

# To Compare the Intubating Conditions of Cisatracurium with Rocuronium – A Prospective, Randomized Double-blind Study

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## Abstract

**Background:** Neuromuscular blocking agents are usually administered during anesthesia to facilitate endotracheal intubation and to provide muscle relaxation during surgery. There are few studies comparing cisatracurium versus rocuronium for the assessment of intubation conditions and hemodynamic response. In this study, we have compared the intubating conditions, hemodynamic events between cisatracurium and rocuronium.

**Materials and Methods:** This prospective, randomized, double-blind, controlled study includes 70 adult patients of both sexes aged between 20 and 60 years with ASA Grade I and II. These patients were randomly allocated into two groups of 35 each. Group A received 0.1 mg/kg of inj. cisatracurium (2 ED95). Group B received 0.6 mg/kg of inj. rocuronium (2 ED95). The intubating conditions, hemodynamic variables, and adverse reactions were compared between these groups.

**Results:** In our study, the mean percentage depression of adductor pollicis at 180 s was 66.43% ( $\pm 24.94\%$ ) in cisatracurium group against 18.29% ( $\pm 15.19\%$ ) in the rocuronium group which was statistically significant. The blockade at adductor pollicis was more intense with rocuronium compared to cisatracurium at 180 s in our study.

**Conclusion:** In our study, it is concluded that the suppression of muscle twitch at adductor pollicis muscle was significantly more with rocuronium than cisatracurium. The intubating conditions assessed as per Copenhagen conference score system were superior with rocuronium than with cisatracurium. The hemodynamic parameters such as heart rate and MAP were similar in both the groups.

**Key words:** Cisatracurium, Intubation, Rocuronium

## INTRODUCTION

Neuromuscular blocking agents are usually administered during anesthesia to facilitate endotracheal intubation and to provide muscle relaxation during surgery. An ideal neuromuscular blocking agent should have quick onset of action that provides the best intubating conditions and also enable the reversal of blockade within a short period of time. They should not possess cumulative effects that may

lead to residual paralysis. The poor intubating conditions may increase the incidence of difficult intubation, trauma to the airway and can cause laryngeal injury, as manifested by voice hoarseness and vocal cord damage. Since laryngoscopy and intubation are associated with hemodynamic responses<sup>[1]</sup> such as tachycardia and hypertension routinely, suboptimal relaxation of vocal cords can further exaggerate. Hence, an ideal muscle relaxant should provide vocal cord immobility quickly, adequate relaxation of jaw, and less hemodynamic responses that make placement of endotracheal tube easy with direct laryngoscopy. The ideal neuromuscular blocking agent is one which has brief duration of action, provides profound relaxation, and is free from hemodynamic changes.

Succinylcholine<sup>[2]</sup> was used routinely to aid intubation for its rapid onset of action and reliable neuromuscular blockade

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that causes profound relaxation of the cords. The side effects such as muscle pain, hyperkalemia, and pressure changes in the ocular and intracranial compartments led to the use of non-depolarizing muscle relaxants. The non-depolarizing muscle relaxants which are currently in use in clinical practice are vecuronium, atracurium, and rocuronium.<sup>[3]</sup> The potency of the drug is determined by the dose–response curves which describe the relationship between twitch depression and dense. The effective dose 50 or ED50 is the median dose corresponding to 50% twitch depression to supramaximal electric stimulus. The ED95 is the dose of neuromuscular blocking agent that is expected to produce 95% block at the adductor pollicis. Several multiples of the ED95 are usually administered to ensure adequate neuromuscular blockade for intubation and to minimize the time to maximum block that is more commonly used for dosing muscle relaxants. Therefore, equipotent doses are usually compared to find the pharmacodynamic properties.<sup>[4]</sup> The time of onset is shortened by increasing the dose at intubation but at the expense of prolonged time to recovery. Cisatracurium and rocuronium are non-depolarizing muscle relaxants belonging to different classes of intermediate acting muscle relaxants, with cisatracurium belonging to benzylisoquinolinium group and rocuronium to steroidal group.

Cisatracurium is 4 times as potent as atracurium. It is eliminated by Hoffman elimination (77%). At physiological pH and temperature, cisatracurium is converted to laudanosine and monoquaternary acrylate. The amount of laudanosine produced is 5 times less than atracurium. Histamine release is also nil with cisatracurium making it more suitable for intubation as it does not cause hypotension like atracurium. The elimination is not dependent on liver and renal function. The effective dose ED95 is 0.05 mg/kg and doses in the range of twice to 4 times of ED95 have been studied for intubation with varying time for suppression of twitch response.

Rocuronium, an intermediate acting non-depolarizing muscle relaxant, has a structure similar to vecuronium and pancuronium. It is approximately 6–10 times less potent and the ED95 dose for suppression of twitch is observed at 0.3 mg/kg. The recommended dose for intubation within 1 min is 1 mg/kg. However, the duration of action is prolonged up to 90 min with such higher dosage. Hence, the drug has been investigated for their intubating conditions starting from 0.3 mg/kg to 0.9 mg/kg.

The intubating conditions measured in terms of vocal cord mobility and jaw relaxation were found to be satisfactory even with the lowest dose of 0.3 mg/kg. The suppression of twitch response was 5–6 min with 0.3 mg and was 2.6–3 min with 0.6 mg/kg. However, the incidence of

tachycardia and hypertension was more with lowest dose used that demanded additional doses of fentanyl and propofol.

Literature data on rocuronium and cisatracurium showed studies where comparison of different dosages has been done with succinylcholine as a relaxant<sup>[5]</sup> for intubation.

There are few studies comparing cisatracurium versus rocuronium for the assessment of intubation conditions and hemodynamic response.<sup>[6,7]</sup> When two drugs are compared, it is meaningful to compare only equipotent doses and usually clinically relevant doses (twice the ED95%) of both.

## MATERIALS AND METHODS

This prospective randomized double-blind study was conducted in the TOT complex, Govt. General Hospital, Kakinada, attached to Rangaraya Medical College between January 2019 and June 2019. After obtaining the Institutional Ethical Committee approval and informed written consent, 80 adult patients belonging to ASA I and II, of both sexes, aged between 20 years and 60 years were taken up for this study.

The sample size was calculated assuming the mean time for onset time of blockade with cisatracurium which was 50.45 s with a standard deviation of 20 and 70.75 s and with a standard deviation of 27.31 for rocuronium. The sample size was calculated for a power of 90% and 5% alpha error. The required sample size was 29 subjects in each group. To account for non-participation or loss to follow up of 20%, another 6 subjects were included to the study groups. Hence, the final sample size was 70 which divided into two groups.

### Inclusion Criteria

The following criteria were included in the study:

1. Surgeries planned under general anesthesia with endotracheal intubation
2. ASA I and II patients
3. Elective surgeries.

### Exclusion Criteria

The following criteria were excluded from the study:

1. Myopathies
2. Chronic liver disease
3. Chronic renal disease
4. Obesity with BMI >30 mg/kg/m<sup>2</sup>
5. Patients with anticipated difficult airway.

These 70 adult patients are randomly allocated into two groups

Group A: 0.1 mg/kg of inj. cisatracurium (2 ED95).  
 Group B: 0.6 mg/kg of inj. rocuronium (2 ED95).

The study drugs were loaded by an independent anesthesiologist as per the computer generated random numbers. The person who loaded the drug did not participate in monitoring the study parameters.

Inj. cisatracurium and inj. rocuronium twice the ED95 were loaded according to patients body weight and diluted to 10 ml.

The patient was then shifted to the operating room, all the standard monitors were connected, and the electrodes for TOF monitoring were attached to the right wrist for stimulation of ulnar nerve. After securing iv access, patients were pre-oxygenated with 100% oxygen for 3 min, inj. midazolam 1 mg iv, and inj. fentanyl 2 µg/kg given. After 3 min, patient induced with inj. propofol 2 mg/kg iv. and checked for ease of mask ventilation. The study drug was given based on computer generated numbers.

After 180 s, TOF count was monitored and the percentage depression of adductor pollicis was noted. Then, intubation conditions were assessed according to the Copenhagen conference score (CCS) and were intubated with ETT size 7 mm ID PVC in female and with 8 mm ID PVC in male patients. The position of ETT was confirmed with capnography and bilateral air entry.

Then, physiological parameters, heart rate and mean arterial pressure, were noted at pre-induction, post-induction, and for every 3 min for the first 15 min. The side effects such as any skin reactions and idiosyncratic anaphylactic reactions were also noted.

### Study Parameters

1. Percentage depression of adductor pollicis twitch at 180 s
2. The CCS
3. Physiological parameters – heart rate and mean arterial pressure.

At the end of surgery, anesthesia was reversed with inj. neostigmine 0.05 mg/kg and inj. glycopyrrolate 0.01 mg/kg and shifted to PACU.

## RESULTS

This randomized comparative trial was conducted to compare the intubating conditions between equipotent doses of cisatracurium and rocuronium (2×ED95) in elective surgeries requiring general anesthesia with endotracheal intubation and controlled ventilation. A total

of 70 subjects were included in the study – 35 subjects in each group [Tables 1 and 2].

Group A received an intubating dose of inj. cisatracurium 0.1 mg/kg (2×ED95) and Group B received an intubating dose of inj. rocuronium 0.6 mg/kg (2×ED95).

The collected data were analyzed with IBM.SPSS statistics software 23.0 version. To describe about the data, descriptive statistics, frequency analysis, and percentage analysis were used for categorical variables and the mean and S.D were used for continuous variables. To find the significant difference between the bivariate samples in independent groups, the unpaired sample *t*-test was used. To find the significance in categorical data, Chi-square test was used. In all the above statistical tools, the *P* = 0.05 is considered as statistically significant.

## DISCUSSION

The onset time, duration of action of muscle relaxants, and the type of surgery are important factors in choosing the appropriate drugs to achieve rapid, successful tracheal intubation. Rocuronium, atracurium, and cisatracurium<sup>[8]</sup> are frequently used muscle relaxants for short to intermediate duration surgical procedures. The adequacy of conditions for tracheal intubation is a function of several factors, such as depth of anesthesia at the time of intubation attempt and the level of neuromuscular block at the time of attempt.

Cisatracurium,<sup>[9]</sup> at higher doses – 4 times the ED95 dose, provides neuromuscular blocking property at 90 s that ensures optimal intubating conditions. The intubating conditions measured in terms of vocal cord mobility and priming<sup>[10,11]</sup> rocuronium 0.3 mg/kg. However, the suppression of twitch response is delayed up to 5–6 min with 0.3 mg/kg of rocuronium<sup>[12]</sup> and 2.6–3 min with 0.6 mg/kg rocuronium. The objective of the present study was to compare the 16 undergoing elective surgery. In our study, the intubating conditions and the percentage depression of adductor pollicis<sup>[13]</sup> twitch were assessed at 180 s following twice the ED95 dose of cisatracurium or rocuronium.

The study groups were comparable with respect to age, gender, and weight. None of the patients were excluded from the study and did not have any complications in the intraoperative period.

### The Percentage Depression of Adductor Pollicis [Tables 3 and 4]

In our study, the mean percentage depression of adductor pollicis at 180 s [Figure 1] was 66.43% (±24.94%) in cisatracurium group against 18.29% (±15.19%) in the

**Table 1: Comparison of demographic profile between the study parameters**

S. No.	Parameters	Group A n=35	Group B n=35	P-value
1	Age	33.97±13.19	40.89±13.7	0.478
2	Sex			0.328
	Male	19(34.3%)	24(65.6%)	
	Female	16(45.7%)	11(31.4%)	
3	Weight (in kg)	62.24±12.1	59.53±10.97	0.392
4	BMI (kg/m <sup>2</sup> )	22.88±2.51	22.29±2.38	0.402
5	ASA			0.329
	Status 1	62.9%	37.1%	
	Status 2	37.1%	62.9%	

**Table 2: Duration of surgery**

Parameter	Group A (n=35) (mean ±SD)	Group B (n=35) (Mean ±SD)	Unpaired t-test
Duration of surgery (in hours)	2.17±0.62	2.43±0.81	0.141

**Table 3: Median of percentage depression of adductor pollicis twitch at 180 s**

Parameter	Group A (n=35) Median (IQR)	Group B (n=35) Median (IQR)
Percentage depression of adductor pollicis twitch at 180 s	75 (2, 96)	21 (0, 47)

**Table 4: Mean of percentage depression of adductor pollicis twitch at 180 s**

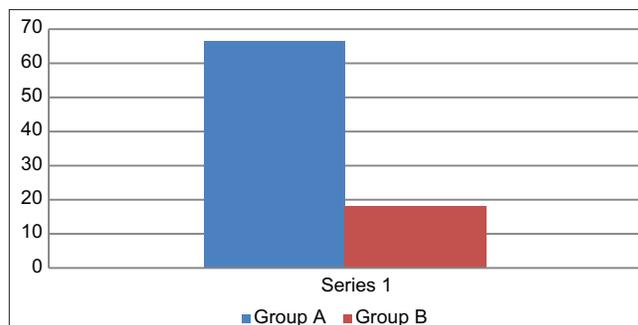
Percentage depression of adductor pollicis twitch at 180 s comparison between groups by unpaired t-test						
Groups	n	Mean	S.D	t-value	P-value	
Percentage depression of adductor pollicis twitch at 180 s	Group A	35	66.43	24.94	9.753	0.0005**
	Group B	35	18.29	15.19		

\*\*Highly significant at P<0.01 level

rocuronium group which was statistically significant. The blockade at adductor pollicis was more intense with rocuronium compared to cisatracurium<sup>[14]</sup> at 180 s in our study.

Omera *et al.*<sup>[15]</sup> found the onset time of action for cisatracurium at 160.4±14.3 s following twice the ED95 dose of cisatracurium and the intubating conditions were acceptable only after 150 s following cisatracurium.

Naguib *et al.*<sup>[6]</sup> reported early onset of neuromuscular blockade at 1.3 min with 0.6 mg/kg of rocuronium compared to equipotent dose of cisatracurium. However,



**Figure 1: Bar diagram showing mean of percentage depression of adductor pollicis twitch at 180 s**

Kim *et al.*<sup>[7]</sup> reported the onset time for blockade as 2.7 (2.2–3.2) min at the larynx and 3.9 (3.0–4.8) min at the adductor pollicis following administration of cisatracurium at 0.1 mg/kg. They noted that the onset time and the recovery time were fast at the laryngeal muscle compared to adductor pollicis. Hyunjung *et al.*<sup>[12]</sup> reported that twice the ED95 dose of rocuronium produce T1 suppression at 102 ± 49 s compared to 197 ± 53 s with cisatracurium.

In our study, we found similar results where the percentage of twitch suppression was significantly low for rocuronium than cisatracurium indicating more blockade.

**The Copenhagen Consensus Conference Score [Tables 5 and 6 and Figure 2]**

Omera *et al.*<sup>[15]</sup> demonstrated the intubating conditions to be acceptable after 150 s with twice the ED 95 dose of cisatracurium. However, the intubating conditions at 60 s were clinically acceptable in about 80% of patients who received 0.6 mg of rocuronium. We found similar results as evidenced by the excellent and good scores in majority of subjects who received rocuronium.

Hyunjung *et al.*<sup>[12]</sup> reported excellent intubating conditions with both rocuronium and cisatracurium. However, the onset time was significantly longer with cisatracurium (197 ± 53 s), compared to that of rocuronium (102 ± 49 s).

Heggeri *et al.*<sup>[13]</sup> reported that none of the patients at 60 s showed a TOF count of 0 with 2×ED95 dose of rocuronium. However, the intubating conditions were excellent at 60 s with 0.9 mg/kg of rocuronium in 97% of subjects. Bhandari *et al.*<sup>[6]</sup> reported excellent to good intubating conditions in 93.33% of patients at 60 seconds with rocuronium 0.9 mg/kg.

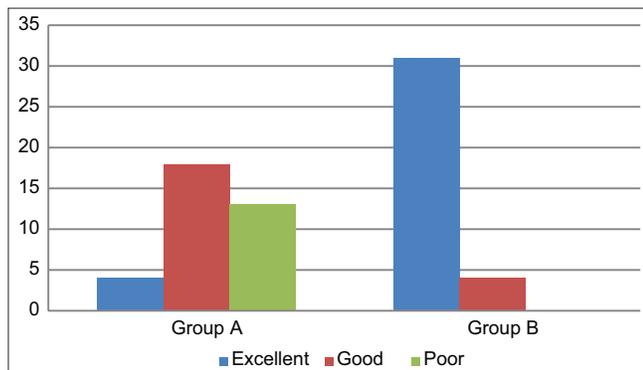
In our study, the Copenhagen consensus conference score with rocuronium was excellent in 88.6% of patients and good in 11.4% of patients. None of the patients had poor score with rocuronium, whereas 37.1% of subjects had poor score with cisatracurium. The Copenhagen consensus

**Table 5: Comparison of CCS score among the two groups**

CCS	Comparison between CCS with groups			t-value	P-value
	Groups		Total		
	Group A	Group B			
Excellent					
Count	4	31	35	42.738	0.0005
%	11.4	88.6	50.0		
Good					
Count	18	4	22		
%	51.4	11.4	31.4		
Poor					
Count	13	0	13		
%	37.1	0.0	18.6		
Total					
Count	35	35	70		
%	100.0	100.0	100.0		

**Table 6: The Copenhagen consensus conference score**

Score	Jaw relaxation	Vocal cords	Diaphragmatic response
Excellent	Relaxed jaw	Abducted immobile vocal cords	No diaphragmatic movement
Good	Relaxed jaw	Abducted immobile vocal cords	Some diaphragmatic movement (bucking)
Poor	Relaxed jaw	Moving vocal cords	Coughing on intubation
Inadequate	Jaw is not relaxed	Abducted vocal cords	Impossible intubation.



**Figure 2: Comparison of Copenhagen conference score between the groups**

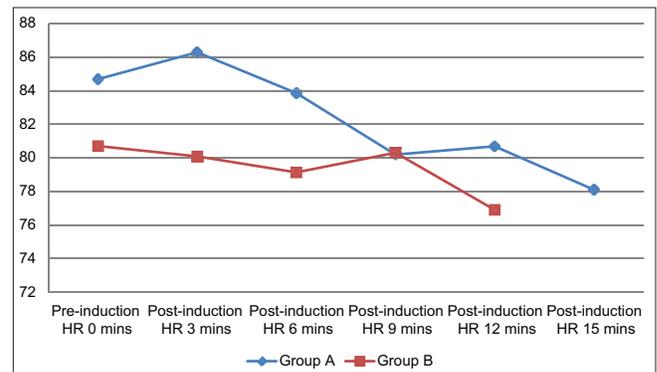
conference score with cisatracurium was excellent in 11.4% of patients and good in 51.4% of patients in our study. However, there were no patients with a score of inadequate CCS. The poor scores noted in the cisatracurium group could be due to the lower dose that was used in our study.

**Table 7: Heart rate at different time intervals between the groups**

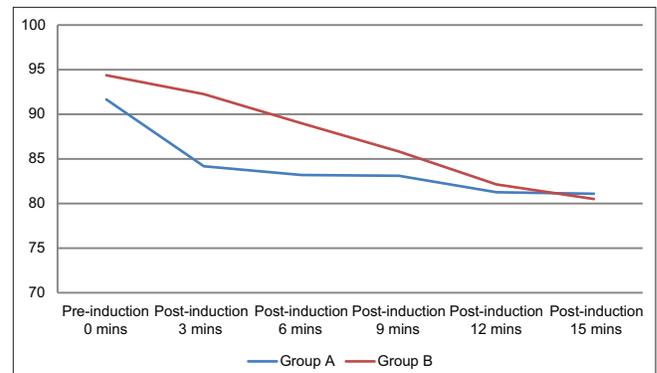
Parameter (per min)	Group A (n=35) (Mean±SD)	Group B (n=35) (Mean±SD)	Unpaired t-test P-value
Pre-induction HR 0 min	84.69±18.49	80.71±13.47	0.308
Post-induction HR 3 min	86.29±17.83	80.09±15.75	0.128
Post-induction HR 6 min	83.86±15.9	79.14±10.46	0.148
Post-induction HR 9 min	80.2±14.01	80.31±12.75	0.972
Post-induction HR 12 min	80.69±16.94	76.91±16.76	0.352
Post-induction HR 15 min	78.11±16.3	74.63±14.96	0.355

**Table 8: Mean arterial pressure at different time intervals between the study groups**

Parameter (in mm Hg)	Group A (n=35) (Mean±SD)	Group B (n=35) (Mean±SD)	Unpaired t-test P-value
Pre-induction 0 min	91.66±13.41	94.37±16.65	0.455
Post-induction 3 min	84.17±16.22	92.26±18.26	0.654
Post-induction 6 min	83.2±15.09	89±14.25	0.385
Post-induction 9 min	83.11±14.09	85.83±12.45	0.396
Post-induction 12 min	81.26±12.48	82.14±14.17	0.782
Post-induction 15 min	81.09±12.46	80.51±12.44	0.848



**Figure 3: Heart rate at different time intervals between the groups**



**Figure 4: Mean arterial pressure at different time intervals between the study groups**

Hyunjung *et al.* observed ideal intubating conditions with cisatracurium at higher doses in the range of 3–4 times the ED95 dose of cisatracurium.

#### Physiological Parameters [Tables 7 and 8, Figures 3 and 4]

There were no differences between the changes in the heart rate and blood pressure at different time intervals between both the groups in our study. Jammer *et al.* reported that 2×ED95 and 3×ED95 of cisatracurium did not show statistically significant change in HR and MAP. Hyunjung *et al.*<sup>[12]</sup> reported no difference in hemodynamics at equipotent doses of cisatracurium and rocuronium.

#### Limitations of the Study

The recovery characteristics of the neuromuscular blockade were not assessed. In our study, comparing equipotent dose of cisatracurium and rocuronium, the intubating conditions were optimal with rocuronium as compared to that of cisatracurium at 180 s. The intensity of blockade as measured by TOF was more for the group that received rocuronium.

## CONCLUSION

In our study, we compared the intubating conditions between cisatracurium and rocuronium given at twice the ED95 dose at 180 s, we found

- The suppression of muscle twitch at adductor pollicis muscle was significantly more with rocuronium than cisatracurium
- The intubating conditions assessed as per CCS scoring system were superior with rocuronium than with cisatracurium
- The hemodynamic parameters – heart rate and MAP were similar in both the groups.

## REFERENCES

1. Nandi R, Basu SR, Sarkar S, Garg R. A comparison of haemodynamic responses between clinical assessment-guided tracheal intubation and neuromuscular block monitoring-guided tracheal intubation: A prospective,

- randomised study. *Indian J Anaesth* 2017;61:910-5.
2. Chatrath V, Singh I, Chatrath R, Arora N. comparison of intubating conditions of rocuronium bromide and vecuronium bromide with succinylcholine using “timing principle”. *J Anaesthesiol Clin Pharmacol* 2010;26:493-7.
3. Mitra M, Nag A, Ganuly T, Kar S, Lahira S. Quality of laryngoscopic view and rapidity of development of intubating conditions after atracurium, vecuronium and rocuronium. A randomized controlled study. *J Bioequivalence Bioavailab* 2016;1:128-33.
4. Scheiber G, Ribeiro C, Marichal A, Bredendiek M, Renizing K. Intubating conditions and onset of action after rocuronium, vecuronium and atracurium in young children. *Anaesth Analg* 1996;83:320-4.
5. Whally DG, Maurer WG, Knapik AL, Estafanous FG. Comparison of neuromuscular effects, efficacy and safety of rocuronium and atracurium in ambulatory anaesthesia. *Can J Anaesth* 1998;45:954-9.
6. Naguib M, Samarkandi AH, Ammar A, Elfaqih SR, Al-Zahrani S, Turkistani A. Comparative clinical pharmacology of rocuronium, cisatracurium and their combination. *Anesthesiology* 1998;89:1116-24.
7. Kim KS, Chung CW, Shin WJ. Cisatracurium neuromuscular block at the adductor pollicis and the laryngeal adductor muscle in humans. *Br J Anaesth* 1999;83:483-4.
8. Zeidan A, Nahle N, Maaliki H, Baraka A. Cisatracurium or rocuronium versus rocuronium-cisatracurium combination. *Middle East J Anaesthesiol* 2006;18:879-86.
9. Adamus M, Belohlavek R, Koutna J, Vujcikova M, Janaskova E. Cisatracurium vs. rocuronium: A prospective, comparative, randomized study in adult patients under total intravenous anaesthesia. *Biomed Pap Med Fac Univ Palacky Olomouc Czech Repub* 2006;150:333-8.
10. Lin SP, Chang KY, Chen YJ, Lin SM, Chang WK, Chan KH, *et al.* Priming with rocuronium to accelerate the onset time of cisatracurium during intubation. *J Chin Med Assoc* 2009;72:15-9.
11. Xiaobo F, Jianjuan K, Yanlin W. Comparison of the variability of the onset and recovery from neuromuscular blockade with cisatracurium versus rocuronium in elderly patients under total intravenous anesthesia. *Braz J Med Biol Res* 2012;45:676-80.
12. Hyunjung L, Jeong S, Choi C, Jeong H, Lee S, Jeong S. Anesthesiologist’s satisfaction using between cisatracurium and rocuronium for the intubation in the anesthesia induced by remifentanyl and propofol. *Korean J Anesthesiol* 2013;64:34-9.
13. Heggeri VM, Harbshettar AS, Deka A, Rajkhowa T. Intubating conditions of two different doses of rocuronium at 60 seconds; by clinical assessment; and with T.O.F response of adductor pollicis muscle. *J Clin Diagn Res* 2015;9:UC24-8.
14. Parasa M, Vemuri NN, Shaik MS. Comparison of equipotent doses of rocuronium and vecuronium. *Anesth Essays Res* 2015;9:88-91.
15. Omera MA, Hammand Y, Helmy A. Rocuronium versus cisatracurium: Onset of action, intubating conditions, efficacy and safety. *Alexandria J Anaesth Intens Care* 2005;8:27.
16. Bhandari R, Verma AP, Singh RP, Agrawal M, Mitra S, Krishan G. A clinical evaluation of the intubating conditions using two different doses of rocuronium and its comparison with succinylcholine for rapid sequence induction: A prospective single blind study. *Int J Contemp Med Res* 2018;5:34-9.

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