SUBXIPHOID PERICARDIAL DRAINAGE FOR PERICARDIAL TAMPONADE

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As a result of recent reports and enthusiasm for video-assisted thorascopic pericardiectomy, we reviewed our experience with subxiphoid pericardial drainage. From August 15, 1988, to June 7, 1993, 155 patients underwent subxiphoid pericardial drainage for pericardial effusion associated with pericardial tamponade. The group comprised 85 female (55%) and 70 male patients whose ages ranged from 5 weeks to 88 years. The procedure was carried out with general anesthesia in 113 patients (72%) and with local anesthesia and sedation in 42 patients. Underlying cancer was present in 82 patients; 73 patients had benign disease. Follow-up is complete in all patients. The overall 30-day mortality was 20%; in patients with cancer it was 32.9% (27/82) versus 5.4% (4/73) for patients with benign disease. No postoperative death was attributed to the surgical procedure. Recurrent pericardial tamponade necessitating further surgical intervention occurred in four patients (2.5%), two with cancer (2.4%) and two with benign disease (2.7%). Median survival after subxiphoid pericardial drainage in patients with benign disease was more than 800 days versus 83 days in patients with cancer ($p < 0.01$). Median survival after pericardial drainage in patients with cancer who had malignant pericardial effusion was 56 days compared with 105 days for patients with cancer who did not have tumor in the pericardium ($p < 0.05$). We believe that subxiphoid drainage is the procedure of choice for patients with pericardial tamponade. It is accomplished quickly, is associated with minimal morbidity, and prevents recurrent tamponade in 97.4% (151/155) of patients. (*J THORAC CARDIOVASC SURG* 1995;109:546-52)

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Cardiac tamponade is defined as hemodynamically significant cardiac compression by accumulating pericardial contents that evokes and defeats compensating mechanisms.¹ A wide variety of pathologic conditions may cause pericardial effusion leading to pericardial tamponade. Cardiac tamponade requires drainage to prevent cardiac decompensation and death. The effusion can be drained by needle or catheter pericardiocentesis,²⁻⁴ subxiphoid pericardial drainage,⁵⁻¹⁷ pericardial window performed through a left anterior thoracotomy,^{5, 18, 19} pericardiectomy performed by an open thoracotomy,^{18, 19} or video-assisted thorascopic (VATS) pericardiectomy.²⁰⁻²² The most effective method of drainage to prevent recurrence is subject to contro-

Patients and methods

Patients. We reviewed the records of 155 patients with pericardial effusion who underwent subxiphoid pericardial window for pericardial effusion associated with pericardial tamponade from August 15, 1988, to June 7, 1993. The

patients were treated at Rush-Presbyterian-St. Luke's Medical Center, Chicago, Illinois (89 patients), or Albany Medical Center, Albany, New York (66 patients). There were 85 female patients (55%) and 70 male patients whose ages ranged from 5 weeks to 88 years. The procedure was carried out with general anesthesia in 113 patients (72%) or with local anesthesia and sedation in 42 patients. Cancer was present in 82 patients; 42 of these patients had malignant effusion and 40 did not have tumor within the pericardium according to cytologic and histologic analyses (Table I). Seventy-three patients had benign disease (Table II). Cardiac tamponade was diagnosed on the basis of subjective symptoms, physical signs, chest roentgenography, electrocardiography, and echocardiography. Recurrence of tamponade was defined as a need for further surgical intervention. Follow-up is complete in all patients.

Surgical technique. General anesthesia is preferred for performing subxiphoid pericardial drainage, but the procedure may be performed with local anesthesia plus adequate sedation in the patient with severe tamponade who cannot tolerate general anesthesia. If general anesthesia is used, the patient's skin is prepared and draped before induction of anesthesia to avoid delay if hypotension develops.

A small incision is made from the lower end of the

Table I. Tumor types in patients with cancer

Type	No. of cases
Lung	30 (36.5%)
Breast	23 (28%)
Lymphoma	7
Mesothelioma	5
Other primary tumor	7
Gastric	2
Sarcoma	3
Thymoma	2
Unknown primary tumor	3
Total	82

Table II. Diagnosis in patients with benign disease

Diagnosis	No. of cases
Postcardiotomy syndrome	17
Connective tissue disease	10
Chronic renal failure	9
Viral pericarditis	9
Human immunodeficiency virus	6
Tuberculosis	3
Congestive heart failure	3
<i>Hemophilus influenzae</i>	2
Idiopathic	14
Total	73

sternum caudally for approximately 6 to 8 cm. The upper linea alba is divided in the midline and the xiphoid sternum is split or resected. The peritoneum is not opened. The tissue plane between the posterior wall of the sternum and the anterior pericardium is developed by blunt finger dissection. A small retractor is placed in the abdominal incision and a right-angled retractor is used to elevate the distal sternum. The anterior pericardium is incised; the fluid is drained (Fig. 1) and is sent for bacteriologic and cytologic analyses. The pericardium is explored digitally to identify adhesions or tumor deposits. A piece of pericardium approximately 2 to 3 cm in diameter is excised and submitted for bacteriologic and histologic analyses (Fig. 1). Through a separate stab wound in the left upper part of the abdomen, a 28 F chest tube is placed through the pericardiotomy for postoperative suction drainage (Fig. 2). It is important to place the chest tube through a separate incision because a chest tube left in the operative wound can lead to improper wound healing, wound infection, and incisional hernia. The pericardial incision is left open; the abdominal incision is closed with interrupted or running absorbable sutures. The chest tube is left in place for 4 to 5 days after the operation.

Statistical methods. The data were analyzed by means of SAS (Statistical Analysis Systems, Inc., Cary, N.C.). The Lifetest Procedure was used to estimate the means and medians that are reported. The Gehan (Wilcoxon) test²³ was used to estimate *p* values when comparing survival distributions. Survival curves are plotted by the Kaplan-Meier method.

Fig. 1. Close-up view of pericardial drainage technique.

Results

Operative mortality, defined as death within 30 days of operation or during the same hospitalization, occurred in 31 patients (20%). The 30-day postoperative mortality in patients with cancer was 32.9% (27/82) and in patients with benign disease, 5.4% (4/73). The causes of death of the four patients with benign disease who died in the postoperative period are summarized in Table III. None of the postoperative deaths was attributed to the surgical procedure. Recurrent pericardial tamponade, necessitating further surgical intervention, occurred in four patients (2.5%): two patients with cancer (2/82, 2.4%) and two patients with benign disease (2/73, 2.7%). Recurrent tamponade did not develop in any patient with malignant pericardial effusion. Median survival after subxiphoid pericardial drainage in patients with benign disease was more than 800 days versus 83 days in patients with cancer (*p* < 0.01). Median survival after pericardial drainage in patients with cancer who had malignant pericardial effusion was 56 days, compared with 105 days for patients with cancer who did not have malignant effusion (*p* < 0.05, Fig. 3). All but one of the 42 patients with malignant pericardial effusion have died of their disease (mean follow-up 107 days).

Fig. 2. Placement of pericardiostomy tube through a separate stab wound in the left upper quadrant.

One patient with breast cancer who had a malignant effusion is alive without recurrent pericardial tamponade at 2.2 years. Fifteen of the 40 patients with cancer but benign effusion (5 lung, 6 breast, and 4 other) were alive at the time of analysis and 25 have died of their disease (62.5%) (mean follow-up 264 days).

Thirty patients with lung cancer had a median survival after subxiphoid pericardial drainage of 56 days. Twenty-three patients with breast cancer had a median survival of 195 days. Twenty-nine patients with other tumors had a median survival of 46 days after pericardial drainage ($p < 0.01$, Fig. 4, Table IV). Among patients with malignant pericardial effusion, those with breast cancer had significantly better survival after drainage than patients with either lung or other types of cancer ($p < 0.01$, Fig. 5).

Within this series eight patients had human immunodeficiency virus infection, and two of them had malignant effusion resulting from lymphoma; no tumor or specific causative agent was identified in six patients. All eight patients with human immunodeficiency virus died without recurrent pericardial tamponade; mean follow-up was 130 days.

In all eight patients on whom autopsy was per-

Table III. Postoperative mortality in patients with benign disease

Time to death	Cause of death
48 hr	Pneumonia, sepsis, multiorgan failure
13 days	Perforated colon, sepsis, multiorgan failure
20 days	Juvenile rheumatoid arthritis, tuberculosis
25 days	Human immunodeficiency virus, sepsis, multiorgan failure

formed, the potential pericardial space was fused with dense adhesions between the pericardium and epicardium.

Discussion

Patients with pericardial tamponade are critically ill and require expeditious drainage of the pericardial space. Pericardiocentesis may provide temporary relief of tamponade but is not adequate for definitive therapy. In a series of 36 patients with pericardial tamponade reported by Markiewicz, Borovik, and Ecker² in 1986, 83% of the patients had recurrent tamponade after successful needle pericardiocentesis. Wong and associates³ reported a series of 52 patients with pericardial tamponade who were treated with pericardiocentesis. Seventeen of the 52 patients (32%) had unproductive or unsuccessful pericardiocentesis and eight of the 52 patients (15%) had serious complications. These complications included one death, one cardiac arrest, one aspiration of a subdiaphragmatic abscess, and five ventricular punctures without adverse sequelae.

Piehler and his associates¹⁸ (1985), after review of 145 patients with pericardial effusion treated by surgical drainage, suggested a direct relationship between the extent of pericardial resection and the incidence of recurrent effusion. These authors advocate complete pericardiectomy rather than subxiphoid drainage or pericardial window created by anterior thoracotomy. Within their series, however, only 13 patients underwent subxiphoid drainage, and only one of the 13 required reoperation (7.7%). Five patients in this series who underwent transthoracic pericardial window required reoperation (5/24, 20.8%). These numbers are too small to allow meaningful statistical analysis or to adequately assess the effectiveness of subxiphoid drainage. Naunheim and colleagues⁵ (1991) report no significant difference in survival or freedom from recurrent effusion between patients treated by subxiphoid or

Fig. 3. Survival for all patients. Patients with benign disease had significantly longer median survival than patients with cancer. Patients with cancer and benign effusion had significantly longer median survival than patients with malignant pericardial effusion.

Fig. 4. Survival for patients with cancer by tumor type. Patients with breast cancer had significantly longer median survival than patients with lung or other types of cancer.

transthoracic drainage. In this series, postoperative respiratory complications were more prevalent in patients treated by transthoracic drainage than in patients treated by subxiphoid drainage.

Reports of high recurrence rates after pericardial drainage^{1, 18, 24} have led to interest in VATS pericardiectomy.²⁰⁻²² Advocates of VATS pericardiectomy

point out that it allows for a large pericardial resection, as recommended by Piehler and colleagues.¹⁸ Our data suggest that a large pericardiectomy is not necessary. VATS pericardiectomy necessitates general anesthesia and single lung anesthesia in all cases, and patients with pericardial tamponade also require needle pericardiocentesis before VATS

Fig. 5. Survival for patients with malignant pericardial effusion. Patients with breast cancer had significantly longer median survival than patients with lung or other types of cancer.

Table IV. Median survival of patients with cancer

Tumor type	No. of patients	Median survival (days)	Range (days)
Breast—overall	23	195	
Malignant effusion	13	114	25-180
Benign effusion	10	>800	1-1460
Lung—overall	30	56	
Malignant effusion	13	73	4-223
Benign effusion	17	56	1-447
Other—overall	29	46	
Malignant effusion	16	21	1-497
Benign effusion	13	95	7-1247

pericardiectomy. These are significant considerations in these gravely ill patients.

Early pericardiectomy has been advocated for patients with pericardial effusion resulting from *Hemophilus influenzae*^{5,25} and tuberculosis.^{5,19} In our series, tuberculous pericarditis was successfully controlled by subxiphoid drainage in all three patients with this complication. Subxiphoid drainage was unsuccessful in one of two patients with *Hemophilus influenzae* pericarditis, and pericardiectomy was necessary. For patients with infectious pericardial effusion it seems rational to perform subxiphoid drainage as the initial procedure, provided that the patients are monitored closely for evidence of recurrent tamponade or constriction.

Sugimoto and his colleagues¹⁷ (1990) suggest that the success of pericardial drainage is dependent on obliteration of the pericardial space by adhesions. Our experience adds further support to this theory. All eight of our patients who underwent autopsy were found to have obliteration of the pericardial space by dense adhesions. The surgical technique that we use does not create a pericardial window into the peritoneal space. The pericardium is approached extraperitoneally. We believe that postoperative tube suction drainage allows adhesions to form between the pericardium and epicardium, thus obliterating the pericardial space and preventing reaccumulation of fluid.

Our study confirms that patients with malignant pericardial effusion causing tamponade have a very limited life expectancy. There is a significant difference in survival, however, between patients with malignant effusion and those with underlying cancer who do not have tumor within the pericardium (see Fig. 3). This differentiation is important and should be taken into consideration when planning long-term care of these patients.

In summary, our experience leads us to conclude that subxiphoid pericardial drainage provides expeditious, effective, and durable treatment, with low morbidity, for pericardial tamponade from all causes. We believe it is the procedure of choice for patients with pericardial tamponade.

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Discussion

Dr. Joseph I. Miller (*Atlanta, Ga.*). On the basis of earlier experience from 1974 to 1978, we found a 4.5% incidence of recurrence after subxiphoid drainage for benign disease. It may be that the tubes were left in place for too short a time. A fair number of these procedures were done for purulent pericarditis and viremic type infections. Starting in 1978 we switched to left parietal pericardiectomy. We have done 248 of these procedures with five hospital deaths and no recurrence in the group.

I agree that subxiphoid drainage is appropriate for malignant disease caused by lung cancer. However, I still advocate that the standard pericardiectomy through a left thoracotomy requires about a 45-minute operating time and has an operative mortality of about 1% to 1.5%. I am not sure that standard pericardiectomy should be abandoned in favor of this operation for the entire group of patients with effusive pericardial disease.

Dr. Norman J. Snow (*Cleveland, Ohio*). We have a smaller series in Cleveland of about 53 patients, but the results are similar. The recurrence rate is 3.8%. One recurrence was due to use of a sump drain instead of negative suction, and the other was due to systemic disease rather than surgical technique.

Mortality was likewise low; one death occurred in a patient who was taken to the operating room in a moribund condition, (that is a problem with patient selection) and one was a cardiac death from postoperative hemothorax.

A most important point is the change from the preliminary title of the paper, "Subxiphoid Pericardial Window," to the current title, "Pericardial Drainage." I think the

concept of the pericardial window should be eliminated from our lexicon and that drainage with negative pressure suction and apposition of parietal and visceral pericardium are the most important things to be learned here.

Four or 5 days of suction is important. As soon as the tubes are inserted, our colleagues on the medical service are asking to remove them. Virtually all of the patients in a series such as this are going to be in the hospital for 4 to 5 days because of their underlying disease, be it benign or malignant. Therefore, I see no particular advantage to anything that might facilitate earlier dismissal in this patient population.

Are there any indications now for transthoracic drainage of these effusions? Are there any reasons to accede to our oncologists' requests that we instill sclerosants or antineoplastic agents into the pericardium?

Dr. Moores. The answers to your questions are no and no. In my opinion, the initial approach in almost everybody with pericardial tamponade should be subxiphoid drainage. We changed the title to pericardial drainage when we realized that we were not making a pericardial window. The term *window* in our work is a misnomer. The procedure we describe is a tube pericardiostomy.

Sclerosing agents have a very limited role. There is usually a marked amount of inflammatory response in the pericardium of these patients, and this is adequate to cause the epicardium and the pericardium to stick. I do not think adding an irritant is necessary.

Dr. Akio Wakabayashi (Orange, Calif.). My comments relate to anesthesia for thoracoscopy. Before the double-lumen tube became available I did more than 200 cases of thoracoscopy with just a single regular endotracheal tube. This can be done, especially for a pericardial window drainage procedure, because the pericardium is so big and close to the left wall of the chest that one-lung ventilation is not necessary, and for that, there is no difference between the subxiphoid approach and the thoracoscopy approach. I used to use the subxiphoid approach myself before I started to do pericardial window procedures through a left thoracoscopy. I find that thoracoscopy allows much better visualization and the option of how much of the pericardium can be taken. This is a personal choice, but I prefer a thoracoscopy approach.