The Egyptian Journal of Hospital Medicine (April 2023) Vol. 91, Page 5130- 5134

Surgical Pericardial Window Versus Pericardiocentesis in Patients with Pericardial Effusion Indicated for Drainage

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ABSTRACT

Background: Existing data, which compare the outcomes of surgical pericardial window operation versus pericardiocentesis in patients with significant pericardial effusion indicated for drainage, are limited and not enough to guide the best management option for these patients. Here, we examined the results for individuals who were treated for pericardial effusion with either pericardiocentesis or a surgical pericardial window.

Patients and methods: A retrospective, single-center, observational, comparative study of patients who were admitted to the Cardiothoracic Surgery Department, Tanta University. Between January 2018 and December 2022. 200 individuals with pericardial window surgery or pericardiocentesis were identified using hospital registries.

Results: Both surgical pericardial window and pericardiocentesis were beneficial in this research for treating patients with substantial pericardial effusion, and there was an insignificant difference in overall mortality between the two procedures. Nevertheless, there were disparities between the two approaches, with more patients requiring further treatments if the fluid was drained with pericardiocentesis, as well as a higher rate of residual pericardial effusion and re-accumulation of pericardial effusion in the pericardiocentesis group.

Conclusion : The surgical pericardial window operation is superior to pericardiocentesis in the management of patients with significant pericardial effusion indicated for drainage with regard to the incidence and amount of residual effusion and as regards to the occurrence of pericardial effusion re-accumulation**;** however, both techniques are safe, life-saving and effective approaches for the management of patients with instances of cardiac tamponade and severe pericardial effusion.

Keywords: Surgical pericardial window, Pericardiocentesis, Cardiac tamponade, Pericardial effusion, Post cardiac surgery complications.

INTRODUCTION

Patients with chronic heart failure, cardiac surgery, and certain other benign and malignant pericardial, cardiac, and extra-cardiac disorders may present with pericardial effusion (PE) [(1)].

It might be as minor as an asymptomatic effusion or as severe as a large effusion that causes cardiac tamponade. The symptoms of a significant pericardial effusion may be treated or prevented by various procedures, including cardiac tamponade [(2)]. While pericardiocentesis is explored often, many clinicians have given up on this non-operative method since it typically fails to evacuate fluid completely and is linked to high recurrence rates [(3)]. A surgical pericardial window surgery provides permanent therapy, reducing the likelihood of a recurrence of fluid entrapment by allowing the effusion to drain continuously after partial pericardial excision [(4)].

Two approaches are often used in pericardial window surgery, although the best method has not been determined [(5)]. When using the thoracotomy method, an incision is made in the left fifth intercostal space. When using the subxiphoid method, an incision is made below the xiphoid process of the sternum. The 2015 guidelines from the European Society of Cardiology for treating pericardial illness include class IC recommendations for both possible treatment strategies, but there isn't much evidence to show which is better [(6&7).] In this research, we looked at how well pericardiocentesis and surgical pericardial window surgery work to treat pericardial effusion.

MATERIAL AND METHODS

Study of all patients referred to the Cardiothoracic Surgery Clinic at Tanta University with a substantial pericardial effusion requiring drainage. Between January 2018 and December 2022, 200 individuals with pericardial window surgery or pericardiocentesis were identified using hospital registries. This research also included patients who developed postoperative pericardial effusion after heart surgery and needed drainage.

Two groups were created; Group A: 121 patients who had pericardiocentesis.

Group B: 79 patients who had surgical pericardial window operation.

The patient's management decisions and the modality and approach used for each patient management were according to the treating surgeon's opinion.

Patients under the age of 18 and those undergoing a different procedure, such as a valve replacement or coronary artery bypass grafting, during the pericardial window were not included in the study, nor were those who had undergone emergency surgery during a cardiac arrest without a definitive diagnosis of pericardial effusion.

Received: 28/11/2023
Accepted: 30/01/2023

Patients' ages, sexes, occupations, marital statuses, number of children, smoking histories, and comorbid conditions were recorded.

Data on laboratory parameters, patient outcomes, and echocardiographic variables were also gathered.

In-hospital mortality, the amount of residual effusion, 30-day re-accumulation of the effusion (defined as an increase in effusion size by one categorical variable (i.e., small to moderate) or an effusion requiring reintervention), and procedural success (defined as successful drainage of the effusion with a resolution of tamponade or symptoms, if present) were all factors considered. The frequency of morbidity after the procedure was also recorded. Significant bleeding was defined as hemorrhage with a loss in hemoglobin of at least 2 g/dL or any blood transfusion within the first 48 hours, and hemodynamic instability was defined as a systolic blood pressure of less than 100 mmHg or the need for vasopressors during the first 48 hours after surgery.

Both procedures were compared for their effects on the subset of patients who had pericardial effusion after heart surgery.

In cases of organized pericardial effusion as clotted hemopericardium, loculated pericardial effusion, loculated suppurative pericarditis, and cases of posterior pericardial effusion, the definitive management was via surgical pericardial window operation, which is a mandatory intervention in these cases. However, in cases of massive circumferential free and clear serous or transudative pericardial effusion, both pericardiocentesis and surgical pericardial window can offer curative management. This difference can guide the doctor's choice of management options for patients suffering from symptomatic significant pericardial effusion [8].

Ethics of the study:

The patients' signed permission was obtained. The findings from this study were exclusively utilized for academic reasons. Approval from the Ethical Committee of the Faculty of Medicine-Tanta University, number 36249/12/22, was obtained.
The study was done after approval from the Ethical Committee in Cardiac Surgery Unit, Tanta Medical Centre, Cardiothoracic Surgery Department, Tanta University. The Declaration of Helsinki, the World Medical Association's code of ethics for studies involving humans, guided the conduct of this work.

Statistical analysis

The data were analyzed using SPSS version 27 (IBM, Armonk, NY, USA). The data's normality was determined with the use of the Shapiro-Wilks test and histograms. Parametric quantitative data were summarized as mean ± SD and examined using an unpaired student t-test. The chi-square test was used to examine qualitative data provided as frequencies (%). In this study, statistical significance was defined as a two-tailed P value ≤ 0.05.

RESULTS

Table 1 demonstrates that between-group differences in valvular heart disease and hypertension prevalence were statistically significant.

Table (1): Patients' demographic data were compared between the two groups

	Pericardiocentesis (n = 121)		**Pericardial Window (n = 79)**		**Test of Sig.**	**p**
Age (years)						
Median (IQR)	58 (41 – 72)		59 (46.5 – 73)			
Sex	No.	%	No.	%	χ^2	p
Female	35	28.9	32	40.5	2.877	0.090
Male	86	71.1	47	59.5		
Co-morbidities						
Heart Failure	24	19.8	24	30.4	2.914	0.088
Coronary artery disease	28	23.1	22	27.8	0.565	0.452
Valvular heart disease	48	39.7	53	67.1	14.375	<0.001*
Hypertension	59	48.8	53	67.1	6.516	0.011*

SD: Standard deviation, IQR: Interquartile range, χ^2: Chi square test, t: student t-test, U: Mann-Whitney test,
*: Statistically significant

Statistically significant differences in systolic blood pressure, diastolic blood pressure, and operation indication are shown in Table 2.

Table (2): Comparison between the two studied groups according to the clinical findings on patients' examination

	Pericardiocentesis (n = 121)		Pericardial Window (n = 79)		Test of Sig.	p
Systolic BP (mmHg)						
Mean ± SD.	140.42 ± 27.61		149.78 ± 26.88			
Diastolic BP (mmHg)						
Mean ± SD.	84.65 ± 16.4		89.47 ± 15.51			
Heart rate						
Mean ± SD.	100.49 ± 18.34		96.96 ± 13.82			
Left ventricular ejection fraction (%)						
Mean ± SD	52.99 ± 11.27		52.97 ± 11.03			
Symptoms	No.	%	No.	%	χ^2	p
Chest pain	49	40.5	24	30.4	2.110	0.146
Dyspnea	89	73.6	50	63.3	2.375	0.123
Effusion size						
Small	100	82.6	58	73.4	4.590	0.101
Moderate	17	14	20	25.3		
Large	4	3.3	1	1.3		
Indication for procedure						
Clinical tamponade	33	27.3	20	25.3	7.829	0.050*
Diagnostic	1	0.8	5	6.3		
Echocardiographic tamponade	53	43.8	25	31.6		
Large pericardial effusion without tamponade	34	28.1	29	36.7		

SD: Standard deviation, χ^2: Chi-square test, t: student t-test, *: Statistically significant

There was no statistically significant difference between the two groups in Table 3 when it came to the laboratory tests.

Table (3): Comparison between the two groups of studied cases according to the laboratory investigations results

		Pericardiocentesis (n = 121)	Pericardial Window (n = 79)	Test of Sig.	p
Creatinine (mg/dL)	Median (IQR)	1.22 (0.34 – 2.53)	0.9 (0.32 – 2.54)		
Hemoglobin (g/dL)	Mean ± SD.	11.83 ± 2.12	11.54 ± 2.16		
Platelets (1000/uL)	Mean ± SD.	264.55 ± 18.79	249.96 ± 15.91		
INR	Median (IQR)	1.43 (0.68 – 1.98)	1.34 (0.73 – 1.94)		
PTT	Median (IQR)	35.4 (26.6 – 44.2)	32.2 (24.95 – 43.8)		
WBCs (1000/uL)	Median (IQR)	8.1 (4.6 – 11.7)	7.2 (5.25 – 11.6)		

INR: international normalized ratio, PTT: partial thromboplastin time, WBCs: white blood cells, SD: Standard deviation, IQR: Interquartile range, t: student t-test for parametric data, U: Mann-Whitney test for non parametric data, *: Statistically significant

Table 4 shows a high statistically significant difference between the studied groups regarding drain data.

Table (4): Comparison between the two groups of studied cases according to drain data

		Pericardiocentesis (n = 121)		Pericardial Window (n = 79)		Test of Sig.	p
Drain	Pericardial drain left in place	70	57.9	67	84.8	16.098	<0.001*
Drain duration (days)	Mean ± SD	2 (1 – 3)		3 (1 – 5)			

SD: Standard deviation, χ^2: Chi square test, t: student t-test, *: Statistically significant

Table 5 shows a statistically significant difference between the studied groups regarding the incidence and amount of residual effusion and the occurrence of pericardial effusion re-accumulation.

Table (5): Comparison between the two groups of studied cases according to patients' outcome

	Pericardiocentesis (n = 121)		Pericardial Window (n = 79)		χ^2	p
In-hospital mortality	2	1.7	2	2.5	0.188	0.664
Procedural success	117	96.7	78	98.7	0.816	0.366
Residual effusion	85	70.2	33	41.8	16.021	<0.001*
Re-accumulation	25	20.7	6	7.6	6.230	0.013*
Hemodynamic instability	2	1.7	4	5.1	1.910	0.167
Major bleed	2	1.7	1	1.3	0.048	0.826
Stroke	1	0.8	2	2.5	0.941	0.332
Myocardial infarction	2	1.7	0	0	1.319	0.251

χ^2: Chi-square test, *: Statistically significant.

DISCUSSION

Cardiac tamponade, shock, and even mortality may result from pericardial effusion, a medical condition characterized by an abnormally large buildup of fluid in the pericardial cavity. It is not clear what treatment is best for those who are experiencing symptoms as a result of large pericardial effusions.

There are two main methods for draining pericardial fluid: surgical (pericardial window procedure) and percutaneous (pericardiocentesis) [(9)].

Several other modalities for surgical drainage of pericardial effusion, such as surgical pericardial window operation via anterolateral thoracotomy and via a sternotomy, and more recently, the use of a video-assisted thoracoscopic (VATS) minimally invasive approach, have been proposed since the subxiphoid surgical approach was first described in 1829 [(10)].

While needle pericardiocentesis significantly improves patients' symptoms in the short- and sometimes long-term, treatment cannot provide permanent effective therapy of pericardial effusion. Nonetheless, pericardiocentesis has a higher mortality rate, complication rate, and recurrence rate than surgical pericardial window surgery [(11)].

The results of this retrospective observational and comparative study revealed that both techniques, the pericardial window operation, and the pericardiocentesis approach proved to be effective in the management of patients with significant pericardial effusion, and there was no significant difference in the overall mortality between the surgical pericardial window versus the pericardiocentesis group for significant pericardial effusions. However, there are significant differences between the two techniques, with more patients needing repeat procedures if the effusion was drained using pericardiocentesis.

Comparable rates of short- and long-term survival were seen across patients who received percutaneous pericardiocentesis and those who underwent open surgical drainage; however, the pericardiocentesis group had a higher rate of repeat drainage, and surgical pericardial window grafting was more common in the pericardiocentesis group. Hence, one must weigh the potential for treatment-related problems against the potential benefit of a more definitive approach when deciding between open surgical drainage and percutaneous pericardiocentesis [(12)].

In this research, we showed that the prevalence of valvular heart disease and hypertension significantly differed between the two groups.

Our results align with those of **Saltzman *et al.*** [(13)], who stated that iatrogenic causes accounted for 11.4% of all cases, and post-surgical causes accounted for 32.1% of all cases. Significantly more patients in the post-surgical and iatrogenic groups underwent surgical drainage than pericardiocentesis (43.1% vs. 25.6%, respectively; P=0.01 and 15.7% vs. 4.2%, respectively).

Our findings are consistent with those of **Labbé *et al.*** **[(14)]**, who observed that the only statistically significant difference between the two groups was that fewer patients in the pericardiocentesis group had valvular heart disease (p <0.01).

Horr *et al.* **[(15)]** showed that pericardiocentesis is more likely to be performed as a quick bedside life-saving technique to alleviate cardiac tamponade in patients who are acutely unstable and have effusions that are accessible (not localized).

There was a statistically significant difference between the two groups studied in this study with respect to drain data, with drainage taking longer in the pericardiocentesis group and shorter in the surgical pericardial window group.

Our results are in line with those of **Saltzman *et al.*** **[(13)]**, who likewise found that the pericardiocentesis group had a greater incidence of repeat drainage procedures (28.9% vs. 2.8%; OR, 14.2; 95% CI, 3.3-61.3; P 0.0001). Pericardiocentesis patients in **Labbé *et al.***'s **[(14)]** research suffered protracted drainage, with the pericardial catheter kept in place for at least 24 hours and up to 7 days until drainage had ceased, which is consistent with our study's findings.Regarding the frequency of pericardial effusion re-accumulation and the incidence of persistent pericardial effusion, there was a statistically significant difference between the pericardiocentesis and pericardial window groups.

Labbé *et al.* **[(14)]** showed that the total incidence of recurrence of pericardial effusion was 23% and that the rate was substantially different in the two groups

(31.0% pericardiocentesis vs. 5.3% pericardiotomy, p = 0.046), which is consistent with our study's findings.

Horr *et al.* [15] showed that re-accumulation was greater in the patient group who received pericardiocentesis, which is consistent with our findings. Leaving a pericardial drain in place after the first surgery reduces the chance of re-accumulation by 10%. While recurrence rates were greater with pericardiocentesis, in-hospital mortality was much reduced compared to surgical therapy.

The findings of our investigation are consistent with those of **Ebaid *et al.* [16]**, who observed that only a small percentage of effusions develop into hemodynamically important cases of cardiac tamponade. In contrast to the pericardial window group, the pericardiocentesis group had a greater rate of recurrent cardiac tamponade. Patients who need anticoagulant medication following cardiac surgery are at a higher risk for developing post-operative pericardial effusion and late pericardial tamponade. In patients undergoing heart valve surgery, the posterior pericardiotomy approach proved very helpful in avoiding late pericardial tamponade.

Similar to this, **Ebaid *et al.* [16]** found that patients with pericardial windows had a higher frequency of chest tube drainage of more than 500 cc/24 hours (40 patients, or 20%, vs. 5 patients, or 2.5%, respectively; p=0.005).**Kopecky and colleagues[17]** published the first percutaneous pericardiocentesis series in 1986. Numerous other investigations have since confirmed this method's general effectiveness and safety. Percutaneous pericardiocentesis is a less intrusive procedure than surgical pericardial window surgery for patients with cardiac tamponade, making it more useful in intensive care units.

There was no fatality in research by **Kopecky *et al.* [17],** including 42 patients, but the complication rate was 2.4%, and the recurrence rate was 24%. [9].

Celerrnajer *et al.* [18] conducted research with 36 patients and found a 3% death rate, 5.6% complication rate, and 19.4% recurrence rate.

Study limitations:

This research has a few caveats. The study's findings may not represent the general population due to its retrospective observational and comparative design and single-center setting. In addition, this research bundled all surgical procedures together and compared them to pericardiocentesis, despite the fact that there may be significant variances depending on the surgeon and the procedure.

CONCLUSION

The surgical pericardial window operation is superior to pericardiocentesis in the management of patients with significant pericardial effusion indicated for drainage with regard to the incidence and amount of residual effusion. As regards the occurrence of pericardial effusion re-accumulation**,** however, both techniques are safe, life-saving, and effective approaches for the management of patients with massive pericardial effusion and cases of cardiac tamponade.

Financial support and sponsorship: Nil.
Conflict of Interest: Nil.

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