

Effect of Esmolol on Cardiac Recovery after Cardiopulmonary Bypass Surgery

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ABSTRACT

Introduction: During cardiopulmonary bypass (CPB) surgery, beta-blockers are generally avoided due to the concern of negative inotropic effects which may result in difficult weaning of patients. The present study was done to evaluate the effect of esmolol (a beta blocker) on recovery and rhythm of cardiac muscles during CPB.

Material and Methods: Sixty patients of rheumatic heart disease undergoing CPB received either esmolol 1 mg/kg (Study group, 30 patients) or the same volume of saline (Control group, 30 patients) before removing aortic clamp. Recovery of patients was assessed in terms of heart auto re-beat ratio, ventricular fibrillation after primary re-beat, heart rate after constant re-beat, requirement of temporary perioperative pacemaker, requirement of vasoactive drugs during weaning from cardiopulmonary bypass, recovery time, posterior parallel time and total bypass time.

Results: The mean age of patients in study and control group was 62.3±2.3 and 61.24± 2.32 years respectively. In esmolol treated group heart underwent re-beat automatically in 90% of patients, ventricular fibrillation after primary re-beat occurred in 6.66% patients, mean recovery time was 4.2±1.2 min, heart rate after steady re-beat was 50± 15 beats/min, only 16.66% patients needed increased dosage of vasoactive drugs and posterior parallel time was 25±8 min. In control group heart underwent re-beat automatically in 26.66% of patients, ventricular fibrillation after primary re-beat occurred in 40% patients, mean recovery time was 4.5±.3 min, heart rate after steady re-beat was 90±15 bits/min, only 50% patients needed increased dosage of vasoactive drugs and posterior parallel time was 30±9 min.

Conclusion: In present study esmolol has shown that it can be helpful in cardiac recovery in patients undergoing cardiopulmonary bypass.

Keywords: Cardiopulmonary bypass, heart rate, esmolol, arrhythmia

INTRODUCTION

Efficacy of early administration of beta blockers to ventricular responses during cardiopulmonary bypass (CPB) surgery or within 10 minutes after aortic clamp is released is well documented.¹

Esmolol is being used for different indications including STEMI, atrial fibrillation, aortic dissection and hypertension and ventricular tachyarrhythmias.²

Esmolol is an ultra-short acting cardioselective beta blocker with plasma half life of 9 minutes; it has shown to be cardio-protective in different animal and clinical model.³ There are very limited studies which have investigated the use of esmolol on cardiac recovery and rhythm during CPB surgery.³

In present study, we evaluated the effect of esmolol on the

cardiac recovery in patients undergoing rheumatic heart surgeries.

MATERIAL AND METHODS

It was a prospective randomized study was done in Deptt of Anesthesia, Gandhi Medical College and Hamidia Hospital, Bhopal over a period of 6 months between July 2015 to Dec. 2015. The study included 60 patients of rheumatic heart disease (RHD).

A written informed consent from all the patients and Ethical Committee approval was obtained before starting the study. Patients with mitral stenosis or regurgitation undergoing elective valve replacement surgery, of either sex and between the ages of 20 - 40 years were included in the study. Patients with ASA grade 2, 3 or 4, having other associated valvular or coronary abnormalities; uncontrolled pre-existing arrhythmias were excluded from the study.

All patients were randomly divided into 2 groups (30 patients in each) by sealed envelope method. Study group who received esmolol 1mg/kg prior to removal of aortic clamp and Control group who received equal volume of isotonic saline.

All patients received alprazolam on the night before surgery. In operation theater pulse oximeter, electrocardiogram was attached. Intra-arterial catheter for invasive blood pressure monitoring and central venous catheter were placed in situ.

All patients were induced with thiopentone 3-5 mg/kg, fentanyl 5-10 µg/kg and vecuronium 0.1 mg/kg. Patients were then maintained on oxygen, isoflurane and fentanyl at 2µg/kg/hr and relaxant. Two temperature probes (nasopharyngeal and rectal), Ryles tube, urinary catheter were also placed in situ.

During cardiopulmonary bypass, all myocardial preservation protocols were followed and temperature was maintained between 30-32 degree celsius.

Recovery of patients after cardiopulmonary bypass was assessed in terms of heart auto re-beat ratio (heart beat returning itself without ventricular fibrillation or a temporary pacemaker), ventricular fibrillation after primary re-beat, heart rate after constant re-beat, requirement of temporary perioperative pacemaker, requirement of vasoactive drugs

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Parameters	Control Group	Study Group	P Value
Automatic Re-Beat*	8 (26.66)	27 (90)	0.0001
Ventricular Fibrillation*	12 (40)	2 (6.66)	0.0060
Temporary Pacemaker*	3 (10)	4 (13.33)	NS
VDR*	15 (50)	5 (16.66)	0.0137
HR After Successful Re-beat (beats/min)#	95±15	90±15	NS
HR After Steady Re-Beat (beats/min)#	90±15	50±15	0.001
Bypass Time (min)#	70±10	65±10	<0.05
Recovery Time (min)#	4.5±1.5	4.2±1.2	NS
Posterior Parallel Time(min)#	30±9	25±8	<0.05

*Data is expressed as no of patients (%), #data is expressed as mean±SD. VDR; vasoactive drug requirement during weaning from bypass, HR; heart Rate, NS; not significant.

Table-1: Comparison of different parameters for recovery of patients after cardiopulmonary bypass

during weaning from cardiopulmonary bypass, recovery time (time from reperfusion to steady heart beat), posterior parallel time (time from aortic unclamping to weaning from bypass) and total bypass time.

STATISTICAL ANALYSIS

The quantitative data was analyzed using IBM SPSS- ver.20 software and expressed as mean± standard deviation (SD) and difference compared using one-factor analysis of variance. The qualitative data was compared with chi-square analysis. P<0.05 was considered significant.

RESULTS

In present study mean age of patients in Study and Control group was 62.3±2.3 and 61.24± 2.32 years respectively.

In present study, there was no difference in mean age, cardiac function (ejection fraction and LV end-diastolic pressure), physical examination variables and gender between both the groups (p>0.05).

There were no differences in physical examination variables, cardiac function (ejection fraction and LV end-diastolic pressure), ASA physical status, ethnicity, or gender (p>0.05).

In present study, following esmolol treatment, heart underwent re-beat automatically in 27 (90%) patients in Study group compared to 8 (26.66%) patients in Control group (p<0.05).

Ventricular fibrillation after primary re-beat occurred in 12 (40%) cases in Control group but only 2 (6.66%) cases in Study group (p<0.05).

The mean recovery time was 4.2±1.2 min in Study group and 4.5±.3 min in Control group (p>0.05).

Heart rate after steady re-beat was higher in control group as compared to study group and heart rate after successful re-beat was also higher in control group as compared to study group (table 1).

Fifty percent of patients in control group required higher dosage of vasoactive drugs during weaning from bypass whereas in study group only 16.66% patients required it (p<0.05).

DISCUSSION

Utility of beta-adrenergic blocking drugs to control arrhythmias after cardiac surgeries are well recognized.^{4,5} The present study is more elaborated study, mainly focusing on cardiac recovery and heart rhythm during CPB surgery.

The findings of the present study suggest that esmolol can fulfill the requirement of controlling ventricular responses

like automatic re-beat and Ventricular Fibrillation.

The present study has found a positive effect of esmolol in preventing ventricular arrhythmia in patients undergoing cardiopulmonary bypass surgery when compared to control group (p<0.05).

More no of patients in esmolol treated group got automatic re-beat success (90%), reduced the chances of ventricular fibrillation after primary re-beat as compared to control group. In present study, esmolol treatment did not enhance the requirement of temporary cardiac pacemaker with the aim of maintaining required heart rate after cardiopulmonary bypass (CPB) surgery. It may be due to the fact that when esmolol is administered in the early stages of surgery, it rarely depresses the heart rate or contractility.³

Esmolol is also reported to improve the heart recovery and oxygen consumption and delivery equilibrium which in turn enhance energy stores in myocardium and in that way provide benefits for the weaning process.³

It has been found that most of the physicians have a tendency to use beta blocker in non surgical patients for the treatment of different arrhythmias like ventricular arrhythmia.^{6,7} In accordance with the study done by Bassiakou et al and Jingjun et al, present study also observed that beta blocker can be an alternative to improve cardiac rhythm in cardiopulmonary bypass patients.^{6,7} There are different studies and meta-analysis for the use of esmolol in cardiac surgery.^{8,9}

Cork et al did a study on 29 patients and reported that patients who received esmolol infusion found to have lower heart rate.¹ Almost similar result was observed in present study.

Visser FC et al also advocated the use of esmolol during cardiac surgery; they reported that it could be a best alternative to depolarizing cardioplegia.¹⁰

The present study had few limitations like small sample size hence a large randomized clinical trials are required to confirm these findings.

CONCLUSION

The findings of the present study show that esmolol can provide rapid and clinical important control on ventricular response during Cardiopulmonary Bypass surgery.

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