A COMPARATIVE STUDY OF PRE-INDUCTION ROCURONIUM WITH POST-INDUCTION SUCCINYLCHOLINE FOR RAPID SEQUENCE INTUBATION IN EMERGENCY SURGERIES

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ABSTRACT

BACKGROUND

Rapid Sequence Intubation (RSI) is the demand for emergency surgeries. Many investigators leveled Succinylcholine as the gold standard for the RSI intubation. But in most of those studies, both Succinylcholine and Rocuronium were used post-induction and the dose of Rocuronium varied. Hence, the present study is designed to compare the intubating condition achieved by pre-induction Rocuronium 1 mg/ kg body weight vs. post-induction Succinylcholine 1.5 mg/kg body weight and to determine whether Rocuronium can be the suitable alternative to Succinylcholine in RSI intubation.

MATERIALS AND METHODS

The study was designed,

1. To compare the intubating condition achieved by Rocuronium and Succinylcholine during rapid sequence intubation for emergency surgeries.
2. To find out whether Rocuronium can be the suitable alternative to Succinylcholine.

144 consenting patients of ASA-I and ASA-II of either sex and age group of 18 - 45 yrs. were taken up for the study.

RESULTS

There was no significant difference in intubation conditions achieved by either drug. Induction to vocal cord paralysis time was little shorter with succinylcholine than Rocuronium, but statistically insignificant. However, paralysis caused by Rocuronium lasted for longer extent of time (35 - 52 mins.), whereas paralysis of Succinylcholine recovered spontaneously after 5 - 10 mins.

CONCLUSION

Rocuronium may be recommended as an alternative to Succinylcholine if used pre-induction with 1 mg/kg BW for RSI intubation and advantageous for emergency surgeries of approximate one-hour duration or more.

KEYWORDS

Rocuronium, Succinylcholine, Rapid Sequence Intubation, Emergency Surgeries.

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BACKGROUND

Rapid Sequence Intubation (RSI) is the demand for emergency surgeries, where there is no time to ensure pre-induction fasting and to overcome full stomach condition. Efforts are still continuing to find out the best Neuromuscular Blocking Agent in this regard. Succinylcholine and Rocuronium Bromide are the two available options. Use of Succinylcholine for rapid sequence intubation has been the gold standard because of its quick onset, good intubating condition and break down by plasma cholinesterase. It does not require any reversal agent. But it causes hyperkalaemia, post-paralysis myalgia, increase in ICP and IOP, rarely malignant hyperthermia, etc. Moreover, it is contraindicated

in 48 hours post burn and crush injury, denervation syndrome, hyperkalaemia, open eye injury, raised ICP etc.^{[1],[2],[3],[4]}

William K. Mallon et al studied 520 patients undergoing Rapid sequence intubation either with Succinylcholine or Rocuronium and concluded that Succinylcholine remained the drug of choice for Rapid sequence intubation unless contraindicated.^[5] Jeffrey Joseph Perry et al studied 468 numbers of patients undergoing Rapid sequence intubation and compared intubating condition using Rocuronium in dosage equivalent to those using Succinylcholine and found that Succinylcholine created excellent intubating conditions more reliably than Rocuronium in the emergency department.^[6] M. Madhusudan et al also opined that Suxamethonium still continues to be the "gold standard" for providing ideal tracheal intubation conditions.^[7]

Rocuronium Bromide has been under trial as an alternative to Succinylcholine for Rapid sequence intubation. Freidrick K. Puhringes et al investigated 30 patients undergoing outpatient surgery for tracheal intubating conditions with Rocuronium and Succinylcholine and concluded that Rocuronium could be a suitable alternative to Succinylcholine for Rapid sequence intubation in outpatient anaesthesia.^[8] Recently, the drug Sugammadex has been

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found capable of safely reversing profound rocuronium-induced neuromuscular blockade.^{[9],[10]}

Dr. Singh Ajeet et al in a prospective randomised double blind study compared 0.6 mg/kg - 1 rocuronium (Group-A) with 1.5 mg/kg-1 suxamethonium (Group-B) for tracheal intubating conditions and found that the onset time and duration of action were more with rocuronium, but the results showed no significant difference in the intubating conditions achieved in both the groups.^[11]

In most of the studies Succinylcholine was used with the dose of 1.5 mg/kg body weight for Rapid sequence intubation, whereas Rocuronium was used in less than 1 mg/kg body weight dosage. While for Rapid sequence intubation Succinylcholine was given in higher doses, the doses of Rocuronium probably were little lower than the RSI range. Hence, the present study with the title "a comparative study of Rocuronium with Succinylcholine for rapid sequence intubation of emergency surgeries" is designed to compare the intubating conditions using Succinylcholine and Rocuronium in dosage of 1.5 mg/kg body weight and 1 mg/kg body weight respectively.

MATERIALS AND METHODS

The study was designed,

1. To compare the intubating condition achieved by Rocuronium and Succinylcholine during rapid sequence intubation for emergency surgeries.
2. To find out whether Rocuronium can be the suitable alternative to Succinylcholine.

After approval by Institutional Ethical Committee, 144 consenting patients of ASA-I and ASA-II of either sex and age group of 18 - 45 yrs. were taken up for the study.

Duration of Study

Oct. 2014 to Sept. 2015.

Study Design

A randomised controlled trial.

Study Setup

Department of Anaesthesiology, Agartala Govt. Medical College and GBP Hospital.

Study Population

144 consenting patients of ASA-I and ASA-II category within 18 - 45 yrs. of either sex divided into two groups of 72 each, undergoing Rapid Sequence Intubation for emergency surgeries.

Sample Size

Considering 80% patients achieving excellent intubating condition with Succinylcholine and fixing 80% power for the study to be able to detect a minimum difference of 18% with administration of Rocuronium for intubation at 5% level of significance, the minimum sample size requirement for the study was determined to be 72 subjects in each group using the formula for determining sample size in comparative studies using proportions based on the power of study - Anaesth Analg.^[8]

Randomisation

Study subjects were allocated to control (Succinylcholine) group and study (Rocuronium) group by Block Randomisation Technique consisting block size of 2.

Inclusion Criteria

1. ASA I and ASA II.
2. Age group 18 - 45 yrs.
3. Sex - either sex.

Exclusion Criteria

Following patients were excluded from the study.

1. Patients with hypertension.
2. Unconscious patients.
3. Patients known or suspected to have hyperkalaemia, signs of raised ICP, chronic muscular disease, crush injury, non-acute burns.

Outcome Variables

Primary Outcome Variables

Three 10 points numerical descriptor scale are in use to describe -

1. Patient's body movements during intubation.
2. Vocal cord movement during intubation.
3. Anaesthesiologist's overall satisfaction with the extent of paralysis on intubation.

(Three numerical descriptor's scale were in use to determine the degree of paralysis obtained by the drugs - Rocuronium and Succinylcholine).

Severe Movement

No Movement

A scale of zero corresponds to severe movement and score of ten corresponds to no movement.

Secondary Outcome Variables

- Time from drug administration to vocal cord paralysis.
- Time from drug administration to clinical recovery.
- Any complication during intubation.
- Clinical recovery was assessed on the basis of Steward Score for clinical recovery.

Wakefulness	Ventilation	Movement	Point
Not responding	Airway requires maintenance	Not moving	0
Responds to stimuli	Maintaining good airway	Non-purposeful movements	1
Fully awake	Coughing on command	Moves purposefully	2

Parameters Studied

Demographic Profiles

- Age in years.
- Sex (male/female).
- Body weight (kg).

Clinical Parameters

- Patient's body movements during intubation.
- Vocal cord movement during intubation.
- Anaesthesiologists' overall satisfaction with the extent of paralysis on intubation.
- Time from drug administration to vocal cord paralysis.
- Time from drug administration to clinical recovery.
- Any complication during intubation.

- Clinical recovery was assessed on the basis of Steward Score for clinical recovery.

Statistical Plan

Data entry and analysis were performed in computer using SPSS-15 software version. Data were presented with the help of suitable tables and charts. Chi-square test and student 't' test were performed for testing statistical significance. P value of ≤ 0.05 was considered as significant.

Study Methodology

All patients were premeditated uniformly with Inj. Glycopyrrolate 0.2 mg IV, Inj. Ondansetron 4 mg IV and Inj. Pantoprazole 40 mg IV before induction of anaesthesia. Anaesthesia was administered with Inj. Propofol sleep dose and maintained by controlled ventilation with N₂O and O₂ and sevoflurane.

Injection Succinylcholine was used as paralytic agent in control group at 1.5 mg/kg body weight immediately after induction. Inj. Rocuronium was used as paralytic agent in study group at 1 mg/kg body weight just before induction. Before injecting either drug possibility of bag and mask ventilation was ensured. Both drugs were injected using the peripheral vessel line connected to the infusion of Ringer's lactate.

For all the patients, after performing all the necessary proceedings a questionnaire including the patient's demographic information and medical history were filled up and all the received information during and after the anaesthesia were recorded.

Patients were randomised to control (Succinylcholine) group and study (Rocuronium) group by Block Randomisation Technique consisting block size of 2. The dose of sevoflurane in both groups were same (0.4%). Intubation was performed under direct laryngoscopic view.

Patient's body movements and vocal cord movement during intubation and the anaesthesiologist's overall satisfaction with the extent of paralysis on intubation were recorded.

Time from drug administration to paralysis from drug administration to clinical recovery, any complication during intubation were recorded. Clinical recovery was assessed on the basis of Steward Score for clinical recovery after giving reversal.

RESULTS

Demographically both the groups (Study and Control) were identical. There was no significant difference between the groups in respect of age, body weight and sex, which may be seen in Table - I and II.

There was no significant difference in intubating conditions achieved by rocuronium with that of Succinylcholine, which is depicted in Table III.

Both the drugs - Succinylcholine and Rocuronium provided excellent intubating condition. There was no significant difference of intubating condition clinically.

Induction to complete paralysis time was little shorter with Succinylcholine than Rocuronium, but statistically insignificant. However, paralysis caused by Rocuronium lasted for longer extent of time (35 - 52 mins.), whereas paralysis of Succinylcholine recovered spontaneously after 5 - 10 mins. Time from drug administration to clinical recovery

was longer in study group than control group and the difference was statistically significant. However, there was no difference in Steward Score for clinical recovery both before and after clinical recovery among the groups described in Table IV.

There was around 15% - 20% increase in Mean Arterial Pressure (MAP) only in Group 'C' during intubation, but MAP came down to baseline shortly after intubation. No other adverse effect could be observed in either group.

Demographic Profile	Group 'S'	Group 'C'	't'	P value
Age in years	34 (SD - 3.6)	35 (SD - 5.5)	1.291	0.198
Body weight (Kg)	52.8 (SD - 4.2)	53.5 (SD - 3.5)	1.086	0.279

Table I. Age and Body Weights of the Study Subjects

*Group S = Study Group, Group C = Control Group

Demographic Profile	Group 'S'	Group 'C'	Chi-Square	P Value
Sex (Male)	51.39%	48.61%	0.028	0.8676

Table II. Sex Distribution of the Study Subjects

Parameters	Group 'S'	Group 'C'	't' & 'df'	P Value
Patients body movements during intubation	9.8 (SD-3.6)	10 (SD-5.5)	t = 0.258 df = 142	0.796
Vocal cord movement during intubation	9.8 (SD-4.2)	9.8 (SD-3.5)	t = 0.000 df = 142	1.000
Anaesthesiologist's overall satisfaction with the extent of paralysis on intubation	9 (SD-4.1)	10 (SD-3.4)	t = 1.552 df = 142	0.123

Table III. Parameters during Intubation of the Study Subjects

Parameters	Group 'S'	Group 'C'	't' and 'df'	P Value
Time from induction to paralysis	43.71 (SD - 5.32) sec	42.51 (SD - 2.56) sec	t = 1.725, df = 142	0.086
Time from drug administration to clinical recovery (assessed on the basis of Steward Score for clinical recovery)	53.22±3.41 min	8.66±1.87 min	t = 97.222, df = 142	0.000
Any complication during intubation	NIL	15% - 20% rise in MAP		

Table IV. Time Distributions of Induction to Paralysis, Drug Administration to Clinical Recovery and Complications of the Study Subjects

DISCUSSION AND CONCLUSION

Rocuronium is a non-depolarising muscle relaxant of low potency. So, adequate standard dose of Rocuronium needs to be used to achieve desired intubating conditions. Its onset of action is fast and comparable to that of Succinylcholine if used with adequate dose. Succinylcholine 1 mg/kg

corresponds to 3 times of its ED95, while Rocuronium 0.6 mg/kg dose corresponds to only 2 times of its ED95.

Perry JJ et al compared Rocuronium with Succinylcholine for RSI in a randomised control trial and found that Succinylcholine created superior intubation conditions to Rocuronium when comparing both excellent and clinically acceptable intubating conditions.^[12]

Laurin EG et al conducted a one year prospective cohort comparison study to compare Rocuronium and Succinylcholine for RSI in the Emergency Department and concluded that both Succinylcholine and Rocuronium produced fast and reliable paralysis for RSI. Although, Succinylcholine had a faster onset and provided more relaxation, the difference had no clinical significance.^[13]

Sluga, Mathias MD et al investigated whether in emergent cases endotracheal intubation conditions obtained at the actual moment of intubation under succinylcholine differ from those obtained 60s after the injection of rocuronium on one-hundred-eighty adult patients requiring rapid sequence induction of anaesthesia for emergent surgery and concluded that succinylcholine (1 mg/kg) allows for a more rapid endotracheal intubation sequence and creates superior intubation conditions compared with rocuronium (0.6 mg/kg).^[14]

In most of the previous studies Succinylcholine was used with standard intubating dose (1 - 1.5 mg/kg body weight), whereas Rocuronium was used with lower intubating doses (0.6 - 0.8 mg/kg body weight) probably to limit the duration of Rocuronium. Emergency surgeries of around one hour duration can easily be performed with adequate intubating dose of Rocuronium, whereas intubation with Succinylcholine needs to be supplemented with NDMRs.

McCourt KC, Salmela L, Mirakhur RK, Carroll M, Mäkinen MT, Kansanaho M, Kerr C, Roest GJ and Olkkola KT studied to compare the tracheal intubating conditions during a rapid sequence induction of anaesthesia using Rocuronium 0.6 (n = 61) or 1.0 mg.kg-1 (n = 130) or suxamethonium 1.0 mg.kg-1 (n = 127) as the neuromuscular blocking drugs and concluded that Rocuronium 1.0 mg.kg-1 can be used as an alternative to Suxamethonium 1.0 mg.kg-1 as part of a rapid sequence induction provided there is no anticipated difficulty in intubation. The clinical duration of this dose of rocuronium is, however, 50-60 mins.^[15]

Most of the major emergency surgical procedures require around one hour duration or more. While using Rocuronium for RSI with adequate dose, the same dose may be sufficient enough for total length of surgical relaxation, whereas if Succinylcholine is chosen for RSI maintenance of relaxation needs administration of further muscle relaxant. So, Rocuronium has definite advantage over Succinylcholine for major emergency surgeries.

Regarding cost effectiveness, Succinylcholine is cheaper than Rocuronium. However, cost of individual dose of either drugs makes little difference.

The significant difference in respect of the time of clinical recovery following drug administration favours Succinylcholine over Rocuronium for RSI as claimed by other researchers, but needs administration of further muscle relaxant.

In the present study, all the emergency surgeries could not be included. Further study with larger sample size preferably involving all age groups may be of worth. Induction to paralysis time, though found little shorter with Succinylcholine, higher doses of Rocuronium (1.2 mg/kg body weight) can be tried to achieve similar paralysis time for Rocuronium with that of Succinylcholine.

Rocuronium may be recommended as an alternative to Succinylcholine if used pre-induction with 1 mg/kg body weight for RSI intubation and advantageous for emergency surgeries of approximate one-hour duration or more.

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