Original Research Article

Comparison of effect of anticholinergic premedication on intubation condition and time on induction with low dose rocuronium in children undergoing short surgical procedures

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Abstract

Background: Period of loss of consciousness to tracheal intubation is critical specially in children. Rocuronium is utilized for rapid induction, however conventional doses may lead to delay in neuromuscular recovery. Low dose rocuronium poses an attractive alternative in this scenario. Use of anticholinergic premedication can affect the effect of rocuronium. Present study evaluated effect of anticholinergic drugs along with low dose rocuronium in children undergoing short surgical procedures. **Methods:** Institutional ethics committee approval was taken. 75 children aged 3 to 8 years from ASA grade I were divided into 3 equal groups to receive no premedication, atropine or glycopyrrolate before induction with low dose rocuronium. Time to intubation, intubation conditions, hemodynamic variables and requirement for second dose of rocuronium was studied. To compare time to intubation, MAP and HR between the groups t test was used. Significance was defined as $P<0.05$ **Results:** All 75 patients completed the study satisfactorily. Demographic data and the baseline vitals were comparable in all three groups. Study revealed that mean pulse rate of atropine group was higher as compared to other groups. For mean arterial pressure, study revealed statistically significant changes amongst all three groups from preinduction values to that after fentanyl administration and after the bolus dose of propofol. Mean intubation time for patients of Group A was 136.52±13.88 seconds, of Group B was 98.32±10.39 seconds and of Group C was 117.00±13.83 seconds. Laryngoscopy was found to be difficult in 16% patients in Group A and C but only 4% patients Group B. Group B had highest proportion of patients with ideal intubation conditions however, the intergroup difference in proportion was not statistically significant. Second dose of rocuronium was required in 60% (Group A), 32% (Group C) but only in 16% of Group B patients. No complications were seen in any of the three groups. **Conclusion:** Low dose rocuronium provides advantages over routine dose of rocuronium specially in pediatric age group. Premedication with iv atropine before induction reduced time by 28s also while achieving satisfactory intubation conditions.

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INTRODUCTION

The time from loss of consciousness to intubation is when the patient is at risk of hypoxia and pulmonary aspiration. Speed of establishment of neuromuscular blockade determines length of this period. Hence, it is desirable to use muscle relaxant with a short onset time. Rocuronium bromide is characterized by rapid onset and intermediate duration of neuromuscular block.[1] The standard intubating doses of rocuronium are 0.6–1.0 mg/kg. However, standard dose rocuronium may cause delay in recovery of neuromuscular function specially in children. Reduced dose of muscle relaxant may be preferrable for short

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surgical procedures. With low dose of rocuronium, the duration of action should be shorter, but the onset of action may be delayed. The onset time is partly determined by the distribution rate with which these drugs reach the neuromuscular junction. This is influenced by cardiac output and muscle blood flow.[2] In children stroke volume remains unchanged. Therefore, cardiac output is determined by heart rate. Effects of drugs on heart rate changes cardiac output thereby changing the time for adequate relaxation due to which intubation time may be altered. Anticholinergic premedication may thus have additional beneficial effect by increasing the heart rate and shortening intubation time.[3] This study was done to determine the effects of anticholinergic medication on intubation time with a low dose of rocuronium (0.3 mg/kg) to achieve successful tracheal intubation conditions during iv anesthesia using propofol and fentanyl in children undergoing short surgical procedures.

METHODS

Study was approved by Ethics Committee and conducted at tertiary care teaching hospital in western India. Written informed parental consent was obtained. Sample size was estimated assuming effect size keeping power of study at 80% for categorical outcomes.[4] 75 children aged 3 to 8 years from ASA grade I, undergoing short surgical procedures (anticipated to be over within 30 minutes) were included. Patients with a known allergy to the drugs used in this study, neuromuscular disease, anticipated-to-be-difficult airway were excluded from this study. Children were randomized into three groups in 1:1:1 ratio. Patients were randomly assigned to receive either saline, atropine or glycopyrrolate (group A, B and C respectively) prior to anesthesia induction. The intubation time was defined as the time from the end of rocuronium injection to the start of laryngoscopy. Tracheal intubation was attempted as per modified Dixon's up-and-down method,[5] beginning at 120 s, in all groups. If intubation was successful intubation time was decreased by one interval for the next patient in that group and vice versa. The anesthesiologist performing intubation was blinded to the study drug. Intubation conditions were assessed by Viby-Mogensen[6] scoring system [Table 1].

Table 1: Intubation Condition Scoring

Assessment of intubation conditions				
Variables		Intubating conditions		
		Acceptable		Unacceptable
		Excellent	Good	Poor
Ease of laryngoscopy (jaw relaxation)		Easy	Fair	Difficult
	Vocal cord position	Abducted	Intermediate	Closed
	Vocal cord movement	None	Moving	Closing
Airway	Reaction (coughing)	None	Diaphragm	Sustained(10s)
	Movement of the limbs	None	Slight	Vigorous

Successful intubation was defined as excellent intubation conditions when all variables were excellent. On finding suboptimal conditions second dose of rocuronium 0.3 mg/kg was administered. Hemodynamic variables were measured and recorded at the following times: pre-induction value; following fentanyl; after propofol; before laryngoscopy; 1 min after intubation. SPSS 11.0 (SPSS Inc., Chicago, IL, USA) was used to perform statistical analyses. A two-sample Z-procedure was used to compare time between the two groups. Values are expressed as the mean ± SD or median [interquartile range] or number of patients (%). Unpaired t test was used to compare patients' characteristics and induction profiles. To compare the MAP and HR between the groups at each time point, an independent t test was used. Significance was defined as $P<0.05$.

RESULTS

All 75 patients completed the study satisfactorily. Demographic data and the baseline vitals were comparable in all three groups. Right herniotomy followed by left herniotomy was the most common surgical procedures. Heart rate and MAP of various groups at different time intervals are shown in Table 2 and 3 respectively.

Table 2: Heart rate at different times in all groups

Pulse Rate (min)	Group I (Control)		Group II (Atropine)		Group III (Glycopyrrolate)		P
	Mean	SD	Mean	SD	Mean	SD	
Pre-Induction Value	116.76	15.37	135.96	21.09	132.24	21.71	0.002
After Fentanyl administration	102.68	14.06	122.04	23.05	115.96	19.12	0.002
After the bolus dose of propofol	92.96	12.65	113.72	21.04	102.52	16.54	<0.001
Just Before Laryngoscopy	92.96	13.17	111.76	19.23	101.84	15.30	<0.001
1 minute after intubation	100.96	11.30	119.04	17.41	109.80	14.33	<0.001

Table 3: Mean Arterial Pressure at different times in all groups

Mean Arterial Pressure (mmHg)	Group I (Control)		Group II (Atropine)		Group III (Glycopyrrolate)		P
	Mean	SD	Mean	SD	Mean	SD	
Pre-Induction Value	91.32	9.04	102.80	7.82	100.84	11.06	<0.001
After Fentanyl administration	78.88	7.70	87.12	9.22	86.84	8.78	0.001
After the bolus dose of propofol	72.76	7.09	81.32	11.32	77.88	9.65	0.008
Just Before Laryngoscopy	75.60	7.14	81.00	9.57	77.96	7.72	0.073
1 minute after intubation	82.08	8.67	88.84	11.86	86.08	11.70	0.093

Study revealed that mean pulse rate of atropine group was higher as compared to other groups. There was statistically significant change in pulse rate after the bolus dose of propofol, just before laryngoscopy and 1 minute after intubation observed in all three groups however changes were most significant in control group. For mean arterial pressure, study revealed statistically significant changes amongst all three groups from preinduction values to that after fentanyl administration and after the bolus dose of propofol. However, there was no significant change just before laryngoscopy and 1 minute after intubation. Intragroup analysis showed significant changes at various time intervals compared to pre induction values across all three groups. Using the Dixson's up and down method the mean intubation time for patients of Group A was 136.52±13.88 seconds, of Group B was 98.32±10.39 seconds and of Group C was 117.00±13.83 seconds. Only 36% patients in Group A were intubated in less than 120 sec compared to 100% in Group B and 88% in Group C. Laryngoscopy was found to be difficult in 16% patients in Group A and C but only 4% patients Group B. Vocal cord was abducted in 60%, 72% and 64% in Groups A, B and C respectively. Ideal conditions were found in most of the patients in all three groups. Group B had highest proportion of patients with ideal intubation conditions however, the intergroup difference in proportion was not statistically significant. Second dose of rocuronium was required in 60% (Group A), 32% (Group C) but only in 16% of Group B patients. No complications were seen in any of the three groups.

DISCUSSION

A study by Eikermann *et al.*[7] reported high dose of rocuronium (0.5–1.0 mg/kg) did not result in improvement of intubation conditions. With high dose, time for complete neuromuscular recovery is too long for short pediatric procedures. Low dose rocuronium in such a setting is preferable. We studied mean time for a low dose of rocuronium (0.3 mg/kg) that is required for successful tracheal intubation during iv anesthesia induction using propofol and fentanyl. The study proves that atropine (10 lg/kg) can reduce mean time of intubation with low dose rocuronium. The onset time for rocuronium (0.3 mg/kg) has been reported to be 87.3 s (range 30–150 s) in healthy children under halothane anesthesia.[8,9] However, we found that the time for successful tracheal intubation in 50 % of children was more than 90 seconds in both groups under i.v. anesthesia induction with rocuronium (0.3 mg/kg). One possible explanation for the different results may be that Driessen *et al.*[7] used halothane anesthesia, which dramatically increases the neuromuscular blockade and shortens the onset time of any muscle relaxant compared to intravenous anesthesia. The onset of neuromuscular blocking agent action is reportedly influenced by the potency of the agent itself, the injected dosage, and circulation factors, which may influence its course to the neuromuscular junction.[10,11] An earlier study comparing the change in cardiac output before and after the administration of atropine demonstrated that i.v. atropine (10 lg/kg) could induce a significant increase in cardiac output during constant rate infusion of propofol in adult patients.[12] In this study, although cardiac output was not measured during anesthesia induction, HR was higher in the atropine group than in the control group during the study period. Therefore, in this study, atropine may increase cardiac output, with resultant favorable effects on rocuronium as well as i.v. anesthetics. In pediatric anesthesia[11], reducing the time required for the mask ventilation is very important during anesthesia induction. This study hence focused on the time for successful intubation rather than dose of anesthetic used. Thus, if the 0.3 mg/kg dose of rocuronium is selected for endotracheal intubation, other combinations of larger doses of propofol and/or opioids or inhaled induction using high concentrations of sevoflurane, rather than i.v. atropine, might be clinically helpful to facilitate intubation conditions. Among opioids, fentanyl has a rapid onset of 1 min, which does not delay the induction time, and has a duration of 20–30 min, which can be ideal for short surgeries[12]. Although remifentanil also has a fast onset and an even shorter duration of action, we chose fentanyl because it is less expensive and can be used as a bolus dose instead of an infusion. There are several limitations to this study. One of them is the lack of cardiac output measurement. The hemodynamic effects of atropine may differ depending on the induction agents used as well as

the chosen dose of atropine. Thus, further studies to elucidate the ideal dose of atropine along with quantitative measurements of the onset of neuromuscular block might be needed in children. Another limitation of this study is that neuromuscular function was not monitored in this study, we could not demonstrate the effect of atropine on the onset of rocuronium action. However, complete paralysis of the adductor pollicis muscle, the most frequent site at which neuromuscular blockade is measured, has been reported to be a poor indicator of intubation time.[5] In conclusion, the time of intubation of a low dose of rocuronium (0.3 mg/kg) that is required for excellent tracheal intubation was 199 s during i.v. anesthesia induction using propofol and fentanyl in children. Although i.v. atropine (10 mcg/kg) before anesthesia induction reduced TimeEI95 by 28s, further evaluation is required to elucidate whether atropine could facilitate the onset of rocuronium in children.

CONCLUSION

Low dose rocuronium provides advantages over routine dose of rocuronium especially in pediatric age group. Premedication with i.v. atropine (10 mcg/kg) before anesthesia induction reduced mean time for intubation by 28s also while achieving satisfactory intubation conditions.

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