Anterior parasternal approach for creation of a pericardial window

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ABSTRACT

INTRODUCTION The optimal method for creation of a pericardial window (PW) is still controversial and it remains a surgical challenge, mainly in obese patients. The aim of this study was to evaluate the efficacy and safety of a novel approach that has not been described previously, for creation of a PW in patients with symptomatic, chronic, large pericardial effusion.

METHODS We retrospectively analysed the records of 30 patients (14 men, 16 women) who underwent a PW procedure between 2001 and 2011. The mean age was 63 years (standard deviation [SD]: 17 years, median: 60 years, range: 27–90 years) and the mean body mass index was 34 kg/m² (SD: 2 kg/m²). The operation was performed through a curvilinear parasternal approach, 6–8 cm in length, followed by a mini-thoracotomy between ribs 4 and 5. Discharged patients were followed up clinically.

RESULTS The mean operative time was 73 minutes (SD: 21 minutes) and a median of 658 ml (range: 300–1,500 ml) of fluid was evacuated. The main aetiologies were idiopathic in 17 patients (57%) and malignant in 9 (30%). Seven patients (23%) died in hospital owing to underlying malignancy. Postoperative complications included mild renal failure (20%), respiratory failure (20%), pneumonia (13%), atrial fibrillation (10%) and atelectasis (6%). There were no wound infections. The median length of stay following the procedure was 8 days. In a median follow-up period of 3.8 years, 16 patients with non-malignant effusion were free of recurrence of pericardial effusion.

CONCLUSIONS The anterior parasternal approach for creation of a PW is simple, safe and efficacious, and results in long-term symptomatic improvement, specifically in patients with non-malignant effusions. This approach may be more appealing in obese patients.

KEYWORDS

Pericardial window – Pericardial effusion – Pericardiocentesis

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Pericardial effusion (PE) existing for longer than three months is defined as chronic PE.¹ Decompression and drainage of large chronic PE in patients presenting with signs and symptoms of cardiac tamponade, pretamponade or symptoms of right heart failure remains a clinical and surgical challenge.^{2–4}

Large chronic PE results mainly from malignancy, idiopathic, viral, inflammatory, autoimmune or renal causes.^{5–7} The patients may be asymptomatic or mildly symptomatic for long periods and so the amount of fluid may reach anywhere between 200 ml and several litres. If left untreated, large chronic PE may cause cardiac tamponade, heart failure syndromes or constrictive pericarditis.⁸ Consequently, once detected, especially if accompanied by symptoms, it is recommended to surgically drain the PE by creating a pericardial window (PW). This approach is mostly appealing when a pericardial biopsy is also of diagnostic value.

The most commonly used surgical approaches for creating a PW are through either a subxiphoid, lateral or anterior thoracotomy.^{9–11} The recently developed video assisted

thoracoscopic surgery (VATS) approach has opened new opportunities for drainage of the pericardium with minimal surgical trauma.¹² However, all these methods have certain limitations. VATS requires a specific technology that is not always available, and is limited by the need for free pleural space and one lung ventilation with a double lumen endotracheal tube. The anterior or lateral approach is not convenient in morbidly obese patients or in women with large breasts (either natural or after breast augmentation surgery).⁴ The subxiphoid approach is less effective in patients with ascites or morbid obesity.¹⁵

The limitations inherent in the above mentioned techniques motivated us to develop an improved anterior parasternal approach for creation of a PW, both in patients with normal body habitus as well as in obese patients.

Methods

The study was conducted in accordance with the amended Declaration of Helsinki. The institutional review board

approved the protocol. The medical records of 30 patients with large chronic PE who underwent a PW operation between 2001 and 2011 were studied retrospectively. Demographic data, clinical and imaging data, indications for surgical treatment, surgical reports, in-hospital complications, short-term results, length of hospital stay and late outcomes were collected, analysed and compared with previously published studies. Pretamponade was defined as finding a large PE with signs of right ventricular compression on transthoracic echocardiography (TTE) but without systemic signs of shock or organ hypoperfusion.

Surgical procedure

The operation is ideally performed under general anaesthesia with mechanical ventilation and the patient placed in a supine position. However, the operation can also be performed under local anaesthesia with conscious sedation in haemodynamically unstable patients.

We perform a left parasternal curvilinear incision (length 6–8 cm) (Fig 1) of the skin, subcutaneous fat and major pectoralis muscle until the ribs surface, crossing and exposing the cartilage of ribs 4 and 5. The next step is an anterior mini-thoracotomy along the upper margin of the fifth rib with preservation of the left internal thoracic artery. The third step involves spreading of the fourth intercostal space using a paediatric rib retractor for exposure of the anterior surface of the pericardium. Following this is a blunt dissection of the anterior pericardial surface and incision of the pericardium. The pericardial fluid is then evacuated with a large bore suction tube (Fig 2) and a larger PW (6cm x 4cm) is created with bipolar diathermy scissors. After inserting two chest tubes (one in the anterior position [24Fr] and another in the posterior position [28Fr] between ribs 8 and 9 on the level of the posterior axillary line), the wound is closed in a standard method after an intercostal block (Fig 3).

Figure 1 Left parasternal curvilinear incision following surgery

Figure 2 Evacuation of the pericardial fluid with a large bore suction tube

Postoperative complications

Respiratory failure was defined as a need for mechanical ventilatory support for more than 12 hours following surgery. Postoperative pneumonia was diagnosed in patients with fever and typical findings in either chest x-ray or computerised tomography. Renal failure was defined as an increase in creatinine of 0.5mg/dl compared with the baseline.

Results

Thirty patients (14 men, 16 women) were operated on. The mean age was 63 years (standard deviation [SD]: 17 years,

Figure 3 Pericardial window immediately following surgery

Figure 4 A patient with relatively large breasts a few weeks after surgery

median: 60 years, range: 27–90 years). The mean body mass index (BMI) was 34kg/m^2 (SD: 2kg/m^2). The BMI was over 30kg/m^2 in 12 women and in 11 men. Relatively large breasts were noted in 13 women (Fig 4).

Preoperative period

The most common clinical manifestations of large chronic PE were pronounced dyspnoea ($n=20$, 67%), tamponade or pre-tamponade ($n=9$, 30%), chest pain ($n=6$, 20%), right heart failure with peripheral oedema and ascites ($n=4$, 30%) and syncope ($n=3$, 30%). Treatment with non-steroidal anti-inflammatory drugs, colchicine and steroids was administered to 16 patients with non-malignant PE without any significant improvement. Temporary drainage by pericardiocentesis before the operation was performed in 18 patients; this was owing to malignant PE in 4 patients and non-malignant effusion in 14 patients, with evacuation of 1,700ml of fluid on average. In five patients, the indication for pericardiocentesis was severe haemodynamic instability.

Operative procedure

The mean duration of the operation from induction of anaesthesia to skin suturing was 75 minutes (SD: 21 minutes). There were no intraoperative complications. The median volume of the evacuated PE was 658ml (mean: 700ml, SD: 139ml, range: 300–1,500ml). The histology and cytology of the removed pericardium and the pericardial fluid did not modify the preoperative diagnosis in any of the patients.

Postoperative period

The median length of hospital stay was 8 days (mean: 10 days, SD: 6.8 days, range: 4–34 days [a patient with wide-spread end-stage malignancy]). Prolonged hospitalisation was mainly associated with advanced malignancy. Early postoperative complications occurred in 20 patients: mild transient acute renal failure in 6 patients (20%), acute respiratory failure in 6 patients (20%; all with known chronic

obstructive pulmonary disease), pneumonia in 4 patients (13%), pulmonary oedema in 1 patient and atrial fibrillation in 3 patients (10%). There were no wound infections. Left pleural effusion (small to moderate) occurred in 14 patients (47%) as a result of continuous drainage of the pericardial fluid into the pleural space.

TTE was performed between days 3 and 5 after the operation. Minimal to small PE was found in 10 patients (33%). There was no PE in 17 patients (57%). Three patients (10%) had residual moderate PE without any symptoms of pressure on the right heart chambers. Repeat TTE three months after the operation revealed small PE in only one patient and no wound infections.

Follow-up review

Eight of fourteen patients with malignant PE died owing to progression of the malignant disease during the first three months after the operation. Sixteen patients with non-malignant PE were followed for a median of 3.8 years. There was no recurrence of PE in any of these patients.

Discussion

This paper presents the immediate and long-term results of 30 consecutive patients with large chronic PE who underwent a PW operation using a novel anterior curvilinear parasternal approach that has not been described previously. We applied this surgical approach in highly symptomatic patients who failed medical treatment or had end-stage malignant disease. The results show that this alternative approach offers the surgeon a simple technique for creating a relatively large (6cm x 4cm) window for permanent and continuous drainage of PE directly to the pleural space. This surgical approach results in low incidence of perioperative complications and durable high efficacy over a prolonged period of follow-up (median: 3.8 years).

There are currently two main surgical techniques for creation of a PW in patients with chronic large PE: through a left thoracotomy (anterior or lateral) or through a subxiphoid approach. Recently, several studies have been published of the VATS PW technique with fair results.^{4,10,12} However, there is still not enough experience with VATS worldwide and as a result, the subxiphoid or open thoracotomy techniques are more commonly used.^{11,13,14} The selection of the surgical approach and technique to be used needs to consider anatomical and pathophysiological factors of each individual patient as well as the surgeon's expertise, the patient's body habitus, co-morbidities and the likelihood of having pleural or pericardial adhesions due to previous surgical interventions or radiotherapy in patients with malignancy.

We employed our technique both in patients with normal body habitus and in morbidly obese patients or women with large breasts. This novel surgical approach is applied routinely in our institution and all 30 operations were performed by a single thoracic surgeon (EA). In contrast, in the study by Liberman *et al*, in which a large volume of such operations was performed, only 2 out of 22 surgeons performed 30 operations or more.¹⁵

Similar to our series, other studies reviewed their data retrospectively over a period of ten years.^{4,12,15–17} The age of their patients was much younger than in our study. Furthermore, our patients were highly symptomatic, after failure of several drug therapy attempts, and had very pronounced manifestations of the pericardial disease. Despite such unfavourable conditions, the incidence of perioperative and postoperative complications was lower than in other published studies.^{4,11,15,18}

Five of our patients were haemodynamically unstable and hypotensive. In such cases, this novel approach can also be carried out under local anaesthesia and conscious sedation. Mild renal failure was noted in 20% of our patients, most probably due to transient alterations in right heart function and pressures immediately after the alleviation of prolonged external pressure.

We believe that the low complication rate is mostly due to the minimal invasiveness of our technique, the supine position of the patient during the operation, ventilation of both lungs (in contrast to single lung ventilation in VATS) and the continuous monitoring of the operation with transoesophageal echocardiography. The presence of left pleural effusion in the early postoperative period is mainly a result of effective drainage through the PW to the left pleural space. Moreover, during the follow-up period, a gradual disappearance of pleural fluid was noted. Consequently, left-sided pleural effusion was not considered a postoperative complication.

The mean duration of operation in our study was 73 minutes, similar to that in other reported studies.¹⁵ The operative time for creation of a PW through the subxiphoid approach was almost equal to that in our study.^{4,18} However, a shorter duration (45 minutes) was reported with VATS.^{4,18}

Conclusions

This paper describes a novel, simple, safe and less traumatic approach for creation of a PW and drainage of large chronic PE. The in-hospital and later clinical outcomes of our patients are comparable with previously published studies of other commonly used techniques. This surgical approach does not require specialised equipment and may be more efficacious in obese patients, in women with large breasts or in patients with ascites.

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