Original Article

A STUDY OF PRIMING TECHNIQUE OF ROCURONIUM IN FACILITATING INTUBATION

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SUMMARY:

Tracheal intubation is usually performed after induction of anaesthesia followed by relaxation of skeletal muscle with depolarizing or non-depolarizing Neuro Muscuc c lar Block Agent (NMBA). The ability to intubate the trachea rapidly and safely is still paramount in all clinical situations. ..Suxamethonium is still the drug of choice for this purpose. This short-acting depolarizing NMBA is probably the most popular drug used for making intubation quick, easy and atraumatic. But this drug has many side effects like post operative muscle pain , hyperkalemia , malignant hyperthermia, masseter rigidity etc. For these reasons, researchers have concentrated to develop an alternative drug to suxamethonium or an alternative method of using non-depolarizing NMBA (Neuromuscular Blocking Agent) for rapid sequence induction to intubation technique.

Rocuronium bromide, an aminosteroid non-depolarizing NMBA , the onset time of which is significantly shorter than equivalent doses of other non-depolarizing NMBA .Priming technique with rocuronium has been investigated by several authors in an attempt to reduce the onset time and also to optimize it's efficacy and reduce the incidence of side-effects.

This study was performed to investigate the influence of priming technique on the intubating time and intubation conditions with standard intubating dose of rocuronium (0.6 mg/kg), which may be comparable with standard intubation dose of suxamethonium (1.5 mg/kg). Thus using priming technique Rocuronium with standard intubating dose (0.6 mg/kg) may be suitable alternative to suxamethonium for rapid sequence induction of anaesthesia.

So, we can avoid many life-threatening side-effects associated with suxamethonium like, hyperkalemia, massater spasm, malignant hyperthermia and we can also avoid mega-dose of rocuronium (0.9-1.2 mg/kg) used for same purpose.

A total number of 90 adult subjects, aged 18-45 yr, ASA I-II, undergoing elective surgery were studied. The selected patients were equally divided into three groups, 30 patientsin each group.Following induction with thiopentone (5mg/kg) and Fentanyl (2?gm/kg), patients in group-I (n=30) received suxamethonium 1.5 mg/kg, group-II (n=30) received a priming dose of rocuronium 0.06 mg/kg followed 3 minutes later by an intubating dose of 0.54 mg/kg and group-III (n=30) received rocuronium 0.6 mg/kg in single bolus injection. Neuromuscular function was assessed at the wrist using acceleration transducer (TOF-watch). In priming group any unpleasant symptoms during priming like visual disturbance, feeling of dyspnoea, difficulty in controlling tongue were closely observed. Intubating conditions were assessed using the intubation criteria of Cooper et al. as excellent, good, fair or poor, based on jaw relaxation, position of the vocal cords and response of the diaphragm to intubation. The main outcome variables were intubating time and intubating conditions.Timing at intubation showed that all of the patients of suxamethonium group (group-I), 86.7% of the priming group (group-II) and nearly three quarter (73.3%) of the single dose rocuronium group (group-III) were feasible to be intubated within 60 second. The difference between the priming and the single dose rocuronium group was not statistically significant in terms of timing of intubation (p = 0.329). While evaluating intubating conditions, no significant difference was also observed between priming group (group-II) and single dose rocuronium group (group-III) in jaw relaxation (p=0.698), vocal cords movement (p=0.646) and response to intubation (p=0.514).The suxamethonium group allowed much earlier intubation compared to other two groups (p = 0.039) and in terms of intubating conditions, smooth intubation was significantly higher in suxamethonium group (Group-I) compared to other two groups (p = 0.043).

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In terms of unpleasant effects of priming it was observed that 1.1% of the patients of priming group had visual disturbances, 3.3% dyspnoea, 1.1% difficulty in controlling tongue and 2.2% difficulty in swallowing during the priming interval and remaining 92.7% was free of any unwanted side-effects. Haemodynamic state at intubation and just after intubation demonstrateds that the haemodynamic variables like pulse rate, systolic blood pressure, diastolic blood pressure, oxygen saturation (SpO_2) all were within physiological range and almost homogeneously distributed among the three groups and no adverse outcome was noticed.

Using priming technique with standard intubating dose of rocuronium 0.6 mg/kg has no beneficial effects on reducing intubation time and providing better intubating conditions over single bolus injection of rocuronium 0.6 mg/kg .So Rocuronium 0.6 mg/kg in single bolus injection can replace suxamethonium for quick endotracheal intubation in surgical procedures of short and medium duration.

INTRODUCTION

Ability to intubate the trachea rapidly and safely is still very important in all clinical situations including emergency anaesthesia where there is possibility of regurgitation and aspiration of gastric contents.For making intubation quick, easy and atraumatic,suxamethonium is still the drug of choice. This short-acting depolarizing NMBA is probably the most popular drug used . But this drug has many side effects, some of which are minor and can be prevented (e.g. muscle pain can be prevented by pretreatment of small dose of non-depolarizing NMBA). However, it cannot be used safely in severely burned patient, patients with plasma cholinesterase deficiency, patients with myotonia or in patients susceptible to malignant hyperthermia. It is also relatively contraindicated in patients with severe liver disease, penetrating eye injuries or on patients with raised intracranial pressure.

Rocuronium bromide, an aminosteroid non-depolarizing NMBA is newly introduced in our country, the onset times of which is significantly shorter than equivalent doses of other non-depolarizing NMBA . In the majority of the patients, clinically acceptable intubating conditions are obtained within 60 to 90 seconds after a 0.6 mg/kg dose of rocuronium with a clinical duration of action of 30 to 40 minutes under balanced anaesthesia[1]. Based on onset of action, Magorian et al[2]. suggested that 0.9 to 1.2 mg/kg rocuronium may be necessary as an alternative to suxamethonium, but this mega-dose correspondingly increases the clinical duration of action[3]. Clinical durations were shown to be 50 minutes following a 0.9 mg/kg dose and around 80 minutes following a 1.2 mg/kg dose of rocuronium[1,2]. So in order to achieve the onset of action closer to the onset of suxamethonium, using mega-dose of rocuronium is not desirable for the short and medium duration of surgical procedures. For this reason, various alternative methods were studied with standard intubating dose of rocuronium (0.6 mg/kg) in a view to achieve comparable onset time and intubating conditions following suxamethonium like, timing[4] or priming principle. Timing is potentially unpleasant and dangerous for the patient.

'The priming principle' has been described by Foldes[5] consists of administering a small dose of non-depolarizing NMBA 3 to 6 minutes prior to induction allowing sufficient time for relaxant to reach the receptors and than administering a second larger dose to facilitate rapid intubation after induction. Priming technique with rocuronium has been investigated by several authors in an attempt to reduce the onset time and also to optimize it's efficacy and reduce the incidence of side-effects Griffithetal6Jaochimet.al7 used a priming dose of 0.06 mg/kg and after priming interval of 3 minutes, intubating dose of 0.54 mg/kg were administered to compare onset times and intubating conditions with the patients receiving rocuronium 0.6 mg/kg in bolus dose.

In the present study, a priming dose of rocuronium 0.06 mg/kg and a priming interval of 3 minutes were chosen to compare the influence of priming technique on the onset times and intubating conditions with standard intubating dose (0.6 mg/kg) and outcome was also compared with a control group receiving suxamethonium (1.5 mg/kg). Previous studies of the priming principle of rocuronium have been investigated by using propofol as induction agent [6] or Naguib [7] some used additional TPS 2mg/kg immediately prior to tracheal intubation. All the intubations were done by principle investigator himself to avoid subjective variation. The first attempt was made at 30 second

after administration of intubating dose of relaxant (rocuronium or suxamethonium). Intubating conditions were assessed using the criteria described by Cooper et al. [1] as excellent, good, fair or poor based on jaw relaxantion, position of vocal cords and response to intubation. Any unpleasant effects of priming like visual disturbance, feeling of dyspnoea etc. were closely observed. If the first attempt was designated to be sign of unacceptable intubation conditions, subsequent intubation attempt was made at every 30 second interval until intubation can be achieved with good to excellent intubation condition.

This study was performed to investigate the effects of priming rocuronium on the intubation time and intubation conditions,to find out whether tracheal intubation is possible within 60 sec. with standard intubating dose of rocuronium using priming technique.Also to avoid side-effects associated with the use of suxamethonium like, post operative muscle pain, hyperkalemia, malignant hyperthermia, massater rigidity etc.and to observe whether priming technique is associated with any unpleasant symptoms like, visual disturbance, feeling of dyspnoea etc.

MATERIALS AND METHODS

This prospective, randomized study was carried out in the department of Anaesthesiology and ICU, Dhaka Medical College Hospital, during the period of July, 2006 to June, 2008.90 (Ninety) patients, aged between 18-45 years, ASA I & II ,Mallampati class I & II admitted in Surgery, Gynae&Obs. and ENT departments of Dhaka Medical College Hospital, undergoing elective surgery, requiring general anaesthesia and endotracheal intubation were selected for the study.Patients who had anticipated difficult intubation or history of difficult intubation (Mallampati class III & IV),patients having medications affecting neuromuscular function,history of drug allergy or any hypersensitivity,patients with hepatic or renal impairment,morbidly obese patients were excluded from the study.After recruitment ,patients were divided into three groups , 30 patients in each group.Group-I patients (n=30) received Thiopentone (5mg/kg) and Fentanyl (2?gm/kg), followed by intubating dose of Suxamethonium (1.5mg/kg).Group-II patients (n=30) received priming dose of Rocuronium (0.06mg/kg), 3 minutes later, anesthasia was induced with Thiopentone (5mg/kg) and Fentanyl (2?gm/kg), followed by intubating dose of Rocuronium (.54mg/kg).Group-III patients (n=30) received Thiopentone (5mg/kg) and Fentanyl (2?gm/kg), followed by intubating dose of Rocuronium 0.6mg/kg in single dose. Patients data were collected in prescribed forms containing patient's particulars, Pre-induction variables(Pulse,Blood pressure,SpO2) 3 minutes after priming(Pulse,Blood pressure, SpO2,Visual disturbance, Feeling of dyspnoea, Difficulty in controlling tongue,Difficulty in swallowing, TOF ratio)Post-induction variables (Pulse rate,Blood pressure,SpO2,TOF ratio) Time interval between administration of NMBA (Suxamethonium or Rocuronium) and completion of intubation in seconds,Scoring of intubating conditions. After arrival of the patient in operation theatre intravenous access was secured with a wide-bore cannula, i.v infusion was started with Hartmann's solution at a rate of 2 ml/kg/hr . Acceleration transducer (TOF- Watch) was connected to the thumb and the electrodes were placed over the ulnar nerve on the medial side of the wrist, so that the distal electrode was setting where the proximal bending line crosses the radial side of flexor carpi ulnaris muscle. The proximal electrode was placed 2.5 cm above the distal one. The test hand was immobilized in a supinated position. All the patients were pre-oxygenated for 3 minutes.

After pre-oxygenation, anaesthesia was induced in every patient with Fentanyl (2 ?g/kg) and Thiopentone (5mg/kg) and TOF ratio was started to measure at every 10s interval.

In group-I (control group), the patients received suxamethonium (1.5 mg/kg).**In group-II,** patients received priming dose of rocuronium 0.06 mg/kg. After 3 minutes of priming interval, patients were enquired about any unpleasant symptom and then anaesthesia was induced with fentanyl and thiopentone in usual doses. After loss of consciousness, intubating dose of rocuronium 0.54 mg/kg was given. **In group-III**, after induction of anaesthesia, patients received standard intubating dose of rocuronium 0.6 mg/kg in single dose. All drugs were given into a rapidly running infusion of Hartmann's solution. Injection times were 10s for thiopentone and less than 5s for rocuronium, diluted to a volume of 5 ml. After induction of anaesthesia, mask ventilation was not done till tracheal intubation unless the oxygen saturation goes to <95%.

The head of the patient was placed in the 'sniffing position' before intubation procedure started. The first intubation attempt was made 30s after administration of intubating dose of relaxant

(suxamethonium or rocuronium) with an appropriate sized Macintosh blade by the principal investigator himself. Intubating conditions were assessed using the criteria of Cooper et al.1 as excellent, good, fair or poor based on jaw relaxation, position of the vocal cords and response of the diaphragm to intubation.

If first attempt was designated to be sign of unacceptable intubation conditions, subsequent intubation attempts were made at every 30s intervals until intubation was achieved with acceptable conditions. If endotracheal tube was not passed successfully within 90s after use of relaxant, this was recorded as a failed intubation. Intubation time was recorded as the number of seconds from the end of administration of intubating dose of relaxant to the insertion of the tube in the trachea, as measured by a stop-watch with the help of a trained assistant and TOF ratio, 3 minutes after priming and at the time of intubation were also recorded.

Statistical Analysis

Summary statistics (sample size, mean) were calculated for all quantitative variables of each group. TOF ratio and haemodynamic variables were compared between the groups using ANOVA test. Intubating conditions were compared among the groups using chi-square test . P-value of less then 0.05 was considered statistically significant.

RESULTS

Table I shows the distribution of demographic characteristics among the three groups. The mean age of Group-I was higher (35.4 ? 8.0 years) than that of Group-II (30.4 ? 9.0 years) and Group-III (31.5 ? 10.5 years) although the difference did not reach the level of significance (p = 0.099). The weight of the subjects in three groups was almost homogenous. The groups were also homogeneous in terms of sex distribution (p = 0.241). (Table-I).

Haemodynamic state 3 minutes after priming:

Table II shows the haemodynamic state 3 minutes after priming in Group-II. The mean heart rate was 81 ? 9 /minute, mean systolic blood pressure 113.9 ? 10.7 mmHg, mean diastolic blood pressure 72.3 ? 6.9 mmHg, mean SpO_2 100 ? 00 (%) and mean TOF ratio 87 ? 5.8 (%) (Table-II). All the haemodynamic variables were in stable condition 3 minutes after priming.

Side-effects 3 minutes after priming in Group II:

Figure 1 shows that 1.1% of the patients of Group-II had visual disturbance, 3.3% dyspnoea, 1.1% difficulty in controlling tongue and 2.2% difficulty in swallowing 3 minutes after priming (Figure-1).

Table I

Demographic characteristics among the three groups

	Groups			
	Group - I (n = 30)	Group - II (n = 30)	Group - III (n = 30)	
Age (yrs)#	35.4 ± 8.0	30.4 ± 9.0	31.5 ± 10.5	0.099
Weight (kg)#	52.5 ± 6.9	47.6 ± 8.7	49.6 ± 8.8	0.073
Sex¶	7/23	13/17	9/21	0.241

Data were analysed using ANOVA statistics and are presented as mean ± SD; ¶data pertaining to sex were analyzed with the help of χ^2 Test and are expressed as male-female ratio.

Table II

Haemodynamic state 3 minutes after priming in Group-II

Haemodynamic variables	Mean	SD
Heart rate (/minute)	81	09
Systolic BP (mmHg)	113.9	10.7
Diastolic BP (mmHg)	72.3	6.9
SpO_2 (%)	100.0	00
TOF ratio (%)	87.0	5.8

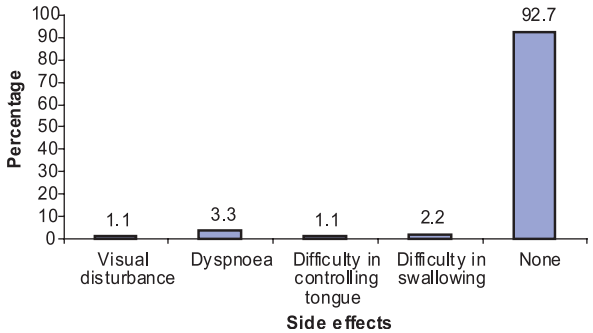

Fig.-1: *Side-effects encountered by the patients 3 minutes after priming*

Timing of intubation:

Timing at intubation shows that 30% of the patients of Group-I, 20% of Group-II and 10% of Group-III were successfully intubated at 30 sec following induction. The rest of Group-I (70%), 66.7% of Group-II and 60% of Group-III were effectively intubated at 60 sec. The entire suxamethonium group (Group-I), 86.7% of the priming rocuronium group (Group-II) and nearly three quarter (73.3%) of the single dose rocuronium group (Group-III) were feasible to be intubated within 60 seconds. The suxamethonium group allowed much earlier intubation compared to other two groups (p = 0.039). However, the difference between the priming and the single dose rocuronium group was not statistically significant in terms of timing of intubation (p = 0.329).

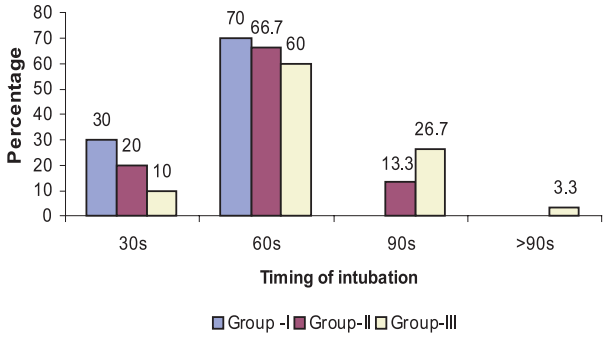

Fig.-2: *Comparison of timing of intubation among the groups*

INTUBATING CONDITIONS:

Jaw relaxation:

Table III shows that 60% of the subjects of Group-I and Group-II and 53.4% of Group-III exhibited good relaxation of jaw relaxation at the time of intubation. The moderate relaxations were 40%, 40% and 43.3% in Group-I, Group-II and Group-III respectively. No significant difference was observed among the three groups in terms jaw relaxation (p = 0.698) (Table-III).

Table III

Comparison of jaw relaxation among the three groups

	Group			
	Group I (n = 30)	Group II (n = 30)	Group III (n = 30)	
Minimal	00	00	1(3.3)	
Moderate	12(40.0)	12(40.0)	13(43.3)	0.698^{NS}
Good	18(60.0)	18(60.0)	16(53.4)	

#Data were analysed using χ^2 Test.
*Figure in the parentheses denotes corresponding percentage

Table V illustrates the response to intubation among the three groups. Over 56% of Group-I, 33.3% of Group-II and 36.7% of Group-III did response at all to intubation, 43.3% of Group – I, 66.7% of Group – II and 56.7% of Group-III responded to intubation by slight diaphragmatic movement. Only 2(6.6%) cases of Group-III responded by mild coughing. The smooth intubation was significantly higher in Group-I compared to other two groups (p = 0.043), while Group-II and Group-III were almost identical in terms of smooth intubation (p = 0.514) (Table-V).

Vocal cords:

Two-third of Group-I and 60% of Group-II and 56.7% of Group-III showed completely open vocal cord (p = 0.646), a condition need for successful intubation (Table IV).

Table IV

Comparison of state of vocal cords at intubation among the groups

	Group			
	Group I (n = 30)	Group II (n = 30)	Group III (n = 30)	
Closing	00	00	1(3.3)	
Moving	10(33.3)	12(40.0)	12(40.0)	0.646^{NS}
Open	20(66.7)	18(60.0)	17(56.7)	

#Data were analysed using χ^2 Test.
*Figure in the parentheses denotes corresponding percentage

Response to intubation:

Table V

Response to intubation among the three groups

	Group			
	Group-I (n = 30)	Group-II (n = 30)	Group-III (n = 30)	
Mild coughing	00	00	2(6.6)	
Slight diaphragmatic movement	13(43.3)	20(66.7)	17(56.7)	0.043
None	17(56.7)	10(33.3)	11(36.7)	

#Data were analysed using χ^2 Test.
*Figure in the parentheses denotes corresponding percentage

COMPARISON OF INTUBATION SCORE:

Based on intubation score 63.3% of Group-I, 53.3% of Group-II and 43.3% of Group-III were categorized as having excellent outcome. The rest of the respective groups, except 1(3.3%) subject of Group-III had good outcome (Table-VI). The mean intubation score in three groups were not statistically different (p = 0.286).

Table VI

Comparison of intubation score among the three groups.

	Group			
	Group I (n = 30)	Group II (n = 30)	Group III (n = 30)	
0 – 2 (Poor)	00	00	00	
3 – 5 (Fair)	00	00	00	
6 – 7 (Good)	11(36.7)	14(46.7)	16(53.3)	
8 – 9 (Excellent)	19(63.3)	16(53.3)	13(43.3)	
Mean ± SD	7.8 ± 1.2	7.6 ± 1.2	7.2 ± 1.6	0.286^{NS}

#Data were analysed using χ^2 Test.

*Figure in the parentheses denotes corresponding percentage

TOF ratio at different stages of intubation in Group II & III:

Comparison of TOF ratio at different stages of intubation in Group II and III showed no significant differences (p = 0.644 and p = 0.457 respectively) (Table VII)

Table VII

Comparison of TOF ratio at different stages of intubation in Group II & III

	Group		
	Group II (n = 30)	Group III (n = 30)	
3 minutes after priming	87.0 ± 5.8	Not done	
At intubation	57.4 ± 8.4	54.5 ± 7.8	0.644^{NS}
Just after intubation	39.7 ± 13.8	36.4 ? 14.6	0.457^{NS}

Data were analysed using unpaired t-Test and presented as mean ± SD.

DISCUSSION

Various techniques are used to reduce intubation time of non-depolarizing NMBA like timing, administration of mega-dose or 'priming principle'. However, timing (administration of neuromuscular blocking drugs 20 sec. before induction agent) is potentially unpleasant and dangerous for the patient (e.g. due to intravenous line precipitate) resulting in a conscious but paralyzed patient. While application of mega-dose of rocuronium may be suitable for rapid-sequence induction and intubation, but at the cost of much longer duration of action[2], which is not desirable in the surgical procedures of short and medium duration.

'The priming principle' has been described by Foldes[5] consists of administering a small dose of non-depolarizing NMBA 3 to 6 minutes prior to induction allowing sufficient time for relaxant to reach the receptors and then administering a second larger dose to facilitate rapid intubation after induction. A suitable Priming dose would allow the patient to maintain adequate respiration, protect his airway and be well tolerated. Priming technique with rocuronium has been investigated by several authors in an attempt to reduce the onset time and also to optimize its efficacy and reduce the incidence of side-effects.

Griffith et al.[6] used a priming dose of 0.06 mg/kg and after priming interval of 3 minutes, intubating dose of 0.54 mg/kg were administered to compare onset times and intubating conditions with the patients receiving rocuronium 0.6 mg/kg in bolus dose. They found that the onset times with priming rocuronium (34±6sec) were significantly shorter ($p<0.01$) than those without priming (59±14sec).

Yavascaoglu et al.[9] studied 75 adult patients (17–67yr.) using different priming interval (two and three minutes) and priming doses (priming dose: rocuronium 0.06 or 0.1 mg/kg, intubating dose 0.54 or 0.5 mg/kg). They found that priming with three minutes interval shortened the onset time of rocuronium, while a two-minute interval did not significantly decrease the onset time.

Naguib[8] reported significant acceleration of the onset times of rocuronium in the priming group using same priming dose and priming interval. However, he administered additional thiopental sodium 2 mg/kg immediately prior to tracheal intubatin.

In the present study, timing at intubation showed that 30% of the patients of group-I, 20% and 10% of the patients of group-II and group-III respectively were successfully intubated at 30 second following induction. All of the patients of suxamethonium group (group-I), 86.7% of the priming group (group-II) and nearly three quarter (73.3%) of the single dose rocuronium group (group-III) were feasible to be intubated within 60 second. The suxamethonium group allowed much earlier intubation compared to other two groups ($p = 0.039$). However, the difference between the priming and the single dose rocuronium group was not statistically significant in terms of timing of intubation ($p = 0.329$). This result correlate poorly with the findings of Griffith et al.[6], Yavascaoglu et al.[9] and Naguib[8] who all observed significant acceleration of onset time of rocuronium using same priming dose and priming interval.

The reason for these disparities was due to differences in anaesthetic technique. Intubating conditions depend not only on the degree of neuromuscular blockade but also on the depth of anaesthesia. Satisfactory intubating conditions had been reported without muscle relaxant following a propofol-alfentanyl induction[10]. In addition, propofol was reported to produce significant depression of laryngeal reflexes[11]. In the previous studies, Griffith et al.[6] and Yavascaoglu et al.[9] induced anaesthesia with midazolam, fentanyl and propofol and also used 60% N20 in oxygen until tracheal intubation and additional doses of thiopentone[8] or propofol[9] were used as needed prior to tracheal intubation. On the other hand, in this study, we used thiopental sodium, the commonly used induction agent in our country and neither additional dose of TPS nor any inhalational agent except oxygen was used prior to tracheal intubation.

The other reason for the differences was due to the use of different modes of nerve stimulation. Rocuronium induced neuromuscular block develops faster at the adductor muscles of larynx than at the adductor pollicis muscle, so it appears that intubation may be performed before complete block is achieved as measured at the thumb[12]. In a study conducted by[13] observed that, at the time of intubation, the neuromuscular block achieved at the adductor pollicis muscle was incomplete in most patients. They expressed their opinion that, when conducting studies of intubating conditions, only frequent-interval intubation attempts begun sufficiently early can development of optimum laryngeal conditions. This is particularly true for fast-acting muscle relaxants, such as rocuronium, where peripherally assessed onset of neuromuscular block can give no exact indication of moment when optimum laryngeal relaxation has first been achieved [7]. The use of repetitive intubation attempts to evaluate tracheal intubating conditions has been reported previously[14]. AP Dobson et al.[15] used predetermined time interval of 30 sec. in their study to evaluate effective time to satisfactory intubating conditions using rocuronium 0.6 mg/kg to 120 adult patients anaesthetized with propofol or thiopentone. Sparr et al.[16] also used predetermined time interval of 45 sec. to evaluate onset time and intubating conditions following rocuronium 0.6 mg/kg in adults patients anaesthetized with either propofol or thiopentone. The observation of Jaochim et al.[7] correlated well with the present study in terms of TOF-ratio, which was around 0.57 and 0.54 at the time of successful intubation in group-II and group-III respectively.

In terms of intubating conditions, no significant difference was observed between priming group (group-II) and single dose rocuronium group (group-III) in jaw relaxation ($p=0.698$), vocal cords movement ($p=0.646$) and response to intubation ($p=0.514$). This result agrees with the findings of Griffith et al.[6] who observed good to excellent intubating conditions in the majority of the patients in priming group compared with single dose rocuronium group, but this finding did not reach statistical significance.

In this study it was found that about three-quarter (73%) of the patients of group-III, were feasible to be intubated within 60 seconds following single bolus dose of rocuronium o.6 mg/kg. This result agrees with the findings of Scheiber et al.[13], who observed good to excellent intubating conditions after rocuronium 0.6 mg/kg can be obtained within 30-60 seconds in young children.

This study also showed that the suxamethonium group allowed much earlier intubation compared to other two groups ($p = 0.039$) and in terms of intubating conditions, smooth intubation was significantly higher in suxamethonium group (Group-I) compared to other two groups ($p = 0.043$). This finding correlated well with the study of Cheng

et al.[17] who found superior intubating conditions with suxamethonium (1.5 mg/kg) in comparison with rocuronium (0.6 mg/kg) during modified rapid-sequence induction using alfentanyl and thiopentone in children. In an another study Tryba et al.[4] found same intubation conditions following a single bolus dose of rocuronium (0.6 mg/kg) and suxamethonium (1.5 mg/kg) but they used thiopentone 6 mg/kg and rocuronium was administration immediately prior to thiopentone. Based on intubation score as described by cooper et al.(1992), 63.3% of Group-I, 53.3% of Group-II and 43.3% of Group-III were categorized as having excellent outcome. The rest of the respective groups, except 1(3.3%) subject of Group-III had good outcome. The mean intubation scores in three groups were not statistically different ($p = 0.286$) (Table VI).

In terms of unpleasant effects of priming we observed that 1.1% of the patients of priming group had visual disturbances, 3.3% dyspnoea, 1.1% difficulty in controlling tongue and 2.2% difficulty in swallowing during the priming interval and remaining 92.7% was free of any unwanted side-effects. TOF-ratio, 3 minutes after priming was around 0.87, this observation correlates well with the findings of Aziz et al.[18] who reported TOF-ratio of around 0.89 in young rocuronium group in a study to investigate the effect of priming with vecuronium and rocuronium on young and elderly patients.

Haemodynamic state at intubation and just after intubation demonstrated that the haemodynamic variables like pulse rate, systolic blood pressure, diastolic blood pressure, oxygen saturation (SpO_2) all were within physiological range and almost homogeneously distributed among the three groups and no adverse outcome was noticed. All the haemodynamic variables were also stable at three minutes after priming in the patients of group-II (Table-II).

From the above description, it is clear that for fast-acting non-depolarizing NMBA, like rocuronium, using 'priming principle' has no significant beneficial effects on reducing the onset time and ensuring better intubating conditions. On the contrary priming technique is not completely devoid of harmful effects to the patients. From the result of this study, we also observed that suxamethonium group allowed much earlier intubation compared to other two groups and in terms of intubating conditions, smooth intubation was significantly higher in suxamethonium group. We also found that more than 75% of the patients of the remaining two groups were feasible to be intubated within 60 seconds with good to excellent intubating conditions and the mean intubation scores among the three groups were not statistically different ($p = 0.286$). So, rocuronium 0.6 mg/kg in single bolus dose following induction with thiopental sodium can be suitable alternative to suxamethonium for rapid tracheal intubation for surgical procedures of short and medium duration.

CONCLUSION

Using priming technique with standard intubating dose of rocuronium 0.6 mg/kg has no beneficial effects on reducing intubation time and providing better intubating conditions over single bolus injection of rocuronium 0.6 mg/kg and this technique is not completely devoid of harmful effects to the patients. So Rocuronium 0.6 mg/kg in single bolus injection can replace suxamethonium for quick endotracheal intubation in surgical procedures of short and medium duration and thus protecting the patients from its side-effects.

REFERENCES

1. Cooper R, Mirakhur RK, Clarke RSJ, Boules Z. Comparison of intubating conditions after administration of Org 9426 (rocuronium) and suxamethonium. Br J Anaesth 1992;69:269-73.
2. Magorian T, Flannery KB, Miller RD: Comparison of rocuronium, succinylcholine and vecuronium for rapid-sequence induction of anaesthesia in adult patients. Anaesthesiology 1993; 79:913-8.
3. De Mey JC, Debrock M, Rolly G. Evaluation of the onset and intubation conditions of rocuronium bromide. Eur J Anaesthesiol 1994;11(Suppl 9):37-40.
4. Tryba M, Zorn A, Thole H, Zenz H. Rapid-sequence orotracheal intubation with rocuronium: a randomized double-blind comparison with suxamethonium –preliminary communication. Eur. J. Anaesth. 1994; 11(9): 44-48.
5. Foldes F. Rapid tracheal intubation with non-depolarizing neuromuscular blocking drugs:the priming principle(Letter). Br J Anaesth 1984; 56:663.

6. Griffith KE, Joshi GP, Whitman PF, Garg SA. Priming with rocuronium accelerates the onset of neuromuscular blockade. J Clin Anaesth 1997; 9:204-7.

7. Jaochim Schmidt MD, Andrea Irouschek, Tino Muenster MD, Thomas M. A priming technique accelerates onset of neuromuscular blockade at the laryngeal adductor muscles. Can J Anesth. 2005;52(1):50-54.

8. Naguib M. Different priming techniques including mivacurium accelerate he onset of rocuronium. Can J Anaesth 1994;41:902-7

9. Yavascaoglu B, Cebelli V, Kelebek N, Uckunkaya N, Kutlay O. Comparison of different priming techniques on the onset time and intubating conditions of rocuronium. Eur J Anaesthesiol 2002; 19:517-21.

10. Scheller MS, Zornow MH, Saidman LJ. Tracheal intubation without use of muscle relaxant: a technique using propofol and varying doses of alfentanyl. Anaesth Analg 1992;75:788-93.

11. McKeating K, Bali IM, Dundee JW. The effects of thiopentone and propofol on upper airway integrity. Anaesthesia 1998;43:638-40.

12. Meistelman C, Plaud B, Donati F. Rocuronium (Org 9426) neuromuscular blockade at the adductor muscles of the larynx and adductor pollicis in humanes. Can J Anaesth 1992;39:665-9.

13. Scheiber G, Ribeiro FC, Marichal A, Bredendiek M, Renzing K. Intubating conditions and onset of action after rocuronium, vecuronium, and atracurium in young children. Anesth Analg. 1996 Aug; 83(2):320-4.

14. Schiller DJ, Feldman SA. Comparison of intubating conditions with atracurium, vecuronium and pancuronium. Anaesthesia 1984;39:1188-91

15. A.P. Dobson, A. McCluskey, G. Meakin, R. D. Baker. Effective time to satisfactory intubation conditions after administration of rocuronium in adults, comparision of propofol and thiopentone for rapid sequence induction of anaesthesia. Anaesthesia 1999;54:172-97.

16. Sparr HJ, Luger TJ, Heidegger T, Putensen-Himmer G. Comparison of intubating conditions after rocuronium and suxamethonium following 'rapid-sequence induction' with thiopentone in elective cases. Acta Anaesthesiol Scand 1996;40:425-30.

17. Cheng CA, Aun CS, Gin T. Compassion of rocuronium and suxamethonium for rapid tracheal intubation in children. Paediatre Anaesth. 2002 Feb;12(2): 140-45.

18. Aziz L, Jahangir SM, Choudhury SN, Rahman K, Hirakawa M. The effect of priming with vecuronium and rocuronium on young and elderly patients. Anesth Analg 1997; 85:663-6.