Research Article

# A comparative study of rocuronium bromide and succinylcholine for endotracheal intubation using neuromuscular monitoring

V B Gowda[1], Asha N[2], Namrata Ranganath[3], Henjarappa K S[4*], Sowmya M J[5], Arathi B H[6]

[1,3]Associate Professor, [4,6]Assistant Professor, Kidwai Memorial Institute of Oncology, Bangalore, Karnataka, INDIA.
[2]Assistant Professor, BMCRI Bangalore, Karnataka, INDIA.
[5]Assistant Professor, RRMC and H, Bangalore, Karnataka, INDIA.
**Email:** drhenjarappa@gmail.com

## Abstract

**Background:** Rapid and safe endotracheal intubation is of paramount importance in practice of general anaesthesia. Securing patients airway smoothly and quickly minimizes the chances of aspiration of gastric contents. Succinylcholine chloride was unparalleled in terms of its onset and duration of action but was not devoid of adverse effects. **Aims and Objectives:** The purpose of the present study was to compare the intubating conditions of Rocuronium bromide with that of Succinylcholine and to evaluate the haemodynamic effects of these agents during laryngoscopy and intubation using Train of Four Watch as a neuromuscular monitor. **Materials and Methods:** This prospective clinical study was conducted at Kidwai Memorial Institute of Oncology on patients who underwent various oncosurgeries requiring intubation. 60 adult patients of ASA grade I and II of either sex in the age group of 18-65 years were selected and randomly divided into 2 groups. Group I (n=30) was intubated with Rocuronium bromide 0.9 mg/kg body weight. Group II (n=30) was intubated with Succinylcholine chloride 1.5 mg/ kg body weight. Neuromuscular monitoring was done using peripheral nerve stimulator and intubating condition was assessed using Steyn modification of Helbo Hamsen score. Descriptive statistical analysis was carried out to calculate Mean and Standard deviation. Student "t" test was used to find the significance of study parameters on continuous scale and Chi-square/Fisher Exact test on categorical scale between two groups. **Results:** Succinylcholine 1.5 mg/kg body weight produced excellent condition in 100% (n=30) of cases at 75.40±20.28 seconds and 100% of patients had excellent intubating conditions with Rocuronium bromide 0.9 mg kg-1 body weight at 89.40±29.66 seconds. Increase in heart rate, systolic, diastolic blood pressure and mean arterial pressure was seen more in succinylcholine when compared to Rocuronium and this response came back to normal by 20 min. **Conclusion:** Rocuronium bromide is a hemodynamically stable drug. It is possible to achieve perfect intubating condition with Rocuronium bromide and can be used as an alternative to Succinylcholine in patients who are at risk for adverse sequelae of Succinylcholine.

**Keywords:** Rocuronium Bromide, Succinylcholine, Endotracheal Intubating conditions, Haemodynamics, Neuromuscular monitoring.

[*]**Address for Correspondence:**
Dr. Henjarappa K S, Assistant Professor, Kidwai Memorial Institute of Oncology Bangalore, Karnataka, INDIA.
**Email:** drhenjarappa@gmail.com
Received Date: 30/05/2015 Revised Date: 07/06/2015 Accepted Date: 12/06/2015

| Access this article online | |
|---|---|
| Quick Response Code: | Website: www.statperson.com |
| | DOI: 14 June 2014 |

## INTRODUCTION

The ease with which endotracheal intubation is performed depends upon the degree of muscle relaxation and depth of anaesthesia. Succinylcholine chloride, introduced in 1951, by Bovet is a synthetic depolarizing muscle relaxant. It falls short of ideal muscle relaxant due to its potentially hazardous side effects, like bradycardia and other dysarrhythmias, rise in serum potassium, postoperative myalgia, rise in intraocular, intragastric and intracranial pressure, development of Phase 2 block after large dose or continuous infusion. In addition, its use is contraindicated in many conditions including burns and

How to site this article: Henjarappa K S *et al.* A comparative study of rocuronium bromide and succinylcholine for endotracheal intubation using neuromuscular monitoring. *International Journal of Recent Trends in Science and Technology* June 2015; 15(2): 345-350 http://www.statperson.com (accessed 15 June 2015).

certain neurological diseases, also duration of Succinylcholine is prolonged in patients with pseudocholineestrase deficiency. These many adverse effects were large in number to bring disrepute to the drug in clinical practice. Thus, the search began for a relaxant that could replace succinylcholine. Essentially the drug was expected to have a fast and rapid onset of action as that of to facilitate rapid procurement of airway and at the same time be devoid of the side effects of succinylcholine. Rocuronium bromide (Org 9426), a non depolarizing muscle relaxant was introduced in 1994. Rocuronium bromide after its introduction was the first drug to challenge the onset time of succinylcholine and was devoid of all the adverse effects of Succinylcholine. Rocuronium bromide had an onset time of 60 seconds with two or three times the $ED_{95}$ dose ($0.3mg/kg^{-1}$). Thus, Rocuronium bromide came largely to replace succinylcholine for rapid procurement of airway.[1,2,3,4]

## AIMS AND OBJECTIVES

**Primary Objective**

1. To compare and study the endotracheal intubating conditions after administration of Rocuronium bromide (0.9 mg/kg) and Succinylcholine (1.5mg/kg) in patients undergoing elective surgery.
2. To compare onset time and duration of clinical relaxation using TOF (Train of four) watch.

**Secondary Objective:** To evaluate and compare the haemodynamic effects during laryngoscopy and intubation between the two groups.

## MATERIALS AND METHODS

A prospective comparative clinical study was conducted at Kidwai Memorial Institute of Oncology on patients who underwent various oncosurgeries requiring intubation. After obtaining Institutional and Ethical committee clearance, 60 adult patients of ASA grade I and II of either sex in the age group of 18-65 years requiring intubation for various surgeries were selected and were randomly divided into 2 groups. Group I received 0.9mg/kg body wt of Rocuronium bromide, Group II received 1.5mg/kg body wt of Succinylcholine to facilitate endotracheal intubation. Informed consent was taken from the patients regarding the procedure. Patients with airway abnormalities and past history of difficult intubation, pregnancy, obesity and neuromuscular disorders, cardiac, hepatic and renal disease, history of drug allergy, medication with drugs that interact with neuromuscular transmission like Aminoglycosides, Calcium channel blockers were excluded from the study.

## STATISTICAL ANALYSIS

Student "t" test (two tailed, independent) was used to find the significance of study parameters on continuous scale between two groups on metric parameters. Chi-square/Fisher Exact test was used to find the significance of study parameters on categorical scale between two or more groups. The Statistical software namely SAS 9.2, SPSS 15.0, Stata 10.1, MedCalc 9.0.1, Systat 12.0 and R environment ver.2.11.1 were used for the analysis of the data and Microsoft Word and Excel was used to generate graphs, tables.

## RESULTS

**Table 1:** Age distribution of patients studied

| Age in years | Group I | | Group II | |
|---|---|---|---|---|
| | No. | % | No. | % |
| 18-20 | 2 | 6.7 | 3 | 10.0 |
| 21-30 | 13 | 43.3 | 12 | 40.0 |
| 31-40 | 7 | 23.3 | 8 | 26.7 |
| 41-50 | 6 | 20.0 | 5 | 16.6 |
| >50 | 2 | 6.7 | 2 | 6.7 |
| Total | 30 | 100.0 | 30 | 100.0 |
| **Mean ± SD** | **34.43±10.57** | | **32.30±10.72** | |

Samples are age matched with p=0.441

**Table 2:** Gender distribution of patients studied

| Gender | Group I | | Group II | |
|---|---|---|---|---|
| | No. | % | No. | % |
| Male | 15 | 50.0 | 16 | 53.3 |
| Female | 15 | 50.0 | 14 | 46.7 |
| Total | 30 | 100.0 | 30 | 100.0 |

Samples are gender matched with p=0.500

**Table 3:** Weight distribution of patients studied

| Weight (kg) | Group I | | Group II | |
|---|---|---|---|---|
| | No. | % | No. | % |
| 40-50 | 17 | 56.7 | 12 | 40.0 |
| 51-60 | 11 | 36.7 | 13 | 43.3 |
| 61-70 | 2 | 6.6 | 5 | 16.7 |
| Total | 30 | 100.0 | 30 | 100.0 |
| Mean ± SD | 50.30±6.58 | | 54.50±6.93 | |

Weight distribution is significantly less in Group I (50.30 kg), when compared to Group II (54.50 kg) with p = 0.019, which is significant

**Table 4:** ASA grade distribution of patients studied

| ASA | Group I | | Group II | |
|---|---|---|---|---|
| | No. | % | No. | % |
| Grade I | 18 | 60.0 | 20 | 66.7 |
| Grade II | 12 | 40.0 | 10 | 33.3 |
| Total | 30 | 100.0 | 30 | 100.0 |

Distribution of ASA is statistically similar in two groups with p=0.395,

**Table 5:** Comparison of Heart rate (beats per minute) between two groups

| Heart rate (beats/minute) | Group I | Group II | p value |
|---|---|---|---|
| **Heart rate** | | | |
| Basal | 85.23±12.19 | 86.07±12.65 | 0.796 |
| 1minfenta | 86.77±11.10 | 89.40±12.84 | 0.399 |
| 1minthio | 89.93±12.86 | 97.83±12.51 | 0.019* |
| **After intubation** | | | |
| 0min | 95.97±10.67 | 106.13±14.60 | 0.003** |
| 1min | 110.67±13.94 | 114.00±12.01 | 0.325 |
| 2min | 101.03±11.85 | 110.00±14.64 | 0.012* |
| 3min | 92.73±10.55 | 104.73±12.28 | <0.001** |
| 4min | 92.60±9.59 | 103.83±10.38 | <0.001** |
| 5min | 91.80±11.61 | 97.80±10.65 | 0.042* |
| 10min | 89.50±11.22 | 92.07±11.62 | 0.388 |
| 15min | 88.10±14.76 | 90.47±12.47 | 0.505 |
| 20min | 87.87±14.72 | 88.57±14.05 | 0.851 |

There was significant rise in p<0.05 in heart rate. p value moderately significant at 1min after Thiopentone, 2min and 5min after intubation. p value strongly significant at 0, 3 and 4th min after intubation. Increase in heart rate was seen more in group 2, there was no change in ECG this response came back to normal by 20 min. But certain increase in heart rate was seen in group I at 1st minute with normal ECG and returned to basal heart rate by 20 minute. The mean rise in heart rate in group I at 1st minute after intubation was 110.67±13.94 wherein group II, it was 114.00±12.01.

**Table 6:** Comparison of systolic blood pressure (SBP) mmHg between two groups

| SBP (mmHg) | Group I | Group II | p value |
|---|---|---|---|
| **SBP (mmHg)** | | | |
| Basal | 123.33±16.57 | 122.27±10.70 | 0.768 |
| 1minfenta | 123.53±14.30 | 124.87±12.14 | 0.699 |
| 1minthio | 122.03±14.34 | 125.63±12.19 | 0.299 |
| **After intubation** | | | |
| 0min | 125.47±17.19 | 127.43±13.45 | 0.624 |
| 1min | 127.77±18.63 | 131.60±14.09 | 0.373 |
| 2min | 122.83±19.08 | 132.43±13.98 | 0.030* |
| 3min | 118.07±13.76 | 128.83±14.91 | 0.005** |
| 4min | 117.43±14.05 | 122.40±15.69 | 0.202 |
| 5min | 115.90±15.22 | 121.27±13.46 | 0.154 |
| 10min | 114.63±13.31 | 116.77±14.99 | 0.562 |
| 15min | 113.80±14.71 | 114.93±12.22 | 0.747 |
| 20min | 113.27±13.79 | 115.47±13.53 | 0.535 |

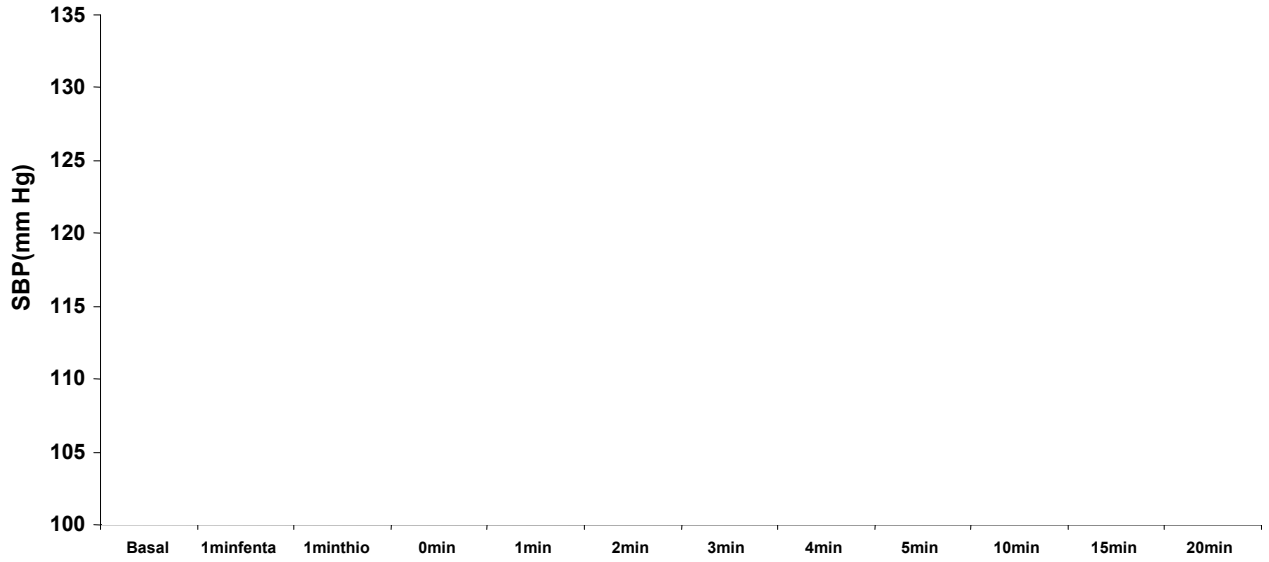


**Figure 1:** SBP Analysis

There was significant rise in systolic blood pressure with p <0.05. p value moderately significant at 2min after intubation.(0.03). p value strongly significant (0.005) at 3min after intubation. Increase in SBP from basal value increases after 2min and 3min after intubation in both groups and returned to basal by 15 min. The mean increase in SBP in group I is 127.77±18.63 and group II 131.60±14.09 at 1 minute after intubation.

**Table 7:** Comparison of diastolic blood pressure (DBP) mmHg between two groups

| DBP (mmHg) | Group I | Group II | p value |
|---|---|---|---|
| **DBP (mmHg)** | | | |
| Basal | 80.40±9.60 | 83.47±11.61 | 0.270 |
| 1minfenta | 82.67±10.36 | 85.20±11.49 | 0.374 |
| 1minthio | 82.87±10.74 | 85.77±11.92 | 0.327 |
| **After intubation** | | | |

| | | | |
|---|---|---|---|
| 0min | 86.10±14.92 | 86.20±14.72 | 0.979 |
| 1min | 88.53±17.15 | 89.97±15.36 | 0.734 |
| 2min | 84.97±16.79 | 91.73±17.07 | 0.127 |
| 3min | 83.13±14.17 | 90.40±18.99 | 0.098+ |
| 4min | 81.60±13.14 | 84.70±18.18 | 0.452 |
| 5min | 81.60±14.69 | 82.70±16.23 | 0.784 |
| 10min | 80.13±12.74 | 80.77±16.35 | 0.868 |
| 15min | 80.00±12.58 | 81.83±15.56 | 0.618 |
| 20min | 78.63±12.98 | 80.90±16.60 | 0.558 |

There was significant rise in $p<0.05$ in diastolic blood pressure. p value suggested significance at 3min after intubation. The mean increase in DBP in group I was 88.53±17.15 at 1st minute and group II 91.73±17.07 at 2nd minute following intubation. Increase in DBP from basal value increased in both groups and returned to basal by 15 min, lasted more in group I patients.

**Table 8:** Comparison of Mean arterial pressure (MAP) between two groups

| MAP (mmHg) | Group I | Group II | p value |
|---|---|---|---|
| **MAP (mmHg)** | | | |
| Basal | 95.53±10.18 | 97.50±9.77 | 0.449 |
| 1minfenta | 96.67±10.37 | 99.77±9.83 | 0.288 |
| 1minthio | 96.83±10.65 | 99.70±9.38 | 0.273 |
| **After intubation** | | | |
| 0min | 100.20±13.53 | 100.43±12.75 | 0.945 |
| 1min | 102.07±16.01 | 105.20±14.55 | 0.431 |
| 2min | 99.00±15.68 | 106.03±14.06 | 0.073+ |
| 3min | 95.27±13.05 | 104.87±16.70 | 0.016* |
| 4min | 94.27±12.36 | 98.13±15.34 | 0.287 |
| 5min | 93.63±13.42 | 96.23±13.36 | 0.455 |
| 10min | 92.20±11.48 | 93.57±13.00 | 0.668 |
| 15min | 91.67±12.39 | 93.67±11.80 | 0.525 |
| 20min | 90.90±12.32 | 93.50±12.49 | 0.420 |

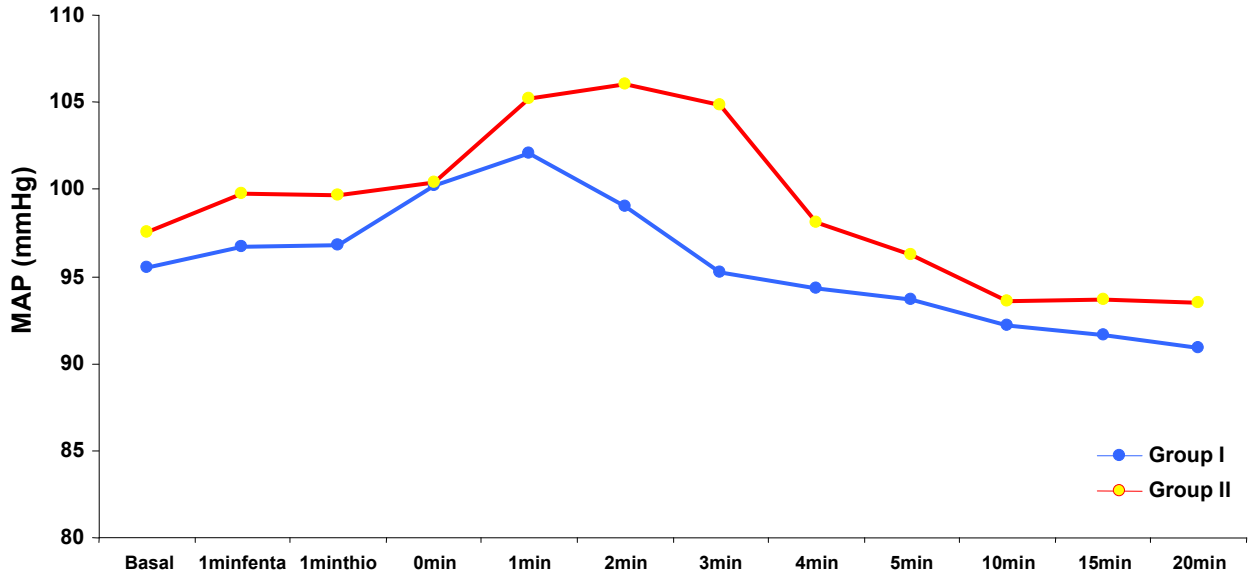


**Figure 2:** MAP Analysis

There was significant rise in $p<0.05$ in mean arterial pressure. p value suggested significance at 2min after intubation. p value moderately significant at 3min after intubation. Increase in MAP from basal value increased at 0, 1, 2min after intubation in both groups. The mean rise in MAP was 102.07±16.01 at 1 minute in group I, 106.03±14.06 at 2 min in group II following intubation. Group I returned to basal by 3 min, Group II returned to basal by 5 min.

**Table 9:** TOF 0 seconds distribution of patients studied

| TOF | Group I | | Group II | |
|---|---|---|---|---|
| | No. | % | No. | % |
| 40-60 | 6 | 20.0 | 5 | 16.7 |
| 61-80 | 10 | 33.3 | 18 | 60.0 |
| 81-100 | 4 | 6.7 | 4 | 6.7 |
| >100 | 10 | 33.3 | 3 | 10.0 |
| Total | 30 | 100.0 | 30 | 100.0 |
| Mean ± SD | 89.40±29.66 | | 75.40±20.28 | |

TOF response was statistically significant- more in Group I (89.40) when compared to Group II (75.40) with p=0.037* being moderately significant. This significance suggests Rocuronium in group I takes more time for intubation than group II.

## DISCUSSION

Succinylcholine was unparalleled in terms of its onset and duration of action. The type of relaxation obtained with this drug was so good that even today it is used as a gold standard and other drugs are compared with it. Rocuronium bromide was introduced in order to provide a very rapid relaxation for endotracheal intubation. In view of this the present study compares the intubating conditions and haemodynamic responses of Rocuronium and succinylchoine when TOF showed 0.

**Intubating dose:** The ED95 dose of Succinylcholine chloride is 0.392 mg kg-1 body weight. Four times the ED95 dose which approximates 1.5mg kg-1 body weight was employed for intubation in the present study which is almost similar to that of Huizinga ACT *et al.*, Aparna Shukla, Dubey KP, Sharma MSN, Weiss JH *et al.*, Aleksandra J Mazurek *et al.*, and Neerja B *et al.*, Weirda JMKH [7,8,9,10,11,12]

The $ED_{95}$ of Rocuronium is 0.3 mg/kg body weight. In the present study the dose used was 3X $ED_{95}$ i.e. 0.9 mg/kg body weight. It has been shown to provide good to excellent intubating condition at 60 sec by, Fuchs Buder T and Tassonyi E *et al.*, Weiss JH *et al.*, Neerja B *et al.*, Toni Magorian *et al.*, Crul JF *et al.*, Hemmerling TM *et al.*. [4,9,11,13,14,15]

In the present study, Succinylcholine 1.5 mg/kg body weight produced excellent condition in 100% (n=30) of cases at 75.40±20.28 which is comparable with that of Aparna Shukla *et al.*[8]. It is noted that the incidence of excellent intubating conditions with Rocuronium bromide 0.9 mg kg-1 body weight ranged from 80% in the study of Toni Magorian *et al.*[13], to 100% in the study of Naguib M *et al.* [21]. The incidence of good intubating conditions ranged from 6% in the study of Fuchs Buder *et al.*[4] to 20% in the study of Toni Magorian *et al.*[13]. In the present study, 100% of patients had excellent intubating conditions with Rocuronium bromide 0.9 mg kg-1 body weight at 89.40±29.66 seconds which is comparable with studies of Neerja B *et al.*[11] and Verma RK *et al.*[18]

### HAEMODYNAMIC EFFECTS (Table 5, 6, 7, 8)

Increase in heart rate is seen more in group II (Succinylcholine) than group I (Rocuronium), there was no change in ECG this response came back to normal by 20 min.The rise in heart rate and mean arterial pressure may be as a result of sympathetic stimulation produced due to laryngoscopy and intubation. The haemodynamic changes[22,23,24] following the administration of Rocuronium bromide have been studied by Eamon P. McCoy *et al.*[22] and Mark E. Hudson *et al.*[23]. Eamon P. McCoy *et al.*[22] have demonstrated changes in heart rate (+7%), mean arterial pressure (-5%), systemic vascular resistance (-12%), that were insignificant. They concluded that Rocuronium bromide in doses of 0.6 mg kg-1 is associated with changes of only small magnitudes in haemodynamic variables. Mark E. Hudson *et al.*[23] measured the haemodynamic effects of Rocuronium bromide in adults undergoing cardiac surgery with cardiopulmonary bypass. There was no change in myocardial oxygen demand and supply. Although, CVP and PAP decreased significantly Rocuronium bromide had no effect on pulmonary capillary wedge pressure, systemic vascular resistance, mean arterial pressure and cardiac index. Thus, Rocuronium bromide has been demonstrated to be hemodynamically a stable drug. In our study, there was a rise in mean heart rate following administration of Rocuronium bromide 0.9 mg kg-1 body weight, following intubation. There was a similar increase in mean arterial pressure by 28.63% from pre induction value following Rocuronium bromide 0.9 mg kg-1 body weight following intubation. This was a haemodynamic response to laryngoscopy and endotracheal intubation, which subsided to near pre induction, values 20 minutes after intubation. Trend in haemodynamic changes to laryngoscopy and intubation were more in Succinylcholine chloride than Rocuronium bromide.

## CONCLUSION

Although NMJ monitors not included under the standards for basic anaesthetic monitoring by the American Society of Anaesthesiologists, the real value of such monitors lies in the fact that they guide the optimal management of patients receiving neuromuscular blockers. It is possible to achieve perfect intubating condition with Rocuronium bromide and can be used as

an alternative to Succinylcholine particularly in patients who are at risk for adverse sequelae of Succinylcholine. Rocuronium bromide 0.9mg/kg may be considered an optimum dose for intubation. Rocuronium bromide is a hemodynamically stable drug.

## REFERENCES


1. Ronald D Miller: Anaesthesia, Churchill Livingstone, 7th edition, 2000: p. 419,446,448,449,450,452. (6)
2. Erwin K Kastrup, Steven K Hebel. Drugs facts and comparisons, Wolters Kluwer Company, 52nd Edition, 1998: p. 1915. (23)
3. Wierda JM. Clinical observations on neuromuscular blocking action of ORG 9426, a new steroidal non-depolarizing agent. Br J Anaesth 1990; 64: 521. (24)
4. Fuchs Buder T and Tassonyi E. Intubating conditions and time course of Rocuronium induced neuromuscular block in children. Br J Anaesth 1996; 77: 335-338. (26)
5. Srivastava U, Kumar A, Gandhi NK, Saxena S, Agarwal S. Comparison of propofol and fentanyl with thiopentone and suxamethonium for tracheal intubation in children. Ind J Anaesth. 2001;45:263-6 (3) scoring system
6. Steyn MP, Quinn AM, Gillespie JA, Miller DC, Best CJ, Morton NS. Tracheal intubation without neuromuscular block in children. Br J Anaesth. 1994;72:403–6 (4)
7. Huizinga ACT, Vandenbrom RHG, Weirda JMKH, Hommes FDM, Hennis PJ. Intubating conditions and onset of neuromuscular block of Rocuronium (Org 9426): a comparison with Suxamethonium. Acta Anaesthesiol Scand 1992; 36: 463-68. (94)
8. Shukla A, Dubey KP, Sharma MSN, Comparative evaluation of hemodynamic effects and intubating conditions after administration of Org 9426 and Succinylcholine. Indian J Anaesth 2004; 476-79. (95)
9. Wiess JH, Cratz I, Goldberg ME, Afsar M, Insinga F, Lorijani G. Double-blind Comparison of two doses of Rocuronium and Succinylcholine for rapid sequence induction of anaesthesia. J Clin Anaesth 1997; 9(5): 379-382. (12)
10. Aleksandra J. Mazurek, Bronwyn Rac, Susan Hann, Ikakim J, Barbara Castro, Charles J Cote: Rocuronium versus Succinylcholine: Are they equally effective during rapid sequence induction of anaesthesia? Anaesth Analg 1998; 87: 1259-1262. (15)
11. Neerja B, Indu B, Virendra K, Arya, Pramila C: Comparison of intubating conditions after Rocuronium and Succinylcholine following "Rapid sequence Induction" with Thiopentone in emergency surgeries. J Clin Anaesth 1999; 15(3): 285-289. (17)
12. Weirda JMKH, Hommes FDM, Nag JHA, Van den Broek L. Comparison of time course of action and endotracheal intubating conditions of Vecuronium bromide, Rocuronium bromide and Mivacurium chloride. Anaesthesia 1995; 50: 393-396. (90)
13. Toni Magorian, Flannery KB, Ronald D Miller. Comparison of Rocuronium, Succinylcholine and vecuronium for rapid sequence induction of anaesthesia in adult Patients. Anaesthesiology 1993; 79: 913-918. (9)
14. Crul JF, Vanbelleghem V, Buyse L, Heylen R, Van Egmond J. Rocuronium with alfentanil and propofol allows intubation within 45 seconds. Eur J Anaesth 1995; 12: 111-112. (11)
15. Hemmerling TM *et al.*. Comparison of Succinylcholine with two doses of Rocuronium using a new method of monitoring neuromuscular block at laryngeal muscles by surface laryngeal electromyography, British Journal of Anaesthesia, 2000; 85: 251-255. (18)
16. Magnonian T, Flannery KB, Miller RD. Comparison of Rocuronium Succinylcholine and Vecuronium for rapid sequence induction of anaesthesia in adult patients. Anaesthesiology 1993; 79: 913-18. (88)
17. Latorre F, Stanek A, Gervais HW, Kleemann PP. Intubation requirements after Rocuronium Succinylcholine. Anasthesiol Intensivemed Notfallmmed Schmezther 1996; 31 (8): 470-73. (89)
18. Verma RK, Goordayal R, Jaiswal S, Sinha GK. A comparative study of the intubating conditions and cardiovascular effects following Succinylcholine and Rocuronium in adult elective surgical patients. Internet J Anaesth 2007; 14 (1): (91)
19. Mirakhur RK, Cooper AR, Clarke RSJ. Onset and intubating conditions of Rocuronium bromide compared to those of Suxamethonium. Eur J Anaesth 1994; 11 (9): 41-43. (92)
20. Cooper R, Maddinini VR, Mirakhur RK, Fee JPH. Influence of dose and anaesthetic technique on the onset and duration of action of Rocuronium (Org 9426): a comparison with Suxamethonium. Anaesthesiology 1992; 77 (3A): A 905. (93)
21. Naguib M, Samarkandi AH, Ammar A and Turkistani A. Comparison of Suxamethonium and different combinations of Rocuronium and mivacurium for rapid tracheal intubation in children; Br J Anaesth 1997; 79: 450-455. (13)
22. Eamon P McCoy, Venkat R, Maddineni, Peter Elliot, Rajinder K Mirakhur, Ian W Carson. Haemodynamic effects of Rocuronium during fentanyl anaesthesia: Comparison with vecuronium. Can J Anaesth 1993; 40: 703-8. (28)
23. Mark E Hudson, Kenneth P Rothfield, William C Tullock, Leonard L Firestone. Haemodynamic effects of Rocuronium bromide in adult cardiac surgical patients. Can J Anaesth 1998; 45: 139-43. (29)
24. Levy, Jerold H, Davis, Gwenk, Duggan, Jane. Determination of haemodynamic and histamine release of Rocuronium when administered in increased doses under nitrous oxide/oxygen sufentanil anaesthesia. Anaesth Analg 1994; 78: 318 (30)


Source of Support: None Declared
Conflict of Interest: None Declared