

# The Effect of Posterior Pericardiotomy on Pericardial Effusion and Atrial Fibrillation after Off-Pump Coronary Artery Bypass Graft

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**Abstract-** The most common type of arrhythmia following coronary artery bypass graft (CABG) is atrial fibrillation (AF) with an incidence rate of 20-30%. Pericardial effusion is one of the etiologic factors of atrial fibrillation occurring after CABG. Posterior pericardiotomy (PP) causes the drainage of blood and fluids from the pericardial space into the pleural space leading to a decreased pericardial effusion. Most of the studies dealing with the occurrence of AF in the surgical operation of CABG have focused on patients undergoing on-pump CABG. The purpose of the present study was to determine the effect of posterior pericardiotomy on pericardial effusion and atrial fibrillation following the off-pump CABG. This study was a clinical trial conducted on 207 patients. The patients were randomly assigned to groups A, and B. Posterior pericardiotomy was performed on the patients in Group A. This was not done on patients in Group B. Following general anesthesia and median sternotomy, the left internal mammary artery (LIMA) and saphenous vein were harvested simultaneously. Following the injection of heparin, distal and proximal anastomosis was performed and at the end of surgery, a longitudinal incision with a length of 4 cm was performed parallel and posterior to the left phrenic nerve from the left vein to diaphragm for patients in the pericardiotomy group. 105 patients in the pericardiotomy group and 102 patients in the control group were examined regarding demographic variables, AF incidence, and pericardial effusion. There was no statistically significant correlation between two groups. There was no statistically significant difference between the two groups regarding the rate of AF incidence ( $P=0.719$ ) and the rate of pericardial effusion ( $P=1$ ). Posterior pericardiotomy has no effect on postoperative AF incidence and pericardial effusion in patients undergoing the off-pump CABG.

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## Introduction

The most common type of arrhythmia following coronary artery bypass graft (CABG) is atrial fibrillation (AF) with an incidence rate of 20-30% (1,2). AF complications include lack of hemodynamic stability, increased hospital stay, home mortality, stroke, thrombotic complications, embolus, extra drug therapy, and consequently increased hospital expenses (3,4). Various factors contribute to the development of AF. Yet, the exact cause still remains unknown (1). Among the factors contributing to the occurrence of AF are increased sympathetic and parasympathetic tone, an enlarged atrium, transmission of electrolytes and intercellular fluids, pericardial inflammation, metabolic

disturbances, and pericardial effusion (5,6). Pericardial effusion is one of the etiologic factors of AF occurring after CABG (7) and if left untreated, can prevent the filling of the heart and consequently a decreased cardiac output and ultimately leading to tamponade (1). Some studies have reported that posterior pericardiotomy can decrease the postoperative AF in patients undergoing the on-pump CABG (1). However, the mechanism by which PP causes a decrease in postoperative arrhythmia is unknown. Yet, it is possible that the pericardial effusion induces a mechanical pressure on the atrium leading to atrial irritation and finally to arrhythmia (5). PP causes the drainage of blood and fluids from the pericardial space into the pleura leading to decreased pericardial effusion (8). PP produces complications as the

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obstruction of the bypassed grafts, as a result, of compression by the PP ridges and cardiac hernia (9). Many studies report that the off-pump CABG reduces AF in patients compared to the on-pump method (10). The majority of the studies conducted on the incidence of AF in CABG dealt with patients undergoing the on-pump CABG. The purpose of the present study was to determine the effect of posterior pericardiotomy on pericardial effusion and atrial fibrillation following the off-pump CABG.

### Materials and Methods

The present research was a clinical trial carried out after obtaining the Committee of Ethics approval and the patients' written informed consent. The sample consisted of the candidates of off-pump CABG studied in Yazd Afshar Hospital in Iran. The patients suffering from arrhythmia, pericardial effusion, electrolyte or hemodynamic disturbances or those who had simultaneous preoperative CABG and valvular repair were excluded from the study. The sample volume included 207 patients randomly assigned to groups A and B. Posterior pericardiotomy was performed for the patients in group A. This was not done for patients in group B.

The patients in both groups were anesthetized in a similar way, and all the surgeries were performed by the same cardiovascular surgeon. Following the medial sternotomy, the left internal mammary artery (LIMA) was released, and the saphenous vein was excised from the patient's foot at the same time. Following heparin injection with a dose of 150 $\mu$ /kg, anastomosis of the distal and proximal grafts was performed. At the end of surgery, a longitudinal incision with a length of 4 cm was performed parallel and posterior to the left phrenic nerve from the left pulmonary vein to diaphragm for the patients in the pericardiotomy group. Heparin was reversed with a sufficient amount of protamine. The pleural space was opened for all patients and two chest tubes were used: one inserted in the left pleural space and the other in the anterior mediastinum. The anterior pericardium was left open in both groups. For both groups, no drain was inserted at the posterior part of the heart (to prevent arrhythmia) and finally, the chest was closed using the routine method.

Following patient transport to the ICU, the drains were connected to the continuous suction with a pressure of about 10 mmHg. To diagnose effusion, all patients were echoed and any effusion exceeding 1 cm was considered as significant. The patients were under

constant monitoring during the first 48 hrs and any type of arrhythmia more than 30 min was considered as significant. During the postoperative healing period, patients were monitored daily for electrolytes, blood pressure, pulse, O<sub>2</sub> saturation, urine volume, urea, and Cr in the ICU.

The instrument used in this study was a checklist consisting of 33 items. The patients' background and demographic information, as well as the preoperative, perioperative, and postoperative data, were collected carefully. The data were analyzed using SPSS13 via Chi-square, Fisher Exact Test, and Mantle-Haenzel test.

### Results

The present study investigated the effect of posterior pericardiotomy on postoperative pericardial effusion and atrial fibrillation following the off-pump CABG in 207 candidates of this surgery. The patients were randomly assigned to two groups: the pericardiotomy group (105 patients), and the non-pericardiotomy group (102 patients). Of 207 patients, 142 were male, and 65 were female. 72 men (68.6%) and 33 women (31.4%) were operated via pericardiotomy and 70 men (68.6%) 32 women (31.4%) underwent OPCAB without pericardiotomy. The correlation between the two groups was not statistically significant using the *Chi-square* test ( $P$ -value= 0.993). As Table 1 shows, variables thought to affect the study were collected and statistically examined. They were the same for both groups and were not statistically different.

Regarding the incidence of arrhythmia, as shown in the table below, of all the patients undergoing CABG, 11 cases developed postoperative arrhythmia. Of these, 5 (4.8%) belonged to the pericardiotomy patients, and 6 (5.9%) belonged to the non-pericardiotomy group. This correlation was tested by Chi-square and was not significant at  $P$ -value= 0.719.

Regarding the rate of pericardial effusion in this study, as the following table shows, of all the patients undergoing CABG, 25 patients developed postoperative pericardial effusion. Of these, 10 cases (90.9%) in the pericardiotomy group and 12 cases (85.7%) in the non-pericardiotomy group developed postoperative mild effusion, 1 case (9.1%) in the pericardiotomy group and 2 cases (14.3%) in the non-pericardiotomy group developed postoperative moderate effusion. This correlation was not significant via Fisher Exact Test at  $P$ -value= 1.

The intubation time, ICU stay, and hospital stay was not statistically significant between the two groups with

P-value set at 0.098, 0.338, and 0.904, respectively.

**Table 1. Frequency distribution of background variables in two groups**

Variable	Pericardiotomy	Control - Group	P-value
Mean age (years)	61/07±10/4	61/4±11/6	0/820
Diabetes mellitus	45(40/9%)	29(30/9%)	0/136
HTN	60(54/5%)	41(43/6%)	0/120
HIP	50(45/5%)	36(38/3%)	0/302
Smoking	41(37/3%)	25(26/6%)	0/104
Mean Graft per Patient	2/1±0/721	2/1±0/692	0/204
NIHA	I	12(10/9%)	8(8/5%)
	II	39(35/5%)	36(38/3%)
	III	40(36/4%)	25(26/6%)
	IV	19(17/3%)	25(26/6%)
EF	Good	79(72/5%)	51(54/3%)
	Moderate	21(19/3%)	35(37/2%)
	Poor	9(8/3%)	9(8/5%)

**Table 2. Incidence rate of postoperative arrhythmia in both groups after off-pump CABG**

Arrhythmia	Pericardiotomy		Control - Group		Total	
	Num	%	Num	%	Num	%
NO	100	95/2	96	94/1	196	94/7
YES	5	4/8	6	5/9	11	5/3
<b>Total</b>	105	100	102	100	207	100

P-value=0/719

**Table 3. Incidence rate of pericardial effusion in two groups after off-pump CABG**

Group	Pericardiotomy	Control - Group
P.E	Num	Num
Mild	10	12
Mod	1	2

P-value=1

## Discussion

The present study aimed at determining the effect of posterior pericardiotomy on postoperative pericardial effusion and atrial fibrillation in patients undergoing the off-pump CABG. 105 patients were assigned to two groups: group A or the pericardiotomy group, and group B or the non-pericardiotomy group. Our findings revealed that the incidence rate of AF and pericardial effusion was less in the pericardiotomy group compared to the non-pericardiotomy group. Yet, it was not statistically significant. Furthermore, intubation time, ICU stay, and hospital stay was not significantly different between the two groups. This means that PP has no effect on the incidence of AF and pericardial effusion rate in patients undergoing the off-pump CABG without using CPB.

The study by Ekim *et al.*, aimed at investigating the

effect of PP on the incidence of pericardial effusion and AF following on-pump CABG. In this study, 100 patients were divided into two groups: group A (the pericardiotomy group), and group B (the non-pericardiotomy group). The results indicated that a premature effusion was present in 6 patients (12%) of the pericardiotomy group and 21 patients (42%) of the control group. The number of patients developing postoperative AF was significantly less in the pericardiotomy group ( $P<0.01$ ). Finally, the incidence of SVT in patients with premature effusion was significantly greater compared to that of patients without pericardial effusion (11). These findings are not consistent with ours. It should be pointed out that Ekim's study focused on patients undergoing the on-pump CABG while our study used the off-pump CABG method.

A metaanalysis study by Biancari and Mahar

entitled: “The Effect of Posterior Pericardiotomy on preventing AF in CABG” was conducted on 736 patients after CABG. The results showed that the incidence rate of AF was 8.1% in the PP group and 28.1% in the control group ( $P= 0.003$ ). The premature pericardial effusion was significantly less in the PP group ( $P<0.0001$ ). In this study, PP significantly reduced the incidence of AF and SVT after CABG. The PP technique decreases arrhythmia by reducing the pericardial effusion as pericardial effusion is one of the main provoking causes of arrhythmia after CABG (8). These findings are not consistent with ours. However, it should be pointed out that Ekim *et al.*, focused on patients undergoing the on-pump CABG while we applied the off-pump method. The CPB process itself causes the higher incidence of pericardial effusion in patients undergoing on-pump CABG compared to those undergoing the off-pump CABG. Probably, the use of CPB and the less pericardial effusion in our study account for the inconsistency of our study with Ekim’ and Biancari’s studies. Also, the off-pump method itself is one of the effective methods of decreasing the postoperative arrhythmia after CABG.

The study by Bakhshandeh *et al.*, was conducted on 410 patients undergoing CABG with or without valvular surgery. The echographic results revealed that the pericardial effusion was not observed in 178 patients with PP during the first 15 postoperative days, yet, all the control patients developed mild effusion. Also, 6 patients in the PP group developed mild pericardial effusion 1 month after the operation, while 157 patients in the control group developed mild effusion. This study offers PP as an effective method for preventing effusion and its complications (12). Our findings are not consistent with those of Bakhshandeh *et al.*, (12) regarding the incidence of arrhythmia. This might be due to first, in Bakhshandeh *et al.*, (12) study, the patients underwent the on-pump CABG, second, his patients had undergone the valvular surgery which increased their risk of pericardial effusion due to clotting problems, third, their sample volume was twice greater than ours, and fourth, in Bakhshandeh’s study, the operations were performed by several surgeons while ours were done by just one surgeon.

All the studies inconsistent with ours used the on-pump technique while we applied the off-pump method. In our study, there was not a significant difference between the two groups regarding pericardial effusion due to lack of use of CPB and the resulting decrease in clotting disturbances related to CPB. As a result, the incidence of arrhythmia was not significantly different

in two groups. Additionally, the study by Yorgancioglu (2000) entitled: “An Unusual Experience with Posterior Pericardiotomy” reported one case of complications of pericardiotomy occurring in the experiments. As the study reports, a patient undergoing CABG developed ischemia of the myocardium due to the compression of one of the bypassed grafts against the edges of PP and its obstruction. The problem was settled by closing the patient’s PP (9).

The findings of our study indicated that PP has no effect on the rate of incidence of pericardial effusion and consequently, on AF in off-pump CABG patients. Regarding the complications of PP, it is recommended that more research be done on the effect of posterior pericardiotomy on pericardial effusion and the incidence of arrhythmia after off-pump CABG using greater sample volumes so that more sound and definite comments may be put forward regarding the forbidding of off-pump CABG pericardiotomy.

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