Intubating Conditions after Three Different Doses of Rocuronium†

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Abstract

This randomized controlled trial study evaluated the intubating conditions at 1 minute after 0.3, 0.6 and 0.9 mg/kg of rocuronium in 108 Thai patients who were enrolled for elective surgery under general anesthesia with fentanyl, thiopental and isoflurane at King Chulalongkorn Memorial Hospital.

Excellent or good conditions were observed in 77.8 per cent ($p<0.05$) with rocuronium 0.3 mg/kg compared to 94.4 and 97.2 per cent at 0.6 and 0.9 mg/kg of rocuronium, respectively but the excellent condition was 16.7 ($p<0.05$), 52.8 ($p<0.05$) and 77.8 per cent ($p<0.05$) from each dose. In females, the excellent condition was 33.3 ($p<0.05$), 83.3 and 88.9 per cent while it was only 0, 22.2 and 66.7 per cent ($p<0.05$) in males. Therefore, rocuronium $\geq$ 0.6 mg/kg should be adequate for intubation. Furthermore, in a situation where an excellent condition is very important, a dose of $\geq$ 0.9 mg/kg of rocuronium is recommended especially in male patients.

Key word : Rocuronium, Intubation, Muscle Relaxant

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Rocuronium bromide is a monoquaternary aminosteroid neuromuscular blocking agent which has a rapid onset and a duration of action similar to vecuronium. Intubation at 60s after a dose of 2 x ED_{95} (0.6 mg/kg) was successfully performed (1-8). In addition, TH. Prien et al(9) reported good to excellent intubating conditions at 69s after 1 x ED_{95} rocuronium. Therefore, the purpose of this study was to characterize the intubating conditions at 60s after a dose of 1or 2 or 3 x ED_{95} rocuronium

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in adult Thai patients; as well as to study the cardiovascular changes during and 7 min after intubation ; the correlation between intubating condition and Train of four (TOF) count of adductor pollicis at the time of intubation.

MATERIAL AND METHOD

The study was a prospective, double-blinded, randomized controlled trial. After approval by the local ethics committee and written informed consent was obtained, 108 ASA PS I-II patients aged 15-55 yr, body weight 40-75 kg, requiring orotracheal intubation for elective surgery under general anesthesia were enrolled into the study. Exclusion criteria were pregnancy, breast-feeding, renal, hepatic and neuromuscular diseases, receiving medication known to interfere with neuromuscular transmission or neuromuscular blocking agents, anatomically difficult airway, or patients with the risk of aspiration.

Patients received no premedication and were allocated to one of three groups according to randomization. Baseline monitorings including heart rate, blood pressure, oxygen saturation and electrocardiogram were recorded. Following pre-oxygenation, anesthesia was induced with thiopentone 3 mg/kg, fentanyl 1 μg/kg and ventilation was assisted in hypoventilated patients.

After the loss of eyelash reflex: supramaximal stimuli, control twitch height (TH) and TOF count were identified and repeated every 12s, thiopentone 4 mg/kg and a study-dose of rocuronium were injected simultaneously. Each dose of rocuronium (0.3, 0.6 or 0.9 mg/kg) was diluted to 7 ml with normal saline and was injected as a bolus dose within 5s in a rapid running IV infusion. Intubation was performed at 60s after rocuronium and the intubating condition was assessed according to the modification of Goldberg ME et al[10] and Krieg N et al[11] (Table 1) by a study-blinded anesthesiologist. Intubation was repeated every minute if the first attempt had failed. TOF count at the intubation was recorded as well as the heart rate and blood pressure changes until 7 minutes after intubation.

Anesthesia was maintained with N_2O: O_2: isoflurane, fentanyl and rocuronium as needed. When the surgery was finished, atropine 0.02 mg/kg and prostigmine 0.05 mg/kg were administered and the patient was extubated when TOF were equally 4.

Results were analyzed by Mantel – Haenszel Chi-square, Paired *t* - test, ANOVA, Fisher's Exact and Mann-Whitney U test. Differences were considered significant at $p < 0.05$ level. Acceptable intubating conditions meant an excellent or good intubating condition while unacceptable intubating condition meant poor or not possible intubating condition. In addition, TOF counts were the number of contractions of adductor pollicis that responsed to the sequential stimulations from nerve stimulator. Normal TOF counts should be 4. The TOF counts will correspond to the degree of neuromuscular blockade from muscle relaxants (grading from 4 to 0).

RESULTS

The three groups were comparable with respect to age, weight, height, and ASA status as shown in Table 2.

The intubating conditions are shown in Table 3. The excellent intubating condition in each group was significantly different from the other groups (16.7 *vs* 52.8 *vs* 77.8%, respectively). According to gender, we found that in females, the excellent condition was 33.3 per cent, 83.3 per cent and

Table 1. Intubating conditions (modification of Goldberg ME et al and Krieg N et al).

Grade	Intubating condition	Description
1	Excellent	visualization of larynx easy, vocal cords relaxed and open, easy passage of the endotracheal tube without bucking or coughing.
2	Good	visualization of larynx easy, vocal cords relaxed and open, easy passage of the endotracheal tube with slight bucking or coughing.
3	Poor	visualization of larynx difficult, vocal cords moving, reaction of vocal cords on intubation with moderate bucking or coughing.
4	Not possible	visualization of larynx difficult, vocal cords closed, intubation not possible.

Table 2. Demographic data [mean (SD)].

	0.3 mg/kg	0.6 mg/kg	0.9 mg/kg
Age (yr)	36.8 (9.9)	38.5 (11.0)	35.5 (9.4)
Weight (kg)	58.1 (8.5)	57.9 (9.6)	56.7 (7.8)
Height (cm)	162.1 (7.7)	162.6 (8.0)	162.8 (6.7)
Sex M : F	18 : 18	18 : 18	18 : 18
ASA I : II	36 : 0	34 : 2	35 : 1

Table 3. Intubating conditions : excellent, good, poor, not possible. [case (%)].

	0.3 mg/kg	0.6 mg/kg	0.9 mg/kg
Total :			
- Excellent	6 (16.7) *	19 (52.8) *	28 (77.8) *
- Good	22 (61.1)	15 (41.7)	7 (19.4)
- Poor	7 (19.4)	2 (5.6)	1 (2.8)
- Not possible	1 (2.8)	0	0
Female :			
- Excellent	6 (33.3) *	15 (83.3)	16 (88.9)
- Good	10 (55.6)	2 (11.1)	2 (11.1)
- Poor	2 (11.1)	1 (5.6)	0
- Not possible	0	0	0
Male :			
- Excellent	0	4 (22.2)	12 (66.7) *
- Good	12 (66.7)	13 (72.2)	5 (27.8)
- Poor	5 (27.8)	1 (5.6)	1 (5.6)
- Not possible	1 (5.6)	0	0

* $p < 0.05$; compare among groups.

Table 4. Intubating conditions : acceptable, unacceptable [case (%)].

	0.3 mg/kg	0.6 mg/kg	0.9 mg/kg
Total :			
- Acceptable	28 (77.8) *	34 (94.4)	35 (97.2)
- Unacceptable	8 (22.2)	2 (5.6)	1 (2.8)
Female :			
- Acceptable	16 (88.9)	17 (94.4)	18 (100)
- Unacceptable	2 (11.1)	1 (5.6)	0
Male :			
- Acceptable	12 (66.7) *	17 (94.4)	17 (94.4)
- Unacceptable	6 (33.3)	1 (5.6)	1 (5.6)

* $p < 0.05$; 0.3 mg/kg compared to either 0.6 mg/kg or 0.9 mg/kg

88.9 per cent respectively. While in males the excellent condition was only 0, 22.2 per cent and 66.7 per cent.

At high dose (0.9 mg/kg) of rocuronium, no significant difference was found in the incidence of excellent intubating condition between genders (88.9 *vs* 66.7%).

The acceptable intubating condition in 0.3 mg/kg group (77.8%) was significantly less than the dose of 0.6 mg/kg group (94.4%) and 0.9 mg/kg group (97.2%) as shown in Table 4.

At the time of intubation, there were significantly more patients with TOF count equal to 4 in the 0.3 mg/kg group than 0.6 and 0.9 mg/kg

Table 5. TOF count (case).

	TOF				
	0	1	2	3	4
0.3 mg/kg *	1	1	0	0	34
0.6 mg/kg	7	1	2	5	21
0.9 mg/kg	11	1	7	3	14

* $p<0.05$; 0.3 mg/kg compared to either 0.6 mg/kg or 0.9 mg/kg

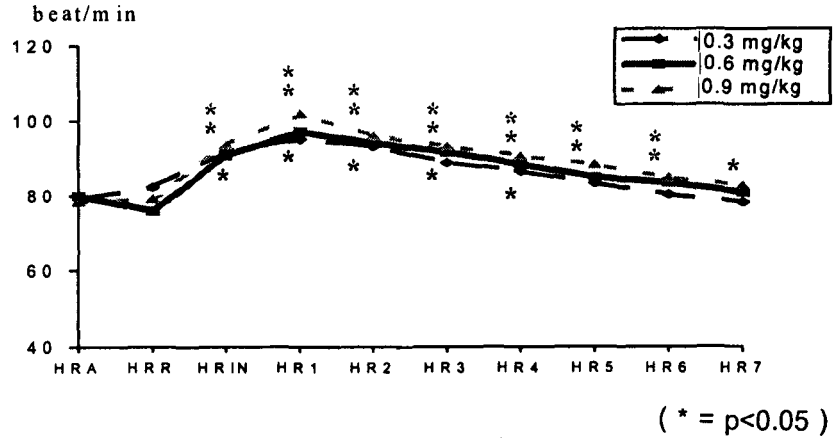

Fig. 1. Heart rate (beat/min) (* = $p<0.05$).

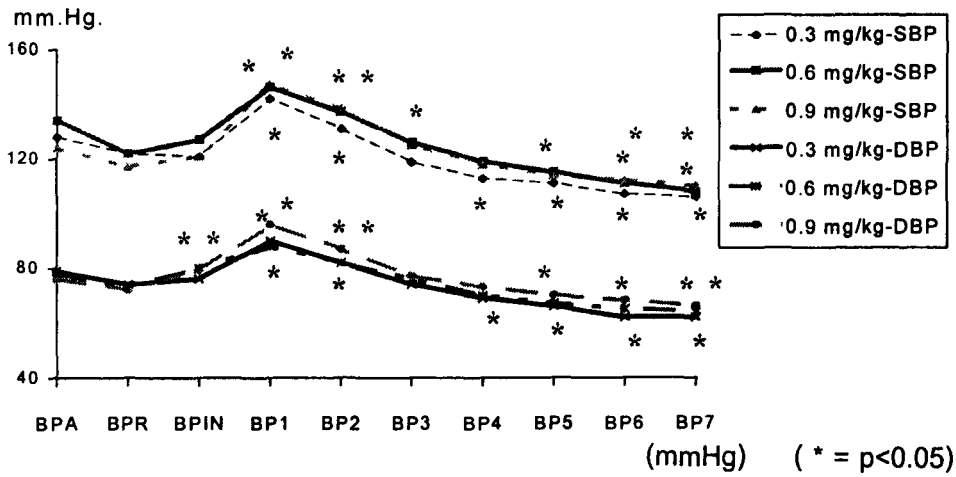

Fig. 2. Systolic and diastolic blood pressure (mmHg) (* = $p<0.05$).

groups (34 *vs* 21 and 14 cases, respectively, Table 5). Heart rate and blood pressure changes during the period of study were less than 20 per cent from the baseline value and there was no significant difference among the 3 groups (Fig. 1, 2). In addition, no serious side effects were noted in this study.

DISCUSSION

Theoretically, an excellent intubating condition is the standard goal for intubation in all patients especially in emergency cases. Clinically, no serious complications are reported after good intubating condition in elective cases. So both excellent and good intubating conditions are

accepted by most anesthesiologists. While poor and impossible intubating conditions causes serious complications such as hypoxia, hypercarbia, arrhyth-mia, aspiration, cardiac arrest and should be avoided in all patients.

Rapid onset of action of rocuronium is very useful for intubation within 60s. Many previous reports had similar results[1-7]: A.J. English et al[1] found 56.7 and 40.0 per cent of the patients who received rocuronium 0.6 mg/kg had excellent and good intubating conditions, respectively. While B. Nonneman et al[2] found 55.0 and 40.0 per cent from the same dose of rocuronium, compared to 52.8 and 41.7 per cent from this study.

B. Nonneman used 0.9 mg/kg with the result of 80.0 per cent for an excellent condition and 20.0 per cent for good intubating condition, compared to 77.8 and 19.4 per cent from our study.

Though rocuronium 0.3 mg/kg could be used for intubation in 77.8 per cent of patients with acceptable results, only 16.7 per cent had excellent condition. Increasing the dose of rocuronium to 0.6 and 0.9 mg/kg was able to improve the intubating condition significantly to 94.4 and 97.2 per cent which was strongly confirmed by TOF count.

From this study, females were more sensitive to rocuronium than males because 16.7 per cent of patients with excellent condition in the 0.3 mg/kg group were all female. In addition, there was no significant difference of the incidence of excellent intubating condition between the 0.6 mg/kg group and 0.9 mg/kg group in female patients (83.3 *vs* 88.9%, respectively). So, rocuronium 0.6 and 0.9 mg/kg would be recommended for a highly successful rate in females especially in emergency situations. In contrast, for male patients, an excellent intubating condition in the 0.6 mg/kg group was only 22.2 per cent and 66.7 per cent in the 0.9 mg/kg group. So, the dose of 0.9 mg/kg is recommended in emergency conditions for male patients.

The difference in response to rocuronium between genders in this study was similar to FS Xue et al[12] who reported that females were more sensitive to rocuronium than males, so the dose of rocuronium could be reduced in females.

From this study, heart rate and blood pressure changes were within 20 per cent from baseline values and the patterns of changes were similar to normal responses to laryngoscopy and intubation. Also no serious arrhythmia was detected in this study.

It is concluded that rocuronium 0.3, 0.6, or 0.9 mg/kg can provide acceptable intubating conditions in the majority of Thai patients, but a higher dose will provide excellent conditions especially in male patients.

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เปรียบเทียบสภาวะการใส่ท่อช่วยหายใจหลังการได้รับโรคูโรเนียม 3 ขนาด†

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ทำการศึกษาแบบ randomized controlled trial เพื่อประเมินสภาวะการใส่ท่อช่วยหายใจที่ 1 นาที หลังการให้ rocuronium 0.3, 0.6 และ 0.9 มก/กก ในผู้ป่วยไทย 108 รายที่มารับการวางยาสลบด้วย fentanyl, thiopental และ isoflurane สำหรับการผ่าตัดแบบไม่ฉุกเฉินที่โรงพยาบาลจุฬาลงกรณ์

พบสภาวะการใส่ท่อช่วยหายใจระดับดีถึงดีมากร้อยละ 77.8 ($p<0.05$) ในกลุ่ม 0.3 มก/กก เปรียบเทียบกับร้อยละ 94.4 และ 97.2 ในกลุ่ม 0.6 และ 0.9 มก/กก ตามลำดับ ซึ่งเมื่อพิจารณาสภาวะการใส่ท่อช่วยหายใจเฉพาะระดับดีมากนั้น พบร้อยละ 16.7 ($p<0.05$), 52.8 ($p<0.05$) และ 77.8 ($p<0.05$) ในกลุ่ม 0.3, 0.6 และ 0.9 มก/กก ตามลำดับ โดยเมื่อศึกษาแยกเพศพบว่า สภาวะการใส่ท่อช่วยหายใจระดับดีมากมีถึงร้อยละ 33.3 ($p<0.05$), 83.3 และ 88.9 ตามลำดับในเพศหญิง แต่พบเพียงร้อยละ 0, 22.2 และ 66.7 ($p<0.05$) ตามลำดับในเพศชาย ดังนั้นจึงแนะนำให้ใช้ rocuronium ขนาด $\geq$ 0.6 มก/กก สำหรับการใส่ท่อช่วยหายใจในผู้ป่วยทั่วไป แต่ถ้าต้องการสภาวะการใส่ท่อช่วยหายใจในระดับดีมากนั้น ควรใช้ขนาด $\geq$ 0.9 มก/กก จะดีกว่า โดยเฉพาะในเพศชาย

คำสำคัญ : โรคูโรเนียม, การใส่ท่อช่วยหายใจ, ยาหย่อนกล้ามเนื้อ

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