A COMPARATIVE STUDY OF ROCURONIUM, VECPERONIUM AND SUCCINYLCHOLINE FOR RAPID SEQUENCE INDUCTION OF ANAESTHESIA.

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SUMMARY
The study was carried out in 90 patients aged 16-60 years, of ASA I - II and Mallampati I - II who were scheduled to undergo various surgeries under general anaesthesia. The patients were divided into three groups. All the groups were compared for the time of onset of muscle relaxation, intubating conditions, and haemodynamic changes. Anaesthesia techniques for all the groups were the same with difference in the neuro-muscular blocking agent given for intubation. After induction, succinylcholine 1.5 mgkg⁻¹, rocuronium 0.6 mgkg⁻¹ and vecuronium 0.1 mgkg⁻¹ were given to patients of group I, II and III respectively. Analysis of the results were as follows: Succinyl choline and rocuronium have statistically comparable duration of onset of muscle relaxation while vecuronium took significantly longer time. Succinylcholine and rocuronium produced good to excellent intubating conditions in all patients at 90 seconds whereas that of vecuronium was acceptable in only 83.3% of cases. Vecuronium showed remarkable cardiovascular stability while slight tachycardia was observed with rocuronium and a rise in blood pressure with succinylcholine.

Keywords : Succinylcholine, Rocuronium, Vecuronium, Rapid sequence induction.

Introduction
In the present day practice, muscle relaxation is used to serve two prime purposes; one, to facilitate endotracheal intubation and the other, to provide surgical relaxation. The time interval from the suppression of protective reflexes by induction, to accomplishment of intubation is a critical period, during which regurgitation and tracheobronchial aspiration of acid gastric contents can occur most frequently. Rapid sequence intubation is proved to be the technique of choice in these situations. The ideal neuro-muscular blocking agent for rapid sequence intubation should have a fast onset, brief duration of action, provide profound relaxation and be free from haemodynamic changes.

Succinylcholine, is the gold standard muscle relaxant for rapid sequence intubation. When succinylcholine is undesirable or contraindicated, the non-depolarizing neuromuscular blocking agents are used for this purpose. But none of the nondepolarisers available are found to be consistently effective. Newer, rapidly acting agents like rocuronium and mivacurium have given promising results in rapid sequence intubation, but their availability and cost, limit their routine use. This study is aimed at determining the efficacy of rocuronium, a newer non-depolarizing neuromuscular blocking agent for rapid sequence intubation in the local population. We have also tried to compare its action to the routinely used non-depolarizing neuromuscular blocking agent vecuronium and the gold standard succinylcholine.

Material and methods
For this study, 90 patients of ASA I - II and Mallampati I - II, aged 16 to 60 years and of either sex were selected. Height and weight criteria were not taken into account. All the patients were elaborated about the study and a written consent was obtained. They were randomly divided into three groups.

Group I (n-30): received succinylcholine 1.5 mgkg⁻¹ body weight
Group II (n-30): received rocuronium 0.6 mgkg⁻¹ body weight
Group III (n-30): received vecuronium 0.1 mgkg⁻¹ body weight

After noting preoperative pulse rate, SpO₂ and blood pressure, they were pre-medicated with atropine 0.6 mg I.V. Patients were pre-oxygenated with 100% oxygen for three minutes. Anaesthesia was induced with 2.5% thiopentone 3-5 mgkg⁻¹ I.V. After loss of consciousness, each patient received respective neuromuscular blocking agent I.V. as a single bolus over 5 seconds. The time was noted. They were allowed to...

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breathe 100% oxygen by the face mask of a semi-closed Magill circuit till respiration had stopped completely or only weak diaphragmatic contractions were left. This time was also noted. IPPV was then gently started with 100% oxygen. The time of onset of action was taken from the completion of injection of neuro-muscular blocking agent to the cessation of respiration.

Laryngoscopy was performed and intubating conditions were assessed at 60 seconds after injection of neuromuscular blocking agent and if found unsatisfactory, lungs were ventilated and patients were reassessed at further intervals of 30 seconds (90 S, 120 S, 150 S, 180 S) till the intubating conditions were found to be good to excellent. Endotracheal intubation was then done with appropriate sized cuffed endotracheal tube. The lungs were subjected to controlled ventilation via Bain’s circuit.

Table - 1 : Cooper et al scoring system.

<table>
<thead>
<tr>
<th>Score</th>
<th>Jaw relaxation</th>
<th>Vocal cord</th>
<th>Response to intubation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Poor</td>
<td>Closed</td>
<td>Severe coughing/bucking</td>
</tr>
<tr>
<td>1</td>
<td>Nominal</td>
<td>Closing</td>
<td>Mild cough</td>
</tr>
<tr>
<td>2</td>
<td>Moderate</td>
<td>Moving</td>
<td>Slight diaphragmatic movement</td>
</tr>
<tr>
<td>3</td>
<td>Good</td>
<td>Open</td>
<td>None</td>
</tr>
</tbody>
</table>

Individual scores were added to give overall intubation score. An intubation score of 8-9 was considered excellent, 6-7 good, 3-5 poor and 0-2 bad. Good to excellent intubation score were taken as clinically acceptable.

The intubating conditions were graded using ‘Cooper et al’ scoring system (table 1).5 The signs of histamine release (bronchospasm, rashes, hypotension) and fasciculations were noted. Anaesthesia was maintained with nitrous oxide along with oxygen (60: 40) and halothane. The vital signs of the patient were noted shortly after giving neuro-muscular blocking agent, immediately after performing intubation and then at 5 minutes, 10 minutes, 20 minutes and 30 minutes after intubation. The duration of action of neuromuscular blocking agent was taken as the time period from injection of intubating dose of neuromuscular blocking agent to return of spontaneous respiration. The muscle paralysis was maintained with subsequent doses of non-depolarizing neuro-muscular blocking agent.

At the end of surgery, all anaesthetics were stopped and 100% oxygen was given. Respiratory efforts were allowed to return and residual neuromuscular blockade was reversed with slow I.V. injection of neostigmine 0.05 mgkg⁻¹ and 0.02 mgkg⁻¹ atropine.

When respiration became normal and tidal volume was adequate, extubation was done. After extubation, patients were oxygenated with 100% oxygen for 5 minutes and shifted to post operative ward. All the results were compiled, compared and analysed statistically.

**Results**

Table - 2 : Demographic profile of different study group.

<table>
<thead>
<tr>
<th></th>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
</tr>
</thead>
<tbody>
<tr>
<td>n</td>
<td>30</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Age (Years)</td>
<td>40.63±10.08</td>
<td>40.1±9.83</td>
<td>40.37±9.01</td>
</tr>
<tr>
<td>Weight (Kg)</td>
<td>59.3±14.02</td>
<td>59.23±13.83</td>
<td>59.1±13.53</td>
</tr>
<tr>
<td>Male:Female</td>
<td>18:12</td>
<td>20:10</td>
<td>17:13</td>
</tr>
</tbody>
</table>

Table - 3 : Onset of action in different study groups. (Time interval from injection of neuro-muscular blocking agent to cessation of respiration).

<table>
<thead>
<tr>
<th>Onset of action (Sec)</th>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
</tr>
</thead>
<tbody>
<tr>
<td>21 – 30</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>31 – 40</td>
<td>17</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>41 – 50</td>
<td>11</td>
<td>13</td>
<td>0</td>
</tr>
<tr>
<td>51 – 60</td>
<td>0</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>61 – 70</td>
<td>0</td>
<td>6</td>
<td>5</td>
</tr>
<tr>
<td>71 – 80</td>
<td>0</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>81 – 90</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>91 – 100</td>
<td>0</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>101 – 110</td>
<td>0</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>111 – 120</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>Mean±SD</td>
<td>46.69±14.78</td>
<td>53.67±11.87</td>
<td>78.20±14.89</td>
</tr>
</tbody>
</table>

Table - 2 shows that there is a statistically even distribution of age, weight and sex among all the groups. Table - 3 shows that the mean time of onset of action of group I was 46.69±14.78 sec, of group II was 53.67±11.87 sec and of group III was 78.20±14.89 sec. Statistically, there was no significant difference in the time of onset between group I and group II (p>0.05), but the time of onset was significantly longer in group III when compared to other two groups (p<0.001).
the stress of intubation. Fig. 3 shows a statistically significant change in mean blood pressure in group I after administration of the drug (89.91 mmHg to 91.34 mmHg) while the changes in group II and group III are not statistically significant. There is a significant change in mean blood pressure in all the three groups just after intubation, which could be attributed to the stress of intubation.

Fig. 1 shows the quality of intubating conditions at 60 seconds after the administration of neuro-muscular blocking agents. It clearly depicts the advantage of succinyl choline over the other groups. In group I 96.7% of cases had acceptable intubating conditions at 60 seconds, out of which 90% were excellent. In group II, 90% of patients showed acceptable intubating conditions, which were graded excellent in 70% cases. None of the patients had excellent intubating conditions at 60 seconds in group III and only 13% showed acceptable intubating conditions.

Fig. 2 shows the comparison of changes in mean pulse rate in different study groups. It is evident from fig. 2 that just after injection of the drug, statistically there is no significant change in mean pulse rate in group I and group III but group II shows a significant change in mean pulse rate (4-5 beats/minute⁻¹). All the groups are showing a significant change in mean pulse rate just after intubation; this change could be due to the onset of action.

Discussion

In the present study, onset of action of neuromuscular blocking agents was assessed by clinical methods, which depended on the onset of apnoea and cessation of chest movements. The mean time for the onset of action of succinylcholine (1.5 mgkg⁻¹) was 46.69±14.78 seconds, which is consistent with Puhringer et al⁶ [0.8 minutes] and Magorion et al⁷ [50±17 seconds]. Rocuronium had shown the mean onset time to be 53.67±11.87 seconds, which is consistent with the results of Cooper et al [45-59 seconds depending upon the dose (0.5 – 0.9 mgkg⁻¹)]. But Folds et al⁸ and Wierda et al⁹ reported considerably longer time.

In the study, the mean time of onset for vecuronium (0.1 mgkg⁻¹) was 78.2±14.89 seconds. Viby et al¹⁰ found the onset of action to be 77.4±16.50 seconds and Cason et al¹¹ found it to be 85±27 seconds. Hence our results are consistent with theirs.

The intubating conditions were assessed by Cooper et al scoring system. In our study, succinylcholine showed acceptable intubating conditions in 96.70% of cases at 60 seconds, out of which 90% were excellent. Our findings are consistent with that of Goldberg et al¹² and Cooper et al⁵ who found good to excellent intubating conditions in most patients at 60 seconds.
In rocuronium group, 90% of cases had acceptable intubating conditions at 60 seconds out of which 70% were excellent and at 90 seconds all patients had acceptable intubating conditions. Wierda et al. found that intubating conditions were good to excellent one minute after administration of rocuronium at a neuromuscular block of 88%. Zhou et al. showed that 84% of cases had good to excellent intubating conditions at 60 seconds after rocuronium. These results are consistent with ours. At 60 seconds, the rocuronium showed good jaw relaxation in 86.70% cases and fully relaxed vocal cords in 93.3% cases. But 56.70% patients showed mild coughing, reason being the delayed effect of rocuronium on diaphragm.14

In our study, vecuronium group had acceptable intubating conditions in only 13.3% cases at 60 seconds and none of them were excellent. At 90 seconds 83.3% cases had acceptable intubating conditions of which 33.3% were excellent. All except one patient showed acceptable intubating conditions at 120 seconds, who was intubated at 150 seconds with excellent intubating conditions. The optimum time of intubation with vecuronium was found to be 90-120 seconds. Our results were consistent with that of Agoston et al. who found that with a dose of 0.08 mgkg⁻¹ vecuronium provided ideal intubating conditions with complete relaxations of cords at 90-100 seconds. Mayer et al. stated that satisfactory intubating conditions were found with vecuronium at 60 seconds and none of them were excellent. At 90 seconds conditions were acceptable in all the patients but excellent in only 25%.

The results of our study showed that rocuronium as well as succinylcholine produced better intubating conditions than vecuronium at 60 and 90 sec. Wierda et al. compared intubating conditions of rocuronium and vecuronium at 90 sec and found that good to excellent intubating conditions were present in all the patients in rocuronium group at 90 seconds and only in 80% cases in vecuronium group (only 30% were excellent). Boek et al. found better intubating conditions with rocuronium than vecuronium at 90 seconds. These results are consistent with our results.

In the present study, preoperative values of pulse rate and blood pressure were taken as control. Among all the three groups, rocuronium group showed slight tachycardia (4-5 beats per minute) in 63% patients just after the injection of the drug. These results are consistent with Booth et al. who reported that during first minute following injection of rocuronium, heart rate increased by 36%.

There was a significant change in mean arterial pressure just after administration of succinylcholine. The findings are consistent with Theshelf et al. who reported that there was a rise in blood pressure following succinylcholine and it was explained on the basis of stimulation of the autonomic ganglion.

The findings of rise in heart rate and mean arterial pressure in all the groups just after intubation is due to the stress response of intubation.

It was concluded from this study that rocuronium produces intubating conditions which are satisfactory in comparison to succinylcholine. Rocuronium is haemodynamically stable except for a slight tachycardia and has no adverse effects. It may be a suitable alternative for succinylcholine during rapid sequence induction especially in patients who are at risk of adverse effects of succinyl choline. Vecuronium which is also haemodynamically stable with no adverse effects, but for its delayed onset of action, cannot be considered as a better alternative to rocuronium and succinylcholine for rapid sequence induction.

References