**Original
Article**

Long-Term Outcomes after Video-Assisted Thoracoscopic Pericardiectomy for Pericardial Effusion

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Purpose: Chronic or recurrent pericardial effusion is often associated with malignant disease. However, there have been few reports of the long-term outcomes after video-assisted thoracoscopic (VATS) pericardiectomy. We have performed it since 1992, and report our procedure and outcomes.

Methods: Patients who underwent VATS pericardiectomy were investigated.

Results: In all, 29 patients (12 men; median age: 61 (23–88) years) were evaluated; 8 had no malignancies and 21 did. Preoperative performance status (PS) scores were as follows: 1, 11 patients; 2, 10 patients; 3, 5 patients; and 4, 2 patients. One patient with malignancy died intraoperatively. PS improved significantly after the procedure ($p = 0.0163$). Median survival times were 5360 days in the nonmalignant group, 160 days in the malignant group, 209 days in breast cancer patients, and 62 days in other malignancy patients. The nonmalignant group had significantly longer survival than the malignant group ($p = 0.0015$). Most cases had uneventful postoperative courses. No recurrent pericardial effusions have been observed.

Conclusion: In cases of nonmalignant pericardial effusion, long-term survival is expected following VATS pericardiectomy. Malignant pericardial effusion has a poor prognosis, but most cases maintain good PS. However, early postoperative death may occur, and it is important to select patients carefully.

Keywords: VATS pericardiectomy, video-assisted thoracoscopic pericardiectomy, pericardial effusion, long-term outcomes, performance status

Introduction

Chronic or recurrent pericardial effusion is often associated with malignant disease, such as lung cancer, breast cancer, and malignant lymphoma.¹⁾ Studies in the past have reported poor outcomes for patients with symptomatic malignant pericardial effusions, with median

survivals of about 1–3 months.^{1–4)} Survival is significantly better in patients with benign effusions than in those with malignant effusions. Consequently, tissue diagnosis is essential.³⁾ Previous surgical approaches were median sternotomy, anterolateral thoracotomy, or the subxiphoid approach. Recently, video-assisted thoracoscopic (VATS) pericardiectomy has been reported to be safe and effective.^{5,6)} We started complete VATS in 1992 and have used it aggressively for pericardiectomy for pericardial effusion. We report our procedure and long-term outcomes after VATS pericardiectomy for pericardial effusion.

Materials and Methods

VATS pericardiectomy was performed for 29 cases with recurrent or symptomatic pericardial effusions from 1998 to 2015. According to the patients' general

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Fig. 1 Schema and picture of the operative procedure. (A) Left lateral decubitus position and surgical incision. (B) Supine position and surgical incision. (C) Excision of pericardium anterior to the phrenic nerve. (D) Pericardial window.

condition, the procedure was performed in the lateral decubitus position or the supine position under general anesthesia (Figs. 1 and 2). The trachea was canalized with a double lumen tube for selective ventilation of the lung. When the procedure was performed in the lateral decubitus position, a 3-cm operator's port was made in front of the anterior line of the latissimus dorsi muscle on the posterolateral incision line (almost in the fifth intercostal space), and a 5-mm port for the thoracoscope was inserted at the middle axillary line (almost in the sixth intercostal space, at a point that looks down the major fissure, sometimes more caudally). If necessary, one working port was made at a posterior location on the same line. On the other hand, when the procedure was performed in the supine position, a 3-cm operator's port was placed lateral of the inframammary line, and a 5-mm port for the thoracoscope was inserted at the point below the nipple on the same line. When there was a pleural effusion, its pathologic findings were examined. When cytology of the pericardial fluid was not examined

Fig. 2 Comparing overall survival in cases with malignancy and no malignancy ($p = 0.0015$).

preoperatively, it was submitted for examination. After the pericardium was grasped with DeBakey forceps, 1–3 cm of pericardium was excised with an electrosurgical knife, and fluid from the pericardial space was drained to the thoracic cavity. Before the operation was

Table 1 Primary diseases of the cases

Malignancy	Lung carcinoma	Adeno	5
		Squamous	2
		Non-small	1
	Breast cancer		8
	Thymic carcinoma		1
	Thymoma		1
	Cholangiocarcinoma		1
	Ovarian cancer		1
	Synovial sarcoma		1
	Total		21
No malignancy	Radiation-induced pericarditis		2
	Chronic heart failure		2
	After total arch replacement		1
	Chylopericardium		1
	Idiopathic		2
	Total		8

completed, a 20 Fr or 24 Fr thoracic tube was inserted into the thoracic space from the thoracoscopic port.

The patients' background characteristics and long-term outcomes were examined, and preoperative performance status (PS) and postoperative PS were compared. The Wilcoxon signed-rank test, Kaplan–Meier survival curves, and the log-rank test were used for statistical analysis. A *p* value of <0.05 was considered significant. All statistical analyses were performed using the JMP statistical software package (version 12.2.0 SAS Institute Inc.).

Results

The patients were 12 men and 17 women. Their age at operation ranged from 23 to 88 years (median: 61 years). Dyspnea was the most common manifestation. The second most common complaint was edema of the lower legs. Examples of other complaints were chest discomfort, palpitations, appetite loss, malaise, cough, and nausea. Preoperative PS scores were 1 in 11 patients, 2 in 10 patients, 3 in 5 patients, and 4 in 2 patients. One patient with malignancy died intraoperatively. The sides for the approaches were the left side in 22 cases and the right side in 7 cases. The drain was removed 1–21 days after surgery. Eight patients had no malignancy. Eight patients had primary lung cancer, eight patients had primary breast cancer, and four patients had other malignant diseases (**Table 1**).

Median survival time was 5360 days in the nonmalignant group, 126 days in lung cancer patients, 209 days in breast cancer patients, and 62 days in other malignancy patients. The nonmalignant group had a significantly longer survival time than the malignant group

Fig. 3 Survival curve of pericardial fluid cytology-positive versus cytology-negative (excluding one case in whom cytology was not performed) (*p* < 0.0001).

(*p* = 0.0015) (**Fig. 2**). A case of primary malignant disease had long-term survival, but it was a thymoma and pericardial fluid cytology was benign. The group with cytology-positive pericardial fluid had significantly longer survival than the cytology-negative group (**Fig. 3**). Postoperative PS improved significantly compared with preoperative PS (*p* = 0.0163) (**Fig. 4**). The postoperative courses of most cases were uneventful. However, one of the other malignancy patients died intraoperatively; the patient had terminal cholangiocarcinoma and metastasis. This case was predicted to have a poor prognosis, but VATS pericardiectomy was performed because the patient desired improvement of PS and discharge home. In the surviving cases, no recurrences of effusion have been observed for a long time.

Fig. 4 Survival curve of preoperative versus postoperative performance status ($p = 0.0163$).

Discussion

VATS pericardiectomy was found to be effective in this study. The mean postoperative follow-up period in this series was 1088 days, during which there was no recurrence. Long-time outcomes were good, and cases with a benign pericardial effusion had particularly good outcomes. In addition, pericardiectomy improved postoperative PS compared with preoperative PS, and it increased the quality of life (QOL) of end-stage patients so that some of them could spend the remainder of their time at home. The approaches were more frequent from the left side than from the right side. The reason for this is that the heart is close to the chest wall, and it is advantageous for selective ventilation of the lung. Therefore, the pericardium was excised easily. However, it is possible to operate from either side.

The results of the present study demonstrated that patients had a good prognosis following VATS pericardiectomy. In contrast, there was one case of intraoperative death in a patient with end-stage cholangiocarcinoma. Two deaths occurred within 30 days of the operation. One of these patients died of acute respiratory distress syndrome, having had general edema and anemia preoperatively. Small intestinal hemorrhage occurred postoperatively, and then acute respiratory distress syndrome developed. The cause of death of the other case was lung cancer with multiple metastases. It is necessary to select patients carefully for this operation because some of them may have a poor preoperative condition.

The previous surgical techniques for pericardial effusions had been methods using a subxiphoid or a transthoracic route. Several cases of VATS pericardiectomy had

been reported, for example, not only for malignant pericardial effusions, but also after cardiac transplantation, uremic pericarditis, nontuberculous mycobacterial infection, and so on.⁷⁻¹⁰ It has been reported that operative time and rates of pneumothorax or prolonged air leaks were higher with VATS pericardiectomy, but long-term control of the effusion was better than with the subxiphoid procedure.⁷ There was no minor morbidity in the present study, and good outcomes were obtained. Thus, VATS pericardiectomy appears to be helpful.

A 1- to 3-cm diameter of pericardium was excised. Excision of a 3- to 5-cm diameter of pericardium has been reported.⁷⁻⁹ It was reported that over a follow-up period of 6 months to 6 years, the effusion recurred in three of five cases (60%).¹¹ There were no recurrences in the present study.

Siyamek et al. reported that patients whose pathology showed malignant effusion and metastatic disease of the pericardium had worse survival.¹² The results of the present study also showed that malignant cases had a poor prognosis, and benign cases had a good prognosis. We recommend VATS pericardiectomy for benign pericardial effusions. On the other hand, in cases of malignant pericardial effusions, pericardiectomy should be carefully considered although it may improve postoperative PS and QOL. The future issue is to identify those patients with malignant pericardial effusion who are most likely to benefit from pericardiectomy.

Conclusion

In cases of nonmalignant pericardial effusions, VATS pericardiectomy is expected to provide long-term survival. However, patients with malignant pericardial effusions have a poor prognosis, though in most cases, their PS is better. However, pericardiectomy may result in early postoperative death, and it is important to decide the surgical indication carefully.

Disclosure Statement

The authors have no conflicts of interest.

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