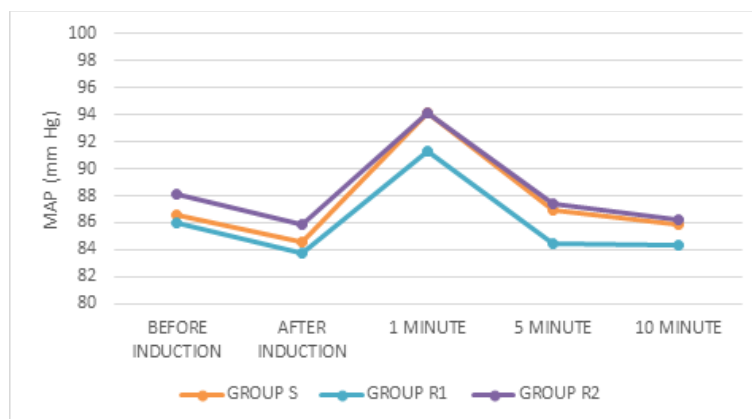


Fig. 5: MAP Variations

ANOVA test p value >0.05 before induction, at 0, 1, 5, 10 minutes

Statistics: Statistical analysis was done using the software SPSS-11. Quantitative data viz. hemodynamic parameters, age, weight, duration of action of the three study groups were expressed in terms of mean \pm SD and compared across the group using ANOVA. Qualitative data viz. Sex, ASA category and Intubating conditions were compared across the group using Chi square test. Differences were considered statistically significant if $p < 0.05$ for all the above statistical analysis.

Results

All three study groups were comparable to each other and there was no significant difference between the groups ($p > 0.05$) in terms of age, sex, weight, ASA grading (Table 2).

Intubating conditions were assessed as per Cooper scale and shown in the Table 3 and Fig. 1. Intubation was said to be acceptable if the grade was Excellent or Good and unacceptable if grade was Fair or Poor. Intubation was acceptable in all children. Group S and Group R₂ produced similar intubating conditions and there was significant difference in intubating conditions in Group R₁ compared to that of Group S and Group R₂ with p value < 0.05 .

The duration of action of the study drugs is as shown in Table 4.

The variations in Heart rate, Systolic pressure, Diastolic pressure and Mean arterial pressure are as shown in Fig. 2, 3, 4, 5 respectively. There is no significant difference between the three groups as $p > 0.05$.

Discussion

In our study, we have compared two different doses of Rocuronium with Succinylcholine for tracheal intubation in paediatric patients and evaluated whether Rocuronium can be an acceptable alternative to Succinylcholine with regard to intubating conditions and hemodynamic variations.

In our present study we have used 3 x ED₉₅ (0.9mg/kg) and 4 x ED₉₅ (1.2mg/kg) of Rocuronium bromide and 1.5 mg/kg of Succinylcholine as intubating dose. Similar dose has been used by Nilesh Kumar Patel et al.⁽⁵⁾ Their study suggested that Rocuronium 0.9mg/kg provides comparable tracheal intubating conditions as Suxamethonium 1.5mg/kg. M. Naguib A et al.⁽⁶⁾ compared the intubating conditions of Rocuronium 0.9mg/kg with Scoline for rapid tracheal intubation in children. Their study demonstrated that Rocuronium could possibly be considered as an acceptable alternative to Suxamethonium in children. Woolf, Rex L, Crawford, et al.⁽⁷⁾ compared the dose response of rocuronium bromide in children anesthetized with propofol to that of succinylcholine. They recommended the use of rocuronium at a dose of 1.2mg/kg when rapid onset and intermediate duration of neuromuscular block were needed in children.

In our study laryngoscopy and intubation was performed at 60 seconds after the administration of the neuromuscular blockade. This was in view of comparing the intubating conditions between the three groups at a particular time. This goes in correlation with other studies by Huizinga A C et al,⁽⁸⁾ Puhlinger F K et al.⁽⁹⁾ and Cooper et al,⁽¹⁰⁾ who found that Rocuronium produced clinically acceptable intubating conditions within 60 to 90 seconds after administration of the drug.

In this study we have used the rating scale by Cooper⁽³⁾ to assess the intubating conditions. In the Rocuronium 1.2mg/kg group, 'Excellent' intubating conditions were seen in 96.7% of the children and good intubating conditions in remaining 3.3% of the children. It was similar to the effects produced by Succinylcholine 1.5mg/kg in our study. Rocuronium 0.9mg/kg produced 'Excellent' intubating conditions in 83.3% of the children and 16.7% children showed good intubating conditions. There were no failed intubations in any of the three groups. These values goes in favour of the various studies by Mirakhr R K, Cooper A R, Magorian T, Huizinga A C et al.^(8,10)

In our study the duration of action of Rocuronium 0.9mg/kg has a range of 21-36 minutes. The mean duration of action was 28.47 ± 4.06 minutes. Rocuronium 1.2mg/kg has a range of 28-49 minutes duration of action. The mean duration of action was 39.85 ± 4.875 minutes. Succinylcholine has a range of 4-9 minutes duration of action. The mean duration of action was 5.7 ± 1.114 minutes.

This duration of action almost coincides with that reported by Mirakhur R K⁽¹⁰⁾ that the overall duration of clinical relaxation is in the range of 25-35 minutes with 0.9mg/kg Rocuronium. Woolf, Rex L, Crawford, et al⁽⁷⁾ reported the duration of action of Rocuronium 1.2mg/kg as 45 ± 10 minutes which correlates with our study value.

Various haemodynamic parameters like heart rate, systolic blood pressure, diastolic blood pressure and mean arterial pressure were evaluated. All these parameters increased following laryngoscopy and intubation. The increase was maximum at 1 minute after intubation. All the parameters decreased thereafter towards resting values in all the three groups. These changes were not statistically significant.

No untoward side effects were noted in the three groups.

Conclusion

We conclude that Rocuronium is a suitable alternative to Succinylcholine for intubation in paediatric patients in a dose of 0.9mg/kg or 1.2mg/kg. The dosing of Rocuronium can be fixed depending on the duration of surgery owing to slight difference in duration of action of the two doses.

Limitations

- Rocuronium has not been studied in emergency surgeries.
- Rocuronium has not been studied in mechanically ventilated patients.

Conflict of interest

No conflicts of interest.

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