Original Article

Evaluation of intubating conditions after rocuronium bromide in adults induced with propofol or thiopentone sodium

Moazzam Md Shahnawaz, Bano Shahjahan[1], Siddiqui Suhail Sarwar[1]

Department of Cardiac Anaesthesia, Frontier Lifeline & Dr KM Cherian Heart foundation, R-30-C, Mogappair, Chennai, Tamil Nadu, [1]Department of Anaesthesiology and Critical Care, J N Medical College, Aligarh Muslim University, Aligarh, UP, India

Abstract

Aim: The aims of present study were to compare the propofol and rocuronium with thiopentone and rocuronium in terms of clinically satisfactory intubating conditions and to co-relate intubating conditions with degree of paralysis in adductor pollicis muscle using train of four ratio (TOFR). The intubating conditions were evaluated after rocuronium bromide 0.6 mg kg^{-1} at 60 s.
Materials and Methods: 60 patients of ASA grades I-II of either sex, age 18-50 years, undergoing various elective surgical procedures were randomly divided into two groups, propofol rocuronium (PR group) and thiopentone rocuronium (TR group) of 30 patients in each. In the PR group, patients received propofol 2.5 mg kg^{-1} and rocuronium 0.6 mg kg^{-1}; in TR group, patients received thiopentone 5 mg kg^{-1} and rocuronium 0.6 mg kg^{-1}. In all patients the intubating conditions were evaluated by the observer at 60 s. TOFR was measured at the time of intubation by an assistant.
Results: In the PR group the number of the patients placed in intubating conditions grades I, II, III and IV were 40%, 36.67%, 13.33% and 10% and their mean TOFR were 31.8 ± 17.9%, 61.8 ± 14.6%, 61.7 ± 27.9%, and 78.3 ± 5.7% respectively. While in theTR group the number of patients placed in intubating condition grade I, II, and III were 60%, 26.67%, and 13.33% and their mean TOFR , 41.2 ± 28.3%, 68.0 ± 10.9% and 78.7 ± 6.8%, respectively. There was no patient in grade lV in theTR group.
Conclusion: The clinical intubating conditions and degree of paralysis of adductor pollicis muscle after rocuronium 0.6 mg kg^{-1} at 60 s in adults induced with propofol or thiopentone sodium are comparable.

Key words: Propofol, rocuronium, thiopentone sodium, train of four ratio

Introduction

In modern practice of anesthesia, propofol and thiopentone are generally used as induction agents in hemodynamically stable patients. The quality of the intubating conditions is not only determined by muscle relaxation, but also by the quality of anesthesia and the suppression of the laryngeal reflexes by the induction agents.

Address for correspondence: Dr. Md Shahnawaz Moazzam, Department of Cardiac Anaesthesia, Frontier Lifeline & Dr K M Cherian Heart foundation, R-30-C, Ambathur Industerial Estat Road, Mogappair, Chennai - 600 101, Tamil Nadu, India.
E-mail: moazzamms@gmail.com

Access this article online	
Quick Response Code:	Website: www.joacp.org
	DOI: 10.4103/0970-9185.81829

Thus, it has been suggested that the choice of induction agent may influence the rate of onset of satisfactory intubating conditions. Propofol is known to depress laryngeal reflexes[1] and may therefore be a more appropriate induction agent when rocuronium bromide is used for neuro-muscular blockade (NMB).[2]

Rocuronium (ORG-9426) a new non-depolarizing amino steroidal NMB is chemically 2-morpholino, 3-desacetyl, 16-N-allyl pyrrolidino derivative of vecuronium, differing from it at three positions on steroid nucleus. It has a low potency and intermediate duration of action. It has a rapid onset of action and more importantly rapid development of good intubating conditions at standard intubating dose. Rocuronium is about six times less potent than vecuronium.[3] Rocuronium has an intermediate time course of action and is free of clinically significant cardiovascular side effects at effective NMB doses. It has further been shown that neither accumulation, nor production of active metabolites occurs after repeated administration of rocuronium. The rocuronium has flexibility in dosage for onset time and clinical duration. These properties together render rocuronium a flexible NMB, suitable for routine intubation as well as for intubation during

rapid sequence induction of anesthesia. Uses of opioid during induction obtund the upper airway reflexes and give better clinically acceptable intubating conditions.[4]

Generally, propofol and thiopentone are commonly used for induction of anesthesia and succinylcholine or vecuronium is used as NMB for endotracheal intubation. Thus, we designed this study to use rocuronium 0.6 mg kg^{-1} for endotracheal intubation at 60 seconds in adult patients induced with either propofol or thiopentone and evaluated intubating conditions and degree of neuromuscular paralysis at adductor pollicis muscle using TOFR.

Materials and Methods

After informed consent and approval from Hospital ethics committee, 60 patients of ASA physical status I-II of both sex and age group 18-50 years were selected. The patients underwent elective surgical procedures of moderate duration. Exclusion criteria included patients with difficult airway, receiving drugs altering neuro-muscular function or affecting metabolism of NMB drugs, myopathies, thyroid dysfunction, diabetes mellitus or hepato-renal disease and pregnancy. All patients underwent pre-anesthetic evaluation as per protocol.

The patients were randomly divided into two groups of 30 each on the basis of induction agent. The PR group patients administered propofol 2.5 mg kg^{-1} i.v and rocuronium 0.6 mg kg^{-1}. The TR group patients administered thiopentone 5 mg kg^{-1} and rocuronium 0.6 mg kg^{-1}.

Preoperatively, the patient's vitals were recorded and intravenous infusion with Ringer's lactate solution started in the left upper limb. The peripheral nerve stimulator (PNS) was attached over the right ulnar nerve using silver surface electrodes and transducer was fixed on the thumb.

In all patients HR, noninvasive BP, oxygen saturation, ECG and end tidal carbon-dioxide were monitored. All the patients were premedicated 15 min before induction with midazolam 0.03 mg kg^{-1}; ondansetron 0.1 mg kg^{-1} and tramadol 2 mg kg^{-1} intravenously. After pre-oxygenation with 100% O_2 for 3-5 min, patient was induced with propofol 2.5 mg kg^{-1} i.v (in the PR group) or thiopentone 5 mg kg^{-1} i.v (in the TR group). Immediately after induction of anesthesia, rocuronium bromide 0.6 mg kg^{-1} was administered over 5 s. One anesthesiologist (intubator) performed all the intubations. Intubation was attempted at 60 s from the end of the administration of rocuronium. The intubating conditions were evaluated using the grading scheme as described by Dobson *et al.*[5] [Table 1].

Excellent and good intubating conditions were considered as clinically acceptable (CA) and poor and impossible intubating conditions as clinically non-acceptable (CNA) as described by Viby-Mogensen *et al.*,[6]. In case of failure to intubate, second attempt was taken after 30 s and intubating conditions were assessed again. Degree of paralysis in adductor pollicis was measured using TOFR at the time of intubation by an assistant. Patients requiring more than two attempts were considered as failure. Anesthesia was maintained with halothane 0.5-1.0% and N_2O in oxygen (5:3). At the end of the surgery, reversal of neuromuscular blockade was achieved with neostigmine 0.04 mg kg^{-1} and glycopyrrolate 0.01 mg kg^{-1} titrated according to response and the trachea extubated after ensuring full recovery of the patient.

The results were analyzed with the help of a biostatician. Mean and standard deviation, Student's '*t*-test', and 'Z' test were used where applicable, and $P < 0.05$ was considered to be significant.

Results

Basic characteristics including mean age, sex, and weight were comparable in the two groups ($P > 0.05$) [Table 2]. Intubating conditions were rated as excellent in 12 (40%) in the PR group and 18 (60%) in the TR group followed by good in 11 (36.67%) in the PR group and 8 (26.67%) in the TR group, whereas poor in 4 (13.33%) in both groups at 60 s. Three (10%) patients in the PR group in the impossible grade were given second attempt

Table 1: Grading of laryngoscopy and intubating conditions[5]

Grade	Jaw relaxation	Vocal cord	Response to intubation
Excellent	Good	immobile	None
Good	Good	moving	Minimal diaphragmatic movement only
Poor	Good	Moving or actively closing	Coughing or bucking
Impossible	Poor	closed	Intubation not possible

Table 2: Basic characteristics of patient (mean ± SD)

Variable	PR group	TR group	*P* value
Age (years)	34.7 ± 10.3	33.9 ± 8.7	>0.05
Sex (M:F)	9:21	6:24	>0.05
Weight (kg)	54.2 ± 10.7	49.8 ± 9.5	>0.05

Table 3: Intubating conditions in the two groups

Group	Time of intubation	Grade of intubations			
		Excellent *n* (%)	Good *n* (%)	Poor *n* (%)	Impossible *n* (%)
PR	60 s	12 (40)	11 (36.67)	04 (13.33)	03 (10)
	90 s	-	03 (10)	-	-
TR	60 s	18 (60)	08 (26.67)	04 (13.33)	-
	90 s	-	-	-	-

at 90 s and showed good intubating conditions [Table 3].

On comparison, clinically acceptable (CA) intubating conditions were found to be present in 23 (76.67%) in the PR group and 26 (86.67%) in the TR group, whereas clinically non-acceptable (CNA) intubating conditions were found in 7 (23.33%) in the PR group and 4 (13.33%) in the TR group at 60 s. These were statistically not significant ($P > 0.05$) [Table 4].

The TOFR (mean ± SD) was graded excellent in 31.8±17.9% in the PR group and 41.2 ± 28.3% in the TR group, graded good 61.8 ± 14.6% in the PR group and 68.0 ± 10.9% in the TR group, whereas graded poor 61.7 ± 27.9% in the PR group and 78.7 ± 6.8% in the TR group and graded impossible 78.3 ± 5.7% in the PR group only. The TOFR (mean ± SD) in clinically acceptable intubating conditions subgroup was 46.2 ± 22.2% in the PR group and 49.4 ± 27.1% in the TR group, whereas in clinically non-acceptable intubating conditions subgroup was 68.8 ± 21.9% in the PR group and 78.5 ± 6.8% in the TR group. On comparison, these were statistically not significant (>0.05) [Table 5].

Discussion

The ease in performing endotracheal intubation depends on the type and degree of muscle relaxation, depth of anesthesia and the skill of the anesthesiologist. The rapid onset of adequate paralysis for endotracheal intubation could be achieved with rocuronium bromide, the steroidal non-depolarizing NMB agent. Rocuronium is considered better agent for endotracheal intubation among non-depolarizing NMB. The choice of induction agent may influence the rate of onset of satisfactory intubating conditions.[15] Propofol is known to depress laryngeal reflexes[1] and may therefore be a more appropriate induction agent than thiopentone sodium when rocuronium bromide is used as a NMB.

Table 4: Comparison of laryngoscopy grades in clinically acceptable and clinically non-acceptable groups in 60 s

Groups	Clinically acceptable n (%)	Clinically non-acceptable n (%)
PR (n = 30)	23 (76.67)	7 (23.33)
TR (n =30)	26 (86.67)	4 (13.33)
P value	>0.05	>0.05

Table 5: Comparison of intubating conditions and TOFR (mean ± SD)

Intubating conditions	TOFR	
	PR group	TR group
Excellent	31.8 ± 17.9	41.2 ± 28.3
Good	61.8 ± 14.6	68.0 ± 10.9
Poor	61.7 ± 27.9	78.5 ± 6.8
Impossible	78.3 ± 5.7	-
Clinically acceptable	46.2 ± 22.2	49.4 ± 27.1
Clinically non-acceptable	68.8 ± 21.9	78.5 ± 6.8

The age, sex distribution and body weights were nearly similar in both the groups and the difference was not statically significant ($P > 0.05$). The high proportion of females in both the groups was due to the inclusion of patients undergoing gynecological surgery and cholecystectomy.

We did not use opioid like fentanyl, sufentanil, alfentanil, or remifentanil as in other studies, as the use of opioid during induction of anesthesia depress upper airway reflexes and gives better clinically acceptable intubating conditions[5] which may have influenced the result of the study.

When the overall intubating conditions were compared, both groups were found to be satisfactory, and the difference was not statistically significant ($P > 0.05$). The overall incidence of excellent intubating condition was less in the PR group (40%) as compared with the TR group (60%). In the PR group, 36.67% patients were rated as having a good intubating score, which are more than in the TR group (26.67% patients). The incidence of poor intubating condition is same (13.33%) in both groups. The 3 out of 30 (10%) patients in the PR group were placed in the impossible grade on first attempt as vocal cords were closed at 60 s but these patients were intubated at second attempt at 90 s and placed in good intubating conditions. In the TR group no patient was placed in impossible grade.

The findings of this study are supported by the results of various studies. Cooper *et al.*[7] failed to intubate the trachea in 1 out of 20 (5%) patients receiving rocuronium and propofol at first[t] attempt (60 s) because of closed vocal cord. Dobson *et al.*[5] on the other hand found in their study that 1 out of 12 (8.33%) patients were placed in grade IV (impossible) intubating conditions at 60 s in the thiopentone group. Similarly, Andrews *et al.*[8] reported failure to intubate at first attempt in 1 out of 48 patients at 60 s after rocuronium 0.6 mg kg^{-1} as the vocal cords were closed.

In this study, 76.67% patients in the PR group and 86.67% patients in the TR group were placed in the clinically acceptable group and 23.33% patients in the PR group and 13.33% patients in the TR group were in clinically non-acceptable group. Andrews *et al.*[8] observed that the incidence of clinically acceptable intubating conditions were present in 77% of patients rocuronium 0.6 mg kg^{-1} (40% as an excellent and 37% as a good intubating condition).

Sparr *et al.*[9] administered rocuronium 0.6 mg kg^{-1} to premedicated patients, and induced anesthesia with either propofol 2.5 mg kg^{-1} (P-R) or thiopentone 5 mg kg^{-1} (T-R). 32% (8/25) patients in group P-R and 40% (10/25) patients in group T-R were rated as excellent intubating condition and 60% (15/25) patients in group P-R and 40% (10/25) patients in group T-R rated as good intubating conditions. They concluded that no significant difference exists in intubating conditions at 60 s after injection of rocuronium 0.6 mg kg^{-1} in patients induced with either propofol or thiopentone. Dobson *et al.*[5] found in their study that at 60 s after being anesthetized with propofol and rocuronium 0.6 mg kg^{-1}, 7 out of 12 (58.33%) patients rated as excellent and 4 out of 12 (33.33%) patients as good, and with thiopentone and rocuronium, 6 out of 12 (50%) patients rated as excellent and 1 out of 12 (8.33%) patients as good.

TOFR was measured at the time of intubation by an assistant who assessed the degree of paralysis of the adductor pollicis and correlated it with intubating conditions. The overall the degree of paralysis of adductor pollicis (determined by TOFR) in excellent intubating condition was better in the PR group (31.8 ± 17.9%) as compared with the TR group (41.2 ± 28.3%). In the PR group 61.8 ± 14.6% TOFR were measured as having a good intubating score, which are better than in the TR group 68.0 ± 10.9%. The incidence of the degree of paralysis of adductor pollicis in poor intubating condition is 61.7 ± 27.9% in the PR group and in the TR group 78.7 ± 6.8%. In three patients in the PR group found in the impossible grade with TOFR 78.3 ± 5.7% at first attempt and they were intubated at second attempt and placed good intubating condition and their TOFR on second attempt are 42.33 ± 14.6%. While in the TR group, no patient is placed in the impossible grade. The TOFR in clinically acceptable intubating conditions is similar (46.2 ± 22.2%) in the PR group than in the TR group (49.4 ± 27.1%). However, the TOFR in clinically non-acceptable intubating conditions sub-group was better (68.8 ± 21.9%) in the PR group than in the TR group (78.5 ± 6.8%). The difference was not statistically significant ($P > 0.05$). Cooper *et al.*[7] found that the degree of block present after rocuronium 0.6 mg kg^{-1} was about 89 ± 15.2% at 60 s using single twitch (ST) mode in PNS.

Mirakhur *et al.* have shown that complete block of the adductor pollicis muscle is not required for the provision of good intubating conditions; the greater speed of action of rocuronium may contribute to the good intubating conditions. Bowman *et al.*[10] suggested that the low potency of rocuronium results in a higher molecular load being present at the neuromuscular junction, producing an initial high concentration gradient. Another possible reason could be the more rapid action of rocuronium at vocal cord than at the adductor pollicis muscle.

Dubois *et al.*[11] confirmed these findings in clinical practice and demonstrated that when using rocuronium, good to excellent intubating conditions are achieved before 100% block is obtained, i.e. faster than onset time. Paralysis occurs first in the well-perfused fast muscles and last in the diaphragm. At the adductor muscles of the larynx, the onset of block is faster but less intense, than is the case for the adductor pollicis muscle. As the rocuronium bromide induced neuromuscular block develops faster, though less deeply, at the larynx adductor muscles than at the adductor pollicis muscle, it appears that intubation may be performed before complete block is achieved as measured at the thumb.[12–14]

We concluded that the completed block of the adductor pollicis muscle is not required for the provision of good intubating conditions. The clinical intubating conditions after rocuronium bromide 0.6 mg kg^{-1} in adults anaesthetized with propofol or thiopentone sodium are same, in view of clinical intubating conditions and degree of paralysis of adductor pollicis muscle.

References

1. Mckeating K, Bali IM, Dundee JW. The effects of thiopentone and propofol on upper airway integrity. Anaesthesia 1988;43:638-40.
2. Sparr HJ, Giesinger S, Ulmer H. Influence of induction technique on intubating conditions after rocuronium in adults: Comparison with rapid-sequence induction using thiopentone and suxamethonium. Br J Anaesth 1996;77:339-42.
3. Donati F. Effect of dose and potency on onset. Anaesth Pharmacol Rev 1993:1;34-43.
4. Hofmockel R, Benad G. Time course of action and intubating conditions with rocuronium bromide under propofol-alfentanil anesthesia. Eur J Anaesthesiol1995:11;69-72.
5. Dobson AP, McClukey A, Meakin G, Baker RD. Effective time to satisfactory intubating conditions after administration of rocuronium in adults comparison of propofol and thiopentone for RSI of anaesthesia. Anaesthesia 1999;54:172-97.
6. Viby-Mogensen J, Engbaek J, Eriksson LI, Gramstad L, Jensen E, Jensen FS. Good Clinical Research Practice in pharmacodynamic studies of neuromuscular blocking agents. Acta Anaesthesiol Scand 1996:40;59-74.
7. Cooper R, Mirakhur RK, Clarke RS, Boules Z. Comparison of intubating conditions after administration of Org 9426 (rocuronium) and suxamethonium. Br J Anaesth 1992:69;269-73.
8. Andrews JI, Kumar N, Olkkola KT. A large simple randomized trial of rocuronium versus succinylcholine in rapid-sequence induction of anaesthesia along with propofol. Acta Anaesthesiol Scand 1999;43:4-8.
9. Sparr HJ, Luger TJ, Heidegger T. Comparison of intubating conditions after rocuronium and suxamethonium following rapid-sequence induction' with thiopentone in elective cases. Acta Anaesthesiol Scand 1996:40;425-30.
10. Bowman WC, Rodger IW, Houston J, Marshall RJ, McIndewar I. Structure/action relationships among some desacetoxy analogues of pancuronium and vecuronium in the anaesthetized cat. Anesthesiology 1988:69;57-62.
11. Dubois MY, Lea DE, Kataria B, Gadde PL, Tran DQ, Shearrow T. Pharmacodynamics of rocuronium with and without prior

administration of succinylcholine. J Clin Anesth 1995:7;44-8
12. McCoy EP, Connolly FM, Mirakhur RK, Loan PB. Nondepolarizing NMB and train-of-four fade. Can J Anaesth 1995:42;231-6.
13. Meistelman C, Plaud B, Donati F. Rocuronium (Org 9426) neuromuscular blockade at the adductor muscles of the larynx and adductor pollicis in humans. Can J Anaesth 1992:39;665-9.
14. Wright PM, Caldwell JE, Miller RD. Onset and duration of rocuronium and succinylcholine at the adductor pollicis and laryngeal adductor muscles in anesthetized humans. Anesthesiology 1994:81;1110-5.
15. Fuchs-Buder T, Sparr HJ, Ziegenfuss Assess the effect of the choice of induction agent on intubating conditions, 60 sec. After administration of rocuronium 0.6 mg/kg. Br J Anaesth 1998;80:504-6.

Source of Support: Nil, **Conflict of Interest:** None declared.