

# **Pleural Effusions in Neonatal and Pediatric Cardiac Patients**

## **What Every Nurse Needs to Know**

Kim Kellogg, MS, CPNP, CS Mott Children's Hospital, The University of Michigan Heart Center

Melanie Guerrero, MSN, RN, CPN, Children's Hospital Los Angeles

Terri Lynn Dees, MNsc, APRN, PNP-BC, CPNP-AC, Arkansas Children's Hospital

Misty Ellis, MSN, APRN, University of Louisville and Kosair Children's Hospital

Louise Callow, MSN, RN, CPNP, CS Mott Children's Hospital, The University of Michigan Heart Center

### **Introduction:**

Pleural fluid is a small amount of fluid which lies between and lubricates the space between the visceral and parietal pleural and is absorbed into the lymphatic system. When the amount of fluid secreted exceeds the ability to absorb it, pleural effusions occur. There are several reasons for this complication: increased capillary permeability, increased hydrostatic pressure, increased right heart pressures or venous hypertension, decreased oncotic pressure and/or negative pressure changes within the lung.

This guideline defines the various etiologies of pleural effusions, risk factors for development, clinical signs and symptoms, complications, medical and surgical treatment options and special considerations.

### **Critical Thinking Points:**

- Common after cardiac surgery
- Result of multiple etiologies
- Increase patient risk for cardiac decompensation from compromised respiratory function and from treatment interventions
- Increase patient risk for hospital acquired complications
- Prolonged hospitalization

### **Definition**

- Abnormal collection of fluid within the pleural space
- Incidence
  - 25% incidence of pleural effusions in children who have undergone a cardiac surgical procedure
  - Result in significant morbidity
  - Contribute to increased length of hospital stay
- Types of effusions
  - Bloody effusion, hemothorax

- Blood collected in pleural space as a result of surgical trauma or ongoing surgical bleeding
    - Occurs due to direct trauma during surgery, anticoagulation from cardiopulmonary bypass, inadequate hemostasis at the conclusion of operation, coagulation abnormality from transfusion
  - Serous effusion
    - Serous fluid rich in protein which collects in pleural space
    - Occurs due to high venous pressure postoperatively
  - Chylous effusion
    - Chyle-lymphatic fluid rich in fat and has digestive products absorbed by the intestinal epithelium
    - Occurs due to direct trauma to the thoracic duct and lymphatic system during operation
    - Pseudochylothorax (chyliform pleural effusion or cholesterol pleural effusion) mimics chylous pleural effusion in appearance, but lacks the biochemical criteria for chylothorax
  - Malignant effusion
  - Infectious effusion
- Risk factors for development of pleural effusions
  - Bloody effusion
    - Anticoagulation for surgery
    - Platelet function disorder/ coagulation defect from long standing cyanosis/hypoxemia
    - Surgical trauma/inadequate hemostasis in operating room
    - Previous surgery with resultant adhesions
    - Postoperative anticoagulation
  - Serous effusion
    - Systemic venous hypertension typically associated with an extracardiac Fontan or non-fenestrated Fontan
    - Small pulmonary artery size
    - Peripheral pulmonary artery stenosis
    - Significant tricuspid regurgitation
    - Right ventricular diastolic dysfunction typically tetralogy of Fallot, Ebsteins anomaly
    - Alterations in hormones that regulate fluid and electrolyte balance
    - Prolonged mechanical ventilation
    - Elevated pulmonary vascular resistance

- Chylous effusion
  - Surgical interventions in area of thoracic duct, typically PDA ligation, systemic to pulmonary shunt, coarctation or interrupted aortic arch repair, aortic arch reconstruction, redo operations with adhesions
  - Systemic venous hypertension typically Fontan operation
  - Right or left ventricular diastolic dysfunction
- Infectious effusion
  - Empyema
  - Pneumonia
  - Wound infection, mediastinitis
  - Postpericardotomy Syndrome
- Malignant effusion
  - Cancer relapse
- Clinical features
  - Signs and Symptoms
    - Dependent on size of effusion and underlying physiology
    - Shortness of breath
    - Fever
    - Chest pain
    - Desaturation
    - Increase work of breathing, retractions, grunting, flaring
    - Tachypnea
    - Cardiac decompensation
  - Laboratory tests
    - CBC with differential
    - Serum electrolytes, BUN and creatinine
    - Triglycerides and cholesterol of effusion fluid
    - Serum total protein and albumin
    - IGG
    - AT III
  - Diagnostic evaluation
    - Chest xray: AP/PA, lateral, decubitus
    - Ultrasound
    - Echocardiogram
    - Chest CT
  - Sequelae
    - Malnutrition

- Weakness
  - Dehydration
  - Metabolic acidosis
  - Compromised immune status, infection
  - Requirement for intervention
  - Coagulopathy
  - Respiratory distress
  - Longer hospitalization
- Treatment options - Medical
  - Chylous effusions
    - Diet modification: Low fat diet (<20gram/fat per day or formula with medium chain triglycerides with MCT such as Portagen or Enfaport)
    - Breast milk treated to reduce fat content
    - Diet modification course 6 weeks
    - NPO, parenteral nutrition and lipids 7-10 days or until drainage is reduced
    - Octreotide infusion to reduce splanchnic blood flow may be helpful
    - IGG infusions
  - Serous
    - Supportive care for respiratory and cardiac systems
    - Diuretic therapy
    - Electrolyte and albumin replacement and monitoring
  - Infectious
    - Treat etiology of infection
    - NSAIDS and GI prophylaxis
  - Blood
    - Clotting factors: platelets, fresh frozen plasma, cryoprecipitate pending results of coagulation studies
    - Red blood cell transfusion for maintenance of adequate hematocrit
    - Factor VII
    - Volume replacement with lactate ringers, normal saline, blood, dextran, or 5% albumin boluses to maintain hemodynamic stability
    - Calcium and bicarbonate replacement as indicated depending on volume of transfusion
    - Use of blood warmer, rapid transfuser for large volume colloid replacement
  - Cardiac imaging by catheterization or MRI

- Assess residual lesion amenable to surgical repair
  - Intervention in catheterization lab: coil collaterals, balloon dilation of obstruction
- Treatment options - Surgical
  - Pleurocentesis for effusions not likely to recur or in situation where immediate drainage required and time for chest tube placement not safe
  - Chest tube placement for stable but large effusion or effusion with expectation for continued drainage
  - Re-exploration for bleeding if coagulation intake and bleeding continues
  - Thoracic duct ligation for chylous effusion not amenable to medical treatment
  - Pleurodesis for recurrent chylous effusion despite thoracic duct ligation
  - Reoperation for residual hemodynamically significant defect
    - SVC obstruction
    - Collateral flow not amenable to catheterization intervention
    - Tricuspid regurgitation
    - Residual shunt with ventricular diastolic overload
    - Pulmonary artery obstruction
    - Obstruction to pulmonary blood flow
- Special considerations
  - Nutritional inadequacy
    - Albumin supplementation to maintain serum albumin level >2gram/dl
    - Multi-vitamin
    - Electrolyte replacement
  - Respiratory support
    - Oxygen
    - Noninvasive support: CPAP, BiPAP, HFNC
    - Mechanical ventilation
    - Positioning
  - Infectious complications
    - Prophylactic antibiotics while chest tube in place
    - Risk of central line placement for management of prolonged effusion
    - Risk of sepsis from loss immunoglobulin, white cells and lymphocytes
    - Risk of invasive procedure for chest tube placement and maintenance

## References:

Talwar, S., Agarwala, S., Mittal, C., Choudhary, S., Airan, B. (2010). Pleural effusions in children undergoing cardiac surgery. *Annals of Pediatric Cardiology*, 1 (3), 58-64.

Zulga, M. (2012). Chylothorax after surgery for congenital heart disease. *Current Opinion in Pediatrics* 24:291-294.

Chan, E., Russell, J., Williams, W., et al. (2005). Postoperative chylothorax after cardiothoracic surgery in children. *Ann Thoracic Surg*, 80, 1864-1870.

Bauman, M. E., Moher, C., Bruce, A. K., et al. (2013). Chylothorax in children with congenital heart disease: incidence of thrombosis. *Thrombosis Research*, 132, e83-e85.

McCulloch, M. A., Conaway, M. R., Haizlip, J. A., et al. (2008). Postoperative chylothorax development is associated with increased incidence and risk profile for central venous thromboses. *Pediatric Cardio*, 29, 556-561.