A comparative study to evaluate the effectiveness of timing principle and priming principle for tracheal intubation using rocuronium

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Abstract

The present study is to compare the "Timing principle" and the "Priming principle" for tracheal intubation using rocuronium during balanced anesthesia by assessing the Intubating conditions and Hemodynamic changes during intubation. The succinylcholine is considered to be the best drug for rapid tracheal intubation because of its rapid onset and ultrashort duration of the action. The “priming technique” uses a sub-paralyzing dose of non-depolarizing muscle relaxant where 20% of ED 95 or 10% of the intubating dose was administered 2 to 4 min before administering an intubating dose. This technique has been proved to accelerate the onset of action by 30 to 60 seconds. In “timing principle” a single bolus of non-depolarizing muscle relaxant was given followed by the administration of the induction agent after the first sign of the onset of clinical weakness. The “high – dose regimen” was used when tracheal intubation has to be accomplished in less than 60 – 90 seconds. The study was conducted in Madras Medical College, Chennai. The groups were comparable based on age and weight. Males were more in Group RP. Using the “Timing principle” with rocuronium 0.6 mg/kg consistently provides good to excellent intubating conditions at 60 seconds after the induction of anesthesia. Using the “Priming principle” with rocuronium 0.06 mg/kg followed by rocuronium 0.54 mg/kg consistently provides fair to good intubating conditions at 60 seconds after induction of anesthesia.

Keywords: Rocuronium, Tracheal Intubation, Priming Principle and Timing principle

Introduction

The objective of the present study is to compare the "Timing principle" and the "Priming principle" for tracheal intubation using rocuronium during balanced anesthesia by assessing the Intubating conditions and Hemodynamic changes during intubation. The succinylcholine is considered to be the best drug for rapid tracheal intubation because of its rapid onset and ultrashort duration of the action. Although succinylcholine is widely used for tracheal intubation, its use is associated with malignant hyperthermia, hyperkalemia (1) in susceptible patients, myalgia, raised intraocular pressure and raised intracranial pressure. Rocuronium was developed as an alternative to succinylcholine with the similar rapid onset but with minimal side effects. The induction technique was modified to reduce the onset time. The “priming technique” uses a sub-paralyzing dose of non-depolarizing muscle relaxant where 20% of ED 95 or 10% of the intubating dose was administered 2 to 4 min before administering an intubating dose. This technique has been proved to accelerate the onset of action by 30 to 60 seconds. In “timing principle” a single bolus of non-depolarizing muscle relaxant was given followed by the administration of the induction agent after the first sign of the onset of clinical weakness. The “high – dose regimen” was used when tracheal intubation has to be accomplished in less than 60 – 90 seconds.

Materials and Method

The study was conducted in Madras Medical College, Chennai after obtaining ethical committee approval. Informed consent was obtained from all the patients preoperatively. We evaluated the intubating conditions with rocuronium bromide as the muscle relaxant according to the timing principle and compared it with the priming principle using Rocuronium bromide. We chose sixty patients undergoing elective surgical procedure. In the operating room, they were randomly allocated to two groups, Group RT (ROCURONIUM TIMING) and Group RP (ROCURONIUM PRIMING). Group RT received rocuronium bromide 0.6 mg/kg and was intubated 60 seconds after the onset of clinical weakness. Group RP received a priming dose of rocuronium bromide 0.06 mg/kg and After 3 min, intubating dose of rocuronium 0.54 mg/kg was given, and patients were intubated after 60 seconds. The induction technique was modified to reduce the onset time. The “priming technique” uses a sub-paralyzing dose of non-depolarizing muscle relaxant where 20% of ED 95 or 10% of the intubating dose was administered 2 to 4 min before administering an intubating dose. This technique has been proved to accelerate the onset of action by 30 to 60 seconds. In “timing principle” a single bolus of non-depolarizing muscle relaxant was given followed by the administration of the induction agent after the first sign of the onset of clinical weakness. The “high – dose regimen” was used when tracheal intubation has to be accomplished in less than 60 – 90 seconds. All patients received Inj. Glycopyrrolate 5 µg/kg i. m. 45 min before induction as premedication. Inj. Fentanyl 12 µg/kg i. v. was administered to the patient on the table. Patients were informed that they might feel weak before going to sleep during anesthesia. They were also informed about the post-operation...
questionnaire. Patients were monitored using pulse oximetry, ECG, ETCO2, and noninvasive blood pressure. All patients were pre-oxygenated for 3 min. **Group RT:** In the Timing principle group, patients were asked to keep their eyes widely open as long as possible. Inj. Rocuronium 0.6 mg/kg was given. They were observed for the presence of pain on injection like withdrawal of hand. They were also closely observed for the first sign of clinical weakness, specifically the onset of ptosis. At this time, Inj. Thiopentone 5mg/kg was administered. 60 seconds after induction, tracheal intubation was performed by an experienced anesthesiologist who was unaware of the induction sequence. Intubating conditions were assessed according to the **Table 2.**

**Group RP:** In the priming group, first a priming dose of Rocuronium 0. 06mg/kg was given. 3 min later, patients were induced with Inj. Thiopeptone 5mg/kg, Inj. Rocuronium 0.54mg/kg and Inj. Lignocaine 1.5mg/kg. 60 seconds after induction, tracheal intubation was performed by an experienced anesthesiologist who was the induction sequence. Intubating conditions were assessed according to the Cooper scoring scale (Table 2).

**Table 1: Demographic data**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Group RT (n=30)</th>
<th>Group RP (n=30)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yrs)</td>
<td>30.60±9.67</td>
<td>32.20±12.18</td>
<td>0.580</td>
</tr>
<tr>
<td>Male/Female</td>
<td>15/15</td>
<td>23/7</td>
<td>0.060</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>50.30±8.09</td>
<td>53.3±10.93</td>
<td>0.230</td>
</tr>
</tbody>
</table>

**Table 2: Cooper Scoring Scale**

<table>
<thead>
<tr>
<th>Jaw Relaxation</th>
<th>Vocal Cord Position</th>
<th>Response to Intubation</th>
<th>Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impossible</td>
<td>Closed</td>
<td>Severe coughing or bucking</td>
<td>0</td>
</tr>
<tr>
<td>Difficult</td>
<td>Closing</td>
<td>Mild coughing</td>
<td>1</td>
</tr>
<tr>
<td>Fair</td>
<td>Moving</td>
<td>Slight diaphragmatic movement</td>
<td>2</td>
</tr>
<tr>
<td>Easy</td>
<td>Open</td>
<td>No movement</td>
<td>3</td>
</tr>
</tbody>
</table>

On confirmation of correct placement of the tube, controlled positive pressure ventilation was instituted using nitrous oxide and oxygen. Intubation was scored as excellent (8-9), good (6-7), fair (3-5)), and poor (0-2). Pulse rate and blood pressure of all the patients were recorded from the time of administration of Inj. Fentanyl and up to 5 min after intubation. Patients were also observed for any adverse effects like pain on injection, tachycardia, hypertension, bradycardia, hypotension, arrhythmia, laryngospasm, bronchospasm, anaphylactic/anaphylactoid reactions. All the patients were interviewed 4-24 hours after the surgical procedure, and following questions were asked.

1. Did he/she feel weak immediately before going to sleep for operation?
2. Did he/she feel short of breath immediately before going to sleep for operation?

**Statistical analysis:** The differences in the proportions are tested for statistical significance using nonparametric Chi-square test for variables measured on a nominal scale. When testing for two factors, the Mann-Whitney "U" test or Wilcoxon two-sample test is used. For variables measured on a continuous scale, when testing for two groups, Student "t" test was used.

**Results**

The groups were comparable based on age and weight. Males were more in Group RP.

The mean intubation time was 81.80±3.42 seconds in Group RT and 76.60±4.49 seconds in Group RP, the difference is statistically significant (p <0.001).

The Intubating conditions were assessed according to the Cooper scoring scale, and the results are shown in Table 3. According to SCR score patients were distributed and more number of cases were in "score 2" among Group RP than Group RT. Moreover, Group RT has more no. of cases in score three than Group RP, which is statistically significant. The distribution of cases in score 1 and score three between Group RT and Group RP were found to be statistically insignificant. But the distribution of cases in score 2 (moving) found to be significant with more no. of cases in Group RP. The distribution of cases in score 1 and score three between Group RT and Group RP were found to be statistically insignificant. But the distribution of cases in score 2 (slight diaphragmatic movement) found to be statistically significant with more no. of cases in Group RP. The distribution of cases by SCR-Total scoring status categories and the two groups was observed to be statistically significant. Group RP has more number of cases in fair to good intubating conditions, while Group RT has more number of cases in good to excellent intubating conditions. **(Table 3)**
Table 3: Intubating conditions

<table>
<thead>
<tr>
<th>Scoring</th>
<th>Group RT (n=30)</th>
<th>Group RP (n=30)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>SCR-Jaw relaxation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Score 0: Nil</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Score 1: Mild</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Score 2: Moderate (Fair)</td>
<td>11</td>
<td>36.7</td>
<td>22</td>
</tr>
<tr>
<td>Score 3: Good (Easy)</td>
<td>19</td>
<td>63.3</td>
<td>8</td>
</tr>
<tr>
<td>SCR-Vocal cords</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Score 0: Closed</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Score 1: Closing</td>
<td>0</td>
<td>0.0</td>
<td>1</td>
</tr>
<tr>
<td>Score 2: Moving</td>
<td>2</td>
<td>6.7</td>
<td>13</td>
</tr>
<tr>
<td>Score 3: Open</td>
<td>28</td>
<td>93.3</td>
<td>16</td>
</tr>
<tr>
<td>SCR-Response to intubation</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Score 0:</td>
<td>0</td>
<td>0.0</td>
<td>0</td>
</tr>
<tr>
<td>Score 1: Mild coughing</td>
<td>0</td>
<td>0.0</td>
<td>2</td>
</tr>
<tr>
<td>Score 2: Slight diaphragmatic movement</td>
<td>13</td>
<td>43.3</td>
<td>19</td>
</tr>
<tr>
<td>Score 3: None</td>
<td>17</td>
<td>56.7</td>
<td>9</td>
</tr>
<tr>
<td>SCR-T</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scores 3-5: Fair</td>
<td>4</td>
<td>13.3</td>
<td>23</td>
</tr>
<tr>
<td>Scores 6-7: Good</td>
<td>18</td>
<td>60</td>
<td>7</td>
</tr>
<tr>
<td>Scores 8-9: Excellent</td>
<td>8</td>
<td>26.7</td>
<td>0</td>
</tr>
</tbody>
</table>

The mean systolic blood pressure values were lesser in Group RT than Group RP. The difference in the mean values of systolic blood pressure was observed to be not statistically significant between Group RT and Group RP at all the time points studied. The mean diastolic blood pressure values were lesser in Group RT than Group RP until two min after intubation and was either the same or higher after that. The difference in the mean values of diastolic blood pressure was observed to be not statistically significant between Group RT and Group RP at all the time points studied. The mean MAP values were lesser in Group RT than Group RP. The difference in the mean values of MAP was observed to be not statistically significant between Group RT and Group RP at all the time points studied. The mean pulse rate values were lesser in Group RT than Group RP at all time points measured which was not statistically significant. There was no tachycardia in both the groups. (Table 4) Sp02 was 100% in both the groups throughout the surgical procedure (before induction, at induction, at intubation, one, two three min and five min after intubation).

Pain developed in 2 patients among Group RT and one patient among Group RP cases. Hypertension was encountered in 7 (23%) among Group RP and 5 (17%) among Group RT, the difference being statistically not significant (p=0.740). We encountered adverse effects in 8 (26.7%) among Group RP and 7 (23.3%) among Group RT (statistically not significant,(p=0.770).
nsion (14) -
econds after thiopentone induction agent (9) - timing dose of vecuronium. This muscle relaxant. Timing principle was introduced by reduce the effective onset time of the non-depolarizing agent at the earliest sign of the onset of clinical weakness. The objective of the timing principle is to induce general anesthesia and muscle relaxation simultaneously rather than sequentially and also to reduce the effective onset time of the non-depolarizing muscle relaxant. Timing principle was introduced by Culling et al. (6) in 1989. This technique has been applied to produce good intubating conditions rapidly with non-depolarizing muscle relaxants. In this technique, the time from the induction of anesthesia to complete relaxation is reduced, and the peak effects of the muscle relaxant and the intravenous induction agent may closely coincide. In the timing principle, the induction sequence is individualized on the onset of clinical weakness. Koyoma K, Katayama et al. (10) in their study has demonstrated that excellent intubating conditions can be attained 70 seconds after thiopentone administration using timing principle with vecuronium. Koyoma k, et al. (11) has shown that timing principle along with small priming doses of vecuronium is safe for rapid tracheal intubation.

<table>
<thead>
<tr>
<th></th>
<th>2-min. after intubation</th>
<th>3-min. after intubation</th>
<th>5-min. after intubation</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>133. 10±17.24</td>
<td>136. 40±16.41</td>
<td>126. 70±13.47</td>
</tr>
<tr>
<td>p-value</td>
<td>0. 460</td>
<td>0. 310</td>
<td>0. 700</td>
</tr>
<tr>
<td></td>
<td>89. 20±12.30</td>
<td>92. 20±10.35</td>
<td>87. 10±10.23</td>
</tr>
<tr>
<td></td>
<td>104. 20±112.79</td>
<td>106. 50±11.69</td>
<td>99. 60±11.89</td>
</tr>
<tr>
<td></td>
<td>102. 90±11.78</td>
<td>108. 70±14.37</td>
<td>100. 40±13.56</td>
</tr>
</tbody>
</table>

Discussion

The cardinal requirements of General anesthesia are a loss of all sensation, sleep (unconsciousness), muscle relaxation and the abolition of reflexes. In the modern practice, these modalities are achieved by using a combination of drugs with each drug having a specific purpose.

In high-risk patients who are prone to aspiration, RSI is the preferred technique of induction. Succinylcholine continues to be the relaxant of choice as it consistently provides muscle relaxation within 60 to 90 sec and enables rapid tracheal intubation. Non-depolarizing muscle relaxants are used in RSI usually as pre-curarization. When succinylcholine is undesirable or contraindicated, the onset of action of non-depolarizing neuromuscular blocking drugs can be accelerated by using high doses of an individual agent or by a combination of relaxants or by giving a priming dose of the relaxant before intubating dose. Recently, timing principle using non-depolarizing muscle relaxants have been used in RSI as it provides ideal intubating conditions within 60 – 90 sec. Silverman et al. (7) demonstrated that the timing principle for RSI is a reliable alternative in cases where Succinylcholine is contraindicated. Mohamed Naguib (8) has shown that priming a vecuronium block with vecuronium resulted in a neuromuscular block similar to that of succinylcholine both in the onset of action and in intubating conditions. Musich & Walts (9) demonstrated that pulmonary aspiration of gastric contents has been associated with a priming dose of vecuronium. This may be due to the rapid onset of the muscle relaxant at the adductor muscles of the larynx, as compared to the adductor pollicis. A similar potential risk may exist when the timing principle technique is used.

Timing Principle: Timing principle involves the administration of a single bolus dose of a non-depolarizing muscle relaxant in an adequately pre-medicated patient followed by the administration of the induction agent at the earliest sign of the onset of clinical weakness. The objective of the timing principle is to induce general anesthesia and muscle relaxation simultaneously rather than sequentially and also to reduce the effective onset time of the non-depolarizing muscle relaxant. Timing principle was introduced by Culling et al. (6) in 1989. This technique has been applied to produce good intubating conditions rapidly with non-depolarizing muscle relaxants. In this technique, the time from the induction of anesthesia to complete relaxation is reduced, and the peak effects of the muscle relaxant and the intravenous induction agent may closely coincide. In the timing principle, the induction sequence is individualized on the onset of clinical weakness. Koyoma K, Katayama et al. (10) in their study has demonstrated that excellent intubating conditions can be attained 70 seconds after thiopentone administration using timing principle with vecuronium. Koyoma k, et al. (11) has shown that timing principle along with small priming doses of vecuronium is safe for rapid tracheal intubation.

Time of onset of Clinical Weakness

Sieber T. et al. (12) in their study using the timing principle with rocuronium used ptosis as the marker of earliest sign of clinical weakness as the neuromuscular block at the orbicularis oculi and the levatorpalpebraesuperioris are similar. Debaene et al. (13) demonstrated that the onset of neuromuscular block in the diaphragm was faster than adductor pollicis but similar to orbicularis oculi. Beoit Plaud et al. (14) in his study has stated that the corrugator superciliiariss and not the orbicularis oculi reflect the neuromuscular block at the laryngeal adductors. In our study, we used ptosis as the marker of earliest sign of clinical weakness.

Sieber T. et al. (12) used Inj. Midazolam and Inj. Fentanyl before induction. In our study, we used Inj. Fentanyl alone before induction of anesthesia as Inj. Midazolam can cause anterograde amnesia and find out if patients were satisfied with the technique postoperative would then be difficult to interpret. As we wanted to assess the true extent of discomfort/satisfaction in our study.

Postoperative questionnaire, only two patients in the Group RT and no patient in Group RP complained about weakness and shortness of breath before induction of anesthesia.

When the timing principle is used, the initial signs of clinical weakness precede loss of consciousness. A potential risk, therefore, is that patients would experience an uncomfortable feeling during the induction sequence. In our study, only two patients demonstrated restlessness at the time when ptosis was observed. This suggests that patient satisfaction with
the manner in which they went to sleep (in response to
the post-op questionnaire) was not because of amnestic
effects of anesthetics, but because the degree of muscle
weakness present was not associated with discomfort.
The restlessness was subjective as there was no
evidence of desaturation while observing for the first
sign of clinical weakness (ptosis).

**Priming Principle:** Several groups of investigators
have suggested giving a small sub-paralyzing dose of
the non-depolarizer (about 20% of ED 95 or about 10%
of the intubating dose) 2 to 4 min before administering
a second larger dose for tracheal intubation. This
procedure termed ‘priming’ has been shown to
accelerate the onset of the block of most non-
depolarizing neuromuscular blockers by about 30 to 60
seconds, with the result that intubation can be
performed within approximately 90 seconds after the
second dose. Rocuronium bromide and mivacurium
chloride are non-depolarizing neuromuscular blocking
agents that have been recently introduced to clinical
practice. Rocuronium has a brief onset but an
intermediate duration of action. Rocuronium may be the
muscle relaxant of choice for Priming techniques
because of it the rapid onset of action than the other
non-depolarizing muscle relaxants. Griffith KE, et al
demonstrated that priming with rocuronium 0.06mg/kg
followed three min later by rocuronium 0.54mg/kg
resulted in a neuromuscular block similar to that of
Succinylcholine.\(^{(15)}\)

**Intubating Conditions:** There are three methods to
appropriately time the tracheal intubation: Clinical
judgment, Neuromuscular monitoring either by twitch
suppression (maximum blockade) or TOF ratio, or by
fixed time after the administration of neuromuscular
blocking agent such as 60 seconds, 90 seconds, 120
seconds, etc. The technique using judgment alone is
relatively insensitive. S. Agoston\(^{(16)}\) has demonstrated that
meticulous recording of onset of neuromuscular block at adductor pollicis is probably obsolete. Use of
single standardized qualitative rating scale for the
assessment of intubating conditions is required to
compare data from various studies. So we used scales
that assess clinical criteria only to evaluate the quality
of tracheal intubation.

Many factors influence the intubating conditions,
the most important of which are the degree of
relaxation of the muscle involved, the depth of
anesthesia, the anatomy of the upper airways and the
skill of the anesthetist. The superior intubating
conditions due to succinylcholine is not only because of
its rapid onset of action but also because of its greater
potency at the laryngeal muscles than other
nondepolarizing neuromuscular blocking drugs.
However, Naguib M et al.\(^{(8)}\) have demonstrated that
the priming technique can be made to provide better
intubating conditions for tracheal intubation in less than
90 seconds.

Intubating conditions were assessed in our study
with the Cooper scoring scale which takes into
consideration the ease of laryngoscopy, the position of
the vocal cords during scope and the diaphragmatic
response to tracheal intubation. Group RT and Group
RP differed significantly on the intubating conditions.
The intubating condition was fair in 13.3% and 76.7%
in Group RT and Group RP; while good in 60% and
23.3% in Group RT and Group RP respectively. The
intubating condition was excellent in 26.7% of patients
in Group RT. Twenty-two patients in Group RP had
moderate (fair) jaw relaxation compared to eleven
patients in Group RT. Thirteen patients in Group RP
had vocal cords moving compared to two patients in
Group RT. Nineteen patients in Group RP had slight
diaphragmatic movement compared to thirteen patients
in Group RT. This difference in the diaphragmatic
movement was the reason for the discrepancy in the
ratio of excellent to fair intubating conditions between
Group RT and Group RP. In our study, we observed
that the mean time for intubation using priming
principle is 75s and resulted in fair (76.7%) to good
(23.3%) intubating conditions. The average time for
intubation using timing principle is 82 s and resulted in
good (60%) to excellent (26.7%) intubating conditions.

I. Redai and S. A. Feldman\(^{(17)}\) demonstrated that
rocuronium is ineffective at priming rocuronium, and
both rocuronium and vecuronium reduced the onset
time of vecuronium block when given as priming
agents. Rocuronium is an unusual drug in that its onset
time is rapid compared to recovery time. Rapid onset
time might be due to an early pre-synaptic site of
action. An early pre-synaptic action would be of little
effect in accelerating the onset of a drug already
possessing this action, and this would explain its
ineffectiveness at priming itself. This may be the reason
for the fair to good intubating conditions using priming
principle in our study.

**Hemodynamic Changes:** Koyama et al.\(^{(18)}\) examined
the circulatory response to intubation when timing
principle was used with vecuronium. They concluded
that the increase in blood pressure and the heart rate
were significantly lower in the timing principle group
than those in the succinylcholine group. They attributed
it to the peak cerebral effect of thiopentone during
intubation. Smith and Saad\(^{(19)}\) showed that rocuronium
was better than vecuronium for intubation but with no
significant reduction in the hemodynamic response to
intubation. In our study, there was no statistically
significant difference in the hemodynamic parameters
between the groups. The maximum mean systolic BP
was 147.7 and 150.0 mmHg, maximum mean diastolic
BP was 98.5 and 102.0 mmHg, maximum mean MAP
was 114.7 and 118 mmHg, and maximum mean heart
rate was 102.9 and 108.7 beats per minute for Group

**References**
RT and Group RP respectively. The lack of significant difference might be due to the peak cerebral effect of the anesthetics at the time of intubation in timing principle.

Incidence of Adverse Effects: There are reports of various adverse effects to rocuronium bromide. Pain on injection, hypotension, wheal response, flushing, bronchospasm, and anaphylaxis are possible after the administration of rocuronium. In the study conducted by Thomas, J. Sieber et al.,(20) 5 out of the 30 patients who received Inj. Rocuronium withdrew their forearm. But they did not conclude whether it was because of the pain on injection. K. F. Cheong and W. H. Wong(21) in their study found that lignocaine given before the administration of rocuronium reduced the incidence and severity of pain on injection of rocuronium. In our study, only two patients in Group RT and one patient in Group RP withdrew their forearm during injection of rocuronium. We hypothesize that these two patients might have withdrawn their forearm due to painful stimulus as all other patients had a prior administration of lignocaine. Hypertension was found in 5 patients in Group RT and seven patients in Group RP. Tachycardia was absent in both the groups. The incidence of adverse effects in both the groups is found to be statistically insignificant.

Conclusion

Using the “Timing principle” with rocuronium 0.6 mg/kg consistently provides good to excellent intubating conditions at 60 seconds after the induction of anesthesia. Using the "Priming principle" with rocuronium 0.06 mg/kg followed by rocuronium 0.54 mg/kg consistently provides fair to good intubating conditions at 60 seconds after induction of anesthesia. There are no significant alterations in the hemodynamic parameters during induction with rocuronium used as per the timing principle and the priming principle.

References