ROLE OF POSTERIOR PERICARDIOTOMY IN PREVENTION OF PERICARDIAL EFFUSION AND ATRIAL FIBRILLATION AFTER CORONARY ARTERY BYPASS GRAFTING SURGERY

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Abstract

Objectives: The aim of this prospective study was to evaluate the efficacy of Posterior Pericardiotomy in decreasing the occurrence and development of Pericardial Effusion and related Atrial Fibrillation (AF).

Study Design: Randomized Control Trial (RCT).

Place and Duration of Study: Armed Forces Institute of Cardiology and National Institute of Heart Diseases Rawalpindi, from Jan 2009 to Feb 2010.

Patients and Methods: This prospective randomised study was performed in the first 100 patients undergoing coronary artery bypass grafting surgery (CABG) between January 2009 and February 2010. Patients were randomized into two groups, Posterior Pericardiotomy was performed in 50 patients before releasing aortic cross clamp (Group I); remaining other 50 patients served as the control Group (Group II). 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.

Results: The difference between the two treatment groups, with regards to age, sex, number of bypass grafts, duration of cross clamp, total perfusion time and hospital stay time were not statistically significant. Atrial Fibrillation was noted in 02(4%) patients in Group I and 12(24%) patients in Group II (p 0.004). Pericardial Effusion was present in 03 patients in Group I and 16 patients in Group II (p <0.001). Atrial flutter and other supraventricular arrhythmias were not statistically significant.

Conclusion: Posterior Pericardiotomy proved to be technically easy and efficient procedure in decreasing the occurrence and development of Pericardial Effusion and related Atrial Fibrillation (AF).

Keywords : CABG, Posterior Pericardiotomy, pericardial effusion.

Article

INTRODUCTION

Pericardial Effusion usually occurring in a week after coronary artery bypass grafting surgery (CABG) is small in amount and inconsequential hemodynamically. However, if large enough, circumferential and pooling in strategic area may impede cardiac filling, leading to cardiac tamponade and reduced cardiac output. Prompt management reduces the high mortality rate associated with this problem1.

The incidence of Atrial Fibrillation (AF) after coronary artery bypass grafting surgery (CABG) varies from 5% to 40%2. Though benign, yet may be implicated in causing hemodynamic instability, prolonging hospital stay and increasing the costs of management. It can rarely predispose to a cerebrovascular incident 3,4.

Most of the Pericardial Effusions dissolve spontaneously, however; some are incriminated in the development of supraventricular tachycardia (SVT)5. Studies have shown that patients, with Pericardial Effusion, had a higher incidence of AF6,7,8. Posterior Pericardiotomy has been reported as a useful technique to reduce supraventricular arrhythmias after CABG 9,10. The incidence of Pericardial Effusion may reach up to 40% after cardiac surgery in Control Group and to 8% in Pericardiotomy Group8,11. The aim of this prospective study was to assess the efficacy of Posterior

Pericardiotomy procedure in decreasing the prevalence of Pericardial Effusion and progressive AF.

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MATERIAL AND METHODS

The study was carried out at the Department of Cardiac Surgery, Armed Forces Institute of Cardiology & National Institute of Heart Diseases, Rawalpindi between January 2009 and February 2010. It was conducted on 100 patients out of 158 patients who underwent an elective CABG operation. They were randomly assigned to two Groups (I and II). A total of 49 patients with hyperthyroidism (n=2), chronic obstructive pulmonary disease (n=16), renal dysfunction (n=2), left ventricular aneurysm (n=1), severe left ventricular dysfunction (n=16), or history of AF or previous CABG and patients with combined valvular disease (n=12) were not included to obviate disorders that could be associated with an increase incidence of AF. Patients with dense adhesion of the lung were also excluded (n=9). The study, prior to commencement was approved by the Hospital Ethical Committee. The objectives and protocol for the study were explained to all the patients/participants and a written consent was obtained from each.

Posterior pericardiotomy:

Median sternotomy was the standard approach for the exposure of heart and great vessels in all patients. While harvesting left internal mammary artery(LIMA) left pleural space was entered. Cardiopulmonary bypass (CPB) was established after anticoagulation with heparin (3mg/kg body weight) to an activated clotting time of 400 seconds or atleast twice the preoperative control, with reversal by protamine (3mg/Kg body weight) at the end of operation. CPB was established by cannulation of the ascending aorta with Sarns 24 French cannula and the right atrium (double stage Sarns 36 French single cannula), moderate hemodilution (hematocrit, 20% to 26%) and moderate systemic hypothermia (32°- 34ºC). Antegrade warm blood cardioplegia administration via aortic root was used as myocardial protection alongwith aortic venting. All distal anastomoses were performed in a single cross clamp period. The left internal mammary artery (LIMA) was used in all patients. Right internal mammary artery(RIMA) was used in one patient who was in Group I. Top ends of vein grafts were anastomosed to proximal ascending aorta after release of cross clamp. Posterior pericardiotomy was performed in 50 patients just before releasing aortic cross clamp (Group I) and other 50 patients served as the Control Group (Group II). Longitudinal incision was made parallel and posterior to the left phrenic nerve, extending from the left inferior pulmonary vein to the diaphragm using diathermy in Group I as described by Mullay et al10. Posterior Pericardiotomy was not performed in Group II. Two chest drains of 28 French size were placed, one in the left pleural cavity and the other one in the anterior mediastinum; and the pericardium was left open anteriorly in both Groups. Anaesthetic medication and surgical techniques were similar in each Group. After routine closure of the chest, continuous suction of 10 mm of Hg was applied to the drains which were milked at 60 min interval to ensure tube patency. The volume of blood drained was measured. The chest tubes were removed when the drainage was less than 20ml/hr for 04 consecutive hours. Patients were weaned off the ventilation when they showed hemodynamic stability, no major bleeding, normothermia and consciousness with adequate pain control12. Potassium and magnesium supplements were given as necessary to maintain electrolyte balance within the normal range. The presence of Pericardial Effusion was assessed by 2- dimensional echocardiography, which was performed on post operative days 3,5, before discharge and on first visit (11th- 13th postoperative day). The presence of Pericardial effusion on 2- dimensional echocardiography was assessed with criteria as previously described by Martin et al13. 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. In all patients electrocardiogram was monitored continuously for the first 48 hrs for detecting arrhythmias after operation. Additional electrocardiograms were obtained daily. Arrhythmias (supraventricular) were thought clinically significant when they lasted longer than 20 minutes in the absence of hemodynamic compromise. The analysis of data was done with Statistical Package for Social Sciences (SPSS) version 15. Quantitative variables were expressed as mean ± SD (standard deviation). Qualitative variables were expressed with frequency and percentages. Independent samples t–test was used to compare

quantitative variables between both the Groups. Qualitative variables were compared using chi-square test. The level of statistical significance for all tests was set to $p < 0.05$.

RESULTS

The differences between the treatment Groups with regard to age, gender, number of bypass grafts, duration of cross clamp, duration of cardiopulmonary bypass and hospital stay time were not statistically significant (Table I).

Table 1: Demographic and Operative Data

Parameters	Group1(N=50) Mean± SD	Group II(N=50) Mean± SD	P-value
Gender M/F	36/14	34/16	0.663
Age (yrs)	54.3 ± 8.4	54.3 ± 8.8	>0.72
LVF Good EF ≥ 50	23	21	0.687
Moderate EF = 30-50	27	29	
Preoperative MI	24	27	0.548
No of Grafts	2.90 ± 0.54	2.92 ± 0.49	0.847
Cross Clamp Time (min)	37.08 ± 5.8	37.76 ± 6.3	0.578
CPB Time	56.50 ± 5.08	54.96 ±4.13	0.100
LIMA	50	50	1
RIMA	1	0	0.315
Duration of drainage (hrs)	32.98 ± 2.04	38.02 ±4.95	<0.001
Amount of drainage (ml)	1045.10 ± 106	1072.22 ± 85	0.162

LVF, Left ventricular function; EF, Ejection fraction; MI, Myocardial infarction; CPB, Cardiopulmonary bypass; LIMA, Left internal mammary artery; RIMA, Right internal mammary artery;

Table-2: Post-operative Data

Parameters	Group I (n= 50)	Group II (n = 50)	P-Value
Total Arrhythmias	3	16	0.001
Atrial Fibrillation	2	12	0.004
Atrial Flutter	2	4	0.40
Supraventricular Tachycardia	0	0	
Pericardial Effusion	3	18	<0.001
Pleural Effusion	11	9	0.617
Pulmonary Complications	2	1	0.558
Sternal dehiscence	1	0	0.315
Hospital stay (days)	5.32±.95	5.38±.90	0.748

There was no death in either Group. There were also no significant differences between two Groups with regard to duration of mechanical ventilation or revision for bleeding. Re-exploration was done in two cases in each Group. In Group I from LIMA bed and in Group II from side tributary of Saphenous vein graft. In our study the Control Group II had higher pleural drainage than Group I; however the difference did not achieve statistical significance (1072.22 ± 85 vs 1045.10 ± 106). The duration of drainage in our study was more in Group II than Group I and it was found statistically significant as well ($p <0.001$). The number of patients with pericardial effusion was significantly lower in Group I than Group II i.e. (3 vs 18, $p < 0.001$). Atrial fibrillation was found in 2 patients in Group I and 12 patients in Group II (p 0.004). Atrial flutter developed in 02 patients in Group I and in 04 patients in Group II. Most of the arrhythmias occurred in first five post operative days. There was no significant difference when considering pleural effusion (p 0.617). Sternal dehiscence developed in one patient in Group I in which both LIMA and RIMA was used because of sternal wound infection. Arrhythmia was also significantly more commonly associated with the presence of pericardial effusion ($p <.001$). There was no significant difference in the frequency of pulmonary complications (p 0.558) and hospital stay 5.32 vs 5.38 days (p 0.748) between the two Groups.

DISCUSSION

AF is the most common arrhythmia after CABG and occurs in up to 30-50% of cases of different studies with the major occurrence 2 days after operation14-17. Evidence suggest its incidence may

increase despite improvements in anaesthetic and surgical techniques 18,19 . Etiological factors such as age, postural changes of the atria related to hypertension, right coronary artery involvement, volume overload, peri-operative myocardial infarction, renal failure, electrolyte imbalances and pericardial lesions are thought to play a role in the pathogenesis of post operative AF 18,20. The development of Atrial fibrillation cannot be attributed to a single cause and there is no reliable prophylaxis known14,21. The stress of open heart surgery increases sympathetic tone of the patient and this may predispose to the development of AF18. Sympathetic activation also decreases atrial refrectiveness favouring perpetuation of AF22. Pericardial effusion has also been implicated in the development of AF5. Angelini et al5 presented refractory (to medication and cardioversion) supraventricular arrhythmias due to Pericardial Effusion following open heart surgery, which responded well to the evacuation of the effusion and a consequent sinus rhythm. Mulay and associates10 have demonstrated a reduction in both pericardial effusion and related supra-ventricular arrhythmias with posterior pericardiotomy (8 vs 36%). Hasan Ekim et al24 also showed a significant reduction in the incidence of pericardial effusion and AF in posterior pericardiotomy; and the elapsed time for the occurrence of AF was also different in favour of posterior pericardiotomy. Asimakopoulos et al3 and Arbatly et al 23 have shown that Posterior Pericardiotomy was more effective for pericardial drainage, but they had also shown that AF prevalence was not significantly reduced in comparison with their Control Group. However, in our study, there was a significant reduction in the incidence of Pericardial Effusion and AF in Group I. They also pointed out that pericardiotomy group have significantly higher blood loss, but we did not find significant total blood loss difference between the two Groups - rather pleural drainage was slightly higher in the Group II in our study unexpectedly and duration of drainage was significantly more in Group II. Effusion appeared to be associated with inadequate blood drainage and was reduced, though not totally avoided by the use of two chest drains, one in front and one behind the heart5. Following coronary surgery the space anterior to the heart may accommodate fluid, but behind the heart, adhesions between the inferior surface of the heart and the diaphragm, may create an enclosed space. Moreover, chest drain behind the heart cannot be routinely used because of mechanical irritation and the proximity to the bypass grafts.

In our study we were able to demonstrate that by creating a posterior pericardiotomy, fluid could be drained freely in the left pleural space thereby reducing significantly the incidence of pericardial effusion. Supraventricular arrhythmias were also significantly less common in patients receiving a posterior pericardiotomy than Control Group II. The posterior pericardiotomy incision also makes redundant the need for a chest tube behind the heart, which is particularly safe in situations where graft placed on the inferior surface of the heart may come into contact with the tube.

CONCLUSION

Postrior pericardiotomy is a safe and effective technique which reduces the occurance of pericardial effusion and associated Atrial fibrillation following coronary artery bypass grafting surgery (CABG). We recommend its use in all patients in whom the left pleural space has been opened during harvesting of left internal mammary artery. Additional prospective studies are required to establish the exact relation among the incidences of AF, pericardial effusion and posterior pericardiotomy.

Reference

1.Chuttani K, Pandian NG, Mohanty PK, Rosenfield K, Schwartz SL, Udelson JE. Left ventricular diastolic collapse: an echocardiographic sign of regional cardiac tamponade. Circulation 1991; 83:1999-2006.
2. Lauer MS, Eagle KA, Buckley MJ, De Sanctis R W: Atrial fibrillation following coronary artery bypass surgery. Prog Cardiovasc Dis, 1989; 31: 367–78.
3.Asimakopoulos G, Santa R D, Taggart D P: Effects of posterior pericardiotomy on the incidence of atrial fibrillation and chest drainage after coronary revascularization: a prospective randomized trial. J Thorac Cardiovasc Surg, 1997; 113: 797–9.
4.Pires L A, Wagshal A B, Lancey R, Huang S K: Arrhythmias and conduction disturbance after coronary artery bypass grafting surgery: epidemiology, management, and prognosis (review). Am Heart J. 1995; 129: 799–808.

5.Angelini G D, Penny W J, El-Ghamary F: The incidence and significance of early pericardial effusion after open heart surgery. Eur J Cardiothorac Surg, 1987; 1: 165–8.

6.Arbatlý H, Demirsoy E, Aytekin S et al.The role of posterior pericardiotomy on the incidence of atrial fibrillation after coronary revascularization. J cardiovasc Surg, 2003; 44: 713–17.

7.Bryan AJ, Anglini GD. Pericardial effusion after open heart surgery. Thorax, 1990; 45: 655–56.

8.Ikaheimo M J, Huikuri H V, Airaksinen K E, Korhonen U R. Percardial effusion after cardiac surgery: incidence, relation to the type of surgery, antithrombotic therapy, and early coronary bypass graft patency. Am Heart J. 1988; 116: 97–102.

9.Farsak B, Günaydýn S, Tokmakoðlu H et al. Posterior pericardiotomy reduces the incidence of supraventricular arrhythmias and pericardial effusion after coronary artery bypass grafting. Eur J Cardiothorac Surg.2002; 22: 278–81.

10.Mulay A, Kirk A J B, Angelini G D et al. Posterior pericardiotomy reduces the incidence of supra-ventricular arrhythmias following coronary artery bypass surgery. Eur J Cardiothorac Surg. 1995; 9: 150–52.

11.Erdil N, Nisanoðlu V, Koþar F et al. Effect of posterior pericardiotomy on early and late pericardial effusion after valve replacement. J Cardiac Surg, 2005; 20: 257–60.

12.Auer J, Weber T, Berent R et al. Risk factors of postoperative atrial fibrillation after cardiac surgery. J Cardiac Surg. 2005; 20: 425–31.

13.Martin R P, Rakowski H, French I, Popp R L: Localization of pericardial effusion with wide angle phased array echocardiography. Am J Cardiol. 1978; 42: 904–12.

14.Curzen N, Poole W P. Atrial tachyarrhythmias and coronary artery bypass surgery patient. Br J Cardial. 1994;1: 57-59.

15.Fuller IA, Adams G G, Buxton B. Atrial fibrillation after coronary bypass grafting . J Cardiovascular Surgery. 1989;19: 821-25.

16.Parker F B, Granier-Hays C, Bove EL. Supraventricular arrhythmias following coronary artery bypass: the effect of preoperative digitalis. J Thoracic Cardiovasc Surgery 1983 ; 86: 594-600.

17.Tyras DH, Stothert J C, Kaiser G L. Supraventricular tacharrhythmias after coronary artery revascularization: a randomised trial of prophylactic digitalisation. J Thorac Cardiovascular Surg 1979; 77: 310-4.

18.Auer J, Weber T, Berent R et al: Risk factors of post operative atrial fibrillation after cardiac surgery, 2005; 20 : 425-31.

19.Creswell LL, Schessler RB, Rosenbloom N, Cox JL. Hazards of post operative atrial arrhythmias . Ann Thorac Surg. 1993; 56: 539-49.

20.Aranki SF, Shaw DP, Adams DH et al. Predictions of atrial fibrillations after coronary artery surgery: current trends and impact on hospital resources Circulations, 1996; 94: 390-97.

21.Cujec B, Jhonson D, Bhardwaj B. Cardiac temponade by located pericardial hematoma following open heart surgery: diagnosis by transeosophagial echocardiography. Can J Cardiol. 1991; 7: 37-40.

22.Waldo AL. Mechanism of atrial fibrillation, atrial flutter, and ectopic atrial tachycardia- a brief review circulation. 1987; 75: (suppl 3): 37-40.

23.Arbatly H, Demirsoy E, Aytekin S et al. The role of posterior pericardiotomy on the incidence of atrial fibrillation after coronary revascularization. J Cardio Surg. 2003;44: 713-17.

24.Hasan E, Veysel K, Abdussemed H,et al. Effects of posterior pericardiotomy on the incidence of pericardial effusion and atrial fibrillation after coronary revascularization. Med Sci Monit. 2006; 12 (10): CR 431-34.