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Evaluation of the Onset Time and Intubation Conditions of Rocuronium Bromide in Children

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SUMMARY

We have assessed, in children aged three to eight years, the intubating conditions after administration of rocuronium 0.6 mg/kg at 50 or 60 seconds, in groups of 15 patients. Intubating conditions were excellent in 11, good in 3 and fair in 1 patient at 50 seconds and excellent in 12 and good in 3 patients at 60 seconds. The mean onset time, for all patients, to when the first twitch of the train of four (T_1), measured at the adductor pollicis, was depressed to less than 30% and 5% of control was 50 (SD 11.4) seconds and 94 (SD 31.7) seconds respectively. Depression of T_1 to less than 30% of control, measured at the adductor pollicis in children, appears to indicate that intubating conditions will be clinically acceptable when using rocuronium.

Key Words: NEUROMUSCULAR RELAXANTS: rocuronium; ANAESTHETICS: paediatric; INTUBATION, TRACHEAL: timing

Rocuronium bromide is a neuromuscular blocking agent with a rapid onset of action and an intermediate duration of action. Rocuronium has a potency of 15 to 20% when compared with vecuronium and it is this relative low potency that has been suggested as accounting for the rapid onset of action[1]. Good intubating conditions have been demonstrated in adults at 60 seconds[2] after administration of rocuronium 0.6 mg/kg ($2xED_{90}$). Onset time is shorter in children and it is possible that good intubating conditions may be achievable in less than 60 seconds. This study was designed to assess neuromuscular function and intubating conditions at 60 seconds and 50 seconds after the administration of rocuronium bromide 0.6 mg/kg in children aged three to eight years.

PATIENTS AND METHODS

The study was approved by the Women's and Children's Hospital Ethical Committee. Informed written consent was obtained from the parents of thirty ASA 1 or 2 patients aged between 3 and 8 years who were scheduled for elective tonsillectomy. The patients were pretreated with EMLA cream to the dorsum of both hands. On arrival in the induction room intravenous access was secured and an infusion of Hartmann's solution commenced. To the other hand electrodes for the Datex Relaxograph (Datex Instrumentarium, Finland) were attached and secured with a crepe bandage. The electrodes were placed for stimulation of the ulnar nerve at the wrist and recording of the compound action potential from the adductor pollicis muscle. The relaxograph was connected to a personal computer so that all data could be downloaded directly to an Excel spreadsheet.

Anaesthesia was induced with fentanyl 2 μg/kg, thiopentone 6 mg/kg and maintained with 66% N_2O in oxygen until after intubation when 1% halothane was added. Following loss of consciousness the ulnar nerve was stimulated supramaximally with repetitive trains-of-four (2 Hz for 2 seconds at 10 second intervals). After a baseline EMG recording had been made, rocuronium bromide 0.6 mg/kg was given. For the first 15 patients intubation was attempted at 60 seconds after injection (60s group). For the second 15 patients intubation was attempted at 50 seconds (50s group). Intubation conditions were graded as excellent (easy passage of the endotracheal tube without coughing; vocal cords relaxed), good (passage of the tube with slight cough; vocal cords relaxed), fair (passage of the tube with moderate coughing or bucking; some vocal cord movement), or impossible (vocal cords adducted or not visualized; jaw not relaxed)[3].

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RESULTS

The two groups were comparable for age, weight and sex distribution (Table 1). Intubation was possible in all patients. In the 60s group intubation conditions were graded as excellent in 12 of the 15 patients and good in the other three patients. In the 50s group intubation conditions were excellent in 11 patients, good in three and fair in one patient.

The mean height of the first twitch of the TOF (T_1), for all patients, was 25% (SD 14) at 50 seconds and 15% (SD 10) at 60 seconds (Table 2). The onset time for all patients, to when T_1 was depressed to less than 30% and 5% of control, was 50 seconds (SD 11.4) and 94 seconds (SD 31.7) respectively (Table 1).

TABLE 1

Mean (SD) age, weight, onset time to when T_1 depressed to less than 30% and 5% and distribution of sex in the study groups

	All	50 second group	60 second group
Age (years)	5.7 (1.8)	5.5 (1.9)	5.9 (1.8)
Weight (kg)	22.0 (6.8)	20.8 (6.2)	23.2 (7.4)
Sex (m/f)	16/14	7/8	9/6
Onset 30% (secs)	50.0 (11.4)	50.7 (11.0)	49.3 (12.2)
Onset 5% (secs)	94.0 (31.7)	87.3 (25.5)	100.7 (36.5)

TABLE 2

The height of the first twitch of the TOF (T_1) and the ratio of T_4 to T_1 of the TOF during the first 100 seconds following injection of rocuronium 0.6 mg/kg for all patients

Time (seconds)	T_1% [mean (SD)]	TOF [mean (SD)]
0	97 (4)	102 (3)
10	94 (7)	101 (7)
20	90 (16)	94 (13)
30	70 (23)	79 (22)
40	43 (20)	55 (24)
50	25 (14)	36 (24)
60	15 (10)	23 (20)
70	10 (7)	10 (17)
80	8 (6)	6 (13)
90	6 (5)	4 (10)
100	4 (5)	6 (18)

DISCUSSION

Provision of muscle relaxation for endotracheal intubation of patients undergoing emergency surgery demands a drug that can provide a rapid onset and offset of action. The only drug to date to provide these conditions is suxamethonium. However suxamethonium has many well-documented side-effects[4]. The nondepolarizing agent rocuronium has been shown to provide good intubating conditions at 60 seconds and it has been suggested that it may be suitable for rapid-sequence induction[2].

In paediatric patients recuronium has a more rapid onset and a shorter duration of action than in adults[5]. The onset of action of rocuronium at the adductor muscles of the larynx is more rapid than at the adductor pollicis[6]. This may be due to a higher blood supply to the neuromuscular junction of the laryngeal muscles[6]. The onset of block with rocuronium also appears to follow a biphasic pattern. There is a very rapid initial 75-85% twitch suppression followed by a slower onset of the ultimate 15-25%[7]. It is possible that the first phase of onset is the important phase for satisfactory intubation. This has been shown in our study where clinically adequate intubating conditions were achieved with 85% block at 60 seconds and 75% block at 50 seconds.

A recent review questioned the usefulness of onset to 100% neuromuscular blockade at the adductor pollicis as a meaningful endpoint to quantify optimal intubating conditions[8]. It was suggested that the rate of development of adequate intubating conditions would be a more useful parameter in the evaluation of efficacy and safety of muscle relaxants for intubation. It may however be possible to correlate degree of neuromuscular blockade at the adductor pollicis with intubating conditions if it can be consistently shown that intubating conditions are satisfactory at a certain degree of blockade at the adductor pollicis. This of course may be specific for each neuromuscular blocking agent, population group and anaesthetic technique.

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