Original Article

The effect of sevoflurane versus propofol anesthesia on troponin I after congenital heart surgery, a randomized clinical trial

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Abstract

Background: The ischemic preconditioning phenomenon can save myocardium against move severe ischemic damages and reduce infarction size and furthermore a heart rhythm disturbance. In this study we examine relationship between troponin I (as a structural myocardial protein) level and anesthetic agents in the children.

Materials and Methods: In this study 84 children under 12 years age before cardiac surgery were divided randomly into two groups of 42 each. For anesthetic maintenance sevoflurane with dose of 0.5-1 MAC was used in Group 1 and 100-150 mg/kg/min of intravenous propofol in Group 2 for maintenance of anesthesia. Troponin I level was assessed 2 before and 1 hour after anesthetic induction. Outcome measures included the serum cardiac troponin I level in children before and after surgery in two study groups.

Results: There was no significant difference between two groups in indices and both groups were homogenous in this point of view. The troponin I level after surgery was significantly increased in two groups. In the sevoflurane group it was 0.04 ± 0.12 to 0.05 ± 0.09 ng/ml (*P* value = 0.003) and the propofol group was 0.12 ± 0.26 to 0.19 ± 0.38 ng/ml (*P* value = 0.001).

Conclusions: In this study two Anesthetic regimens were compared to assess the mean troponin I level before and after pediatric closed heart surgery, and it was shown that mean troponin level before and after surgery in the sevoflurane group was less than the propofol group. But this result was not statistically significant. These results indicate that although more protective effects of sevoflurane on myocardial injuries during pediatric cardiac surgery is predominant but this effect has no significant difference in the propofol group.

Key Words: Heart surgery, pediatric, propofol, sevoflurane, Troponin I

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INTRODUCTION

Pediatric death due to congenital heart diseases has increased from 2.7% to 7.7%.[1] That is probably because of performing heart surgery in early stages.[2] Inhaled anesthetic agents have a major protective effect in myocardial ischemia and reperfusion damage.[3,4] Some specific anesthetic agents like isoflorane and

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sevoflurane can regulate this phenomenon. Which is induced by other stimulators inhaled anesthetic agents can save high energy phosphates, reduce free oxygen Radicals, increase collateral circulation flow, decrease platelet aggregation and neutrophyl adhesion to coronary artery wall and finally decrease in platelet thrombosis formation.[5] Altogether all myocardial saving mechanisms in ischemia and reperfusion by inhaled anesthetics do not understand, because this protection also exists in cardioplegy time.[6]

Sevoflurane is one of the newest anesthetic drugs with fast induction of anesthesia and fast regression in comparison with other drugs.[7] Previous studies on sevoflurane have shown that sevoflurane is effective in post ischemic repair and can cause a decrease in infarction size and threshold time for ischemic preconditioning (IPC) via activating ATP-dependent potassium channels (K-ATP) and at the end can reduce delayed cardiac events in patients under CABG and improve 1 year survival.[8,9]

It is showed that propofol as an intravenous anesthetic agent can reduce myocardial dysfunction after ischemia, infarction size and tissue degeneration due to ischemia but in some other studies it has not shown any protection against ischemic and reperfusion damage could not have drug effect with stimulation of IPC.[3,5,10] Today troponin I is one of the preferable biochemical markers in cardiac injuries.[11,12] With measuring troponin I level the admission duration and 1 year survival could be estimated.[13] According to previous studies the effectiveness of these two drugs in IPC stimulation and myocardial protection is not clear and confident. There is few studies in this matter and most of similar studies are on the adults under CABG, for this reason and according to the importance of myocardial protection during cardiac surgery we decided to arrange this study to measure the plasma level of troponin I as an reliable detector of myocardial injury in children undergoing cardiac surgery and to show the effects of two drugs, sevoflurane and propofel fentanyl in myocardial protection and the compare the troponin I level in two groups.

MATERIALS AND METHODS

This study was double-blind randomized clinical trial conducted on 84 patients in Yazd University of Medical Sciences, Iran. The patients and someone who collected the data were not aware completely of details of the study. Inclusion criteria included children who underwent cardiac surgery. Exclusion criteria were emergent surgery, combined or re-do procedures, chronic inflammatory disease, malignancy, current infections, and preoperative treatment with steroids. Sample size was done with simple randomization. This study was performed after obtaining the approval of Committee of Ethics at Yazd University of Medical Sciences and also obtaining the informed written consent from each candidate from June 2012 to November 2013. The patients were randomly equally allocated into two groups of 42. For anesthetic induction in all 84 patients 3 μ/kg fentanyl and 5 mg/kg thiopental sodium was used and 0.5 mg/kg of intravenous atracurium used as a muscle relaxant. Then sevoflurane with a dose of 0.5-1 MAC was used in Group 1 and 100-150 mg/kg/min of intravenous propofol in Group 2 for maintenance of anesthesia. Patients referred to intensive care unit after surgery and monitored as standards like pulse oxymetery, ECG monitoring, capnography and measuring arterial blood pressure. Extubation of the patient after admission to ICU is by anesthesiologist decision. For troponin I level assessment, two blood samples were taken before and 1 hour after anesthetic induction. After centrifugation, the samples were sent to laboratory to qualify the troponin I level using the ELISA method by "troponin Monobind" kit. The sensitivity of the kit was 0.05 ng/ml according to the Kit reference [Figure 1]. An information form was used for any patient including age, sex, type of surgery, type of anesthetic drug, surgery duration, cardiac ejection fraction before surgery, troponin I level before and after the surgery. Data of groups are given as mean ± SD for age, weight, height, surgery duration, LV ejection fraction (EF), heart rate, systolic and diastolic blood pressure before and after the surgery or percentage of

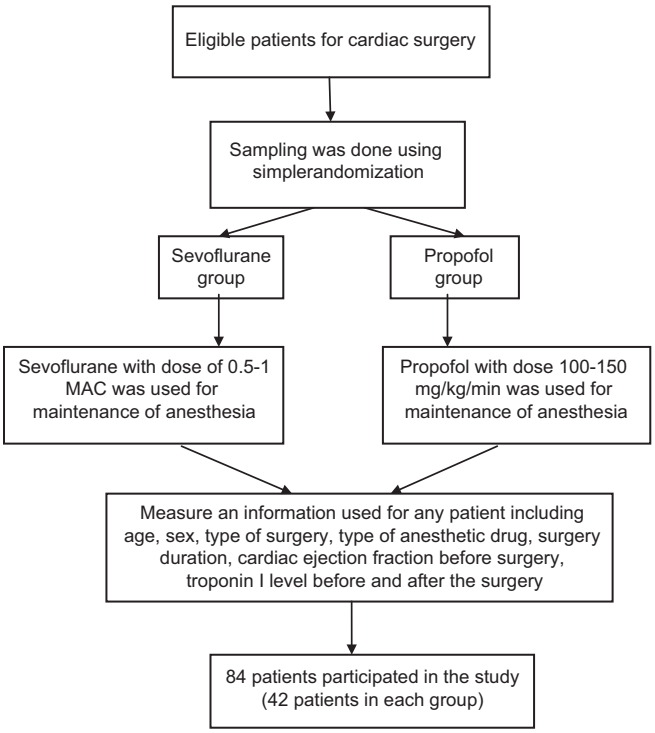

Figure 1: The flow chart of the study phases

sex and type of surgery (PDA, PA Banding, BT Shant, COA, Atrial Septectomy, and PDA + PA Banding). Data was analyzed with the *t*-test, ANOVA, Wilcoxon Test, and Man-Whitney test. Statistical analyses were performed using SPSS version 15.0. A *P* value less than 0.05 was significant.

RESULTS

Two study groups (42 patients in each group) were compared by demographic indices like sex, age, weight, heart rate, systolic and diastolic blood pressure before and after the surgery, surgery duration and EF. The distribution of demographic data is given in Table 1. There was no significant difference between two groups in indices and both groups were homogenous in this point of view.

Mean of troponin I in the sevoflurane group was 0.04 ± 0.12 ng/ml before surgery and it was 0.05 ± 0.09 ng/ml in the propofol group. There was no significant statistical difference between troponin I levels before surgery in two groups. Mean of troponin I level before and after surgery was assessed and is shown in Table 2. The troponin I level after surgery was significantly increased in the sevoflurane group (*P* value = 0.003) and increased in the propofol group (*P* value = 0.001). The comparison of mean of differences in troponin I levels before and after the surgery in two groups was assessed and it was not significant (*P* value = 0.25).

Table 1: Comparison of mean percentage of demographic variables in two study groups

Group Variables	Mean±SD	
	Sevoflurane	Propofol
Gender (%)		
Male	20 (47.6)	21 (50)
Female	22 (52.4)	21 (50)
Age (months)	26.7±29.8	30.4±19.9
Weight (kg)	9.3±5.7	11.4±3.6
Duration of surgery (min.)	74.7±12.9	80.2±13.7
LVEF (%)	62.9±3.2	61.2±3.5
Heart rate (b/min)	121±18	109±9
Systolic BP (mmHg)	97±10	102±7
diastolic BP (mmHg)	64±12	70±6

SD: Standard deviation, LVEF: Left ventricular ejection fraction , BP: Blood pressure

Table 2: Comparison means of troponin I before and after surgery in two groups

Variables Group	Troponin before surgery (ng/dl)	Troponin after surgery (ng/dl)	Difference (ng/dl)	*P* value*
Sevoflurane	0.04±0.12	0.05±0.09	0.08±0.2	0.003
Propofol	0.12±0.26	0.19±0.38	0.14±0.37	0.001
P value**			0.25	

P value*: Wilcoxon test, *P* value**: Man-Whitney test

DISCUSSION

The study was designed to assess the protective effects of two anesthetic drugs, seveflurane versus propofol, on myocardium damage during closed cardiac surgery in children under 12 years old. This study is unique to assessment of protective effects of these two anesthetic drugs on children under off-pump cardiac surgery.

There are several determinant factors that show myocardial injury amount and after surgery outcomes. These factors are some relevant to patients and some relevant to surgery type and others related to myocardial protective methods. In this study the demographic characteristics of patients were equal and there was no significant difference.

This homogenity of sample omitted any bias due to patient demographic. Surgery is another important impressive effect on myocardial damage. In this study several pediatric cardiac surgery types (PDA, PA Banding, BT Shant, COA, Atrial Septectomy, PDA + PA Banding) were compared with each other and did not find any significant difference between two samples. Therefore, bias effects of surgery type were not remarkable.

Anesthetic methods were similar in two groups and the difference was only in drug. So with relative omitting of confounding factors, the differences between plasma troponin I level, before versus after surgery, could be a good indicator for assessment of protective effects of two drugs in pediatric cardiac surgery. In our study the plasma concentration of troponin I in two study groups was significantly increased after surgery in comparison with before surgery. This subject could be an indicator of myocardial injury during the cardiac surgery.

In Malagon *et al*. study in 2005 in Netherlands on cardiac troponin I level in pediatric open heart surgery, the troponin level after cardiac surgery with three anesthetic drugs, midazolem, propofol and sevoflurane, was increased in 8 hours after the surgery. But this increase in all three groups was the same without any significant statistical differences.[10] The difference between our study and their study was surgery type. In our study the surgery was off-pump and theirs was open-heart surgery and with use of CPB. The mean of troponin level in our study was lower, which might be due to surgery type and could be suggestive that in closed cardiac surgery myocardial injury is lesser that open heart. In statistical analysis of data it was shown that there were no significant statistical differences between the two groups, although the mean differences of troponin level before versus after

surgery in sevoflurane was lesser than in the propofol group (0.14 ng/ml versus 0.08 ng/ml, respectively). It shows that the differences between protective effects of two drugs are not statistically significant but sevoflurane cause has a more protective effect.

Dehert and colleges have been performed yet 4 Randomized clinical Trials (RCT) an adults under CABG using on- pump protocol to compare the effects of Inhaled anesthesia versus Intravenous forms. In all studies there was a significant decrease in plasma Troponin levels in Inhaled anesthetic group versus Intravenous group.[14]

In Xia *et al*. study to survey the isoflurane and propofol effects on troponin level in adults there were no significant differences between two groups which was in correlation with our study results.[15]

In previous studies on sevoflurane it has been shown that sevoflurane was effective in myocardial recovering after ischemia and could cause infarct size limitation and reduce threshold time for IP (With effect on late phase) and with activating ATP-related potassium channels (K-ATP), and as a result could reduce the dilatory cardiac events in CABG patients and improve 1 year survival.[9]

Although there are some studies in this matter despite showing the protective effects of sevoflurane but these effects were not so strong to prefer use of the drug in cardiac surgery. Our study was another proof for this claim.

CONCLUSIONS

We concluded that mean troponin level before and after surgery in the sevoflurane group was less than in the propofol group. But this result was not statistically significant. This result indicates that although more protective effects of sevoflurane on myocardial injuries during pediatric cardiac surgery is predominant but this effect has no significant difference from propofol. According to ever-increasing intent to closed heart surgery methods and limited similar studies in the pediatric group it is suggested to perform much more burden studies in with larger sample size in this matter.

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