Journal of Cardiovascular Disease Research

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 08, 2024

Original research article

Intubating dose of rocuronium and cisatracurium in adults undergoing elective surgeries under general anesthesia: Comparison of intubation score

[1]Dr. Paramanand Reddy, [2]Dr. Nidhi Mali Patil
[1]Consultant Anaesthesiologist, District Government Hospital, Bagalakote, Karnataka, India.
[2]MICU Registrar, Sagar Hospital, Jayanagar, Bengaluru, Karnataka, India.

Corresponding Author: Dr. Nidhi Mali Patil

Accepted on: 18/07/2024

Abstract

The volume of distribution of cisatracurium is limited by its large molecular weight and high polarity. The steady state volume of distribution is equal to 145 ml/kg in healthy adults receiving opioid anaesthesia which is approximately 21% larger in similar patients receiving inhalation anaesthesia. Rocuronium acts by combining with nAchRs without causing any activation of these ion receptor channels. It acts competitively with ACh at α subunits of postjunctional nAChRs. 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 muscle relaxant for intubation. Intubation score was comparable across all three groups with p=0.248.
Keywords: Intubation score, general anesthesia, rocuronium and cisatracurium

Introduction
Rocuronium bromide is a non-depolarizing skeletal muscle relaxant for intravenous administration introduced in 1994. It is intermediate in its onset and duration of action.
Small infants are more sensitive to neuromuscular blocking agents because of the immature acety1choline receptors at their neuromuscular junctions. Clearance seems to be higher in children than in infants less than 1 year of age. The shortest half-life is determined in children between 4 to 8 years [1].
Physiological changes of aging include loss of body water and muscle mass accompanied by increased body fat, as well as reduction of hepatic and renal function. Thus the clearance of most drugs administered to the elderly is reduced, which also holds true for rocuronium. The loss of body water reduces the volume of distribution of less lipophilic compounds such as muscle relaxants [2].
The volume of distribution of cisatracurium is limited by its large molecular weight and high polarity. The steady state volume of distribution is equal to 145 ml/kg in healthy adults receiving opioid anaesthesia which is approximately 21% larger in similar patients receiving inhalation anaesthesia [3].
The binding of cisatracurium to plasma proteins has not been successfully studied due to its rapid degradation at physiologic pH. Inhibition of degradation requires non-physiological conditions of temperature and pH which are associated with changes in protein binding [4].
The degradation of cisatracurium is largely independent of liver metabolism. It undergoes Hofmann elimination (a pH and temperature-dependent chemical process) to form laudanosine and the mono-quaternary acrylate metabolite.
Laudanosine is further metabolized to desmethyl metabolites which are conjugated with glucuronic acid and excreted in the urine [5].
The monoquaternary acrylate undergoes hydrolysis by non-specific plasma esterases to form the monoquaternary alcohol (MQA) metabolite. The MQA metabolite can also undergo Hofmann elimination but at a much slower rate than cisatracurium [6].

Methodology
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 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

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 08, 2024

divided into 3 groups of 30 patients each, who received one of the following muscle relaxant for intubation,

1. Group A (n=30)-Rocuronium 0.9mg/kg.
2. Group B (n=30)-Cisatracurium 0.15mg/kg.
3. Group C (n=30)-Cisatracurium 0.2mg/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 more than 30 minute.

Exclusion Criteria

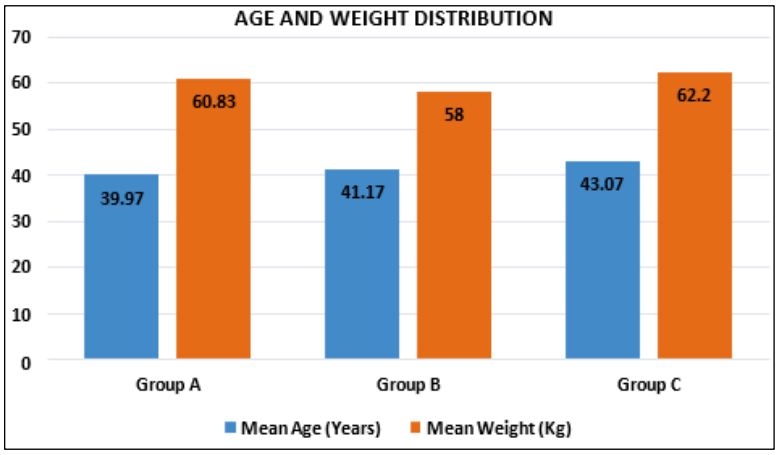
- Inaccessible arm positions or likely changes in arm position during surgery.
- Patients in whom difficult airway is anticipated.
- Patients who require rapid sequence induction.
- Patients undergoing laparoscopic surgeries.
- Hepatic or renal disease.
- Patients who are recipient of any drugs known 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 pre-medicated with tablet ranitidine 150mg on the night prior to surgery.

Results

Table 1: Comparison of age and weight distribution between groups

		N	Mean	Std. Deviation	F	p
Age (Years)	Group A	30	39.97	12.139	0.615	0.543
	Group B	30	41.17	10.158		
	Group C	30	43.07	10.346		
Weight (Kg)	Group A	30	60.83	10.639	1.927	0.152
	Group B	30	58	6.973		
	Group C	30	62.2	7.251		



Graph 1: Comparison of age and weight distribution between groups

In our study, the age group extended from 20 to 60 years. It was found that group A (39.97±12.139), group B (41.17±10.158) and group C (43.07±10.346) were comparable with respect to age in years (F=0.615, p=0.543).

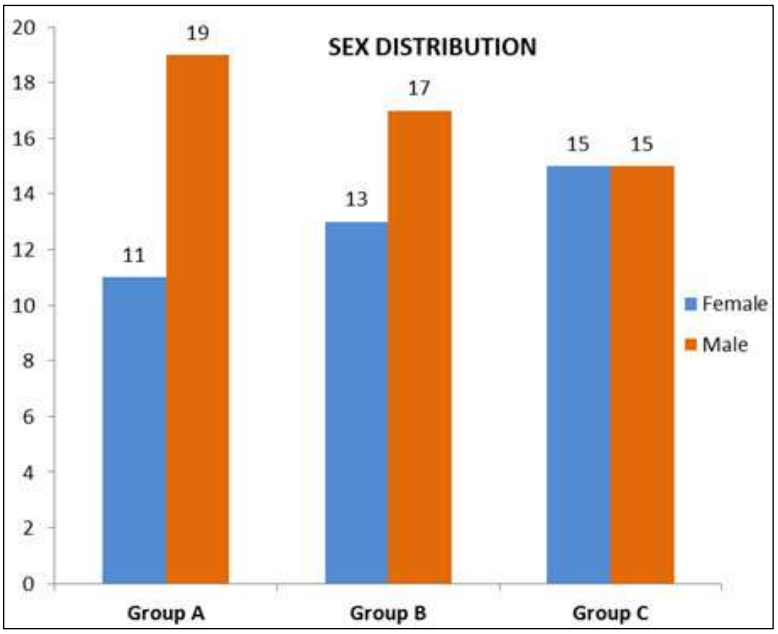
Also, when weights of individuals were compared; group A (60.83±0.639), group B (58.00±6.973) and group C (62.2±7.251) were found to be comparable. The difference in weights was statistically not

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 08, 2024

significant (F=1.927, p=0.152).

Table 2: Comparison of sex distribution between groups

		Sex		Total
		F	M	
Group A	Count	11	19	30
	%	36.70%	63.30%	100.00%
Group B	Count	13	17	30
	%	43.30%	56.70%	100.00%
Group C	Count	15	15	30
	%	50.00%	50.00%	100.00%
Total	Count	39	51	90
	%	43.30%	56.70%	100.00%



Graph 2: Comparison of sex distribution between groups

Sex distribution pattern in percentage, female: male being; 36.7:63.3, 43.3:56.7 and 50:50 in group A, B and C respectively. Gender did not differ between the groups.

Table 3: Comparison of intubation score between groups

	Mean	Std. Deviation	F	p
Group A	8.63	0.669	1.419	0.248
Group B	8.4	0.724		
Group C	8.67	0.606		

Intubation score was comparable across all three groups with p=0.248.

Discussion

A penchant for curiosity, quest for improvement and an unending desire for discovering newer and better drugs has always been the forte of medical practitioners. The assurance of a secure airway with endotracheal tube gives an unmatchable satisfaction for an anaesthesiologist. However, with the large number of neuromuscular blockers to choose from (not to mention the newer ones that are added every year), the choice of drug can often be confusing even for a seasoned anaesthesiologist.

Succinylcholine is generally considered as an ideal drug for intubation barring few contraindications like raised intracranial pressure, cases of head trauma, known case of skeletal muscle disorders and it may also lead to hyperkalemia, myalgia etc. Rocuronium is usually chosen as an alternative for rapid sequence intubation in cases when succinylcholine is contraindicated. Cisatracurium is a relatively newer drug, not widely available in our country. Thus, in our study, we put to test; rocuronium and cisatracurium. These drugs were chosen in lieu of their novelty, similar pharmacokinetic and pharmacodynamic profiles. We compared them against few basic parameters like onset time of single bolus dose, ease of intubation, haemodynamic stability after intubation and also the duration of action [7].

The present study was conducted on 90 patients divided randomly into 3 groups of 30 each. Group A received rocuronium 0.9mg/kg, group B received cisatracurium 0.15mg/kg and group C received

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 08, 2024

0.2mg/kg.
ED95 is the dose of neuromuscular blocker needed to produce 95% suppression of single twitch height. Dosage of muscle relaxant required to facilitate endotracheal intubation and further maintenance of the attained blockade is expressed in multiples of ED95.
ED95 of rocuronium is 0.3mg/kg and that of cisatracurium is 0.05mg/kg [8].
The decision to choose and compare 3 x ED95 of Rocuronium(0.9mg/kg), 3 x ED95 and 4 x ED95 each of cisatracurium (0.15mg/kg and 0.2mg/kg respectively) was taken after reviewing previous studies; where, further higher doses of both drugs were used without any adverse effects to the patients. Schultz P *et al.* [9] (2000) published a study comparing Rocuronium at doses of 0.6 mg/kg, 0.9 mg/kg and 1.2 mg/kg. Similarly, cisatracurium is also studied at exceedingly higher doses of 4 x ED95 and 6 x ED95.(45) In accordance with these studies we conducted our study and as expected no adverse effects were witnessed in any of the study participants owing to high dose of drugs.
In our study, the groups were compared with respect to age distribution, weight distribution and also sex distribution. It was however found that there doesn't exist any significant difference between the three, thus obviating any bias whatsoever that may arise because of age, sex and weight of the patient.
Feng Xiaoba *et al*., [10] conducted a study at Zhongnan Hospital, Wuhan University in 2012 and compared variability of onset and recovery between Rocuronium 0.9mg/kg and cisatracurium 0.15mg/kg. They divided the study population into adults (n=40, 18-64 years) and elderly (n=40, >/= 65years) groups. They concluded that rocuronium had significantly shorter time of onset for both the adult and elderly when compared to cisatracurium, but the variability of cisatracurium was significantly greater in the same age groups. The duration of the action for rocuronium group was significantly longer in the elderly population than in the elderly who received cisatracurium, and the variability of the duration was significantly greater in the rocuronium group. In conclusion, rocuronium exhibited more variability in these parameters than cisatracurium, more so in the elderly. However these results cannot be extrapolated to our study since there doesn't exist any comparable age differences between our study groups. Also, the methodology differs i.e., this study was done under total intravenous anaesthesia but ours is done under inhalational anaesthesia and acceleration transducer was used to monitor the twitches but we relied on visual inspection.
It is found that females have higher sensitivity (20-30 % more) to the effects of aminosteroid neuromuscular blockers. However, we could not derive any such conclusion from our study since there doesn't exist any significant sex differences between the groups. It is imperative at this juncture to quote one such study which looked at the effects of our study drugs in varying sex groups. Adamus M. *et al.* (2008) [11] compared the impact of gender of the patient on the course of neuromuscular blockade after a single bolus dose of rocuronium 0.6mg/kg or cisatracurium 0.1mg/kg when TIVA was given. Their results showed that females were significantly more sensitive to rocuronium, with shorter time to onset and longer duration of action when rocuronium was administered. Recovery index was similar in both genders for both drug groups. Thus they advised dose reduction in females to achieve the same onset and duration of block as in males [12].
Above two studies would lay down the framework for introducing our current study to future prospects. The same parameters could be studied by considering age and sex differences.

Conclusion

- Intubation score was comparable across all three groups with p=0.248.
- No adverse events were witnessed during the course of study because of the study drugs.

References

1. R Maddineni V, P McCoy E, K Mirakur R, J McBride R. Onset and duration of action and haemodynamic effects of rocuronium bromide under balanced and volatile anesthesia. Acta Anaesthesiol Belg. 1994;45:41-7.
2. Khuenl-Brady KS, Sparr H. Clinical pharmacokinetics of rocuronium bromide. Clin Pharmacokinet. 1996 Sep;31(3):174-83.
3. McCoy EP, Mirakhur RK, Maddineni VR, Wierda JM, Proost JH. Pharmacokinetics of rocuronium after bolus and continuous infusion during halothane anaesthesia. Br J Anaesth. 1996 Jan;76(1):29-33.
4. Cooper RA, Maddineni VR, Mirakhur RK, Wierda JM, Brady M, Fitzpatrick KTJ. Time course of neuromuscular effects and pharmacokinetics of rocuronium bromide (Org 9426) during isoflurane anaesthesia in patients with and without renal failure. Br J Anaesth. 1993 Aug;71(2):222-6.
5. Van Miert MM, Eastwood NB, Boyd AH, Parker CJ, Hunter JM. The pharmacokinetics and pharmacodynamics of rocuronium in patients with hepatic cirrhosis. Br J Clin Pharmacol. 1997 Aug;44(2):139-44.
6. Kim KS, Chung CW, Shin WJ. Cisatracurium neuromuscular block at the adductor pollicis and the laryngeal adductor muscles in humans. Br J Anaesth. 1999;83(3):483-4.
7. Kisor DF, Schmith VD. Clinical pharmacokinetics of cisatracurium besilate. Clin Pharmacokinet.

ISSN:0975 -3583,0976-2833 VOL 15, ISSUE 08, 2024

1999 Jan;36(1):27-40.
8. Savarese JJ, Lien CA, Belmont MR, Wastila WB. The clinical pharmacology of new benzylisoquinoline-diester compounds, with special consideration of cisatracurium and mivacurium. Anaesthesist. 1997 Oct;46(10):840-9.
9. Schultz P, Ibsen M, Ostergaard D, Skovgaard LT. Onset and duration of action of rocuronium-from tracheal intubation, through intense block to complete recovery. Acta Anaesthesiol Scand. 2001 May;45(5):612-7.
10. 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(7):676-80.
11. Adamus M, Gabrhelik T, Marek O. Influence of gender on the course of neuromuscular block following a single dose of cisatracurium or rocuronium. Eur J Anaesthesiol. 2008;25(7):589-95.
12. Liu X, Kruger PS, Weiss M, Roberts MS. The pharmacokinetics and pharmacodynamics of cisatracurium in critically ill patients with severe sepsis. Br J Clin Pharmacol. 2012;73(5):741-9.