

Malignant Tension Hydrothorax with Mediastinal Shifting: Emergency Decompression of a Rare and Potentially Lethal Respiratory Condition

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Abstract

Introduction: A Tension Hydrothorax is defined as a massive pleural effusion presenting with hemodynamic abnormalities secondary to mediastinal compression. In these patients the pleural volume increases the intrathoracic pressure to the point of compromising diastolic filling and cardiac output simulating a cardiac tamponade physiology. This is an uncommon yet potentially fatal medical emergency that if left untreated may lead to cardiac arrest. Early detection and rapid intervention of these patients prevents cardiorespiratory collapse.

Case presentation: We present a two-case report of patients presenting with a malignant tension hydrothorax managed in the emergency room with ultrasound-guided decompression thoracentesis and the other patient with tube thoracostomy.

Conclusion: Although these life-saving decompressive interventions appear simple, not having proper training is an independent factor for chest tube and thoracentesis complications. Courses and simulation training can benefit physicians to minimize potential complications when managing emergency conditions and pathologies such as a Tension hydrothorax which continues to be a medical challenge. Whether thoracentesis or thoracostomy is superior in managing this condition remains in debate and a clinical dilemma.

Keywords: Tension hydrothorax; Pleural effusion; Thoracostomy; Thoracentesis

Introduction

A pleural effusion is the excess pleural fluid within the pleural cavity defined as >15 cc and generally considered to be significant above 500 cc. Normal volume is approximately 0.1 to 0.3 ml/kg, produced at 0.01 ml/kg/h from parietal capillaries and removed by parietal lymphatics at 0.28 ml/kg/h. When normal pleural physiology is impaired, pleural fluid accumulates; this happens through transudate mechanisms such as increased hydrostatic pressure seen in heart failure or decreased oncotic pressure seen in liver failure. Transudate effusions are more likely to be bilateral and chest tubes are usually not needed. Exudate mechanisms however occur through inflammatory and infectious processes such as pneumonia, obstructive processes as in neoplasms or trauma. Exudate effusions are usually unilateral and some may eventually need a chest tube. When massive, pleural effusions can cause significant cardiopulmonary and hemodynamic compromise secondary to mediastinal compression manifesting as tamponade physiology known as a tension hydrothorax. This is due to the pleural fluid volume causing an increase in intrathoracic pressure leading to an inadequate diastolic filling and cardiac output simulating a cardiac tamponade. The exact incidence of this rare condition is unknown, however it is a potentially fatal medical emergency, that if unrecognized early may progress to cardiac arrest [1-10]. Although thoracentesis is the initial approach to most pleural effusions, patient stabilization takes priority in these patients because of the level of hemodynamic and respiratory insult; therefore chest tube decompression may be required in some patients depending on the clinical presentation, suspected etiology and physician preference and training. The criteria for placing a chest tube in massive pleural effusions include associated pneumothorax or hemothorax, respiratory and hemodynamic instability, and grade III-V parapneumonic effusions. There are no absolute contraindications for chest tube placement except refusal by the patient or adherence of the lung to the chest wall. History of pleurodesis may also predict better results with thoracentesis. Relative contraindications include coagulopathies, loculations and large tumors masquerading as

effusions. Here we report two cases of patients presenting with a tension hydrothorax, one managed with ultrasound-guided thoracentesis and another with a chest tube [11-19].

Case Presentation

Case 1

A 43-year-old male patient presents to the ER with a clinical picture of acute progressive respiratory difficulty during the last 4 days. On admission, there was severe dyspnea with significant use of accessory respiratory muscles, tachycardia (113 bpm), less than normal pulse oximeter (88% SaO₂), blood pressure of (89/48 mmHg), absent right pulmonary breath sounds and dullness to percussion. Neither jugular ingurgitation nor muffled heart sounds were present. The patient's initial chest X-ray showed a massive unilateral right pleural effusion along with tracheal and mediastinal deviation to the opposite hemithorax (Figure 1). Considering the pleural fluid volume, respiratory insult and hemodynamic compromise, a chest tube was inserted using standard Royal College of Surgeons' and ATLS recommendations; chest tube placed in the 5th intercostal space with anterior axillary line revealed a serosanguinous odorless fluid under pressure. The chest tube was connected to a pleural drainage system without suction and clamped at 1400 cc immediate drainage. Post-thoracostomy chest X-ray confirmed appropriate chest tube position as well as mediastinal and tracheal realignment (Figure 2). Immediately following drainage, the

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Figure 1: Chest X-ray revealing a massive right unilateral pleural effusion with mediastinal shift-compression and tracheal deviation (tension hydrothorax).



Figure 2: Post-chest tube AP Chest X-ray confirming appropriate chest tube placement and tracheal realignment.

patient's respiratory pattern, hemodynamics and adequate oxygenation were restored and attained. Pleural fluid analysis showed a malignant-exudate effusion, with a negative gram stain and bacterial culture. Follow-up chest X-ray showed a right lung mass not initially visible due to the effusion volume.

Case 2

A 29-year-old female patient with a clinical history of bilateral metastatic breast cancer treated with chemotherapy and radiotherapy presents to the ER with a clinical picture of 1 week consisting of severe dyspnea, left pleuritic pain and significant use of accessory respiratory muscles. On admission she had a blood pressure of (119/60 mmHg) heart rate of (122 bpm) a respiratory rate of (24 rpm) and O₂ saturation of 87%. Physical exam revealed absent left breath sounds, dullness to percussion and jugular ingurgitation. Initial chest X-ray showed a massive left-sided pleural effusion with mediastinal compression and



Figure 3: Chest X-ray revealing a massive left unilateral pleural effusion with mediastinal shift-compression and tracheal deviation (tension hydrothorax).



Figure 4: Post-chest tube AP Chest X-ray confirming low chest tube and tracheal realignment with persistent pleural air.

tracheal deviation to the opposite hemithorax (Figure 3). Emergency ultrasound-guided needle decompression revealed 3000 cc of an odorless serous-yellowish fluid under pressure. Post-thoracentesis chest X-ray showed a 25% pneumothorax secondary to needle decompression and the patient had a chest tube placed. Following drainage, the patient's respiratory pattern and hemodynamics were quickly restored. Post-chest tube X-ray showed tracheal and mediastinal realignment, and a low placed chest tube with persistent pleural air later placed on suction (Figure 4). Pleural fluid analysis revealed a malignant-exudate effusion with negative gram-stains.

Discussion

Massive pleural effusions are defined as occupying >2/3 of the hemithorax and can be either malignant (67%) or non-malignant. 10% of pleural effusions present as massive and 10% of patients with pleural carcinomas have massive effusions with complete hemithorax opacification. Up to 65% of cancer patients will have pleural effusions at one point during their ailment and when present in the context of malignancy, life-expectancy is 4 months. Non-malignant causes include trauma, chylothorax, pancreatitis, cirrhosis, TBC, parapneumonic effusions and other autoimmune diseases. Physical exam will usually

show reduced or absent breath sounds over the affected hemithorax along with dyspnea, simple chest X-rays are usually sufficient to confirm increased pleural fluid. Large pleural effusions may be evacuated either by thoracentesis or by tube thoracostomy depending on clinical presentation, suspected etiology and the attending physician's preference.

The most common complication of thoracentesis is a pneumothorax which can occur in about 20%-39% of cases without the use of radiology; when performed using ultrasound-guidance, pneumothorax rates are reduced to 2.5%-13.9%; of which 30-50% require a chest tube. Chest tube complications have a rate of 3%-18%, the most common being malpositioning. Care must taken when draining the pleural cavity to avoid causing reexpansion lung edema, a rare complication (0.2%) which can appear when pleural fluid or air in a collapsed or trapped lung is evacuated too rapidly [20-24]. Although uncommon, it is recommended not to exceed a fluid drainage of more than 1000 cc at insertion or 1500 cc within the first 24 hours as a precaution. When performing thoracentesis, a more than 1100 cc immediate fluid evacuation increases the risk of developing a pneumothorax, therefore whether tube thoracostomy or thoracentesis is superior for decompressing a tension hydrothorax is still in debate since re-establishing proper cardiothoracic dynamics usually requires an initial drainage of at least 1500 cc. A chest tube therefore can both drain the fluid as well as address a pneumothorax, whereas thoracentesis may result in a patient requiring a second procedure.

Placement of chest tubes or thoracentesis, simple yet high-risk and sometimes lifesaving invasive techniques, are usually performed by surgeons (chest tube), pulmonologists (thoracentesis) and radiologists (image-guided thoracentesis), at teaching hospitals closed thoracostomies are performed mostly by surgery residents and to a minor degree by residents of other specialties. Although placing a chest tube is considered to be a simple procedure, with insufficient expertise and training it can become life threatening. The literature shows that general surgery residents have a lower chest tube complication percentage than residents in other residency programs (7%), family and internal medicine (13%) emergency medicine (40%). Being a non-surgical trainee is thus an independent risk factor for chest tube placement complications. Courses such as the Specialty Skills in Cardiothoracic Surgery Course offered by the Royal College of Surgeons, ATLS training and other similar courses may greatly benefit physicians exposed to chest tube requiring pathologies. One study showed faster tube thoracostomy performances when practiced on simulation-embalmed cadavers. In performances with image-guided thoracentesis; radiologists and radiology residents have the lowest pneumothorax rates of 0.5-1.8% in comparison to other specialties.

A Tension hydrothorax is a rare and potentially fatal medical emergency that can quickly lead to cardiac arrest, early suspicion and detection of this condition may prove lifesaving with the proper decompression with a chest tube or needle thoracentesis [23-33]. This condition continues to be a medical challenge and whether thoracentesis or tube thoracostomy is superior in decompressing a tension hydrothorax remains in debate and a clinical dilemma. The decision is made depending on the attending physician's preference, equipment availability and the patient's hemodynamic status. Both of our patients had a malignant tension hydrothorax and decompression technique was chosen according to their individual hemodynamic and respiratory needs.

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