A Study of Hemodynamic Effects of Rocuronium Bromide and other Muscle Relaxants in Cardiac Surgery

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ABSTRACT

Introduction: Use of muscle relaxants in cardiac surgery poses a challenge to anaesthesia due to narrow margin of safety and limited cardiovascular function. Therefore aim of present study is to find out the hemodynamic effects of Rocuronium bromide and other muscle relaxant in cardiac surgery.

Material and Methods: Present study was carried out on sixty (60) patients of different age groups from both sexes scheduled for various cardiac surgical procedures at L.P.S. Institute of Cardiology, GSVM medical college Kanpur during the period of August 1998 to August 1999. Patients were classified in 3 equal groups. Muscle relaxants were given according to the group and hemodynamic parameters were recorded carefully at the interval of two, five and ten minutes.

Results: No statistically significant changes were observed in systolic blood pressure, diastolic blood pressure and central venous pressure at 2 minutes, 5 minutes and 10 minutes after the administration of all three drugs (P >0.05) compared with control values. Significant increase in heart rate was observed at 2 minutes and 5 minutes after the administration of Pancuronium (P <0.05).

Conclusion: On basis of present study's result, it can be said that Rocuronium bromide is safer in cardiac surgery as compared to Vecuronium & Pancuronium.

Keywords: Anaesthesia, Hemodynamic, Cardiac Surgery, Pancuronium, Vecuronium, Rocuronium

INTRODUCTION

The scope and technique of anaesthesia was revolutionised in 1942 when H.R. Grifth and E. Johanson deliberately used "CURARE" to achieve muscular relaxation during surgery. Since then various synthetic non-depolarizing muscle relaxants e.g. gallamine triethiodate, pancuronium bromide, vecuronium, bromide, atracurium besylate have been introduced and their use has now become firmly established as an integral part of modern anaesthesia. The role of muscle relaxant is to facilitate endotracheal intubation and to provide surgical relaxation.[1-3] Endotracheal intubation performance depends upon the depth of anaesthesia, degree of muscle relaxation and anaesthesiologist's skill.[2] Muscle relaxant's duration and type of surgery are critical factors in choosing the correct muscle relaxant to achieve successful tracheal intubation.[4]

Since very beginning it was a common practice to administer suxamethonium to facilitate endotracheal intubation followed by a long acting non-depolarizing muscle relaxant. This sequence has several disadvantages e.g. two drugs are required, various side effects of suxamethonium viz. increased intragastric pressure leading the chances of regurgitation, increased intraocular pressure, increased plasma CPK levels, post anaesthetic muscular pain, myoglobinurea and hyperkalemia[5] leading to cardiac arrest in patients specially with pre-existing hyperkalaemia in the patients of the electric burn.

Ideally each patient should first be tested for his sensitivity to the muscle relaxants to be used and a suitable dose should be determined prior to administering to the patients. However, it is conventionally not followed under most clinical circumstances. It is common practice to administer a small dose of non-depolarising muscle relaxant before administering suxamethonium for endotracheal intubation for preventing fasciculation and post anaesthetic muscular pain. Such precurarisation dose often produces visible signs of neuromuscular blockage like ptosis, nystagmus without disturbing the respiratory physiology of patient. This can be accepted as an effective and safe test dose for determining the sensitivity of individual patients against non-depolarising muscle relaxants.

The older non-depolarizing muscle relaxants have got its own side effects and limitations in its use; viz. D. tubocurarine causes histamine release and ganglion blockade, thereby hypotension. Gallamine has got atropine like action at post ganglionic nerve ending causing tachycardia.Various scientific anaesthetists claimed that recently introduced pancuronium bromide, vecuromium bromide and recuronium bromide devoid of foresaid limitation and side effects. The anaesthesia in cardiac surgery patients itself posed a challenge to the anaesthesia in the view of use of muscle relaxant at the cardiac surgery involve narrow margin of safety, limited cardiovascular function. Thus it was thought worth by to undertake the study entitled a study of hemodynamic effects of recuronium bromide and other muscle relaxant in cardiac surgery.

MATERIAL AND METHODS

After obtaining Institutional Ethical Committee clearance

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and written informed consent for surgery and general anaesthesia, present study was carried out on sixty (60) patients of different age groups from both sexes scheduled for various cardiac surgical procedures at L.P.S. Institute of Cardiology, GSVM medical college Kanpur during the period of August 1998 to August 1999. Patients with pre-existing neuromuscular disorders like myasthenia gravis or history of drug intake like streptomycin, neomycin etc. known to influence neuromuscular transmission were excluded from the study. Patients were classified into three groups as follows-

Group A: Pancuronium bromide (20 patients)

Group B: Vecuronium bromide (20 patients)

Group C: Rocuronium bromide (20 patients)

Various hemodynamic parameters like heart rate, blood pressure (systolic & diastolic) and central venous pressure were studied and analysed. Pre-anaesthetic assessment and routine investigations were done prior to surgery. Patients were graded according to the American society of anaesthesiologist (ASA). Patients of ASA class I, II and III were included in this study. All patients were premedicated with intramuscular injection of morphine (0.1–0.2 mg/kg) and injection promethazine (25 mg), 45 minute before induction in the pre-operative room.

All patients were pre oxygenated for 3-5 minutes and induced with 3-5 mg/kg of IV injection of thiopentone sodium and intubation was achieved with 2 mg/kg of suxamethonium. A central venous triple lumen catheter (Arrow) & radial arterial line (20 gohmeda) were put in the right internal jugular vein & in radial artery respectively immediately after induction. Then after putting CVP catheter and radial line, all the parameters described above were taken immediately and recorded. Then patients were given muscle relaxant according to the group and above mentioned parameters were recorded carefully at the interval of two, five and ten minutes.

After endotracheal intubation patients were connected with anaesthetic ventilator (Ohmeda 7800) and anaesthesia was maintained with 50% O_2 and 50% N_2O with intermittent positive pressure ventilation. Volatile inhalational anaesthetic agents were not used for maintenance of anaesthesia. Reversal of anaesthesia was not done at the end of surgery in open heart surgery cases & all the patients were kept on ventilator post operatively and gradually weaned off accordingly. All closed heart surgery patients were reversed & extubated on table.

Statistical comparisons were made by using 'T' test. Control values were compared with the value at 2 min. after muscle relaxant given, 5 min. after muscle relaxant given & 10 min after muscle relaxant given for Heart rate, systolic blood pressure, diastolic blood pressure, central venous pressure.

RESULTS

Table 1 shows that out of total number of 60 patients, 35 (58.33%) were males and 25 (41.67%) were female. It is also evident from the study that the maximum patients (31.67%) belonged to 30-40 years age group where minimum patients (3.34%) were of 10-20 years age group. The maximum patients (26.67%) were operated for mitral valve replacement followed by close mitral valvotomy.

Table 2 represents hemodynamic response to Pancuronium

Age group (Yr)	Group A		Group B		Group C		Total No.	%
	Male	Female	Male	Female	Male	Female		
10-20	1	0	0	0	0	1	2	3.34
20-30	2	1	3	1	2	0	9	15.0
30-40	5	1	4	2	3	4	19	31.67
40-50	3	3	2	2	3	4	17	28.33
50-60	1	2	3	1	0	1	8	13.33
60-70	0	1	2	0	1	1	5	8.33
Total	12	8	14	6	9	11	60	100.0

Table-1: Distribution of cases according to age and sex

Parameter	0 min	2 min	5 min	10 min
Systolic BP	108.55±9.89	109.65±9.54	110.15±17.4	104.5±12.66
Diastolic BP	65.75±8.46	59.05±7.83	70.85±10.53	66.25±8.71
Heart Rate	92.65±15.02	97.45±12.77*	101.4±12.56*	100.7±14.18
Central Venous Pressure (CVP)	8.25±3.20	8.3±2.73	8.0±2.57	7.75±2.40
* Represents the p value <0.05.				

Table-2: Haemodynamic Responses to Pancuronium Bromide Administration

Parameter	0 min	2 min	5 min	10 min
Systolic BP	117.15±18.01	114.05±13.84	113.15±12.10	113.2±16.49
Diastolic BP	69.4±13.69	67.95±11.43	68.6±11.44	69.55±12.94
Heart Rate	101.2±12.67	98.6±12.88	99.75±11.28	95.05±12.86
Central Venous Pressure (CVP)	12.75±5.15	12.3±5.22	12±5.47	11.75±5.30

Table-3: Hemodynamic Responses to Vecuronium Bromide Administration

Parameter	0 min	2 min	5 min	10 min
Systolic BP	119.89±13.07	119±13.23	119.45±12.45	119.4±12.96
Diastolic BP	17.15±10.97	71.2±11.74	68.75±10.35	69.85±10.87
Heart Rate	102.9±18.63	103.15±17.9	104.85±13.61	102.7±5.42
Central Venous Pressure (CVP)	15.5±6.21	15.25±6.29	14.95±6.23	14.8±6.13

Table. 4 Hemodynamic Response to Rocuronium Bromide Administration

bromide administration. No statistically significant changes were observed in systolic and diastolic blood pressure at 2 minutes, 5 minutes and 10 minutes after the administration of drug (P >0.05) compared with control values. Significant increase in heart rate was observed at 2 minutes and 5 minutes after the administration of drug (P <0.05). No statistically significant changes were observed in central venous pressure (CVP) at 2 minutes, 5 minutes and 10 minutes after the administration of drug (P >0.05).

Table 3 represents hemodynamic response to Vecuronium bromide administration. No statistically significant changes were observed in systolic blood pressure, diastolic blood pressure, heart rate and central venous pressure at 2 minutes, 5 minutes and 10 minutes after the administration of drug (P >0.05) compared with control values.

Table 4 represents hemodynamic response to Rocuronium bromide administration. No statistically significant changes were observed in systolic blood pressure, diastolic blood pressure, heart rate and central venous pressure at 2 minutes, 5 minutes and 10 minutes after the administration of drug (P >0.05) compared with control values. It shows that Rocuronium has very stable hemodynamic profile.

DISCUSSION

The present study was carried out and completed on 60 patients of different age groups & sex who underwent major cardiac surgical procedure for different pathological conditions at LPS institute of GSVM Medical College Kanpur.

We cannot be very strict about the dose of muscle relaxants since this depends not only on the physical built of a patients, the normality of the neuromuscular transmission, the presence or absence of certain diseases which affect the metabolism and excretion of these drugs. Extreme caution was taken to see that the same standard premedication was used in all cases to avoid the influence on the dosages and action of muscle relaxant drug. Barbiturates have been shown to have a slight depressant effect on the neuromuscular junction but by giving the induction dose of thiopentone sodium on a body weight basis; this small effect should be almost equal in all patients.

Nitrous oxide has no effect on results of our study and any shall effect that it does have, should be similar in all patients. All the patients were taking same treatment of cardiac problem. That would have no effect on result of this study. No inhalation agents which have myocardial depressant effect have been used in this study. All the patients were falling under American society of Anaesthesiologists (ASA) class I, II, III. All the cases were screened pre-operatively and thorough clinical examination and investigation were done.

Mccoy et al.[6] in a study of 20 patients about to undergo CABG demonstrated that Rocuronium bromide 0.6 mg/kg could be safely used in such patient, no significant vagolytic or ganglion blocking effects were noticed and no significant ischemic changes were observed. These results were compared to the effects of an equivalent dose of Vecuronium. No significant differences in cardiovascular changes were seen between Rocuronium bromide and Vecuronium. Present study results are quite similar to the study done by Mccoy et al.

In a study by Nitschmannet et al.[7], cardiovascular parameters were measured in patients scheduled for coronary artery bypass grafting after administration of 0.9 mg/kg Rocuronium. The results were compared with those obtained following an equipotent dose of Vecuronium (0.15 mg/kg). Neither heart rate, mean arterial blood pressure nor cardiac output was altered to a clinically relevant degree following Rocuronium or Vecuronium. Present study results are highly comparable to the study done by Nitschmann et al.[7]

Study done by Quill et al.[8] on Rocuronium found results similar to present study. Study done by Mathew et al.[9] shows statistically insignificant changes in mean arterial pressure following Vecuronium and Rocuronium administration. Wierda et al[10] reported that Vecuronium did not significantly affect SBP, DBP or heart rate.

CONCLUSION

From result of present study, we conclude that Rocuronium has no effect on systolic blood pressure like Vecuronium & Pancuronium. Rocuronium has no significant effect on Diastolic & mean blood pressure. Regarding the vagolytic activity, Rocuronium appears to fall in range between Vecuronium, that has no vagal activity and Pancuronium that causes some vagal induced increase in heart rate. CVP is not affected by Rocuronium bromide like Vecuronium bromide and Pancuronium.

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