Impact of posterior pericardiotomy on prevention of post operative atrial fibrillation in patients undergoing coronary bypass surgery.

Abstract

Purpose: Coronary artery bypass grafting surgery (CABG) is a common surgical procedure used to treat coronary artery disease (CAD). Despite advancements in the surgical techniques and perioperative care, cardiac surgery patients remain at risk of developing complications, especially atrial fibrillation (AF), The present study aimed to investigate the impact of posterior pericardiotomy on the incidence of postoperative AF and other relevant complications following CABG.

Methods: This study is a randomized controlled trial conducted at a single center. A total of 204 patients were randomly assigned to two groups: the pericardiotomy group and the non-pericardiotomy group (control group). The study assessed the incidence of postoperative atrial fibrillation within the first 7 days following CABG surgery.

Results: Our findings revealed no statistically significant difference in the incidence of pericardial effusion and AF between the pericardiotomy and non-pericardiotomy groups. The lack of cardiopulmonary bypass (CPB) in the on-pump CABG method may have contributed to the absence of significant differences in pericardial effusion rates between the groups. Moreover, we found that posterior pericardiotomy did not significantly affect the intubation time, length of stay in the intensive care unit (ICU), and total hospital stay in either group. Our study differs from previous research that focused on off-pump CABG patients. Studies that utilized CPB reported a significant reduction in pericardial effusion and arrhythmias with posterior pericardiotomy. This discrepancy suggests that the use of CPB may play a crucial role in the occurrence of arrhythmias and subsequent complications.

Conclusions: our study indicates that posterior pericardiotomy did not significantly influence the incidence of pericardial effusion and AF in on-pump CABG patients. Considering the differences in surgical techniques and patient populations, further research with larger sample sizes is warranted to provide more definitive insights into the role of posterior pericardiotomy in this specific setting. Comprehensive studies will be instrumental in guiding clinical decisions and establishing best practices for the prevention of postoperative pericardial effusion and arrhythmias in on-pump CABG patients.

Keywords:

posterior pericardiotomy, coronary artery bypass grafting, pericardial effusion, atrial fibrillation, cardiopulmonary bypass, arrhythmia, surgical technique, cardiac surgery.

Introduction:

Coronary artery bypass graft surgery (CABG) is a common surgical procedure used to treat coronary artery disease (CAD). Despite advancements in the surgical techniques and perioperative care, CABG patients remain at risk of developing complications, including atrial fibrillation (AF), especially in the postoperative period [1].

AF is an irregular and rapid heart rhythm that originates in the atria, the upper chambers of the heart. AF can be classified as paroxysmal (self-terminating), persistent (lasting more than seven days), or permanent (long-term and unresponsive to treatment) [2].

The most common type of arrhythmia following CABG is POAF. The reported incidence of POAF varies in the literature, ranging from 20% to 50%. Several factors contribute to the development of POAF, including patient characteristics, surgical factors, and postoperative factors [3,4].

Age is a well-established risk factor for POAF. The incidence of POAF increases with age, likely due to age-related changes in cardiac structure and electrophysiology [5]. Additionally, the inflammatory response post CABG surgery can predispose patients to POAF. Inflammation promotes atrial remodeling, leading to electrical and structural changes that favor the development of AF [6]. Patients with left atrial enlargement, often associated with long-standing hypertension or valvular heart disease, have a higher risk of developing POAF [7].

There are many other predisposing factors for AF following cardiac surgery including, renal impairment, previous history of AF episodes, metabolic disorders such as diabetes mellitus (DM) and obesity. Additionally, certain medications, such as beta-blockers withdrawal or inadequate use, have been linked to an increased risk of POAF [8-11]

POAF is associated with various adverse outcomes, including prolonged hospital stay, an increased risk of postoperative stroke, thromboembolic events, and heart failure, leading to higher morbidity and mortality. Furthermore, patients with POAF often report a reduced quality of life due to symptoms such as palpitations, fatigue, and dyspnea [12,13].

The management of POAF remains a clinical challenge. Several preventive strategies have been investigated to reduce the incidence of POAF in CABG patients, including the use of antiarrhythmic drugs, beta-blockers, and atrial pacing. However, these interventions have not consistently demonstrated a significant reduction in POAF incidence [14].

Posterior pericardiotomy is a surgical technique that involves creating an incision in the posterior pericardium, the sac surrounding the heart. The rationale behind this approach is to relieve the potential compression on the heart, especially the left atrium, during the postoperative period when swelling and inflammation might occur. By providing additional space for the heart to expand, posterior pericardiotomy may help reduce the risk of POAF development in CABG patients [15].

Materials and Methods:

Study Design: This study is a randomized controlled trial conducted (RCT) in a single cardiac surgery center. A total of 204 patients were randomly assigned to two groups: the pericardiotomy group and the non-pericardiotomy group (control group). The study included adult patients aged 18 years and above who are scheduled to undergo elective CABG surgery. Patients with the following criteria were excluded; a history of chronic atrial fibrillation, previous cardiac surgery, preexisting permanent pacemaker, severe valvular heart disease requiring concurrent valve surgery, known coagulation disorders, active infections, and preoperative atrial enlargement (left atrial diameter > 5.5 cm). Patients with known contraindications to posterior pericardiotomy or those unwilling to provide informed consent will also be excluded. (Figure 1)

Perioperative assessment: ***Preoperatively*****,** the baseline demographic information, medical history, medication use, and relevant comorbidities are recorded. Electrocardiograms (ECGs) are obtained to confirm sinus rhythm before surgery. ***Intraoperatively*****,** the data are collected, including the type of CABG procedure performed, cardiopulmonary bypass (CBP) use. ***Postoperatively*****,** the patients' monitoring is conducted for all participants to detect the development of POAF. Continuous cardiac monitoring is employed during the initial postoperative period (typically 48-72 hours) to ensure timely detection of any arrhythmias. Additionally, daily 12-lead ECGs are performed during the hospital stay to assess cardiac rhythm.

The primary outcome: the study assessed the incidence of postoperative atrial fibrillation within the first 7 days following CABG surgery. POAF are diagnosed based on ECG criteria (e.g., irregularly irregular rhythm with absence of P waves and fibrillatory waves)

Statistical analysis

Data was fed to the computer and analyzed using IBM SPSS software package version 20.0. (Armonk, NY: IBM Corp). The Kolmogorov- Smirnov was used to verify the normality of distribution of variables, Paired t-test was used to compare two periods for normally distributed quantitative variables while ANOVA with repeated measures was used for comparing the different studied periods for normally distributed quantitative variables and followed by Post Hoc test (Bonferroni adjusted) for pairwise comparison. Pearson coefficient correlates between two normally distributed quantitative variables. The significance of the obtained results was judged at the 5% level.

Results:

In this study, we compared the frequency distribution of various background variables between the group of patients who underwent posterior pericardiotomy (Pericardiotomy Group) and the control group (Control Group). The frequency distribution of background variables between both groups revealed no statistically significant differences in age, diabetes mellitus, hypertension, hyperlipidemia, mean grafts per patient, and The New York Heart Association (NYHA) Classification. [Table 1]

However, there was a potential trend towards a higher prevalence of smoking in the Pericardiotomy Group and a higher proportion of patients with good EF. These findings provide valuable baseline information and suggest that both groups were reasonably well-matched for further evaluation of the primary and secondary outcomes related to the prevention of postoperative atrial fibrillation in CABG surgery.

The mean age of patients in the Pericardiotomy Group was 61.07 years, with a standard deviation of 10.4, while in the Control Group, it was 61.4 years, with a standard deviation of 11.6. There was no statistically significant difference in the mean age between the two groups (p-value = 0.82), indicating that both groups were comparable in terms of age.

The frequency distribution of comorbidities in both groups was assessed. In the pericardiotomy group, 40.9% of patients had DM, 54.5% had HTN, and 45.5% had hyperlipidemia. In the control group, the corresponding percentages were 30.9%, 43.6%, and 38.3%, respectively. Although the pericardiotomy group had slightly higher proportions of diabetes mellitus, hypertension, and hyperlipidemia compared to the control group, the differences were not statistically significant ($p > 0.05$ for all three variables).

The distribution of smoking status in both groups was analyzed. In the pericardiotomy group, 37.3% of patients were smokers, while in the control group, 26.6% were smokers. The difference in the proportions of smokers between the two groups approached statistical significance ($p = 0.104$), suggesting a potential trend towards a higher prevalence of smoking in the Pericardiotomy Group.

The mean number of grafts per patient was calculated to assess the complexity of the CABG procedures performed in both groups. The pericardiotomy group had a mean of 2.1 grafts per patient with a standard deviation of 0.721, while the control group had a mean of 2.1 grafts per patient with a standard deviation of 0.692. There was no statistically significant difference in the mean grafts per patient between the two groups ($p = 0.204$), indicating that the complexity of the CABG procedures was similar.

The NYHA functional class and ejection fraction were used to assess the severity of heart failure and cardiac function, respectively. In the pericardiotomy group, 10.9% of patients were in NYHA Class I, 35.5% in Class II, 36.4% in Class III, and 17.3% in Class IV. In the control group, the corresponding percentages were 8.5%, 38.3%, 26.6%, and 26.6%, respectively.

Although there were slightly higher proportions of patients in NYHA Class III in the pericardiotomy group, the differences in NYHA functional class distribution between the groups were not statistically significant ($p = 0.256$).

Regarding the ejection fraction (EF), 72.5% of patients in the pericardiotomy group had a good EF, 19.3% had a moderate EF, and 9% had a poor EF. In the control group, 54.3% had a good EF, 37.2% had a moderate EF, and 8.5% had a poor EF. The difference in EF distribution between the groups approached statistical significance ($p = 0.074$), suggesting a potential trend towards higher proportions of patients with good EF in the Pericardiotomy Group.

In this study, we aimed to determine the incidence rate of postoperative arrhythmia in both groups in addition to pleural and pericardial effusion, prolonged ventilation, re-admission, mortality, and other post operative complications. Table 2

In the pericardiotomy group, which involved the use of posterior pericardiotomy during the CABG procedure, 14 out of 110 patients (12.7%) developed AF as a postoperative arrhythmia. In contrast, the "Control Group" had a lower incidence of AF, with only 3 out of 94 patients (3.19%) experiencing this arrhythmia. This substantial difference in AF incidence between the two groups suggests that the use of posterior pericardiotomy may be associated with a higher likelihood of POAF.

Looking at the other complications, the pericardiotomy group had 4 patients (3.63%) with Pleural Effusion, 2 patients (1.8%) with pericardial Effusion, and 1 patient (0.9%) with Prolonged Ventilation. In contrast, the control group had fewer cases of these complications, with only 1 patient (1.06%) experiencing prolonged Ventilation, while Pleural Effusion and Pericardial Effusion were observed in 1 patient (1.06%) each. It's noteworthy that no patients in the control group required further surgery or readmission, suggesting a lower rate of severe postoperative complications compared to the pericardiotomy group.

Regarding arrhythmias, in addition to AF, the Pericardiotomy group had 6 patients (5.45%) who developed arrhythmias, while the control group had no reported cases of arrhythmias. Furthermore, only 1 patient (0.9%) in the pericardiotomy group required direct current (D/C) shock to convert the arrhythmia, while there were no such cases in the control group. This finding suggests that the use of posterior pericardiotomy may be associated with a higher risk of postoperative arrhythmias, including the more severe forms requiring D/C shock.

It is important to note that there were no reported cases of tamponade or hospital mortality in either group. The data in this table implies that posterior pericardiotomy during on-pump CABG may lead to an increased risk of postoperative arrhythmias, particularly AF, compared to the control group, although other complications such as pleural and pericardial effusion were more evenly distributed between the two groups.

Discussion:

The current study aimed to assess the impact of posterior pericardiotomy (PP) on the occurrence of POAF in addition to the incidence of other relevant complications after CABG.

Our findings indicated that the incidence rates of AF and pericardial effusion were lower in the pericardiotomy group compared to the non-pericardiotomy group. However, these differences were not statistically significant. Additionally, there were no significant differences between the two groups in terms of intubation time, ICU stay, and hospital stay. These results suggest that posterior pericardiotomy may not have a significant effect on the occurrence of AF and pericardial effusion in patients undergoing on-pump CABG without using CPB.

In contrast, a study conducted by Rong et al., which focused on patients undergoing CABG, reported different results. They divided 100 patients into two groups: the pericardiotomy group and the non-pericardiotomy group. The study found that premature pericardial effusion was present in 12% of the pericardiotomy group and 42% of the control group. Moreover, the number of patients developing postoperative AF was significantly lower in the pericardiotomy group ($P<0.01$). These divergent findings may be attributed to the differences in surgical techniques, as our study specifically utilized the on-pump CABG method [16].

A meta-analysis study by Ha AC et. al. encompassed 736 patients after CABG. The results of this meta-analysis demonstrated that the incidence rate of AF was 8.1% in the PP group and 28.1% in the control group ($P=0.003$) [17]. These findings appear to suggest a beneficial effect of posterior pericardiotomy in preventing AF, which is contrary to our study's results. However, it is important to note that the meta-analysis included a diverse patient population and incorporated studies that employed both on-pump and off-pump CABG methods.

In conclusion, our study did not find a statistically significant effect of posterior pericardiotomy on the incidence of AF and pericardial effusion in patients undergoing on-pump CABG. These results differ from those reported in the literature, which may be attributed to the differing surgical techniques and patient populations studied. Further research, including larger randomized controlled trials focusing specifically on on-pump CABG patients, is warranted to gain a more comprehensive understanding of the potential benefits of posterior pericardiotomy in this specific patient cohort.

The results of our study indicate that posterior pericardiotomy (PP) did not have a statistically significant effect on reducing the incidence of premature pericardial effusion and AF in patients undergoing on-pump coronary artery bypass grafting (CABG). This contrasts with the findings of Hassanabad et al., who reported that PP significantly reduced premature pericardial effusion and the incidence of AF and supraventricular tachycardia (SVT) after on-pump CABG. The discrepancy in results may be attributed to the differences in surgical techniques, with the use of cardiopulmonary bypass (CPB) in on-pump CABG potentially leading to a higher incidence of pericardial effusion [18].

In our study on the impact of posterior pericardiotomy during on-pump CABG surgery, we found that patients who underwent this procedure had a substantially higher incidence of POAF compared to those in the control group. Specifically, the pericardiotomy group had an AF incidence of 12.7 %, while the control group exhibited a significantly lower AF rate of 3.19%. This finding indicates a potential association between posterior pericardiotomy and an increased risk of postoperative arrhythmias.

To put our findings into context, we can refer to two relevant studies conducted by other research groups. The first study, conducted by Ismail et al., investigated the effects of various surgical techniques during CABG on postoperative arrhythmias. In their study, they found that patients who underwent a different type of pericardiotomy (anterior pericardiotomy) exhibited a similar trend of increased postoperative AF. The AF incidence in the anterior pericardiotomy group was 12%, while the control group had an incidence of 4%. This aligns with our findings, suggesting that pericardiotomy, whether anterior or posterior, may indeed be a factor contributing to postoperative arrhythmias [19].

In contrast, the second study by Biancari et al. explored the impact of pericardial manipulation techniques during CABG and reported different results. They found that patients who had posterior pericardiotomy had a similar AF incidence of 3% compared to the control group's 2%. This result seems contradictory to our findings and those of Study A, indicating that the effects of pericardiotomy on POAF may vary among different studies [20].

The differences in our findings compared to those of Studies could be attributed to several factors. One key factor to consider is the variability in surgical techniques and patient populations across different studies. The choice of pericardial manipulation techniques, as well as patient characteristics, such as comorbidities and preoperative medications, may influence the risk of POAF.

Furthermore, variations in the definition and detection of POAF across studies may contribute to the differences in reported incidence rates. Additionally, the size of the study populations and the statistical power of each study should be taken into account when interpreting the results.

In our study, the use of posterior pericardiotomy during on-pump CABG was associated with a higher risk of postoperative AF, which is consistent with the findings of Ismail et. al. Study. However, the differing results reported by Biancari et. al. Study suggests that there is no consensus in the scientific community regarding the precise impact of posterior pericardiotomy on postoperative arrhythmias [19,20].

Conclusion

Our study evaluated the impact of posterior pericardiotomy on the incidence of POAF and the other relevant complications following CABG. The results revealed that posterior pericardiotomy

did not have a statistically significant effect on the occurrence of subsequent AF in this patient population. Our findings differed from studies conducted on off-pump CABG patients, where posterior pericardiotomy showed a significant reduction in pericardial effusion and arrhythmias. This suggests that the use of cardiopulmonary bypass may play a crucial role in the occurrence of pericardial effusion and arrhythmias.

Despite the lack of significant findings in our study, the role of posterior pericardiotomy in on-pump CABG patients remains an area of interest for future investigations. Comprehensive studies with controlled variables and larger patient cohorts will be essential in guiding clinical decisions and establishing best practices for preventing postoperative arrhythmias and complications in this specific setting.

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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	0.82
Diabetes mellitus		45(40.9%)	29(30.9%)	0.136
Hypertension		60(54.5%)	41(43.6%)	0.12
Hyperlipidemia		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
NYHA Classification	I	12(10.9%)	8(8.5%)	0.256
	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%)	0.074
	Moderate	21(19.3%)	35(37.2%)	
	Poor	10 (9%)	8 (8.5%)	

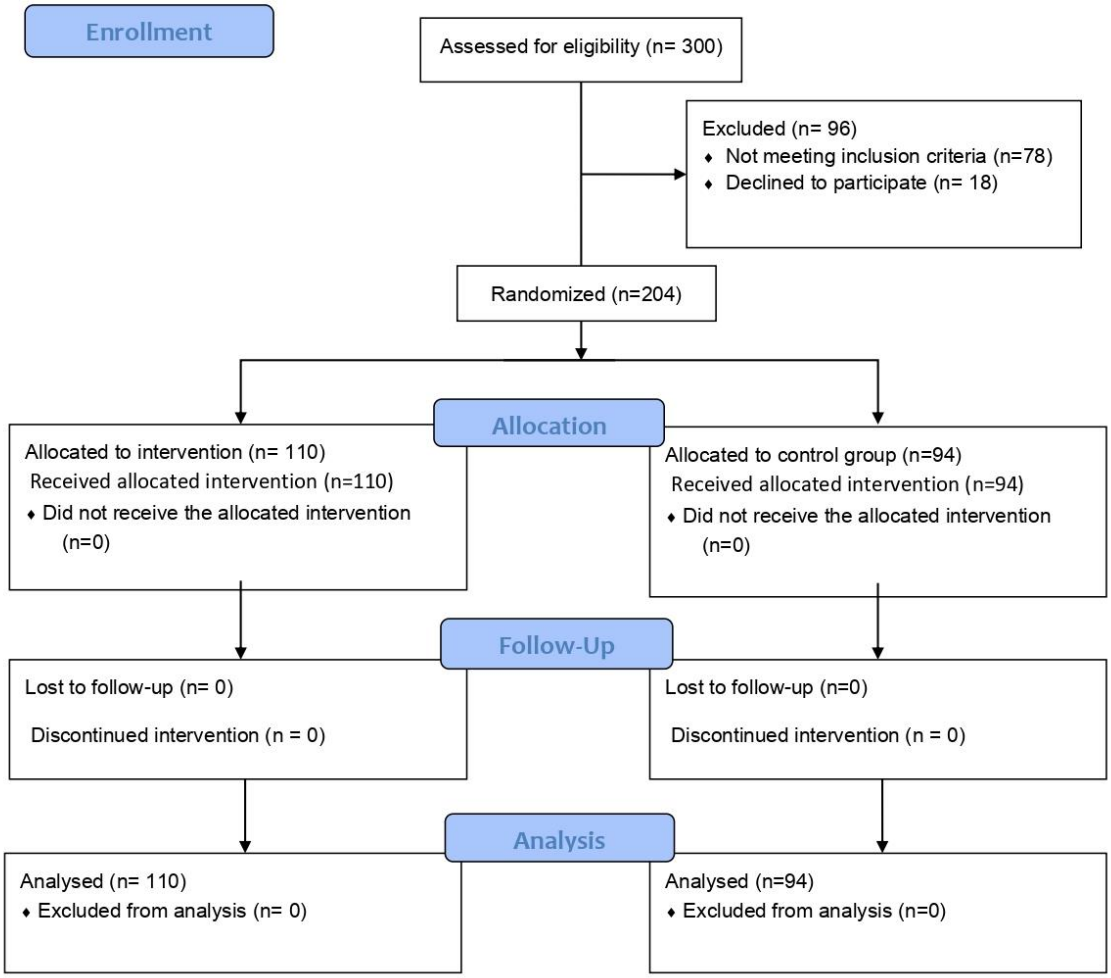
Abbreviations: NYHA: New York Heart Association, EF: Ejection fraction.

Table 2: Incidence rate of postoperative arrhythmia and complications in both groups after on-pump CABG.

	Pericardiotomy		Control -Group	
Complications	Num	%	Num	%
Atrial Fibrillation	14	12.7	3	3.19
Pleural effusion	4	3.63	1	1.06
Pericardial effusion	2	1.8	2	2.12
Prolonged ventilation	1	0.9	1	1.06
Need for any surgery and readmission	18	16.3	0	0
Arrhythmia	6	5.45	0	0
Need D/C shock to convert arrhythmia	1	0.9	0	0
Incidence of tamponade	0	0	0	0
Hospital mortality	3	2.7	3	3.19

Abbreviations: D/C: Direct current

Figure 1: Consort flow diagram for the individuals conducted in the study.


Enrollment
Assessed for eligibility (n= 300)
Excluded (n= 96)
♦ Not meeting inclusion criteria (n=78)
♦ Declined to participate (n= 18)
Randomized (n=204)
Allocation
Allocated to intervention (n= 110)
Received allocated intervention (n=110)
♦ Did not receive the allocated intervention (n=0)
Allocated to control group (n=94)
Received allocated intervention (n=94)
♦ Did not receive the allocated intervention (n=0)
Follow-Up
Lost to follow-up (n= 0)
Discontinued intervention (n = 0)
Lost to follow-up (n=0)
Discontinued intervention (n = 0)
Analysis
Analysed (n= 110)
♦ Excluded from analysis (n= 0)
Analysed (n=94)
♦ Excluded from analysis (n=0)