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The Efficacy of Intubating Doses of Rocuronium and Cisatracurium in Adults Undergoing Elective Surgeries Under General Anaesthesia with Respect to their Onset and Duration of Action

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ABSTRACT
The Primary objective was to compare the efficacy of intubating doses of rocuronium and cisatracurium in adults undergoing elective surgeries under general anaesthesia with respect to their onset and duration of action. After taking written informed consent, 90 patients aged between 20 to 60 years belonging to ASA grade I and ASA grade II of either sex, undergoing elective surgery under general anaesthesia were included in the study. They were randomly divided into 3 groups of 30 patients each, who received one of the following muscle relaxant for intubation, Group A (n=30)-Rocuronium 0.9mg/kg, Group B (n=30)- Cisatracurium 0.15 mg/kg, Group C (n=30)-Cisatracurium 0.2 mg/kg. Time of onset of action was fastest in group A (100.33s) and slowest in group B (201.67s). Duration of action of single intubating dose was longest in group C (69.67 min) and shortest in group A (53.33 min).

INTRODUCTION

Arthur Lawen is credited with usage of a partially purified preparation of curare for the first time in 1912. This heralded the onset of provision of surgical relaxation in an anaesthetized patient.

With the introduction of endotracheal anaesthesia during World War I and balanced anaesthesia in 1926, a search began for a drug which could cause jaw relaxation to facilitate endotracheal intubation. Most of the intubations were done with inhalational technique which was associated with problems like laryngospasm, bronchospasm. Further, there was a need to take the patient sufficiently deep before intubation which lead to haemodynamic disturbances[1,2].

Introduction of succinylcholine changed the practice of anaesthesia drastically. Its rapid onset and ultra-short duration of action facilitated quick endotracheal intubation. But, succinylcholine chloride was marred with adverse effects like hyperkalemia, rise in intragastric, intraocular, intracranial pressures and cardiovascular effects. Thus the quest began for a safer substitute for succinylcholine[3].

The aim of research on neuromuscular drugs was to have non depolarising muscle relaxant, which is like succinylcholine chloride devoid of its side effects. Riding high on the new found enthusiasm for neuromuscular blocking agents, further research and development of newer aminosteroidal and benzylisoquinolinium compounds was witnessed during the 1980s.

Though many NDMR drugs like atracurium besylate, vecuronium bromide and mivacurium chloride were introduced, none of them could challenge succinylcholine chloride in terms of its onset[4].

Since their introduction, muscle relaxants have become a part and parcel of every anaesthesiologist's routine practice. These agents aid not only in endotracheal intubations and mechanical ventilation but also decrease anaesthetic requirement, patient movement and oxygen consumption.

An Ideal Muscle Relaxant Must Possess Following Properties:

- Rapid onset of action.
- Minimal cardiovascular side effects.
- Less cumulative effects.
- Less dependence on hepatic or renal function for its metabolism and excretion.
- No histamine release.
- Pharmacologically inactive metabolite.
- Easily antagonized.

Of all the available relaxants, rocuronium and cisatracurium retain most of the advantages while eliminating the disadvantages of other drugs.

MATERIALS AND METHODS

The proposed study was conducted on 90 patients who underwent elective surgeries under general anaesthesia in the Department of Anaesthesiology, after obtaining ethical committee clearance.

Study Type: Prospective, Randomized and Double-Blind.

After taking written informed consent, 90 patients aged between 20-60 years belonging to ASA grade I and ASA grade II of either sex, undergoing elective surgery under general anaesthesia were included in the study. They were randomly divided into 3 groups of 30 patients each, who received one of the following muscle relaxant for intubation,

- **Group A (n=30):** Rocuronium 0.9 mg/kg.
- **Group B (n=30):** Cisatracurium 0.15 mg/kg.
- **Group C (n=30):** Cisatracurium 0.2 mg/kg.

Inclusion Criteria:

- Patients posted for elective surgery under general anaesthesia.
- Patients belonging to the age group of 20-60 years, of either sex.
- ASA I and II.
- Mallampatti grade I and II.
- Surgery with duration of >30 minute.

Exclusion Criteria:

- Inaccessible arm positions or likely changes in arm position during surgery.
- Patients in whom difficult airway is anticipated.
- Patients who require rapid sequence induction.
- Patients undergoing laparoscopic surgeries.
- Hepatic or renal disease.
- Patients who are recipient of any drugs known to interact with neuromuscular blocking agents.

A detailed history and complete clinical examination of patients was done to rule out the exclusion criteria. Routine investigations like serum hemoglobin, complete blood count, blood grouping, coagulation profile, serum urea, serum creatinine, serum electrolytes and random blood sugar levels were done. 12 lead ECG and chest X-Ray whenever indicated were taken. Preoperative pulse rate, respiratory rate, blood pressure values were noted. Body weight of the patient was documented. Patients were explained about the procedure of general anaesthesia. Patients involved in the study were asked to stay nil per oral (NPO) 8 hours prior to surgery. They were premedicated with tablet ranitidine 150 mg on the night prior to surgery.

Patients were randomly divided into either Group A or Group B or Group C using the online randomization tool www.graphpad.com/quickcalcs/index.cfm and to

maintain allocation concealment sequentially numbered opaque sealed envelope (SNOSE) was used. In order to maintain the blinding, the intubating drug solutions were prepared in identical 5cc syringes by an anaesthetist who was not involved in the study and then handed over to the blinded investigator.

After the patient was brought inside the operation theatre, an intravenous access was obtained by an 18 G IV cannula and ringer lactate solution 10 ml/kg/hr was started. Standard monitors like non-invasive blood pressure, pulse oximetry and electrocardiography were connected to the patient. An average of three recordings of Heart Rate (HR) and Mean Arterial Pressure (MAP) at time intervals of 1 minute was considered as baseline recording (To). A neuromuscular monitor was connected to the patient after the proper position for surgery was given and the patient"s arms were fixed. Paediatric ECG surface electrodes were placed over the volar side of the wrist to stimulate ulnar nerve, after cleansing the skin. The distal electrode was placed approximately 1cm proximal to the point of junction of proximal flexion crease of the wrist and radial side of the tendon of flexor carpi ulnaris. The proximal electrode was placed at about 2-5 cm proximal to the distal. Free movement of the thumb was ensured while other fingers were tightly fixed with tape. Skin temperature over the adductor pollicis muscle was maintained more than 320 c by wrapping the arm in cotton wool.

General anesthesia was induced in all patients with inj. fentanyl (2.0 mcg/kg) IV, inj. propofol (2 mg/kg) IV. Respiration was assisted with 100% oxygen. With the onset of loss of consciousness, the ulnar nerve was stimulated using 0.1 Hz single twitch stimulation mode. Single twitch was elicited by progressively increasing the current strength. The current (supramaximal current) when the maximal thumb adduction was obtained was noted and 1.5 times of this strength was used for eliciting Train of Four stimulus.

RESULTS AND DISCUSSIONS

Onset of action was found to be fastest in group A (100.33±27.728 s) and slowest in group B (201.67±26.533). Individuals in group C took 126.67±32.625 s for onset. This difference was found to be statistically significant (F=98.061, p=0.001).

On intergroup comparison, mean difference between group A and B, group A and C, group B and C was all significant with p values of 0.001, 0.002 and 0.001 respectively.

Duration of action was found to be longest in group C (69.67±6.687min) and shortest in group A (53.33±4.795). Individuals in group B exhibited 57.67±10.063 min as their duration of action. This difference was found to be statistically significant (F=38.134, p=0.001).

Table 1: Comparison of time for onset of action

	Mean	Std. Deviation	F	p
Group A	100.33	27.728	98.061	0.001
Group B	201.67	26.533		
Group C	126.67	32.625		

Table 2: Inter group comparison of time for onset of action

(I) Group	(J) Group	Mean Difference (I-J)	P
Group A	Group B	-101.333*	0.001
	Group C	-26.333*	0.002
Group B	Group C	75.000*	0.001

*The mean difference is significant at 0.05 level

Table 3: Comparison of duration of action

	Mean	Std. Deviation	F	p
Group A	53.33	4.795	38.134	0.001
Group B	57.67	10.063		
Group C	69.67	6.687		

Table 4: Inter group comparison of duration of action

(I) Group	(J) Group	Mean Difference (I-J)	P
Group A	Group B	-4.333	0.084
	Group C	-16.333*	0.001
Group B	Group C	-12.000*	0.001

*The mean difference is significant at 0.05 level

On intergroup comparison, mean difference between group A and C, group B and C was significant with p values of 0.001 for both. Mean difference was not significant between group A and B (p=0.084).

In our prospective, double blinded study we have also compared variations in heart rate and mean arterial pressure before and after intubations. Baseline HR and MAP were comparable across all study groups. There was a fall in HR and MAP noted across all groups after injection of propofol and study drug was given. This can be correlated to the cardiovascular depressive action of propofol and not to the study drugs. Levy[5] has observed no dose related changes in heart rate and blood pressure after Rocuronium. Similarly, Reich[6] had proposed safe haemodynamic changes in patients with coronary artery disease after cisatracurium. Further, intra group and inter group comparison was done to statistically analyse the changes in HR and MAP at various intervals post intubation. A statistically significant difference within the group and between groups was observed in HR and MAP after intubation. Prakash Jammar[7] documented significant difference in these parameters post intubation. These results go against few other studies like Magdy Omera[8] and Hyunjung Lee[9] where, results indicated no significant differences in haemodynamic variables. However, when heart rate between group B and group C was compared, mean difference was statistically significant only at T5 and T10 as opposed to others where in more than two time points showed significant difference. This is indicative of relative stability in haemodynamic parameters when higher dose of cisatracurium is used. El-Kasaby[10] observed that haemodynamic stability were more evident among higher doses of cisatracurium (4× ED95, 6× ED95). Similar findings were also observed by Taivainen[11], Shahram[12].

In our study, onset of action was found to be fastest in group A (100.33±27.728 s) followed by group C (126.67±32.625 s) and group B (201.67±26.533 s). This difference was found to be statistically significant (F=98.061, p=0.001). Thus, we can safely say that the main result of our study is the demonstration of faster onset of neuromuscular blockade with rocuronium when compared with equipotent and more potent doses of cisatracurium. This finding correlates well with the studies published by Geoffrey K. Lighthall[4] and Milan Adamus[3]. There exists an inverse relationship between onset of action of NMBs and molar potency of the NMB. Accordingly, a quicker onset of action can be associated as a characteristic of drugs with low potency. It is thus hypothesized that., when equipotent doses of the drugs are compared, pharmacologic differences between them (if any), must be revealed[4]. The present study demonstrated different clinical responses to cisatracurium and rocuronium when equipotent doses were compared. This suggests that, there must exist factors other than molar potency which govern the onset of action.

Duration of action was found to be longest in group C (69.67±6.687 min), followed by group B (57.67±10.063 min) and was shortest in group A (53.33±4.795). This difference was also found to be statistically significant (F=38.134, p=0.001). While rocuronium had a predictably rapid onset, cisatracurium exhibited an expected longer duration of action. Magdy Omera[8] also obtained similar results by comparing 2 X ED95 doses of both drugs. Duration of action in their study was 30.3 min and 45.77.5 min respectively for rocuronium and cisatracurium.

Also, this result was found to be statistically significant (p< 0.001). But in our study, on intergroup comparison it was found that at equipotent 3 X ED95 doses there is no statistically significant difference in duration of action.

Intubation score was found to be comparable across all the three groups with p=0.248, as was seen in previous studies also. However it must be noted that other drugs used during induction of anaesthesia, play a role of confounding factors. Fentanyl has analgesic potency and propofol has a depressant effect on pharyngeal and laryngeal muscles. They would have also played a role in providing the ideal intubating conditions observed and thus it cannot be attributed to the study drug alone.

The aminosteroidal NMBAs pancuronium, vecuronium, and rocuronium and the benzylisoquinoline cisatracurium have a similar potency to induce a nonspecific skin reactivity[13]. In our study, not even a single case of allergic reaction was witnessed. Intra dermal skin tests were not done before injecting the drug because of the rarity of the condition and this decision is also supported by a retrospective study conducted by Yu Yil Kim[14].

CONCLUSION

Time of onset of action was fastest in group A and slowest in group B. Duration of action of a single intubating dose was longest in group C and shortest in group A.

REFERENCES

1. Stoelting, R.K., J.P. Rathmell, P. Flood and S. Shafer, 2015. Handbook of Pharmacology and Physiology in Anesthetic Practice. 3rd Edn., Wolters Kluwer, Alphen aan den Rijn, Netherlands (Global) and Philadelphia, United States (corporate), ISBN-14: 978-1605475493, Pages: 821.
2. Agoston, S., 1995. Onset time and evaluation of intubating conditions: rocuronium in perspective. Eur. J Ana. Suppl., 11: 31-37.
3. Adamus, M., R. Belohlavek, J. Koutna, M. Vujcikova and E. Janaskova, 2006. Cisatracurium vs. rocuronium: A prospective, comparative, randomized study in adult patients under total intravenous anaesthesia. Biomed. Pap., 150: 333-338.
4. Lighthall, G.K., M.A. Jamieson, J. Katolik and J.G. Brock-Utne, 1999. A comparison of the onset and clinical duration of high doses of cisatracurium and rocuronium. J. Clin. Anest., 11: 220-225.
5. Levy, J.H., G.K. Davis, J. Duggan and F. Szlam, 1994. Determination of the hemodynamics and histamine release of rocuronium (org 9426) when administered in increased doses under n[2]o/o[2]-sufentanil anesthesia. Ane amp Analg., 78: 318-321.
6. Reich, D.L., J. Mulier, J. Viby-Mogensen, S.N. Konstadt and H.K. van Aken et al., 1998. Comparison of the cardiovascular effects of cisatracurium and vecuronium in patients with coronary artery disease. Can. J. Anaesth., 45: 794-797.
7. Jammar, P., D.G. Pathak, I. Begum and R.C. Chauhan, 2017. IJBCP International Journal of Basic & Clinical Pharmacology Original Research Article A clinical comparative study of two intubating doses of cis-atracurium during general anaesthesia for gynaecological surgery. Int J Basic Clin. Phar., 6: 1206-1210.
8. Omera, M., Y.M. Hammad and A.M. Helmy, 2005. Rocuronium versus Cisatracurium: Onset of action, intubating conditions, efficacy, and safety. Alex J Ana Inte Care AJAIC., Vol. 8, No. 2.

9. Lee, H., S. Jeong, C. Choi, H. Jeong, S. Lee and S. Jeong, 2013. Anesthesiologist's satisfaction using between cisatracurium and rocuronium for the intubation in the anesthesia induced by remifentanil and propofol. Kore J. Ane., 64: 34-39.
10. Atef, H., A. El-Kasaby, A. Helmy and M. El-Nasr, 2010. Cisatracurium in different doses versus atracurium during general anesthesia for abdominal surgery. Saudi J. Anaesth., 4: 152-157.
11. Taivainen, T., G.H. Meakin, O.A. Meretoja, K. Wirtavuori and R.J. Perkins et al., 2000. The safety and efficacy of cisatracurium 0.15 mg.kg-1 during nitrous oxide–opioid anaesthesia in infants and children. Anaesthesia, 55: 1047-1051.
12. Amini, S., A.A. Akramifard and M. Roudbari, 2011. Comparison of the effects of different doses of cisatracurium on appropriate time for endotracheal intubation and haemody namicchanges during anesthesia. Zah J Res Med. Sci., 13: 13-17.
13. Mertes, P.M., D.A. Moneret-Vautrin, F. Leynadier and M.C. Laxenaire, 2007. Skin reactions to intradermal neuromuscular blocking agent injections. Anesthesiology, 107: 245-252.
14. Kim, Y.Y., I.T. Kim, S.I. Shin and S.M. Yim, 2018. Intradermal skin tests for rocuronium and cisatracurium in patients with a history of allergy: A retrospective study. Kore J Anes., Vol. 71, No. 4.