

Thoracoscopic Pericardial Window Creation and Thoracic Duct Ligation in Neonates

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ABSTRACT

Objective: We describe 2 newborn infants with persistent pericardial effusion treated with thoracoscopic pericardial window and thoracic duct ligation.

Methods: Patient 1 was a premature female newborn who presented with severe cardiac anomalies, including dextrocardia. She was treated with pulmonary artery banding and pacemaker placement for complete cardiac block. Postoperatively, she developed pericarditis with persistent symptomatic pericardial effusion. She did not improve despite pericardial drain placement. She was treated with a thoracoscopic pericardial window. Patient 2 was a newborn male who presented with cardiac tamponade secondary to congenital chylopericardium. He did not respond to pericardial drain placement or medical management with fasting, total parenteral nutrition, and octreotide. He was treated with thoracoscopic pericardial window and thoracic duct ligation.

Results: Patient 1 improved rapidly. The pericardial effusion disappeared. The chest tube was removed 5 days following surgery. She died 6 weeks later of a cardiac arrhythmia secondary to pacemaker failure. The pericardial effusion had resolved. Patient 2 responded to the pericardial window and thoracic duct ligation. He was discharged 10 days following the procedure.

Conclusions: Thoracoscopy provides an excellent approach to the pericardium. Pericardial windows and biopsy can be safely performed with this approach. The thoracic duct can be easily identified and ligated even in small babies. Recovery can be fast with minimal postoperative discomfort. Cosmetic results are excellent and length of hospitalization is minimized.

Key Words: Thoracoscopy, Pericardial window techniques, Thoracic duct ligation, Infant.

INTRODUCTION

Pericardial effusions are a rare neonatal condition. They have been associated with operative trauma, lymphangiectasis, irradiation, caval obstruction, and primary and metastatic mediastinal tumors (**Table 1**).¹⁻⁴ Occasionally, the exact cause remains unknown. Regardless of the cause, approximately 45% to 55% of pericardial effusions require surgical intervention when medical management fails.^{5,6} Although the indications for surgery are often obvious, as in cardiac tamponade, choosing the best route for drainage is often a complex decision. This is especially true in neonates in whom the thoracoscopic approach is often limited because of the patient's size.

In the present report, we describe 2 cases of pericardial effusion in neonates. One patient had a pericardial effusion after cardiac surgery, and the other had a chylopericardium secondary to congenital lymphangiectasis. Both patients underwent thoracoscopic surgery as successful definitive therapy. The surgical management of these pediatric patients illustrates the safety and effectiveness of thoracoscopic pericardial window creation with or without concomitant thoracic duct ligation as a surgical option for pericardial effusion, even in neonates weighing as little as 3.3 kg.

CASE REPORTS

Case 1

A 3-month-old Hispanic female with a history of dextrocardia, multiple ventricular septal defects, atria septal defect, sinus node dysfunction, and pulmonary venous anomalies presented to our pediatric intensive care unit in respiratory distress requiring mechanical ventilation. An admission chest radiograph demonstrated dextrocardia and cardiomegaly. An initial echocardiogram found good ventricular function and no evidence of pericardial effusion. She was taken to the operating room and had pulmonary artery banding and insertion of a pacing sys-

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Table 1.

Causes of Pericardial Effusion¹⁻⁵

Surgical trauma
Lymphangiectasis
Lymphangiomas
Irradiation
Primary and metastatic mediastinal tumors
Infections (eg, viral, bacterial, tuberculosis)
Caval obstruction or thrombosis
Nonsurgical trauma
Cystic hygromas
Primary pericardial tumors (eg, teratoma, fibroma, lipoma, angioma, leiomyofibroma)
Rheumatic
Idiopathic

Table 2.

Pericardial Fluid Analysis

Fluid Characteristic	Case 1	Case 2
Appearance	Bloody	Cloudy
Color	Bloody	Yellow
WBC (per mm ³)*	375	21 650
RBC (per mm ³)†	211 000	20 000
PMN (%)‡	76	4
Lymphocytes (%)	20	93
Monocytes (%)	4	3
Glucose (mg/dL)	—	54
Triglycerides (mg/dL)	—	964
Total protein (mg/dL)	2.9	4.1
pH	—	8.3
Gram stain	Negative	Negative

*WBC = white blood cells.

†RBC = red blood cells.

‡PMN = Polymorphonuclear leukocytes.

tem. Following surgery, she developed a large pericardial effusion, which was detected on an echocardiogram. A pericardial catheter was placed and drained about 40 cc to 80 cc of serous fluid daily despite medical management. Consequently, she was taken to the operating room for creation of a thoracoscopic pericardial window. Despite her preoperative weight of only 3.3 kg, the patient recovered well after surgery. Follow-up echocardiograms showed no residual effusion. Her chest tube was removed on the fifth postoperative day; however, she died 6 weeks later of a cardiac arrhythmia secondary to pacemaker failure.

Case 2

A newborn male infant was transferred to our neonatal intensive care unit for a pericardial effusion that was diagnosed prenatally via ultrasound. Upon birth, the patient was found to have congenital anomalies including macroglossia, skin folds, and overriding suture plates. The patient underwent a pericardiocentesis on the first day of life, and fluid analysis demonstrated a chylopericardium (**Table 2**). Repeated pericardiocentesis and follow-up echocardiograms revealed a persistent, large pericardial effusion. As a result, a pericardial catheter was inserted, and an average of about 50 cc of chyle drained from it daily despite medical management. The patient

was taken to the operating room on his 27th day of life (weight, 3.9 kg), and a thoracoscopic thoracic duct ligation was performed followed by thoracoscopic creation of a pericardial window. The chest tube was removed on the 5th postoperative day. A repeat echocardiogram postoperatively demonstrated minimal residual pericardial effusion. The patient was subsequently discharged on the 10th postoperative day, and is currently doing well.

Surgical Technique

In both cases, the neonate was given general anesthesia with a single lumen endotracheal tube, and placed in the left lateral decubitus position with the right chest up. After preparing the chest, a 5-mm thoracoscopic trocar was introduced into the thoracic cavity in the mid axillary line, fifth intercostal space. The chest was then insufflated with carbon dioxide to a pressure of 6 to 8 mm Hg to collapse the right lung parenchyma. Then, under direct vision, a second trocar was placed in the anterior axillary line, seventh intercostal space. Finally, to complete the triangulation of the ports, a third trocar was inserted in the posterior axillary line, seventh intercostal space.

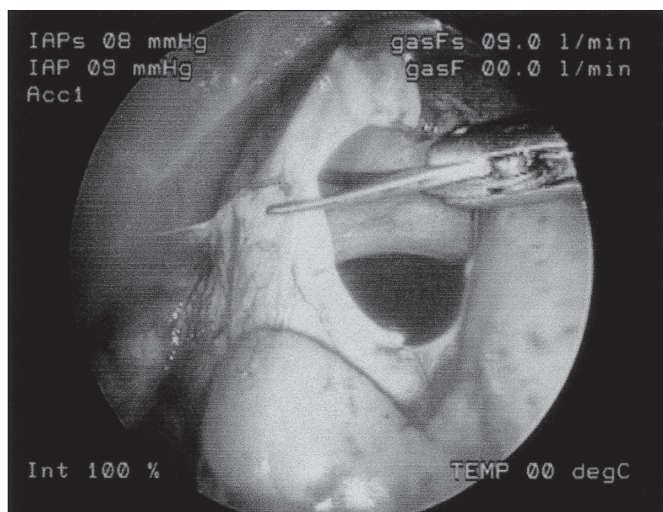


Figure 1. Creation of pericardial window and performance of biopsy.

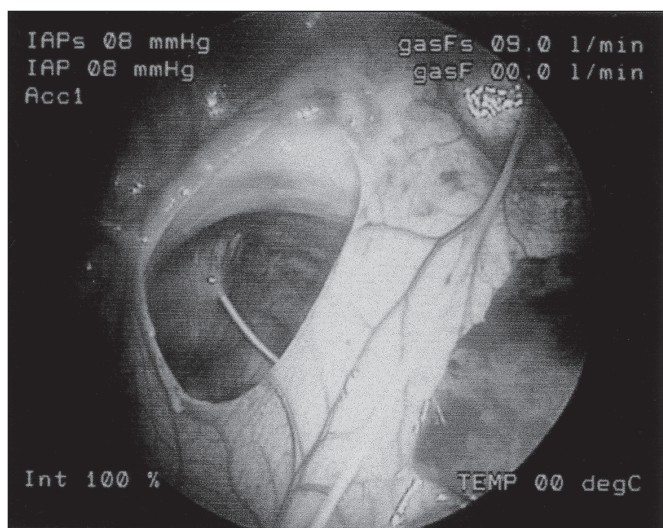


Figure 2. After creation of pericardial window, pericardioscopy was performed. The percutaneously placed catheter for drainage of pericardial tamponade is seen inside the pericardium.

The phrenic and vagus nerves were identified and preserved. The Harmonic scalpel was then used to open the pericardium. An appropriately large pericardial window was created with a combination of the Harmonic scalpel and endoscopic scissors. The fluid drained from the pericardium was suctioned from the chest as well as the

opened pericardial sac. Pericardioscopy was then performed, and the adhesions encountered were divided using the Harmonic scalpel. The procedure was finished with the placement of a chest tube. The ports were removed and closed in the usual fashion.

In the second case, the patient had a chylopericardium; therefore, a thoracoscopic thoracic duct ligation was carried out prior to the creation of the pericardial window (**Figures 1 and 2**). In this patient, a 12F nasogastric tube was placed to make the esophagus easier to recognize during dissection. In addition, 10 mL of intralipid via nasogastric tube was administered about 1 hour prior to surgery to facilitate identification of the thoracic duct. The ports were placed as described above. Then the esophagus, aorta, and azygos vein were identified. Dissection occurred low in the chest on the thoracic vertebral bodies. The pleura were opened over the spine, and the thoracic duct was identified and clipped en bloc with 5-mm Endo Clips. Care was taken not to disrupt the continuity of the duct and its tributaries.⁶ The thoracoscopic pericardial window was then created as described above.

DISCUSSION

Death from cardiac compression by a pericardial effusion was first documented in the 17th century.² The catastrophic complication of cardiac tamponade and death makes the detection and treatment of large pericardial effusions imperative, especially in neonates who naturally have a limited physiological reserve. However, to be clinically significant, a pericardial effusion need not cause cardiac tamponade. Complications including electrolyte, fluid, and acid-base imbalances often develop in children with chronic effusions. Other morbidities include protein wasting, as well as loss of triglycerides, fat-soluble vitamins, and lymphocytes in patients with chylopericardium.⁶⁻⁸ These complications can also be life-threatening if left to run their natural course.

Therapeutic intervention of some kind is mandatory in large and chronic pericardial effusions. Traditionally, as in the 2 cases described in the present report, the initial therapy is medical management. It is only when this approach is unsuccessful that surgical intervention becomes mandatory.

The medical therapy for pericardial effusions is based on the type of fluid encountered. Serous effusions, as in

case 1, are treated with pericardiocentesis and judicious fluid and electrolyte management.⁹ In addition, chylopericardium, as in case 2, is managed with a medium-chain fatty acid diet because it is directly absorbed into the portal system, thus bypassing chylomicron creation and deposition via the thoracic duct into the pericardium. If this diet fails, feedings are stopped and the patient is placed on total parenteral nutrition. Again, failure with this therapy warrants surgical treatment, as in the present cases.^{3,5-8,10}

Pericardial drainage and pericardiocentesis with dietary manipulation are effective therapy in approximately 55% of patients with pericardial effusions.⁵ The remaining patients require surgery. Indications for operative management include tamponade,^{5,11,12} as well as patient intolerance of fluid and nutrient loss.^{3,5,7,12}

Multiple options are available to the surgeon for the treatment of pericardial effusions. Open pericardial window creation has proven a reliable surgical alternative for the drainage of pericardial fluid. Other methods of drainage, such as pericardioperitoneal windows^{5,13} and total pericardiectomy,¹⁴ have been proposed as alternative interventions in adults.

Thoracoscopic pericardial window creation may be the surgical technique of choice in neonates with persistent or symptomatic pericardial effusions. Although thoracoscopic surgery is an established approach in adults, experience demonstrating its usefulness in the pediatric population is limited.¹⁵ The present 2 cases, however, demonstrate that thoracoscopic pericardial window creation with or without thoracic duct ligation is a safe and effective treatment for pericardial effusions in neonates.

The thoracoscopic approach has many advantages over conventional thoracotomy for the drainage of these effusions. The smaller incisions used result in a decrease in postoperative pain and, subsequently, foster fewer pulmonary complications.^{6,13} Consequently, these patients have a shorter hospital stay and a more rapid return to normal activity than those undergoing a classical thoracotomy.⁹ These factors hold true even if concomitant procedures, such as thoracic duct ligation, are carried out, as in case 2.

It is believed by some that small infants are not amenable to minimally invasive surgery because of their size. We, however, disagree. Rather, with use of appropriately sized instruments and careful surgical technique, thora-

scopic pericardial window creation can be performed successfully even in neonates weighing less than 4 kg. The only obvious contraindication for this procedure is the child's inability to tolerate single-lung ventilation during the procedure.^{13,15} Such unstable infants should undergo a conventional thoracotomy.

CONCLUSIONS

Pericardial effusions in neonates require surgical intervention when medical management fails. It is imperative to intervene in a timely fashion so as to prevent severe sequelae, such as protein wasting and malnutrition. The ensuing operation should be a thoracoscopic pericardial window creation despite the patient's size at the time of surgery. Even neonates can benefit from this minimally invasive approach. Therefore, as illustrated by the present cases, thoracoscopic pericardial window creation with or without thoracic duct ligation provides a safe and effective alternative to classical thoracotomy in the drainage of pericardial effusions in the pediatric population.

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