

# Differences in outcomes between surgical pericardial window and pericardiocentesis in children with postpericardiotomy syndrome

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## ABSTRACT

Children with postpericardiotomy syndrome may develop hemodynamically significant pericardial effusions warranting drainage by surgical pericardial window or pericardiocentesis. The optimal approach is unknown. We performed a retrospective observational study at two pediatric cardiac centers. We included 42 children aged <18 years who developed postpericardiotomy syndrome following cardiac surgery between 2014 and 2021. Thirty-two patients underwent pericardial window and 10 underwent pericardiocentesis. Patients in the pericardial window group presented with postpericardiotomy syndrome sooner than those who underwent pericardiocentesis (median 7.5 days vs. 14.5 days,  $P = 0.03$ ) and tended to undergo earlier intervention (median 8 days vs. 16 days,  $P = 0.16$ ). No patient required subsequent drainage. There were no differences between groups in days of pericardial tube duration (median 4 days), complications, and subsequent days of intensive care or hospitalization. For children with postpericardiotomy syndrome with a pericardial effusion warranting drainage, these data suggest that pericardial window and pericardiocentesis have similar efficacy, safety, and resource utilization.

**Keywords:** Cardiac surgery, pericardial effusion, postpericardiotomy syndrome

## INTRODUCTION

Postpericardiotomy syndrome is an inflammatory disease that occurs in the first 1–2 weeks after surgery involving the pericardium or pleura.<sup>[1,2]</sup> The pathophysiology remains poorly understood but is presumed to be an immune-mediated process triggered by small amounts of blood in the pericardial space and/or injury to the pericardium. The reported incidence in children is 10%–28%.<sup>[3–5]</sup> In most cases, the pericardial effusions are relatively small, and medications that target inflammation are utilized. A small subset of patients may have larger or hemodynamically important pericardial

effusions that warrant drainage, either through surgical creation of a pericardial window or pericardiocentesis with or without drain placement.<sup>[5,6]</sup>

There are no data comparing the outcomes of these two methods. Therefore, we conducted a study to determine whether differences exist between the two drainage techniques in efficacy, safety, and resource consumption. Given the more definitive nature of a pericardial window, we hypothesized that this procedure would be associated with greater efficacy, less resource utilization, and equivalent safety to pericardiocentesis.

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## METHODS

This retrospective observational study was conducted at two institutions with nearly identical annual cardiac surgical volume (~300 index cases annually) and clinical outcomes. We included patients <18 years old who underwent a cardiac operation between January 1, 2014, and June 30, 2021, and subsequently were diagnosed with postpericardiotomy syndrome 48 h–90 days later with an associated pericardial effusion that was drained through pericardial window or pericardiocentesis. The criteria for drainage were not standardized at either center. Patients were excluded if the pericardiocentesis or pericardial window was primarily performed to manage bleeding or if the effusion had an alternative etiology (e.g., infection and chylous effusion).

Baseline characteristics, details about the presentation of postpericardiotomy syndrome, and outcomes were collected from the medical records. Patients were divided into two groups based on an initial intervention of either a pericardial window or pericardiocentesis. The outcomes analyzed were measures of efficacy, safety, and resource utilization.

Chi-square or Fisher's exact tests were used to compare categorical variables between groups. To test for differences in continuous variables between groups, Mann-Whitney *U*-tests were used.

## RESULTS

Forty-two patients met inclusion criteria, of whom 32 underwent drainage through a pericardial window (all at Institution A; 1.4% of 2300 index cardiac operations) and 10 patients underwent pericardiocentesis (all at Institution B, 0.4% of 2450 index cardiac operations).

The index operations were quite heterogeneous and more patients in the pericardiocentesis group had major noncardiac anomalies when compared to those in the pericardial window group. Otherwise, there were no significant differences in baseline characteristics [Table 1].

Patients who received a pericardial window were diagnosed earlier after surgery than those who underwent pericardiocentesis [Table 2]. There was also a significant difference in hemodynamic states before drainage in that those undergoing pericardiocentesis had a more severe presentation than those undergoing a pericardial window. However, there was no significant difference between groups in days from index operation to drainage of the effusion, and echocardiogram findings, effusion size, or type of pericardial fluid drained [Table 2].

There was no significant difference between groups in efficacy, including the number of days with pericardial

drain in place, starting a new medication for enlarging effusion, rehospitalization, or repeat drainage. No significant difference was found in the rate of any complications. There was no significant difference in resource utilization following drainage, including the number of echocardiograms performed and the overall number of days in the intensive care unit (ICU) or hospital [Table 3].

## DISCUSSION

In this retrospective review of patients with postpericardiotomy syndrome requiring drainage, surgical pericardial window creation, and pericardiocentesis displayed similar efficacy and resource utilization. Both methods were safe, with low rates of complications.

The two drainage methods have been compared in adults but not in children. Gumrukcuoglu *et al.* compared the two methods in 100 adults with diverse etiologies for cardiac tamponade (only two cases were postoperative) and concluded that pericardiocentesis was preferred in idiopathic pericardial effusions, whereas surgery may be preferred for purulent, recurrent, or malignant effusions. Complication rates were low and similar between procedures.<sup>[6]</sup> However, an initial pericardiocentesis was associated with a higher rate of effusion recurrence.

In our patients, it is interesting to note that those who underwent pericardial windows were diagnosed with postpericardiotomy syndrome about a week sooner and tended to undergo drainage earlier than those who underwent pericardiocentesis. One potential explanation is that Institution A had a lower threshold for draining effusions in patients with postpericardiotomy syndrome. Another factor we considered was the routine empiric intraoperative administration of high-dose corticosteroids for all cardiopulmonary cases at Institution B during the study period, whereas at Institution A, steroids were only given for neonatal bypass cases.<sup>[7]</sup> We speculated that this practice could lead to a lower incidence and delayed presentation of postpericardiotomy syndrome; however, a prior randomized placebo-controlled trial of empiric perioperative methylprednisolone in children undergoing cardiac surgery did not result in a reduction in the rate of postpericardiotomy syndrome.<sup>[5]</sup> Patients who received a pericardiocentesis were less hemodynamically stable at the time of drainage. Definitely managing postpericardiotomy syndrome-associated effusions earlier could minimize the risk of hemodynamic compromise.

Adult patients who undergo pericardiocentesis are more likely to have a recurrent effusion.<sup>[6,8,9]</sup> In our study, however, there was no statistical difference between days with pericardial drain, the starting of new medications,

**Table 1: Comparison of basic characteristics**

	Pericardial window (n=32)	Pericardiocentesis (n=10)	P
Male sex, n (%)	16 (50)	5 (50)	1.00
Major noncardiac anomaly, n (%)	3 (9)	4 (40)	0.04
Genetic syndrome, n (%)	8 (24)	3 (30)	1.00
Any cardiac surgery before the current index operation, n (%)	7 (22)	3 (30)	0.44
Age at index operation (years)	1.7 (0.0–17.8)	6.4 (0.0–15.4)	0.37
Weight at index operation (kg)	9.9 (3.2–106.5)	20.1 (2.9–81.6)	0.42
Index operation			-
AVSD repair	7	1	
Pacemaker/AICD	5	1	
MPA band	2	1	
TOF repair	5	1	
VSD (+/- other procedures)	3	1	
Others	10	5	
Reoperation following index operation, n (%)	1 (3)	0	1.00

Continuous variables are summarized as medians (minimum–maximum). AICD: Automatic implantable cardiac defibrillator, AVSD: Atrioventricular septal defect, MPA: Main pulmonary artery, TOF: Tetralogy of Fallot, VSD: Ventricular septal defect

**Table 2: Comparison of presentations**

	Pericardial window (n=32)	Pericardiocentesis (n=10)	P
PPS diagnosis during the same hospitalization as index operative, n (%)	13 (41)	2 (20)	0.29
Days from index operative to diagnosis of PPS	7.5 (3–77)	14.5 (6–45)	0.03
Days from index operative to drainage	8 (4–82)	16 (6–46)	0.16
In ICU just before the drainage, n (%)	8 (25)	6 (60)	0.06
Hemodynamic state, n (%)			
Stable	28 (88)	5 (50)	0.02
Tachycardia	4 (12)	3 (30)	
Tachycardia and hypotension	0	1 (10)	
Shock	0	1 (10)	
Echocardiogram just before intervention, n (%)			
Effusion	22 (69)	8 (80)	0.85
Effusion + RA collapse	7 (22)	1 (10)	
Effusion + RA + RV collapse	3 (9)	1 (10)	
Largest effusion size (cm)	1.1 (0.5–3.4)	1.7 (0.8–3.1)	0.24
Echocardiogram loculations	0	1 (10)	0.24
Pericardial fluid appearance, n (%)			
Serous	13 (41)	6 (60)	0.07
Serosanguineous	15 (47)	1 (10)	
Sanguineous	4 (12)	3 (30)	

Continuous variables are summarized as medians (minimum–maximum). ICU: Intensive care unit, PPS: Postpericardiotomy syndrome, RA: Right atrium, RV: Right ventricle

**Table 3: Comparison of outcomes**

	Pericardial window (n=32)	Pericardiocentesis (n=10)	P
Efficacy			
Pericardial drain days	4 (2–13)	4 (1–14)	0.38
New PPS medication following drainage for increased effusion size, n (%)	0	1 (10)	0.24
Re-hospitalized specifically for PPS, n (%)	0	1 (10)	0.24
Repeat drainage required	0	0	-
Safety			
Complications due to drainage			
Arrhythmia related to drainage	0	0	-
Other complications	0	0	-
Resource utilization			
Echocardiograms after drainage (same hospitalization)#	3 (1–9)	4 (2–5)	0.30
ICU days postdrainage	1 (0–13)	1.5 (0–18)	0.34
Hospital days postdrainage	5 (2–34)	6.5 (2–76)	0.65
Outpatient cardiology follow up at study center, n (%)	12 (38)	9 (90)	0.009
Cardiology clinic visits first 6 months	4 (2–19)	4 (0–13)	0.84

Continuous variables are summarized as medians (minimum–maximum). PPS: Postpericardiotomy syndrome, ICU: Intensive care unit

or repeat drainage. There was one patient who was re-hospitalized in the pericardiocentesis group. Safety did not differ between the two methods, although the sample size was small.

Finally, resource utilization was hypothesized to be equivalent, which was supported by the data. We found no relationship between the type of drainage procedure and the number of follow-up echocardiograms obtained

during the same hospitalization, nor did we find any difference in ICU or hospital days following the drainage procedure.

Limitations include all the usual factors associated with a retrospective observational study. Unmeasured confounders may have influenced the outcomes. The small sample size may have limited our ability to find significant differences between certain outcomes, especially safety. The study only involved two centers, which limits generalizability.

## CONCLUSIONS

In children with postpericardiotomy syndrome with pericardial effusions warranting drainage, we found no important differences in efficacy, safety, and resource utilization between initial drainage through pericardial window compared to pericardiocentesis. Future investigations involving additional centers and larger numbers of patients are needed to provide greater clarity.

### Declaration of parent consent

The study was approved by the institutional review boards (IRB) at both institutions (Institution A, IRB #001139326; Institution B, IRB #2022-4913) and the need for informed consent was waived.

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Nil.

### Conflicts of interest

There are no conflicts of interest.

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