EFFECT OF POSTERIOR PERICARDIOTOMY ON POSTOPERATIVE SUPRAVENTRICULAR ARRHYTHMIAS AND LATE PERICARDIAL EFFUSION (POSTERIOR PERICARDIOTOMY)

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Objective: The aim of this prospective study was to evaluate the effectiveness of posterior pericardiotomy from the point of pericardial effusion related with supraventricular tachycardia and development of delayed posterior cardiac effusions. **Materials and methods:** This prospective randomized study was carried out in 200 patients undergoing coronary artery bypass surgery in Gülhane Medical Academy Department of Cardiovascular Surgery between June 1996 and June 1997. Patients were divided into 2 groups; each group included 100 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 I patients. Posterior pericardiotomy was not done in group II. **Results:** Atrial fibrillation was developed in 6 patients (6%) in group I and in 34 patients (34%) in group II ($P = .0000007$). Atrial flutter and other supraventricular arrhythmia prevalence was not statistically significant. Early and late pericardial effusion were developed 54% and 21%, respectively, in group II, but neither early nor late pericardial effusion were developed in group I ($P = .00001$). Delayed pericardial tamponade was also significantly lower in group I (0% vs 10%; $P = .001$). **Conclusion:** Posterior pericardiotomy is technically easy to perform and a safe and effective technique that reduces not only the prevalence of early pericardial effusion and related atrial fibrillation but also delayed posterior pericardial effusion and tamponade. (J Thorac Cardiovasc Surg 1999;118:492-5)

Pericardial effusion is commonly seen after coronary artery bypass surgery. It is usually small in amount and inconsequential. However in some cases, pericardial effusion may be circumferential and quite large or it may be regional and located in a strategic area, either of which may impede cardiac filling, reduce cardiac output, and lead to tamponade.¹ Regional pericardial effusions are often localized posteriorly. Previous reports have dealt with the clinical features and management of this problem and have emphasized the high mortality rates associated with delayed treatment.²⁻⁹ Supraventricular tachyarrhythmias (SVTs), mainly a form of atrial fibrillation, occur in up to 40% of patients

undergoing coronary artery bypass grafting (CABG)¹⁰⁻¹⁴ and, although usually benign, can cause hemodynamic instability, prolong hospital stay, and increase cost, and rarely predispose to a cerebrovascular accident.¹⁵ Pericardial effusions are incriminated in the development of SVT after CABG.¹⁶ Posterior pericardiotomy has recently been reported to reduce the prevalence of echocardiographically defined pericardial effusions from 40% in a control group to 8% in a pericardiotomy group, with a simultaneous reduction in the prevalence of SVT from 36% to 8%.¹⁷ In this prospective study we tested the effectiveness of posterior pericardiotomy, not only pericardial effusion related SVT but also the development of late posterior cardiac effusions.

Patients and methods

Between June 1996 and June 1997, 826 coronary artery bypass operations were performed in Gülhane Military Medical Academy (GMMA) Cardiovascular Surgery Department. A total of 169 patients with hyperthyroidism ($n = 2$), chronic obstructive pulmonary disease ($n = 36$), renal dysfunction ($n = 3$), left ventricular aneurysm ($n = 28$), severe left ventricular dysfunction ($n = 15$), and combined valvular heart

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Table I. Patient demography

	Group I (n = 100)		Group II (n = 100)		χ^2	P value
	Mean $\pm$ SD	n	Mean $\pm$ SD	n		
Female (n)		23		27	0.43	.5*
Age (y)	57 $\pm$ 12		61 $\pm$ 8			.06†
Unstable angina (n)		34		28	0.84	.4*
Preoperative MI (n)		41		35	0.76	.4*
Normal LV function (n)		57		65	1.35	.2*
Distal anastomosis (n)	2.8 $\pm$ 0.8		3.1 $\pm$ 0.5			.09‡
Crossclamp time (min)	36 $\pm$ 12		43 $\pm$ 9			.10†
Total perfusion time (min)	48 $\pm$ 5		51 $\pm$ 4			.12†
LITA (n)		100		98		.2‡
RITA (n)		16		12	0.66	.4*
Radial artery (n)		54		45	1.62	.2*
Abnormal coagulation profile (n)		5		4	0.12	.7*
Amount of drainage (mL)	850 $\pm$ 125		925 $\pm$ 115			0.08*

MI, Myocardial infarction.

* χ^2 test.

†Independent *t* test.

‡Fisher's exact test.

disease (n = 16) were not included in this study. Patients who were receiving beta blocker agents treatment (n = 69) were also excluded from the study. This prospective randomized clinical study was performed in the first 200 patients undergoing coronary artery bypass surgery who had not had exclusion criteria. For randomization of the patients, the Table of Random Digits¹⁸ was used, and posterior pericardiotomy was performed in the patients on the first 100 lines of the table; the second 100 lines were accepted as control group. Longitudinal incision was made parallel and posterior to the left phrenic nerve, extending from the left inferior pulmonary vein to the diaphragm (posterior pericardiotomy) in group I as described in Mulay and coworkers.¹⁷ Informed consent was obtained from all patients. Posterior pericardiotomy was not performed in group II. Two chest tubes (one in the left pleural cavity and the other in anterior mediastinum) were inserted, and the pericardium was left open anteriorly in both groups. No drain was placed behind the heart to avoid tube-induced ventricular arrhythmias in both groups. Anesthetic medication and surgical techniques were similar in each group. Cardiopulmonary bypass was established with a roller pump nonpulsatile flow after anticoagulation with heparin (3 mg/kg), and activated clotting time was maintained for more than 480 seconds. Membrane oxygenators (Capiiox-E, Terumo Corp, Tokyo, Japan) were used in all cases. Heparin was reversed by protamine (3.5 mg/kg) at the end of the cardiopulmonary bypass. The left pleural cavity was opened in all patients, and patients with dense adhesion of left lung were excluded. All distal anastomosis was done in a single crossclamp period. The left internal thoracic artery (LITA) was used in all patients. Right internal thoracic artery (RITA) was used in 28 patients; 16 of them were in group I. Patient demography is summarized in Table I. After routine closure of the chest, continuous suction (10 mm Hg) was applied to the drains, which were milked and stripped at 30-minute

intervals to ensure tube patency. Chest tubes were removed when the drainage was less than 20 mL/h for consecutive 4 hours. The presence of pericardial effusion was assessed by 2-dimensional echocardiography, which was performed in postoperative days 3, 5, 7, and 10, before discharge, and 1, 3, 6, and 12 months after discharge. The presence of pericardial effusion on 2-dimensional echocardiography was assessed with criteria described by Martin and colleagues.¹⁹ The maximum diastolic separation between pericardium and epicardium was measured at the level of the tip of mitral valve leaflet. Any effusion greater than 1 cm was considered significant.²⁰ Patients were examined echocardiographically after discharge. Patients with posterior effusion were recorded. Late posterior effusions and tamponade were recorded. Electrocardiograms of patients have been monitored for detecting arrhythmias when patients were in the bed, and if needed, we used standard 12-lead electrocardiograms. Although the patients were discharged, we taught the family to monitor radial artery pulses at least 3 times a day. In addition, standard 12-lead electrocardiograms were obtained from all patients when the echocardiographic examinations were performed. Arrhythmias were thought to be persistent and clinically significant when the arrhythmias were longer than 30 minutes; we did not count arrhythmias that lasted less than 30 minutes.

Statistical analysis was performed with SPSS software version 7.0 (SPSS Inc, Chicago, Ill). Clinical data are expressed as the mean $\pm$ the SD. Differences were analyzed with χ^2 Fisher's exact test and independent *t* tests.

Results

The differences between the 2 treatment groups with regard to age, sex, number of the distal anastomosis, duration of crossclamp, total perfusion time, total vol-

Table II. Postoperative data

	Group I (n = 100)	Group II (n = 100)	χ^2	P value
Total arrhythmias	11	40	22.13	.000002*
Atrial fibrillation	6	34	2450	.0000007*
Atrial flutter	3	5		.4†
Supraventricular tachycardia	2	1		.5†
Pleural effusion	35	29	0.83	.4*
Pulmonary complication	3	2		.5†
Sternal dehiscence	1	1		.8†
Early pericardial effusion	1	54	70.45	.00000001*
Late pericardial effusion	0	21	19.18	.000001*
Posterior tamponade	0	10	10.53	.001*
Hospital stay (d)	7	8	0.07	.8*

* χ^2 test.

†Fisher's exact 1-tailed P value.

ume of drainage, LITA/RITA, radial artery usage, and hospital stay time were not statistically significant (Table I). All SVTs were seen in the first 5 days after the operation. Ventricular arrhythmias were rare. Atrial fibrillation was found in 6 patients in group I and in 34 patients in group II ($P = .0000007$). Atrial flutter was developed in 3 patients in group I and in 5 patients in group II. There was no significant difference when considering pleural effusion. Re-intubation was required because of respiratory insufficiency in 3 patients in group I and in 2 patients in group II. Sternal dehiscence was developed in one patient in each group; RITA and LITA were used in these patients. There was statistically significant difference in early pericardial effusion (1 vs 54 patients; $P = .0000001$). Late pericardial effusion (more than 30 days after operation) was also very common in group II (21 patients). We have not found late posterior pericardial effusion in group I, but in group II we found that 21% delayed pericardial effusion and 10% delayed pericardial tamponade ($P = .01$). Symptomatic delayed posteriorly loculated pericardial effusion required echocardiographically guided pericardiocentesis, as described by Yılmaz and coworkers²⁵ in 6 patients, subxiphoid exploration in 2 patients, and anterolateral thoracotomy in 2 patients. Pericardial tamponade was diagnosed in both the hemodynamic data and the echocardiographic findings in these patients. Early pericardial effusion developed in 1 patient in group I in whom both LITA and RITA were harvested; effusion was on the right side of the heart in early postoperative period. This patient was reopened, and clots around the right atrium were removed. There

was no significant difference between 2 groups in hospital stay time (7 vs 8 days; $P = .8$). Table II gives a summary of the results.

Discussion

SVTs, mainly form of atrial fibrillation, occur in up to 40% of patients undergoing CABG.¹⁰⁻¹⁴ Various causes have been suggested, but no reliable prophylaxis is known.^{13,14,21} Previous reports have demonstrated that patients with pericardial effusion had a higher prevalence of supraventricular arrhythmias.^{16,22,23} After coronary operation, the space anterior to the heart may accommodate fluid and is easily drained from a chest drain; but behind the heart, adhesions between the inferior surface of the heart and the diaphragm may create an enclosed space. Mulay and associates¹⁷ have demonstrated that posterior pericardiotomy could drain freely into the left pleural space thereby reducing the prevalence of pericardial effusion. They also pointed out that supraventricular arrhythmias are significantly less common in patients who are treated with posterior pericardiotomy (8%) than the patients treated conventionally (36%). Asimakopoulos and coworkers²⁴ have shown that posterior pericardiotomy was more effective for pericardial drainage, but they also have shown that atrial fibrillation or SVT prevalence were not significantly reduced (20%) in comparison with the conventional technique (26%). We also did not find any statistically significant difference when considering atrial flutter and SVTs. We wish to point out that such low incidences in the patients in this series will not allow for reliable statistical comparison to obtain valid conclusions, but atrial fibrillation prevalence was significantly lower in the pericardiotomy group ($P = .0000007$). Asimakopoulos and coworkers²⁴ included patients who were receiving beta blockers and who had a poor left ventricle in the preoperative period. But we did not include these patients in our study. They pointed out that pericardiotomy groups have significantly higher blood loss, but we did not find significant blood loss difference between the 2 groups. We think that differences between these studies depend on the study-cohort design. Late cardiac tamponade is a rare but serious complication, and it has been estimated to occur in up to 6% of patients after heart operations.^{2,5} Significant delayed pericardial effusion occurred in 1.11%, and 40% of these patients have posterior cardiac tamponade.²⁵ Posterior pericardiotomy also significantly reduces late pericardial effusion ($P = .000001$) and late posterior tamponade ($P = .001$).

Several factors such as patients age, beta blockers, hyperthyroidism, left ventricular aneurysm/aneurys-

mectomy, additional valve surgical procedures, perioperative myocardial infarction, low cardiac output, renal failure, and respiratory complications influence the development of supraventricular arrhythmias, especially atrial fibrillation. The development of atrial fibrillation cannot depend on a single cause, but posterior pericardiotomy significantly reduces arrhythmias.

Conclusion

Posterior pericardiotomy is technically easy to perform and is a safe and effective technique that reduces not only the prevalence of early pericardial effusion and related atrial fibrillation but also delayed posterior pericardial effusion and tamponade.

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