Comparison of Hemodynamic Parameters of Propofol and Sevoflurane During Cardiopulmonary Bypass Time in Patients Undergoing Coronary Artery Bypass Graft: A Randomized Control Trial

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Abstract

Objective: To compare hemodynamic parameters of propofol and sevoflurane during cardiopulmonary bypass time in patients undergoing coronary artery bypass graft (CABG) surgery to avoid increase in lactate level.

Method: One hundred and twenty-six patients were included. Non probability consecutive sampling was used. Patients were divided in two groups, propofol was given to group 1-P, and sevoflurane to group II-S. Age, clamp-time, bypass-time, mean arterial blood pressure on bypass machine, lactate level (pre-cross clamp lactate level and post-rewarming lactate) and flow-rates on CPB were compared between two groups. SPSS version 24 was used and p value ⩽ 0.05 was considered as significant.

Results: The mean pre-cross clamp lactate level, post- rewarming lactate, total noradrenaline dose used, MAP (Mean Arterial Pressure) during CPB, flow-rate, total bypass-time and cross clamp-time of Group-I was 1.79±0.58 mmol/L, 4.67±0.98 mmol/L, 0.088±0.04µg/kg, 65.37±2.14 mmHg, 5.23±1.06L/min=(CI×BSA), 109.04± 3.08 minutes and 67.90±2.08minutes , respectively. The mean pre-cross clamp lactate level, post- rewarming lactate, total noradrenaline dose, MAP during CPB, flow-rate, total bypass-time and cross clamp-time of Group-II was 1.88±0.62 mmol/L, 4.75±0.22 mmol/L, 0.18±0.12µg/kg, 69.69±2.22 mmHg, 4.66±2.29L/min=(CI×BSA), 110.12±2.82minutes and 68.63±2.47minutes , respectively. The differences were statistically insignificant, except total Noradrenaline dose (p=0.000) and MAP during CPB (p=0.000).

Conclusion: Study reveals that hemodynamic stability in both groups remained same but mean arterial pressure was low which required higher flow-rate. Group II showed increase requirement of vasopressors.

Keywords: Propofol, Sevoflurane, hemodynamic stability, Lactate level, CABG

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Introduction

Among intravenous anesthetics propofol is frequently and widely used anesthetic with high lipid solubility.[1] Pharmacokinetics of propofol allows rapid induction, proper maintenance and early recovery of conscious level at the time of reversal given. On other hand sevoflurane is also widely used volatile and haloginated anesthetic with low blood gas solubility which allows rapid onset of action.[2] Sevoflurane is isopropyl flurinated methyl ether with pleasant fragrance, hemodynamicaly stable and fast emergence in body. Cardiac anesthesiologists recommended sevoflurane in comparison with isoflurane.[3] During cardiac bypass sevoflurane have vasodiator effect due to its smooth muscle ralaxant action on vascular resistance and reduces the

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output of sympathetic system without any effect on smooth muscle stimuli of any other origin.[4] Lots of controversial studies are available in use of sevoflurane and propofol for cardiac stability. Some authors concluded no difference between propofol and sevoflurane use.[5] All above of these conclusions and controversies both drugs are widely in practice in cardiac surgery because of their hemodynamic stability.[6] Lactic acid is an end product of anaerobic metabolism which causes lactic acidosis and leads to tissue hyoperfusion.[7] Measurement of lactic acid can be done with blood lactate level which is helpful for assessment of tissue perfusion and its adequacy in body.[8] Tissue hyoperfusion is a risk of CPB during surgery and after surgical procedure. Increase of decrease in lactate level may be due to degree and duration of hypothermia, duration of CPB, pump flow rate means oxygen delivery, and intraoperative maintenance of anesthesia or hematocrit value.[9]

High lactate level after cardiac operation is a predictor of many complications like prolong ventilatory support and inotropic support which increase the morbidity and mortality rate at the time Icu admission.[10] This study was conducted to correlate the hemodynamic effect of propofol and sevoflurane in terms of hemodynamic stability, blood lactate level, perfusion pressure and complications after and during surgical procedure.

Material and Methods

This study was a randomized control trial, that was conducted in the cardiac surgery department of Chaudhary parvaiz Elahi Institute of cardiology, Multan from May 2017 to May 2018 under supervision of senior staff of cardiac surgery and intensive care unit. One hundred and twenty six patients were included in this study. The sample size was calculated from reference study (Gravel etal, 1999, that was randomized control trial) published in Canadian journal of anesthesia, with the help of www.openepi.com online sample size calculator, with confidence interval of 95% and power of study 80%. Study was started after ethical approval from ethical board of institution, letter NO:06, JAN, 2017. This study has been registered in clinical trial registry (Clinical Trials.gov Identifier: NTC05004545). Informed consent was taken from patients. Non probability consecutive sampling technique was used for collection of data. Patients with history of uncontrolled hypertension, diabetes, any chest trauma or surgery, emergency surgery, known history of drugs used in trial and who were refused to give informed consent were excluded from the study.

All patients who were advised elective coronary artery bypass graft surgery under standard anesthesia and hospital protocols included in the study. Fentanyl 5-15 micrograms/kg, propofol 1-1.5 mg/kg, midazolam 0.05 - 0.1 mg/kg and 0.5 mg/kg atracurium was used for induction of anesthesia. Anesthesia was maintained with isoflurane and additional doses of atracurium and fentanyl till the time of cardiopulmonary bypass. Patients were divided into two equal groups I and II. Group I was given propofol infusion with doses of 75-125 micrograms /kg/min and maintained. In group II sevoflurane 1-2% was given with vaporizer which is connected with CPB pump oxygen supply system. Supply was constantly delivering 3 liter per mint of oxygen and sevoflurane mixture. Once CPB started hypothermia of 32 degree was monitored with hemotherm stockertand monitored through nasal probe. Perfusion pressure monitored through invasive blood pressure monitoring, flow rate monitored according to body surface and cardiac index maintained at 2.4 L/min/m^2. Blood lactate level and hemoglobin monitored with arterial blood gasses on hourly basis through blood gas analyzer ABL 800. Anterograde and retrograde cardioplegia was applied, hemoglobin level maintained at 8 to 9 grams/dl and final lactate level was obtained before rewarming. Cross clamp time and bypass time was recorded. All data was collected and recorded by another person who is unaware of study variables.

Data was recorded and analyzed by using SPSS version 24. Mean and standard deviation were calculated for quantitative variables like age, clamp time, bypass time. Frequency and percentages were calculated for qualitative data like gender. Student t test and chi square test was applied to see association between variables. P value ≤ 0.05 was taken as significant.

Results

One hundred and twenty-six patients of both genders were included in this study. The patients were divided into two groups; n= 63 in Group-I and n=63 in Group-II. The mean age and weight of Group 1-P was 46.09 ± 3.06years and 66.34±4.11kg, respectively. There were more males than females i.e. n=43 (68.3%) and n=20 (31.7%), respectively. While, the mean age and weight of Group II-S was 48.84±2.96 years and 71.14±4.88 kg, respectively. There were more males than females i.e. n=50 (79.4%) and n=13 (20.6%), respectively. The difference of age and weight were statistically signifi-

cant, (p=0.000) and (p=0.000), respectively (Table. I).

The mean pre-cross clamp lactate level, post- rewarming lactate, total noradrenaline dose, MAP during CPB, flow rate, total bypass time and cross clamp time of Group-I was 1.79±0.58 mmol/L, 4.67±0.98 mmol/L, 0.088±0.04μg/kg, 65.37±2.14 mmHg, 5.23± 1.06 L/min = (CI×BSA), 109.04±3.08minutes and 67.90±2.08 minutes, respectively. While, The mean pre-cross clamp lactate level, post- rewarming lactate, total noradrenaline dose, MAP during CPB, flow rate, total bypass time and cross clamp time of Group-II was 1.88±0.62 mmol/L, 4.75±0.22 mmol/L, 0.18±0.12μg/kg, 69.69±2.22 mmHg, 4.66±2.29L/min=(CI×BSA), 110.12±2.82minutes and 68.63±2.47minutes , respectively. The differences were statistically insignificant, except Total Noradrenaline dose (p=0.000) and MAP during CPB (p=0.000). (Table. II). P-value ≤0.05 was considered as significant.

Table 1: *Demographic Variables*

Variable	Group I-P n=63	Group II-S n=63	P-value
Age (years)	46.09±3.06	48.84±2.96	0.000
Weight (kg)	66.34±4.11	71.14±4.88	0.000
Gender			
Male	n=43 (68.3%)	n=50 (79.4%)	0.156
Female	n=20 (31.7%)	n=13 (20.6%)	

Table 2: *Hemodynamic Parameters among the Groups*

Variable	Group I-P n=63	Group II-S n=63	P-value
Pre-cross clamp lactate level (mmol/L)	1.79±0.58	1.88±0.62	0.407
Post- rewarming lactate (mmol/L)	4.67±0.98	4.75±0.22	0.534
Total Noradrenaline dose (μg/kg)	0.088±0.04	0.18±0.12	0.000
MAP during CPB (mmHg)	65.37±2.14	69.69±2.22	0.000
Flow rate (L/min = (CI×BSA))	5.23±1.06	4.66±2.29	0.073
Total bypass time (Minutes)	109.04±3.08	110.12±2.82	0.081
Cross clamp time (Minutes)	67.90±2.08	68.63±2.47	0.075

Discussion

Hemodynamic stability and lactate level control is the main requirement during anesthesia which leads to better outcomes in postoperative period. It is well established truth that hemodynamicaly unstable patients during anesthesia may have high lactate level. In a study by Ranucchi et al[11] it was observed that there was no linearity between association of lactate level and mean CPB time during cardio pulmonary bypass. In his study cut off value for CPB was 96 minutes.

In another study conducted by Shinde et al, it was[12] reported that there was a relationship between CPB and lactate level when cut off value for CPB was 96 minutes, but this relationship among both variables is not linear. Another study was conducted by Essa J et al[13] and was reported that patients in both propofol and sevoflurane group remain hemodynamicaly stable. There was no difference observed regarding noradrenalin dose and lactate level. In propofol group low MAP was observed (63.1 ± 2.6 mmhg).

Another study was conducted by Khare A et al[14] on comparison of sevoflurane and propofol and reported that hemodynamic stability and recovery profile of sevoflurane is equal to propofol. He recommended that sevoflurane can be used as an alternative of propofol in laparoscopic procedures. Heart rate is also same in both groups. In terms of hemodynamic stability of propofol and sevoflurane this study is compareable with our study, but it was performed in different group of patients. Another study was conducted by Likhvanta VV et al[15] and reported that sevoflurane control the cardiac biomarkers release and reduce the hospital stay of patients when compared with propofol infusion in coronary artery bypass graft surgery in which patient was kept for CPB. Use sevoflurane also reduce the 1 year mortality rate by reduction of post-operative complications. Recovery time is also rapid after use of sevoflurane. This study is also comparable with our study. In this study lactate level during and after use of CPB was not monitored.

Another study was conducted by Tang L et al[16] and on use of sevoflurane in inhalational anesthesia for hemodynamic stability and reported that sevoflurane is superior to any other anesthetic agent. Recovery time was not effected with use sevoflurane. Bharti N et al[17] also conducted study on comparison of sevoflurane and propofol and reported that emergence time, recovery time and extubation time was assessed and concluded that there was not markable difference between both groups.

Robba C et al[18] also conducted a similar study on comparison of sevoflurane and propofol anesthesia and reported that induction of anesthesia is safe and fast in both groups, but mean arterial pressure drop is associated

with both groups which can leads to hypoperfusion of spinal cord. In a study conducted by Husedzinovic et al[19] reported that myocardial contractility increased to significant range in sevoflurane group when Doppler echo was performed. Hemodynamic stability and hypertension remains same in both groups at the time of induction and after induction.

Orhon ZN et al[20] conducted a study between propofol and sevoflurane and reported that hemodynamic parameters, spo2 values were not significantly different between two groups. Sevoflurane is as effective as propofol both groups when compared in terms of heart rate and blood pressure. This study is also comparable with our study. Two main factors were reported for responsibility of hemodynamic instability; one blood loss during surgery and second is inadequate anesthesia. It is very important to evaluate the cause hemodynamic instability. Bleeding cause can be corrected with intravenous fluids (colloids, crystalloids) and for anesthetic cause depth of anesthesia should be revaluated.

Tang et al[21] conducted a study using sevoflurane and propofol in patients undergoing cardiopulmonary bypass, they found no difference in adverse events, in terms of low cardiac output and post thoracotomy bleeding, after use of these drugs. These results are comparable with our study. They have studied cardiac output, decline in it is responsible for increase in lactate level.

Maintaining acid-base balance during cardiopulmonary bypass in CABG surgeries is one of the main strategies of management. The metabolic acidosis, as shown by increases in lactate level can be prevented by maintaining adequate perfusion. We compared Sevoflorane and Propofol for studying hemodynamic parameters with their use. That showed both drugs are same in this respect, however higher flow rates are required together with use of noradrenaline to maintain adequqte mean arterial blood pressure and cardiac output, that is mandatory to prevent ischemic injury to body organs and increase in lactate level. Maintaining adequate level of hemoglobin is also part of it. Myocardial pharmacological support in terms of Noradrenaline use was higher in sevoflurane group showing its higher cardiac depressant effect.

Some factors may have been important, affecting our results, like left ventricular ejection fraction at time of surgery, blood loss before onset of CPB machine, that were managed with use of pharmacological support and packed red blood cell transfusion.

Limitations of the study: Our study have certain limitations, that is flow rates and use of inotropes are affected by vasodilation that is caused by various medications used by patient in preoperative period and anesthetics during procedure. Inflammatory response to CPB circuit also causes vasodilation. For maintaining adequate perfusion, and lactate level all these things must be considered.

Results of our study reveal that hemodynamic stability in both groups remains same but mean arterial pressure was low which required high flow rates and vasopressors during cardiopulmonary bypass time. To maintain adequate level of mean arterial blood pressure significantly higher amount of vasopressor was used in group II, that shows more cardiac depressant effect of sevoflurane. During CPB lactate level remained same in propofol infusion and sevoflurane groups during cardiopulmonary bypass graft surgery. Further controlled trialed studies required to justify the superiority.

Conflict of Interest *None*

Funding Source *None*

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Authors Contribution

KUF: Conceptualization of Project

FS: Data Collection

BA: Literature Search

FM: Statistical Analysis

WA: Drafting, Revision

MJ: Writing of Manuscript