

Comparison of rocuronium and suxamethonium by assessing intubation quality and adverse effects in patients undergoing surgery

Paola Patán-Sánchez, M.D.,* Teresa Vélez-Trejo, M.D.,** Luz Ma. San Germán-Trejo, M.D.***

* Anesthesiology resident third grade.
** Assigned Medical to the Service of Anesthesiology.
*** Head of research.

Hospital Regional «Gral. Ignacio Zaragoza»
Distrito Federal, México.

Reprints requests:
Paola Patán-Sánchez, M.D.
Prolongación Venturina Núm. 6 Col. Estrella,
Del. Gustavo A. Madero, D.F., México.
Tel. 04455-1371-8292
E-mail: ppatans@starmedia.com

Received for publication: 09-07-07
Accepted for publication: 14-03-08

SUMMARY

Objectives: To compare the clinical intubation conditions through the sketch of Domoaol between succinylcholine (suxamethonium) and rocuronium bromide at 60 seconds after their appliance, and to evaluate the side effects of such mentioned drugs. **Material and methods:** This was a prospective, transversal, comparative, and open study performed on 60 patients subjected to programmed surgeries, without any kind of difficulty for intubation. The patients were from both sexes, with an age ranging from 18 to 65 years old, ASA E I y II, and they were pre-medicated with midazolam (0.05 mg/kg IV); they had a non-invasive monitoring, and the induction with fentanyl (3 µg/kg), propofol (2 mg/kg IV) was randomly divided in the A group (Succinylcholine 1 mg/kg) an B group (Rocuronium 0.06 mg/kg). The results were recorded on the data collection sheet. **Results:** The intubation conditions for both groups were considered between good and excellent. Adverse effects were found in the 90% of the patients in A group, while in B group they were not present. **Conclusion:** Rocuronium bromide is one of the nondepolarizing neuromuscular relaxants that presents a quicker starting point of action and seems to be a valid option when it is necessary to obtain the upper respiratory tract very quickly.

Key words: Rocuronium, succinylcholine, intubation quality.

RESUMEN

Objetivos: Comparar las condiciones clínicas de intubación por medio del esquema de Domoaol entre la succinilcolina (suxametonio) y el bromuro de rocuronio a los 60 segundos de su aplicación, y evaluar los efectos colaterales de dichas drogas. **Material y métodos:** Estudio prospectivo, transversal, comparativo, abierto, en 60 pacientes sometidos a cirugía programada, sin ningún grado de dificultad para la intubación, ambos sexos, en edad de 18 a 65 años, ASA E I y II, se premedicó con midazolam 0.05 mg/kg IV, monitoreo no invasivo, inducción con fentanyl 3 µg/kg, propofol 2 mg/kg IV, se dividió al azar en el grupo A (succinilcolina 1 mg/kg) y B (rocuronio 0.06 mg/kg), los resultados se registraron en la hoja de recolección de datos. **Resultados:** Las condiciones de intubación para ambos grupos se consideraron entre buenos y excelentes, los efectos adversos se encontraron en un 90% en el grupo A mientras que en el B no se presentaron. **Conclusión:** El bromuro de rocuronio es uno de los relajantes neuromusculares no despolarizantes que tiene inicio de acción más rápido y se perfila como una opción válida cuando es necesario obtener la vía aérea rápidamente.

Palabras clave: Rocuronio, succinilcolina, calidad de intubación.

INTRODUCTION

We all know the effect of non-depolarizing muscle relaxants (NDMRs), including the one that provides the benefit of a fast onset of action similar to that given by succinylcholine, but without the potential danger associated with this drug: the rocuronium.

Succinylcholine: It is the only depolarizing neuromuscular blocker providing fast onset of neuromuscular blockade (NMB), fast recovery and economic price, factors contributing to its permanence despite its side effects. This powerful relaxant, administered at doses used (1 mg/kg) in clinical practice, produces a 100% blockade with duration of about 8.5 minutes.

The sequence after administration is the following: latency to onset of muscle fasciculation: 25 to 35 sec; average length of fasciculation: 25 to 40 sec; latency to maximum blockade: 60 to 80 sec; latency until the onset of recovery: 4.5 to 6.5 minutes; no accumulation in repeated doses of suxamethonium is observed⁽¹⁾.

Side effects: fasciculations, increased myoglobin and creatinine phosphokinase, masseter muscle spasm, cardiac effects, hyperkalemia, increased intracranial and intraocular pressure, abnormal neuromuscular sensitivity, anaphylaxis, malignant hyperthermia.

Rocuronium: New non-depolarizing muscle relaxant that has a latency period and offers a very fast development of blockade, it allows intubating conditions at 60 sec similar to those obtained with suxamethonium, but with excellent cardiovascular stability⁽¹⁾. The establishment of the blockade is faster in the adductor muscles of the larynx, but less intense, than in the muscles of the extremities, and after the diaphragm muscle is affected⁽²⁾. The rocuronium's low potency is an advantage because the latency is faster; on the other hand, the determination of the effective dose that produces the effect 95 (DE95) is around 0.3 mg/kg, a dose of 2 DE95 (0.6) provides excellent intubating conditions in a minute with a latency period of 33 sec. By using a 0.6 mg/kg standard dose, the duration of effect is from 30 to 32 min, and by using low doses (0.3 to 0.4) the duration is shortened to 22 min. High doses (1 mg/kg) produce a relaxing effect up to from 60 to 70 min. Repeated doses do not produce accumulation or prolongation of their effect. Spontaneous recovery from 25 to 75% is from 12 to 20 min. The NMB occurs faster at the laryngeal muscles than at level of thumb muscles and it allows us to perform a tracheal intubation prior to obtaining a complete blockade measured at level of thumb⁽³⁾.

Side effects of rocuronium include anaphylactic reactions, although they are very rare they must be taken into account; moreover it has been described pain at application site. On the other hand, must always be borne in mind that the rocu-

ronium is capable of releasing histamine, both locally and systemically.

Several authors have assessed intubating conditions using a clinical criterion based on non-standard clinical scales proposed by various researchers. Lund and Stovner were the first to introduce a scale as a tool to evaluate the intubating conditions, by describing three criteria: 1) jaw relaxation; 2) position and mobility of the vocal cords; and 3) reaction to intubation. By classifying the condition as excellent, satisfactory, or poor. In 1980, Krieg et al. introduced a modified scale which currently remains in force, by replacing the relaxation of the jaw by laryngoscopy and assigning a numerical value to each criterion. Currently the clinical intubating conditions are assessed based on the scale developed by Sandor Agoston, which was approved in Copenhagen in 1994. Most of the currently used scales agree to evaluate the following parameters: laryngoscopy (jaw relaxation, resistance to laryngoscopy), vocal cords (position and movement), and reaction to intubation (coughing and limb movement), by calling as *excellent, good and poor, or acceptable and unacceptable* conditions⁽⁴⁾. The purpose of this work is to compare the intubation quality through the clinical conditions using the scheme Domoaol between rocuronium bromide (0.6 mg/kg) and succinylcholine (1 mg/kg) within 60 seconds of application, as well as side effects of these muscle relaxants in patients undergoing scheduled surgery.

MATERIAL AND METHODS

With the approval of Research and Ethics Committees and under informed consent, this prospective, cross, comparative, open study in main operating rooms of General Regional Hospital "Ignacio Zaragoza" was conducted. After administration of succinylcholine (1 mg/kg) and rocuronium bromide (0.6 mg/kg) to 60 patients with surgical pathology and scheduled surgery, without any degree of intubation difficulty (Mallampati I or II, Patil Aldreti I, Bellhouse Doré I), both sexes, aged between 18 and 65 years, with an ASA classification of EI or II, and with reported serum electrolytes within normal parameters, intubating conditions were graded clinically (Scheme Domoaol) within 60 seconds.

Patients involved in this study adhered to the following conditions: venous access with polyethylene catheter not less than 18 gauge and use of Ringer's lactate solution. Pre-anesthetic medication was 0.05 mg/kg IV midazolam. According the patient's status, SpO₂, MAP, and HR were monitored by noninvasive methods. Fentanyl (3 µg/kg) was administered, and it was induced using a 2 mg/kg IV dose. The patients were randomly induced into two groups (n = 30) denominated as Group A (succinylcholine) and Group

Table I. Domoaol Scheme⁽⁵⁾.

| Parameters | 1 | 2 | 3 | 4 |
|-----------------------|-----------|--------------------|-----------------|--------------|
| Laryngoscopy | Easy | Regular | Difficult | Impossible |
| Vocal cords | Open | Moving | Closing | Closing |
| Masseters | Relaxed | Regular relaxation | Poor relaxation | Contractures |
| Rejection of the tube | Non | Diaphragm | Evident | Severe |
| Score | 4 to 5 | 6 to 8 | 9 to 12 | 13 to 16 |
| Grade | IV | III | II | I |
| Conditions | Excellent | Good | Regular | Bad |

B (rocuronium). The Group A received 1 mg/kg of succinylcholine as intubating dose, and the Group B received 600 µg/kg rocuronium bromide as intubating dose. Orotracheal intubation (OTI) was performed 60 seconds after administering the muscle relaxant. The clinical intubating conditions were assessed through the following parameters: Amended scheme Domoaol (Table I), masseter muscles (relaxed muscles, regular relaxation, poor relaxation, contracted muscles), laryngoscopy (easy, regular, hard, impossible), vocal cords (open, moving, closing, closed), and rejection to the endotracheal tube (none, clear diaphragm, aperture, severe). Each of the studied parameters received an assessment of 1 to 4, in ascending order of difficulty, the obtained scores were summed and grouped into 4 categories: 1) 4-5 for an excellent score; 2) 6-8 for a good score; 3) 9-12 for a regular score; 13-16 for a bad score.

The study completed at the time that patient's correct intubation was verified, from this time the maintenance of anesthesia was performed based on the type of surgery and patient conditions.

Statistical analysis was performed to compare the differences of qualitative variables obtained both in the succinylcholine group and in the rocuronium group, using the Chi square test.

RESULTS

The two groups were homogeneous with respect to age, sex, and weight. Moreover, 60 patients divided into two groups were included of this study. Succinylcholine and rocuronium were administrated in group A and group B, respectively. The average age in the group A was 45.2 years, while in group B was 47.53 years. There were 21 women (70%) and 9 men (30%) in group A, and there were 23 women (76%) and 7 men (23%) in group B. The average weight was 69.13 kg in group A and 64.93 kg in group B (Table II).

Direct laryngoscopy was performed in all patients within 60 seconds of the administration of muscle relaxant. In group A (succinylcholine), easy laryngoscopy was performed in

Table II. Population characteristics.

| Characteristics | Succinylcholine | Rocuronium |
|-----------------|-----------------|-------------|
| Age (x) | 45.20 years | 47.53 years |
| Sex | | |
| Female | 21 (70%) | 23 (76%) |
| Male | 9 (30%) | 7 (23%) |
| Weight (x) | 69.13 kg | 64.93 kg |

Source: Data collection sheet.

76% (23/30) of patients, regular laryngoscopy in 20% (6/30) of patients, and difficult laryngoscopy in a 3.3% (1/30) of patients. In group B (rocuronium), easy laryngoscopy was performed in 63.3% (19/30) of patients, regular laryngoscopy in 30% (9/30) of patients, and difficult laryngoscopy in 6.6% (2/30) of patients ($p > 0.001$).

The position of the vocal cords during laryngoscopy was open in 100% (30/30) of patients in group A, and was open in 93% (28/30) of patients and moving in 7% (2 patients) of patients ($p > 0.001$) in group B.

The conditions of the masseter muscles were: in group A, relaxed in 96% (29/30) of patients and 3.3% (1/30) of patients with regular relaxation; in group B, 73% (22/30) of patients had relaxed muscles, 23.3% (7/30) of patients had regular relaxation and 3.3% (1/30) of patients had poorly relaxed muscles ($p > 0.001$).

The tube rejection was as follows: No rejection was observed in 90% (27/30) of patients and 13.3% (4/30) of patients had diaphragmatic movements in Group A (succinylcholine). On the other hand, 90% (27/30) of patients did not show rejection and 10% (3/30) of patients had diaphragmatic movements ($p > 0.001$) (Table III) in Group B (rocuronium).

Intubating conditions were excellent in 80% (24/30) of patients and good in 20% (6/30) of patients in group A (succinylcholine), whereas they were excellent in 70% (21/30) of patients and good in 30% (9/30) of patients ($p > 0.001$) (Figure 1) in group B (rocuronium).

Table III. Summary of intubation conditions.

| Parameters | Succinylcholine | Rocuronium |
|------------------------|-----------------|------------|
| Laryngoscopy | | |
| Easy | 23 (76%) | 19 (63.3%) |
| Regular | 6 (20%) | 9 (30%) |
| Difficult | 1 (3.3%) | 2 (6.6%) |
| Vocal cords | | |
| Open | 30 (100%) | 28 (95%) |
| Moving | 0 | 2 (7%) |
| Masseters | | |
| Relaxed | 29 (96%) | 22 (73%) |
| Regular relaxation | 1 (3%) | 7 (23.3%) |
| Poor relaxation | 0 | 1 (3.3%) |
| Rejection of the tube | | |
| No rejection | 27 (90%) | 26 (86.6%) |
| Diaphragmatic movement | 3 (10%) | 4 (13.3%) |

Source: Data collection sheet.

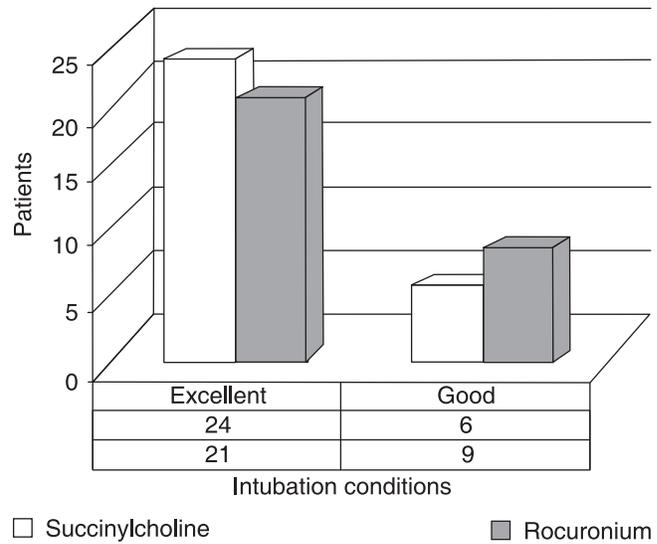
With regard to adverse effects, 90% (27/30) of patients had fasciculations and 10% (3/30) of patients did not show any side effect in group A (succinylcholine). On the other side, 100% (30/30) of patients did not show any side effect ($p > 0.001$) en group B (rocuronium)

This study was not designed to assess hemodynamic stability; however, statistically significant changes were observed ($p > 0.001$) in both blood pressure (BP) and heart rate (HR).

In group A (succinylcholine), 93% (28/30) of patients did not show changes and 7% (2/30) of patients showed an increase in BP by 30% over baseline as compared to group B (rocuronium) in the which 100% (30/30) of patients did not show changes on BP, and as for the HR, 93% (28/30) of patients did not changes and 7% (2/30) of patients had an increase by approximately 20% in group A (succinylcholine), and 100% (30/30) of patients did not changes in group B (rocuronium). Overall, there are no major hemodynamic changes following the use of rocuronium and/or succinylcholine; and if there were, they could be influenced by these inducing drugs and/or depth of anesthesia.

DISCUSSION

The time between the onset of the induction of anesthesia and securing the airway should be considered a dangerous period and must be shortened as much as possible. Regurgitation and tracheobronchial aspiration of stomach contents occur most frequently during this period. It is well known that good intubating conditions minimize the risk of intubation-related trauma. Additionally, coughing and



Source: Data collection sheet.

Figure 1. Intubation conditions obtained for succinylcholine and rocuronium.

movements associated with this procedure should be avoided in certain situations, such as eye injuries, cerebral artery aneurysms, intracranial hypertension, etc. Intubating conditions depend on the depth of anesthesia and the employed technique, not being able to get good conditions with the usually used doses of anesthetics; therefore, the intubation is facilitated by the use of neuromuscular relaxants⁽⁵⁾. It has sought a “ideal” muscle relaxant that has the following characteristics: 1) A non-depolarizing mechanism of action; 2) Fast onset of action; 3) Short duration of action; 4) Fast recovery; 5) Without cumulative effect; 6) No effect on the cardiovascular system; 7) It must not release histamine; 8) It must be reversible by cholinesterase inhibitors; 9) High potency; 10) Pharmacological inactive metabolites⁽⁶⁾.

The interest of the anesthesiologist to achieve a good, safe and rapid endotracheal intubation and the dissemination of the features offered by rocuronium bromide have logically caused the execution of multiple works for evaluating intubation conditions obtained after administration of rocuronium bromide, both at different doses and at different times, as well as for comparing if the conditions are equal, better or worse than those obtained at the same times and after administration of succinylcholine.

In our study, all patients could be intubated in excellent or good conditions, but patients in group A have a best conditions of excellent intubation as compared to group B, this difference is due to the four variables scored by the scheme Domoaol.

By comparing our study with one conducted in 2005 by Mathias Sluga, he did not had significant difference in intubating conditions obtained using 1 mg/kg succinylcholine as compared to 0.6 mg/kg rocuronium, using the Copenhagen's scale where the only difference is the presence of mobility of the limbs⁽⁶⁾.

In comparison with the study by R. Bustamante and M. Ramos, in which the Domoaol scale was used to assess intubating conditions obtained using succinylcholine (1 mg/kg) and rocuronium (600 mg/kg) within one minute after intubation, they obtained excellent or good conditions for both drugs, although a significantly greater number of patients were intubated in excellent manner with succinylcholine⁽⁷⁾.

In the study by Aurelio Otero Rosaleo, intubating conditions were evaluated between rocuronium at a 0.6 mg/kg dose and succinylcholine at a 1 mg/kg dose. Optimal intubating conditions were found in 97.62% of patients. Among results obtained by Aurelio Otero Rosalee and our results there is a significant difference, because we achieved optimum intubating conditions in 100% of the individuals. The sum of excellent plus good intubating conditions is the optimum conditions in the study⁽⁸⁾.

Regarding adverse effects, we observed some adverse effects with the use of succinylcholine, fasciculations were the most common and less serious event in 90% of cases as compared to rocuronium, with the rocuronium any side effects were observed. This is a great advantage related with its use.

As compared to study by Bayter, he found the presence of fasciculations in both groups: 6 patients (15.4%) in the succinylcholine group and 3 patients (7.3%) in the rocuronium group, without significant differences in his study. Must always be borne in mind that due to the sample size and despite the presumably low expected incidence of complications, we can not categorically state their absence.

Within hemodynamic stability, as discussed above, rocuronium offers great hemodynamic stability, confirming the information found in the literature.

Using different scales to assess intubating conditions as poor, regular, good and excellent conditions, results from various reviewed studies agree that intubating conditions were good to excellent in 95% of cases⁽⁵⁻⁸⁾.

CONCLUSION

This work was done in patients with scheduled surgery and gives us a foothold in the management of patients requiring urgent airway control due to good to excellent conditions were obtained using rocuronium, the sum of these conditions provides optimal intubating conditions in 100% of cases similarly to those offered by succinylcholine, but without the risk involved with its use.

From a hemodynamic perspective, our patients had good hemodynamic stability with rocuronium.

Rocuronium bromide is a non-depolarizing neuromuscular relaxants having faster onset of action and is emerging as a valid option when it is necessary to obtain quickly the airway.

REFERENCES

1. Álvarez-Gomes, Gonzáles-Miranda. Muscle relaxants in anesthesia and intensive care. Editorial ELA, Enero 1996:49-58,173-181.
2. Viñas P. Monitoring of neuromuscular blockade with rocuronium bolus and continuous infusion in laparoscopic cholecystectomy. <http://anestesia.kinta-dimension.com/areas/monografias/rocuronio.shtml>
3. Andújar R, De Larrobla M, Balverde M, Saralegui J. Comparison of tracheal intubating conditions obtained with rocuronium administered in inverse sequence and succinylcholine in rapid sequence. *Anesth Analg Reanim* 2001;17:13-19.
4. Sluga M, Ummenhofer W, Studer W, Siegemund M, Marsch SC. Rocuronium *versus* succinylcholine for rapid sequence induction of anesthesia and endotracheal intubation: A prospective, randomized trial in emergent cases. *Anesth Analg* 2005;101:1356-1361.
5. Bustamante R, Ramos M, Luxoro C, Varas M, Moreno A. Quality assessment of rocuronium intubation on a full stomach. *Rev Soc Anest de Chile*, Vol. 29, Octubre de 2000, N° 2. www.socanestesia.cl/rev_anestesia/0406/04-bloqueadores.asp
6. Aurelio-Otero R. Comparative study of intubating conditions between rocuronium bromide and succinylcholine in patients with full stomach. http://www.scare.org.co/rca/archivos/articulos/1997/vol_3/PDF/estudio_comparativo_de_las_condi.pdf
7. Contreras G, Chalita BJ. Induction of rapid sequence: Comparative study between rocuronium bromide and succinylcholine. *Rev Ven Anes* 1998;3:44-51.
8. Hernández-Revilla M, Ramírez-Hernández F, Guzmán-Sánchez J. Comparative evaluation of clinical conditions for tracheal intubation obtained with two brands of vecuronium. *Rev Méx Anest* Vol. 28. No. 2 Abril-Junio 2005:80-84.