THORACOSCOPIC PERICARDIAL WINDOW SURGERY FOR COMPLEX POSTOPERATIVE PERICARDIAL EFFUSION AFTER CARDIAC SURGERY: A CASE SERIES

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Postoperative pericardial effusion is a common complication after cardiac surgery, particularly when the effusion is recurrent, or clinically significant. When the effusion is predominantly posterior, or associated with clot formation, percutaneous drainage begins difficult or ineffective. We retrospectively reviewed 6 patients who developed clinically significant pericardial effusion after open cardiac surgery and underwent left thoracoscopic posterior pericardial window. Imaging showed non-drainable loculated or posterior effusions in all cases. The interval from surgery to effusion ranged from 10 days to 2 months. Intraoperative findings included clotted hemopericardium, hemorrhagic effusion, and serous effusion. Histopathology showed chronic pericarditis without malignancy or tuberculosis. All patients improved after surgery, with no recurrence, mortality, or major complication at 3 months.

Keywords: Pericardial effusion, thoracoscopy, pericardial window, cardiac surgery, hemopericardium.

I. INTRODUCTION

Pericardial effusion is a well-recognized complication after cardiac surgery. Although echocardiographic studies have reported postoperative pericardial fluid in up to 10% to 40% of patients, only a small subset, approximately 1% to 5%, develops clinically significant effusion requiring drainage or urgent intervention.[1]

The pathophysiology of postoperative pericardial effusion is multifactorial and involves an interplay between retained blood within the pericardial sac, local disturbances of coagulation and fibrinolysis, and inflammatory reactions of the pericardium.[2-4] In routine clinical practice, echocardiography-guided pericardiocentesis is the first-line treatment for hemodynamically significant effusion or cardiac tamponade. However, the effectiveness of percutaneous drainage depends heavily on the location and morphology of the effusion. Posteriorly located collections, multiloculated spaces, and effusions containing fibrin strands or organized clot are frequently inaccessible or incompletely drained through a percutaneous route.[2,5]

Surgical pericardial window offers a more definitive solution in such circumstances because it permits direct evacuation of fluid, removal of clot, disruption of septations, and acquisition of pericardial tissue for pathological examinations. Thoracoscopic techniques provide a minimally invasive approach could be a feasible solution to avoid re-open sternum, minimize risk of mediastinum infection and exposure of the lateral and posterior pericardial

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space and have been associated with low recurrence rates in selected patients. [6-9]

Despite these advantages, reports specifically addressing postoperative pericardial effusions that are loculated, posteriorly distributed, or unsuitable for percutaneous drainage remain limited, especially from real-world settings in Hanoi medical university Hospital. We therefore aimed to describe the clinical and pathological characteristics of this subgroup and to evaluate the early outcomes of thoracoscopic pericardial window as definitive treatment.

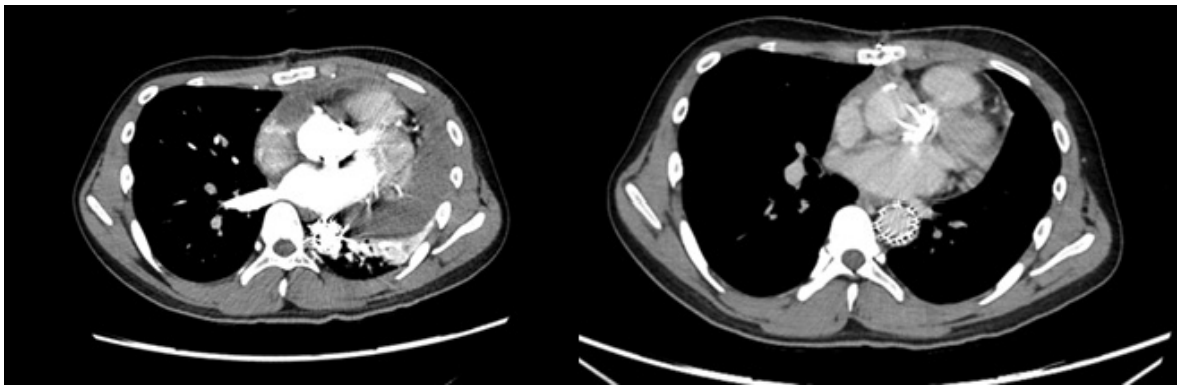
II. CASE PRESENTATION

This case series describes six patients who developed clinically significant pericardial effusion after open cardiac surgery and were treated at Hanoi Medical University Hospital. The report focuses on the clinical context of detection, imaging characteristics, therapeutic decision-making, surgical management, and short-term outcomes in patients with postoperative pericardial effusion that was recurrent, loculated, predominantly posterior, or unsuitable for percutaneous drainage.

Clinical information was retrospectively reviewed from medical records, echocardiography, contrast-enhanced chest computed tomography, operative notes, histopathological reports, and follow-up assessments. The therapeutic strategy was determined according to the location and morphology of the effusion, feasibility of percutaneous drainage, and the patient's clinical condition. In all included patients, surgical drainage by thoracoscopic posterior pericardial window was selected as definitive treatment. Surgical treatment was indicated when the postoperative pericardial effusion was clinically significant and either recurrent after prior drainage, associated with cardiac compression or tamponade physiology, or considered unsuitable for complete percutaneous drainage because of posterior location, loculation, septation, or suspected organized clot.

Six patients met the inclusion criteria. All had undergone various major open cardiac procedures, including mitral valve replacement with or without tricuspid repair, double-valve replacement, ascending aortic or arch surgery, and Bentall procedure. The time from index surgery to clinically significant pericardial effusion ranged from 10 days to 2 months, with most cases presenting within the first 3 postoperative weeks. Two patients had recurrent effusion after prior pericardiocentesis, whereas the remaining patients presented with large effusions associated with clinical or echocardiographic evidence of cardiac compression.

On preoperative imaging, all effusions were either loculated or predominantly posterior. Several cases showed fibrin septation or imaging features suggestive of clot, explaining why percutaneous drainage was considered technically unfeasible. These anatomical features were confirmed intraoperatively.



Imagine 1 CT scan before and after the operation

Table 1. Baseline Clinical and Operative Characteristics of the 6 Patients

Pt	Index operation	Time	Operative finding	Effusion pattern	Prior drain
1	LA plication + mechanical MVR + tricuspid repair	12 d	Clot + ~200 mL blood	RA region	No
2	Mechanical MVR + AVR + tricuspid annuloplasty	10 d	Clot compressing anterior RV + 150ml blood	Anterior RV	No
3	Ascending aorta replacement + arch debranching	1 mo	~300 mL serous fluid	Loculated; recurrent	2 times
4	Mechanical MVR for healed IE	20 d	~300 mL old hemorrhagic fluid	Loculated; mild tamponade	No
5	Mechanical Bentall + arch bypass + stent graft	13 d	~250 mL hemorrhagic fluid with fibrin	Posterior; non-drainable	No
6	Mechanical MVR + AVR	2 mo	~250 mL serous fluid	Loculated; recurrent	Yes

Abbreviations: *LA, left atrium; MVR, mitral valve replacement; AVR, aortic valve replacement; IE, infective endocarditis; RA, right atrium; RV, right ventricle.*

Intraoperatively, 2 patients had clotted hemopericardium, 2 had non-clotting hemorrhagic effusion, and 2 had a clear serous effusion. In the hemorrhagic cases, the fluid was frequently dark and old, often accompanied by fibrin strands or septation.

Organized clot was seen either as adherent to the pericardium or producing direct compression over the right-sided cardiac chambers. In the 2 patients with prior pericardiocentesis, surgery was undertaken for recurrence and for definitive treatment of the underlying loculated process.

Histopathological examination of the resected pericardium demonstrated chronic inflammatory and fibrotic change in all patients, with varying degrees of vascular congestion. No specimen showed evidence of tuberculosis or malignant involvement. All patients experienced clear symptomatic improvement after surgery. During 3 months of follow-up, there was no recurrent pericardial effusion or death. No thoracoscopy-related major adverse event was documented, including reoperation for bleeding, conversion to sternotomy, myocardial injury, phrenic nerve injury, respiratory failure requiring prolonged ventilation, severe infection, stroke, or recurrent tamponade requiring repeat drainage.

III. DISCUSSION

Postoperative pericardial effusion should not be regarded as a single homogeneous entity. Instead, the present series suggests that clinically significant effusions after cardiac surgery result from the interaction of 2 dominant processes: retained blood within the pericardial space and a persistent inflammatory response of the pericardium itself. This combined mechanism helps explain not only why effusions develop, but also why they become recurrent, loculated, or resistant to standard percutaneous treatment. [1-3,9,10]

In the early postoperative period, retained blood appears to be a central factor. After mediastinal drains are removed, a variable quantity of residual blood may remain within the pericardial cavity. With time, this material may undergo fibrinolysis and appear as non-clotting hemorrhagic effusion or alternatively organize into clotted hemopericardium. Ashikhmina et al reported that postoperative pericardial effusion requiring drainage occurred in a small but clinically significant proportion of patients and was strongly associated with perioperative factors, supporting the concept that retained blood and factors related to the index operation are key contributors.[1]

Our findings are consistent with that model. Most patients in our series had either clotted hemopericardium or old hemorrhagic effusion, and the most acute presentations occurred within the first 2-3 postoperative weeks. In several cases, organized clots directly contributed to cardiac compression, particularly over the right-sided chambers. This observation is clinically important because it highlights a major limitation of percutaneous pericardiocentesis: organized clot cannot be adequately evacuated through a needle or catheter, even when some free fluid is present.

Retained blood, however, is not merely a mechanical burden. Blood degradation products may amplify local inflammation, stimulate fibrin deposition, and promote formation of fibrous septations. Over time, this leads to compartmentalization of the pericardial space and conversion of a potentially drainable effusion into a multiloculated process. This mechanism explains why, in our cohort, effusions were predominantly posterior or loculated and why imaging findings correlated closely with intraoperative findings of fibrin strands and organized collections.[2,4,10]

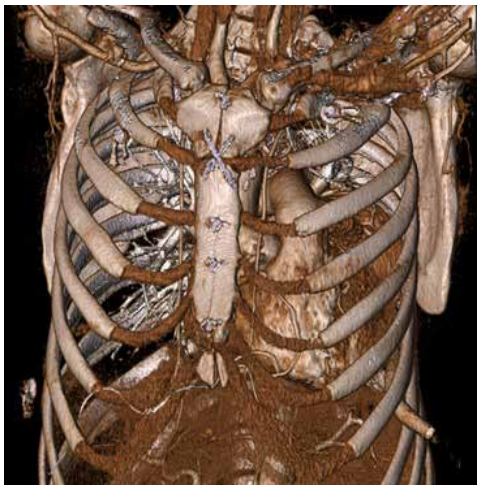
The inflammatory component of the disease was also strongly supported by histopathology. All biopsy specimens showed chronic pericarditis with fibrosis and vascular congestion, and none suggested tuberculosis or malignancy. These findings indicate that postoperative effusions in this setting are frequently maintained by

chronic inflammation rather than by ongoing bleeding alone. Previous studies by Imazio et al. have emphasized the role of inflammatory mechanisms, particularly post-pericardiotomy syndrome, in late or recurrent effusion.[4,11]

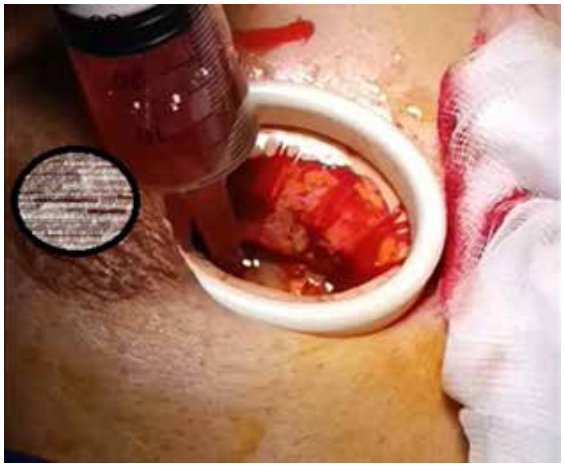
From a therapeutic perspective, our results reinforce the importance of tailoring treatment to the morphology of the effusion rather than its volume alone. While medical therapy and pericardiocentesis remain appropriate for uncomplicated effusions, their effectiveness is limited in cases of posterior, loculated, or clot-associated collections. Jung HO et al. demonstrated that the success of pericardiocentesis depends largely on fluid accessibility, with significantly reduced efficacy in loculated effusions.[5] In such cases, incomplete drainage and persistence of fibrin or clot predispose to recurrence.

Thoracoscopic pericardial window addresses both the mechanical and inflammatory components of the disease. It allows complete evacuation of fluid, removal of clot, disruption of septations, and acquisition of pericardial tissue for diagnosis. Previous studies have consistently shown lower recurrence rates with surgical drainage compared with percutaneous approaches, particularly in complex effusions.[6-8]

From a technical standpoint, several practical considerations may improve safety and operative efficiency in this specific patient population. Because these patients often have compromised hemodynamics, intubation of general anesthesia carries a higher risk of instability. In selected cases with large effusion or tamponade physiology, preliminary decompression through a 2cm 5th intercostal left anterior thoracic access under local anesthesia may help stabilize the patient before intubation. The patient is then positioned in a 30-degree right lateral tilt to optimize the operative field within the pleural cavity.



Imagine 2. 3D reconstruction to select an optimal trocar placement in patient with enlarge heart post operation



Imagine 3. Mini incision in 5th intercostal mid clavicular to drain the pericardial fluid under local anesthesia

Port placement should also be adapted to anatomy, and preoperative chest CT reconstruction facilitates accurate selection of optimal trocar placement. In our experience, the heart is frequently enlarged and positioned close to the anterior chest wall, making standard 5th intercostal port placement suboptimal. A more inferior and slightly posterior camera position (typically at the 7th-8th intercostal space along the mid-axillary line) provides a wider

operative field and avoids interference with the heart. An additional working port at the 5th-6th intercostal space along the mid-axillary line allows adequate triangulation.

After entering the pericardial space, complete evacuation of fluid and removal of clot are essential. Fibrin septations should be carefully disrupted, and pericardial biopsy should be obtained. In our practice, the definitive pericardial window is preferably created at a posterolateral site, slightly posterior to the phrenic nerve, to optimize dependent drainage-particularly in cases with posterior collections. Preoperative computed tomography is highly valuable in planning port placement and anticipating the location of the dominant fluid pocket.

Taking together, these findings suggest that thoracoscopic pericardial window should not be reserved as a last-line option after failing pericardiocentesis. In patients with imaging evidence of loculation, posterior effusion, or clot, early surgical intervention may provide a more definitive and reliable solution.

Potential complications of thoracoscopic pericardial window include bleeding, myocardial or coronary injury, phrenic nerve injury, respiratory complications, infection, and recurrence requiring repeat drainage. None of these major thoracoscopy-related events was documented in our series. In Case 1, although the collection was most evident near the right atrial region on imaging, the effusion remained intrapericardial, and the surgical objective was definitive dependent drainage through a posterior pericardial window rather than direct right-sided chamber exposure; therefore, the left thoracic approach was maintained

This study has several limitations, including its small sample size, single-center design, and relatively short follow-up. However, it focuses on a clinically important subgroup of patients with complex postoperative pericardial effusion, in whom minimally invasive surgical treatment yielded consistent short-term success.

IV. CONCLUSIONS

Complex postoperative pericardial effusion is frequently driven by a combination of retained blood, fibrinous loculation, and chronic pericardial inflammation. When the effusion is posteriorly distributed, septated, recurrent, or associated with clot, percutaneous drainage may be inadequate or impossible. In this setting, thoracoscopic pericardial window provided definitive treatment in all 6 patients in our series, with no recurrence, no mortality, and no documented thoracoscopy-related major adverse event during 3 months of follow-up. Thoracoscopic pericardial window should therefore be considered a valuable early treatment option for selected patients with non-drainable postoperative pericardial effusion.

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