# Propofol Versus Isoflurane Anesthesia: Comparsion Of Hemodynamic Parameters In Cardiac Surgeries

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**Aim:** The hemodynamic effects of propofol-fentanyl and isoflurane-fentanyl anesthesia during surgery were compared in 100 patients undergoing coronary artery bypass grafting (CABG) and valvular surgeries. **Material and Methods:** Patients were divided into two groups randomly. Group PF (n=50) were induced with Fentanyl, Midazolam, Vecuronium and Propofol infusion. While Group IF (n=50) were induced with Fentanyl, Midazolam, Vecuronium and Isoflurane (0-2%) as per the standard doses. Hemodynamic measurements were made before induction of anesthesia and at various times throughout the surgery. **Observation and Results:** Significant decreases in mean arterial pressure MAP, left ventricular stroke work index (LVSWI), and stroke volume index (SVI) occurred after 15 minutes of propofol anesthesia. With isoflurane MAP was well maintained with reductions in LVSWI and SVI. Isoflurane was, however, associated with a slight increase in heart rate (HR), whereas no significant change in HR in patients receiving propofol. With both techniques there was no significant change in systemic vascular resistance index. Isoflurane prevents myocardial damage and thus it is cardio protective by developing ischemic preconditioning phenomenon. **Conclusion:** The study suggests that propofol-fentanyl anesthesia is an acceptable technique but Isoflurane- fentanyl is still preferred due to less hemodynamic instability and greater myocardial protection in cardiac surgeries. [Shah H et al NJIRM 2013; 4(6) : 44-49]

**Key Words:** A Cardiac Surgery, Valvular Surgery, Propofol, Fentanyl, Isoflurane.

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**Introduction**: The introduction of anesthesia was made by Morton[1], the inventor and revealer of inhalation anesthesia before whom every time surgery was an agony. He deserves the chief credit for introduction of ether as an anesthetic agent. Ether has got the maximum partition coefficient, hence, induction is slow.

Isoflurane, a new volatile anesthetic agent, synthesized in 1965 by R.C.Terrell[2], has replaced halothane because of its many advantages. It is not hepatotoxic and has minimal cardiovascular depressant effect. It is not nephrotoxic[3]. Over and above these, isoflurane is rapidly absorbed as well as eliminated from the body since it has low blood/gas partition coefficient(1.43)[4] Total intravenous anesthesia (TIVA) with propofol and opioids effectively obtunds the adrenergic response to surgical stress with a concomitant reduction in plasma catecholamine concentrations.[5-7]

The end-systolic pressure-diameter relationship (ESPDR) of the left ventricle (LV) is a reliable method to quantitatively assess LV contractility because it is relatively independent of changes in preload and incorporates afterload changes. Therefore we conducted a prospective, double blind study to quantify the cardio dynamic effects of propofol-fentanyl (PF) anesthesia in comparison with isoflurane-fentanyl (IF) anesthesia in patients undergoing coronary artery bypass grafting (CABG).

**Material & Methods:** After approval from the Institutional Ethical Committee and informed written consent, this prospective randomized double blind study was carried out in the Matsama Heart Centre, SBKS MI & RC, Piparia, Baroda. 100 patients of either sex scheduled for CABG or valvular surgeries were included in our study.

Patients having contraindication to opioids dependence, blood coagulopathy, history of drug allergy and abuse and any major systemic illness were excluded from the study.

After detail pre-anesthetic evaluation, routine and specific investigations, each patient was informed regarding the type of study. Preoperative adequate fasting hours (12 hours) were confirmed and baseline vital parameters (pulse rate, blood

pressure, respiratory rate, $SpO_2$ and temperature) were recorded. Arterial pressure monitoring, CVP, PAP & TEE as per need of operation to be done. Premedication of Inj. Glycopyrrolate 0.2 mg will be given 5 minutes before surgery along with Inj. Ondansetron 4 mg and Inj. Ranitidine 50 mg.

100 Patients were randomly allocated into two Groups. In Group PF (n=50), Anesthesia was induced with fentanyl, 10 micrograms/kg, and Vecuronium 0.2 mg/kg, and was maintained with a Propofol infusion commenced at 4 mg/kg/h (range 1 to 10 mg/kg/h) while in Group IF (n=50), Isoflurane commenced at 1 %( range 0 to 2%). Additional fentanyl, 2.5 micrograms/kg, was given before sternotomy. Hemodynamic measurements were made before induction of anesthesia and at various times throughout the surgery.

Patients will be monitored intraoperative for pulse rate, blood pressure, SpO2, ECG, PAP & PAOP & other hemodynamic monitoring & complications. Patient will be assessed for renal and pulmonary functions intra-operative. Cardiac output measurement can be done by various methods such as by using Transesophageal echocardiography (TEE) intraoperative or by using PA Catheterization based on Fick's Principle of Temperature. In our study we have used real time TEE and by using following formula we have calculated Left ventricular stroke work index and stroke volume index. Stroke Volume Index (SVI) = CI/HR × 100, CI = Cardiac Index, HR = Heart Rate

Left Ventricular Stroke Work Index (LVSWI): SVI × (MAP-PAOP) × 0.0136
MAP =mean arterial pressure, PAOP= pulmonary artery occlusion pressure

Statistical Analysis: All data were analyzed statically using T- test and a value of P<0.05 was considered significant. The data's were presented as Mean ± SD and percentage.

**Result:** A total of 100 patients were recruited for the study. There were no significant differences between the two groups in demographic data and duration of surgery (Table 1).

**TABLE 1: DEMOGRAPHIC PROFILE**

| PARA METERS | GROUP PF n=50 | GROUP IF n=50 | P VALUE | |
|---|---|---|---|---|
| **Mean Age (years)** | 58.6 ± 11.9 | 56.06 ± 10.9 | p>0.05 | NS |
| **Mean Height (cms)** | 158.53 ± 2.13 | 159.72 ± 1.62 | p>0.05 | NS |
| **Mean Weight (kg)** | 68.53 ± 4.76 | 65.56 ± 3.76 | p>0.05 | NS |
| **Sex (m/f)** | 26/24 | 27/23 | | |
| **Duration of surgery (min)** | 228.6 ± 27.2 | 238.6 ± 23.4 | p>0.05 | NS |

NS – Non Significant S- Significant

**Figure 1: Changes In Mean Arterial Blood Pressure & Heart Rate**

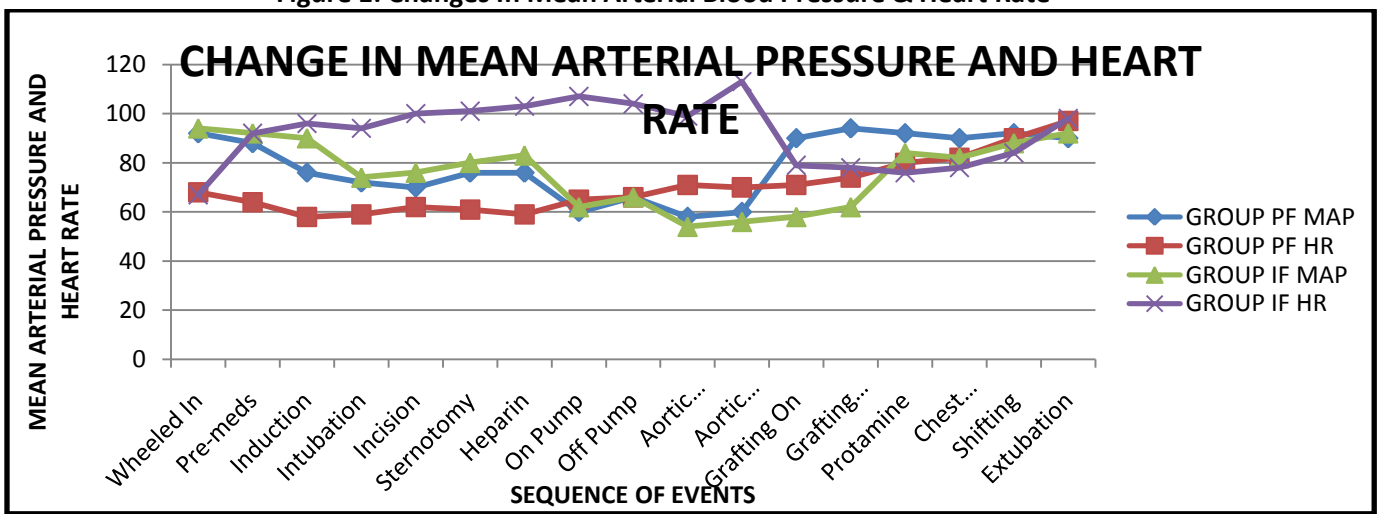
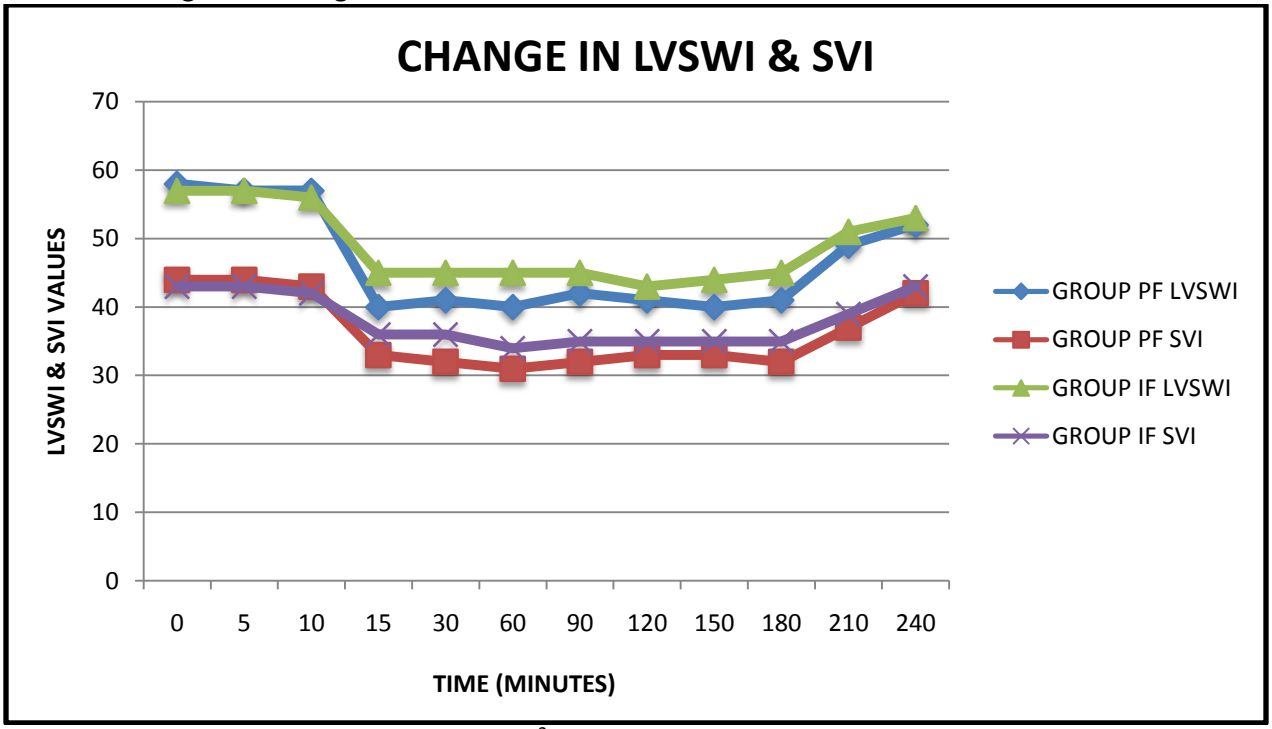


Figure 1 demonstrates change in mean arterial pressure and heart rate at various stages of surgery. Change in MAP followed by propofol induction which is statistically significant while there is also change in heart rate in both the groups which is beneficial in off pump CABG by reducing the diameter of LV according to Frank Starling's Law.

**Figure 2: Change In Left Ventricular Stroke Work Index & Stroke Volume Index**




LVSWI: Left Ventricular Stroke work Index (g/m$^2$/beat), SVI: Stroke Volume Index (mL/m2/beat) ,Change in LVSWI and SVI 15 minutes after induction is strongly significant and it remains same throughout the surgery.

**Discussion:** An anesthetic regimen including an isoflurane and fentanyl induction is quite safe considering hemodynamic stability as compare with propofol fentanyl induction. From the multiple studies a commonly accepted and applied principle for cardiac surgeries has been validated: preservation of oxygen supply distal to coronary lesions requires an anesthetic technique that prevents $MVO_2$ from increasing. Heart rate and blood pressure must be kept at or below that of the quiet, awake state[8, 9].

Instead of using TEE, Cardiac Output monitoring and various indexes can be calculated by using PA Catheterization based on Fick's principle of temperature. In few of the patient we had used CVP monitoring as a hemodynamic parameter rather than inserting PA catheter. Cost of continuous Cardiac output monitoring with PA catheter is quite high while we had TEE probe readily available in cardiology which does not add any extra economic burden to the patient or the institute. PA Catheter is multi-channel so high chance of infection. And the last but most important reason of using TEE is it is a faster real time indicator of Ischemia or any insult to the heart which one can assess in a much better way as compare to PA Catheter- cardiac output monitor. Because of above considerable facts, we had used TEE in our study

LePage et al. demonstrated that neither ejection fraction nor end diastolic volume was altered while using propofol as an induction agent in CABG. Propofol produced no significant change in cardiac output or stroke volume in our study as well that remains consistent with most other studies[10].

Paul S. et al. reexamined the effects of propofol on myocardial contractility. For this, a chronically instrumented dog model was used to avoid the confounding influences of acute surgical intervention and concomitant anesthetic intervention. The result demonstrates that propofol causes dose dependent depression of myocardial contractility in chronically instrumented dogs[11].

Propofol causes significant reduction (24%) in Left ventricular stroke work index that is mainly because in diseased heart, it increases LV emptying acts by reducing SVR. Propofol reduces LVSWI 29% as compare to Isoflurane which is 24% and Propofol also reduces SVI 22% as compare to Isoflurane which is 16% 15 minutes after induction. Propofol induced hypotension appeared to be mediated by large degree of reduction in systemic vascular resistance and venodilation. Thus, it causes hemodynamic depression with relative maintenance of global myocardial function[12, 13].

In contrast, some researchers have demonstrated that propofol may produce direct myocardial depression. Mulier et al. used TEE and peripheral ABP to calculate end systolic pressure volume relationships (ESPVR). They reported that propofol produced a significant decrease in the slope of ESPVR, suggesting direct negative inotropic effect[14,15].

Reiz et al.[16, 26] have reported that isoflurane reduced coronary resistance significantly in patients with coronary artery disease, with evidence of myocardial ischemia. Larsen et al.[17] also reported ischemia (lactate production) in three of ten CABG patients after sternotomy
Emerson A. et al. demonstrated that induction with isoflurane involved purposely decrease mean arterial pressure by 18% while in our study there was significant reduction in MAP (20% $p<0.05$) and slight increase in heart rate (9%). That was entirely the result of systemic vascular dilation because cardiac index and heart rate did not change.[18]

**Protection By Isoflurane:** During ischemia, ATP is degraded to its purine metabolites, which diffuse across cell membranes and are washed away by reperfusion. Rephosphorylation of ATP catabolites cannot occur and so ATP has to be formed more slowly by *de novo* synthesis. Isoflurane and Enflurane have been shown to preserve myocardial ATP stores and therefore improve myocardial recovery.[19,20]

Unlike the reversible damage caused by myocardial ischemia, myocardial infarction causes a more permanent injury, often resulting in ventricular impairment and conduction defects, and is one of the leading causes of peri-operative mortality. Protection against myocardial infarction by ischemic preconditioning and isoflurane is now well described.

**Ischemic Preconditioning** (IPC) is an experimental technique for producing resistance to the loss of blood supply, and thus oxygen, to tissues of many types. In the heart, IPC is an intrinsic process whereby repeated short episodes of ischemia protect the myocardium against a subsequent ischemic insult. It was first identified in 1986 by Murry *et al*[21]

Two types of protection can be provided. Acute lasts for 1-2 hr and delayed lasts for 12-24 hrs. Jenkins *et al*.[22] demonstrated, in a randomized controlled trial of 33 patients undergoing elective CABG, that the preconditioned group had significantly less myocardial damage, as evidenced by lower postoperative troponin T levels. It has been well documented that patients suffering from angina before their myocardial infarction have a less complicated clinical course.[23,27]

Isoflurane has been shown to protect the human myocardium from ischemia in a similar fashion to ischemic preconditioning[24]. Belhomme *et al*. [25] confirmed this in humans in a study of 20 elective CABG patients. Ten control patients had an intravenous fentanyl/flunitrazepam anesthetic, without any exposure to isoflurane, and the 10 test patients were exposed to isoflurane for 5 min, followed by a 10-min washout period before aortic cross-clamping. The isoflurane group had significantly lower troponin I and creatine-kinase–

myoglobin (CK-MB) levels and higher levels of ecto-5'-nucleotidase (a marker of protein kinase C activation).

**Conclusion:** The study suggests that propofol-fentanyl anesthesia is an acceptable technique but Isoflurane- fentanyl is still preferred due to less hemodynamic instability and greater myocardial protection in cardiac surgeries.

**Acknowledgement:** We are thankful to Cardiothoracic surgeons and Residents working at Matsama Heart Center. We are thankful to Department of Anesthesiology, SBKS MI & RC for their support.

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| Conflict of interest: None |
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| Funding: None |