

Research Article

Assessment of haemodynamic stability with intubating dose of intravenous rocuronium bromide versus vecuronium bromide in predominantly stenotic valvular cardiac surgery patients

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ABSTRACT

Background: In the purely or predominantly mitral stenotic heart surgeries, the principal haemodynamic goals are to maintain a sinus rhythm and avoiding tachycardia. Thus rapid airway control and hemodynamic stability are vital for successful anaesthetic management of patients undergoing the cardiac surgeries. In such patients, muscle relaxants play a pivotal role for achieving good hemodynamic stability. Hence, this study was conducted to evaluate the hemodynamic stability of rocuronium bromide i.v. vecuronium bromide.

Methods: The study conducted was randomized prospective double blind study in 60 adult patients (30 in each group) undergoing elective cardiac valvular surgery. Each group received either intubating dose of Rocuronium (0.6 mg/kg body weight) or intubating dose vecuronium (0.1 mg/kg body weight) intravenously after receiving sedation and analgesia. Hemodynamic parameters like heart rate, systolic and diastolic blood pressure, mean arterial pressure and central venous pressure were recorded at baseline 10 minutes after sedation /analgesia at induction, laryngoscopy and at intubation. Any side effects during intubation were noted.

Results: Intubating doses of either Rocuronium or vecuronium are not associated with any haemodynamic adverse effects. Also there were no statistically significant ($p < 0.05$) differences between both these groups, in any of the variables at any time.

Conclusions: The present study showed that Rocuronium had maintained excellent cardiovascular stability for the dose given to the patient. There was no statistically significant increase in heart rate, systolic, diastolic and mean arterial blood pressure after administration of Rocuronium as compared to vecuronium in the study.

Keywords: Hemodynamic changes, Mitral stenotic heart surgeries, Rocuronium, Vecuronium, Intubation

INTRODUCTION

Valvular heart diseases are still common in developing countries like India due to prevalence of rheumatic fever in these countries. In India, rheumatic heart disease (RHD) is prevalent in the range of 5-7 per thousand in 5-15 year's age group and there are about 1 million RHD cases in India.¹ RHD is always associated with mitral regurgitation, aortic stenosis or aortic regurgitation. In the purely or predominantly mitral stenotic heart surgeries, the principal haemodynamic goals are maintaining a

sinus rhythm (if present preoperatively) and avoiding tachycardia, as it is poorly tolerated because of decreased time for diastolic filling. Maintenance of normal sinus rhythm, heart rate and intravascular volume is critical in patients with aortic stenosis as ventricular filling depends upon the atrial contraction.² Loss of a normally timed atrial systole, tachycardia or atrial fibrillation seriously impairs ventricular filling and leads to rapid deterioration of the condition. Thus rapid airway control and hemodynamic stability are vital for successful anaesthetic management of patients undergoing cardiac surgeries and

who come under ASA grade III and ASA grade IV category.³ In these patients, among all the drugs used for a smooth induction, muscle relaxants play a pivotal role. Intravenous Vecuronium bromide, an intermediate acting non-depolarising muscle relaxant is widely used because of its desirable properties and is also considered as the “gold standard” among muscle relaxants for cardiovascular stability.^{4,5} It has a slow onset of action and causes bradycardia when used with narcotics.^{6,7}

Intravenous Rocuronium bromide is a relatively new steroidal intermediate acting non-depolarising neuromuscular blocking agent with a faster onset of action and proved of having minimal cardiovascular side effects in animal and human studies.^{8,9}

Also it is argued that mild inotropic and chronotropic effect of Rocuronium is an advantage with the use of relatively higher doses of opioids. Thus in the need of looking for a neuromuscular agent, for achieving good hemodynamic stability, this study was conducted to evaluate the efficacy of Rocuronium bromide (intubating dose: 0.6 mg/kg body weight) and compared its efficacy with routinely used i.v. vecuronium bromide (intubating dose: 0.1 mg/kg).

METHODS

The study performed was a randomized prospective double blind study in 60 adult patients (30 in each group) undergoing elective cardiac valvular surgery in a tertiary care centre in Mumbai. First group of 30 patients received Rocuronium bromide (0.6 mg/kg) and second group of 30 patients received vecuronium bromide (0.1 mg/kg) randomly for intubation.

Withdrawal criteria

Patients having heart rate less than 20% of the base line and BP of less than 20% of the baseline after giving the induction agent were withdrawn from the study and were not given the study drug. Standard resuscitation measures applied.

Inclusion criteria

- Patients with Mallampatti class I or II
- Adult male or female with age group of 18 yrs - 60yrs posted for elective cardiac valve replacement surgery

Exclusion criteria

- Patients with history of difficult intubation or anticipated difficult intubation i.e. Mallampatti class III or IV
- Patients known to have or suspected to have renal, hepatic, metabolic, neuromuscular disorders, those with congestive cardiac failure.

- Patients with known / suspected allergy to narcotics or neuromuscular blocking agent under study or to other medication used during general anaesthesia.

A detailed pre-anaesthetic evaluation including history of previous medical illness, previous surgeries, general examination and appropriate baseline investigations were carried out and recorded in the proforma. An informed written consent was obtained. All preoperative medications were noted and given until the morning of the surgery.

On the operating table, patients was re- examined, intravenous access was obtained with 18G venous cannula and as slow ringer lactate drip was starte. On the other hand a radial arterial line was inserted with a 20G jelco cannula under local anaesthesia for continuous invasive blood pressure monitoring (IBP). Baseline values of heart rate blood pressure (systolic / diastolic, mean arterial pressure) and central venous pressure were recorded by an observer who did not know which group the patient is assigned to. After baseline recordings, the patients received sedation with IV midazolam 0.02 mg/kg body weight and analgesia with IV fentanyl 5µg/kg.

10 minutes after sedation and analgesia, induction of general anaesthesia was started. All patients were pre-oxygenated with 100% oxygen by face mask for 3 minutes. Induction was done with Propofol IV (1 mg/kg body weight) and patients ventilated with O₂:air:Sevo 50:50:1% respectively. Vital parameters recorded at this stage and only those patients without hemodynamic compromise were involved further in the study. Thus patients (30 patients in each group) randomly received either intubating dose of Rocuronium (0.6 mg/kg body weight) or intubating dose Vecuronium (0.1 mg/kg body weight) intravenously.

All patients were mask ventilated with 50% air, 50% oxygen and Sevoflurane. Laryngoscopy was done at the end of three minutes by the same anesthetist to avoid errors. Intubating conditions in both the groups were evaluated and scored according to the four step scale proposed by Goldberg and his colleagues. As per Goldberg and colleagues intubating conditions are described as:

- *Excellent*: Easy passage of endotracheal tube without coughing, vocal cords relaxed.
- *Good*: Passage of tube with slight cough vocal cords relaxed.
- *Poor*: Passage of tube with moderate coughing or bucking some vocal cord movements.
- *Impossible*: vocal adducted or not visualized, jaw not relaxed.

Hemodynamic parameters like heart rate, systolic and diastolic blood pressure, mean arterial pressure and central venous pressure were recorded by the same blinded observer at baseline 10 minutes after sedation

/analgesia at induction, laryngoscopy, intubation then every 30 seconds for first 2mins, every 1 minute till 10 minutes and every 5 minutes till 30 minutes from the time of intubation. Any side effects if observed during intubation were noted. Anaesthesia was maintained with nitrous oxide (50%), oxygen (50%) and 0.5% Isoflurane as an inhalational agent, with IPPV (intermittent positive pressure ventilation) in both groups. In this study patients did not receive any surgical stimulus or medication for 30 minutes after the intubation.

All the values were subjected to statistical analysis and expressed as mean±SD. Chi-Square test was applied to all the results. To find out difference between the two groups unpaired 't' test was used.

RESULTS

Patients in both the groups were comparable with respect haemodynamic parameters of heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP) and peripheral capillary oxygen saturation (SpO₂) at baseline. Intubating conditions were good both groups after receiving rocuronium and vecuronium.

As shown in Figures 1-4 ten minutes after sedation/analgesia a fall in the mean heart rate and blood pressure recordings (systolic, diastolic and mean arterial pressure) was noted in each group and from Figure 5 it was evident that an estimate of arterial oxygen saturation (SpO₂) was not affected throughout the study. This fall in the above parameters was not statistically significant between the two groups and is attributed to the effect of the sedation and analgesic agent used.

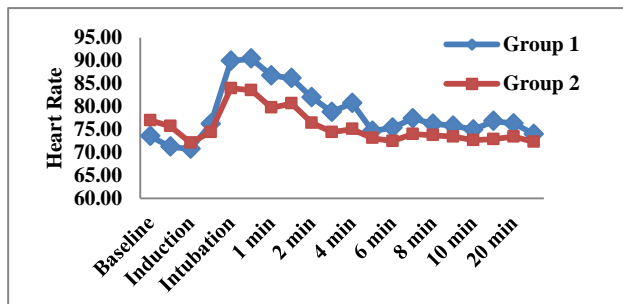


Figure 1: Comparison of heart rate.

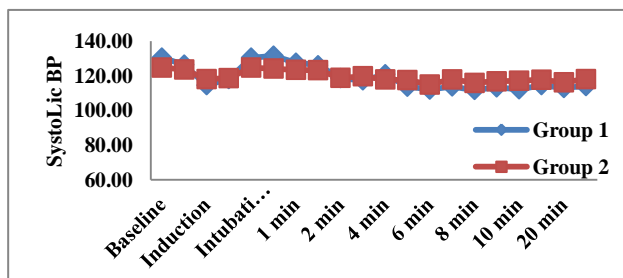


Figure 2: Comparison of systolic blood pressure.

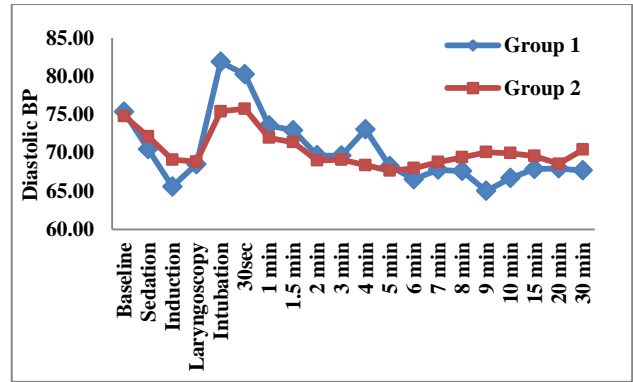


Figure 3: Comparison of diastolic blood pressure.

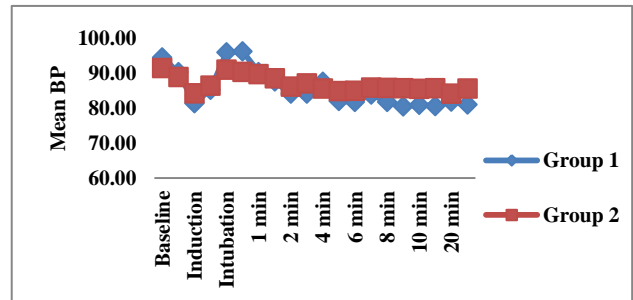


Figure 4: Comparison of mean arterial pressure.

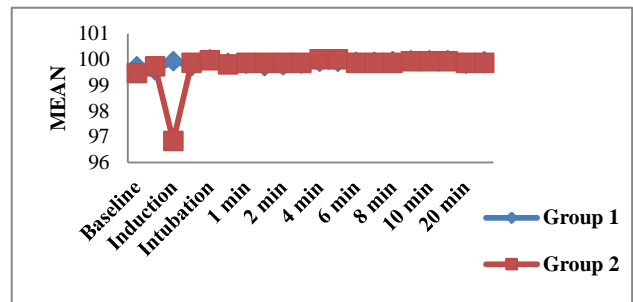


Figure 5: Comparison of peripheral capillary oxygen saturation.

Following induction no statistically significant difference was noted in the above mentioned parameters between the two groups, so both groups were comparable at induction point which was taken as a reference level for comparing subsequent values. Patients then received intubating doses of i.v. Rocuronium bromide and i.v. vecuronium bromide as neuro-muscular blocking agents randomly. Intubations were done in both the groups and all haemodynamic parameters recorded for 30 minutes from the time of intubation.

From the figures it was shown that there was an rise in the mean heart rate, systolic, diastolic and MAP in both the groups following laryngoscopy and intubation. This rise observed in both groups can be attributed to pressor reflexes of intubation stimulus. These changes though statistically significant from induction value, they were transient and without any haemodynamic instability or

deterioration of patients' cardiovascular status and did not require any active intervention. These changes were clinically acceptable.

Intergroup analysis for all parameters was done and this did not show any statistically significant difference between the two groups at any time during the study.

DISCUSSION

Haemodynamic stability is of utmost importance in any kind of cardiac surgery. It is important to maintain haemodynamic stability during anaesthetic induction, in patients undergoing surgery for valvular heart disease (VHD). The common practice includes, use of high dose opioids and nondepolarising muscle relaxants. In India, rheumatic heart disease (RHD) is still common and in these patients, multiple valvular lesions are encountered.

It is conceivable that Rocuronium (an analogue of Vecuronium) with mild vagolytic action leading to small increase in heart rate (HR), similar duration of action to Vecuronium but with the faster onset on action, a favourable recovery pattern and non-cumulative property may be beneficial in most cardiac lesions. Thus this study thus was carried out to evaluate the effect on haemodynamic stability with intubating dose of i.v. rocuronium bromide with i.v. vecuronium bromide in valvular cardiac surgery patients.

In the present study all the hemodynamic parameters were decreased during sedation, induction, laryngoscopy and were increased after intubation with Rocuronium and vecuronium in both groups and later further decrease in the values are observed with increase in time. All the values between the two groups are non-significant when compared and our findings in the present study were in accordance with McCoy et al, Levy et al and Nitschmann et al which was found no significant alteration in haemodynamics after Rocuronium administration.¹⁰⁻¹²

McCoy et al used invasive cardiovascular monitoring studied the cardiovascular effects of Rocuronium in humans. There was no evidence of histamine release in any patients.¹⁰ Levy et al investigated the haemodynamic effects of 0.6, 0.9 or 1.2 mg/kg Rocuronium (2, 3 and 4 X ED95).¹¹ The cardiovascular profile of the three increasing doses was similar and none of the three doses had any adverse effect on the cardiovascular functions of any patients.¹¹

Nitschmann using rocuronium (0.9 mg/kg) or Vecuronium (0.15 mg/kg) in patients undergoing coronary artery bypass grafting reported no significant change in haemodynamics. These studies confirm with our results regarding haemodynamics of Rocuronium.¹² These findings are also similar to that of Cornet et al evaluated the effects of Rocuronium bromide on haemodynamics and left ventricular function in patients undergoing abdominal aortic surgery. He observed that

haemodynamics and LV function were not affected by Rocuronium; no significant changes in B. P., heart rate and cardiac output were noted in response to Rocuronium administration.¹³

Similarly while doing comparison of intubating conditions and haemodynamic effects of Rocuronium and mixture of Vecuronium and Rocuronium in patients undergoing elective coronary artery bypass graft surgery, Girishbabu and Chaturvedi found out that there was an increase in heart rate following Rocuronium administration but the average maximum increase of 5 beats/min was clinically insignificant.

Rocuronium is 3-6 times less potent than Vecuronium as a neuromuscular blocker but is slightly more potent in blocking the responses to either vagal or preganglionic sympathetic stimulation. Therefore the margin between the neuromuscular blocking effect and the unwanted vagal blocking action is less than that of Vecuronium. Thus the slight increase in heart rate may be beneficial along with opioids used for induction of these patients. The present study showed that both Vecuronium and Rocuronium were associated with clinically unimportant hemodynamic changes.¹⁴

Also the study done by Deepak et al effect of muscle relaxants on heart rate, arterial pressure, intubating conditions and onset of neuromuscular block in patients undergoing valve Surgery, concluded that onset of action of muscle relaxant, was fastest with Rocuronium.¹⁵

In contrast to our study Robertson et al when compared cardiovascular effects with 3X ED95 of Rocuronium and Vecuronium, he found that there were statistically significant increases from baseline in one or more (heart rate, BP) hemodynamic parameters in the Rocuronium group when compared to Vecuronium group.

He attributed these cardiovascular changes to the vagolytic action of Rocuronium bromide, and although statistically significant they were not likely to be clinically important.¹⁶

CONCLUSION

The present study showed that both Vecuronium and Rocuronium were associated with clinically unimportant hemodynamic changes. Rocuronium has maintained excellent cardiovascular stability for the dose used in present study.

There was no statistically significant increase in heart rate, systolic, diastolic and mean arterial blood pressure following Rocuronium administration in the present study as compared to Vecuronium. Rocuronium bromide can therefore be advocated as the drug of choice in elective as well as in emergency cardiac valvular surgery where rapid intubation will be beneficial without compromise of hemodynamic stability.

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Conflict of interest: None declared

Ethical approval: The study was approved by the Institutional Ethics Committee

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