INTRODUCTION:
Rapid Onset of a neuromuscular blocking agent is one of the important properties to be considered for its choice in endotracheal intubation. For a long period, "Suxamethonium" – a muscle relaxant was practised as the gold standard for its rapid onset, brief duration and good intubation conditions. However, its side effects(Verheijen D Fau - Nizankowska et al.) associated with its mechanism of action posed a clinical need of newer research molecules without such side effects. This led to advent of "Vecuronium" and "Atracurium" with shorter onset times(Pasko-Majewska, Owczuk R Fau - Wujtewicz, & Wujtewicz). However, these drugs were less efficient to facilitate intubation. It is a non-depolarizing monoquaternary aminosteroid compound. Due to paucity of data on comparative effectiveness of R versus V, we aimed to investigate non-inferiority of R in onset time, intubation conditions and duration of action compared to V. We also aimed to evaluate comparative hemodynamic difference induced by both drugs.

MATERIALS AND METHODS:
After obtaining institutional approval at Dhiraj General Hospital, Pipariya, sixty(n=60) consented patients of ASA I&II of both sexes aged 18 to 60 years ,weighing 42 to 80 kgs undergoing general anesthesia and surgery were included in double blinded parallel-group randomized fashion with two equal sized (n=30 in each group) groups : Group R(Rcuronium intubating dose 0.6mg/kg and maintenance dose 0.15mg/kg) and and Group V(Vecuronium intimating dose 0.1mg/kg and maintenance dose 0.02mg/kg). The patients with neuromuscular disease or disorder, increased risk of pulmonary aspiration, Mallampati grade III & IV,medication known to influence neuromuscular function, anticipated difficult intubation, previous administration of antihistaminic or antibiotics 24 hrs before surgery were excluded from study. Pregnant female patients were also excluded from the study.

Clinical Intervention:
A. Patient Preparation:
After detailed pre-anesthetic evaluation with all patients taking no oral intake 6-8 hours prior induction, peripheral venous line was secured with 18 Gauge venous cannula and LV infusion was started. Baseline H/R, BP, SpO2 were recorded and ECG was monitored using BPL Excello Pro monitor followed by premedication with Inj. Glycopyrrolate 0.2 mg , Inj. Ondensetron 4 mg , Inj Midazolam 1mg and Inj Tromadol 1.5 mg/kg IV. 10 min before induction.

B. Induction and maintenance:
All patients were pre-oxygenated with 100% O2 for 3 minutes. Surface electrode were fixed on ulnar side of volar surface of wrist and connected to peripheral nerve stimulator.All patients were induced with Thiopentone 5-7 mg/kg I.V. After the loss of consciousness(loss of eyelid reflex), Train of Four(TOF) reading was obtained with peripheral nerve stimulator(INMED make, model Ns100).

The response to stimulation of ulnar nerve at the wrist was monitored using surface electrodes placed after cleaning the skin. A supramaximal stimulus was delivered using frequency of 2 Hz and a current strength ranging 30-50 mA. The number of responses of adductor pollicis following ulnar nerve stimulation at the wrist was counted. After recording baseline TOF reading, the test neuromuscular blocking drug was injected. The patients randomly received an injection of equivalent doses of either Rocuronium 0.6 mg/kg (Group -R) or Vecuronium 0.1mg/kg (Group-V) for tracheal intubation. The response of adductor pollicis to a TOF stimulation every 15 seconds was monitored.

After administration of muscle relaxant endotracheal intubation was attempted every 30s in beginning, 60s after drug administration until intubation could be achieved with good or excellent condition and TOF' count was noted at the time of intubation. The intubating condition was evaluated and score on a scale based on Cooper et al (Gupta & Kirubahar, 2010) grading was noted -Systolic BP, diastolic BP, HR were recorded at 1,5,10,15 minutes after intubation and thereafter every 15 minutes throughout the surgery in both groups.

Table - 1: Cooper et al. Score of Intubating conditions' scales

<table>
<thead>
<tr>
<th>Score (Cooper et al) (Cooper, Mirakhar RK Fau - Clarke, Clarke Rs Fau - Boules, &amp; Boules)</th>
<th>Jaw relaxation</th>
<th>Vocal cords</th>
<th>Diaphragmatic response</th>
</tr>
</thead>
<tbody>
<tr>
<td>Excellent</td>
<td>Complete</td>
<td>Open</td>
<td>None</td>
</tr>
<tr>
<td>Good</td>
<td>Moderate</td>
<td>Slight moving</td>
<td>Slight movement</td>
</tr>
<tr>
<td>Fair</td>
<td>Minimal</td>
<td>Closing</td>
<td>Coughing</td>
</tr>
<tr>
<td>Poor</td>
<td>None</td>
<td>Closed</td>
<td>Bucking</td>
</tr>
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All patients were intubated with appropriate size cuffed portex oral ET tube. The ET tube was secured in place after checking for adequate air entry in both lung fields and the cuff was inflated. Thereafter anaesthesia was maintained with N2O, O2 & Isoflurane using Bain circuit. Neuromuscular function was monitored once in 15 seconds with TOF. When the 2nd twitch of TOF recover, a further increment of Rocuronium 0.15 mg/kg in Group R and Vecuronium 0.02 mg/kg in Group V was given. Thereafter TOF was recorded once in 60 seconds.

Duration was taken as the time from the end of inj. of Neuromuscular blocker (NMB) to recovery of 2nd response to TOF. Surgical relaxation was maintained at loss of 3 responses to TOF and at the appearance of 2nd response to TOF. Neuromuscular function was monitored once in 15 seconds with TOF. When the 2nd twitch of TOF recover, a further increment of Rocuronium 0.15 mg/kg in Group R and Vecuronium 0.02 mg/kg in Group V was given. Thereafter TOF was recorded once in 60 seconds.

Intubation conditions
In group R, intubating condition were excellent in 24 patients (80%) whereas only 11 patients (36.6%) in group V.

Table 4: Comparative intubation conditions in both study (group R) and control group (group V).

<table>
<thead>
<tr>
<th>Group</th>
<th>Excellent</th>
<th>Good</th>
<th>Fair</th>
<th>Poor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rocuronium</td>
<td>24(80%)</td>
<td>6(20%)</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Vecuronium</td>
<td>11(36.6%)</td>
<td>14(46.6%)</td>
<td>4(13.3%)</td>
<td>1(3.3%)</td>
</tr>
</tbody>
</table>

Train of Four
In group R, till first twitch out of 4, 7 patients (%), underwent successful neuromuscular blockade at adductor pollicis, whereas none in case of group V. Considering failure of blockage, no of patients were more in group V (n=15) as compared to those in group R (n=6).

Table 5: Comparative response to TOF for both groups (Group R and V).

<table>
<thead>
<tr>
<th>TOF</th>
<th>Group R</th>
<th>Group V</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No</td>
<td>%</td>
</tr>
<tr>
<td>0 / 4</td>
<td>2</td>
<td>6.6</td>
</tr>
<tr>
<td>1 / 4</td>
<td>5</td>
<td>16.6</td>
</tr>
<tr>
<td>2 / 4</td>
<td>8</td>
<td>26</td>
</tr>
<tr>
<td>3 / 4</td>
<td>9</td>
<td>27</td>
</tr>
<tr>
<td>4 / 4</td>
<td>6</td>
<td>20</td>
</tr>
</tbody>
</table>

Hemodynamic Changes:
In both groups, heart rate, systolic and diastolic blood pressure showed statistically non-significant difference at 5 mins post intubation.

RESULTS:

Demographics:
Both groups (Group R and Group V) were found comparable in terms of age, weight distribution and gender with no statistical significant difference (p>0.05).

Table 2: Baseline Characteristics – Age, Gender and Weight(N-Not Significant)

<table>
<thead>
<tr>
<th></th>
<th>Group R</th>
<th>Group V</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age</td>
<td>40.43±11.02</td>
<td>42.33±11.22</td>
<td>0.4889(NS)</td>
</tr>
<tr>
<td>Mean wt.</td>
<td>57.97±9.76</td>
<td>57.13±8.39</td>
<td>0.7241(NS)</td>
</tr>
<tr>
<td>Sex(M/F)</td>
<td>12/18</td>
<td>15/15</td>
<td>1.000(NS)</td>
</tr>
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Time taken for Intubation in secs:
Patients in group R were found to have lesser time taken for intubation ie. within 60 and 90 secs only as compared to those in group V (i.e. extended upto 120 and 150 sec). Also, major proportion of patients with accomplished intubation (n=22/30) were found in group R compared to only one patient (n=1/30) in group V within first 60 secs post induction. Another important observation was delayed accomplishment in intubation in major proportion of patients in group V (n=19/30 and n=7/30 within 120 and 150s respectively).

Table 3: No. of patients with accomplished intubation based on time taken for intubation
Fig 3: Comparative DBP trend in both groups

DISCUSSION:
Advent of neuromuscular blocking agent has expanded new horizons in anaesthetic practice and led the modern era of surgery in field of cardiothoracic, neurological and organ transplantation sciences. In 1983, all the requirements of an ideal neuromuscular block was mentioned(Krieg N Fau - Mazur, Mazur L Fau - Booij, Booij Lh Fau - Crul, & Crul), which included rapid onset time, excellent intubation conditions and shorter duration of action. Though vecuronium and rocuronium demonstrated promising clinical benefit, no robust data was found to determine either one’s superiority. Present study was a comparative effectiveness study between rocuronium and vecuronium on their onset times, intubation conditions category and duration of action during general anesthesia.

To rationalize use of muscle relaxants in correlation with proper assessment of neuromuscular transmission during induction and maintenance, we adopted “Train of Four” stimulation of ulnar nerve at wrist along with monitoring of neuromuscular function as per recommendations in previous evidence(Ali). Moreover, evaluation approach for intubation conditions was similar to that adopted in previous studies(De Haes, Eleveld D Fau - Wierda, & Wierda), (Mazurek et al.) i.e. within 60 secs, first attempt of intubation and afterwards at every 30 secs interval with attempt of intubation, continual assessment of intubation conditions. Additionally, there was no administration of inhalational anesthetic or opioid after muscle relaxant administration till intubation.

Similar studies by Alvarez-Gómez et al.(Alvarez-Gomez et al.), Van De Brock et al.(van den Broek, Hommes Fd Fau - Nap, Nap Hj Fau - Wierda, & Wierda) David G. Whalley et al.(Whalley, Maurer Wg Fau - De Brock et al.(van den Broek, Hommes Fd Fau - Nap, Nap Hj Fau - Wierda, & Wierda), (Mazurek et al.) i.e. within 60 secs, first attempt of intubation and afterwards at every 30 secs interval with attempt of intubation, continual assessment of intubation conditions. Additionally, there was no administration of inhalational anesthetic or opioid after muscle relaxant administration till intubation.

which was comparable to Lambalk L.M et al.(Lambalk, De Wit Ap Fau - Wierda, Wierda Jm Fau - Hennis, Hennis PJ Fau - Agoston, & Agoston), Tannieres–Ruffie ML et al.(Tannieres-Ruffie ML Fau - Vourc'h & Vourc'h) and Fahey et al.(Fahey Mr Fau - Morris et al.).

The two intermediate acting steroidal drugs, Vecuronium and Rocuronium could be considered to offer good cardiovascular stability. Similar findings to those demonstrated by Maddineni VR et al.,(Maddineni, McCoy Ep Fau - Mirakur, Mirakur Rk Fau - McBride, & McBride) Hudson ME et al(Hudson, Rothfield Kp Fau - Tullock, Tullock Wc Fau - Firestone, & Firestone) and Levy JH et al(Levy, Davis Gk Fau - Duggan, Duggan Fau - Szlam, & Szlam) were obtained in terms of no change in heart rate with given dose of rocuronium. However, similar trend in vecuronium was also observed rendering the statistical difference between heart rate change in both groups over the time interval statistically non-significant, which was consistent with findings from Wierda JM et al.,(Wierda et al.), Robertson EN et al.(Robertson En Fau - Booij, Booij Lh Fau - Frenge, Frenge Rj Fau - Crul, & Crul) and Kaufman JA(Kaufman, Dubois My Fau - Chen, Chen Jc Fau - Lea, & Lea). Similar non-significant trend observed in change in systolic and diastolic blood pressure also in both group showed cardiovascular stability of both rocuronium and vecuronium.

Moreover, there were no side effects or adverse events noted in any of both groups. Another major observation was found in terms of ease of reversal in both groups, where rocuronium proved to be superior with demonstrated clinical impact.

For evidence based safe and effective anaesthesia, it is must to have neuromuscular blocking agent with rapid onset time, excellent/good intubation conditions and also longer duration of action of initial dose of anesthetic drug. From our study, it is proven that rocuronium is superior in facilitating rapid onset time, excellent intubation conditions and duration of action as compared to those in vecuronium. However, we would like to acknowledge the bias that might have skewed the distribution graph due to small sample size. As a future scope, interdose comparison of rocuronium and associated clinical effects with more number of subjects i.e. bigger sample size could be planned to have concrete idea before hospital system integration.

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