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Comparison of intubating conditions and haemodynamic changes using Vecuronium and Rocuronium bromide for laryngoscopy

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Abstract

The use of muscle relaxant for intubation has become an important aspect of modern anaesthesia. Different new nondepolarizing drugs are in use for the same purpose.

Aims and Objectives: To compare the effect on intubating conditions and haemodynamic changes using Vecuronium and Rocuronium bromide for laryngoscopy.

Methodology: Present randomized controlled study was conducted on 60 patients, between 18 - 60 years of age and belonging to ASA grade I & II who were scheduled for various elective surgeries under general anaesthesia. These patients were randomly allocated into two groups of thirty each. All were premedicated and induced with Inj. Fentanyl and Inj. Propofol. After induction tracheal intubation was facilitated by giving either Inj. Rocuronium 0.6 mg/kg or Inj. Vecuronium 0.1 mg/kg to patients of Group A and Group B respectively. Anaesthesia was maintained on N₂O (66.6%) and O₂ (33.3%) mixture Analgesics, and either Vecuronium or Rocuronium as muscle relaxant with Sevoflurane.

Conclusion: There was no difference in intubating conditions and haemodynamic response between Rocuronium and Vecuronium.

Keywords: Intubating conditions, haemodynamic changes, Vecuronium, Rocuronium bromide, laryngoscopy

Introduction

A tracheal tube was not usually passed easily before the introduction of neuromuscular blocking drugs as anaesthesia branch was in primitive stage. Following the introduction of neuromuscular blocking drugs, in anaesthesia practice, the incontrovertible advantages of intubation in the safe maintenance of airway have changed the indication of intubation from specific need to almost a routine use in general anaesthesia practice. Thus, the use of muscle relaxant has become an important aspect of modern anaesthesia.

Initially Suxamethonium was used widely as muscle relaxant revolutionized anaesthesia practice by providing intense neuromuscular blockade of very rapid onset and ultra-short duration, thereby greatly easing the maneuver of tracheal intubation. But, its use is associated with various side effects, some of which are inconvenient while others may be potentially harmful. In addition, its use may be contraindicated in some situations¹.

The unwanted side-effects include: muscle fasciculations, post-operative myalgia, hyperkalemia, increased intraocular, intracranial pressures, and cardiovascular effects which include bradyarrhythmias and Asystole.

Prolonged apnea may be encountered in individuals with atypical Pseudocholinesterase. It may also induce malignant hyperthermia and Myoglobinuria, a grave situation in susceptible patients. Thus, it falls short of an ideal muscle relaxant due to its potentially hazardous side effects, in spite of having the advantages of rapid action and quick recovery. Thus, the need for a rapid acting non-depolarizing neuromuscular blocking agent to replace Suxamethonium for rapid sequence induction of anaesthesia has therefore been obvious for many years.

The search for better drugs to meet the properties of an ideal neuromuscular blocking agent, led to the development of new non-depolarizing neuromuscular blocking drugs. Recently, developed drug of intermediate duration includes Vecuronium and Atracurium which are, to a major extent, free from various side effects encountered with Suxamethonium. However even after intubating doses, onset time is relatively slow as compared with Suxamethonium that of for rapid tracheal intubation. The use of high initial bolus dose of either Atracurium or Vecuronium shortens the onset time, but at the expense of a prolonged

Duration of action, which may be undesirable in certain situations [2, 3].

The new addition in the list of neuromuscular blocking agents is Rocuronium bromide, which fills the gap for an agent, with rapid onset while lacking the potentially adverse features associated with Suxamethonium, retaining a medium duration of action and meeting most of the requirements of an ideal neuromuscular blocking agent.

Rocuronium bromide, the 2 morpholino 3 disacetyl 16 N allyl-pyrrolidino derivative of Vecuronium, has proven to be five to seven times less potent than Vecuronium with an ED₉₅ of 0.3 mg/kg as compared to an ED₉₅ of 0.056 mg/kg of Vecuronium. This lack of potency is thought to be an important factor in determining the onset of neuromuscular blocking. Rocuronium is an aminosteriod non depolarizing neuro muscular blocking agent used in modern anaesthesia, to facilitate endotracheal intubation and to provide skeletal muscle relaxation during surgery or mechanical intubation. Introduced in 1994, Rocuronium has rapid onset, and intermediate duration of action. The intubating dose of Rocuronium is 0.6 mg/kg².

Vecuronium bromide is a muscle relaxant in the category of non-depolarizing blocking agents. Vecuronium bromide is indicated as an adjunct to general anaesthesia, to facilitate endotracheal intubation and to provide skeletal muscle relaxation during surgery or mechanical ventilation. The intubating dose for Vecuronium bromide is 0.1 mg/kg³.

Considering the various side effects of Suxamethonium and attractive properties of Vecuronium and Rocuronium, the present study was undertaken to evaluate the intubating conditions and hemodynamic changes using Vecuronium and Rocuronium for laryngoscopy.

Aim: To compare intubating conditions and hemodynamic changes using Rocuronium and Vecuronium for laryngoscopy.

Objective: To Study parameters for Hemodynamic changes: Heart rate, Blood Pressure and Intubating conditions like ease of intubation, vocal cord position and response to intubation while doing laryngoscopy,

Material and Methods

The present study was conducted after approval from the institutional ethics committee at Poona Hospital and Research Centre conducted from 1st of January 2015 to 31st of December 2016.

Study population and Sample size

60 ASA grade I and grade II patients of either sex from different surgical specialties posted for various elective procedures under general anaesthesia were taken for the study.

Study design: The Study was Randomized Prospective Study.

Inclusion criteria

ASA grade I and II, Age between 18 to 60 years.

Exclusion criteria

- Preexisting problems of difficult intubation, Paralysis or neuro muscular disorder,

- H/O drug intake that might affect neuromuscular blocking agent
- Impaired renal or hepatic function
- Pregnant women and lactating mothers.

Methodology

All the patients were subjected to a detailed pre-anaesthetic checkup in regard of history, a thorough general and systemic examination. After this, they were ordered routine and any specific investigation if required. An informed consent of all the patients was also taken after the evaluation. Patient's name, Age, Sex, Weight and MRD number were noted. Patients were randomized to receive either Inj. Rocuronium or Inj. Vecuronium falling into Group A and Group B respectively. Time in seconds from injection of study drug till TOF score 0 (onset time) and duration of action were measured by intermittently noting response to TOF.

Material

TOF machine, Monitors: Pulse oximetry, NIBP, ECG were attached.

Pre-operative parameter like pulse rate, blood pressure and SpO₂ were monitored preoperatively and recorded in all cases.

Patients were randomly divided into two groups

Group A: All patients were given intubating dose of Rocuronium 0.6 mg/kg.

Group B: All patients in this group were given an intubating dose of Vecuronium 0.1 mg /kg.

Premedication and Induction

All the patients were premedicated with Inj. Glycopyrrolate (0.004mg/kg) i.v and 4 mg Inj. Ondansetron (75microgram/kg).The patients were pre-oxygenated with 100% oxygen for 3 minutes before induction. Induction of anaesthesia was performed with Inj. Fentanyl 2mg/kg, Inj. Propofol 2mg/kg intra venously. After abolition of eye reflex, intubating dose of muscle relaxant of either Inj. Rocuronium (0.6 mg/kg) or Inj. Vecuronium (0.1mg/kg) as selected by randomization was given. The time of administration of relaxant was noted. The degree of muscle relaxation was monitored with the help of TOF (Train of four) machine. Direct laryngoscopy was performed when TOF is 0 and the intubating conditions were observed according to Copenhagen consensus conference rating scale. The time interval from the administration of the relaxant to the time at which TOF shows 0 was noted (onset time).

The patient was then intubated with adequate size cuffed endotracheal tube and intermittent positive pressure ventilation was started with N₂O and O₂ mixture through Bain circuit. Just immediately after intubation, pulse rate and blood pressure was recorded.

Maintenance of anaesthesia

All patients were maintained on Nitrous oxide and Oxygen mixture and intermittent injection of Rocuronium or Vecuronium. Analgesics and Sevoflurane were given as per requirement. The patients were given IPPV. Duration of muscle blocked i.e. upto TOF ratio 0.7

Reversal and extubation

At the end of surgery, and TOF ratio 0.7 or greater reversal

was done with Inj. Neostigmine 50 microgram/kg and Inj. Glycopyrrolate 8 microgram/kg. After return of adequate respiratory effort and upper airway reflexes along with spontaneous eye opening, extubation was done. The patient was shifted to recovery.

Parameter observed

The following observations were made and recorded during the peri-operative period.

1. Onset of action (assessed by TOF machine at reading 0)
2. Intubating conditions
 - a. Laryngoscopy: Jaw relaxation

- b. Vocal cord: position and movement
- c. Response to intubation: Coughing and Limb Movement

3. Cardiovascular Response

Pulse rate, blood pressure and oxygen saturation (SpO₂) were

Recorded baseline, immediately after intubation and 10 minutes later.

Intubating conditions were assessed as excellent, good or poor using the 'Copenhagen Consensus Rating Scale.

Table 1: Copenhagen consensus conference rating scale

| Intubating Conditions Variables | Clinically Acceptable | | Clinically Un-Acceptable |
|--|-----------------------|---------------|--------------------------|
| | Excellent | Good | Poor |
| laryngoscopy | easy | fair | difficult |
| vocal cords position | abducted | intermediate | closed |
| movement | none | moving | closing |
| response to intubation movement of limbs | none | slight | vigorous |
| coughing | none | diaphragmatic | sustained (>10s) |

Laryngoscopy

Easy: Jaw relaxed, no resistance to blade in the course of laryngoscopy.

Fair: Jaw relaxed, slight resistance to the blade.

Difficult: Poor jaw relaxation, active resistance of the patient to laryngoscopy.

Intubating Conditions

Excellent: All variable listed under 'excellent' must be present.

Good: Only variable listed under 'excellent' or 'good' must be present.

Poor: The presence of any variable listed under 'poor'.

Data Analysis

The data collected and its statistical significance of

Difference of categorical variables across two intervention groups is tested using Chi-Square Test or Fisher's exact probability test. The statistical significance of inter-group difference of mean of continuous variables is testes using independent sample 't'(unpaired student's 't' test) test, after confirming the underlying normality assumption. P-values less than 0.05 are considered to be statistically significant. The entire data was statistically analyzed using Statistical Package for Social Sciences (SPSS ver 16.0, Inc. Chicago) for MS Windows.

Results

The age, sex and ASA distribution did not differ significantly between two intervention groups (P-value>0.05).

The distribution of mean time for train of four 0(onset) monitoring between two intervention groups (n=60).

Table 2: Show the train of four group

| Train of Four Monitoring | Group A (n=30) | | Group B (n=30) | | P-value (Group A v Group B) |
|--------------------------|----------------|------|----------------|------|-----------------------------|
| | Mean | SD | Mean | SD | |
| Time (Sec) | 59.2 | 4.04 | 136.6 | 6.59 | 0.001*** |

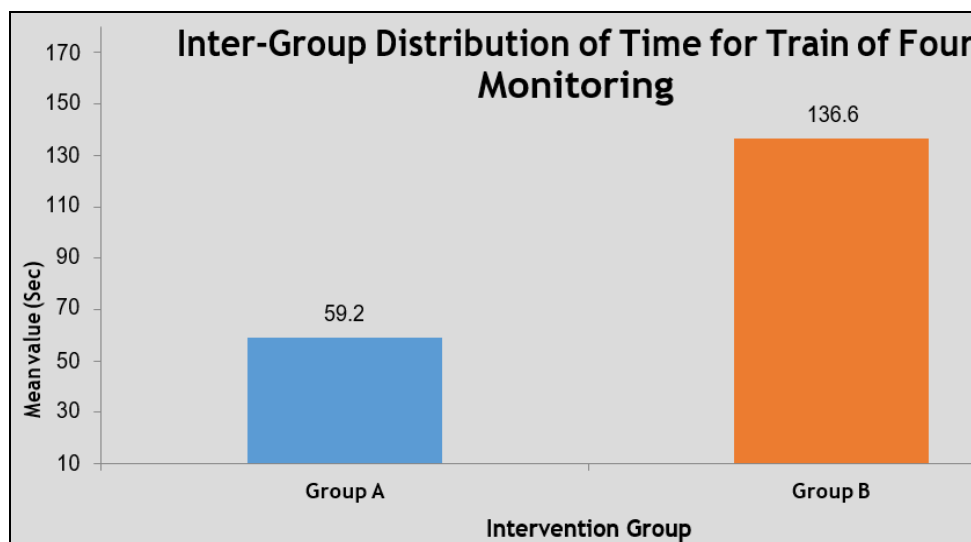


Fig 1: The distribution of mean time for train of four monitoring between two intervention groups (n=60).

The mean ± standard deviation of train of four = 0 monitoring of the Patients from Group A and Group B is 59.2 ± 4.04 Sec and 136.6 ± 6.59 Sec respectively.

The distribution of mean time for train of four = 0 monitoring is significantly higher in Group B compared to Group A (P- value<0.001).

Table 3: The inter-group comparison of Heart Rate at each time interval (n=60).

| Heart Rate (Per Min) | Group A (n=30) | | Group B (n=30) | | P-value (Group A VS Group B) |
|----------------------------|----------------|------|----------------|------|------------------------------|
| | Mean | SD | Mean | SD | |
| Baseline | 81.7 | 4.35 | 83.5 | 5.30 | 0.156NS |
| Immediate After Intubation | 91.5 | 5.41 | 93.5 | 4.69 | 0.131NS |
| After 10-Mins | 80.6 | 4.08 | 83.2 | 5.15 | 0.039* |

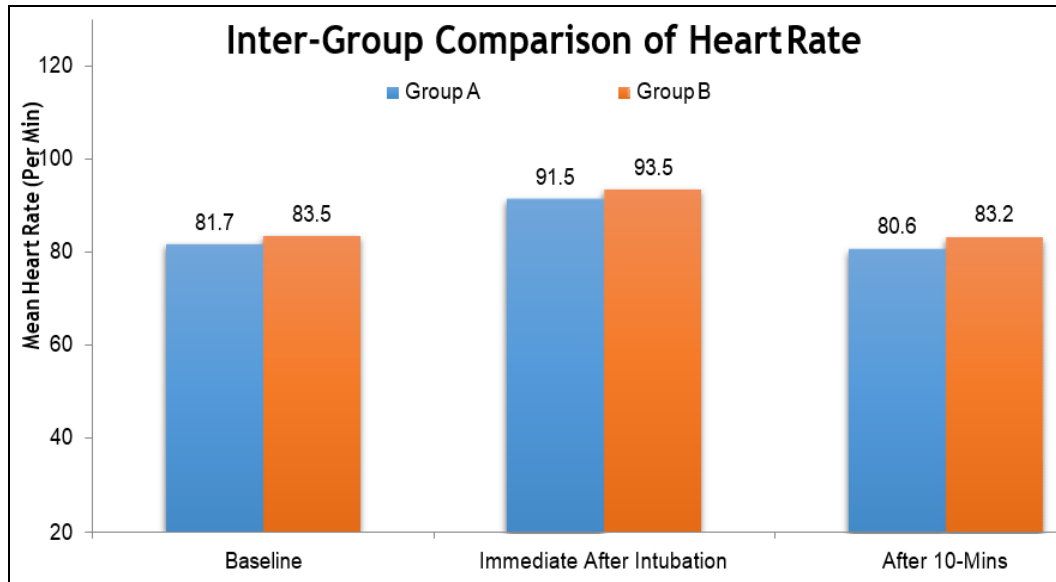


Fig 2: The inter-group comparison of Heart Rate at each time interval (n=60).

The average baseline and immediate after intubation heart rate did not differ significantly but average heart rate after intubation is significantly higher in Group B.

The average baseline, immediate after intubation and after 10-mins diastolic BP did not differ similarly the inter-group comparison of SPO2 did not differ significantly.

Table 4: The inter-group comparison of Duration of action (n=60).

| Duration of action | Group A (n=30) | | Group B (n=30) | | P-value (Group A v Group B) |
|--------------------|----------------|------|----------------|------|-----------------------------|
| | Mean | SD | Mean | SD | |
| Duration (Mins) | 41.1 | 4.40 | 45.3 | 3.12 | 0.001*** |

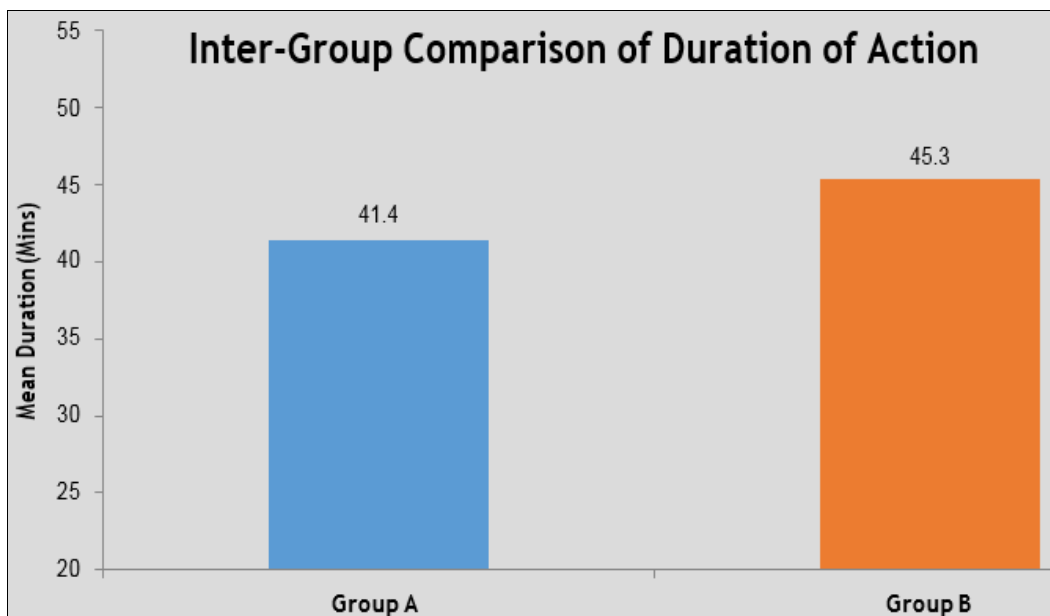


Fig 3: The average duration of action is significantly higher in Group B compared to Group A.

Table 5: The inter-group comparison of intra-operative Laryngoscopy (n=60).

| Laryngoscopy Status | Group A (n=30) | | Group B (n=30) | | P-value (Group A vs Group B) |
|---------------------|----------------|-------|----------------|-------|------------------------------|
| | n | % | n | % | |
| Easy | 30 | 100.0 | 30 | 100.0 | 0.999NS |
| Difficult | 0 | 0.0 | 0 | 0.0 | |
| Total | 30 | 100.0 | 30 | 100.0 | |

Values are n (% of patients). P-value by Chi-Square test. P-value <0.05 is considered to be statistically significant. *P-value<0.05, **P-value<0.01, ***P-value<0.001, NS: Statistically Non-Significant.

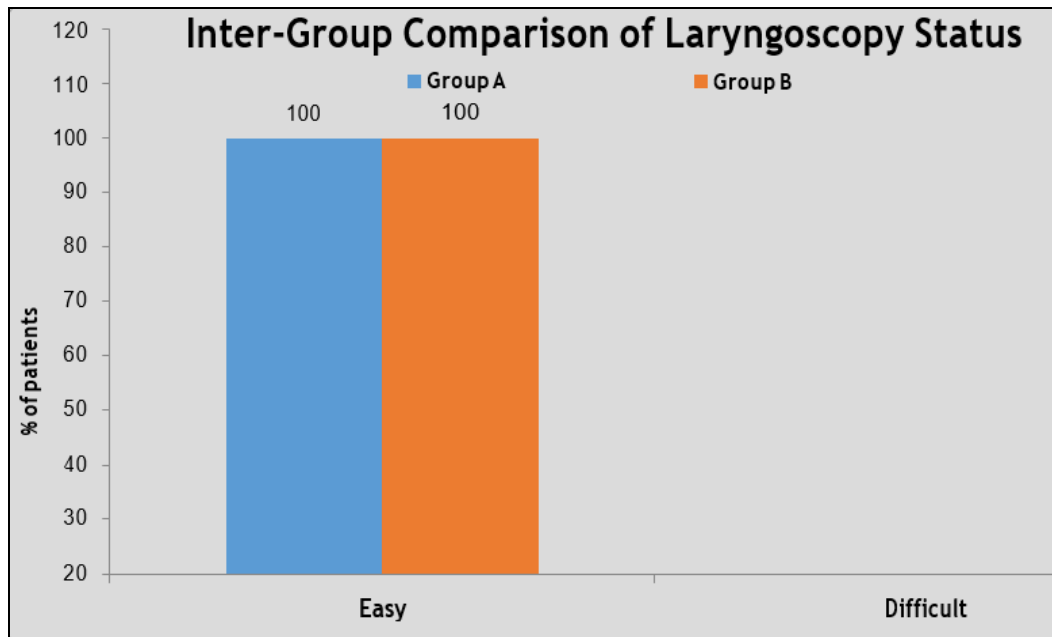


Fig 4: The inter-group comparison of intra-op status of Laryngoscopy (n=60).

Comments inter-group comparisons

The distribution of intra-op Laryngoscopy and the inter-group comparison of intra-op status of Vocal cord did not

differ significantly between two intervention groups (P-value>0.05).

Table 6: The inter-group comparison of Response to intubation (n=60).

| Response to intubation | Group A n=30 | | Group B =30) | | P-value (Group A v Group B) |
|------------------------------|--------------|-------|--------------|-------|-----------------------------|
| | n | % | n | % | |
| No Movement of Limb No Cough | 30 | 100.0 | 30 | 100.0 | 0.999NS |
| | 30 | 100.0 | 30 | 100.0 | |
| Total | 30 | 100.0 | 30 | 100.0 | |

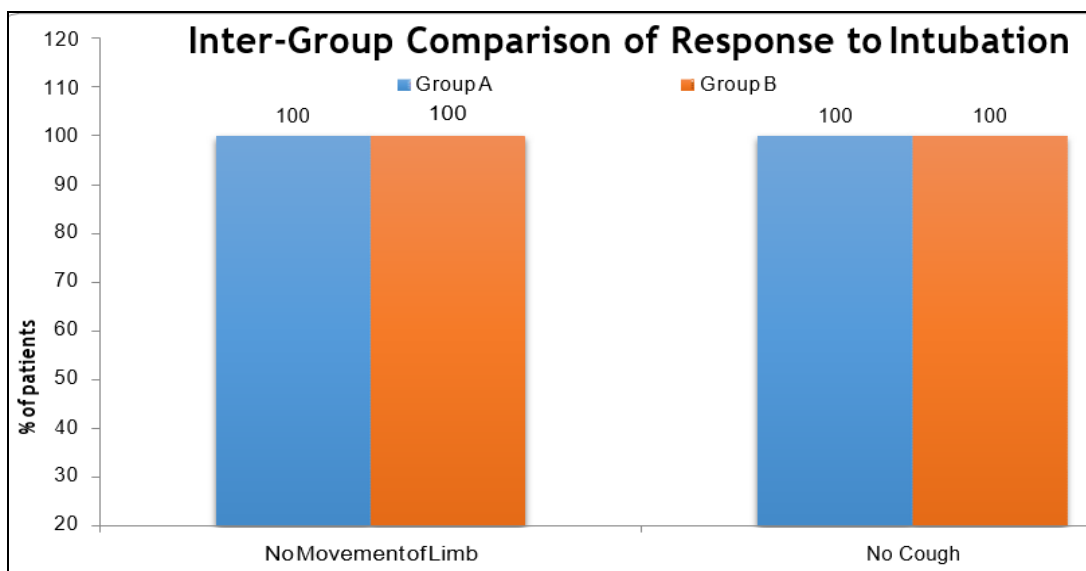


Fig 5: The inter-group comparison of Response to intubation (n=60).

Comments inter-group comparisons

1. The distribution of response to intubation (movement and cough) did not differ significantly between two intervention groups (P-value > 0.05 for both).

Discussion

Before discovery of muscle relaxant, intubation was difficult as anaesthesia was in primitive stage. With subsequent discovery of drugs like Succinylcholine, Gallium, Curare derivatives intubating patient made easy [4]. But they were associated with many side effects [1, 6, 7]. Like Pancuronium is long acting muscle relaxant but have Vagolytic effect [5]. Atracurium is short acting muscle relaxant but it has histamine releasing property though these muscle relaxants do provide good intubating conditions. So present study is an attempt to evaluate and compare the intubating conditions and hemodynamic changes using of newer muscle relaxants like Rocuronium and Vecuronium for laryngoscopy.

The studies conducted by J.M.K. H. Wierda *et al.* [7], Bartkowski RR *et al.* [14], And Robertson EN *et al.* [9], reported that Rocuronium provide clinically acceptable intubating conditions in shorter time with least side effects as compared to succinylcholine and vecuronium. The results of the above studies have encouraged us to undertake the present.

The 60 patients were of average age 37.2yrs and 36.3yrs age in group A and group B respectively (Table.1). Basal vital parameters were noted. All pts were premedicated and induced with Inj. Fentanyl and Inj. Propofol. After induction tracheal intubation was facilitated by giving either Inj. Rocuronium 0.6 mg/kg (Group A) and Inj. Vecuronium 0.1 mg/kg Group B respectively. Onset of muscle relaxant effect noted with TOF reading. Similarly intubating condition was noted as excellent to poor. Anaesthesia was then maintained on N₂O (66.6%) and O₂ (33.3%) mixture and either Vecuronium or Rocuronium. And Sevoflurane. Also duration of relaxant effect was noted with both drugs (TOF 0) which was

Haemodynamic response

The mean pulse rate variation was observed just immediately after intubation and ten minutes later. The average baseline and immediate after intubation heart rate did not differ significantly between two intervention groups (The average heart rate after intubation was significantly higher in Group B compared to Group A (P-value < 0.05).

Blood pressure shoot up immediately after intubation and return slowly to near its basal value within ten minutes in both the group groups (Table 3). Since these changes were common to both the groups, it can be inferred that, pressure response during laryngoscopy and intubation was responsible for this transient rise rather than the drugs used. As this response depends upon depth of anaesthesia and drugs used in both groups were similar and dose dependent. Hypertensive response was not in excess as all patients were ASA grade I-II. The oxygen saturation (SpO₂) was maintained throughout the procedure.

The results observed above were similar with the findings of W.M. Schramm *et al.* [10]. Which concluded that there was no significant changes in the mean arterial pressure after treatment with Rocuronium (0.6 mg/kg) and Vecuronium (0.1 mg/kg).

Lewy *et al.* [8]. Reported that in doses upto 1.2 mg/kg

Rocuronium has minimal cardiovascular effects both in healthy patients and those with cardiovascular disease. These results were consistent with findings of this study.

Onset of action

The time required to achieve TOF 0 (train of four 0), with the help of TOF machine was early i.e. 59.266 ± SD seconds in group A (0.6 mg/kg, Rocuronium) and 136.6 ± SD seconds in group B (0.1 mg/kg, Vecuronium). The results of our study substantiated the findings of J.M.K. Wierda *et al.* [7] and Neeraja Bharti *et al.* [12]. In their studies they demonstrated that the rate of development of neuromuscular block and hence the onset of action was faster with Rocuronium than Vecuronium.

Duration of action

The time interval from TOF = 0 to the return of the first respiratory excursion gave the clinical duration of action of the respective relaxant used. The average duration of action is significantly higher in vecuronium Group B i.e. 45.3 ± 3.12 compared to Rocuronium Group A 41.1 ± 4.40. (Table 4) Study conducted by Lin *et al.* [11] observed that clinical durations of action were 44.2 ± 13.2 min in Rocuronium group and 42.5 ± 9.1 min in Vecuronium group respectively. Our study observations were comparable with this study.

Intubating conditions

A standardized intubation score according to "Copenhagen consensus

Conference rating scale" was used for the evaluation of intubating condition for this study. Intubation was attempted, just immediately after the TOF=0 and certain parameters were assessed.

Laryngoscopy status (Table 1, 5):

- The following parameters were observed – Ease at laryngoscopy
- Position and movement of vocal cords
- Response to intubation,
- E.g. movement of limbs and coughing.

Accordingly, intubation scores were given as excellent, good or poor. We observed that all patients in group A and B provides easy laryngoscopy. During intubation cords were abducted and there was no movement of limbs or cough response to intubation in all the patients of both groups.

Man TT *et al.* [13]. And Lin PL *et al.* [11]. showed that both Rocuronium and Vecuronium provided good to excellent intubating conditions. In our studies also we got same results i.e both Rocuronium and Vecuronium provided excellent intubating conditions.

Conclusion

There was no difference in intubating conditions and haemodynamic response between drugs Rocuronium and Vecuronium.

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