Video-assisted Thoracoscopic Pericardiectomy for Malignant Pericardial Effusion

HIDETAKA URAMOTO and TAKESHI HANAGIRI

Second Department of Surgery, School of Medicine, University of Occupational and Environmental Health, Kitakyushu, Japan

Abstract. *Background: A malignant thoracic tumour often causes malignant pericardial effusion with cardiac tamponade. However, no standard treatment has yet been established. The purpose of this study was to clarify the utility of performing video-assisted thoracoscopic (VATS) pericardiectomy in patients presenting malignant pericardial effusion. Patients and Methods: VATS pericardiectomy was performed for 11 patients with malignant pericardial effusion from 2000 to 2010. The clinical characteristics and outcome of these patients were retrospectively analysed. Pericardial windows were created under general anaesthesia and single lung ventilation was performed using three trocars. Results: All patients were successfully managed by thoracoscopic resections. There were no surgical difficulties and the postoperative periods were uneventful. The performance status and Hugh-Jones classification both improved after treatment in nine and eight out of eleven cases, respectively. The average duration of chest tube drainage was seven days. No recurrent pericardial effusion was noted during follow-up. Conclusion: The thoracoscopic approach was able to safely resect a sufficient amount of the pericardium and to provide sufficient surgical visualisation while being minimally invasive for patients with malignant pericardial effusion.*

Massive pericardial effusion is an increasingly common complication of malignant tumours (1). There are some modalities of drainage that are performed to control cardiac tamponade (1). Initially, malignant pericardial effusion is classified by the volume of effusion. The treatment is directed at the primary disease in patients with a small amount of malignant effusion without symptoms. In contrast, pericardiocentesis is performed for patients with a massive amount of malignant effusion to prevent cardiac tamponade. This is usually followed by highly sensitive chemotherapy. A surgical approach is considered for tumours that are insensitive to chemotherapy. Surgical drainage of malignant pericardial effusion is classically conducted by either open thoracotomy or subxiphoid pericardiectomy (2). Recently, video-assisted thoracoscopic (VATS) pericardiectomy has gained popularity as a minimally invasive approach (2). However, there have been few reports to date describing this method (2, 3) and the therapeutic value of VATS pericardiectomy remains poorly assessed. This report describes the successful application of VATS pericardiectomy for 11 patients with malignant pericardial effusion.

Correspondence to: Hidetaka Uramoto, Second Department of Surgery, School of Medicine, University of Occupational and Environmental Health, 1-1 Iseigaoka, Yahatanishi-ku, Kitakyushu 807-8555, Japan. Tel: +81 936917442, Fax: +81 936924004, e-mail: hidetaka@med.uoeh-u.ac.jp

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Patients and Methods

Patients and their characteristics. The treatment of clinically diagnosed malignant pericardial effusion, performed between August 2000 to February 2010 at the Second Department of Surgery at University of Occupational and Environmental Health, Kitakyushu, Japan, was investigated retrospectively. A computed tomography (CT) scan was performed to evaluate the pleural state and to determine the predominant localisation of the pericardial effusion and concomitant findings of the pleura for planning the side of intervention. The present technique was applied in eleven patients (five male and six female patients, mean age, 62.0 years). The cancer types included five lung carcinomas, two malignant lymphomas, and one malignant mediastinal tumour (interdigitating cell sarcoma), one malignant mesothelioma, one mediastinal lymph node metastasis (unknown primary origin) and one thymoma in each of the remaining four patients. The most frequent symptoms were dyspnoea on effort and general fatigue.

Methods. Each patient was placed in the right semi-lateral position and underwent VATS pericardiectomy under general anaesthesia using double-lumen endotracheal intubation tube for thoracoscopic accessibility. A thoracoscope was introduced through the seventh intercostal space (ICS) in the posterior axillary line for exploration of the pleural cavity. The operating table was tilted down to the semi-dorsal position to unnecessary handling displace the lung. Two additional trocar sites were placed in the sixth ICS along the anterior

Table I. *Operative data*.

Case	Length[a] (cm)	Area[b] (cm^2)	Time[c] (minutes)	Bleeding (ml)	Drainage duration (days)	Local chemotherapy
1	3.5×3, 3×2.5	17.5	85	Little[d]	10	+
2	8×1	8	120	30	5	+
3	6×4, 3×2	30	85	Little	4	+
4	4×3, 3×2	18	180	Little	7	+
5	3×3	9	40	Little	2	-
6	10×2.5	25	113	Little	9	-
7	4×3	12	120	Little	30	-
8	7×1	7	115	Little	7	-
9	6×5, 3×2	36	110	Little	4	-
10	5×1	5	75	Little	21	+
11	5×2.5	12.5	120	Little	3	-

[a]Length of the pericardial window; [b]total area of resection; [c]operative time; [d]bleeding <1 ml.

and posterior axillary line. These sites were used for grasping instruments and endoscopic scissors. The phrenic nerve was identified and the pericardium was resected anterior to the nerve with endoscopic scissors and a coagulation instrument. The pericardium was then grasped with endoscopic forceps and incised with curved endoscopic scissors. A large pericardial window was created with careful protection of the phrenic nerve. A right-sided approach was selected because severe adhesion in the left thoracic cavity was anticipated due to previous open thoracotomies or infection. An additional resection was performed either anterior or posterior to the phrenic nerve when the total area resected by pericardiectomy was insufficient. A chest drain was inserted into the cavity through one of the port sites, with no attempt to drain the pericardium. The patients were extubated and transferred to the recovery room for observation for a few hours. The patients were followed-up every month within the first post-operative year and at approximately 2- to 4month intervals thereafter. The evaluations included a physical examination, a chest X-ray, an analysis of blood chemistry and measurement of tumour markers. Additional examinations were performed if any symptoms or signs of recurrence were detected.

Results

Clinical experience. VATS pericardiectomy provided an excellent view of both pleural cavity and pericardium and precise selection of biopsy sites. Neither haemodynamic instability nor arrhythmia occurred. The mean total resected area was 16.4 cm^2 and the mean operative time was 106 minutes with minimal bleeding. No intra-operative and post-operative complications were observed in this series. Ten surgical procedures were performed on the left and one on the right side. Injection into thoracic space by anti-cancer drug to control the locoregional recurrence was administered in five cases. The average chest tube drainage time was seven days (Table I). The mean decrease in weight after treatment was 3.4 kg. The performance status and Hugh-Jones classification improved in nine and eight out of the eleven cases examined, respectively (Table II). Additional treatment, such as chemotherapy or radiation, was performed in seven cases. There was no re-accumulation of pericardial effusion at an average follow-up period of 13.7 months. The mean duration of maintenance of a good quality of life was 9.3 months.

Discussion

The increasing number of cancer patients is a result of the continual aging of the population. Therefore, more patients require treatment for malignant pericardial effusion. (1). However, no gold standard therapy in this subset of patients has yet been determined (Table III). Classical pericardial drainage is performed with local anaesthesia, but it is rarely effective. Therefore, percutaneous balloon pericardiectomy is preferable because of its high rate of effectiveness (4). However, both methods have a risk of inducing treatment-related complications, even when performed under echo-cardiography. Furthermore, there is a risk of infection and discomfort due to the catheter tube. In contrast, the surgical approach provides a more effective treatment. Pericardiectomy by open thoracotomy requires general anaesthesia and it often causes severe pain, pulmonary complications and longer postoperative hospitalisation (5). The subxiphoid approach is effective and reliable (6). However, the extent of a pericardial resection is limited because of restricted access. The above methods all have advantages and disadvantages and the optimal drainage procedure therefore still remains controversial (2, 3).

VATS procedures are superior to thoracotomy and median sternotomy, with less post-operative pain, better cosmetic result, and a shorter hospital stay (7). The average amount of pericardial resection is only 9 cm^2 with a subxiphoid approach (8). Indeed, the incidence of re-accumulation may be lower for thoracoscopy because a larger window of pericardium can be excised through thoracoscopy than through the subxiphoid route (8). The mean total area of the

Table II. *Physical change after surgery and patient outcome.*

Case	Loss of weight (kg)	PS[a]	H-J[b]	Therapy[c]	Duration of maintenance of good QOL (months)	Follow-up (months)	Status
1	5	3→1	V→II	CTx	3.0	3.3	Dead
2	2	3→1	IV→IV	CTx	1.5	2.0	Dead
3	5	1→1	II→I	RTx and CTx	2.0	3.0	Dead
4	4	3→2	V→III	n.p	2.0	4.0	Dead
5	3	3→2	IV→III	n.p	2.o	2.0	Alive
6	4	2→1	II→I	CTx	57.0	57.0	Alive
7	0	2→1	II→I	CTx	10.0	60.0	Alive
8	1.4	1→1	I→I	n.p	6.0	6.3	Dead
9	10	2→0	IV→II	RTx and CTx	5.0	6.0	Dead
10	0	3→2	IV→IV	CTx	0.5	0.7	Dead
11	3	3→1	IV→III	n.p	6.0	6.0	Alive

PS: Performance status; HJ: Hugh Jones classification; [a]the change of performance status between before and after the operation; [b]the change of Hugh–Jones classification; [c]treatment after the pericardial window; CTx: chemotherapy; RTx: radiotherapy; n.p: not performed; QOL: quality of life.

Table III. *Comparative methods of treatment for malignant pericardial effusion.*

Method	Certainty	Invasiveness	Visualization	Pain	Performance restriction after treatment
Pericardial drainage	Low	Low	-	Less	Consist
Percutaneous balloon pericardiotomy	Low	Low	-	Less	Consist
Pericardiotomy by thoracotomy	High	High	Good	Much	Free
Subxiphoid pericardiotomy	High	Moderate	Bad	Less	Free
VATS pericardiectomy	High	Moderate	Good	Less	Free

current approach was 16.4 cm^2, thus suggesting unimpeded drainage with medium- to long-term effects (3). Therefore, the current technique is also credible and has very little risk in this situation, and will be likely conducted more frequently as the technology progresses. However, O'Brien *et al.* reported a prospective randomised comparative study showing that both the operative time and minor procedural morbidity were higher for the VATS procedures than for the subxiphoid drainage, although the long-term control of effusion seemed to be better after the VATS procedure than after subxiphoid drainage (3). As a result, that study concluded that subxiphoid drainage should be the preferred approach if a patient's life expectancy is likely to be extremely limited due to major co-morbidities because it is simpler and faster. However, patients without extensive metastasis should be considered for the VATS procedure. In fact, VATS is contraindicated for patients with an altered respiratory function on one-lung ventilation (3). Subxiphoid drainage with local anaesthesia therefore remains the method of choice under these circumstances.

Pericarditis carcinomatosa with cardiac tamponade is confronted in an aggressive terminal stage, but it is still a treatable condition requiring a true therapeutic intervention instead of a mere palliative approach. It is, therefore, crucial to release the circulatory failure in a minimally invasive manner. Moreover, considering the quality of the patient's limited remaining life span, hospitalisation should be minimised (1). The limitations of this study include its retrospective design, the small sample size and the heterogeneity of the patient population. However, the results support the usefulness of VATS pericardiectomy in the treatment of patients presenting malignant pericardial effusion, since this technique is satisfactorily effective and does not cause any complications.

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