Hemothorax

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ABSTRACT

Hemothorax has been recognized as a clinical entity for centuries. However, the use of closed drainage has only recently been described in the last 50 years. Chest radiography remains the mainstay of diagnosis, however computed tomography and ultrasound are useful in some circumstances. The treatment of hemothorax is adequate drainage. Drainage allows for apposition of the visceral and parietal pleura, which aids hemostasis. Massive hemothorax and ongoing bleeding are indications for thoracotomy. Clotted hemothorax can be difficult to drain adequately with tube thoracostomy alone. Video assisted thoracic surgery (VATS) has proven most effective in obtaining adequate drainage if performed early in the patient’s course.

KEYWORDS: Hemothorax, etiology, diagnosis, treatment, video assisted thoracic surgery, empyema, pleural decortication

Objectives: Upon completion of this article the reader should be able to (1) identify patients at risk for hemothorax, (2) list laboratory and radiographic studies that aid in the diagnosis of hemothorax, and (3) understand the options for treatment of hemothorax and the indications for each treatment.

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EPIDEMIOLOGY

Hemothorax results most commonly from blunt, penetrating, or iatrogenic thoracic trauma. Spontaneous hemothorax due to various causes occurs rarely. The causes include complication of anticoagulation therapy, coagulopathy, malignancy, arteriovenous malformation, pulmonary embolism with infarction, and tuberculosis.²⁻⁵

Thoracic trauma was recorded by Egyptian physicians as early as 3000 BC.³ Early methods of treatment included open packing of wounds with a poultice. Theodoric, in the 13th century, recommended debridement and closure of thoracic wounds. Closed chest drainage was introduced in the 19th century. However, it did not become popular until World War II. Radiography was added in the nineteenth century, and it aided significantly in the diagnosis of thoracic pathology.

This article discusses the causes of hemothorax, including spontaneous hemothorax, the diagnosis of hemothorax, and treatment strategies for hemothorax as well as the complications of hemothorax.
Regardless of the etiology, the diagnosis and treatment of hemothorax are similar.

DIAGNOSIS
Hemothorax is diagnosed most commonly when a pleural effusion is detected on chest radiography after thoracic trauma. In the supine patient, such as the trauma patient in spinal precautions, hemothorax may manifest as a diffuse haziness in the affected hemithorax on chest radiograph. Upright chest radiographs usually demonstrate blunting of the costophrenic angle with as little as 250 mL of blood. A lateral decubitus film may be helpful in demonstrating a clotted hemothorax if the effusion/hemothorax does not layer in the most dependent portion of the chest cavity. Delayed hemorrhage occurs in 7 to 9% of penetrating thoracic injuries. Therefore, repeating a chest radiograph in 3 to 6 hours after a penetrating injury is essential. If a patient with thoracic trauma manifests a significant decrease in hematocrit, repeat chest radiography should be obtained independent of the time of injury.

Physical examination can raise the index of suspicion of hemothorax. These findings include decreased ipsilateral breath sounds, dullness to percussion, and decreased fremitus on the affected side. With tension hemothorax, the trachea deviates away from the involved side. The jugular veins are usually not distended because of the blood lost into the chest. This is in contrast to a tension pneumothorax that is associated with jugular venous distention due to the increased intrathoracic pressure.

Patients without a history of trauma may have pleural effusions that are not bloody. Hemothorax is defined as a bloody pleural effusion with a hematocrit or red cell count that is 50% or more of the peripheral blood hematocrit or red cell count. Pleural fluid for analysis can be obtained at the time of chest tube insertion or via thoracentesis.

Besides chest radiography, hemothorax can be identified and assessed with other radiological techniques. Ultrasonography has proved useful in diagnosing traumatic pleural effusions. Bedside ultrasound can be performed rapidly by the surgeon during the initial evaluation of an injured patient. However, quantifying the amount of fluid in the pleural space with ultrasound is difficult. Computed tomography can easily identify and quantify fluid in the pleural space and may be of value in determining the cause of spontaneous hemothorax.

Patients with spontaneous hemothorax require additional diagnostic tests to determine the cause. Pleural fluid should be analyzed for cell count and cytology. In addition, sputum should be obtained for acid-fast bacilli. Coagulation profile should be checked. This should include not only PT (prothrombin time), INR (international normalized ratio), a PTT (activated partial thromboplastin time), but also fibrinogen, fibrinogen degradation products, and d-dimer to evaluate for disseminated intravascular coagulation. Anticoagulants prescribed to the patient should be discontinued, and fresh frozen plasma administered to correct any coagulopathy found. Chest computed tomography may reveal pulmonary lesions such as lung cancer, metastatic disease, arteriovenous malformation, or pulmonary embolus. Although helical computed tomography has been used to evaluate the pulmonary arteries for clot, pulmonary angiography remains the gold standard for the diagnosis of pulmonary embolus. Angiography of both the pulmonary vasculature and the bronchial arteries can identify arteriovenous malformations, and definitive treatment can be achieved with embolization.

TREATMENT
Initial treatment of a hemothorax is directed at correction of hypovolemia and drainage of blood in the pleural space. The latter is best achieved by tube thoracostomy. Adequate pleural drainage achieves three goals. The first is to evacuate the pleural space and bring the visceral and parietal pleura into apposition. The site of bleeding will usually be a vessel in the parietal or visceral pleura. Generally, these vessels will cease bleeding once the space is evacuated and the pleura are in apposition. Second, drainage allows for reexpansion of the pulmonary parenchyma. Lung reexpansion tamponades parenchymal bleeding after most injuries. The third goal of drainage is to remove the clotted blood. Blood contains not only procoagulants, but also anti-coagulants and fibrinolysins. The coagulation cascade interacts with and upregulates the fibrinolytic system. This can result in lysis of the clotted blood and continued bleeding. Fluid in the hemithorax that does not layer on a decubitus radiograph is likely clotted. A clotted hemothorax is less likely to respond to treatment by tube thoracostomy alone.

To facilitate drainage of blood, the largest tube that can be placed between the ribs should be used. Most adults can easily accommodate 36-French tubes. However, tube size ranges from 10F to 20F in infants and 14F to 32F in children ages 1 to 7. Tube thoracostomy should be performed using aseptic technique. A combination of local and parenteral analgesia should be used, keeping in mind that narcotics and sedatives can precipitate hypotension in hypovolemic patients. The patient’s hemodynamic and oxygenation status should be monitored during the procedure. Chest tubes should be inserted in the fifth intercostal space just anterior to the midaxillary line (behind the lateral border of the pectoralis major muscle). In the setting of trauma, we recommend making the skin incision directly over the intercostal space and tunneling straight into the pleural cavity; in other settings, the skin incision can be made
below the fifth intercostal and a subcutaneous tunnel created to reach the fifth intercostal space before entering the pleural cavity. The incision should be large enough to allow for digital examination of the pleural space to insure the lung parenchyma is free, thus preventing injury to the lung during tube insertion. Tube placement is guided by the surgeon’s finger or by use of a clamp. The tip of the tube ideally should lay in the apex of the pleural space. Caution should be used when guiding the chest tube with a clamp, as injury to the lung is possible. After the tube is placed, its position between the ribs should be confirmed by palpation. The tube is secured at the skin using an 0 silk or nylon suture. Petroleum gauze such as xeroform is place around the tube as it exits the skin to decrease the incidence of air leak at this site. Once the tube is secured, it should be placed on 20 cm of water suction.

The amount of blood drained at the time of insertion as well as subsequent drainage should be recorded (the amount drained at the time of insertion should include an estimate of the amount drained onto the sterile drapes, bedding, etc.). In most cases, adequate drainage of the hemothorax is all that is required. However, in approximately 30% of penetrating injuries and 15% of blunt injuries, thoracotomy will be required. Another indication for urgent thoracotomy includes massive hemothorax or continued bleeding.

Massive hemothorax is defined as an initial chest tube output of 20 mL/kg or ~1500 mL. Continued bleeding from the chest tube is defined as more than 2 mL/kg/h or more than 200 mL/h for 2 to 4 hours. Acute hemorrhage of this volume is unlikely to stop spontaneously. Likely sources include intercostal vessels, major pulmonary vessels, great vessels, or a cardiac injury. The chest tube should not be clamped in an attempt to slow the bleeding. Clamping the chest tube will not provide a tamponade effect but will worsen gas exchange and hemodynamics.

An inadequately drained hemothorax can lead to fibrothorax or empyema. If blood remains in the pleural space, proper function of the tube should be insured. With a properly functioning tube, the intrapleural pressure (assessed in the water seal chamber) should vary with the patient’s respiratory phase and should be negative in patients breathing spontaneously. Clot in the chest tube is the most common reason for malfunction. Clots should be removed from the tube using a tracheal suction catheter placed in the lumen of the chest tube under aseptic technique. An improperly positioned chest tube (i.e., placed outside the pleural space) is another cause of inadequate pleural drainage. A lateral chest radiograph can help confirm intrathoracic placement.

If the pleural effusion persists despite a properly functioning and positioned chest tube, a clotted hemothorax is the likely cause. A second chest tube may help resolve the hemothorax; however, multiple thoracostomy tubes fail in up to 30% of patients. To avoid the risk of fibrothorax or empyema, patients with a poorly drained clotted hemothorax should have the clot removed using video assisted thoracic surgery (VATS). VATS drainage of the pleural cavity is best performed 1 to 3 days postinjury to reduce the risk of rebleeding from the injured lung. In addition, the clot is more easily disrupted and removed within 48 to 72 hours. Enzymatic dissolution, although appealing because it is less invasive, results in complete resolution in only 63% of patients. Direct visualization of the pleural space during VATS ensures adequate evacuation of the clot and adequate reexpansion of the lung.

VATS techniques can also be used to drain posttraumatic empyemas. The risk of developing an empyema following trauma is dependent on the amount of lung tissue damage. Patients with trauma-induced hemothorax should be monitored for possible empyema, especially when the hemothorax is associated with significant lung injury.

**SUMMARY**

Hemothorax most commonly results from thoracic trauma. However, spontaneous hemothorax does occur. The goal of treatment is to completely drain pleural blood and reexpand the lung. Retained clotted hemothorax will likely require surgical intervention to prevent fibrothorax and empyema. VATS, which can be used to treat both retained hemothorax and empyema, is most successful when performed early.

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