Effect of Posterior Pericardiotomy on Early and Late Pericardial Effusion After Valve Replacement

Nevzat Erdil, M.D.,* Vedat Nisanoglu, M.D.,* Feridun Kosar, M.D.,† Feray Akgul Erdil, M.D.,‡ Hasan Berat Cihan, M.D.,* and Bektas Battaloglu, M.D.*

**Department of Cardiovascular Surgery, Turgut Ozal Medical Center, Inonu University, Malatya, Turkey; †Department of Cardiology, Turgut Ozal Medical Center, Inonu University, Malatya, Turkey; ‡Department of Anesthesiology, Turgut Ozal Medical Center, Inonu University, Malatya, Turkey*

ABSTRACT ***Objective:*** **Pericardial effusion (PE) after cardiac surgery is frequent. It is more frequently seen after valve replacement or other types of heart surgery. Oral anticoagulants and antiplatelet agents may induce effusion development after open heart surgery. Our objective was to determine the efficiency of posterior pericardiotomy (PP) after cardiac valve operation for reducing the incidence of early and late PE and tamponade.** ***Methods:*** **This prospective randomized study was carried out in 100 consecutive patients undergoing mechanical valve replacement between August 2001 and May 2003 in our institution. Patients were divided into two groups; each group consisted of 50 patients. Longitudinal incision was made parallel and posterior to the left phrenic nerve, extending from the left inferior pulmonary vein to the diaphragm in Group 1. Posterior pericardiotomy was not done in Group 2.** ***Results:*** **Early PE was detected in four patients (8%) and in 19 patients (38%) in Group 1 and Group 2, respectively ($p < 0.001$). No late PE effusion was developed in Group 1 despite nine (18%) late PE developing in Group 2 ($p < 0.003$). The rate of delayed pericardial tamponade was lower in Group 1, but this difference was not statistically significant (0% vs 10%; $p < 0.056$).** ***Conclusion:*** **These findings suggest that PP is an easy, feasible, and beneficial technique for reducing both the occurrence of early and late PE or pericardial tamponade in patients undergoing valve replacement.** doi: 10.1111/j.1540-8191.2005.200375.x *(J Card Surg 2005;20:257-260)*

Clinically insignificant pericardial effusion (PE) frequently occurs in patients undergoing open heart surgery and is usually benign.[1–3] In contrast, cardiac tamponade occurs in a minority of patients after these operations, and is one of the most serious and potentially lethal complications. Pericardial effusion or tamponade may be also related to the preoperative and postoperative use of anticoagulants and antiplatelet agents such as warfarin, aspirin, and clopidogrel after open heart surgery. Postoperative PE or cardiac tamponade may occur without prominent clinical signs and findings, may be easily missed, and, without early diagnosis and treatment, can be life threatening. Thus, when diagnosed, it should be treated promptly.

Although the efficiency of posterior pericardiotomy (PP) in reducing the incidence of PEs and related complications was well established in recent studies[4,5] after coronary artery surgery, so far the usefulness of this method has not been tested in heart valve surgery. Therefore, in this prospective study, we aimed to evaluate the efficiency of PP on early and late PE or cardiac tamponade in patients who underwent valve replacement.

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Address for correspondence: Nevzat Erdil M.D., Department of Cardiovascular Surgery, Turgut Ozal Medical Center, Inonu University, 44315 Malatya, Turkey. Fax: +90-422-341180; e-mail: nerdil@inonu.edu.tr

MATERIAL AND METHODS

Between August 2001 and May 2003, 100 consecutive patients who underwent heart valve operation with mechanical prosthesis were enrolled in the study, in Inonu University, Turgut Ozal Medical Center, Department of Cardiovascular Surgery. Patients with coronary artery disease were not included in this study. This was a prospective randomized clinical study and randomization of the patients was made according to the Table of Random Digits.[6] Patients were divided into two groups as Groups 1 and 2, and each group included 50 patients. Longitudinal incision was made parallel and 15 mm posterior to the left phrenic nerve, extending from the left inferior pulmonary vein to the diaphragm (posterior pericardiotomy) in Group 1 as previously described by Mulay and coworkers.[7] Informed consent was obtained from all patients. Our institutional review board approved this procedure.

Posterior pericardiotomy was not performed in Group 2. Two chest tubes, one in the left pleural cavity and the other in anterior mediastinum, were placed in Group 1. In Group 2 only an anterior mediastinal

tube was inserted. Anesthetic medication and surgical techniques were similar in each group. Conventional median sternotomy was performed in all patients. Before cardiopulmonary bypass (CPB) patients received a loading dose of heparin (300 U/kg) to achieve an activated clotting time (ACT) longer than 450 seconds (Hemochron 80, International Technidyne Corp., Edison, NJ) and additional heparin was given to maintain the ACT over 450 seconds. Cardiopulmonary bypass was performed using a membrane oxygenator (Dideco, D708 Simplex III, Mirandola, Italy). Extracorporeal circuit was primed with Ringer solution, mannitol, and heparin at a dose of 2500 U. Patients were cooled to 28 °C during CPB and were subsequently warmed to a core temperature of 36 °C before weaning from the CPB. Cold blood cardioplegia was used for myocardial preservation and delivered via a ratio of 4:1 by a Medtronic CardioTermTM (CT 400 BR, CA, USA) Cardioplegia System.

St-Thomas-II solution was used both antegradely and retrogradely in all patients. Cold cardioplegia (at 10°C) was infused antegradely (500 mL) and then retrogradely until cardiac reminiscence is established. Intermittent retrograde cold blood cardioplegia was infused in every 20 minutes. A hotshot cardioplegia was also given before declamping the aorta.

After routine closure of the chest, drains were stripped at 30-minute intervals to ensure tube patency. Chest tubes were removed the following day when the drainage was less than 20 mL/h for consecutive 4 hours. All patients received warfarin for anticoagulation on the first postoperative day. Sodium Warfarin (Coumadin®, Eczacibasi, Istanbul, Turkey) dose was regulated according to prothrombin time (PT), prothrombin activity (PTa), and INR, all of which were measured daily until the discharge of the patients. Recommended INR level in our department was in therapeutic range (INR = 2.5-3.5) for all patients. Anti-platelet medication was routinely added in all patients.

The presence of PE on two-dimensional echocardiography was assessed with criteria described by Martin and colleagues.[8] The maximum diastolic separation between pericardium and epicardium was measured at the level of the tip of mitral position. Any effusion greater than 1 cm was considered significant. The diagnosis of PE and tamponade was performed by two-dimensional echocardiographic studies with Doppler examination. Echocardiography was used to detect the localization and amount of PE, and was repeated in postoperative days 3, before discharge, and 1 month after discharge. Patients with early and late PE or tamponade were recorded later.

Statistical analysis was performed with SPSS software version 10.0. Clinical data are expressed as the mean ± SD. Differences were analyzed with chi-square, Fisher's exact test, and independent *t*-tests.

RESULTS

There was no statistically difference between the two treatment groups with regard to age, sex, medication, LV ejection fraction, preoperative pulmonary pressure and functional capacity, operation type, cross-clamp, CPB time, and total volume of drainage (Table 1). There was no early and late mortality in both groups. Number of re-exploration for bleeding, need of positive inotropic support, and ventilation time were similar in two groups ($p > 0.05$). There was no significant difference regarding the pleural effusion.

There was a statistically significant difference in early PE (4 vs 19 patients; $p < 0.001$). Late PE was observed only in Group 2 (9 patients; $p < 0.003$). Delayed pericardial tamponade was found 10% (5 patients) in Group 2 and 0% in Group 1. However, this difference was not significant ($p < 0.056$). Two of these patients had prolonged hemostatic test (INR > 9) due to misusage of warfarin. Symptomatic delayed posterior pericardial tamponade was treated with subxiphoid exploration in three patients, and anterolateral thoracotomy in two patients. Late PE and delayed pericardial tamponade were not detected in Group 1. There was no significant difference between the two groups regarding hospital stay ($p > 0.05$) (Table 2).

DISCUSSION

Postoperative PE is a common complication following open heart surgery with an incidence as high as 85% and is often localized posteriorly and associated with increased morbidity and mortality.[3,4,10–13] Postoperative anticoagulation is a major contributing factor to the occurrence of PEs and cardiac tamponade after cardiac surgery, especially if they are excessively anticoagulated.[9,14,15] Most of PEs usually dissolve spontaneously. Few PEs may progress to cardiac tamponade. Reported incidence of cardiac tamponade ranges from 1% to 31%,[1,3,9] depending on the type of cardiac surgery. Whereas "early" PE or cardiac tamponade occurs within the first 24 hours, "late" PE or cardiac tamponade develops at least 5–7 days after open heart surgery and is often difficult to diagnose.[3]

TABLE 1
Demographic and Clinical Characteristics of Study Patients

	Group 1 (n = 50)	Group 2 (n = 50)	p Value
Sex (F/M)	27/23	34/16	ns
Mean age (years)	40.9 ± 13.9	43.2 ± 15.4	ns
Functional capacity			
NYHA class I-II	11 (22%)	10 (20%)	ns
NYHA class III-IV	39 (78%)	40 (80%)	ns
Ejection fraction	61.6 ± 7.3	59.9 ± 6.9	ns
PAP (mmHg)	46.8 ± 11.3	50.4 ± 15.5	ns
Operation type			
MVR	28 (56%)	27 (54%)	ns
AVR	10 (20%)	13 (26%)	ns
AVR + MVR	10 (20%)	9 (18%)	ns
Modified benthall	2 (4%)	1 (2%)	ns
Cross-clamp time (min)	86.3 ± 39.8	85.8 ± 36.6	ns
CPB time (min)	113.9 ± 51.4	115.3 ± 44.4	ns
Total drainage (mL)	543 ± 126	590 ± 109	ns

F = female; M = male; NYHA = New York Heart Association; PAP = pulmonary artery pressure; MVR = mitral valve replacement; AVR = aortic valve replacement; CPB = cardiopulmonary bypass; ns = not significant.

TABLE 2
Comparison of Postoperative Data of Both Groups

	Group 1 (n = 50)	Group 2 (n = 50)	p Value
Exploration for bleeding	2 (4%)	3 (6%)	ns
Need of positive inotropic support	9 (18%)	13 (26%)	ns
Pleural effusion	9 (18%)	7 (14%)	ns
Pulmonary complication	1 (2%)	2 (4%)	ns
Early pericardial effusion	4 (8%)	19 (38%)	$p < 0.001$
Late pericardial effusion	0 (0%)	9 (18%)	$p < 0.003$
Posterior tamponade	0 (0%)	5 (10%)	$p < 0.056$
Abnormal coagulation profile (n)	6 (12%)	4 (8%)	ns
Hospital stay (day)	7.7 ± 3.7	6.9 ± 1.5	ns

ns = not significant.

The pericardial fluid collected in the gap in front of the heart is easily drained from a chest drain. However, since pericardial adhesions are frequently observed in between inferior-posterior surface of the heart and the diaphragm, they may cause an enclosed gap and make drainage difficult. Additionally, a small amount of PE placed posterior pericardium may compromise the left atrium and ventricle and may lead to localized tamponade. In this sense, opening the left pleural space contiguous with the pericardium is beneficial but not an absolute measure against tamponade.

Although the efficiency of PP in reducing the incidence of PE and associated complications known to be good in patients undergoing coronary artery bypass surgery, the usefulness of this method has not been investigated in cardiac valve surgery until now.[4,5,7,13] As far as we know, this is the first report demonstrating whether PP has been effective in reducing the incidence of PE and its adverse consequents after valve surgery. In our study, early and late PE was significantly lower in PP group. Similarly, posterior cardiac tamponade was lower in Group 1 than in Group 2. This difference was not statistically significant. However, there was a tendency to decrease in incidence of posterior tamponade in patients with PP. Kuralay et al. showed that PP reduced early and late PE except for posterior tamponade after coronary artery bypass grafting operations.[4] Similarly, Mulay and Asimakopoulos et al. demonstrated that PP was more effective pericardial drainage and thereby reduced the incidence of PE after coronary surgery.[7,13] However, as distinct from all these studies, our study has examined the effects of PP on the development of early and late PE and tamponade following cardiac valve surgery besides coronary artery bypass grafting. As a result, our findings indicate that the technique of PP has been effective in reducing the incidence of early and late PE except for delayed posterior tamponade following cardiac valve operations. In this approach, a window is firstly opened from behind the pericardium (posterior pericardial window), and later collection accumulated is easily drained to the left pleural cavity from pericardial gap. Disadvantage of this preventive surgical method is the need of opening the left pleural cavity and placing a chest tube. In this study, although, all patients with PP, a chest tube was placed in left pleural cavity, there was no complication or discomfort related to chest tube drainage. Many surgeons hesitate to perform PP because of risk of nerve injury. Some surgeons may use sharp incision on posterior pericardium. But some bleeding may develop with sharp dissection. We prefer low-powered electrocautery incision at the 15 mm posterior part of phrenic nerve, instead of sharp dissection, and we have not experienced phrenic nerve injury related to left hemidiaphragm elevation.

In conclusion, the results of the present study strongly suggest that PP approach may be useful in the prevention or in the management of PE or tamponade after cardiac valve surgery and has been superiority to conventional management methods.

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