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Evaluation of rapid precurarisation technique using Rocuronium and Atracurium

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ABSTRACT

Objective: To evaluate rapid precurarisation technique using rocuronium on succinylcholine induced fasciculations, intubating conditions and postoperative myalgias and compare it with atracurium
Methods: In a prospective randomized double blinded study 90 patients requiring General Anaesthesia.were recruited to three groups.Group A received intravenous 0.01ml/kg NS, Group B 0.1mg/kg atracurium and Group C 0.1mg/kg rocuronium, after intravenous Fentanyl and Xylocard followed 10 seconds later by propofol. At 90 seconds 1.5mg/kg succinylcholine injected and patients intubated at 120 seconds.
Results: Fasciculations and myalgias were significantly less in Group B and Group C with p < 0.05. Rocuronium was significantly superior to atracurium. There was no difference in intubating conditions.
Conclusion: Rapid precurarisation is effective in reducing incidence of succinylcholine induced fasciculations and postoperative myalgias without adversely affecting the intubating conditions. Rocuronium is more effective than atracurium.

Keywords : Rapid precurarisation, rocuronium, fasciculations, intubating conditions, postoperative myalgias

INTRODUCTION

Despite the recent introduction of short-acting non-depolarising neuromuscular blockers, succinylcholine with its rapid onset of action, short duration of effect, complete and predictable paralysis remains unsurpassed in providing ideal conditions for endotracheal intubation(8,2).

Administration of succinylcholine is associated with many side effects(17,20,1):
Muscle fasciculations
Postoperative myalgias
Elevated intraocular and intragastric pressures
Elevated serum creatine phosphokinase
Myoglobinuria
Hyperkalemia
Phase II block
Malignant hyperthermia

The occurrence of muscle pains following administration of succinylcholine is one of the commonest causes of postoperative discomfort(17). Several factors attribute to myalgias(15) including the choice and use of induction agent, the patient's age and sex(7) and the time of ambulation following surgery(17).

Several strategies have been advocated to decrease the incidence of postoperative myalgias, one of the most successful being the administration of small, sub-paralyzing dose of non-depolarising neuromuscular blocking drug, before the administration of succinycholine (i.e. precurarisation)(11).

An optimal pretreatment interval of three minutes has been recommended for many commonly used agents such as vecuronium, atracurium and d-tubocurarine(13).

Rocuronium has a more rapid onset of action compared with the established non-depolarising agents(9). The effect of the rapid and time-saving precurarisation technique using rocuronium on succinylcholine induced fasciculations, intubating conditions and postoperative myalgias has been evaluated in this study and compared with atracurium.

THE PRECURARISATION TECHNIQUE

The prevalence of fasciculations and postoperative myalgias is high after injection of succinylcholine, especially in women and muscular adults. These myalgias are sometimes so severe, especially in patients who are ambulant within 48 hours of surgery, as to constitute a serious drawback to the use of the drug. One of the most successful strategies to prevent these is administration of a small dose of non-depolarising neuromuscular blocking drug before administration of succinylcholine – "Precurarisation"(11). Precurarisation with 10-15% of the intubating dose of the non-depolariser is recommended(18).

Churchill-Davidson (1954) first suggested that pre-treatment with gallamine, could decrease the incidence and severity of fasciculations and occurrence of postoperative myalgias(6).

Various factors influence the efficacy of pretreatment, including the choice of non-depolarising agent(8), degree of prejunctional receptor block, interval between administration of pretreatment agent and succinylcholine, and the speed of onset of block by non-depolarising drug.

Precurarisation not only attenuates the fasciculations and postoperative myalgias, but also attenuates succinylcholine-induced depolarisation. Therefore muscle relaxation is less complete, onset of paralysis delayed, time of maximum paralysis not known and the return of spontaneous respiration may be delayed(20).

MATERIALS AND METHODS

After approval of the Hospital Ethics Committee, 90 ASA physical status I or II patients, of either sex (18-60 years), presenting for elective procedures requiring General Anaesthesia with endotracheal intubation were included in this study.

Pregnant patients, patients with neuromuscular disease, those on medications known to interact with neuromuscular function, those with anticipated difficult intubation were excluded from the study.

A preoperative evaluation of all patients carried out a day before surgery. The nature of the study explained to the patients in detail and a written informed consent obtained. The patients were randomly allocated into 3 groups of 30 patients each to receive pretreatment as follows :

Group A: 0.01ml/kg Normal Saline.

Group B: 0.1mg/kg Atracurium.

Group C: 0.1mg/kg Rocuronium.

The patients kept fasting for 6 hours for solid food and premedicated with Inj. Atropine g0.01mg/kg body weight intramuscular half hour before surgery.

An intravenous access secured using a 20G intravenous cannula on the nondominant hand. All routine monitors viz. ECG (lead II & V5), pulseoximeter, NIBP placed and baseline recordings of heart rate, blood pressure, oxygen saturation recorded.

Anaesthesia commenced with intravenous Inj. Fentanyl 1.5ug/kg and Inj. Xylocard 0.5mg/kg at Time 0. Pretreatment administered 60 seconds later followed 10 seconds later by Inj. Propofol 2.5mg/kg. At 90 seconds 1.5mg/kg of Succinylcholine injected. 30 seconds later the trachea is intubated and the ease of intubation assessed.

The patient observed for 2 minutes following Succinylcholine administration for presence and the severity of fasciculations graded:

Nil: no visible fasciculations.
Mild: very fine movements of fingertips and/or facial muscles.
Moderate: minor fasciculations on trunk and extremities.
Severe: vigorous fasciculations on trunk and extremities.

The intubating conditions assessed and graded:
Good: Jaw relaxed, vocal cords apart and immobile, no diaphragmatic movement.

Adequate: Jaw relaxed, vocal cords apart and immobile, some diaphragmatic movement.

Poor: Jaw relaxed, vocal cords moving, marked bucking or coughing.

Anaesthesia maintained with Isoflurane 1-2% in a mixture of nitrous oxide and oxygen (50%/50%). Using train-of-four measurement Inj. Vecuronium given to facilitate surgery.

Intraoperative monitoring: Heart rate, blood pressure, oxygen saturation and ECG recorded every minute till 10 minutes after intubation, every 5 minutes thereafter until the end of surgery.

At the end of the procedure, neuromuscular blockade reversed with Inj. Neostigmine 0.06mg/kg preceeded by Inj. Glycopyrrolate 10mcg/kg.

Postoperative monitoring: In the postoperative period, patients asked whether they recalled any blurred vision or difficulty breathing during induction.

All patients evaluated on postoperative days 1, 2 and 4 for myalgias.

Assessment of postoperative myalgias:

Nil: No muscle pain or stiffness.

Mild: Muscle pains or stiffness at one site but not causing any disability or limiting activities.

Moderate: Muscle pains or stiffness at more than one site but not causing any disability or limiting activities.

Severe: Muscle pains or stiffness at one or more sites and causing disability or limiting activities.

The data analysed statistically by Pearson- Chi Square test and ANOVA test.To correlate the incidence of fasciculations with postoperative myalgias, Krauskal-Goodman Gamma analysis was used.

OBSERVATIONS AND RESULTS

Table 1 : Demographic and relevant data

	Group A (n=30)	Group B (n=30)	Group C (n=30)	p value
Age (yrs)	39.20+10.237	40.20+9.897	40.17+11.052	0.915
Sex (M:F)	15:15	16:14	14:16	0.875
Weight(kg)	56.87+6.501	59.07+6.539	57.87+6.595	0.952
Surgical duration(min)	89.17+25.192	97.33+21.162	87.67+22.504	0.222

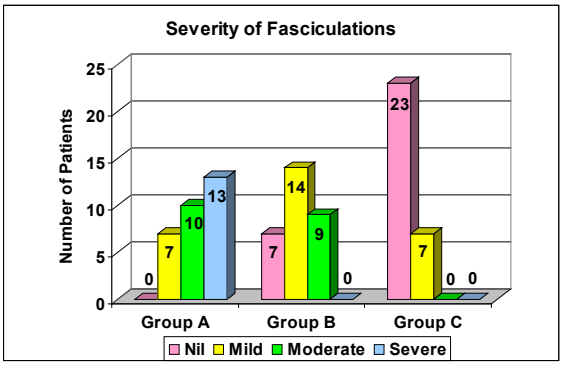
Values are Mean + SD

Table 2 : Preinduction haemodynamic parameters

	Group A (n=30)	Group B (n=30)	Group C (n=30)	p value
PR(/min)	88.30+15.990	87.67+20.315	92.53+19.028	0.545
SBP (mm Hg)	128.63+12.933	131.50+14.061	132.97+17.727	0.528
DBP (mm Hg)	74.30+10.655	79.77+11.631	77.67+14.639	0.234

Values are Mean + S.D.

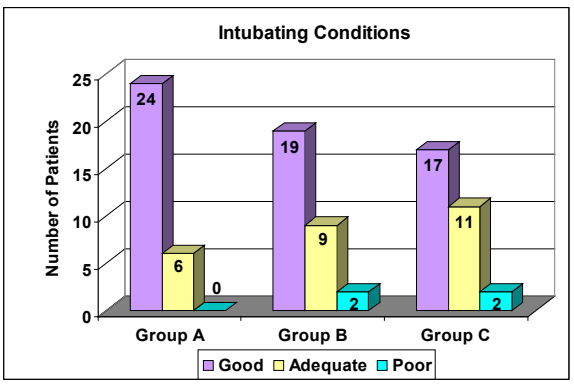
Fig 1 : Incidence and severity of fasciculations



Pearson Chi-Square test : p=0.000 (group C Vs group A).

p=0.000 (group C Vs group B).

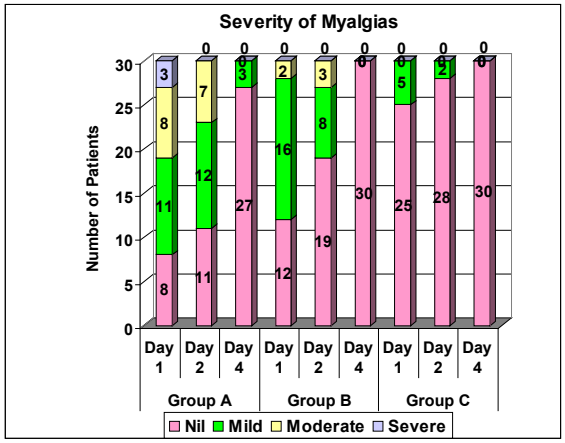
Fig 2 : Intubating conditions



Pearson Chi-Square test : p=0.097 (group C Vs group A).

p=0.856 (group C Vs group B)

Fig 3: Incidence and severity of postoperative myalgias :



Chi-Square test

(Day 1: p= 0.000 group C Vs group A, p=0.002 group C Vs groupB. Day 2: p=0.000 group C Vs group A, p=0.016 group C Vs group B . Day 4: p= 0.076 group C Vs group A, p value NA group C Vs group B.)

Table 3 : Association between fasciculations and postoperative myalgias

			Myalgia				Total
			Nil	Mild	Moderate	Severe	
Fasciculations	Nil	No.	18	11	1	0	30
	Mild	No.	12	9	6	1	28
	Moderate	No.	7	9	2	1	19
	Severe	No.	3	5	4	1	13

Symmetric Measures					
		Value	Asymp. Std. Error(a)	Approx. T(b)	P
Ordinal by Ordinal	Gamma	0.370	0.112	3.102	0.002
No. of Valid Cases		90			
a Not assuming the null hypothesis.					
b Using the asymptotic standard error assuming the null hypothesis.					

There is a positive correlation between the incidence and severity of fasciculations and postoperative myalgias.

DISCUSSION

The occurrence of muscle pains after succinycholine is one of the commonest causes of postoperative discomfort. They are usually first noticed on getting up on the first postoperative morning, are much diminished by the second postoperative day and do not persist beyond the third postoperative day except in very severe cases. They may arise later than this and have been described as late as the fourth postoperative day. The occurrence of the pains was first reported by Bourne et al(2).

The cause is not known but they can follow only 5 mg dose of succinylcholine, an amount enough to produce fasciculations. Therefore, it is not the neuromuscular block but the initial stimulating action of the drug which causes pains. These uncoordinated muscular contractions inflict some temporary damage on the muscle fibres(Paton (14)) .

Bush et al (4) suggested that very low incidence of pain in children is attributable to their rapid circulation, reducing the period of fasciculations.

Various methods have been described to reduce succinylcholine-induced fasciculations and myalgia , but ”precurarisation” remains one of the most successful strategies(11).

We observed that fasciculations are significantly decreased by precurarisation with atracurium and rocuronium to 76.7% and 23.3% respectively. Rocuronium is significantly better than atracurium in reducing the incidence and severity of fasciculations . In Group B and C, no patient had severe fasciculations. In Group C no patient had even moderate fasciculations.

These results are comparable to those obtained by Tsui et al(19) and Martin et al(12).

In a Systematic Review, Subramaniam et al(18) analysed 9 reports. They divided the studies based on the dosage of rocuronium into low dose (< 0.06 mg/kg) and high dose (> 0.06 mg/kg). Both were effective in preventing succinylcholine induced fasciculations. Only high doses of rocuronium were effective in prevention of myalgias after 24 - 48 hours. Intubating conditions were not affected by either doses. Only one study reported significant muscle weakness. Rocuronium pretreatment was found to be more effective than vecuronium and atracurium .

We compared the intubating conditions using Pearson-Chi Square test, which yielded a p value of 0.204 between Group A and B, 0.097 between Group A and C and 0.856 between Group B and C. There was no statistically significant difference in the intubating conditions . The results are comparable to those obtained by Tsui et al(19).

Furthermore as concluded by Booij et al(1) increasing the dose of succinylcholine does not accentuate its adverse effects.

The incidence of myalgias in Group A on postoperative day 1 was 73.3% and on day 2 was 63.3%. The incidence of myalgias following administration of succinylcholine has been variously described as between 85% and 4.5% (15). The values in our study fall well within this range. The incidence of myalgia on postoperative day 4 fell to 10% in Group A.

The incidence of myalgias in Group B on day 1, day 2, and day 4 postoperatively was 60% , 36.7% and 0% respectively whereas the incidence in Group C was 16.7% , 6.7% and 0% respectively. Thus, both atracurium and rocuronium are effective in preventing the postoperative myalgias. This is in accordance with the results obtained by Tsui et al(19). Moreover the statistics also show that rocuronium is better than atracurium in preventing succinylcholine induced myalgias. These results are comparable to those obtained by Tsui et al(19) and Martin et al(12).

Findlay et al(9) have shown that incidence of postoperative myalgias on day 1 was significantly less with rocuronium pretreatment as compared to that without pretreatment ($p<0.01$). Also Subramanium et al(18) concluded that only high doses (> 0.06 mg/kg) of rocuronium were effective in preventing myalgias after 24 – 48 hours, without affecting the intubating conditions.

To find the association between appearance of fasciculations and the incidence of postoperative myalgias, Krauskal-Goodman Gamma Analysis was used and the p value obtained was 0.002 which is statistically significant. Hence there is a correlation between the incidence and severity of fasciculations and postoperative myalgias. This is in accordance with the study conducted by Tsui et al(19). Brodsky et al(3) had however shown that though pretreatment prevents succinycholine induced fasciculations, it does not decrease the incidence of severity of postoperative myalgias. But, they had used pancuronium for pretreatment. Similarly Findlay et al(9) showed that there was no correlation between the strength of fasciculations and myalgias.

A higher dose of succinylcholine (1.5mg/kg) was used in the present study as pretreatment with a nondepolarising relaxant may adversely affect the intubating conditions as recom-

mended by Findlay et al(9) and Raman et al(16).

A dose of 0.6 - 1.2 mg/kg rocuronium will usually produce good intubating conditions within 60-90 seconds.10-15% of a nondepolariser intubating dose is commonly recommended for precurarisation. Hence 0.1mg/kg rocuronium was used in this study, similar to the study conducted by Tsui et al(19). For ease of blinded administration the atracurium pretreatment dose was selected as 0.1mg/kg. The higher dose used in the study (0.1mg/kg rocuronium) as compared to the previously recommended dosage (0.06mg/kg)(5) may have contributed to the rapid precurarisation effect of roucronium. With the use of higher dose of rocuronium, the time needed to perform intravenous induction (30 seconds) and the onset of succinylcholine action (30 seconds) is long enough to begin precurarisation. Rocuronium, because of its rapid onset of action, can provide good intubating conditions within 60 seconds and presumably it may also precurarise in a relatively short interval of 60 seconds.

CONCLUSION

In conclusion, rapid precurarisation technique using rocuronium is effective in reducing the incidence of succinylcholine induced fasciculations and postoperative myalgias, without adversely affecting the intubating conditions.

Rocuronium is more effective than atracurium in reducing the incidence of succinycholine induced fasciculations and postoperative myalgias.

The incidence of postoperative myalgias is positively associated with the incidence and severity of fasciculations.

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