Section: Anesthesiology

Original Research Article

COMPARATIVE STUDY OF INTUBATING CONDITIONS AND CARDIOVASCULAR RESPONSES FOLLOWING SUCCINYLCHOLINE AND ROCURONIUM IN ADULT PATIENTS UNDERGOING GENERAL ANAESTHESIA

Basanta Khumanthem[1], Nameirakpam Charan[2], Laishram Dhanachandra Singh[3], Vandana Sorokhaibam[1], Jayshree Longjam[4], H Thotnimla[4], Ayekpam Panthoisana Chanu[1], Thiyam James Bond[1], Abdul Matin Bin Muzib[1]

[1]PGT, Department of Anesthesiology, JNIMS, Porompat, Imphal, India.
[2]Associate Professor, Department of Anesthesiology, JNIMS, Porompat, Imphal, India.
[3]Assistant Professor, Department of Anesthesiology, JNIMS, Porompat, Imphal, India.
[4]Senior Resident, Department of Anesthesiology, JNIMS, Porompat, Imphal, India.

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Corresponding Author:
Dr. Basanta Khumanthem,
PGT, Department of Anesthesiology, JNIMS, Porompat, Imphal, India.
Email: basantakh3@gmail.com

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ABSTRACT

Background: Succinylcholine has traditionally been used to facilitate rapid tracheal intubation because of its rapid onset and short duration of action. However, its adverse effects and contraindications have increased interest in rocuronium as an alternative neuromuscular blocking agent. This study compared the intubating conditions, onset and duration of action, and cardiovascular effects of rocuronium bromide and succinylcholine in adult patients undergoing elective surgery under general anaesthesia.

Materials and Methods: This prospective, randomized, double-blinded comparative study was conducted in 76 adult patients of American Society of Anesthesiologists (ASA) physical status I and II undergoing elective surgery under general anaesthesia. Patients were randomly allocated into two groups of 38 each. Group A received rocuronium bromide 0.9 mg/kg intravenously and Group B received succinylcholine 1.5 mg/kg intravenously. Intubating conditions were assessed using the Cooper intubation scoring system. Heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure and peripheral oxygen saturation were recorded at baseline, before induction, and at 1, 5, 10, 20, 30 and 40 minutes after intubation.

Results: The mean onset time was significantly longer with rocuronium than with succinylcholine (67.61 ± 5.04 seconds vs 62.47 ± 2.84 seconds; $p < 0.001$). The duration of action was significantly longer with rocuronium (67.17 ± 24.24 minutes) than with succinylcholine (6.17 ± 0.82 minutes; $p < 0.001$). Intubating conditions were comparable between the two groups ($p = 0.133$). Heart rate remained comparable throughout the observation period. Systolic blood pressure differed significantly only at 40 minutes, while diastolic blood pressure and mean arterial pressure showed significant differences at 5 and 40 minutes. Peripheral oxygen saturation remained comparable between groups.

Conclusion: Rocuronium bromide 0.9 mg/kg and succinylcholine 1.5 mg/kg provided comparable intubating conditions in adult patients undergoing elective surgery. Succinylcholine had a slightly faster onset, whereas rocuronium had a substantially longer duration of action. Overall, cardiovascular parameters remained comparable at most observation points.

Keywords: General anaesthesia, Haemodynamic response, Intubating conditions, Neuromuscular blockade, Rocuronium, Succinylcholine, Tracheal intubation.

INTRODUCTION

Neuromuscular blocking agents play an important role in facilitating tracheal intubation and providing adequate muscle relaxation during general anaesthesia. The clinical use of neuromuscular blocking drugs began with the introduction of d-tubocurarine by Griffith and Johnson in 1942.[1] Subsequent concerns regarding the safety of neuromuscular blockade emphasized the importance of appropriate airway management, ventilation and monitoring.[2]

Succinylcholine, a depolarizing neuromuscular blocking agent, was introduced into clinical anaesthesia in the early 1950s and rapidly became widely used because of its rapid onset and short duration of action.[3,4] Its pharmacological characteristics make it particularly useful when rapid tracheal intubation is required. However, succinylcholine is associated with several adverse effects, including myalgia, hyperkalaemia, bradyarrhythmias, increased intraocular and intragastric pressure and the potential for malignant hyperthermia.[3-5]

Rocuronium bromide is an intermediate-acting, non-depolarizing aminosteroid neuromuscular blocking agent with a relatively rapid onset of action. At higher doses, rocuronium has been shown to provide intubating conditions comparable to succinylcholine within approximately 60–90 seconds.[6]

Magorian et al. demonstrated that higher doses of rocuronium, particularly 0.9–1.2 mg/kg, produced intubating conditions comparable with succinylcholine during rapid-sequence induction.[6] Maitriya et al. compared rocuronium and succinylcholine for endotracheal intubation and reported a faster onset with succinylcholine, while rocuronium provided good to excellent intubating conditions in elective procedures.[7,8]

Although several studies have compared these two neuromuscular blocking agents, differences in dose, method of assessment of onset, patient population and methods of haemodynamic assessment make further comparative studies relevant. Therefore, the present study was undertaken to compare rocuronium bromide 0.9 mg/kg with succinylcholine 1.5 mg/kg with respect to onset and duration of action, intubating conditions and cardiovascular responses in adult patients undergoing elective surgery under general anaesthesia.

Aim & Objectives

The present study was done to compare the intubating conditions and cardiovascular effects of rocuronium bromide 0.9 mg/kg and succinylcholine 1.5 mg/kg in adult patients undergoing elective surgery under general anaesthesia. We compared (i) the onset time of rocuronium and succinylcholine (ii) the duration of action of the two neuromuscular blocking agents (iii) the intubating conditions using the Cooper intubation scoring system (iv) the haemodynamic parameters and (v) the peripheral oxygen saturation between the two groups.

MATERIALS AND METHODS

A randomized, double-blinded comparative study was conducted in the Department of Anaesthesiology, Jawaharlal Nehru Institute of Medical Sciences (JNIMS), Imphal among adult patients aged 20–60 years, belonging to ASA physical status I or II, scheduled for elective surgical procedures under general anaesthesia. Patients with Mallampati class III or IV airway, BMI >30 kg/m², pregnancy, neuromuscular disorders, relevant drug interactions, ASA physical status III or IV, or refusal to participate were excluded. A sample size of 76 was calculated based on the findings of Lenin et al where the reported mean onset times were 48.07 ± 4.04 seconds for succinylcholine and 74.4 ± 9.1 seconds for rocuronium.

Patients were randomly allocated into two groups of 38 patients each using a paper-based randomization method viz. (i) Group A**:** Rocuronium bromide 0.9 mg/kg IV and Group B**:** Succinylcholine 1.5 mg/kg IV.

Anaesthetic technique

Patients were premedicated with fentanyl 2 µg/kg and ondansetron 0.1 mg/kg intravenously. Preoxygenation was performed with 100% oxygen for 3 minutes. Anaesthesia was induced with propofol 2 mg/kg after confirming adequate mask ventilation. The allocated neuromuscular blocking drug was administered after induction. The drugs were prepared and administered by personnel other than the investigator to maintain blinding. Tracheal intubation was attempted after approximately one minute following administration of the neuromuscular blocking agent and assessment of jaw relaxation.

Assessment of onset and duration

Drug onset time was defined as the interval between administration of the neuromuscular blocking drug and achievement of complete jaw relaxation. Duration of action was measured from onset of action until the beginning of spontaneous respiratory activity, identified by the appearance of a curare cleft on the end-tidal carbon dioxide tracing.

Assessment of intubating conditions

Intubating conditions were assessed using the Cooper scoring system based on jaw relaxation, vocal cord position and response to tracheal intubation. A total score of 8–9 was considered excellent, 6–7 good, 3–5 fair and 0–2 poor.

Haemodynamic monitoring

Heart rate, systolic blood pressure, diastolic blood pressure, mean arterial pressure and SpO_2 were recorded before premedication, before induction, 1 minute after intubation, 5 minutes, 10 minutes, 20 minutes, 30 minutes and 40 minutes after intubation. Anaesthesia was maintained with oxygen, nitrous

oxide and sevoflurane, with further neuromuscular blockade as required.

Data were entered and analysed using MS Excel and SPSS version 19. Continuous variables were expressed as mean (SD). Unpaired t-test was used for comparison of continuous variables and Fisher's exact test was used for categorical variables. A p-value <0.05 was considered statistically significant for the present analysis.

RESULTS

A total of 76 patients were included, with 38 patients in each group. The two groups were comparable with respect to age, weight, height, BMI, sex, ASA physical status and baseline haemodynamic variables. No statistically significant differences were observed in baseline characteristics.

Onset and duration of action

The mean onset time in the two groups were 67.61 ± 5.04 seconds in rocuronium group and 62.47 ± 2.84 seconds in Succinylcholine group and it was statistically significant (p<0.001) meaning that, succinylcholine had faster onset. Regarding the mean duration of action, it was longer in Rocuronium group (67.17 ± 24.24 minutes) compared to Succinylcholine group (6.17 ± 0.82 minutes. (p<0.001). [Table 1]

Table 1: Comparison of Onset Time and Duration of Action

Time	Rocuronium group		Succinylcholine group		P value
	Mean	SD	Mean	SD	
Onset time (sec)	67.61	5.04	62.47	2.84	0.000
Duration of action (min)	67.17	24.24	6.17	0.82	0.000

Intubating conditions

Overall Cooper intubation scores were comparable between the two groups, with no statistically significant difference (p = 0.133). The majority of patients in both groups had excellent intubating conditions. Jaw relaxation, vocal cord position and response to intubation were also comparable between groups.

Haemodynamic parameters

Heart rate remained comparable between the two groups at baseline and at all subsequent observation points (Fig. 1). Systolic blood pressure was comparable at baseline and at 1, 5, 10, 20 and 30 minutes. A statistically significant difference was observed at 40 minutes - Rocuronium: 124.95 ± 11.14 mmHg and Succinylcholine: 114.89 ± 14.23 mmHg (p = 0.001) (Fog. 2). Diastolic blood pressure showed significant differences at 5 and 40 minutes. Mean arterial pressure also showed significant differences at these time points. Despite these isolated statistically significant differences, the majority of haemodynamic measurements remained comparable between groups.

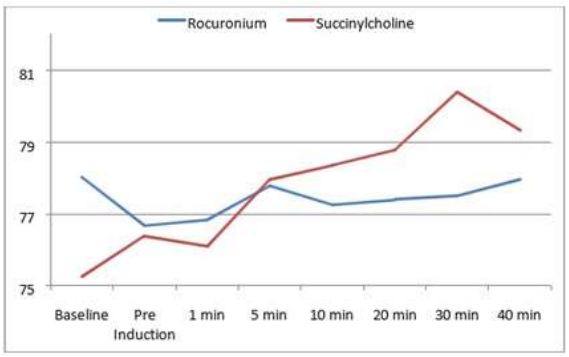


Figure 1: Comparison of Mean Heart Rate between the groups

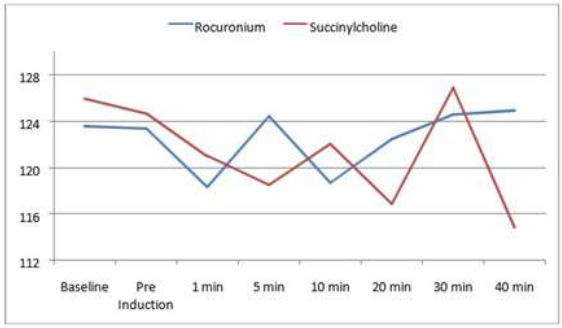


Figure 2: Comparison of Mean Systolic Blood Pressure between the groups

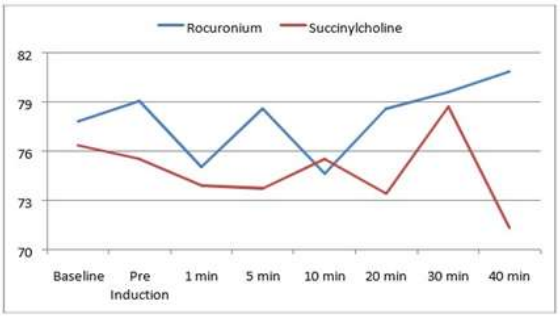


Figure 3: Comparison of Mean Diastolic Blood Pressure between the groups

Peripheral oxygen saturation

SpO_2 remained stable throughout the observation period and was comparable between the two groups at all measured time points.

DISCUSSION

Rapid and safe tracheal intubation requires adequate neuromuscular blockade, good intubating conditions and acceptable haemodynamic stability. Succinylcholine has traditionally been used because of its rapid onset and short duration of action, whereas rocuronium provides a non-depolarizing alternative with an intermediate duration of action.

Onset of action

In the present study, the mean onset time was significantly shorter with succinylcholine than with rocuronium (62.47 ± 2.84 seconds versus 67.61 ± 5.04 seconds; $p < 0.001$).

This finding is consistent with previous studies demonstrating a faster onset of succinylcholine compared with conventional doses of rocuronium. Lenin et al reported an onset time of 48.07 ± 4.04 seconds for succinylcholine and 74.4 ± 9.1 seconds for rocuronium 0.8 mg/kg.[9] Maitriya et al also reported faster onset with succinylcholine compared with lower-dose rocuronium.[7] The differences in onset times between studies may be related to the dose of rocuronium used and the method employed to define onset.

The approximately five-second difference observed in the present study is statistically significant but may have limited clinical relevance during controlled elective intubation.

Duration of action

The duration of neuromuscular blockade was significantly longer with rocuronium than succinylcholine. The mean duration was 67.17 ± 24.24 minutes for rocuronium compared with 6.17 ± 0.82 minutes for succinylcholine ($p<0.001$). This finding is consistent with the pharmacological characteristics of the two drugs. Magorian et al and Wright et al also reported a substantially longer clinical duration of action with rocuronium.[6,10] The longer duration of rocuronium may be useful during elective procedures where sustained neuromuscular relaxation is required, although the duration also needs to be considered when planning reversal and postoperative recovery.

Intubating conditions

The present study demonstrated comparable intubating conditions with rocuronium 0.9 mg/kg and succinylcholine 1.5 mg/kg. There was no statistically significant difference in the overall Cooper intubation score ($p = 0.133$). The findings are consistent with the study by Jose et al, in which rocuronium 0.9 mg/kg and succinylcholine produced well-to-excellent intubating conditions.[11] Mahalakshmi et al similarly reported comparable intubating conditions with rocuronium 0.9 mg/kg and succinylcholine.[8] The present findings therefore indicate that, at a dose of 0.9 mg/kg, rocuronium can provide satisfactory intubating conditions during controlled elective anaesthesia. Brukul et al compared rocuronium bromide and succinylcholine for endotracheal intubation and reported better intubation conditions with succinylcholine when compared with rocuronium 0.6 mg/kg.[11] The difference in rocuronium dose is important when comparing these findings with the present study, because the current study used rocuronium 0.9 mg/kg.

Haemodynamic response

In the present study, heart rate remained comparable between the two groups at all observation points. Similarly, systolic blood pressure was comparable at most time points, with a statistically significant difference occurring at 40 minutes. Diastolic blood pressure and mean arterial pressure showed statistically significant differences at 5 and 40 minutes. These isolated differences should be interpreted in the context of the overall haemodynamic pattern, as the majority of measured values were comparable between groups. Lenin et al reported that both rocuronium and succinylcholine were associated with changes in heart rate and blood pressure following intubation but without significant differences between groups.[9]Sarada et al also reported comparable haemodynamic responses between rocuronium and succinylcholine.[12]

Jose et al reported transient increases in haemodynamic variables following laryngoscopy and tracheal intubation, with values returning towards pre-induction levels within several minutes.[11] These changes were considered related to the sympathetic response to laryngoscopy and intubation rather than solely to the neuromuscular blocking agent.

Peripheral oxygen saturation

SpO_2 remained stable and comparable between the two groups throughout the observation period. This finding reflects adequate preoxygenation, ventilation and controlled anaesthetic management during the study period.

Clinical interpretation

The present study demonstrates that rocuronium 0.9 mg/kg provides intubating conditions comparable to succinylcholine 1.5 mg/kg during elective general anaesthesia. Succinylcholine had a statistically faster onset, whereas rocuronium had a considerably longer duration of action. The results are broadly consistent with previous studies comparing the two neuromuscular blocking agents.[6-14] The difference in onset should be interpreted according to the clinical context, as the present study involved controlled elective surgical patients rather than emergency rapid-sequence intubation.

CONCLUSION

Rocuronium bromide 0.9 mg/kg and succinylcholine 1.5 mg/kg provided comparable intubating conditions in adult patients undergoing elective surgery under general anaesthesia. Succinylcholine demonstrated a statistically faster onset of action, whereas rocuronium demonstrated a significantly longer duration of action. Heart rate remained comparable between the groups, while most systolic, diastolic and mean arterial pressure measurements were also comparable, with statistically significant differences at isolated time points.

Thus, rocuronium 0.9 mg/kg provides satisfactory intubating conditions and may serve as an alternative neuromuscular blocking agent to succinylcholine in appropriate elective surgical settings.

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