A Comparative Study of the Intubating Conditions and Cardiovascular Effects following Succinylcholine and Rocuronium in Adult Elective Surgical Patients

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Citation

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Abstract

Background: The study was aimed to compare the effect on intubating conditions, onset, clinical duration and cardiovascular effects following administration of Succinylcholine and Rocuronium in Adult Elective Surgical patients.

Materials and Methods: In a prospective randomised controlled trial, seventy five adult ASA grade I or II patients of either sex in the age group of 18-65 years undergoing elective surgery under general anaesthesia were given either succinylcholine 1mg/kg (group S), Rocuronium 0.6mg/kg (group R) or Rocuronium 0.9mg/kg (group R^+) after induction with thiopentone 4-6mg / kg body weight.

Results and conclusion: The study revealed a statistically significant difference in onset time between the three groups: fastest in group S (52.8 ± 15 sec) followed by R^+ (102.6 ± 40.8 sec) and R (163.2 ± 58.2 sec) respectively. Intubating conditions were excellent to good in 92% patients in group S, 88% in group R and 100% in group R^+. Heart rate and mean arterial pressure were increased in all the three groups with persistence in group R+ > R > S.

INTRODUCTION

Maintenance of a patent airway is a basic and essential component of general anaesthesia (GA), regardless of the technique selected. Endotracheal intubation is one of the available means of doing so in common day to day practice. Muscle relaxants are useful in providing adequate relaxation and enable laryngoscopy and intubation.

In spite of its many undesirable effects, suxamethonium is still preferred in certain clinical situations over most other, mostly non-depolarizing neuromuscular blocking agents, to produce muscle relaxation prior to endotracheal intubation. Its rapid onset of profound muscle relaxation and short apnoea time are special attributes in patients with a high gastric volume as it allows a quick securing of the airway without the need to ventilate the patient, if so needed during the apnoeic interval to prevent desaturation.

Rocuronium is a relatively newer non-depolarizing muscle relaxant. It is expected to have an onset time possibly as rapid as that of succinylcholine without its adverse side effects. But, unlike succinylcholine, rocuronium has little or no cardiovascular side effects ($_1$), and does not cause histamine release ($_2$). Thus it is ideal for rapid-sequence induction of anesthesia and may be preferable to succinylcholine in compromised patients in whom cardiovascular effects are to be avoided. Also, rocuronium has an intermediate duration of action (20-35 min) ($_{3,4}$), similar to that of vecuronium and atracurium and does not depend extensively on renal elimination, hepato-biliary mechanisms primarily accounting for elimination.

The present study was designed to compare the endotracheal intubating conditions, onset and duration of clinical relaxation and cardiovascular side effects after administration of rocuronium and succinylcholine in adult

patients undergoing elective surgery.

MATERIAL AND METHODS

This study was conducted in the Department of Anesthesiology and Intensive Care, Sir Sunderlal Hospital, Banaras Hindu University. Prior to commencing the investigation, approval was obtained from both the ethical and hospital research committee.

75 adult patients of either sex aged between 18-65 years, belonging to either of ASA class I or II and scheduled for elective surgery, were included in this prospective randomized study. Exclusion criteria were- Patients with potential airway problems and suspected difficult intubations, (other than Malampatti grade I or II airway anatomy), patients suffering from neuromuscular disease, patients receiving any medication known to interact with neuromuscular blocking drugs, for example- aminoglycoside antibiotics during the last 24 hours .

All patients received 0.25-0.5 mg oral alprazolam premedication in the evening before surgery and at 2 hrs before induction of anaesthesia. Patients were randomly assigned to any one of the following three groups:

Group S : Patients receiving intravenous succinylcholine 1.0 mg/kg. Group R : Patients receiving intravenous rocuronium (Esmeron) 0.6 mg/kg. Group R^+ : Patients receiving intravenous rocuronium 0.9 mg/kg.

GA Technique:

Inj. Tramadol 2 mg/kg was administered IV, as an analgesic agent in all the three groups. No anticholinergic drug was given during the period of observation.

Patients were preoxygenated for 3 minutes. Anesthesia was induced with intravenous Inj. thiopentone sodium 4-6 mg/kg, the endpoint being the loss of the eyelash reflex. The IV line was flushed with the running IV fluid and immediately a bolus dose of the respective muscle relaxant corresponding to the study group concerned, was injected. Cardiovascular data were recorded at regular one-minute intervals for first ten minutes.

Neuromuscular monitoring was done using a peripheral nerve stimulator (Tristim Tm Model NS-3a) and stimulating the ulnar nerve at the wrist via surface electrodes placed along the course of the nerve. Supra maximal square wave impulses of 0.2 mSec duration in a train-of-four sequence (2 Hz) were delivered. Baseline evoked mechanical response of the adductor pollicis muscle was assessed visually/manually and/or recorded via a force displacement transducer and displayed as a tracing. The evoked response to ulnar nerve TOF stimulation every 10 seconds was recorded. Onset time was recorded on complete ablation of first twitch of TOF while intubating condition was assessed clinically first after 60 sec. then every 30 seconds subsequently. The duration of laryngoscopy was restricted to 15 sec at each attempt. Muscle relaxant was repeated on 25 % recovery of T_1 of TOF (clinical duration).

Intubating conditions were assessed clinically according to the criteria proposed by Goldberg and colleagues, based on observations of jaw relaxation, vocal cord relaxation and motor response to intubation. A scale of 4 grades as described below was used:

Excellent: Jaw relaxed, vocal cords apart and immobile and no diaphragmatic movement.
Good: Jaw relaxed vocal cords apart and immobile and some diaphragmatic movement.
Poor: Jaw relaxed, vocal cords moving and bucking.
Inadequate: Jaw not relaxed and laryngoscopy impossible.

Anaesthesia was maintained on nitrous oxide in oxygen (2:1) and halothane. Additional doses of non-depolarizing muscle relaxant when given when recovery of T_1 reached 25%. The repeat of dose in groups was Inj. Rocuronium 0.6 mg/kg

For the purpose of this study, the following observations were recorded.

Assessment of the three facets of intubation (jaw relaxation, cord relaxation, reaction to intubation) and overall grading of intubating conditions.

Response of the adductor pollicis muscles to percutaneous ulnar nerve TOF stimulation at the wrist before injection of muscle relaxant (baseline), regularly after administration of muscle relaxant till complete abolition of first twitch (onset time) and 25% recovery of T_1 (clinical duration).

Cardiovascular data (mean arterial BP, HR, SaO_2, ECG) before induction (baseline), at the time of intubation and at every minute for 10 minutes thereafter.

Occurrence of fasciculations and/or other complications.

Statistical analysis: The observations were analysed statistically and expressed as mean and standard error of the

mean. Various parameters for the three groups were compared using paired "t" test, one way (ANOVA). For testing the association of demographic data chi square test was applied.

$p<0.05$ was considered to be significant. To test the significance between the groups where 'f' value was significant, the multiple range tests (Student Newman Keuls (SNK) test) has been used. Differences were considered significant when $p<0.05$.

OBSERVATIONS AND RESULTS

Mean age, body weight and sex ratio in all the three groups were almost similar with insignificant difference ($p> 0.05$).

Figure 1

Table I: Demographic data

	Group S	Group R	Group R^+	f	P
Age in years	42.80 ± 13.05	41.04±13.08	37.58±9.99	1.17	NS
Weight in kg	52.08 ± 7.55	52.76±9.17	49.80±9.42	0.68	NS
Sex ratio (M:F)	9:16	10:15	9:16	0.11	NS

The clinical duration was highly significant in all the three groups (Table-2) being lowest in group S, higher in group R and highest in group R^+.

Figure 2

Table II: Onset time and clinical duration (Mean SD)

	Group S	Group R	Group R^+	f	P
Onset in sec	52.80Δ±15.68	163.2±58.20	102.6±40.85	43.24	<0.001
Clinical Duration(min)	5.74#±1.58	22.86*±4.91	34.26†±5.62	265.85	<0.001

Δ Significant between group S & R ($P< 0.01$).
\# Highly significant between group S & R.
* Highly significant between group S & R^+
† Highly significant between group R & R^+

The intubating conditions in group S were comparable to group R^+ at 60 sec [92% in group S compared to 100% in group R^+]. The patients in group R had acceptable intubating conditions in 88% of cases, although a large number [52%] had some diaphragmatic movements [good intubating condition] while in 12.0% cases the intubating condition was poor [Table- III].

Figure 3

Table III: Intubating conditions in different groups at 60 seconds

	Group S		Group R		Group R^+	
	No.	%	No.	%	No.	%
Excellent	19	76.0	09	36.0	20	80.0
Good	04	16.0	13	52.0	05	20.0
Poor	02	8.0	03	12.0	00	0.0
Inadequate	00	0.0	00	0.0	00	0.0

Chi square 14.06; db 6; $P<0.01$

The hemodynamic data as observed in the three groups is given in table- IV. The heart rates showed an increasing trend and until remaining above the baseline for above 6 min in all the three groups. Increases in MBP were found to be significant up to 3, 4 and 6 min in group S, R and R^+ respectively. The maximum increases from base line in these were 18.5%, 20.2% and 23.9% in the three respective groups.

No adverse changes in ECG and SaO_2 were observed. Muscle fasciculations were observed after administration of succinylcholine as predicted.

Figure 4

Table IV: Hemodynamic parameters (Mean heart rate & M.A.P SD).

	Mean H.R. ± S.D.			MAP ± S.D.		
	S	R	R^+	S	R	R^+
Baseline	91.12± 12.60	95.8± 16.47	88.28± 18.86	97.36± 7.12	99.92± 7.52	95.64± 9.93
1 min	97.44*± 18.30	108.24***± 18.84	99.20***± 18.09	108.08***± 12.77	107.92**± 15.53	107.68***± 11.16
2 min	103.24**± 19.93	114.20***± 19.46	105.76***± 20.65	115.40***± 18.48	120.12***± 13.35	118.52***± 11.34
3 min	102.12**± 19.37	114.44***± 19.01	105.68***± 19.45	110.44**± 16.64	113.52***± 15.36	111.96***± 14.31
4 min	97.00± 16.70	107.36**± 19.22	100.88**± 18.93	103.50± 14.53	106.6*± 13.58	107.80***± 12.90
5 min	94.12± 14.14	110.64± 16.48	100.68**± 22.19	99.72± 13.35	101.64± 11.19	106.32***± 14.35
6 min	92.20 ± 14.83	104.40 ± 21.55	96.80* ± 17.46	94.44 ± 13.55	102.64 ± 13.14	102.56 ± 11.24
8 min	90.80± 16.48	99.12± 20.69	93.52± 17.12	97.64± 15.00	101.60± 12.63	101.56*± 12.05
10 min	89.28± 14.60	94.12± 17.26	86.68± 13.76	98.12± 12.2	104.16± 10.90	101.84*± 12.92
11 min	89.16± 12.02	25.20± 18.91	87.60± 14.08	100.96± 12.61	103.44± 11.98	102.92**± 14.15

* 2.064 P<0.005, ** 2.797 P<0.01, *** 3.745 P<0.001

DISCUSSION

An ideal muscle relaxant should have non-depolarizing mechanism of action, rapid onset, short duration, rapid recovery, non-cumulative, no histamine release, no

cardiovascular side effects, high potency, and prompt reversibility by cholinesterase inhibitors and pharmacologically inactive metabolites.

All the three study groups were similar with regards to age, sex and weight. There was significant difference in onset time between three groups. Group S showing fastest onset (52.8 ± 15.0 sec) compared to R^+ (102.6 ± 40.8 sec) and R (163.2 ± 58.2 sec). Magonian et al. ([5]) reported an onset time with succinylcholine (50.0 ± 17.0 sec), 89.0 ± 33.0 sec. and 75.0 ± 28.0 sec after 0.6mg/kg and 0.9mg/kg rocuronium respectively. On other hand Latorre et al ([6]) reported an onset time of 48.0 ± 16.0 sec after 1 mg/kg succinylcholine and onset time of 3.0 minutes after 0.6mg/kg rocuronium. However Weirda et al. ([4]) reported an onset time of 172.0 sec after rocuronium 0.6mg/kg.

The duration of action of succinylcholine as reported by Latoree et al. ([6]) was 7.0 ±2.1 while clinical duration observed in our study was 5.74 ± 1.58 min.

A clinical duration of 17.4 ± 3.2 min after 0.06 mg/ kg rocuronium was reported by Booji et al. ([7]) is 17.4, while we found duration of 22.86 ± 4.9 min after 0.6mg/kg rocuronium. Mirakhur et al. ([3]) and Weirda et al. ([4]) reported a clinical duration of 30.0 min and 33.0 min respectively after 0.9mg/kg rocuronium. This duration is close to our observation of 34.26 ± 5.6 min with 0.9 mg/ kg of rocuronium.

Intubating conditions as observed by Mirakhur et al. ([3]), Copper et al. ([8]) Huizinga et al.([9]) and Shukla et. al. ([10]) were good or acceptable in 95% patients at 60 seconds and in all patients at 90 seconds. The average intubating time as reported by Mirakhur et al. ([3]) was 89 seconds. However, in our study we observed excellent to good intubating conditions in 92% in group S, 88% in group R and in 100% in group R^+. Our observations in rocuronium groups are very close to that observed by above authors ([3], [8],[9],[10]).

No significant changes were observed in hemodynamic parameters by Nitschman et al.([1]), Mac Coy et al.([11]) and Shukla et. al. ([10]) with 0.6 mg/kg rocuronium whereas Robertson et al.([12]) reported a 10-15% increase in mean arterial pressure and 5-10% increase in heart rate with 0.9 mg/kg rocuronium. Sparr et al.([13]) found maximum increase in heart rate and mean arterial pressure of approximately 20% and 35% respectively following intubation after rocuronium and this returned to baseline values in 5 minutes.

We observed an increased heart rate, mean arterial pressure at 1 minute after drug administration in all the three groups which persisted up to 3 min in group S, 4.00 min in group R and 5 min in group R^+. This is same as reported by other authors. The rise in heart rate and mean arterial pressure may be as a result of sympathetic stimulation produced due to laryngoscopy and intubation.

Thus from the above study we conclude that rocuronium in 0.9 mg/kg is safer, better and superior alternative to succinylcholine (1 mg/kg) in conditions where the latter is contraindicated or hazardous.

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