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Delayed Pericardial Effusion Following Heart Valve Surgery: Aspect of Pleuropericardial Window for Prevention

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Abstract

Background: **Delayed pericardial effusion is common after open heart surgery for valvular heart diseases. In particular, cases with cardiac tamponade are associated with significant morbidity and mortality.**

Objectives: **The purpose of this study was to investigate whether intra-operative pleuropericardial window of the right pleural cavity could prevent delayed pericardial effusion in patients undergoing conventional valve surgery.**

Methods: **A retrospective analysis of 205 consecutive patients undergoing valve surgery and survived during August 2006 to February 2007 at our institution was performed. The patients were divided into two groups: group I consisted of 105 patients who underwent conventional valve surgery alone and group II consisted of 100 patients who underwent conventional valve surgery plus intra-operative pleuropericardial window of the right pleural cavity for prevention of delayed pericardial effusion. Patients with clinical suspicion of delayed pericardial effusion were evaluated by transthoracic or transesophageal echocardiography in the first to tenth postoperative week. Other clinical parameters were also analyzed. Differences between groups were demonstrated using the two-sample test of proportion (Z-test) for statistical analysis.**

Results: **Delayed pericardial effusion was significantly more common in patients undergoing conventional valve surgery alone, as compared to conventional valve surgery plus intra-operative pleuropericardial window (11 patients versus 3 patients, $p < 0.05$).**

Conclusions: **Delayed pericardial effusion was more common in patients undergoing conventional valve surgery alone, as opposed to conventional valve surgery plus intra-operative pleuropericardial window of the right pleural cavity. Thus the intra-operative pleuropericardial window should be performed as an additional procedure for prevention of delayed pericardial effusion following valve surgery.**

Key words: **cardiac tamponade, pericardial effusion, pleuropericardial window, heart valve surgery**

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Introduction

Delayed pericardial effusion usually occurs more than 7 days after cardiac operation[1]. Its duration is highly variable, with a median of 22 days and a range of 2 to 100 days in former study[2] and large effusions occur more frequently in patients who are treated with anticoagulant therapy[3]. It usually occurs outside the hospital after the patients have been discharged and it is difficult for the district hospital to diagnose. It is therefore necessary to prevent this condition.

In the presence of pericardial effusion, the intrapericardial pressure depends on the relationship between the absolute volume of the effusion, the speed of pericardial fluid accumulation, and the elasticity of the pericardium[4]. Because the pericardium grows to accommodate its content when subjects to chronic stretching, the hemodynamic effect of pericardial effusion is related to the speed of accumulation of the pericardial fluid. Whereas the rapid accumulation of 150 to 200 ml may result in cardiac tamponade, the slow accumulation of larger effusion (1 to 2 liter) may be well tolerated without evidence of tamponade[5-7].

The normal intrapericardial pressure is negative and is similar to the intrapleural pressure (0-2 mmHg). During inspiration, the intrapericardial pressure decreases abruptly to sub-atmospheric levels due to less negative than intrapleural pressure[4]. So if we create a communication between the pericardial and the pleural space, the pericardial fluid could be washed out to the pleural cavity by means of gravitation and negative pressure effect.

As we know, various mechanisms can remove the pleural fluid collected in pleural cavity. The mechanism of liquid removal is provided by absorptive pressure gradient through the visceral pleura, lymphatic drainage through the stomas of the parietal pleura and cellular mechanisms[8]. In man, maximum pleural lymph flow could attain 30 $mL.h^{-1}$, equivalent to ≈700 $mL.day^{-1}$ (≈40% of overall lymph flow)[9]. So we use this mean to prevent delayed pericardial effusion by using intra-operative pleuropericardial window in patients who underwent conventional valve surgery. We hypothesized that those patients who underwent valve surgery plus intra-operative pleuropericardial window of the right pleural cavity might have lower risk of delayed pericardial effusion. The objective of our study was to prove this hypothesis by investigating whether intra-operative pleuropericardial window of the right pleural cavity could prevent delayed pericardial effusion in patients who underwent conventional valve surgery.

Materials and Methods

The retrospective analysis of 205 consecutive patients undergoing valve surgery and survived at our institution between August 2006 to February 2007. All patients were operated through median sternotomy under cardiopulmonary bypass at mild hypothermia. Single venous cannulation was used in cases of operation for left heart only and double venous cannulation in cases of right heart or both. We divided the participants into 2 groups. Group I (control group) consists of 105 patients who underwent conventional valve surgery alone and group II (experimental group) consists of 100 patients who underwent conventional valve surgery plus intra operative pleuropericardial window of the right pleural cavity. Warfarin was taken on the first day after operation in both groups and kept on. The duration for follow-up was 10 weeks after the operation.

Echocardiographic Evaluation

Transthoracic or transesophageal echocardiography was performed by a registered cardiologist for detection of any large pericardial effusion. The procedure was routinely done in the first visit after operation (about 2 weeks after discharge) or in case of increased cardiac shadow from the chest X-ray or clinical symptoms of cardiac insufficiency.

Statistical Analysis

Differences between 2 groups were analyzed using t-test and the two-sample test of proportion (Z-test). A value of p-value <0.05 was considered statistically significant.

Right Pleuropericardial Window Technique

The pleuropericardial window was performed after declamping the aorta. An incision about 5 cm. was incised from the inner surface of right pericardium (Figure 1). Then a small hole about 1 cm. in diameter was made to the mediastinal pleura by diathermy (Figure 2). Finally 3 tube drains were left in the pericardial cavity, anterior mediastinum and right pleural

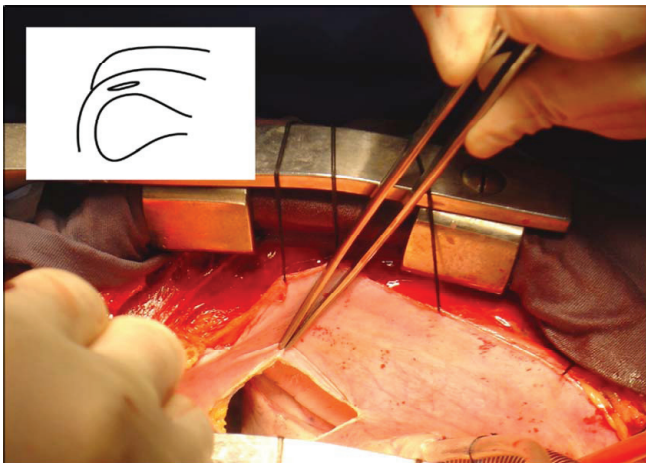

Figure 1 After declamping the aorta, decrease heart volume by turning blood to the machine for good exposure of the pericardium. From the inner site of the pericardium, incise 5 cm. long anterior and parallel the phrenic nerve. This will drain the delayed pericardial fluid to the pleural cavity later.

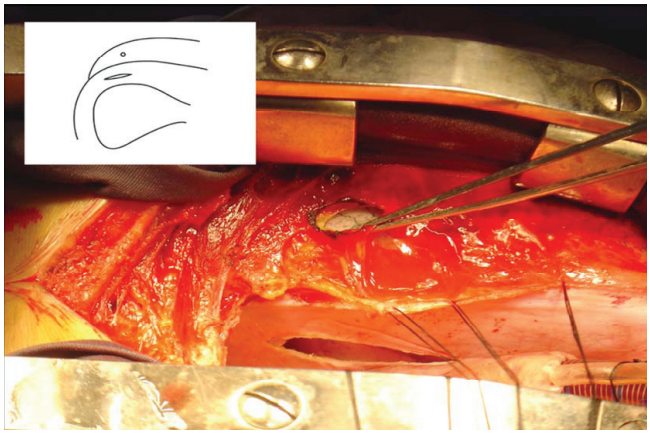

Figure 2 Incise a hole to the mediastinal pleura for putting a chest tube in the pleural cavity to remove the immediate postoperative collection.

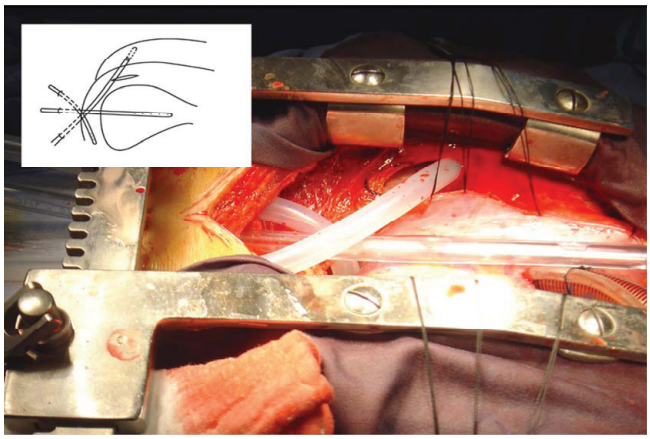

Figure 3 Before closing the chest, left 3 tube drains in pericardial cavity, substernal region and right pleural cavity.

cavity (Figure 3).

Results

A total of 205 patients were enrolled into this study. The patients were divided into 2 groups (control and experimental groups). Table 1 shows the characteristics of patients in preoperative period. We found no significant differences between age of the patients in experimental group and control group but the proportion of male and female patients in

Table 1 Pre-operative characteristics of patients in experimental and control groups

Patient characteristics	Control group (Non pleuropericardial window) (N = 105)	Experimental group (Pleuropericardial window) (N = 100)	P-value
Age (years)	45.24 ± 12.75	47.05 ± 10.54	NS
Male (n)	62	41	<0.05
Female (n)	43	59	<0.05

Table 2 Intra-operative characteristics of patients in experimental and control groups

Patient characteristics	Control group (Non pleuropericardial window) (N = 105)	Experimental group (Pleuropericardial window) (N = 100)	P-value
1 valve surgery (n)	71	74	NS
2 valves surgery (n)	30	25	NS
3 valves surgery (n)	4	1	NS
Occlusion time (min)	62.22 ± 25.43	56.74 ± 23.86	NS
Bypass time (min)	79.79 ± 45.60	74.15 ± 28.11	NS

Table 3.1 Experimental group (pleuropericardial window) with pericardial effusion

No.	Sex	Age (yrs.)	Procedures	Duration after valve surgery until pericardial effusion occur (days)	PT	INR
1	Female	58	MVR	50	15.60	1.25
2	Female	70	MVR	56	21.70	1.69
3	Female	44	MVR	16	54.30	4.01

Table 3.2 Control group (non-pleuropericardial window) with pericardial effusion

No.	Sex	Age (yrs.)	Procedures	Duration after valve surgery until pericardial effusion occur (days)	PT	INR
1	Male	62	AVR	43	14.50	1.18
2	Male	43	AVR	8	16.50	1.37
3	Male	39	MVR	23	20.70	1.71
4	Male	30	MVR	14	24.20	1.92
5	Female	45	MVR	50	26.30	2.09
6	Female	49	MVR	20	32.80	2.78
7	Male	14	MV Repair & TV Repair	12	34.00	2.88
8	Male	51	MV Repair	32	43.30	3.40
9	Female	41	MV Repair & TV Repair	11	139.90	11.28
10	Male	42	DVR	18	197.00	15.89
11	Female	38	MV Repair & TV Repair	52	271.80	21.92

Table 4 Difference between 2 groups of postoperative delayed pericardial effusion patients

Patient characteristics	Control group (Non pleuropericardial window) (N = 105)	Experimental group (Pleuropericardial window) (N = 100)	P-value
Pericardial effusion (n)	11	3	<0.05

experimental group and control group are significantly different (p-value <0.05 and p-value <0.05). Table 2 shows the data in intra-operative period. We found no significant difference between type of valve surgery, occlusion time and bypass time of the participants in experimental and control groups. Table 3.1 and 3.2 show the data of patients who have pericardial effusion after undergoing valve surgery. INR range varied from 1.18 - 21.92 suggesting that delayed pericardial effusion after valve surgery did not depend on INR level only. Patients who underwent conventional valve surgery alone had higher incidence of delayed pericardial effusion than the patient who underwent valve surgery plus intra-operative pleuropericardial window (11 patients vs 3 patients, p-value <0.05) (Table 4).

Conclusion

Delayed pericardial effusion is more common in patients who underwent conventional valve surgery alone as opposed to patients who underwent conventional valve surgery plus intraoperative pleuropericardial window of the right pleural cavity. Right pleuropericardial window is a simple technique but it is a life-saving procedure for prevention of postoperative delayed pericardial effusion or tamponade.

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