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# Kalp Cerrahisinde Postoperatif Perikardiyal Efüzyonun Önlenmesi İçin Posterior Perikardiyal Pencere Tekniği

## Posterior Pericardial Window Technique to Prevent Postoperative Pericardial Effusion in Cardiac Surgery

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***ÖZ***

***GİRİŞ ve AMAÇ:*** *Posterior perikardiyal pencere tekniğinin, koroner arter bypass greftleme (CABG) ameliyatı sonrası perikardiyal efüzyon gelişimini önlemedeki etkinliğini belirlemekti.*

***YÖNTEM ve GEREÇLER:*** *Koroner cerrahi geçirecek hastalar rastgele bir kontrole veya perikardiyal pencere tekniği grubuna ayrıldı. Toplamda 210 hastayı 2 gruba ayırdık, posterior perikardiyal pencere grubu (n = 110) ve kontrol grubu (n = 110). Preoperatif, intraoperatif ve postoperatif klinik veriler retrospektif olarak toplandı. Preoperatif, taburcu olmadan önce ve postoperatif 7. ve 30. günlerde yapılan değerlendirmelere elektrokardiyografi, göğüs radyografisi, ekokardiyografik incelemeler yapıldı. Postoperatif morbidite nedenleri ve yoğun bakım ünitesinde ve hastanede kalış süreleri kaydedildi.*

***BULGULAR:*** *İki grup arasında demografik veriler açısından anlamlı fark yoktu (P >.05). Ekokardiyografi incelemeleri ameliyat öncesi gruplar arasında anlamlı bir farklılık yoktu; bununla birlikte, taburcu edilmeden önce, kontrol grubunda, perikardiyal pencere grubuna kıyasla, erken ve geç kardiyak tamponad anlamlı olarak yüksek bulundu (P <.05). Perikardiyal pencere grubunda postoperatif plevral efüzyon insidansı kontrol grubundan anlamlı olarak yüksek olarak tespit edildi. Yeni başlangıçlı atriyal fibrilasyon, kontrollerde perikardiyal pencere grubundan anlamlı olarak daha yaygındı (P <.05).*

***TARTIŞMA ve SONUÇ:*** *Posterior perikardiyal pencere tekniği, ciddi komplikasyonlar olmadan kolay uygulanabilir ve güvenli bir yöntemdir. Bu prosedür, geç kardiyak tamponadı ve CABG hastalarında ölümcül bir komplikasyon olabilen efüzyonla ilişkili atriyal fibrilasyonu azaltabilir.*

***Anahtar Kelimeler:*** *Posterior perikardiyal pencere, perikardiyal tamponat, plevral efüzyon*

***ABSTRACT***

***INTRODUCTION:*** *The aim was to determine the effectiveness of the posterior pericardial window (PW) technique in preventing the development of pericardial effusion (PE) following coronary artery bypass grafting surgery (CABG).*

***METHODS:*** *Patients undergoing coronary surgery were randomly divided into a control or a PW group. We divided 220 patients randomly into 2 groups, the posterior pericardial window group (n=110) and the control group (n=110). Preoperative, intraoperative and postoperative clinical data were collected retrospectively, including incidence of pericardial tamponade, drainage volume, ventilation time and moderate to large pericardial effusion. Evaluations were completed preoperatively, before discharge, and on postoperative 7 and 30 days including electrocardiography, chest radiography, echocardiography. Postoperative causes of morbidity, the duration of intensive care unit and hospital stay were recorded.*

***RESULTS:*** *There was no significant difference in demographic data between two groups (P>.05). Echocardiography evaluations revealed no significant difference between groups preoperatively; however, before discharge the control group had a significantly higher number of patients with early and late cardiac tamponade compared with the PW group (P<.05). The incidence of postoperative pleural effusion in the PW group was significantly higher than control group. New onset atrial fibrillation was significantly more common in control subjects than in the PW group (P < .05).*

***DISCUSSION and CONCLUSION:*** *Posterior pericardial window technique is a safe and effective method which is easy to perform without any serious complication. This procedure may reduce late cardiac tamponade events and effusion-related atrial fibrillation which may be a fatal complication in CABG patients.*

***Keywords:*** *Posterior pericardial window, pericardial tamponade, pleural effusion*

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## INTRODUCTION

Pericardial effusion represents a common postoperative complication and an important cause of morbidity after cardiac surgery. The incidence of pericardial effusion following cardiac surgery was reported as 50-85% [1,2]. In the first week after surgery, pericardial effusions can result from surgical bleeding and perioperative trauma.

Effusion may surround the heart, but it is most frequently localized to the posterior of the left ventricle. It has been reported that creating a posterior pericardial window (PW) between the pericardial cavity and the left pleural cavity during coronary bypass surgeries reduces the incidence of pericardial effusion, early and late tamponade and atrial fibrillation [3].

In this study, we aimed to assess the effectiveness of posterior pericardial window technique in preventing the development of early and late pericardial tamponade and effusion-related atrial fibrillation.

## MATERIALS and METHODS

### Patients and data collection

The Ethics Committee of Istanbul Bilim University approved this study. All patients' preoperative demographic and clinical data were collected, including age, gender, major co-morbidities, left ventricular ejection fraction (LVEF%) and New York Heart Association Heart Failure Class (NYHA).

We assigned 220 patients into 2 groups: patients undergoing posterior pericardial window (Group 1; n =110) and control group (Group 2; n = 110). The criteria for participating in the study were patients undergoing coronary artery bypass grafting (CABG) surgery.

Exclusion criteria were as follows: a previous cardiac or thoracic operation, valvular heart surgery or combined valvular heart and CABG surgeries, left-sided pleural adhesions, rhythm disturbances such as atrial fibrillation, hyperthyroidism, renal failure with a plasma creatinine level of >2.0 mg/dL).

### Operative Procedure

All patients underwent a median sternotomy. Before cardiopulmonary bypass (CPB), each patient received a loading dose of heparin (3 mg/kg) and then additional heparin doses to achieve an activated clotting time >480 seconds. Arterial and venous cannulations were performed before the initiation of CPB in accordance with the surgical procedure. Moderate hemodilution with a Hematocrit level of 20%-26% and a moderate systemic hypothermia of 28°C-32°C were used during CPB. For myocardial protection, isothermic hyperkalemic blood cardioplegia was provided with antegrade cardioplegia. Heparin was reversed with protamine administration of 3.5 mg/kg iv at the end of the CPB.

The posterior pericardial window procedure was performed before removal of the aortic cross-clamp. In our study, a pericardial fenestration was performed far away from the phrenic nerve. The pericardial tissue was clamped and retracted upwards to allow fenestration via the use of a low-power electrocauterization instrument. In both groups, we placed 2 chest tubes at the end of surgery, one in the left pleural cavity and the other in the anterior mediastinum. In the postoperative period, the chest tubes were removed when the amount of daily drainage was under 100 mL.

In the postoperative period, the patients were monitored continuously via electrocardiography during the first 3 days after the operation. Continuous monitoring was subsequently reinstituted whenever an arrhythmia was suspected. Echocardiographic evaluations to detect pleural effusion or pericardial tamponade were performed by the same cardiologist before surgery, after surgery on day 1, before discharge on postoperative 7th day, 1st, 3rd, 6th and 12th months.

Grading of PE was made according to the criteria previously discussed in the literature [3]. Small grade <10 mm echo-free space in diastole, medium grade 10 mm echo-free space in diastole, large grade 20 mm echo-free space in diastole with compression of the heart. The chest radiographs were collected preoperatively, on postoperative days 1 through 5, and on postoperative days 15 and 30.

Preoperative demographic data and perioperative parameters are summarized in (Table 2). We

recorded postoperative causes of morbidity and the duration of ICU and hospital stay.

**Statistical Analysis**

The statistical analysis of the study was performed by SPSS 21.0. Results are presented in a descriptive fashion as a number (percentage), as the mean SD, or as the median. Qualitative or categorical variables were compared by the chi-square test or the Fisher exact test, as appropriate. Quantitative continuous variables were compared with the unpaired Student t test for variables with a normal distribution and with the nonparametric Mann- Whitney U test for variables not normally distributed. Values of P<0.05 were considered statistically significant.

**RESULTS**

The mean age of pericardial window group was 67.51±7.35 years, whereas it was 66.84±6.92 years for the control group. The number of male patients was 71 (64.5%) in pericardial window group and 39 (35.5%) of patients were female. There were 68 (61.8%) and 42 (38.1%) subjects in control group. All preoperative demographic data for both groups including the incidence of diabetes mellitus, chronic obstructive pulmonary disease, peripheral vascular disease and the preoperative left ventricular ejection fraction were not significantly different (P>.05, Table 1).

The mean cardiopulmonary bypass time was 86.48±21.89 min and total aortic cross clamp time was 53.15±17.23 min in Group 1; whereas the mean cardiopulmonary bypass time was 89.32±19.15 min and total aortic cross clamp time was 55.31±09.11 minutes in Group 2 (P>.05, (Table 2).

There were no statistically significant difference between the groups with respect to ICU and hospital stay durations. Before discharge the control group had a significantly higher number of patients with early (0.9%) and late cardiac tamponade (2.7%) compared with the pericardial window group (P<.05).

**Table 1. Preoperative Demographic Data**

| Parameters | Pericardial Window Group (n=110) | Control Group (n=110) | P value |
|---|---|---|---|
| **Age** | 67.51±7.35 | 66.84±6.92 | .40 |
| **Gender** | | | |
| **Male** | 71 (64.5%) | 68 (61.8%) | .84 |
| **Female** | 39 (35.5%) | 42 (38.1%) | .78 |
| **Diabetes Mellitus** | 45 (40.9%) | 52 (47.2%) | .06 |
| **Hypertension** | 67 (60.9%) | 63 (57.2%) | .43 |
| **COPD** | 14 (12.7%) | 9 (8.2%) | .08 |
| **Peripheral Vascular Disease** | 6 (5.4%) | 9 (8.2%) | .35 |
| **LVEF (%)** | 48.44±3.18 | 46.73±4.52 | .57 |
| **NYHA** | 2.55±0.63 | 2.70±0.43 | .65 |

**COPD indicates chronic obstructive pulmonary disease; LVEF, left ventricular ejection fraction, NYHA; New York Heart Association Heart Failure Class. Values of P < 0.05 were considered statistically significant. ± Data are presented as the mean SD.*

The incidence of postoperative pleural effusion in the PW group was significantly higher (6.3%) than control group (2.7%) (P<.05). New onset of postoperative atrial fibrillation was significantly more common in control group (14.5%) than in the PW group (4.5%, P<.05).

According to the amount of pericardial effusion, there was no significant difference between groups preoperatively; however, before discharge, the control group had a significantly higher number of patients with moderate (18%) and large (3.6%) pericardial effusion compared with PW group (2.7% vs 0% respectively, P<.05).

In addition, the incidence of high pericardial effusion was more in the control group than PW group on postoperative days of 7 and 30 (P<.05). Three (2.7%) patients of control group were readmitted for pericardial effusion drainage secondary to late tamponade. No mortality was recorded.

**Table 2. Perioperative and Postoperative Parameters**

| Parameter | Pericardial Window Group (n=110) | Control Group (n=110) | P value |
|---|---|---|---|
| **Cross-clamp time, min** | 53.15±17.23 | 55.31±09.11 | .63 |
| **CPB time, min** | 86.48±21.89 | 89.32±19.15 | .59 |
| **Drainage, mL** | 438.91±246.81 | 523.15±278.45 | .38 |
| **ICU stay, hour** | 38.45±14.67 | 42.47±16.54 | .51 |
| **Hospital stay, day** | 7.3±1.65 | 7.8±2.15 | .45 |
| **Early Revision for Bleeding (%)** | 3(2.7%) | 2 (1.8%) | .34 |
| **Early Tamponade, n (%)** | 0 (0%) | 1 (0.9%) | .05 |
| **Late Tamponade, n** | 0 (0%) | 3 (2.7%) | .04 |
| **Postoperative AF** | 5 (4.5%) | 16 (14.5%) | .03 |
| **Postoperative Pleural Effusion** | 7 (6.3%) | 3 (2.7%) | .04 |
| **Pericardial Effusion Before Discharge** | | | 0.01 |
| **Small** | 107 (97.2%) | 76 (69.0%) | |
| **Moderate** | 3 (2.7%) | 20 (18.1%) | |
| **Large** | 0 (0%) | 4 (3.6%) | |
| **Postoperative Control Pericardial Effusion >Moderate** | | | 0.4 |
| **7$^{th}$ day** | 0 (0%) | 2 (1.8%) | |
| **30$^{th}$ day** | 0 (0%) | 1 (0.9%) | |

*CPB: cardiopulmonary bypass, ICU: internal care unit, AF: atrial fibrillation, min: minutesValues of P < 0.05 were considered statistically significant.*

## DISCUSSION

Pericardial effusion is a benign clinical finding that is frequently observed after cardiac surgery. Approximately 30% of patients, the insidious clinical presentation becomes evident 4 to 10 days after cardiac surgery; however, development of cardiac tamponade has been reported in only 1% of patients with pericardial effusion [4]. Postoperative pericardial effusion or tamponade may present without prominent clinical signs and findings, there is a potential risk for life-threatening events. The delayed presentation of pericardial effusion or tamponade may arise several days to weeks after the operation. In these clinical situations, early diagnosis would aid in the early treatment [5].

Pericardial effusions occurring after 7 days postoperatively are usually related to postpericardiotomysyndrome. Postpericardiotomy syndrome occurs in 10-40% of patients after cardiac surgery [6,7]. Typically, late pericardial tamponade develops 1-2 weeks after surgery. The reported prevalence of late pericardial tamponade after cardiac surgery varies among studies (0.8-8.5%) and may be life-threatening [8]. Therefore, postpericardiotomy syndrome prevention can reduce pericardial effusion-related postoperative morbidity and mortality [9].

The inflammatory response that appears during coronary artery bypass grafting is mostly related to surgical trauma. The release of immune mediators is further enhanced by cardiopulmonary bypass. The systemic inflammatory response is an important cause of organ dysfunction and can affect patient outcomes. Postpericardiotomy syndrome is an autoimmune disorder triggered by cardiac antigen exposure [10-12].

The pericardial fluid collected in a gap in front of the heart usually is easily drained via a chest drain; however, because pericardial adhesions are frequently observed between the inferior and posterior surfaces of the heart and the diaphragm, they may create an enclosed gap that makes drainage difficult. The use of our pericardiotomy technique enables better drainage of the pericardial fluid and prevents the formation of effusion or tamponade. In our study, none of the patients in Group 1 developed

early tamponade, whereas late pericardial tamponade was observed in 3 (2.7%) patients in the control group (P<.05).

The incidence of postoperative pleural effusion in the PW group was significantly higher (6.3%) than control group (2.7%, P<.05). Postoperative pericardial effusion drained to the left pleural cavity in pericardial window group. According to our opinion this method may help to prevent cardiac tamponade.

Recent studies reported that postoperative pericardial effusion can provoke the development of atrial fibrillation which is the most prevalent arrhythmia in the postoperative period [13,14]. In our study we releaved that new onset postoperative atrial fibrillation was significantly more common in control group (14.5%) than in the PW group (4.5%, P<.05).

Early cardiac tamponade after open heart surgery is usually related to surgical bleeding or coagulopathy due to CPB, whereas late tamponade seems to be multifactorial in origin. There are two ways of preventing late tamponade. The first one is to prevent the formation of fluid that causes tamponade. The second is draining the fluid from the pericardium. The procedure of creating a PW prevents late cardiac tamponade via the second way, which overall prevents tamponade formation [15]. In our study, the control group had a significantly higher number of patients with early (0.9%) and late cardiac tamponade (2.7%) compared with the pericardial window group (P<.05).

Posterior pericardial window is effective on early and late pericardial tamponade. However it should be carefully used in patients in whom posterior wall revascularization was performed especially by sequential grafting. The saphenous graft was squeezed by the edges of the posterior pericardiotomy incision.

The study is limited in its ability to find associations with other baseline patient characteristics. A larger number of cases would certainly be more valuable. This study could not planned as a randomized study.

## CONCLUSION

We conclude that posterior pericardial window technique is a simple, safe and effective method for reducing the incidence of pericardial effusion and late pericardial tamponade after cardiac surgery. This simple method reduces morbidity as it reduces the rehospitalization rate, provides a better quality of health care for the patient.

**Conflict of interest**:

None declared.

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