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EVALUATION OF INTUBATING STATE USING TRAIN OF FOUR STIMULATION WITH 0.6 MG/KG ROCURONIUM IN SUBJECTS UNDERGOING ELECTIVE SURGERIES

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ABSTRACT

Background: With the neuromuscular blocking agents, it is recommended to use TO (train of four) stimulation. The assessment of intubating state using train of four and 0.6mg/kg rocuronium is scarce in the literature. **Aims:** The present study was done for estimation of the subject's proportion with an excellent intubating state with the use of 0.6mg/kgrocuronium and train of four at adductor pollicislongus at different time intervals, immediately and 24 hours after extubation, time to reach T0 and T1 and time to attain sore throat. **Methods:** 212 subjects were divided into 2 groups namely T0 and T1 where the intubating state was evaluated following 0.6mg/kg rocuronium and monitoring by the train of four. The data collected were statistically analyzed with a t-test and Chi-square test where $p<0.05$ was taken as the level of statistical significance. **Results:** Intubating time was 132.58±30.73 seconds which was 142.96±27.06 seconds for Group T0 and 122.36±30.78 seconds for T1 which was significantly higher for T0 with $p<0.01$. Intubating condition was poor in 0.92% (n=1), good in 5.55% (n=6), and excellent in 93.51% (n=101) subjects respectively of group T0, whereas, in Group T1, it was poor, good, and excellent in 1.92% (n=2), 8.65% (n=9), and 89.42% (n=93) subjects respectively. **Conclusion:** Non-significantly higher proportion of subjects with excellent intubating conditions were seen at T0 after 0.6mg/kg rocuronium administration. 20 seconds more were taken to reach T0 compared to T1with less immediate and late sore throat incidence.

KEYWORDS: General anesthesia, Intubating condition, Neuromuscular monitoring, Rocuronium, Sore throat, Train of four

INTRODUCTION

One of the most prominent advancements in the field of anesthesiology is the neuromuscular blocking agent introduction clinically. This advent has caused a revolution in the anesthesia practice. The only available muscle relaxant causing speedy tracheal intubation is succinylcholine. However, numerous ill-effects have been linked to the use of succinylcholine including increased intracranial tension, raised intra-ocular tension, bradyarrhythmias, hyperkalemia, myalgia, fasciculation in muscles, masseter spasm, malignant hyperthermia, anaphylaxis, and raised intragastric pressure.[1]

With the associated undesirable effects of succinylcholine, its use is not desirable in conditions such as spinal cord injury, open eye injury, intracranial bleed, acute head injury, burns, neuromuscular disorders, renal diseases, and/or cerebrovascular accidents. Hence, a non-depolarizing muscle relaxant is needed for such conditions having a rapid onset of action. One such clinically acceptable alternative is Rocuronium which effectively substitutes suxamethonium owing to its property of rapid action onset for both emergency and elective surgeries and intubation with the added advantage of eliminating undesirable side effects associated with Suxamethonium.[2]

Rocuronium is a non-depolarizing muscle relaxant having intermediate action duration and rapid onset. Rocuronium is used in the two doses of 0.6mg/kg and 0.9mg/kg. The most commonly used dose is 0.6mg/kg for 60 seconds

duration. Previous literature data has shown that in 60 seconds of use, 0.9mg/kg provides excellent intubating conditions, whereas, other studies conducted in the previous literature depict that better intubating conditions are seen with 0.6mg/kg rocuronium compared to the dose of 0.9mg/kg. However, the dose of 0.6mg/kg remains the most widely used dose in clinical practice.[3]

In endotracheal intubation cases, rocuronium remains the most common and widely used non-depolarizing muscle relaxant. With the use of rocuronium in a 0.6mg/kg dose for 90 seconds, clinically acceptable results have been reported in the previous literature data. However, the scarce literature data assessed and quantitative proportion of subjects with excellent intubating conditions and the time needed to attain these. Also, after a train of four (TOF) stimuli, a standard and observable endpoint, which is the disappearance of all twitches (T0) and three twitches (T1) are scarce in the literature. Also, the best intubating conditions suggesting endpoint are not described well in the literature.[4]Hence, the present study was done to quantitively evaluate the proportion of subjects with excellent intubating conditions following 0.6mg/kg rocuronium administration in TOF stimulation-guided intubation in elective surgery. The study also assessed the time to reach T0 or T1 after rocuronium, sore throat incidence immediately and after 24 hours, anesthetic agent effect on intubation, and intubating condition.

MATERIALS AND METHODS

The present prospective clinical study was conducted at an Indian health care center after clearance was taken from the concerned Ethical committee. The study population was contributed by subjects undergoing elective surgical procedures at the Institute. The study included 212 subjects of both genders within the age range of 18-60 years and a mean age of 37.4±6.46 years. The inclusion criteria for the study were subjects in the age range of 18-60 years, both males and females, ASA (American Society of Anesthesiology) physical status I and II, and subjects undergoing elective dental surgery of > 1-hour duration under general anesthesia and endotracheal intubation. The exclusion criteria were subjects with BMI <20 or >30, anticipated difficult airway, and subjects with neuromuscular disease. After explaining the detailed study design, informed consent was taken from all the subjects in both written and verbal form.

After the final inclusion of the study subjects, vitals were examined along with BIS (bispectral index), and the intravenous line was established. For induction, premedication was done with an inhalation agent, inducing agent, opioid analgesia, and midazolam premedication. To attain 40-50 BIS, the agent was selected by a consultant anesthesiologist. Neuromuscular transmission was monitored using a digital monitor. After consciousness loss, neuromuscular block monitoring was done by a train of four stimulation at APL (abductor pollicislongus). 4 successive stimuli were delivered at 2Hz at 200µs pulse duration for 0.5 sec which was repeated every 10 seconds. As a bolus, 0.6 mg/kg rocuronium was given over 5 seconds. 90% of receptors were taken when one of 4 twitches was present (T1). 100% receptors were considered occupied after all 4 twitches were lost (T0).

After the disappearance of either three/four twitches, tracheal intubation was done by the anesthesiologist. Onset time was considered as rocuronium injection to T0 or T1 attainment. TOF endpoint was blinded to the intubating anesthesiologist. Intubating conditions were recorded as poor, good, or excellent. Target BIS of 40-60 was maintained with a volatile inhalational agent. After surgery completion, the volatile agent was stopped, the trachea was extubated, and the residual neuromuscular block was reversed. Preoperatively, sore throat was assessed 24 hours after surgery and immediately following extubation. 212 study subjects were divided into 2 groups of trachea intubation at T0 and T1.

The collected data were subjected to statistical evaluation using SPSS version 20, Chicago Inc., USA. The data were expressed in percentage and number, and mean and standard deviation. The level of significance was kept at $p<0.05$. The tests used were Chi-square, student t-test, and ANOVA.

RESULTS

The present study included 212 subjects divided into 2 groups of trachea intubation at T0 and T1. The mean age of the study subjects for groups T0 and T1 was37.52±12.36 and35.76±11.43 years respectively. In T0 there were 68.51% (n=74) females and 31.48% (n=34) males, whereas in T1 there were 70.19% (n=73) females and 29.80% (n=31) males. 72% (n=) of the study subjects were ASA type I and 28% (n=) were ASA type II. The study results showed that intubating time was 132.58±30.73 seconds which was 142.96±27.06 seconds for Group T0 and 122.36±30.78 seconds for T1 which was significantly higher for T0 with $p<0.01$. Intubating condition was poor in 0.92% (n=1), good in 5.55% (n=6), and excellent in 93.51% (n=101) subjects respectively of group T0, whereas, in Group T1, it was poor, good, and excellent in 1.92% (n=2), 8.65% (n=9), and 89.42% (n=93) subjects respectively which was statistically non-significant with $p=0.218$ (Table 1).

On assessing the excellent and non-excellent conditions in the study subjects, for inhalation with sevoflurane excellent condition was seen in 90.90% (n=140) subjects, with isoflurane in 76.92% (n=20) subjects, and none in 96.87% (n=31) subjects. With nitrous oxide use, the excellent condition was seen in 91.21% (n=135) subjects and without nitrous oxide in 87.5% (n=56) subjects which were non-significant with p=0.264. The non-significant difference was also seen with the use of propofol or thiopentone as an iv induction agent with p=0.05, among two groups, T0 and T1 with p=0.09, and between genders with p=1.000. For onset time, the area under the curve was 0.542 and was non-significant p=0.418. Concerning fentanyl and midazolam doses, the area under the curve was 0.564 and 0.536 respectively with both showing statistically non-significant results with p=0.224 and 0.492 respectively (Table 2).

Table 1: Intubation Time and Conditions in the Study Subjects

S. No.	Intubation and Related Conditions	Group T0 (n=108)	Group T1 (n=104)	Total	*p*-value
1.	**Intubating time (seconds)**	142.96±27.06	122.36±30.78	132.58±30.73	<0.01
2.	Intubating condition % (n)				
a)	Poor	0.92 (1)	1.92 (2)	1.41 (3)	0.218
b)	Good	5.55 (6)	8.65 (9)	7.07 (15)	
c)	Excellent	93.51 (101)	89.42 (93)	91.50 (194)	

Table 2: Intubation Time and Conditions in the Study Subjects

S. No	Factor	Excellent % (n)	Non-excellent % (n)	*p*-value
1.	**Inhalation**			
a)	Sevoflurane	90.90 (140)	9.09 (14)	0.132
b)	Isoflurane	76.92 (20)	23.07 (6)	
c)	None	96.87 (31)	3.12 (1)	
2.	**Nitrous oxide**			
a)	Yes	91.21 (135)	8.78 (13)	0.264
b)	No	87.5 (56)	12.5 (8)	
3.	**IV induction agents**			
a)	Propofol	91.35 (148)	8.64 (14)	0.05
b)	Thiopentone	86 (43)	14 (7)	
4.	**Groups**			
a)	T0	95.19 (99)	4.80 (5)	0.09
b)	T1	84.25 (91)	15.74 (17)	
5.	**Gender**			
a)	Females	87.82 (137)	12.17 (19)	1.000
b)	Males	94.64 (53)	5.35 (3)	
	Variables	**Condition**	**Area under curve**	**p-value**
1.	**Onset time**	**Excellent (202)**	0.542	0.418
2.		Non-excellent (10)		
3.	**Fentanyl Dose**	**Excellent (202)**	0.564	0.224
4.			Non-excellent (10)	
5.	**Midazolam Dose**	**Excellent (202)**	0.536	0.492
6.		Non-excellent (10)		

For intubation attempts, in Group T0 one and two attempts were done in 95.37% (n=103) and 4.62% (n=5) subjects respectively, whereas, in Group T1, one and two attempts were done in 93.26% (n=97) and 6.73% (n=7) subjects respectively which was statistically non-significant with p=0.598. Cormack-Lehane grade of 1, 2, and 3 was seen in 66.6% (n=72), 31.48% (n=34), and 1.85% (n=2) subjects of group T0, and in 69.23% (n=72), 28.84% (n=30), and 1.92% (n=2) subjects respectively of Group T1 which was statistically non-significant with p=0.766 (Table 3).

On evaluating the incidence of sore throat in the two groups, it was seen that immediate sore throat was seen in 3.70% (n=4) subjects of Group T0, 13.46% (n=14) subjects of T1, and 8.49% (n=18) subjects in total which was significantly higher in Group T 1 with p=0.02. Late report of sore throat was reported by no subject of Group T0 and in 4.80% (n=5) subjects of T1, 4.80% (n=%) subjects of Group T1, and 2.35% (n=5) subjects in total which was significantly higher for Group T1 with p-0.01 as shown in Table 4.

DISCUSSION

Intubating time was 132.58±30.73 seconds in study subjects, 142.96±27.06 seconds for Group T0, and 122.36±30.78 seconds for T1 which was significantly higher for T0 with p<0.01. Intubating condition was poor in 0.92% (n=1), good in 5.55% (n=6), and excellent in 93.51% (n=101) subjects respectively of group T0, whereas, in Group T1, it was poor, good, and excellent in 1.92% (n=2), 8.65% (n=9), and 89.42% (n=93) subjects respectively which was statistically non-significant with p=0.218. These findings were consistent with the results of Nakadate Y et al[5] in 2021 and Wardhana A et al[6] in 2019 where authors reported similar intubating conditions in their studies.

For the assessment of the excellent and non-excellent conditions in the study subjects, for inhalation with sevoflurane excellent condition was seen in 90.90% (n=140) subjects, with isoflurane in 76.92% (n=20) subjects, and with none in 96.87% (n=31) subjects. With nitrous oxide use, the excellent condition was seen in 91.21% (n=135) subjects and without nitrous oxide in 87.5% (n=56) subjects which were non-significant with p=0.264. The non-significant difference was also seen with the use of propofol or thiopentone as an iv induction agent with p=0.05, among two groups, T0 and T1 with p=0.09, and between genders with p=1.000. For onset time, the area under the curve was 0.542 and was non-significant

Table 3: Intubation Attempts and Cormack-Lehane Grade in the Study Subjects

S. No.	Parameter	Group T0 (n=108)	Group T1 (n=104)	Total (n=212)	*p*-value
1.	**Intubation attempts (n)**				
a)	One	95.37 (103)	93.26 (97)	94.33 (200)	0.598
b)	Two	4.62 (5)	6.73 (7)	5.66 (12)	
2.	**Cormack-Lehane Grade**				
a)	1	66.6 (72)	69.23 (72)	67.92 (144)	0.766
b)	2	31.48 (34)	28.84 (30)	30.18 (64)	
c)	3	1.85 (2)	1.92 (2)	1.88 (4)	

Table 4: Incidence of Immediate and Late Sore Throat in the Study Subjects

S. No.	Sore Throat	Group T0 (n=108)	Group T1 (n=104)	Total	*p*-value
1.	**Immediate**				
a)	Yes	3.70 (4)	13.46 (14)	8.49 (18)	**0.02**
b)	No	96.26 (104)	86.53 (90)	91.50 (194)	
2.	**Late**				
a)	Yes	0 (0)	4.80 (5)	2.35 (5)	**0.01**
b)	No	100 (108)	95.19 (99)	97.64 (207)	

p=0.418. Concerning fentanyl and midazolam doses, the area under the curve was 0.564 and 0.536 respectively with both showing statistically non-significant results with p=0.224 and 0.492 respectively. These results were in agreement with the studies of Fuchs-Buder T et al[7] in 2007 and Scheiber G et al[8] in 2007 where factors and parameters o anesthesia showed a similar effect on excellent intubating conditions.

Concerning intubation attempts, in Group T0 one and two attempts were done in 95.37% (n=103) and 4.62% (n=5) subjects respectively, whereas, in Group T1, one and two attempts were done in 93.26% (n=97) and 6.73% (n=7) subjects respectively which was statistically non-significant with p=0.598. Cormack-Lehane grade of 1, 2, and 3 was seen in 66.6% (n=72), 31.48% (n=34), and 1.85% (n=2) subjects of group T0, and in 69.23% (n=72), 28.84% (n=30), and 1.92% (n=2) subjects respectively of Group T1 which was statistically non-significant with p=0.766. These results were similar to the findings of Patel DD et al[9] in 2013 and Gupta N et al[10] in 2015 where authors reported similar attempts and grading as in the subjects of the present study.

For evaluation of the incidence of sore throat in the two groups, it was seen that immediate sore throat was seen in 3.70% (n=4) subjects of Group T0, 13.46% (n=14) subjects of T1, and 8.49% (n=18) subjects in total which was significantly higher in Group T 1 with p=0.02. Late report of sore throat was reported by no subject of Group T0 and in 4.80% (n=5) subjects of T1, 4.80% (n=%) subjects of Group T1, and 2.35% (n=5) subjects in total which was significantly higher for Group T1 with p-0.01. These results were in agreement with the results of Khurshid H et al[11] in 2015 and Parikh K et al[12] in 2014 where authors reported comparable incidence of early and late sore throat in their subjects.

CONCLUSION

Within its limitation, the present study concludes that the proportion of subjects with the excellent intubating condition was non-significantly higher at T0 compared to T1 after the use of 0.6mg/kg rocuronium with lesser reports of sore throat. The present study had a few limitations including a smaller sample size and a short monitoring period. Universal acceptance is not associated with Blumenthal incision owing to its large incision. Also, ease of performing and learning frown incision is low, however, SIA has made its choice among ophthalmic surgeons.

CONFLICTS OF INTEREST

Nil

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