

Effect of Rocuronium and Succinylcholine on Intraocular Pressure during Rapid Sequence Induction and Endotracheal Intubation

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ABSTRACT

AIM: Patients who require endotracheal intubation in the emergency department often require a rapid sequence induction (RSI) technique to protect against gastric contents aspiration and facilitate intubation. Two muscle relaxants which are commonly used during RSI are Succinylcholine and Rocuronium. Both of them can cause undesirable rise in Intraocular pressure (IOP). The present study was undertaken to compare the effects of these two drugs on IOP.

METHODS: It was a prospective randomized study on 60 patients aged 20-50 years, and of ASA grade I and II, undergoing elective abdominal surgery in a tertiary care referral hospital. IOP was measured preoperatively and then just before intubation, immediately after intubation, one minute, three minutes and five minutes after intubation.

RESULTS: Succinylcholine had significantly higher mean IOP as compared to Rocuronium before intubation till three minutes after intubation ($p < 0.001$). When change in IOP was compared from baseline, Succinylcholine showed an increase in mean IOP till one minute after intubation while Rocuronium had a decrease in mean IOP at all time intervals.

CONCLUSION: Of the two muscle relaxants used for RSI, Rocuronium has better control over IOP and other side effects as compared to Succinylcholine.

Key words: Rapid Sequence Induction; Intra Ocular pressure; Rocuronium; Succinylcholine

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INTRODUCTION

The tissue pressure of intraocular contents is called the intraocular pressure^[1]. The normal range is 10-20 mmHg and is maintained at this level throughout life with some diurnal and seasonal variation. An acutely raised IOP may cause expulsion of the global contents through a surgical or traumatic opening or may lead to retinal artery occlusion and retinal ischemia. In the chronic setting, raised IOP may cause nerve damage at the head of optic nerve leading to visual field loss. This may be due to a direct effect of the raised pressure upon the nerves, or the effect of chronic under perfusion of the nerve head^[1].

Patients who require endotracheal intubation in the emergency department (ED) often requires a rapid sequence induction (RSI) technique to protect against aspiration of gastric contents, facilitate intubation, and/or protect against increased intracranial pressure (ICP).

Succinylcholine is one of the commonly used muscle relaxants during RSI. However the elective use of Succinylcholine in anaesthesia has largely been abandoned because of unwanted side effects despite it providing excellent intubating conditions more rapidly than other agents. Though it remains the relaxant of choice in non fasting patients yet Succinylcholine produces an undesirable rise

in IOP^[2] which may prove disastrous in patients with penetrating eye injuries.

Intraocular pressure is influenced by several factors such as central venous pressure, choroidal blood volume changes, and extraocular muscle tonicity^[3]. Sudden increase in blood pressure, as occurs after laryngoscopy and endotracheal intubation, results in the choroidal blood volume increase and eventually a 10 to 20 mm Hg increase in IOP^[4]. This increase in IOP can be troublesome in patients with acutely or chronically raised IOP presenting either for corrective ophthalmic surgery or for non ophthalmic surgery.

Muscle relaxants are given as a part of a rapid –sequence induction to facilitate tracheal intubation. Both depolarizing and non depolarizing muscle relaxants can be used for this purpose. Increase in IOP following endotracheal intubation during general anaesthesia is commonly reported as a side effect while using depolarizing muscle relaxant, Succinylcholine.

The present study was done to look for the effect of non-depolarizing muscle relaxant Rocuronium and that of depolarizing muscle relaxant Succinylcholine on intraocular pressure (IOP), when administered intravenously for rapid sequence induction in patients undergoing general anaesthesia for elective abdominal surgeries.

MATERIAL AND METHODS

The present study was conducted in the department of anaesthesiology in collaboration with ophthalmologist, in a tertiary hospital from Jan 2011 to June 2012.

A total of 60 patients undergoing elective abdominal surgery under general anesthesia, aged between 20-50 years, ASA grade I and II physical status (I is normal healthy patient: II is patient with mild systemic disease) were enrolled for the study after proper ethical clearance and informed consent of the patient. Patients with ocular disease with or without increased IOP; with anticipated difficult intubation; Mallampati grade III and IV (Visualization of the soft palate and the base of the uvula; Soft palate is not visible at all respectively); history of cardio respiratory illness; obesity; and contraindication to the use of Succinylcholine were excluded from the study.

The patients were randomly divided in two groups according to the computer generated randomized tables. Group I (*n* = 30) comprised of patients who received injection Succinylcholine 1.5 mg/kg intravenously to achieve muscle relaxation for endotracheal intubation while Group II (*n* = 30) included patients who received injection Rocuronium 0.9 mg/kg intravenously to achieve muscle relaxation for endotracheal intubation.

All the patients went through relevant history taking and general and systemic examination. Complete ocular examination was done by an Ophthalmologist to rule out any ocular disease and more so the presence or tendency of getting raised intraocular pressure.

No premedication was advised before surgery. Preoperative recording of heart rate, non invasive blood pressure and arterial oxygen saturation (SPO₂) was done. Preoperative baseline IOP was measured by a Schiotz tonometer after instillation of 4% lignocaine eye drop in the right eye (TB).

All the patients were administered injection Glycopyrrolate 0.2 mg intravenously and pre-oxygenated with 100% oxygen for 3 minutes. Induction of anaesthesia was carried out with injection Propofol 1% 2 mg/kg intravenously. Injection Succinylcholine and injection Rocuronium were diluted to 10 mL with normal saline prior to administration.

Tracheal intubation was performed after 60 second of

administration of Succinylcholine and Rocuronium in group I and group II patients respectively. No other drug including opioids, muscle relaxants or volatile anesthetics were given to patients in either of the groups for 5 minutes following intubation of trachea.

Intraocular pressure was recorded in right eye just before intubation (T₁), immediately after intubation (TA₁), one minute after intubation (TA₂), three minutes after intubation (TA₃) and five minutes after intubation (TA₄).

Data so obtained was subjected to statistical analysis using SPSS software version 15.0. Chi-square test and Student “*t*” test was used and *p* value of less than 0.05 was taken as statistically significant.

OBSERVATION AND RESULTS

A total of 60 patients aged 20 to 50 years undergoing elective abdominal surgery under general anesthesia were enrolled for the study. They were randomly allocated in two groups of 30 patients each. Group I (receiving I.V Succinylcholine 1.5 mg/kg) for muscle relaxation for endotracheal intubation and group II (receiving I.V Rocuronium 0.9 mg/kg).

Mean age of patients in group I was 34.07 ± 8.37 years whereas it was 29.97 ± 7.66 years in group II. Although there was a difference in age between two groups yet it was statistically insignificant (*p* = 0.053).

Male to female ratio in both the groups was 13:17, thus showing a perfect gender wise match. Mean weight of patients in group I was 50.10 ± 6.92 kg as compared to 49.23 ± 6.31 kg in group II (Table 1).

On comparing the IOP values between two groups at different time intervals we found that the mean value of IOP was slightly higher in group II only at baseline and after 5 minute of intubation with *p* = 0.053 and *p* = 0.704 respectively. While at all other time i.e. just before intubation, immediately after intubation and one minute after intubation, the IOP was significantly lower than that in group I (*p* ≤ 0.001) (Table 2).

When the change in IOP from baseline was observed and compared

Table 1 Comparison of Demographic Variables between two groups.

S. No.	Characteristic	Group I	Group II	Significance of difference
1.	Mean Age ± SD (Range) in years	34.07±8.37 (20-50)	29.97±7.66 (20-50)	<i>t</i> = 1.979; <i>p</i> = 0.053.
2.	Male: Female	13:17	13:17	$\chi^2 = 0$; <i>p</i> = 1.
3.	Mean weight ± SD (Range) in kg	50.10 ± 6.92 (36-64)	49.23 ± 6.31 (30-60)	<i>t</i> = 0.507; <i>p</i> = 0.614.

Table 2 Comparison of IOP between two groups at different time intervals.

Variable	Group I		Group II		<i>t</i>	<i>p</i>
	Mean	SD	Mean	SD		
Baseline	15.95	2.45	16.98	1.47	-1.974	0.053
Before intubation	17.90	2.45	12.30	1.82	10.043	< 0.001
Immediately after intubation	20.23	3.16	14.68	2.28	7.797	< 0.001
1 min	16.40	3.65	12.65	2.32	4.757	< 0.001
3 min	12.88	3.01	11.24	2.23	2.390	0.020
5 min	10.89	2.00	11.10	2.38	-0.382	0.704

Table 3 Change in IOP in two groups.

Baseline to	Group I				Group II			
	Mean	SD	<i>t</i>	<i>p</i>	Mean	SD	<i>t</i>	<i>p</i>
Before intubation	1.95	0.84	-12.665	<0.001	1.95	0.84	-12.665	<0.001
Immediately after intubation	4.28	1.89	-12.402	<0.001	4.28	1.89	-12.402	<0.001
1 min	0.45	2.64	0.934	0.358	0.45	2.64	0.934	0.358
3 min	-3.07	2.37	7.093	<0.001	-3.07	2.37	7.093	<0.001
5 min	-5.06	2.11	13.172	<0.001	-5.06	2.11	13.172	<0.001

between two groups, we found that in group I, a significant increase in IOP was present at “before intubation” and “immediately after intubation” ($p < 0.001$) however this IOP subsequently decreased and reached to a significantly lower level than baseline by 3 minutes and 5 minutes after intubation ($p < 0.001$).

While in group II mean IOP was significantly lower than base line ($p < 0.001$) throughout the time period (Table 3).

DISCUSSION

Rapid sequence induction (RSI) is a process whereby pharmacologic agents specifically a sedative (e.g. induction agent) and a neuromuscular blocking agent are administered in rapid succession to facilitate endotracheal intubation^[5].

The purpose of RSI is to make emergent intubation easier and safer, thereby increasing the success rate of intubation and decreasing the complications of intubation.

In our study, two muscle relaxants Succinylcholine and Rocuronium are compared.

It was observed that there was a significant difference in IOP between two groups. It was significantly lower in group II as compared to group I from before intubation till 3 minutes after intubation.

Observation of ‘within group changes’ from baseline, showed a reduction in IOP from “before intubation” in group II, as compared to an increase in IOP during this period in group I, thereby showing a suppressive response of Rocuronium. Though both groups had increase of IOP after intubation yet the suppressive effect of Rocuronium was able to keep the IOP below the baseline values and hence showed mean value below the baseline level at all the observed time intervals. This was in concordance with the finding of Chiu *et al*^[6] who also used the same dose of Succinyl choline and Rocuronium with similar intubating conditions. In a study by Vinik *et al*^[7] who used 0.6 mg/kg of Rocuronium, the percentage change in IOP from baseline was significantly decreased in group II following intubation and although this trend continued after induction but the difference was no longer statistically significant. It may be because of low dose of Rocuronium.

The finding of initial rise in IOP as compared to baseline in group I till one minute after intubation and then subsequent decrease in IOP as compared to group II which has decrease in IOP at all time interval, is similar to those reported in literature by Mace, 2008^[8] but is against the findings of Mitra *et al*^[9] who observed the immediate decrease in IOP in both the groups.

The difference in findings of two groups is because of difference in action of two drugs. The ability of succinyl choline to check the reverse diffusion of acetylcholine to nerve terminals might cause an increase in IOP. In contrast Rocuronium prevents Acetylcholine from accessing the nicotinic receptors thus preventing against rise in IOP.

The major increase in IOP due to Succinylcholine is caused by contraction of extraocular muscles although dilatation of choroidal vessels is a contributing factor. Rocuronium reduces the tone of extraocular muscles and produces decrease in arterial and venous pressure due to paralysis.

The slight differences found in our study from earlier studies might be attributable to differences in certain methodological aspects such as premedication, induction agents, dose of Rocuronium, setting and patient characteristics.

The present study suggests that Rocuronium 0.9 mg/kg is comparable to Succinyl choline 1.5 mg/kg in facilitating RSI but is having a better control over IOP.

The findings are encouraging in view of the reported contraindications to the use of Succinylcholine and can be explored for use of Rocuronium as muscle relaxants during RSI. Larger studies with variable dosages of Rocuronium are recommended to find out the conclusive evidence in order to recommend its use in routine clinical practice.

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