# Rapid sequence induction and intubation with 1 mg/kg rocuronium bromide in cesarean section, comparison with suxamethonium

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## ABSTRACT

**Objective:** To demonstrate that Rocuronium Bromide can be used for rapid sequence induction in emergency conditions.

**Methods:** Our study was performed between December 2005 and May 2006 in Jordan University Hospital, Jordan. We studied the efficacy and intubating conditions after administrating of Rocuronium Bromide 1 mg/kg at 60 second in group of 60 pregnant women undergoing elective or emergency cesarean section and compared the results with those obtained after giving Suxamethonium 1 mg/kg at 60 seconds in a group of patients similar to the Rocuronium group.

**Results:** Intubating conditions after 1 mg /kg of Rocuronium Bromide were found to be acceptable (good and excellent) in 95% of patients and were similar to the Suxamethonium group (97%). The endotracheal tube could be passed through the vocal cards of all patients enrolled in the study.

**Conclusion:** Rocuronium Bromide 1 mg/kg can be safely used for rapid sequence induction in cesarean section and the intubating conditions are similar to those of Suxamethonium.

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Suxamethonium has been used clinically for rapid sequence induction of anesthesia for more than 50 years.[1] Due to its associated side effects, a lot of research has been carried out to find out a non-depolarizing muscle relaxant[2-4] to replace Suxamethonium. Among all non-depolarizing muscle relaxants available, Rocuronium Bromide offers the fastest onset of action due to its lower potency;[5] in addition, the intubating conditions at 60 seconds after administration of 0.6 mg/kg proved to be similar to Suxamethonium.[6] The results of these studies have been questioned because of the difference between the 2 drugs in the onset of action on the laryngeal muscles and the adductor pollicis.[7,8] Magorian et al[9] found that Rocuronium can have similar effects on laryngeal muscles if the dose ranged between 0.9-1.2 mg/kg, while Crul et al[10] found better intubation conditions at 60 seconds with the dose of rocuronium 0.9 mg/kg. It is worth mentioning that Crul et al[10] used alfentanil and propofol as part of the induction technique. Hemmerling et al[8] concluded that with a comparable degree of neuromuscular block, the onset time of Suxamethonium at the adductor pollicis was significantly shorter than for rocuronium 0.6 mg/kg and 0.9 mg/kg. Induction agent used during rapid sequence induction may have an influence on intubating conditions, this was proved by Skinner et al[11] who found that etomidate and rocuronium alone cannot be recommended for intubation at 60 seconds under rapid sequence induction conditions. Dobson et al[12] concluded that using rocuronium 0.6 mg/kg may be suitable in situations where Suxamethonium is contraindicated. Abouleish et al[13] found that using 6 mg/kg of thiopenton as an induction agent in cesarean section along with rocuronium 0.6 mg/kg provided 90% excellent/good intubating conditions. Improving intubating conditions can be carried out also by increasing the dose of neuromuscular blocking agent; Sakles et al[14] used 1 mg/kg of rocuronium in emergency department and concluded that intubation conditions were favorable at 45 seconds, and the use of Rocuronium

in the emergency department was useful. The purpose of our study is to evaluate the intubating conditions after using rocuronium bromide 1 mg/kg along with thiopenton 5 mg/kg as an induction agent in elective or emergency cesarean section, and to compare that with Suxamethonium 1 mg/kg as a control group.

**Methods.** After obtaining the approval of the ethical and IRB (Institutional Review Board) committees at Jordan University Hospital, an informed consent was taken from 120 patients American Society of Anesthesiologists (ASA) I-II who underwent either elective or emergency caesarean section under general anesthesia between December 2005 and May 2006. The sample size (N) was calculated using the following formula: $N=Z^2Pq/\delta^2$ (Where Z=1.96, P=20, q=1-P, $\delta^2$= the precision),[19] and it was found to be 96, therefore we increased the sample size to 120 to magnify the power of the study. All patients with neuromuscular disease, patients receiving anticonvulsant therapy or any other drug which may interfere with neuromuscular blocking agents and those patients expected to be difficult to intubate have been excluded from the study. Randomization was carried out by randomly shuffling sealed envelopes indicating the type of the muscle relaxant to be used for intubation. The patients were imparted into 2 groups, a control group of 60 patients received thiopenton 5 mg/kg and Suxamethonium (50mg/ml) in a dose of 1 mg/kg (group S), another 60 patients have received thiopenton 5 mg/kg and Rocuronium (10 mg/ml) in a dose of 1 mg/kg to facilitate rapid sequence induction and intubations of the trachea after 60 seconds (group R). Patients in the 2 groups were preoxygenated for 3 minutes. Heart rate, ECG, non-invasive blood pressure, $O_2$ saturation, Train of four (TOF) using a nerve stimulator ( Innervator® by Fisher & Paykel, New Zealand) at the ulnar nerve were all monitored in all patients. A 16G cannula was inserted in one of the largest veins of the dorsum of the non-dominant hand; a free flowing Hartman solution was then started. All the drugs were injected through the vein where the solution was running; induction agent (thiopenton 5 mg/kg) was given within 20 seconds. Cricoid's pressure was applied once the induction is started to be given and the muscle relaxant was only given after the loss of consciousness, which was determined by the loss of eye lash reflexes. Then we assessed the intubations conditions in the 2 groups during rapid sequence induction. Tracheal intubation was carried out by a senior anesthetist 60 seconds after finishing the muscle relaxant administration. The intubator who was blinded to the type of administered muscle relaxant was called to the theatre 40 seconds after the relaxant administration. Intubation was assessed by the intubator using a modified system used by Viby-Mogenson et al,[20] which included Jaw relaxation, position of the vocal cords, and diaphragmatic movement (**Table 1**). Each one of these variables was assigned to a value from the list: and the intubating conditions were classified as excellent, good, or poor. Intubating conditions were classified according to the worst variable so that intubation was considered excellent if all variables were

**Table 1 -** Modified Viby-Mogenson Grading system for intubation. Criteria used to attribute scores to each of 3 variables used in evaluating intubating condition.

| Criteria | Excellent | Good | Poor |
|---|---|---|---|
| Jaw relaxation | Relaxed | Relaxed | Poor relaxation |
| Vocal cord position | Abducted | Intermediate | Closed |
| Diaphragmatic activity | None | Diaphragm only | Sustained coughing |

**Table 2 -** Demographic characteristics.

| Characteristics | Rocuronium | Suxamethonium | *P*-value |
|---|---|---|---|
| Number | 60 | 60 | |
| Mean Age | 33.1 ± 4.9 | 31.2 ± 6.5 | 0.06 |
| Mean weight | 77.8 ± 13.9 | 78.1 ± 12.4 | 0.9 |
| Gravida (mean ± SD) | 4.0 ± 2 | 3.0 ± 3 | 0.3 |
| Para (mean ± SD) | 2.0 ± 2 | 2.0 ± 2 | 0.6 |
| *American Society of Anesthesiologists* | | | |
| 1 | 50 | 57 | |
| 2 | 10 | 3 | |

**Table 3 -** Intubating conditions.

| Intubating conditions | Rocuronium | Suxamethonium |
|---|---|---|
| Excellent | 20 (33) | 32 (53) |
| Good | 37 (62) | 26 (44) |
| Poor | 3 (5) | 2 (3) |

excellent. If one of the variables was good then the intubation condition was considered good, if one of the variables was poor then intubation conditions were considered poor. The TOF has been monitored at the ulnar nerve, the intubation has been carried out despite the number of the twitches seen, and the time of the disappearance of the 4 twitches was documented.

Statistical analysis was carried out using SPSS software version 12.0 for windows and statgraphics plus 5.1 professional software by statistical graphics corp (USA). Analysis of variance was carried out to study the differences both among and between the groups. The mean and standard deviation was expressed for all eligible data and the p value was considered to be significant ($p$<0.05).

**Results.** The age of the studied population ranged between 19-43 years with mean (+SD) of 33.1 (+4.9) for Rocuronium and 31.2 (+6.5) for Suxamethonium group ($p$=0.06), the mean weight for the rocuronium group was 77.8 and Suxamethonium group was 78.1 kg ($p$=0.9). The 2 groups had comparable number of pregnancies ($p$=0.06). American Society of Anesthesiologists classification in all of our studied population was either ASA-I or ASA-II (**Table 2**). The intubations conditions in the Rocuronium group and the Suxamethonium group are shown in (**Table 3**), where the Rocuronium group patients had an acceptable intubating conditions (excellent, good ) in 95% of cases (excellent in 20 cases [33%], good in 37 cases [26%], and poor in only 3 cases [5%]). In the Suxamethonium group, acceptable intubating conditions were found in 97% of the cases (excellent in 32 patients [53%], 26 patients [44%] had good conditions and only 2 patients [3%] had poor intubating). The differences between the Suxamethonium and Rocuronium groups in terms of acceptable intubating conditions were not statistically different (p=NS).

Mean arterial pressure (MAP) and heart rate were monitored in the 2 groups, MAP (+ SD) in the Suxamethonium group was 107 mm Hg (± 8) and for the Rocuronium group was 106 mm Hg (± 2.4) ($p$=0.4). Heart rate was 108 beats/minute (± 2) and 120 beats/minute (± 2) in the Suxamethonium and the Rocuronium groups respectively ($p$=0.01). The onset of a maximum block in the Suxamethonium and Rocuronium groups; determined by the intubator was 66 seconds (± 3.2) and 65.8 seconds (± 3.2). The results were not statistically significant, maybe due to the increasing dose of rocuronium to 1 mg/kg that also fasten the maximum block at the peripheral muscles.[6,14]

**Discussion.** The reason for which rapid sequence induction of anesthesia is used, is to prepare the upper airway of the patient in a manner in which it can be intubated and the airways are secured as quickly as possible. This condition is always needed in cesarean section under general anesthesia whether it is carried out as elective or emergency conditions. We studied clinically acceptable intubating conditions in patients undergoing cesarean section after giving Suxamethonium 1 mg/kg or Rocuronium 1 mg/kg along with thiopenton 5 mg/kg as an induction agent. The results of our study showed that under condition of real rapid sequence induction, intubating condition at 60 seconds were acceptable (excellent or good) in 95% of patients who received Rocuronium 1 mg/kg compared with 97% of patients who received Suxamethonium 1 mg/kg. Several previous studies have been carried out to replace Suxamethonium with nondepolarizing neuromuscular blocking agents during rapid sequence induction in cesareans section; examples include Vecuronium,[2] Pancuronium and Rapacurium.[3,4] None of these agents gained clinical acceptance, due to the delayed onset and long duration of action of these drugs. On the other hand, the rapid onset of action of Rocuronium - a nondepolarizing muscle relaxant of the amino steroid family - has been proven by Min et al[5] who concluded that the rapid onset of action of Rocuronium compared with Pancuronium or Vecuronium is due to its lower potency. The results of the early studies comparing the intubating conditions after using Rocuronium bromide in a dose of 0.6 mg/kg with Suxamethonium 1 mg/kg[6] have been questioned, due to the small number of studied patient and the differences in the onset of action of the 2 drugs on the laryngeal muscles and the adductor pollicis.[7,8] These results have been supported by de Rossi et al[15] wherein the onset of neuromuscular block occurs more rapidly at the muscles of the upper airway including the masseter muscle than the adductor pollicis. Increasing the dose of Rocuronium to 0.9-1.2 mg/kg was found to improve the incidence of acceptable intubation conditions in a manner similar to that of Suxamethonium at 60 seconds.[9,10,14] Such results are expected because Rocuronium has dose-related effects on the muscles of the upper airways. However, high doses are associated with longer duration of action, which is approximately 60 minutes. This prolongation of action was accepted in our conditions, knowing

that the duration of a cesarean section in our hospital ranges between 50-60 minutes. Induction agent used may influence the intubating conditions. Skinner et al[11] studied Etomidate and Rocuronium for rapid sequence induction and they found that combination cannot be used alone in these conditions. Dobson et al[12] found that Rocuronium bromide in a dose of 0.6 mg/kg along with propofol may be a suitable alternative for Suxamethonium during rapid sequence induction of anesthesia when the later is contraindicated. In another study, Abouleish et al[13] increased the dose of thiopenton to 6 mg/kg and combined that 0.6 mg/kg of Rocuronium, which resulted in 90% excellent to good intubating conditions; although they had to wait 80 seconds before attempting intubation. Rocuronium does not cross the placenta in significant amount,[13] we used 1 mg/kg of Rocuronium combined with Thiopentone 5 mg/kg, which is still the drug most widely, used as an induction agent in cesarean section. The results were comparable in terms of the number of acceptable intubating conditions in both groups. Using opioids as part of the induction technique in rapid sequence induction has a conflicting results; Fentanyl used by Weiss et al[16] did not improve the intubating conditions, while Crul et al[10] found that Alfentanil with Propofol was a useful combination to facilitate intubation. We could not use opioids as a part of our induction technique due to the fact that these drugs are lipid soluble, and they cross the placenta quickly causing respiratory depression to the fetus and affecting the Apgar score. There was a slight increase in the heart rate after 5 minutes following the induction, while there were no significant changes in the mean arterial blood pressure; this increase in the heart rate may be caused by the positive effects of rocuronium bromide on the cardiovascular system which reflects similarity between our results and the previous studies.[13,16-19]

In conclusion, we noticed that the intubating conditions after rocuronium bromide 1 mg/kg in emergency or elective caesarean section were similar to those obtained following the administration of Suxamethonium 1 mg/kg, and thus, Rocuronium can be used as an alternative to Suxamethonium for rapid sequence induction in caesarean section.

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