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COMPARISION OF ONSET OF ACTION, DURATION AND INTUBATING CONDITIONS OF ROCURONIUM BROMIDE AND SUCCINYLCHOLINE IN ADULT PATIENTS.

Medical Science

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ABSTRACT

Background: The major uses of muscle relaxation for surgery are: to facilitate endotracheal intubation and to provide surgical relaxation. Succinylcholine, with its rapid onset time, excellent intubating conditions, and short duration of action is a favourite of many anaesthesiologists for rapid endotracheal intubation. However, it falls short of the status of the ideal muscle relaxant - due to its life-threatening side effects such as hyperkalaemia, cardiac arrest and malignant hyperthermia. Rocuronium may serve as a useful alternative for many clinicians to facilitate endotracheal intubation, not only in elective cases under adequate anaesthesia, but also in emergency situations requiring rapid sequence intubation. The side effect profile of Rocuronium is way more limited, and way more acceptable to that of succinylcholine. While there have been many studies on the dosage of Rocuronium greater than /equal to 1mg/kg, which have demonstrated comparable onset and intubating conditions to succinylcholine, this study involves a lower dose(0.9mg/kg) elective surgery cases, where a minor difference in the time of onset is of no significant concern. **Objective:** To compare onset of action, duration and intubating conditions of Rocuronium Bromide (0.9mg/kg) and Succinylcholine (1.5mg/kg) in adult ASA I and II patients posted for elective surgery. **Method:** this was a randomized, double-blind, prospective, clinical study conducted on 100 ASA I and II patients posted for elective surgery. Patients were divided into two groups using 'slips in the box technique':
Group A – received Rocuronium bromide 0.9 mg/kg
Group B – received Succinylcholine 1.5mg/kg
Results:
- The intubating conditions using Goldberg's score were acceptable in both groups= excellent or good conditions.
- But the Succinylcholine group had more instances of excellent intubating conditions, and this difference was statistically significant. $p<0.05$
- The Mean arterial pressure increased after laryngoscopy in both groups, but its difference between the two groups was not statistically significant at any time interval. $p>0.05$
- In the Rocuronium group, 6 patients had significant tachycardia. HR>120, and 5 patients had hypotension (MAP<60mm Hg)
- In the Succinylcholine group, 7 patients had significant tachycardia. HR>120, and 6 patients had hypotension (MAP<60mm Hg).

Conclusion: this study reveals that Rocuronium, at a dose of 0.9mg/kg, is an effective substitute for Succinylcholine as the choice of muscle relaxant, and offers similar intubating conditions, at 1 minute. Considering the lower side effect profile, Rocuronium at the dose of 0.9 mg/kg can be the ideal choice for muscle relaxant during elective surgery.

KEYWORDS

INTRODUCTION

The major uses of muscle relaxation for surgery are:
1. To facilitate endotracheal intubation.
2. To provide muscle relaxation for the surgery

The use of a neuromuscular blocker improves the overall intubating conditions, and increases the first-attempt success rate of intubation.

Succinylcholine has a rapid onset time, offers excellent intubating conditions, and short duration of action, and has been the choice of relaxant for intubation since a long time.

But it is falling out of favour due to its extensive side effect profile which includes hyperkalaemia, cardiac arrest, malignant hyperthermia, post operative myalgia.

Rocuronium bromide, an amino-steroidal compound, is a derivative of vecuronium. It has a rapid onset and intermediate duration of action. It doesn't cause any significant histamine release. There are very few contraindications to the use of Rocuronium (mainly, hypersensitivity). Onset time for a 0.9 mg/kg dose of Rocuronium ranges from 1 to 1.5 minutes.

The availability of a fast-acting reversal agent, Sugammadex, makes Rocuronium a real contender for the choice of muscle relaxant at induction. Sugammadex at a dose of 2mg/kg can reverse a 1.2mg/kg induction dose of rocuronium in 2 minutes (time to recovery, train of four=0.9).

The side effect profile of Rocuronium has been found to be way more limited, and way more acceptable to those of succinylcholine. The aim of this study is to assess the efficacy of Rocuronium in comparison with Succinylcholine for endotracheal intubating conditions, following induction with Propofol as a sole induction agent, in elective surgery cases, in an otherwise healthy adult population.

While there have been many studies on the dosage of Rocuronium greater than /equal to 1mg/kg, which have demonstrated comparable onset and intubating conditions to succinylcholine, this study involves a lower dose(0.9mg/kg) elective surgery cases, where a minor difference in the time of onset is of no significant concern.

METHOD

After approval from the institutional ethical committee, a written informed consent was obtained from all patients and a double blind randomised prospective clinical study was carried out at Saraswathi Institute of Medical Sciences, Anwarpur, Hapur (Uttar Pradesh)

Study Duration: November 2020 to October 2022

Sample size: 100 ASA I and II adult patients posted for elective surgery at our institution.

Study Design: Randomized, double-blind, prospective, clinical study
Patients were divided into two groups using 'slips in the box technique':
Group A – received Rocuronium bromide 0.9 mg/kg
Group B – received Succinylcholine chloride 1.5mg/kg

Inclusion Criteria:
- Patients admitted in the hospital undergoing elective surgery under general anaesthesia.
- Age 18- 60 years
- Weight= 35-80 Kgs
- American Society of Anaesthesiologists (ASA) physical status I & II

- All genders

Exclusion criteria:

- Patient refusal for procedure.
- Patient with heart rate < 60 beats per minute pre operatively.
- Patient with systolic blood pressure < 100 mm of Hg pre operatively.
- Patient with physical status ASA III & IV.
- Patient with burns or other known contraindications to the drugs under study.
- Central or peripheral neuropathies.
- History of significant cardiovascular, renal, hepatic, neurological, psychiatric or neuromuscular disorders
- An intravenous line was established for intravenous access. All the patients were premedicated with inj. Glycopyrrolate 4 µg/kg IV, inj. Ranitidine 1 mg/kg IV, inj. Ondansetron 80 µg/kg slow IV and inj. Fentanyl 2 mcg/kg IV. Then pulse, blood pressure, SpO2 were noted as pre-induction data.
- All the patients were pre-oxygenated with 100% O2 via face mask for 3 minutes. In group A, anaesthesia was induced with inj. Propofol 2mg/kg IV, followed by inj. Rocuronium bromide 0.9mg/kg IV. In group B, anaesthesia was induced with inj. Propofol 2mg/kg IV, followed by inj. Succinylcholine 1.5 mg/kg IV.
- In both the groups, jaw relaxation and vocal cord relaxation was considered for direct laryngoscopy at 60 seconds. Immediately after intubation (time=0minute) and at 2, 5, 10 minutes, and then every 10 minutes, the pulse, blood pressure (Mean arterial pressure) and SpO2 were recorded.
- Bradycardia was defined as a decrease in heart rate by more than 20% of thew baseline, or below 50 beats/min.
- Significant tachycardia was taken as a heart rate greater than 120 beats per minute.
- Hypotension was taken as a fall in mean arterial pressure (MAP) below 60mm of Hg.
- Intubating conditions were assessed using the criteria of Goldberg scale.

The three criteria of this score were as follows:

A. Ease of laryngoscopy/intubation (evaluated together with jaw relaxation),
B. Vocal cords movement
C. Response of the diaphragm/patient to tracheal intubations.

It is a four-point scale. The appropriate values were selected and added up to form a numeric score, of a maximum of 12.

Table 1.

Score	Ease of laryngoscopy/ Jaw relaxation	Vocal cords	Response to intubation
1	Good	Fully open	None
2	Fair	Open	Slight diaphragmatic movement
3	Difficult	Moving	Moderate coughing
4	Poor	Closed	Severe coughing or bucking

A score of
3 rated as excellent; 4-6 rated as good;
7-9 rated as poor and
0- rated as inadequate or impossible intubating conditions.

Good and excellent intubating conditions were taken to be clinically acceptable in this study.

Anaesthesia was maintained using a closed circuit with circle absorber having 50% N2O (nitrous oxide) and 50% O2 (oxygen) with controlled ventilation. The time of appearance of the curare cleft was noted, and was considered as the time of recovery from the intubating dose of the muscle relaxant.

After clinical recovery from intubating dose of muscle relaxant, anaesthesia was continued using O2, N2O, isoflurane and further doses of muscle relaxants. After completion of the surgery, reversal of neuromuscular blockade was achieved with inj. Neostigmine 0.05 mg/kg and inj. Glycopyrrolate 0.008 mg/kg IV. After satisfactory recovery, the patients were extubated. The data was entered in Microsoft Excel data sheet and imported to IBM SPSS version 25.0 and inter group analysis was done. For the qualitative variable like age, sex and adverse effects, frequency and percentage were shown. Comparison of this data was done using the Chi Square test.

For the quantitative variables like time to onset of neuromuscular paralysis, hemodynamic changes; mean ± standard deviation (S.D.) were shown. After checking the assumption for normality, comparison of the data was done using the F test.

Graphical presentation was done using the simple and multiple bar charts. The probability value $p < 0.05$ was considered statistically significant.

OBSERVATION AND RESULTS:

Table 2. Patient distribution

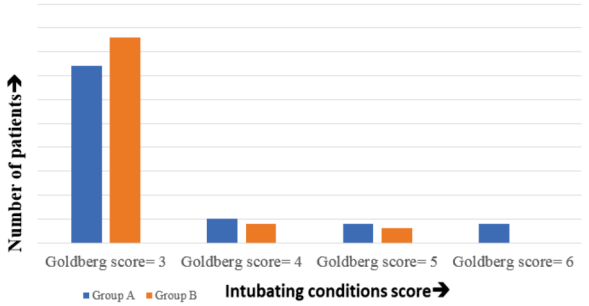
GROUPS	NO. OF PATIENTS	DRUG USED
A	50	Rocuronium bromide
B	50	Suxamethonium chloride

The mean age in group A was 34.58 + 10.89 years, while the mean age for group B was 35.48 +11.36 years. The difference between the two groups regarding age was not statistically significant.

The sex distribution in Group A and Group B was similar, and the difference was not statistically significant.

Table 3. Intubating conditions score

	Group A	Group B	P value
Goldberg score= 3	37	43	0.046
Goldberg score= 4	5	4	>0.05
Goldberg score= 5	4	3	>0.05
Goldberg score= 6	4	0	>0.05



While all subjects in the study had acceptable intubating conditions, more patients intubated after administration of succinylcholine had better intubating conditions at 1 minute of administration. p value= 0.046.

This difference was statistically significant. The mean time of onset of jaw relaxation in Group A was 56.8 ±2.01 seconds vs 40.04 ± 4.20 seconds in Group B. The difference between the mean times of onset between the groups was statistically significant. p value <0.01

The time of appearance of curare cleft was 53.18 + 6.6 minutes in group A vs 12.16 + 2.03 minutes in group B. This difference between the groups was statistically significant. p value<0.01

The difference between heart rates in Group A vs group B was statistically insignificant for all time intervals. An initial elevation in heart rate was noted in all subjects, post laryngoscopy.

Both groups initially had a significant rise in Mean arterial pressure, just after laryngoscopy.

The difference between Mean arterial pressures (MAP) in Group A vs group B was not statistically significant for any time interval.

The difference between SpO_2 in Group A vs group B was statistically insignificant for all time intervals.

DISCUSSION

Tracheal intubation during anesthesia can be facilitated by the administration of neuromuscular blocking agents like Succinylcholine or Rocuronium.

Owing to its adverse effects, Succinylcholine is slowly falling out of favour of anaesthetists everywhere.

Rocuronium, serves as an effective substitute for the choice of muscle relaxant to facilitate endotracheal intubation, owing to its lower side effect profile and rapid onset at a dose of 0.9mg/kg or higher.

Rocuronium does have a longer duration of action, but it can be reversed easily with Sugammadex.

Intubating conditions:

Acceptable intubating conditions were also seen in the double-blind study by Weiss JH, Gratz I, Goldberg ME et al comparing two doses of rocuronium and succinylcholine for rapid-sequence intubation, where it was found that Rocuronium bromide at a dose of 0.9 mg/kg provided intubating conditions similar to succinylcholine 1.5 mg/kg at 1 minute. This study's findings correlate well with the study done by Patil BO, Sonavdekar SR, Mathur R, et al, who observed that Succinylcholine was an ideal agent for intubation in all surgical procedures. Intubating conditions of Rocuronium bromide at a dose of 0.9mg/kg was comparable to Succinylcholine 1.5mg/kg at 1 minute.

Rao M H, Venkatraman A, Malleswari R also observed that Rocuronium produced comparable intubating conditions to that of succinylcholine, but did not have the short duration of action of the latter. Thus, it was deemed more suitable for cases where a rapid reversal would not be required. These results were similar to the findings in the current study, which has used Rocuronium for elective surgery cases.

Lam AM, Pavlin EG, Visco E, Taraday J. compared Rocuronium versus succinylcholine-atracurium for tracheal intubation and maintenance relaxation during propofol anaesthesia. They compared 30 ASA physical status I and II adult patients scheduled for elective surgeries with general anaesthesia. Intubation was successful in all patients and there was no difference in scores between the two groups. Although onset time was shorter with succinylcholine than with rocuronium, neuromuscular blockade was successfully antagonized in both groups, and the recovery profile was not different between the two groups. They concluded that Rocuronium bromide at a dose of 0.6 mg/kg, when used with propofol and fentanyl for induction, provides intubating conditions similar to succinylcholine 1.0 mg/kg at 1 minute. The actual onset time and offset time, however, are significantly longer with rocuronium. There was no difference between atracurium and rocuronium as a maintenance drug. Rocuronium is suitable for surgical procedures greater than 30 minutes, eliminating the need for an additional relaxant to succinylcholine.

Thangluai T, Singh N Ratan et al evaluated Succinylcholine 1.5 mg/ kg IV, rocuronium bromide 0.6 mg/ kg, and vecuronium bromide 0.08 mg/ kg in 90 adult patients of ASA I & II undergoing major elective surgery at RIMS hospital. They found that both succinylcholine and rocuronium produced excellent intubating conditions in the majority of the patients. The succinylcholine group had a slightly higher chance of creating excellent intubating conditions, but the difference was not statistically significant. These findings are similar to the ones in the present study.

Onset of action

Our onset times are similar to those observed by Magorian T, Flannery KB, Miller RD. They concluded that the onset times for the two larger doses of rocuronium were similar to that for succinylcholine, but clinical duration of action with rocuronium was significantly longer. The brief onset time achieved with rocuronium indicates that administration of 0.9-1.2 mg/kg is an acceptable alternative to succinylcholine for rapid-sequence induction of anaesthesia.

The study by Huizinga AC, Vandenbrom RH, Wierda JM, Hommes FD, Hennis PJ. comparing Intubating conditions and onset of neuromuscular block of rocuronium, found excellent intubating conditions at 60seconds, at a dose of 0.6mg/kg.

Han TH, Martyn JA. Found that onset time was close to 30 seconds with a dose of 1.5mg/kg of Rocuronium. This is faster than the onset time in our study, which could be explained by the reduced dose used therein.

Duration of action

In the study done by Baykara N, Woelfel S, Fine GF et al, the time to recovery from neuromuscular blockade after administration of Rocuronium ranged from 27 to 62 minutes in children and from 37 to 94 minutes in adults. This correlates well with the time to recovery obtained in our study 46.52± 10.43 minutes.

H. B. Ammundsen, M. K. Sørensen, M. R. Gätke, in their publication in *British Journal of Anaesthesia*, conclude that the duration of action of succinylcholine 1mg/kg is 4-8 minutes in patients with normal Butyrylcholinesterase activity.

Benumof *et al.* calculated that preoxygenated healthy adult patients can withstand an 8-min period of apnea until desaturation to 90% occurs, but the average duration to 90% twitch height recovery after succinylcholine, 1 mg/kg, is greater (10 min)

Present study uses a higher dose of succinylcholine, which explains the longer duration of action.

No statistically significant haemodynamic changes or adverse effects were noted in this study.

Limitations of the study

- The use of Propofol, and the duration of the procedure (intubation), likely had a greater effect on the haemodynamic parameters than either of the drug under study.
- Paediatric patients, patients older than 60 years, and obese patients were not included, which limits the applicability of the results of this study.
- A larger sample size will establish further conclusive evidence.

Conflict of interest

There was no conflict of interest.

CONCLUSION

In conclusion, this study reveals that Rocuronium, at a dose of 0.9mg/kg, is an effective substitute for Succinylcholine as the choice of muscle relaxant, and offers similar intubating conditions, at 1 minute. Considering the lower side effect profile, Rocuronium at the dose of 0.9 mg/kg can be the ideal choice for muscle relaxant during elective surgery.

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