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Original research article

Hemodynamic stability of each intubating dose of rocuronium and cisatracurium in adults undergoing elective surgeries under general anaesthesia

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Abstract

It is worthwhile to note that the comparative clinical profile of rocuronium and cisatracurium are reported in less number. Armed with evidences of safety profile of these two drugs, we decided to find out if exceeding of the standard induction doses provides more favorable conditions for intubation. The proposed study was conducted on 90 patients who underwent elective surgeries under general anaesthesia the Department of Anaesthesiology, after obtaining ethical committee clearance. 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. There are no dose-related effects on the incidence of changes from baseline (30% or greater) in mean arterial blood pressure or heart rate associated with rocuronium bromide administration over the dose range of 0.12 to 1.2 mg/kg (4 x ED95) within 5 minutes after rocuronium bromide administration and prior to intubation.

Keywords: Hemodynamic stability, rocuronium, cisatracurium

Introduction

Rocuronium bromide, an analogue of vecuronium was introduced in 1994 and it became the first competitor for succinylcholine chloride. It is an aminosteroidal nondepolarizing neuromuscular blocker with an intermediate duration of action. It has an onset time similar to succinylcholine, thus fastest among other nondepolarizing neuromuscular blockers [1, 2]. The onset time, intubating conditions and duration are influenced by the dose of rocuronium. Rocuronium doesn't trigger histamine release and the adult ED95 is 0.3mg/kg.

Cisatracurium was introduced in 1995, is a stereoisomer of atracurium. It is also an intermediate duration, non-depolarizing, benzylisoquinolinium neuromuscular blocker. Not only it is one of the ten isomers constituting the racemic mixture of atracurium, it is also its cis and optical isomer. High potency and subsequently lower dosing and less laudanosine production, stable cardiovascular profile, and Hofmann elimination are the ideal characters that led to purification of cisatracurium from the other isomers. Consequently, it is extensively used not only in adult but also paediatric cases. The adult ED95 of cisatracurium is 0.05mg/kg [3].

It is worthwhile to note that the comparative clinical profile of rocuronium and cisatracurium are reported in less number. Armed with evidences of safety profile of these two drugs, we decided to find out if exceeding of the standard induction doses provides more favorable conditions for intubation. In this study, we compared cisatracurium and rocuronium at 3 x ED95 and 4 x ED95 doses. Our motto was to use a balanced opioid/sevoflurane technique and compare the onset and duration of neuromuscular block produced at these doses. This information is a valuable addition to any clinical anaesthesiologist's knowledge. To date, not many Indian studies are available which had compared these two drugs under the same experimental conditions at equipotent doses [4].

Methodology:

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

Study Type: Prospective, Randomized and Double-Blind after taking written informed consent, 90

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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,

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.

Results

Table 1: Intra group comparison of heart rate at various intervals

		Mean	Std. Deviation	F	P
T0	Group A	89.17	10.319	0.66	0.519
	Group B	87.03	8.294		
	Group C	87.13	4.718		
T1	Group A	91.33	10.011	5.798	0.004*
	Group B	83.77	9.616		
	Group C	86.6	5.846		
T2	Group A	92.17	9.322	12.463	0.001*
	Group B	82.97	8.588		
	Group C	83.8	5.129		
T3	Group A	96.17	12.049	3.837	0.025*
	Group B	89.57	9.291		
	Group C	91.87	5.637		
T4	Group A	93.2	9.974	15.311	0.001*
	Group B	83.63	8.892		
	Group C	82.6	4.717		
T5	Group A	89.53	8.858	14.345	0.001*
	Group B	85.53	9.16		
	Group C	78.53	5.667		
T6	Group A	90.33	9.987	21.032	0.001*
	Group B	78.27	6.71		
	Group C	81.63	4.597		
T7	Group A	87.8	8.907	14.345	0.001*
	Group B	78.77	8.207		
	Group C	78.27	5.825		
T8	Group A	86.77	9.069	8.205	0.001*
	Group B	79.23	8.985		
	Group C	79.03	7.083		
T9	Group A	87.4	10.493	11.816	0.001*
	Group B	79.07	8.694		
	Group C	76.7	7.41		
T10	Group A	86.27	9.986	13.276	0.001*
	Group B	83.27	8.477		
	Group C	75.17	7.207		
T11	Group A	81.9	9.297	0.139	0.871
	Group B	81.63	9.272		
	Group C	82.77	7.436		

*Statistically significant difference with p=<0.05.

Baseline (T0)

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Baseline heart rates in group A (89.17±10.319), group B (87.03±8.294) and group C (87.13±4.718) were comparable (F=0.66, p=0.519).

Before Intubation (T1, T2)
Change in heart rates after injection of induction agent (T1) and study drug (T2) were found to be statistically significant with p=0.004 for the former and p=0.001 for the latter.

After Intubation (T3 to T11)
When heart rates were documented at pre-determined time intervals after intubation, it was observed that the change in heart rate were statistically significant from T3 to T10 with all the p values <0.05. Heart rate was comparable at T11 (p=0.871).

Table 2: Inter group comparison of heart rate at various intervals

Dependent Variable	(I) Group	(J) Group	Mean Difference (I-J)	p
T1	Group A	Group B	7.567*	0.003
		Group C	4.733	0.114
	Group B	Group C	-2.833	0.631
T2	Group A	Group B	9.200*	0.001
		Group C	8.367*	0.001
	Group B	Group C	-0.833	1
T3	Group A	Group B	6.600*	0.023
		Group C	4.3	0.237
	Group B	Group C	-2.3	1
T4	Group A	Group B	9.567*	0.001
		Group C	10.600*	0.001
	Group B	Group C	1.033	1
T5	Group A	Group B	4	0.173
		Group C	11.000*	0.001
	Group B	Group C	7.000*	0.003
T6	Group A	Group B	12.067*	0.001
		Group C	8.700*	0.001
	Group B	Group C	-3.367	0.249
T7	Group A	Group B	9.033*	0.001
		Group C	9.533*	0.001
	Group B	Group C	0.5	1
T8	Group A	Group B	7.533*	0.003
		Group C	7.733*	0.002
	Group B	Group C	0.2	1
T9	Group A	Group B	8.333*	0.002
		Group C	10.700*	0.001
	Group B	Group C	2.367	0.927
T10	Group A	Group B	3	0.545
		Group C	11.100*	0.001
	Group B	Group C	8.100*	0.001

*The mean difference is significant at 0.05 level.

Bonferroni multiple comparison test was done only on those time instants where, the difference in heart rate was found to be statistically significant.

When group A and group B were compared
Mean difference was statistically significant at T1, T2, T3, T4, T6, T7, T8 and T9 with p values of 0.003, 0.001, 0.023, 0.001, 0.001, 0.001, 0.003 and 0.002 respectively. It was not significant at T5 and T10.

When group A and group C were compared
Mean difference was statistically significant at T2, T4, T5, T6, T7, T8, T9 and T10 with p values of 0.001, 0.001, 0.001, 0.001, 0.001, 0.002, 0.001 and 0.001 respectively. It was not significant at T1 and T3.

When group B and group C were compared:
Mean difference was statistically significant at T5 and T10 with p values of 0.003 and 0.00 respectively. It was not significant at T1, T2, T3, T4, T6, T7, T8 and T9.

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Table 3: Intra Group Comparison Of Mean Arterial Pressure At Various Intervals

		Mean	Std. Deviation	F	p
T0	Group A	92	5.589	2.755	0.069
	Group B	87.93	7.939		
	Group C	92.1	9.506		
T1	Group A	90.43	6.616	8.053	0.001*
	Group B	82.83	7.746		
	Group C	89.17	9.029		
T2	Group A	88.2	5.404	9.057	0.001*
	Group B	80.57	7.873		
	Group C	87.7	9.487		
T3	Group A	92.2	7.712	5.189	0.007*
	Group B	85.9	7.88		
	Group C	87	8.65		
T4	Group A	92.47	4.798	27.93	0.001*
	Group B	83.37	7.127		
	Group C	81.13	6.506		
T5	Group A	88.2	5.352	8.813	0.001*
	Group B	82.1	7.577		
	Group C	82.33	5.996		
T6	Group A	90.53	6.852	24.717	0.001*
	Group B	77.57	6.569		
	Group C	84.17	7.935		
T7	Group A	86.73	7.23	12.218	0.001*
	Group B	78.03	6.494		
	Group C	83.2	6.825		
T8	Group A	89.4	4.546	18.164	0.001*
	Group B	79.17	7.773		
	Group C	85.5	7.147		
T9	Group A	86.73	6.4	11.111	0.001*
	Group B	78.2	6.89		
	Group C	83	7.733		
T10	Group A	83.6	7.04	0.055	0.947
	Group B	84.23	6.986		
	Group C	84	8.42		
T11	Group A	79.27	7.244	18.371	0.001*
	Group B	79.53	6.922		
	Group C	90.67	10.344		

*Statistically significant difference with p=<0.05.

Baseline (T0)

Baseline mean arterial pressures in group A(92.00±5.589), group B(87.93±7.939) and group C(92.10±9.506) were comparable (F=2.755, p=0.069).

Before intubation (T1, T2)

Change in mean arterial pressures after injection of induction agent (T1) and study drug (T2) were found to be statistically significant with p=0.001 for both.

After intubation (T3 to T11)

When mean arterial pressures were documented at pre-determined time intervals after intubation, it was observed that the change in mean arterial pressure is statistically significant from T3 to T9 and T11 with all the p values <0.05. Mean arterial pressure was comparable at T10 (p=0.947).

Table 4: Inter group comparison of mean arterial pressure at various intervals

Dependent Variable	(I) Group	(J) Group	Mean Difference (I-J)	p
T1	Group A	Group B	7.600*	0.001
		Group C	1.267	1
	Group B	Group C	-6.333*	0.007
T2	Group A	Group B	7.633*	0.001
		Group C	0.5	1
	Group B	Group C	-7.133*	0.002
T3	Group A	Group B	6.300*	0.01
		Group C	5.200*	0.044
	Group B	Group C	-1.1	1
T4	Group A	Group B	9.100*	0.001

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		Group C	11.333*	0.001
	Group B	Group C	2.233	0.504
T5	Group A	Group B	6.100*	0.001
		Group C	5.867*	0.002
	Group B	Group C	-0.233	1
T6	Group A	Group B	12.967*	0.001
		Group C	6.367*	0.003
	Group B	Group C	-6.600*	0.002
T7	Group A	Group B	8.700*	0.001
		Group C	3.533	0.147
	Group B	Group C	-5.167*	0.013
T8	Group A	Group B	10.233*	0.001
		Group C	3.9	0.076
	Group B	Group C	-6.333*	0.001
T9	Group A	Group B	8.533*	0.001
		Group C	3.733	0.128
	Group B	Group C	-4.800*	0.029
T11	Group A	Group B	-0.267	1
		Group C	-11.400*	0.001
	Group B	Group C	-11.133*	0.001

*The mean difference is significant at 0.05 level.

Bonferroni multiple comparison test was done only on those time instants where, the difference in mean arterial pressure was found to be statistically significant.

When Group A and Group B Were Compared

Mean difference was statistically significant at T1, T2, T3, T4, T5, T6, T7, T8 and T9 with p values of 0.001, 0.001, 0.01, 0.001, 0.001, 0.001, 0.001, 0.001 and respectively. It was not significant at T11.

When Group A and Group C Were Compared

Mean difference was statistically significant at T3, T4, T5, T6 and T11 with p values of 0.044, 0.001, 0.002, 0.003 and 0.001 respectively. It was not significant at T1, T2, T7, T8 and T9.

When Group B and Group C Were Compared

Mean difference was statistically significant at T1, T2, T6, T7, T8, T9 and T11 with p values of 0.007, 0.002, 0.002, 0.013, 0.001, 0.029 and 0.001 respectively. It was not significant at T3, T4 and T5.

Discussion

There are no dose-related effects on the incidence of changes from baseline (30% or greater) in mean arterial blood pressure or heart rate associated with rocuronium bromide administration over the dose range of 0.12 to 1.2 mg/kg (4 x ED95) within 5 minutes after rocuronium bromide administration and prior to intubation [5]. Increases or decreases in MAP are reported in 2 to 5% of geriatric and other adult patients, and in about 1% of paediatric patients. Heart rate changes (30% or greater) are documented in 0 to 2% of geriatric and other adult patients.

The cardiovascular profile of cisatracurium allows it to be administered by rapid bolus at higher multiples of the ED95. It has no dose-related effects on mean arterial blood pressure (MAP) or heart rate (HR) following doses ranging from 2 to 8 × ED95 (> 0.1 to > 0.4 mg/kg), administered over 5 to 10 seconds, in healthy adult patients or in patients with serious cardiovascular disease [6].

Conclusion

Baseline heart rate and mean arterial pressure were comparable across all the groups. Change in HR and MAP after induction with propofol and injection of study drug was statistically significant. HR and MAP also changed significantly almost throughout the monitoring period after intubation except when heart rate of group B and group C was compared (Mean difference was significant only at T5 and T10 but was comparable throughout). This indicates better haemodynamic profile of cisatracurium at 4 times ED95 than 3 times ED 95.

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