Video Thoracoscopic Management of Benign and Malignant Pericardial Effusions*

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Surgical management of symptomatic benign and malignant effusive pericarditis is often required. Twenty-two patients with medically recalcitrant effusive, nonconstrictive pericarditis underwent pericardial resection by a video-assisted thoracoscopic surgical (VATS) technique (9 malignant, 13 benign). Pericardiectomy, resulting in complete drainage of the pericardial space and control of patient symptoms was accomplished routinely. Ipsilateral pleural effusions, originally present in 11 patients, were also managed. The VATS pericardiectomy was well tolerated even by gravely ill patients. This approach should be considered as an alternative to lateral thoracotomy or subxiphoid pericardial window for the surgical management of patients with symptomatic benign and malignant pericardial effusions.

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Pericardial effusions, which present in various clinical settings (Table I), often present difficult management problems. This is particularly true for the patient with a known malignant disease in whom life expectancy is limited. Management goals center on identifying patients who require treatment, and then providing lasting relief from the pericardial effusive process and related symptoms with measures that produce the least morbidity. Surgical management of medically recalcitrant pericardial effusions may often be required. Commonly used operative approaches include the subxiphoid pericardial window and, alternatively, pericardiectomy through an anterolateral thoracotomy or median sternotomy. All these approaches have specific shortcomings. Although the subxiphoid pericardial window is championed by some surgeons because of the relatively minor operative insult related to the procedure, others criticize its routine use because it is associated with high pericardial effusion recurrence rates. The more extensive operative incisions of thoracotomy and sternotomy, with their consequent increased perioperative morbidity, complicate the use of these approaches. Herein we introduce video-assisted thoracoscopic surgical (VATS) pericardiectomy as a means of performing an extensive pericardial resection that is equivalent to open thoracotomy approaches, but that has the additional merit of operative morbidity comparable with the subxiphoid pericardial window technique.

Patients and Methods

We have used the VATS approach to manage 22 patients with

Table 1—Pericardial Effusion in Cancer and Other Patients: Etiology

<table>
<thead>
<tr>
<th>Etiology</th>
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<tbody>
<tr>
<td>• Idiopathic</td>
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<tr>
<td>• Infectious</td>
</tr>
<tr>
<td>• Cardiomyopathy/congestive heart failure (primary or postchemo-therapy)</td>
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<td>• Uremic</td>
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<tr>
<td>• Postirradiation therapy (20% to 30% of patients following medias-\tinal irradiation)</td>
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<td>• Malignant infiltration (30% to 50%)</td>
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effusive pericarditis. All patients presented with recurrent symptoms pericardial effusions. Thirteen patients presented with inflammatory pericarditis, and 9 patients had pericardial effusions due to malignant disease. Figure 1 shows a computed tomography scan from a representative patient. The primary symptom was shortness of breath (19 patients), although a significant number of patients (eight) also complained of chest pain. Fourteen patients were referred to us for surgical pericardiectomy after medical treatment had failed to control their symptomatic pericardial effusions. These same 14 had also undergone therapeutic pericardiocentesis to relieve symptoms of cardiac tamponade prior to referral; all had experienced recurrence of the effusions, however. The etiologies of the pericardial effusions in this series are summarized in Table 2.

The VATS procedure requires general anesthesia with double-lumen endotracheal intubation to allow for ipsilateral pulmonary collapse. Hemodynamic (arterial and central venous pressure) monitoring is used routinely. If clinical signs of tamponade are present, preoperative pericardiocentesis should be performed—as it was in the 14 patients who had failed therapeutic pericardiocentesis—to avoid hemodynamic problems during induction of anesthesia. The patient is placed in the right lateral position, and the chest is prepared widely to permit conversion to open thoracotomy if necessary. Mechanical ventilation to the ipsilateral lung is

FIGURE 1. Computed tomography scan of chest of patient with significant pericardial effusion and bilateral pleural effusions.
discontinued. Near-complete atelectasis occurs once the initial pneumothorax is induced. We insert a 10-mm trocar (Auto Suture Surgiports, United States Surgical Corporation, Norwalk, Conn) through the 7th intercostal space to create intrathoracic access for the thoracoscope and camera (Karl Storz Endoscopy-America, Inc, Olympus OTV-S2, Olympus Corporation, Lake Success, NY). Exploratory video thoracoscopy is performed initially to identify (and biopsy) any associated pulmonary, pleural, or mediastinal pathologic condition. Appropriate sites are then selected for further trocar placement.

A VATS pericardiectomy usually requires 3 intercostal access sites to accommodate for the video camera and endoscopic instruments. Additional incisional sites are most commonly positioned in the 6th intercostal space along the anterior and posterior axillary lines (Fig 2). One port is used to introduce grasping instruments to hold or retract the pericardium. Endoscopic scissors are directed through the other port to incise the pericardium. Occasionally, another access site at the 4th intercostal space is used to introduce a retracting instrument to displace the lung.

Constant positive pressure of up to 8 cm H2O can be employed by carbon dioxide insufflation throughout the VATS procedure to induce and maintain total atelectasis of the left lung. This facilitates exposure and visualization of the pericardium, although it is not required or used routinely. Endoscopic electrocautery and endoscopic scissors (Endoscopes, US Surgical Corp, Norwalk, Conn) are used to divide and excise the pericardium after it has been tented away from the myocardium with a single-pronged skin hook introduced through an additional 3-mm incision at the 5th intercostal space along the anterior axillary line (Fig 3 A and B). Sterile cardiac defibrillator paddles and a defibrillation unit are always made available in the operating room to protect against an inadvertent sustained cardiac arrhythmia. The phrenic nerve is identified and preserved intact (Fig 3C). During the course of the superior and lateral extent of the pericardial resection, close attention is paid to avoid injury to the left atrial appendage. Eight- to 10-cm² swaths of pericardium are excised routinely anterior and posterior to the phrenic nerve; the specimens are removed through one of the trocar sites. After completion of the pericardial excision, chest tubes are inserted into the chest through the trocar sites under direct thoroscopic vision. One tube is placed between the lingula and the pericardium in proximity to the area of pericardial resection. If a significant associated pleural effusion is found (as it was in 11 patients), a second chest tube may be used to assist drainage of the ipsilateral pleural space (Fig 4). Chemical pleurodesis can be induced with a variety of agents to facilitate pleural symphysis when indicated.10,12 The remaining intercostal access sites are closed with absorbable suture.

RESULTS

A pericardial resection equivalent to that achieved using anterolateral thoracotomy was accomplished in these patients. Postoperative control of effusion-related symptoms was achieved in all patients. No recurrence of pericardial effusion has been seen. Despite the illness and disability of many of these patients, no significant morbidity was associated with the procedure. Single-lung anesthesia was well tolerated by all patients.

The 13 patients with benign chronic inflammatory disease remain alive and well without recurrence of pericardial effusion at an average of 7.5 months after surgery (range, 1 to 15 months).

Five of the 9 patients with malignant pericardial effusions are also alive (Table 2). All 3 patients with pericardial involvement from primary lung cancer died 3 weeks to 3 months after surgery. The patient with an extensive, poorly controlled lymphoma died of primary disease progression 2 weeks after surgery. The 5 patients alive to date continue to be free of recurrent symptoms 1 to 5 months following surgery.

Chest tubes were removed when the drainage output was less than 150 ml/24 h. Mean duration of chest tube drainage in all patients was 2 days (range, 1 to 6 days). Mean length of hospital stay was 4 days (range, 3 to 9 days) in patients with benign pericardial disease. Patients with malignant effusions remained hospitalized for 7 days to 4 weeks after surgical recovery to undergo further diagnostic testing and receive additional antitumor therapy.

DISCUSSION

Proper decision-making in the management of pericardial effusive processes requires a careful diagnostic workup to

| Table 2—Etiologies of Pericardial Effusions Managed by Thorascopic Pericardiectomy |
|---------------------------------|-----|
| **Benign Disease (n = 13)**     |     |
| Chronic idiopathic pericarditis | 9   |
| Acute fibrinous pericarditis    | 1   |
| Postcardiomy                     | 1   |
| Uremic                          | 2   |
| **Malignant disease (n = 9)**   |     |
| Lung cancer (adenocarcinoma)    | 3   |
| Breast cancer                   | 2   |
| Lymphoma                       | 1   |
| Cervical cancer                 | 1   |

**Lung**

**Postcardiomy**

**Thoracoscopic**

**Pericardiectomy**

**Scissors**

**Camera**

**Figure 2. Typical sites of trocar placement for thorascopic pericardiectomy.**
ensure that a patient's symptoms are indeed related to the effusion (Table 3). Clinical decisions regarding the use of primary nonoperative management or surgery will be based on the results of previous treatment and the potential for future control of the primary disease process. Functional status and tumor histologic findings are also important considerations when the cancer patient with symptomatic pericardial effusion is being treated (Table 4).

Improvements in video endoscopic equipment and endoscopic surgical instrumentation have expanded the role of thoracoscopy from a limited diagnostic modality to an important, minimally invasive approach to many intrathoracic problems. Over the past year, we have used the VATS approach in over 450 patients for a variety of applications, including lung resection, dorsal sympathectomy, and management of mediastinal, spinal, and esophageal diseases. The facility with which we can perform these procedures has greatly increased with experience, which in turn has facilitated our use of the VATS technique for pericardiectomy.

Although others have reported the use of pericardioscopy and thoracoscopic pericardial fenestration with drainage of the pericardium, the efficacy of these techniques remains to be clarified. The VATS approach appears to be an ideal, minimally invasive surgical technique that provides excellent visualization of the pericardium, often superior to that achieved through open thoracotomy. This technique also facilitates a pericardial resection equivalent to that of most open thoracotomy approaches.

**Table 3—Pericardial Effusion: Diagnostic Evaluation**

- History/physical examination
  - Dyspnea, hypoperfusion/hypotension, distended neck veins, distant heart sounds, paradoxical pulse
- Standard chest roentgenogram
  - Enlarged cardiac silhouette
- Electrocardiogram
  - Electrical alternans
- Echocardiography (M-mode and 2-D) “Gold” standard for diagnosis
- Computed tomography of chest
  - Possibly identify pericardial mass lesion
- Right heart catheterization
  - Elevated right-sided pressures/possible pressure plateau of pericardial constriction

**Table 4—Malignant Pericardial Effusion: Treatment Options**

- Best supportive care
- Repeated pericardiocentesis
- Pericardiocentesis and drainage ± sclerosis
- External-beam radiotherapy
  - If radiosensitive tumor
- Direct systemic chemotherapy
  - If chemosensitive tumor
- Surgical drainage/pericardiectomy
  - Subxiphoid window, transthoracic window/pericardiectomy by lateral thoracotomy, median sternotomy, or thoracoscopy
Until this reported experience with VATS pericardiectomy, we had preferred a limited left anterolateral thoracotomy to perform pericardiectomy for effusive pericarditis. We had reserved subxiphoid pericardial drainage for patients with cardiac tamponade and significant general functional impairment, in whom thoracotomy posed too great a risk. Although our experience is limited, we are encouraged with the efficacy of VATS pericardiectomy as an alternative for surgical management of effusive pericardial disease.

Nonetheless, VATS pericardiectomy should be performed with great caution in patients with thick-walled pericardial processes with minimal effusions and/or significant pericardial-to-epicardial adhesions. The surgeon should always be prepared for immediate conversion from this thorascoscopic approach to an open thoracotomy when necessary to avoid potential myocardial injury. The patient with constrictive pericarditis is still best approached through a left lateral thoracotomy or median sternotomy with preparation for cardiopulmonary bypass standby.**

In conclusion, VATS pericardiectomy may become a preferred surgical technique for controlling many cases of effusive pericarditis. The patient with malignant pericardial effusion may particularly benefit from this minimally invasive approach, which can effect a significant pericardial resection without the associated morbidity of thoracotomy.

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