Original Article

Comparison of Intubating Conditions and Hemodynamic Effects of a Combination of Rocuronium and Vecuronium with Rocuronium or Vecuronium Used alone in Patients Undergoing Elective Lower Abdominal and Perineal Surgery

Parameswar Pankaj Kumar Rout, Ankur Sharma[1]

Departments of Neuroanesthesia and [1]Anesthesia, AIIMS, New Delhi, India

Abstract

Aim: Neuromuscular blockers are drugs used to facilitate endotracheal intubation and to improve surgical working conditions during general anesthesia. Rocuronium with rapid onset of action acts synergistically with other nondepolarizing agents. The purpose of this study was, therefore, to compare onset time, clinical duration, intubating conditions, and hemodynamic changes with rocuronium, vecuronium, and a combination of rocuronium and vecuronium. **Methodology:** This prospective, randomized, double-blind, controlled comparative study included 150 American Society of Anesthesiologist Grade I or Grade II adult patients, scheduled for elective lower abdominal (gynecological and general surgical) and perineal surgery requiring general anesthesia with endotracheal intubation. The tracheal intubation conditions were evaluated on the first attempt and scored on a scale described by Clarke and Mirakhur (excellent, good, poor, and inadequate). In addition to routine cardiovascular monitoring, hemodynamic parameters were specifically noted before the administration of the intubating dose of study drug and 1, 2, 5, 10, and 15 min thereafter. **Results:** In rocuronium group and rocuronium and vecuronium combination groups, excellent and good intubation conditions were achieved in 78% and 22% of cases as compared to 42% and 58% in vecuronium group, respectively. **Conclusion:** The drug combination can provide a clinically comparable condition for tracheal intubation with near similar hemodynamic parameters as compared with rocuronium alone. This further points out toward the fact that the combination of rocuronium with vecuronium can be economical alternative for rapid intubation in elective surgical cases.

Keywords: Intubating conditions, rocuronium, vecuronium

Introduction

Neuromuscular blockers are drugs used to facilitate endotracheal intubation and to improve surgical working conditions during general anesthesia. The time interval between suppression of the protective reflexes by induction of anesthesia and the development of satisfactory intubating conditions is a critical period. It is desirable that this period should be as short as possible.

Suxamethonium due to its rapid onset of action and providing a good intubating condition is still the drug of choice for rapid endotracheal intubation.[1,2] However, it falls short of ideal muscle relaxant due to its potential hazardous side effects such as hyperkalemia, sinus bradycardia, fasciculation increase intraocular pressure, increase in intracranial pressure, and malignant hyperthermia.

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Rocuronium is the first drug with an onset approaching similar to succinylcholine.[3] The intubating conditions with it are satisfactory and similar to those observed in succinylcholine and provide adequate muscle relaxation.[4] Rocuronium is monoquaternary analog of vecuronium, designed to provide rapid onset of action.[5] Rocuronium is six times less potent than vecuronium.[6,7]

The purpose of our study was therefore to compare onset time, clinical duration, intubating conditions, and hemodynamic

Address for correspondence: Dr. Ankur Sharma, C/O Mr. Suneel Vyas, C-2/2287, Vasant Kunj, New Delhi, India. E-mail: ankuranaesthesia@gmail.com

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changes with rocuronium, vecuronium, and combination of rocuronium and vecuronium.

Methodology

Following approval from the Institutional Ethical Committee and with a written informed consent, this prospective, randomized, double-blind, controlled comparative study was conducted at tertiary care hospital. This study included 150 American Society of Anesthesiologist (ASA) Grade I or II patients, aged 20–60 years, scheduled for elective lower abdominal (gynecological and general surgical) and perineal surgery requiring general anesthesia with endotracheal intubation.

Exclusion criteria of this study were anemia (Hb <9 g %), compromised renal status, pulmonary status (e.g., COPD and bronchial asthma), and cardiac status, for example, heart block (II degree and above), hypertension, cardiac failure, patient on β-blockers (ASA grade III or above), blood coagulation disorders, diabetes, difficult intubation (Mallampati Grade 3 and 4), more than three attempts at intubation, duration of laryngoscopy exceeds more than 30 s, hypersensitivity to any of the drugs used in the study, patients unwilling to give consent for proposed study, and patients with body mass index (BMI) >25.

After securing an intravenous (IV) access in operation theater, an infusion of Ringer lactate 5 ml/kg/h was started. After recording the baseline parameters, the patient was premedicated with 50 mg of ranitidine, 2 mg of midazolam, 2 μg/kg of fentanyl, and 0.2 mg of glycopyrrolate intravenously, provided the pulse rate is not more than 90/min. After preoxygenated with 100% O_2 for 3 min, induction was done with propofol 2 mg/kg IV over 2 min and lungs were ventilated with 100% oxygen through a face mask. Patients were divided into three groups using computer-generated random number table, each comprising 50 patients. Group I received 0.6 mg/kg of rocuronium IV, Group II received 0.1 mg/kg of vecuronium IV, and Group III received 0.3 mg/kg of rocuronium IV plus 0.05 mg/kg of vecuronium IV. The study drugs were administered as a bolus dose injected over 5 s into a fast-flowing IV line after induction. One min after the administration of the muscle relaxant, laryngoscopy was performed and intubating conditions were assessed, if tracheal intubation was unsuccessful, the protocol allowed for another attempt at 60 s. The tracheal intubation conditions were evaluated on the first attempt only and scored on a scale described by Clarke and Mirakhur[8] (excellent: jaw relaxed, vocal cords apart and immobile, and no diaphragmatic movement; good: jaw relaxed, vocal cords apart and immobile, and some diaphragmatic movement; poor: jaw relaxed, vocal cords moving, and substantial diaphragmatic movement; and inadequate: jaw immobile, vocal cords closed, and severe coughing and bucking).

After successful tracheal intubation, anesthesia was maintained with 50% N_2O in O_2, 0.4% isoflurane and additional muscle relaxation was achieved by supplementary doses of the initial muscle relaxant or combination of muscle relaxants assigned to the patient. The neuromuscular effects of the muscle relaxants were assessed by recording the onset time (time interval between the completion of injection of the muscle relaxant and the time of intubation) and the clinical duration (time interval between the completion of the injection of the muscle relaxant and return of spontaneous respiration after the first dose of muscle relaxant).

In addition, to routine cardiovascular monitoring, the heart rate (HR) and blood pressure were specifically noted before the administration of the intubating dose of study drug and 1, 2, 5, 10, and 15 min thereafter. At the end of the surgery, the patients were reversed with neostigmine and glycopyrrolate. All the patients were observed in the postoperative ward for any side effect.

We defined following parameters in the present study: (1) hypotension (systolic blood pressure [SBP] <25% of baseline or 90 mmHg, whichever is lower); (2) hypertension (SBP >25% of baseline value or 150 mmHg, whichever is higher); (3) tachycardia (HR >25% of baseline value); (4) bradycardia (HR <60 beats/min); and (5) an arrhythmia (any ventricular or supraventricular premature beat or any rhythm other than sinus).

The data were analyzed using Student's *t*-test. Values within the groups were examined using paired *t*-test and values between the groups were analyzed with unpaired *t*-test. $P < 0.05$ was considered statistically significant ($P < 0.05$).

Results

In the present study, 150 patients were studied in three groups, for example, Group I, Group II, and Group III comprising 50 patients each. The three groups had comparable demographic and physical characteristics, for example, age, sex, weight, height, and body mass index as shown in Table 1 and Figures 1-3. Most of the patients belonged to ASA Grade I (78.66%).

Table 1 also shows that intubation was possible in all cases and none belonged to poor and inadequate, but the proportion with excellent or good condition was greater with rocuronium and rocuronium and vecuronium combination groups. In Group I and Group III, 78% of cases excellent intubation condition was achieved as compared to 42% in Group II. In Group I and Group III, 22% of cases good intubation condition was achieved as compared to 58% in Group II [Figure 4]. The tracheal intubating conditions were evaluated on the first attempt only and scored on a scale described by Clarke and Mirakhur.

Clinical duration among different groups is shown in Figures 5 and 6. In Group I, the maximum number of patients had clinical duration between 16 and 20 min. The mean clinical duration was 18.8 min with a range of 12–27 min. In Group II, the maximum number of patients had a clinical duration

within 21–25 min. The mean clinical duration for this group was 24.9 min with a range of 19–37 min. In Group III, the maximum number of patients had the duration of 15–29 min. The mean clinical duration for this group was 22.9 min with a range of 15–29 min.

In rocuronium group [Table 2], the mean HR showed none or minimal change from the baseline and it remained statistically significant at all recorded intervals until 10 min. Then, it became statistically insignificant after 15 min. The mean arterial pressure (MBP) showed a sudden fall after propofol, fentanyl, midazolam, and study drug which was statistically significant. Then, MBP showed a statistically insignificant rise after 1-min postintubation, but the values became statistically significant thereafter until 10-min postintubation, but at 15 min, it became insignificant. The SBP showed fall after premedication, induction, and intubation at 1 min which was statistically insignificant but after that SBP remains statistically significant until 15 min. The diastolic blood pressure (DBP) decreased after premedication, induction, and intubation at 1 min, 10 min and 15 min which was statistically insignificant. But reduction of DBP remained statistically significant at 2 and 5 min of of enotracheal intubation.

In vecuronium group [Table 3], the mean HR remained statistically insignificant at the recorded intervals except for a significant rise 1-min postintubation. However, it decreased after 10 min which was statistically significant. The MBP continued to fall after intubation which was statistically insignificant at 1 min but became statistically insignificant until 10 min and again at 15 min. The mean SBP continued to fall after intubation which was statistically significant until 15 min. The mean DBP continued to fall after intubation which was statistically insignificant at 1 min but became statistically significant until 5 min and became statistically insignificant at 10 min.

Table 1: Patients' demographics, physical characteristics, and intubating conditions in three groups. values are mean±standard deviation where appropriate

	Group I rocuronium	Group II vecuronium	Group III (rocuronium + vecuronium)
Female/male	42/8	39/11	39/11
Age (years)	31 (5.1)	29 (4.9)	30(3.7)
ASA status (I/II)	47/3	35/15	36/14
Weight (kg)	55 (7.2)	53 (4.3)	51 (6.4)
BMI (kg/m^2)	23.29 (5.3)	22.85(7.2)	21.98 (6.7)
Intubating conditions (%)			
Excellent	39 (78)	21 (42)	39 (78)
Good	11 (22)	29 (58)	11 (22)
Poor	Nil	Nil	Nil
Inadequate	Nil	Nil	Nil

ASA: American Society of Anesthesiologist, BMI: Body mass index

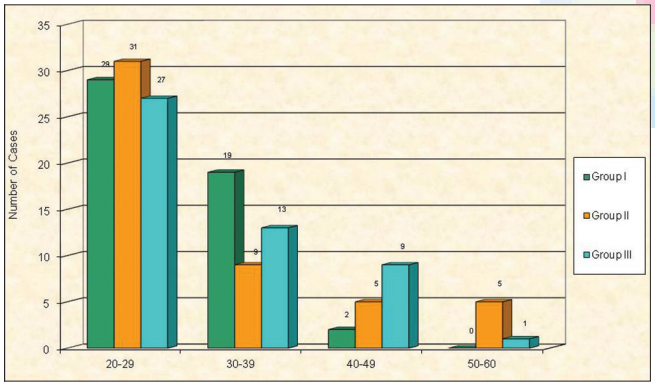

Figure 1: Age-wise distribution of cases in three study groups

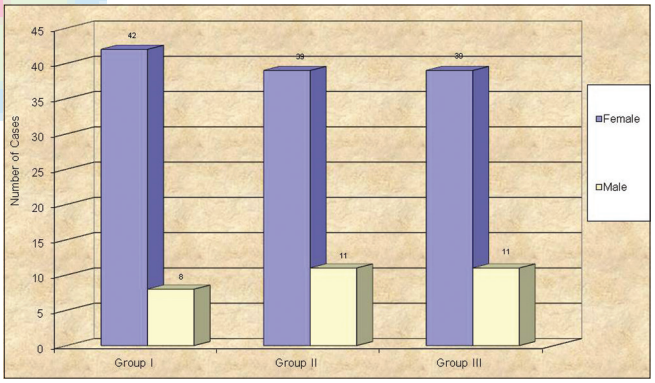

Figure 2: Sex-wise distribution of cases in three study groups

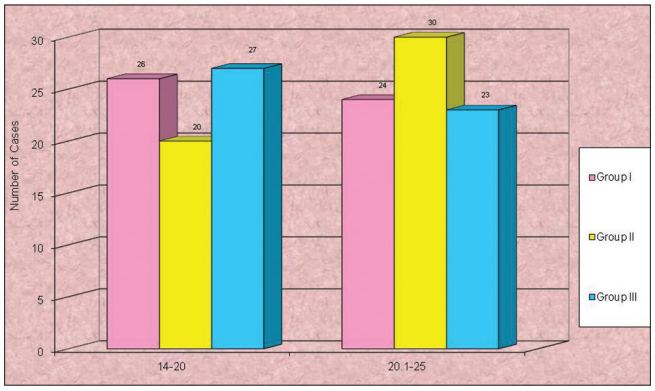

Figure 3: Body mass index-wise distribution of cases in three study groups

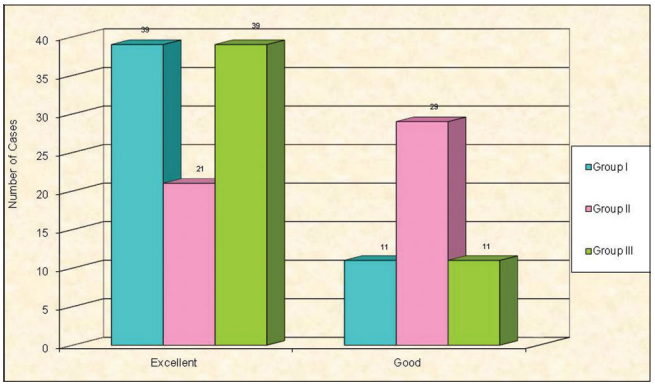

Figure 4: Intubation grades in three study groups

In Group III [Table 4], the mean HR remained statistically insignificant at the recorded intervals except significant rise 1- and 2-min postintubation but statistically significant fall at 15 min. The MBP continued to fall after intubation which was statistically significant until 10 min and became statistically insignificant at 15 min. The SBP continued to fall after intubation which was statistically significant until 15 min. The mean DBP continued to fall after intubation which was statistically significant at 2 min but became statistically insignificant until 15 min.

The above tables show that there were significant differences in the mean heart rate in between Group I (rocuronium) and Group II (vecuronium). Rocuronium had a tendency to increase the heart rate. There were significant changes in heart rate between Group I (rocuronium) and Group III (rocuronium + vecuronium) up to 10 min. The changes in heart rate between Group II and Group III were not significant.

The changes in systolic, diastolic, and MBP between all the three groups were not significant.

Discussion

In the present study, the drugs used as premedication were same in all 150 patients (50 mg of ranitidine, 2 mg of midazolam, 2 μg/kg of fentanyl, and 0.2 mg of glycopyrrolate intravenously). Propofol (2 mg/kg IV slowly) was used as an

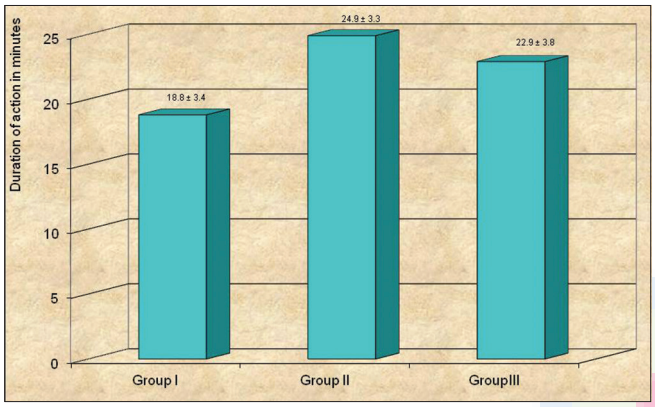

Figure 5: Mean duration of action in three different groups

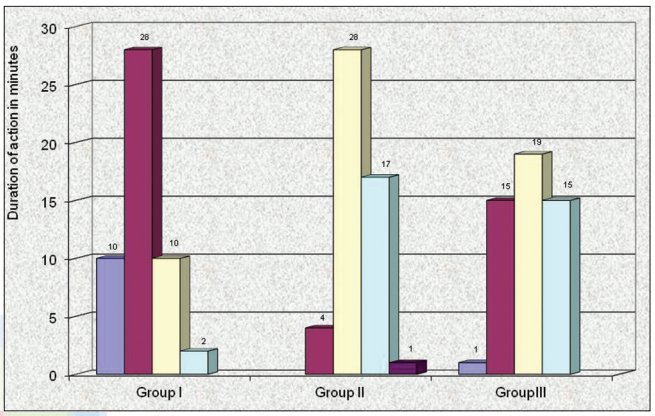

Figure 6: Duration of action in three different groups with number of cases in particular groups

Table 2: Statistical analysis of vital parameters at various time intervals (rocuronium)

	Preoperative	After premedication	Just prior to ETI	After 1 min of ETI	After 2 min of ETI	After 5 min of ETI	After 10 min of ETI	After 15 min of ETI
HR	100.3±16.7	105.8±19.0	107.4±18	112.1±18.7	110.9±18.7	107.2±18.0	104.6±16.6	99.9±18.4
		P=0.0027	*P*=0.0000	*P*=0.0000	*P*=0.0000	*P*=0.0015	*P*=0.0450	*P*=0.8405
SBP	124.5±12.8	123.0±12.2	119.0±12	120.8±16.7	114.2±15.0	116.0±12.8	116.8±13.2	120.4±11.6
		P=0.2801	*P*=0.0034	*P*=0.1297	*P*=0.0001	*P*=0.0001	*P*=0.0001	*P*=0.0478
DBP	80.0±10.4	78.5±11.8	75.7±12.3	76.8±14.8	74.7±12.0	76.2±11.4	77.6±12.6	81.5±14.3
		P=0.3080	*P*=0.0048	*P*=0.1033	*P*=0.0080	*P*=0.0230	*P*=0.1173	*P*=0.2956
Mean blood pressure	93.3±10.4	90.9±11.4	88.6±12.4	90.8±14.8	86.4±13.0	88.2±11.7	89.6±12.4	93.1±12.6
		P=0.0830	*P*=0.0029	*P*=0.2392	*P*=0.0015	*P*=0.0040	*P*=0.0265	*P*=0.8315

ETI: Endotracheal intubation, HR: Heart rate, SBP: Systolic blood pressure, DBP: Diastolic blood pressure

Table 3: Statistical analysis of vital parameters at various time intervals (vecuronium)

	Preoperatie	After premedication	Just prior to ETI	After 1 min of ETI	After 2 min of ETI	After 5 min of ETI	After 10 min of ETI	After 15 min of ETI
HR	93.6±13.6	98.2±13.7	97.4±14.3	100.4±14.6	96.2±15.1	94.0±14.4	89.7±11.6	87.7±10.2
		P=0.0007	*P*=0.0227	*P*=0.0013	*P*=0.2214	*P*=0.8598	*P*=0.0210	*P*=0.0039
SBP	123±6.86	120.9±11.3	118.3±10.6	119.8±12.2	115.4±12.1	115.9±11.7	117.4±11.9	118.5±11.9
		P=0.0563	*P*=0.0001	*P*=0.0131	*P*=0.0000	*P*=0.0000	*P*=0.0004	*P*=0.0018
DBP	79.5±9.5	77.1±10.5	75.4±8.1	77.1±11.5	73.7±12.0	74.5±11.1	76.8±12.2	78.8±11.2
		P=0.0347	*P*=0.0016	*P*=0.1528	*P*=0.0005	*P*=0.0056	*P*=0.1238	*P*=0.6896
Mean blood pressure	92.8±8.6	91.0±10.5	87.9±9.6	90.4±12.1	86.2±12.6	87.8±11.1	88.7±11.4	90±12.1
		P=0.1324	*P*=0.0005	*P*=0.2037	*P*=0.0003	*P*=0.0070	*P*=0.0229	*P*=0.1203

ETI: Endotracheal intubation, HR: Heart rate, SBP: Systolic blood pressure, DBP: Diastolic blood pressure

Table 4: Statistical analysis of vital parameters at various time intervals (rocuronium + vecuronium)

	Preoperative	After premedication	Just prior to ETI	After 1 min of ETI	After 2 min of ETI	After 5 min of ETI	After 10 min of ETI	After 15 min of ETI
HR	98.5±15.4	99.2±14.8	99.4±13.6	104.9±14.1	102.7±14.5	101.2±15.5	94.8±13.3	91.6±12.1
		P=0.6034	*P*=0.5104	*P*=0.0016	*P*=0.0441	*P*=0.2026	*P*=0.0757	*P*=0.0008
SBP	125.4±11.6	121.9±11.6	118.2±13.3	118.3±15.0	117.7±16.3	117.9±14.4	119.1±13.3	121.5±11.9
		P=0.0086	*P*=0.0001	*P*=0.0006	*P*=0.0003	*P*=0.0002	*P*=0.0010	*P*=0.0387
DBP	82.1±8.9	79.8±7.4	76.6±10.8	77.5±12.2	77.7±12.0	78.4±12.4	79.0±10.5	81.5±9.5
		P=0.0507	*P*=0.0013	*P*=0.0129	*P*=0.0169	*P*=0.0546	*P*=0.0574	*P*=0.7306
Mean blood pressure	95.3±9.3	91.1±9.4	88.9±12.0	89.4±13.4	89.3±14.0	90±12.4	91.0±10.9	93.5±10.2
		P=0.0021	*P*=0.0004	*P*=0.0019	*P*=0.0022	*P*=0.0039	*P*=0.0085	*P*=0.2402

ETI: Endotracheal intubation, HR: Heart rate, SBP: Systolic blood pressure, DBP: Diastolic blood pressure

induction agent. The return of spontaneous breathing after intubating dose was considered as the end-point of our study.

Patients belonged to the age group 20–60 years who were included in our study. Majority of patients were 20–40 years old. Age may affect the pharmacokinetics of muscle relaxants since total body water (in particular extracellular volume/volume of distribution) and function of the organ system involved in the elimination of drugs diminish with increasing age.

About 78.66% patients belonged to ASA Grade I (118/150). This validates the study as the sample was free from any concurrent illness. The majority of patients were below 50 kg of weight.

Obese patients can have metabolic alteration that may affect the pharmacokinetics and pharmacodynamics of anesthetic drug. Pühringer *et al*.[9] observed that the onset time was shorter and duration slightly longer in the obese group compared to other groups, but the difference did not reach the level of statistical significance. Taking an account of the height and weight; the BMI calculated in the patients was not more than 25.

The intubating conditions were excellent in 39/50 (78%) patients in Group I and Group III. In contrast, excellent intubating conditions were encountered only in 42% patient in II group.

Various authors explained apnea time as the time when there is a cessation of respiration first detected and also noted jaw relaxation time. In our study, intubating conditions were assessed at a fixed point of time (1 min) after administration of muscle relaxant irrespective of the category of muscle relaxant used.

England *et al*.[10] in their study concluded that rocuronium may act synergistically with other nondepolarizing agents during onset of the blockade but when a steady state is reached, the early synergistic effect is overwhelmed by an alternative mechanism of action which results in an additive effect with other nondepolarizing drugs. It also implies that the quality of tracheal intubation conditions achieved after 1 min might be enhanced using an equipotent mixture of rocuronium with another nondepolarizing drug such as vecuronium. Intubating conditions were similar for groups rocuronium and the mixture ($P > 0.4$). Intubating conditions in rocuronium group were significantly better than those in vecuronium group ($P < 0.05$), and the conditions in mixture group were significantly better than those in vecuronium group. This study also substantiates our results.

Lin *et al*.[11] found that with a dose of 0.1 mg/kg the onset time for vecuronium was 102 ± 26.9 s and the clinical duration was 42.5 ± 9.1 min. Rocuronium in a dose of 0.6 mg/kg has an onset time of 54.9 ± 10.9 s and the clinical duration of 44.2 ± 13.2 min.

Carroll *et al*.[12] found onset time of 2 min in a dose 0.08 mg/kg, the median time of recovery was 31 min for vecuronium. For rocuronium, the onset time was 1 min in dose 0.6 mg/kg and the median time of recovery was 33 min.

In their study, Suri *et al*.[13] found that the intubating conditions were clinically acceptable in 99.6% of patients (excellent 73%, G 26.65%) at 90 s using rocuronium (2 × ED90). The lag time of NMB was 22.53 ± 10.66 s and an average for the onset of block (maximum effect was 90.9 ± 10.6 s.). The duration of clinical muscular relaxation was 22.43 ± 8.30 min.

Hepağuşlar *et al*.[14] concluded that midazolam premedication does not influence the time course of action of rocuronium during sevoflurane anesthesia.

Makhija *et al*.[15] in their study on pediatric cardiac patients found that intubating conditions were acceptable in 100% of patients in rocuronium group and 93.3% of patients in rocuronium and vecuronium groups.

The present study showed that among the three groups, there was a significant increase in heart rate, SBP, diastolic pressure, and MBP after laryngoscopy and intubation.

The rise in pulse rate during laryngoscopy and intubation is either due to the stimulation of epipharynx and laryngopharynx or may be due to the light plane of anesthesia. It is expected that endotracheal intubation will generate a pressor response though it can be subdued with the help of incorporating other drugs, for example, β-blockers, opioids, lignocaine, and Ca channel blockers, etc.[16] In the present study, by the end of 15 min, the pressor response was over and the values returned to near

their baseline level. We also used fentanyl witch subdued the pressor response.

The present study showed that in both the groups, there was a significant increase ($P < 0.05$) in systolic blood pressure after laryngoscopy and intubation. In the present study, we did not use any drug such as lidocaine and esmolol to attenuate the reflex response (rise in pulse and blood pressure) before laryngoscopy and intubation. The cardiovascular effects of muscle relaxants may be produced by muscarinic receptor block, ganglion block, increased noradrenaline release or blockage of its reuptake, and histamine liberation.

Nitschmann *et al*.[17] evaluated the cardiovascular parameters after administration of high dose of rocuronium (0.9 mg/kg, 3 ED90) or vecuronium (0.15 mg/kg 3 ED90) under intravenous anesthesia inpatient scheduled for coronary artery bypass grafting. Measurements were made at 2, 5, and 7 min after administration and 10 and 15 min after subsequent intubation. It was found that heart rate, arterial pressure, and cardiac output were not altered to a clinically relevant degree.

Tables 2-4 depict that the mean HR showed minimal changes from the baseline recording; however, the values remained statistically significant at all recorded intervals until 10 min. The SBP showed fall after premedication, induction, and 1-min postintubation, but the values were statistically insignificant and all within clinically acceptable range. Similarly, the DBP and MAP exhibited a fall in values after premedication, induction, and 1-min postintubation. The rise in pulse rate/min has been documented by many workers and so is corroborated by our study also. Even, there was a rise in HR in Group III also. The relative absence of the gross rise in systolic, diastolic, and MAP in our study is attributed to the inclusion of propofol and fentanyl. Both these agents are claimed to subdue the pressor response. Abundant literature is available on the pressor effects to intubation and its management.

Makhaji *et al*.[15] in their study found that there was a significant increase in HR and MAP after intubation in all the groups (rocuronium, rocuronium and vecuronium, and rocuronium and pancuronium). This study also substantiates our results.

Virmani *et al*.[18] found that 66 patients undergoing elective valve surgery under rocuronium and vecuronium decreased the HR up to 5 bpm after injection. This again is in contradiction to the results of many other workers.

Girish *et al*.[19] during their study in 40 ASA Grade III and IV patients undergoing elective coronary artery bypass graft surgery concluded that both rocuronium and a combination of vecuronium with rocuronium (two groups) were associated with clinically unimportant hemodynamic changes. In the present study, 150 ASA I and II patients scheduled for elective lower abdominal (gynecological and general surgical) and perineal surgery were included and three groups, for example, rocuronium, vecuronium, and a combination of rocuronium and vecuronium were compared for intubating conditions and hemodynamic parameters.

Reviewing all the available literature regarding the status of neuromuscular blocking properties and the effects on cardiovascular system of various neuromuscular blocking agents, and after careful scrutiny, it can be deduced that in most of the literature the results vary a lot.[20-23] It may be because of different techniques of neuromuscular monitoring and different methodology to ascertain the desired end-point. There is a vast variation in the timings of lag time, onset of action, the clinical duration, and the incidence of acceptable (excellent or good) intubating conditions. Our study is purely dependent on the clinical observation by the anesthetist; hence, a little variation in timings for the end-point is bound to occur. As a result, the findings of our study match with the results of few studies but do not corroborate with many of others. This might paint a confusing picture, but wherever appropriate we have presented a valid explanation. Rocuronium has the advantage of rapid onset and intermediate duration of action. The reason for this rapid onset of action has been suggested to be of low potency of rocuronium, entailing the presence of more relaxant molecules in the bloodstream which results in a large concentration gradient toward the biophase. The speed of onset of neuromuscular blocking action is affected by anesthetic technique. If relaxant is given immediately after induction agent, then the onset time is few seconds longer than when steady-state anesthesia has already been achieved with a volatile agent. At dose of 1.2 mg/kg, intubating conditions are very similar to those of suxamethonium.

In the present study, the intubating conditions were excellent in 39/50 (78%) patients in Group I and Group III. In contrast, excellent intubating conditions were encountered only in 42% patient in Group II. The concept behind using the combination of rocuronium and vecuronium is that it acts synergistically in the early part of blockade.

Synergism can occur when different drugs act in different manners. This could be by different actions at the same site or by action at different sites. Although the precise model for the synergistic action of these drugs is still not known, few hypothesis has been put forward (a) the existence of multiple binding sites at the end plate called inverse pattern of affinity, (b) alteration of the pharmacokinetic behavior of one drug by the other, and (c) early presynaptic action of rocuronium.

Hemodynamic stability is an integral and essential goal of any anesthesia technique used in patients with gynecological and general surgery. The present study showed that both vecuronium and rocuronium were associated with no clinically significant hemodynamic changes, although the changes in some variable were occasionally statistically significant. Rocuronium has maintained excellent cardiovascular stability for the dose used in the present study. There was slight increase in heart rate; this increase was hardly of any clinical significance.

Conclusion

The result of the present study clearly indicates that a combination of rocuronium with vecuronium act synergistically to produce neuromuscular blockade. The drug combination can also provide a clinically comparable condition for tracheal intubation with near similar hemodynamic conditions as compared with rocuronium bromide alone. This further points out toward the fact that the combination of rocuronium with vecuronium can be economic alternative for rapid intubation in elective surgical cases.

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Conflicts of interest

There are no conflicts of interest.

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