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The pericardial window: is a video-assisted thoracoscopy approach better than a surgical approach?*

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Abstract

**Objectives:** The approach to the pericardial window in patients with pericardial effusion (PE) remains undefined as to whether a surgical (transthoracic or subxiphoid) or a thoracoscopic pericardial window is the optimal operative approach to PE. We hypothesized that the window into the pleural space created by the thoracoscopy might improve the outcome. **Methods:** We conducted a prospective study between September 2007 and October 2009. All patients with PE diagnosed by echocardiography who attended the Cardiothoracic Department in King Fahd Hospital were included in this study. They were 30 patients (18 males, 12 females aged 44±1.22 years). Patients were subdivided into two groups. Group A, 15 patients underwent the surgical (transthoracic or subxiphoid) procedure and Group B, 15 patients underwent the video-assisted thorascopic procedure. Preoperative, intraoperative and postoperative variables, morbidity, recurrence, and survival were compared in both groups. **Results:** Preoperative variables were well-matched for age, sex, preoperative tamponade, echocardiographical characteristics and co-morbidities between both groups. No recurrence of effusion was observed in the two groups. Operative time was statistically highly significant (P<0.001); it was longer in Group B. There was no intraoperative complication in both groups. There was no postoperative complication in both groups except one case of superficial wound infection in Group A. There was no significance difference between both groups as regard duration of chest tube drainage and length of hospital stay. There was no in-hospital mortality in both groups. **Conclusions:** Pericardial window by video-assisted thoracoscopy is an effective technique for pericardial drainage and biopsy. Apart from its diagnostic value, it allows the physician to fashion a pleuropericardial window for effective drainage while avoiding the complications of classic surgical procedures.

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Keywords: Pericardial window; Thoracoscopy

1. Introduction

Pericardial effusion (PE) complicates many disease processes, both benign and malignant. A variety of treatments are available, ranging from observation, to anti-inflammatory or anti-neoplastic chemotherapy to pericardiocentesis with or without percutaneous catheter drainage, and finally to surgical procedures. There are two surgical options most commonly used today: (1) the surgical (transthoracic or subxiphoid) pericardial window and (2) the video-thoracoscopic pericardial window. We are unaware of any available data to guide the choice between these approaches.

The subxiphoid pericardial window, generally performed by placing a large-bore tube from an upper abdominal incision through the site of a pericardial biopsy [1]. Symphysis between the epicardium and pericardium develops after several days of drainage [2]. Because it is done in the supine position, access is readily available to perform pericardiocentesis if instability occurs after induction.

A pericardial window is a larger biopsy or partial pericardectomy that creates a passage presumably allowing longer-term drainage into an adjacent space, usually the pleural space. Pericardial resection creating such a window can be performed through a limited anterior thoracotomy, formal thoracotomy [3], or since the 1990s, by thoracoscopy [4–8]. The subxiphoid drainage procedure is often erroneously referred to as a window, when in fact no such connection to an adjoining space is made during standard subxiphoid drainage. Thoracotomy is more often followed by pulmonary complications and involves a longer postoperative hospitalization [9].

A thoracoscopic pericardial window does create a true window, but it requires one-lung ventilation and two or three intercostal incisions. The thoracoscopic access allows concurrent performance of additional procedures, such as biopsy of the lung, pleural, or mediastinal masses, or management of a concomitant pleural effusion [4–8]. However, the need for single-lung ventilation and the preference by some surgeons for lateral positioning, which impedes easy access for an emergent drainage, may limit the role of a thoracoscopic pericardial window in patients with hemodynamically significant effusions [5, 6, 8].

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Although a thoracoscopic pericardial window is minimally invasive when compared with thoracotomy, it may in fact be more invasive than a subxiphoid pericardial window. Video-assisted thoracoscopy combines the advantages of a subxiphoid pericardiectomy and a transthoracic pericardial window. It is minimally invasive and permits exploration of the thoracic cavity; drainage is achieved by the creation of a pleuropericardial window [10].

The choice among the surgical approaches to the management of PE must be based mainly on (1) the effectiveness of the procedure in preventing recurrent effusion, and (2) the morbidity and mortality of the procedure. Other considerations include the relative simplicity of the technique and cost. Published recurrence rates have ranged from 2.5% to 16% after a subxiphoid pericardial window [1, 2, 11–21] and 0%–8% after a thoracoscopic pericardial window [4–8, 22, 23]. However, duration and intensity of follow-up, as well as definitions of recurrence have been variable.

We reviewed our experience with surgical (transthoracic or subxiphoid) pericardial window and the thorascoscopic pericardial window, comparing preoperative and intraoperative variables, morbidity, and recurrence. Our goal was to provide data that might guide the choice between the two approaches.

2. Patients and methods

We conducted a prospective study between September 2007 and October 2009. All patients with PE diagnosed by echocardiography who attended the Cardiothoracic Department in King Fahad Hospital are included in this study. They were 30 patients (18 males, 12 females; aged 44 ± 1.22 years). Patients were subdivided into two groups. Group A 15 patients underwent the surgical (transthoracic or subxiphoid) procedure and Group B 15 patients underwent the video-assisted thoracoscopy procedure.

In Group A, seven patients had malignant PE, four patients had PE due to renal failure and four patients had idiopathic PE. In Group B, 10 patients had malignant PE, two patients had PE due to renal failure and three patients had idiopathic PE. Preoperative, intraoperative and postoperative variables, morbidity, recurrence, and survival are compared in both groups.

Echocardiographical data prior to surgical drainage were reviewed for effusion size and the presence of tamponade physiology as indicated by right atrial compression or right ventricular diastolic collapse, or both [24]. The effusion was diffuse in all patients except one patient which was localized posteriorly.

A computed tomography (CT)-scan was performed to identify additional pleural pathology and to determine the predominant localization of the loculated PE and concomitant findings at the pleura.

All data were recorded and outcomes associated with both groups were compared with each other. The primary outcome was postsurgical recurrence of PE. Recurrence was defined as an effusion on postoperative echocardiography that was either moderate or greater, or hemodynamically significant, requiring a second procedure, causing symptoms, or causing death. Secondary outcomes included operative time, intraoperative and postoperative complications, intraoperative technical complications, intraoperative or postoperative bleeding, drainage tube-related complications (e.g. pneumothorax), intraoperative mortality, in-hospital mortality, and hospital lengths of stay which was calculated from the day of the surgical procedure until discharge or in-hospital death. And wound infections or wound healing problems. Operative time was defined as the time from induction of anesthesia until the time the patient left the operating room. Follow-up for three months was done for all our patients after discharge from the hospital.

Two of our patients were hemodynamically compromised and had undergone pericardiocentesis preoperatively.

2.1. Operative techniques

All patients were hemodynamically stable when brought to the operating room, although many had tachycardia or mild pulsus paradoxus, or both. Preoperative percutaneous drainage by the cardiology service had been performed for two of our patients for a hemodynamically significant effusion to urgently stabilize the patients. General anesthesia was used in all cases. Anesthesia time was calculated as time from induction until extubation. A single prophylactic dose of antibiotic was given at the beginning of surgery.

2.1.1. Transthoracic pericardial window

The operative exposure is achieved by a small anterior thoracotomy in the fourth or fifth intercostal space. An inframammary skin incision (6–8 cm long) allows division of the pectoralis muscle to expose the chosen intercostal space. The intercostal space is opened over the superior margin of the rib entering the pleural cavity. A retractor is placed, and samples of pleural effusion are obtained. The adjacent lung is palpated and a biopsy is easily performed, if indicated.

The pericardium is visualized, and careful attention is paid to the phrenic nerve. The pericardiostomy is usually bulging and can be incised anterior to the phrenic nerve with a scalpel or scissors. A generous window (2 × 3 cm) is created, and the pericardium is sent for pathological inspection. A single thoracostomy tube (28 or 32 FF) is placed in pleural cavity and connected to underwater seal drainage; the incision is closed in layers.

2.1.2. Subxiphoid pericardial window

A short incision (about 5 cm long) is made over the xyphoid extending into the midline of the abdomen. The linea is incised, and the xyphoid was incised or may be completely removed. The retrosternal space is entered by finger dissection. With upward retraction, the diaphragmatic aspect of the pericardium is visualized. The pericardium can be grasped with the hook or a pointed long-clamp or can be incised directly. The opening in the pericardium is enlarged by finger dissection, and a protected sucker is inserted into the pericardial space and fluid aspirated. A biopsy specimen is also taken from the pericardium. After all the fluid has been aspirated, the epicardium is inspected. A finger is introduced into the pericardial space to determine if there are any adhesions and if there are any nodules in the pericardium. Finally, through a separate stab
wound, a single thoracostomy tube (28 or 32 FF) is inserted into the pericardial space and connected to underwater seal drainage; the incision is closed in layers.

2.1.3. Video-assisted thoracoscopic pericardial window

The procedure was performed in the lateral decubitus position under general anesthesia and double-lumen intubation. Trocars for the passage of the endoscopic camera and the various surgical instruments were introduced through two or three thoracic incisions of <10 mm at the level of the fourth and sixth intercostal spaces.

The pleural cavity and lung were examined first, and any pleural effusion was evacuated and sent for cytology. Pericardiocentesis was then performed under direct vision, and the fluid was collected for cytological and microbiological analysis. After the phrenic nerve was identified, a stab-incision was usually created on the surface of the distended pericardium using electrocautery. The pericardium was then grasped with endoscopic forceps and incised with curved endoscopic scissors. Loculations and septa were broken down, and the heart was circumferentially freed with a thoracoscopic suction device. A large pericardial window was created with careful protection of the phrenic nerve (Fig. 1). A pericardial specimen was sent for histological and microbiological analysis. A single chest tube was placed into the operative pleural space, through one of the port sites with no attempt to drain the pericardium.

All of the patient were extubated and transferred to the recovery room for a few hours’ observation, and then returned to the ward on the same day. The chest tube was removed when the amount of daily drainage was <100 ml. Postoperative analgesia was provided in all cases.

2.2. Statistical methods

The data associated with the surgical (transthoracic or subxiphoid) pericardial window approach and those associated with the video-assisted thoracoscopy pericardial window approach were calculated and compared (mean ± S.D.) in different situation by using paired t-test. Differences were significant at P<0.05. All analysis was performed with the SPSS V 13 (SPSS Inc, Chicago, IL, USA) for Windows 2003 software.

3. Results

Preoperative variables were well-matched for age, sex, preoperative tamponade, echocardiographical characteristics and co-morbidities between the two groups.

As regard primary outcome, in spite of the sample size is insufficient to draw any conclusion but no recurrence of effusion was observed in both groups.

Secondary outcomes are summarized in Table 1. Operative time was statistically highly significant (P<0.001). It was longer for Group B (111.3±30.7 min) vs. Group A (75.2±25.4 min).

There was no intraoperative complications in both groups and there was no postoperative complications in both groups except one case of superficial wound infection which occurred in a patient with a subxiphoid pericardial window.

Fig. 1. Video-assisted thoracoscopic pericardial window performed on the left side: (a) the phrenic nerve is visualized and pericardiocentesis is performed under direct vision, (b) the pericardium is grasped with a Duval forceps and incised with Metzenbaum scissors, (c) fibrinous septa and loculations are broken under direct vision and the heart is freed by use of a thoracoscopic Senning suction, (d) a pericardial window is created.
Table 1. Comparison of intraoperative and postoperative results

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Surgical</td>
<td>Video-thoracoscopy</td>
<td></td>
</tr>
<tr>
<td>Operative time (min)</td>
<td>75.2 ± 25.4</td>
<td>111.3 ± 30.7</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Intrao. complications</td>
<td>0</td>
<td>0</td>
<td></td>
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<tr>
<td>Postop. complications</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Cardiac</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Respiratory</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Wound infection</td>
<td>1</td>
<td>0</td>
<td></td>
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<tr>
<td>Recurrence of PE</td>
<td>0</td>
<td>0</td>
<td></td>
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<tr>
<td>In-hospital mortality</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Hospital lengths of stay (days)</td>
<td>12.3 ± 22.6</td>
<td>10.2 ± 12.1</td>
<td>0.63</td>
</tr>
<tr>
<td>Duration of chest tube (days)</td>
<td>4.1 ± 1.4</td>
<td>3.4 ± 1.5</td>
<td>0.12</td>
</tr>
</tbody>
</table>

P < 0.001: highly significant. Intraop, intraoperative; Postop, postoperative; PE, pericardial effusion.

Duration of chest tube drainage was insignificant in both groups (P = 0.12). In surgical group were 4.1 ± 1.4 days and in video-assisted thoracoscopic group were 3.4 ± 1.5 days.

Length of hospital stay was insignificant in both groups (P = 0.63). In surgical group were 12.3 ± 22.6 days and in video-assisted thoracoscopic group were 10.2 ± 12.1 days.

There was no in-hospital mortality in both groups.

At the three-month follow-up, there was no recurrence of the effusion, radiographically or echocardiographically.

4. Discussion

Symptomatic PEs are common and may result from a variety of causes. When medical treatment has failed to control the effusion or a diagnosis is needed, surgical intervention is required.

Various approaches have been described for the diagnostic and therapeutic assessment of pericardial disease, including pericardiocentesis, percutaneous catheter drainage and balloon pericardiotomy, subxiphoid pericardial drainage, pericardioperitoneal shunt, subxiphoid pericardial fenestration, and pericardial window through anterior thoracotomy/thoracoscopy [10].

Pericardiocentesis is associated with high rates of early recurrence and, therefore, has been abandoned by most because it is not considered a definitive treatment for PEs [25].

When an operation is required for the management of PE, there are two main options in recent years that have been considered reasonable: (1) a surgical (transthoracic or subxiphoid) and (2) a video-assisted thoracoscopic pericardial window. If it could be shown that there was a clear difference in morbidity, mortality, diagnostic accuracy, recurrence of effusion, or cost between these approaches, then this information would be useful to surgeons who are trying to decide between the two options. Therefore, we reviewed our experience with the two procedures to compare them with respect to these outcomes.

In this series, patients who underwent a surgical (transthoracic or subxiphoid) pericardial window and those who underwent a video-assisted thoracoscopic pericardial window had effusions that were similar in terms of the percentage that were (1) moderate or greater in size and (2) associated with echocardiographic abnormalities suggesting tamponade physiology. General anesthesia was well-tolerated in both groups. Also, single-lung ventilation was well-tolerated in the video-assisted thoracoscopy group. In our practice and in many series [24], patients who are clinically unstable from tamponade are often temporized with percutaneous, echocardiographic-guided drainage prior to any surgical procedure to avoid instability associated with the induction of general anesthesia. In clinically stable patients, our data suggest that effusion size and presence of mild tamponade on echocardiography do not prohibit surgical or video-assisted thoracoscopic approach.

The video-assisted thoracoscopic pericardial window technically and therapeutically had many advantages: it was less traumatic than anterior thoracotomy, and a more extensive pericardial resection was possible compared with the subxiphoid route [10]. Furthermore, better visualization was afforded than with the subxiphoid approach. Loculated effusions, even those located posteriorly that cannot normally be reached without open thoracotomy, were easily drained and looked better cosmetically than anterior thoracotomy.

Our series showed no recurrence of the effusion, radiographically or echocardiographically, at the three-month follow-up. Indeed, the incidence of recurrence may be lower for thoracoscopic and anterior thoracotomy because a larger window of pericardium can be excised than through the subxiphoid route. Piehler and associates [3] suggested a direct relationship between the extent of pericardium resected and the incidence of recurrence or development of constriction. They, therefore, advocated complete pericardiectomy instead of the subxiphoid resection. Using video-assisted thoracoscopic, we could also avoid the subxiphoid (adhesion) route in patients with delayed tamponade after heart surgery.

Operative time was dramatically longer in the thoracoscopic group, a finding that we had anticipated given the added time necessary for (1) placement of a double-lumen endotracheal tube, (2) lateral decubitus positioning, and (3) concomitant thoracoscopic procedures. Mean operative times have ranged from 27 to 57 min in previous series [7, 21] that presumably measured ‘skin-to-skin’ time. We elected to measure anesthesia time to reflect the total time invested by the care team and as the best reflection of operating room costs.

There was no intraoperative or postoperative complication in both groups except one case of superficial wound infection which occurred in patient with subxiphoid pericardial window.

Several series of subxiphoid drainage report complication rates of <4% [15, 18], but higher rates have been reported [16, 17]. Most series of video-assisted thoracoscopic drainage report no complications [4–6, 8]. In our study, there was no in-hospital mortality in both groups.

It should be noted that video-assisted thoracoscopic is contraindicated for patients with tamponade or altered respiratory function in which one-lung ventilation or the lateral operative position is necessary [10]. In these circumstances, subxiphoid drainage remains the method of choice in patients with hemodynamic compensation.

To summarize this study, the surgical (transthoracic or subxiphoid) and video-assisted thoracoscopic approach were both reasonably effective in controlling PEs. The thoracoscopic procedure was associated with a longer operative
time. The subxiphoid procedure can be performed with local anesthesia. Anterior thoracotomy or video-assisted thoracoscopic surgery were more likely to be used when concomitant intrapericardial procedures were required.

In conclusion, although video-assisted thoracoscopy with the creation of a pericardial window requires general anesthesia and single-lung ventilation, it is a safe, minimally-invasive technique that allows for effective pericardial drainage, especially for loculated effusions, accurate biopsies, and effusions with concomitant pleural disease, while avoiding the complications of classic surgical procedures. We suggest that it should be used in carefully selected patients with proper indications. Subxiphoid pericardial window should be the preferred approach in the surgical management of PE if a patient’s life expectancy is likely to be extremely limited due to major co-morbidities or extensive metastatic disease or in patients with hemodynamic compensation because it is simpler and faster.

References