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A study on compare the intubating conditions and duration of action, of suxamethonium, vecuronium and different doses of rocuronium in paediatric patients: In tertiary care hospital, Hyderabad

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Abstract

Background: Suxamethonium, a depolarizing muscle relaxant has remained the undisputed drug for aiding intubation and an ideal drug for securing the airway because of its capabilities to produce excellent intubating conditions within 60 seconds & short duration of action but is contraindicated in certain clinical conditions because of its side effects.

Aim: The present study was undertaken to compare the intubating conditions as well as duration of actions of Suxamethonium 1.5mg/kg, Rocuronium and Vecuronium, a new benzyliisoquinolone non-depolarizing muscle relaxant with relatively rapid onset and short duration of action, 0.1mg /kg at 60 seconds.

Methods: After institutional approval and informed consent, 75 ASA I and II of elective surgeries. Paediatric patients posted for elective surgeries were grouped into 25 patients each. We compared the intubating conditions and duration of action of Suxamethonium 1.5mg /kg, Rocuronium 0.6mg/kg and Vecuronium at 60 seconds. Cardiovascular responses and any side effects related to histamine release were also studied.

Statistical analysis: Statistical tools used in present study are student's test and 'chi squared' test.

Results: Laryngoscopy was found to be easy in all the patients of groups I & II at 60 sec. But in group III it was found to be easy in 15 (60%) patients and difficult in 10 (40%) patients. An excellent score seen in all cases of Group II within 60 sec. In Group I 60% had excellent and 40% had good intubation condition within 60 sec. All the patients in group III had only good intubating conditions that were achieved at 120 sec in 60% and at 10 sec in 40% of the patients.

Conclusions: The present study concluded that rocuronium in a dose of 0.6 mg/kg provides superior intubating conditions compared to its predecessor, vecuronium. However, suxamethonium has maintained its supremacy as the preferred agent for its crash induction. Despite its hemodynamic stability, vecuronium, in doses used for intubation, is hardly suitable as an agent for crash induction as none of the patients could be intubated at 60 or even 90 Secs intubation could only be performed at 120 -150 sec, that too with slight diaphragmatic movement in almost all the cases and slight limb movement in 80% patients. Intubating score was only good in all the patients paralysed with vecuronium. Thus, we concluded that intubating conditions were clinically acceptable in 100% cases with suxamethonium in onset of action, but the overall quality of intubating conditions is better with suxamethonium.

Keywords: Intubation, muscle relaxant, suxamethonium, vecuronium, rocuronium

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, a systole, hyperkalaemia, malignant hyperthermia, raised intra ocular pressure, myalgia and non-metabolism in patients with atypical pseudo cholinesterase etc. [1, 2].

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

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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 [3]. 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.

This study compares the intubating conditions and duration of action, of Suxamethonium, Vecuronium and different doses of Rocuronium in paediatric patients.

Materials and Methods

Study Design

The proposed study entitled Intubating conditions with the use of suxamethonium chloride, vecuronium bromide and rocuronium bromide in paediatric patients

Type of study

A comparative study

Place of study

The study was carried out in the Department of Anaesthesiology, Princes Esra Hospital, Deccan college of Medical Sciences

Study Population

75 patients of either sex aged between 1 to 9 years of ASA grade 1/II, scheduled to undergo various surgical procedures

were chosen as subjects of this study with informed consent.

Inclusion criteria

Pre anaesthetic assessment of each patient was done by taking a detailed history along with a careful and complete general examination one day prior and again on the morning of surgery.

Exclusion criteria

Rule out the presence of any undetected systemic disorders such as haematological and biochemical profile, as well as routine urological investigations etc.

Study Design

The proposed study entitled intubating conditions with the use of suxamethonium chloride, vecuronium bromide and rocuronium bromide in paediatric patients.

After ensuring a fasting status of minimum four hours, the patients were premeditated with midazolam 0.5 mg/kg oral. Grouping was done into three lots of 25 each, and patients were randomly allocated to any one of the following

Group I: Intubation accomplished with IV Rocuronium 0.6 mg/kg.

Group II: Intubation accomplished with IV Suxamethonium 1.5 mg/kg.

Group III: Intubation accomplished with IV Vecuronium 0.1 mg/kg.

Cooper scoring system

Scoring of intubating conditions based on four criteria's was used to rate the degree of relaxation achieved in the three groups.

Criteria	Score		
	1	2	3
Jaw relaxation (Ease of laryngoscopy)	Minimal (Impossible)	Moderate (Difficult)	Complete (easy)
Vocal cords	closed	Intermediate	abducted
Diaphragmatic	Coughing	Bucking	None
Limb movement	Vigorous	Slight	None

Total score:

12: Excellent

8-11: Good

4-7: Poor

Anaesthetic technique: An intravenous route was secured upon the patient's arrival in the operation theatre and Inj Atropine 0.01 mg/kg I.V was administered. Monitoring equipment was then attached and pre induction heart rate, pulse oximetry and non-invasive blood pressure reading were taken.

The ulnar nerve at wrist was selected for neuromuscular monitoring, using surface (ball) electrodes attached to the Organon Teknika neuromuscular monitor. A base line single twitch response was noted.

Preoxygenation was done for five minutes on 100% oxygen. Patients were induced using Thiopentone sodium 5 mg/kg body weight followed by the muscle relaxant preselected for study.

Assessment of quality of intubating conditions was performed using a scoring system based on 4 criteria's i.e. jaw relaxation, vocal cord position, diaphragmatic response and limb movement.

Laryngoscopy was first attempted at 60 sec. In case

laryngoscopy was not possible attempts were repeated at subsequent intervals of 30 sec up to 150 sec, when intubation was to be considered as a failure for the purpose of study.

Neuromuscular monitor was used to observe the correlation between the intubating conditions and the adductor pollicis response to single twitch lunar nerve stimulation.

Following the incubation IV pethidine 1 mg/kg body weight and IV Ondansterone 0.1 mg/kg b. w were administered. Anaesthesia was maintained on mixture with controlled ventilation using the Boyle's anaesthesia machine. Muscle relaxation was maintained as necessary, using ¼ initial dose of relaxant administered. The patients in Gp II (I.E Intubation using suxamethonium 1.5 mg/kg) were subsequently administered IV vecuronium as necessary.

Parameters monitored

Haemodynamic parameters, heart rate, pulse oximetry, non-invasive blood pressure (systolic, diastolic, mean).

Neuromuscular monitoring was accomplished using the Organon Teknika and the response to single twitch nerve stimulation was virtually assessed.

Onset of action of intubating dose of the muscle relaxant

was taken as the time from administration of drug to the time of intubation with good to excellent intubating condition as per the scoring system based on 4 criteria.

All the end of surgical procedure, spontaneous recovery was attempted. Reversal of residual neuromuscular block was carried out. If necessary using IV atropine 0.02 mg/kg and neostigmine 0.05 mg/kg. Patient was extubated after adequate Oropharyngeal toilet.

Results

In the present study the patients categorised as ASA grade I

or II aged between 1-9 years having diverse surgical pathologies were randomly allocated into three groups.

Table 1: Shows the age & sex distribution of the study population

S. NO	Age	Number of Patients					
		Group I		Group II		Group III	
		M	F	M	F	M	F
1	1-5	07	06	08	05	06	06
2	5-9	05	07	06	06	07	06
Total		12	13	14	11	13	12
Grand total		25		25		25	

Table 2: Shows the scheduled procedures of subjects in the study

S. NO	Surgical procedure	No of patients					
		Group I		Group II		Group III	
		No	%	No	%	No	%
1	Cleft lip/Palate repair	2	8	4	16	2	8
2	Hernia repair	2	8	2	8	2	8
3	Tumour excision	4	16	2	8	2	8
4	Hypospadias's	3	12	0	0	7	28
5	Intussusception	1	4	2	8	5	20
6	Wound repairs	4	16	3	12	3	12
7	Incision and Drainage	3	12	2	8	0	0
8	Appendectomy	3	12	0	0	0	0
9	Laparotomy	0	0	6	24	0	0
10	Miscellaneous	3	12	4	16	4	16
Total		25	100	25	100	25	100

The above table shows the various surgical procedures in the three groups.

Table 3: Scoring of incubating conditions with respect to jaw relaxation

Jaw of relaxation (Ease of laryngoscopy)	Score	Group I				Group II				Group III			
		Time in seconds											
		60	90	120	150	60	90	120	150	60	90	120	150
Minimal (impossible)	1	-	-	-	-	-	-	-	-	-	-	-	-
Moderate (Difficult)	2	-	-	-	-	-	-	-	-	-	-	10	-
Complete (Easy)	3	25	-	-	-	-	-	-	-	-	-	5	10

The above table depicts the scoring points on laryngoscopy in the respective groups with these drugs. Laryngoscopy was found to be easy in all the patients of groups I & II at 60

sec. But in group III it was found to be easy in 15 (60%) patients and difficult in 10 (40%) patients.

Table 4: Scoring of intubating conditions with respect to position of vocal cords

Vocal cords	Score	Group I				Group II				Group III			
		Time in seconds											
		60	90	120	150	60	90	120	150	60	90	120	150
Closed	1	-	-	-	-	-	-	-	-	-	-	-	-
Intermediate	2	-	-	-	-	-	-	-	-	-	-	11	4
Abducted	3	25	-	-	-	25	-	-	-	-	-	5	5

The above table depicts the distribution of scoring points in the respective groups with the three drugs with respect to the position of vocal cords in laryngoscopy. Open (abducted) vocal cords were observed at 60 sec. In all cases

of group I & II whereas in group III only 40% patients had open vocal cords at the time of intubation while remaining 60% had intermediate vocal cords position.

Table 5: Scoring of intubating conditions with respect to the Diaphragmatic response to Intubation

Diaphragmatic response	Score	Group I				Group II				Group III			
		Time in seconds											
		60	90	120	150	60	90	120	150	60	90	120	150
Coughing	1	-	-	-	-	-	-	-	-	-	-	-	-
Bucking	2	10	-	-	-	-	-	-	-	-	-	15	10
None	3	15	-	-	-	25	-	-	-	-	-	-	-

The above table depicts the distribution of scoring points with respect to the diaphragmatic response to intubation. None of the patients in Group II had any response to intubation. In Group I, 60% of the patients showed no

response and 40% showed slight diaphragmatic response (bucking) to intubation. Whereas in Group III all the patients showed slight diaphragmatic movement (bucking) in response to intubation.

Table 6: Scoring of intubating conditions with respect to the limb movement response to Intubation

Limb movement	Score	Group I				Group II				Group III			
		Time in seconds											
		60	90	120	150	60	90	120	150	60	90	120	150
Vigorous	1	-	-	-	-	-	-	-	-	-	-	-	-
Slight	2	5	-	-	-	-	-	-	-	--	-	12	08
None	3	20	-	-	-	25	-	-	-	-	-	3	2

The above table depicts the distribution of scoring point with respect to the limb movement at the time of intubation. None of the patients in Group II had any limb movement. 80% of Group I patients showed no limb movement while the remaining 20 % showed slight limb movement. In Group III 80% patients showed slight limb movement while 20% had no limb movement.

Discussion

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

In our present study Rocuronium bromide 0.6 mg/kg, 0.1 mg/kg vecuronium and 1.5 mg/kg of Succinylcholine as intubating dose. Similar dose has been used by Nilesh Kumar Patel *et al.* [1]. Their study suggested that Rocuronium 0.9mg/kg provides comparable tracheal intubating conditions as Suxamethonium 1.5mg/kg. M. Naguib A *et al.* [2]. 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.* [3] 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 AC *et al.* [4] and Cooper *et al.* [6] 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 (6) 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 Cooper A R, Huizinga AC

et al. [4,6].

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 Friedrich *et al.* [5] 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.* [3], 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.

Conclusion

We conclude that Rocuronium is a suitable alternative to Suxamethonium and Vecuronium for intubation in paediatric patients in a dose of 0.6mg/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.

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Conflict of interest

There is no conflict of interest

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