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Original Research

Comparative Evaluation of Thoracoscopic Pericardial Drainage and Subxiphoid Tube Insertion in Patients with Prior Cardiac Surgery

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ABSTRACT

Objective: Clinically symptomatic pericardial effusion (PE) develops in 0.8-5% of patients after open-heart surgery, and delayed effusion is related to morbidity. Comparative evaluation of the outcomes of thoracoscopic pericardial drainage and subxiphoid tube pericardiostomy, which is the standard surgical procedure, has been scantily reported.

Methods: We conducted a longitudinal observation of delayed PEs treated with thoracoscopic pericardial drainage (TPD group; 48 patients) and subxiphoid pericardiostomy (SX group; 91 patients) between May 2012 and June 2017. Changes in the hemodynamic parameters, functional status of patients, and procedure outcomes were compared between the two procedures.

Results: The TPD group had a significantly greater size of effusion (3.9±0.6 cm vs. 3.1±0.5 cm; $p<0.01$), higher pulmonary artery pressure (41.2±9.8 mmHg vs. 36.4±5.6 mmHg; $p<0.01$), and less time interval to emerge syptoms [6 weeks (3–15 weeks) vs. 8 weeks (3–21 weeks); $p<0.01$). Even though the mean operation time was shorter in the SX group (44.6±12.2 min vs. 69.2±22.3 min; $p<0.01$), the same amount of fluid was drained (637.9±182.9 mL vs. 661.3±168.4 mL; $p=0.45$). Improvements in postoperative hemodynamic variables and functional status following both procedures were similar, but symptomatic and echocardiographic recurrence of effusion was significantly more in the SX group (19 patients; 20.9% vs. 2 patients, 4.2%; $p<0.01$) within approximately 2 years of follow-up.

Conclusion: The post-pericardiotomy effusion is a chronic inflammatory process, and the SX drainage provides temporary resolution. TPD may provide equally favorable surgical outcomes; however, it is generally performed to treat more complicated PEs.

Keywords: Cardiac surgery, pericardial effusion, thoracoscopy

INTRODUCTION

Clinically significant pericardial effusion (PE) may develop following open-heart surgery in less than 5% of patients (1, 2). Valve surgery, coagulation disorders, excessive mediastinal drainage, anticoagulant use, autoimmune reactions, and post-pericardiotomy syndrome predispose to the development of effusion (3). Although rare, delayed PE after cardiac surgery may lead to significant morbidity (4-6).

Various modalities have been used for treatmen of the PE, ranging from observation, anti-inflammatory therapy, pericardiocentesis, and eventually open surgery (7). The subxiphoid (SX) drainage is the standard surgical treatment of a PE if the pericardial fluid has a connection to the inferior or anterior pericardial space. This method is also associated with a higher recurrence rate (2, 8). Inferior or anterior adhesions are observed in patients with a prior pericardial intervention (Figure 1) (9-11). Therefore, thoracotomy or thoracoscopic pericardial drainage (TPD) are the best alternatives if the effusion is localized posteriorly or laterally instead of traumatic re-sternotomy in such patients during the recovery period. Thoracotomy is not minimally invasive and often result in pulmonary complications and prolonged postoperative hospitalization (8). However, because the thoracoscopic procedure has low morbidity and mortality rates, it has evolved as the preferred mode of PE treatment considering the high procedural risk of subxiphoid access (12). The morbidity and mortality rates, as well as the efficacy of the procedures in preventing recurrence, should be the basis to determine the most suitable method of surgical management of PE.

The aim of this prospective, observational and longitudinally designed study was to compare the efficacy of TPD and SX for the treatment of localized effusion secondary to cardiac surgery. Notably, the prospective data collection regarding TPD after cardiac surgery has been scantily reported.

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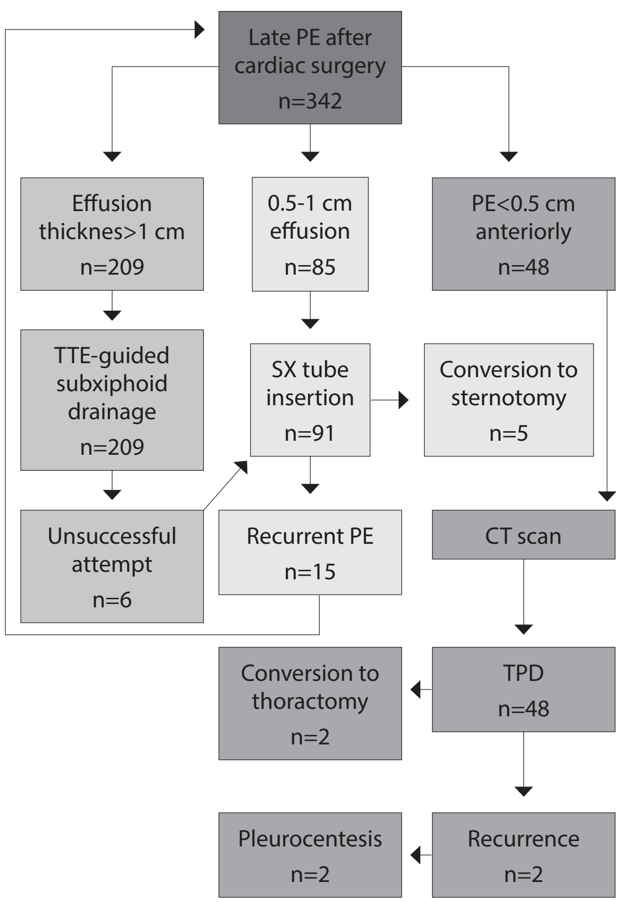
METHODS

Patient Selection

After approval of the prospective observational study protocol by the institutional ethics committee of Kavaklıdere Umut Hospital, Ankara on 3 May 2012, we performed 4731 adult open-heart surgeries in the cardiovascular surgery department between May 2012 and June 2017. Overall, 342 consecutive patients were treated for delayed symptomatic PEs according to the following protocol set as:

Figure 1. The CT image of a symptomatic patient 6 weeks after the mitral valve ring annuloplasty. Most of the pericardial fluid (white arrow) is located to the left lateral side of the left ventricle causing diastolic collapse



Main Points:

- Subxiphoid pericardial drainage serves as an ideal treatment in most symptomatic pericardial effusions requiring surgical interventions.
- Pericardial adhesions late after cardiac surgery may result in an unusual localization of pericardial effusion especially in the posterior and lateral pericardial sacs that are not easily accessible through a subxiphoid incision.
- Thoracoscopic pericardial drainage instead of thoracotomy serves the same successful results comparable with subxiphoid pericardial drainage in this patient subset.

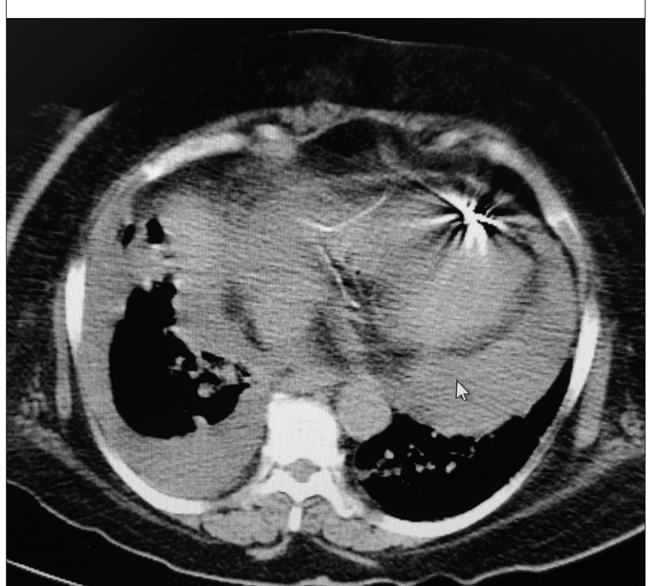
- Massive PEs (203 patients, 59.4%) with >1 cm effusion thickness beneath the posterior border of the sternum were drained using transthoracic echocardiography (TTE)-guided subxiphoid puncture. If this procedure was unsuccessful, these patients were referred for subxiphoid tube insertion.
- Symptomatic massive PE (91 patients, 26.6%), 0.5–1 cm in size, at the anteroinferior pericardial reflection were drained using subxiphoid tube insertion (SX group).
- PEs localized primarily to the lateral or posterior pericardium (Figure 1) with or without <0.5 cm anteroinferior connection (48 patients, 14%) were selected for TPD (TPD group). A computerized tomography (CT) scan was performed on each patient of this group.

The subxiphoid surgery, which is the standard surgical procedure, and the TPD subsets were followed up to compare the results (Figure 2). Our primary endpoints were the success of the procedure in relieving symptoms and recurrence of PE. Informed consent was obtained from each patient.

Diagnostic Tests and Evaluation of PE

Delayed pericardial effusion was described as any effusion in the pericardium developing after discharge from the hospital and the effusion that was not related to possible active surgical bleeding associated with anticoagulation. Notably, the propriety of the percutaneous procedure and the need for surgical drainage was evaluated by the cardiologist based on clinical symptoms, as well as the TTE and CT findings. Echocardiographic evaluation (General Electric Vivid S5, California, USA) was used to measure the size of the echo-free space between the pericardial layers, and to determine cardiac tamponade in case inferior vena cava plethora, right atrial compression, and right ventricular diastolic collapse were present. The symptomatic patients with an anterior echo-free space smaller than 5 mm were further evaluated using the conventional CT scanning (Figure 1). Any collection in

Figure 2. Demonstration of the flow of patients among the procedures



the pericardial space observed on the CT attenuation of less than 10 Hounsfield units was accepted as transudate. The CT images were also used to identify the primary location and extent of PE, adhesions in the pleural space, and functional bypass grafts.

Furthermore, the largest diameter of PE, the changes in hemodynamic parameters [central venous pressure (CVP) measured from central venous line, echocardiographic assessment of pulmonary artery pressure (PAP), and the heart rate], medical management (diuretic use, inotrope infusion, and anti-inflammatory drugs), and the New York Heart Association (NYHA) functional class were recorded to assess the efficacy of both procedures.

Operation Techniques

Except for the clinically unstable patients who required general anesthesia (13 patients; 11 patients with hemodynamic collapse because of severe tamponade and 2 with congestive heart failure with moderate PE, 14.3%), all others underwent subxiphoid tube insertion under local anesthesia. A 5–7 cm skin incision was performed, extending from the linea alba to the xiphoid process. Either fingertip dissection to reach the inferior pericardial margin or blunt surgical dissection was performed to separate the retrosternal tissue. A puncture of the inferior pericardial sac was accomplished to drain the pericardial fluid. A chest tube was inserted after ensuring maximum pericardial drainage.

The TPD patients were operated under general anesthesia and single lung ventilation by using a double-lumen endotracheal tube. Patients were placed supine and their related arms fixed to the operating table, with the shoulder posteriorly extended to approximately 45° and the elbow joint semi-flexed. Three 1 cm trocars were introduced for the passage of a 30° camera and surgical instruments. The camera was introduced first, and adhesions were dissected, if present, between the thoracic interior wall and the anterior surface of the lung. The phrenic nerve was visualized and used as the cornerstone for the pericardial dissection. The pericardial dissection was performed 1.5–2 cm anterior to the phrenic nerve, as much was needed to drain the pericardial fluid. A part of the pericardium was resected to create a window to the pleural space (Figure 3). Any existing PE was removed at the same time by using a surgical suction. Sometimes a blunt dissection was performed over the infero-posterior pericardium or through the posterior of the intrapericardial inferior vena cava with a blunt-ended suction tube to drain the other side of the heart. A chest tube was inserted into the pericardial cavity or to the pleural space in every case.

Clinically stable patients were extubated on the operating table immediately after the operation. The chest tube was removed when the daily drainage had decreased below 50 mL over the previous 12 hours.

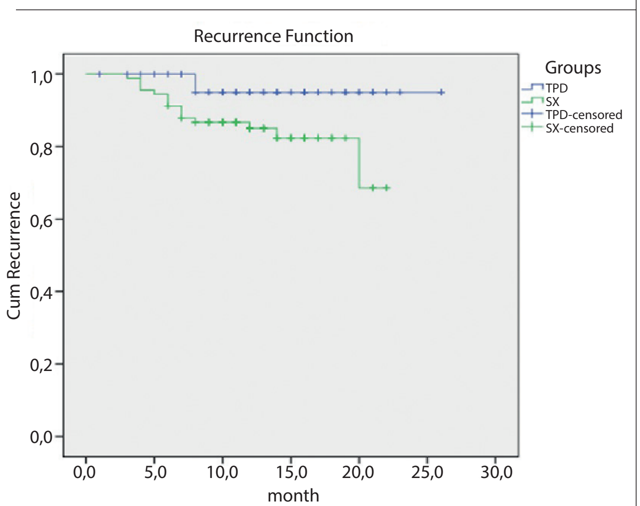
Follow-up

Data were recorded in terms of risk factors necessitating the pericardial drainage, operation time, amount of effusion removed, treatment results, as well as the complications. Patients were followed up with TTE and chest radiogram in the first, second, sixth, and twelfth months after the surgery. Changes in the clinical symptoms before and after TPD were assessed with a physical examination. Any effusion detected on postoperative TTE that required further treatment was defined as recurrence.

Statistical Analysis

Statistical analysis was performed using the IBM Statistical Package for the Social Sciences version 22 (SPSS IBM Corp.; Armonk, NY, USA). Descriptive statistics were presented as frequencies (%), mean and standard deviation for parametric variables, and median (minimum-maximum values) for nonparametric variables. Independent samples *t*-test was performed to assess the statistical significance of differences in parametric variables. Nonparametric variables were compared using the chi-square test, Mann-Whitney U test, and Fisher's exact test, whenever appropriate. Changes in hemodynamic variables after procedures were evaluated using the repeated measures analysis of variance (ANOVA). The Kaplan-Meier analysis was used to estimate the recurrence rate during follow-up. A p-value of less than 0.05 was considered statistically significant.

Figure 3. The thoracoscopic view of the large pericardial window performed in the patient with previous upper J-sternotomy



RESULTS

The clinical data of 139 patients are listed in Table 1. Notably, all patients presented with symptoms, such as fatigue, exertional dyspnea, and edema. Both groups had similar preoperative demographic characteristics. However, the TPD group had a significantly greater PE size (3.6±0.6 cm vs. 3.1±0.5 cm; p<0.01), higher PAP (41.2±9.8 mmHg vs. 36.4±5.6 mmHg; p<0.01), and less time interval of symptom emergence [6 weeks (3–15 weeks) vs. 8 weeks (3–21 weeks); p<0.01] at the time of the index procedure. At least one successful percutaneous pericardiocentesis was performed in 22.9% of TPD patients compared with 41.8% of the SX group in the interval between the cardiac surgery and pericardial drainage procedure (p=0.03). Regarding the additional risk factors, the TPD group had more patients with malignancy, chronic renal failure (CRF), upper abdominal surgery, and morbid obesity, but univariate analysis revealed a nonsignificant difference in frequencies of these comorbidities.

Table 1. Preoperative demographic and clinical parameters of both groups

	TPD Group (N:48)				SX Group (N:91)				
Preoperative Variables	**N**	**%**	**M±SD**	**M(min-max)**	**N**	**%**	**M±SD**	**M(min-max)**	**p**
Age, y			56.6±11.7				54.3±11.5		0.27
Sex									0.40
Male	32	66.7			54	59.3			
Female	16	33.3			37	40.7			
BMI, kg/m^2			26.0±4.0				25.0±3.3		0.14
Prior surgery									
Coronary	12	25			26	28.6			0.65
Valve	31	64.9			47	51.6			0.14
Combined	4	8.3			11	12.1			0.49
Other	1	2.1			7	7.7			0.26
Prior pericardiocentesis	11	22.9			38	41.8			0.03
Preoperative intubation	4	8.3			10	11			0.77
Time to PE symptoms, week				6 (3-15)				8 (3-21)	<0.01
Heart rate, bpm			109.5±23.3				104.7±13.5		0.13
Size of PE, cm			3.6±0.6				3.1±0.5		<0.01
CVP, mmHg			12.4±2.8				11.4±2.6		0.42
PAP, mmHg			41.2±9.8				36.4±5.6		<0.01
Ejection Fraction, %			46.6±9.1				45.57±9.1		0.53
Other Risks									
COPD	3	6.2			5	5.5			1
CRF	6	12.5			6	6.6			0.34
Malignancy	5	10.4			4	4.4			0.27
UAS	2	4.2			0	0			0.12
Morbid obesity	2	4.2			1	1.1			0.27
Concomitant pleural effusion									
Unilateral	5	10.4			15	16.5			0.33
Bilateral	8	16.7			8	8.8			0.17
NYHA Functional Class									0.10
II	5	10.4			20	22			
III	26	54.2			34	37.4			
IV	17	35.4			37	40.7			
Ant-inflammatory drugs									0.77
Ibuprofen	22	45.8			41	45.1			
Colchicum	17	35.4			27	29.7			
Other	3	6.2			9	9.9			
Inotrope use									0.95
Dopamine infusion	16	33.4			37	40.7			
Dobutamin infusion	8	16.7			25	27.5			
Diuretic	33	68.6			75	82.4			0.66

TPD: thoracoscopic pericardial drainage; SX: Subxiphoid; PE: pericardial effusion; BMI: body mass index; bpm: beat per minute; COPD: chronic obstructive pulmonary disease; CRF: chronic renal failure; CVP: central venous pressure; EF: ejection fraction; M±SD: mean±standard deviation; M (min-max): median (minimum-maximum); NYHA: New York Heart Association; PAP: pulmonary arterial pressure; UAS: upper abdominal surgery

Skin-to-skin operation time was shorter in the SX group than the TPD group (44.6±12.2 min vs. 69.2±22.3 min; p<0.01); however, almost the same amount of fluid was drained during both procedures (637.9±182.9 mL vs. 661.3±168.4 mL; p=0.45). Cardiac trauma and bleeding were the reasons for conversion to sternotomy in five patients of the SX group, and two patients with severe pleural adhesions were converted to thoracotomy in the TPD group. Pneumothorax persisting more than 12 hours was more frequently observed in patients who underwent TPD. However, considering all complications, no significant variations in frequencies were observed between both groups (Table 2).

Postoperative hemodynamic variables and functional status were similar for both procedures (Table 3). Symptomatic and

Table 2. Procedural data and procedure-related complications

	TPD Group (N:48)				SX Group (N:91)				
Operative Variables	**N**	**%**	**M±SD**	**M(min-max)**	**N**	**%**	**M±SD**	**M(min-max)**	**p**
Operation, min			69.2±22.3				44.6±12.1		<0.01
Conversion to open surgery	2	4.2			5	5.5			1
Drainage, mL			637.9±182.9				661.3±168.4		0.45
Blood Products, pacs				0 (0-4)				0 (0-5)	0.04
Complications									
Pneumothorax	6	12.5			3	3.3			0.06
Cardiac trauma	0	0			5	5.5			0.16
Phrenic nerve injury	1	2.1			0	0			0.37
Bleeding	4	8.3			2	2.2			0.18
Infection	2	4.2			2	2.2			0.61
CVA	2	4.2			1	1.1			0.27

M±SD: mean±standard deviation; M (min-max): median (minimum-maximum); CVA: cerebrovascular accident

Table 3. Hemodynamic parameters after drainage of the pleural effusion and follow-up data

	TPD Group (N:48)				SX Group (N:91)				
Follow-up Variables	**N**	**%**	**M±SD**	**M(min-max)**	**N**	**%**	**M±SD**	**M(min-max)**	**p**
CVP, mmHg			4.5±2.2				4.6±2.2		0.37
PAP, mmHg			27.5±5.7				27.7±5.0		0.82
EF, %			48.3±7.9				47.0±8.2		0.36
Heart rate, bpm			90.0±10.9				89.5±9.9		0.77
Drainage at ward, mL			246.3±109.3				261.0±109.9		0.46
NYHA Functional Class									0.67
I	25	52.1			51	56			
II	17	35.4			29	31.9			
III	5	10.4			11	12.1			
IV	1	2.1			0	0			
Recurrent PE	2	4.2			15	16.5			0.03
Pleural effusion	14	29.2			9	9.9			<0.01
Pleurocentesis	7	14.6			2	2.2			<0.01
Hospital stay, day				4(2-13)				3(2-20)	<0.01
Mortality	4	8.3			11	12.1			0.50
Follow-up, month			13.2±6.0				12.2±4.4		0.26

CVP: central venous pressure; PAP: pulmonary artery pressureEF: ejection fraction; NYHA: Newyork Heart Associatin; M±SD: mean±standard deviation; M (min-max): median (minimum-maximum); PAP: pulmonary arterial pressure; PE: pleural effusion echocardiographic PE recurrence was encountered more in the SX group (14 patients; 15.4% vs. 2 patients, 4.2%; p=0.03). Two patients with recurrent PE (>2 cm on TEE) in the TPD group had concomitant massive pleural effusion at the same site of thoracoscopy, which resolved completely after pleurocentesis. Fifteen patients in the SX group with recurrent PE required re-intervention with a percutaneous puncture (five patients), repeat subxiphoid surgery (six patients), and TPD (four patients). During the follow-up period, patients of the TPD group required significantly more frequent pleurocentesis (14.6% vs. 2.2%; p<0.01) for pleural effusion (29.2% vs. 9.9%; p<0.01) compared with the SX group.

Table 4. Comparison of hemodynamic changes between and within the groups with repeated measures ANOVA

Hemodynamic Parameters	Repeated Measures ANOVA
CVP	
Within the groups	p<0.01
Between the groups	p=0.18
PAP	
Within the groups	p<0.01
Between the groups	p<0.01
Ejection Fraction	
Within the groups	p<0.01
Between the groups	p=0.46
Heart Rate	
Within the groups	p<0.01
Between the groups	p=0.09

CVP: central venous pressure; PAP: pulmonary artery pressure

Figure 4. Kaplan-Meier survival analysis demonstrating recurrence-free survival of both groups

Efficacy of the pericardial drainage was evaluated by comparing the postoperative changes in CVP, PAP, and ejection fraction (EF). All hemodynamic parameters together with NYHA functional status improved early after both procedures (Table 4). Overall 4 patients in the TPD group, including the 2 of whom were converted to thoracotomy, and 11 patients in the SX group were lost during the follow-up period (p=0.5). The Kaplan-Meier analysis estimated a significantly better recurrence-free survival in the TPD group (mean recurrence time of 25.1±0.6 months with 95% CI: 23.8–26.3 than the SX group (19.2±0.7 months with 95% CI: 17.9–20.5; p=0.03) (Figure 4).

DISCUSSION

Post-cardiac injury syndrome refers to a group of disorders comprising postmyocardial infarction pericarditis (Dressler syndrome), post-pericardiotomy syndrome, and post-traumatic pericarditis (13). Even though the etiopathogenesis of this syndrome is incompletely understood, it is presumed to have an autoimmune reaction triggered by the initial damage of pericardial mesothelial cells, with the possibility of recurrence (13). Notably, no standardized criteria exist for diagnosis, but it is crucial to identify prior pericardial injury (14). Delayed PE after cardiac surgery is considered a post-cardiotomy syndrome, with the reported incidence ranging between 1% and 15% (2, 10, 13). The detected incidence of symptomatic PE in the present study was 7.2%, and more than half of the cases had been treated with percutaneous subxiphoid drainage. The relatively high incidence might be due to the routine echocardiographic follow-up resulting in early detection of the PE even in patients taking aggressive diuretics and anti-inflammatory drugs which may obscure symptoms like fever and oliguria.

A failed medical treatment warrants an interventional decompression to be performed (15). The choice between surgical intervention and pericardiocentesis is based on the location and character of the effusion (10). Subxiphoid puncture and tube insertion are typically sufficient for drainage of the effusion. Nonetheless, they do not provide complete resolution and carry a significant risk of recurrence since both are temporary tunneling (16, 17). When an operation is required for PE management and the subxiphoid drainage is risky or not feasible, the two surgical options have been considered reasonable: thoracotomy and TPD. Notably, TPD is technically and therapeutically advantageous. It is less traumatic to the patient during the recovery period than anterior thoracotomy and provides a more extensive pericardial resection. Localized effusions, even those located posteriorly that cannot be reached without extensive thoracotomy, can be easily drained and look better cosmetically.

A clear indication of an absolute advantage of one technique over the other in terms of mortality, morbidity, recurrence of effusion, and cost, can help the surgeon to make an informed decision when choosing between the two procedures. Nevertheless, from an ethical point of view, a randomized comparison between traumatic thoracotomy procedures and TPD may lead to numerous debates. Therefore, we designed this study to focus on comparing the outcomes of TPD and standard subxiphoid surgery.

In this study, patients who underwent TPD had effusions that were moderate and greater in size and all were associated with an echocardiographic appearance suggestive of tamponade physiology. All patients tolerated general anesthesia and single lung ventilation well. In some series, clinically unstable patients often needed percutaneous intervention with echocardiography-guided needle puncture before any surgical procedure to avoid instability during the induction of anesthesia (15). In the present study, 23% of the TPD group and 42% of the SX group had already experienced percutaneous decompression, albeit electively, before the procedure. Hence, we believe that the presence of moderate and greater tamponade in a clinically stable patient does not hinder TPD.

Previous studies have reported changes in the EF and cardiothoracic ratio (18). Both groups in this study had a significant decrease in CVP and PAP, accompanied by an approximately 5% increase in EF. Despite the evidence of a more complicated location of PE in the TPD group, both groups had similar hemodynamic improvements, concordant with their clinical status. Nonetheless, a disparity emerged during the follow-up period. The two of seven patients with recurrent pleural effusion in the TPD group had concomitant moderate PE on echocardiographic and radiographic controls, which was resolved by pleurocentesis. Despite the same patient profiles with the same etiology, pericardial window creation makes a significant decrease in re-accumulation rates. A 16.5% recurrence rate after subxiphoid pericardial tube drainage was similar to those reported for comparison of open versus percutaneous interventions (9, 11). Therefore, the SX group requires comparatively higher re-intervention for recurrent PE. The rationale could be that the extensive pericardiotomy during the TPD procedure through the potentially risky area prevents intrapericardial re-accumulation. The pleural effusions, -pericardial in origin, drained to thorax through the window which remained open for a considerable time and they required simple needle aspiration in the seven symptomatic patients. Although most of it was absorbed through pleura (15, 19) the pleural effusion after TPD should be considered as recurrence, and it reflects the chronicity of the disease process in the pericardial cavity. The possible absorption by the pleura together with the distribution of fluid to a broader thoracic cavity might cause latency of symptoms to emerge, and this seems to be one of the major advantages over subxiphoid drainage wherein the recurrence rate is about 10.2%–32% (16, 17). Concordant with our results, Piehler et al. (20) proposed that there is a direct relationship between the extent of pericardiectomy and the incidence of recurrence. Therefore, complete pericardiectomy is recommended instead of subxiphoid resection.

Some studies suggest that posterior localization of post-pericardiotomy delayed effusion ranges between 41%–86.1% (10, 21, 22). Removal of the anterior pericardial layers followed by the retrosternal adhesions precludes fluid collections to the retrosternal space where the tube or catheter is inserted during the subxiphoid approach. Notably, these adhesions have the potential to adduct the heart and bypass grafts to the sternum, making them susceptible to injury during blunt dissection. Moreover, anterior pericardial adhesions that jeopardize the subxiphoid access could be avoided with the TPD procedure.

Although some studies in the literature covering the PEs without prohibitive factors for a subxiphoid approach reported no complications with thoracoscopic drainage (4, 20). However, we observed that complications were not rare in our series and could be unique to the drainage of PE after open-heart surgery. Notably, pleural tears that cause pneumothorax and bleeding were seen in 12.5% and 8.3%, respectively. Post-procedural bleeding (between 100 and 200 mL for more than 3 consecutive hours) was managed medically without conversion to thoracotomy, and we sutured the large tears on the visceral pleura in two patients during TPD. We witnessed- cerebral events as a complication of carbon dioxide insufflation. These patients recovered without any sequelae within 36 hours and were extubated in the intensive care unit. Furthermore, conversion to thoracotomy might occur in approximately 5% of cases. Nevertheless, we believe that cardiac trauma, which could be observed during both percutaneous or subxiphoid drainage, is unlikely in TPD because all maneuvers are performed with the guidance of the thoracoscopic camera.

The 10 TPDs were performed from the left side of the thoracic cage. As a procedural note, we recognized that the heart becomes closer to the left thoracic wall in patients with cardiomegaly and obesity, making these patients vulnerable to cardiac injury during the insertion of trocars and surgical instruments. Therefore, we recommend using short trocars without cutting bladeand the camera must be placed first.

We think that the opening of the pericardial space to the left pleura during the left internal thoracic artery (LITA) harvest allows the drainage of postoperative effusion to the thorax. However, if PE recurs, it generally accumulates laterally and posteriorly to the apex of the heart. We cautiously evaluated the CT images to determine an inferior connection to the right side in these cases. If we saw a link, we performed TPD from the right side. Otherwise, localized effusions around the apex without connections were drained from the left side of the thorax, avoiding adhesions near the LITA graft.

CONCLUSION

Subxiphoid tube insertion is the standard procedure for the treatment of PE that could not be treated percutaneously. Notably, TPD has the potential to provide similar favorable results for the treatment of post-surgical PEs with difficult locations. TPD is a safe and valuable alternative and is a justified procedure in case of failed subxiphoid surgery. Therefore, it should be considered more proactively as an alternative to thoracotomy in patients with prior cardiac surgery.

Ethics Committee Approval: Ethics committee approval was received for this study from the ethics committee of Kavaklıdere Umut Hospital.

Informed Consent: Informed consent was obtained from each patient.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept - D.K.; Design - D.K.; Supervision - O.E.; Resources - D.K., O.E; Materials; D.K., O.E.; Data Collection and/or Processing - O.E.; Analysis and/or Interpretation - D.K., O.E.; Literature Search - O.E.; Writing Manuscript - D.K., O.E.; Critical Review - D.K., O.E.

Conflict of Interest: The authors have no conflicts of interest to declare.

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