Haemothorax

Introduction

Haemothorax is defined as a significant amount of blood collecting in the pleural space. It is most commonly the result of penetrating or non-penetrating chest trauma. Haemothorax unrelated to trauma is considerably less common and can have a variety of causes. Prompt identification and treatment of traumatic haemothorax is an essential part of the management of an injured patient. In cases where haemothorax is unrelated to trauma, a careful investigation of the underlying cause must be performed while the haemothorax is being treated.

History

Haemorrhage from or within the chest has long been described in medical writing. By the end of the 18th century a number of surgeons, including John Hunter, advocated creation of an intercostal incision and drainage of the haemothorax. By the 1870s, the surgical evacuation of a haemothorax by trocar and cannula or by intercostal incision was considered routine practice. Not long after this, underwater seal drainage was described by a number of physicians.

Aetiology

The most common cause of haemothorax is trauma. The causes of haemothorax can be traumatic or non-traumatic (*Table 1*).

Iatrogenic haemothorax can result from placement of a central venous catheter, Swan–Ganz catheter, thoracocentesis, pleural biopsy, lung biopsy, and indeed any surgical procedure undertaken within the thoracic cavity.

Pathophysiology

Blood may enter the pleural space from injury to chest wall, diaphragm, lung, vertebra or mediastinum.

Mr N Sreedhar Reddy *is Specialist Registrar in Cardiothoracic Surgery at Hammersmith Hospital, London and* **Mr Philip Hornick** *is Senior Lecturer and Honorary Consultant in Cardiothoracic Surgery at Imperial College, Hammersmith Campus, London W12 0NN*

Correspondence to: Mr P Hornick

The physiological responses to the development of a haemothorax manifest in two major areas: haemodynamic and respiratory. The magnitude of the physiological haemodynamic response is determined by the amount and rapidity of blood loss. The respiratory component is determined by the restriction imposed upon the lung by a large accumulation of blood in the pleural space.

Haemodynamic changes vary depending on the amount of bleeding and rapidity of loss. Signs of shock (tachycardia, tachypnoea, decrease in pulse pressure) occur with the loss of a significant amount of the circulating blood volume. The pleural cavity of an adult man can hold 4 or more litres of blood, without any external evidence of blood loss.

Blood that enters the pleural cavity is exposed to the motion of the diaphragm, lungs and other intrathoracic structures. This results in some degree of defibrination of the blood so that incomplete clotting occurs in the acute stage.

Haemothorax needs to be differentiated from a blood-stained plural effusion; with knowledge of the antecedent clinical history, haemothorax should be considered if the pleural fluid haematocrit is greater than 50% of the peripheral blood haematocrit.

Nearly 37% of patients with blunt chest trauma will have a clinical haemothorax (Shorr et al, 1987). Furthermore, the diagnosis of a traumatic haemothorax should be suspected in any patient with penetrating or non-penetrating trauma to the chest.

Clinical examination

Chest examination may indicate the presence of significant thoracic trauma with external bruising or lacerations or palpable crepitus indicating the presence of air and rib fractures. There may be evidence of a penetrating injury over the affected haemothorax.

The classical signs of haemothorax are decreased chest expansion, dullness to percussion and reduced breath sounds in the affected haemothorax. All these clinical signs may be subtle in the supine trauma patient in the emergency department, and most of the haemothoraces will only be diagnosed after imaging studies.

Investigations

The diagnosis is initially established with a chest radiograph. This may be supplemented with an ultrasound examination.

Chest X-ray

The upright chest X-ray is the ideal primary diagnostic study in the evaluation of haemothorax. As much as 400–500 ml of blood is required to obliterate the costophrenic angle. In the acute trauma setting, the portable supine chest radiograph may be the only view available to make definitive decisions regarding therapy. The presence and size of a haemothorax is difficult to evaluate on supine films. Only a general

Table 1. Causes of haemothorax

Traumatic	Blunt trauma
	Penetrating trauma
	Iatrogenic trauma
Non-traumatic	Rupture of an aortic aneurysm
	Neoplasia (primary or metastatic)
	Blood dyscrasias (including anticoagulation)
	Pulmonary embolism
	Tuberculosis
	Pulmonary arteriovenous fistulae
	Hereditary haemorrhagic telengiectasia
	Catamenial (thoracic endometriosis)

haziness of the affected hemithorax may be noted. As such, a clinical diagnosis is frequently made by taking such a result combined with the history and clinical examination.

Ultrasound

Ultrasonography is used at some trauma centres in the initial evaluation of patients for haemothorax. Aside from requiring specific expertise, one drawback of ultrasonography is that bony injuries, widened mediastinum, and the presence of a pneumothorax are not readily identifiable. As such, ultrasonography plays a complementary role in specific cases in which haemothorax is equivocal on chest X-ray and where it is available.

Computed tomography scan

Computed tomography (CT) scan is a highly accurate diagnostic study for pleural fluid and blood. In the trauma setting, it does not hold a primary role in the diagnosis of haemothorax but is complementary to a chest X-ray. Presently, CT scan is of greatest value in the course of chest trauma for localization of any retained collections of clot in the pleural space following drainage, and to assess the extent of any associated mediastinal and vascular trauma.

Treatment

In the majority of cases, haemothorax is identified from the initial chest X-ray film. In cases of trauma, patient assessment should be performed using the advanced trauma life support (ATLS) protocol (American College of Surgeons, 2004) before tube thoracostomy.

The treatment of choice for patients who have sustained a traumatic haemothorax is the immediate insertion of an intercostal chest drain. The advantages of immediate insertion of chest drain are:

- It allows complete evacuation of blood from the pleural space
- It allows one to quantify the amount of continuous bleeding
- Evacuation of pleural blood decreases the incidence of subsequent fibrothorax and empyema.

Ideally a large bore chest drain tube (size 36–42 F) should be inserted in patients with haemothorax because the blood frequently clots. The chest tube is placed (on the correct side) in the mid-axillary line, behind the pectoralis major (to avoid having to dissect through this thick muscle). This thoracostomy tube should be ideally placed in the 'safe triangle' (Lawa et al, 2003). This is a triangle bordered by the anterior border of the latissimus dorsi, the lateral border of the pectoralis major muscle, and a line superior to the horizontal level of the nipple and apex below the axilla.

Local anaesthetic should be infiltrated at the site of insertion of the drain. A small gauge needle is used to raise a dermal bleb before deeper infiltration of the intercostal muscles and pleural surface. Many cases of damage to essential intrathoracic structures have been described following the use of trocars to insert chest tubes. Blunt dissection of the subcutaneous tissue and muscle into the pleural cavity has therefore become an essential technique. The chest tube should be connected to an underwater seal drainage. This is usually a closed underwater seal bottle in which a tube is placed underwater at a depth of approximately 3 cm with a side vent that allows air to escape, or it may be connected to a suction pump. After tube thoracostomy has been performed, a repeat chest X-ray should always be obtained. This helps to identify chest tube position and completeness of haemothorax evacuation.

It is recommended that patients with haemothorax treated with chest drain insertion should be given antibiotics empirically (Gonzalez and Holevar, 1988). It is reported that there is reduced incidence of empyema and pneumonia if the patient is treated with antibiotics (LeBlanc and Tucker, 1985).

Thoracotomy is the procedure of choice for managing massive haemothorax. The decision to perform surgical exploration in cases of haemothorax from acute trauma is based on a number of factors including the volume and persistence of blood loss, the overall haemodynamic state of the patient and the replacement required.

Broadly speaking, the indications for thoracotomy in haemothorax are:

- If the initial chest drain output is more than 1500 ml
- Continued pleural haemorrhage after chest drain insertion – bleeding more than 200 ml/hour for 4 consecutive hours
- Associated sucking chest wound, major bronchial air leaks
- Suspected cardiac tamponade or major vascular injury
- Associated pleural contamination.

Approximately 20% of patients with haemothorax require thoracotomy (Drummond, 1967).

In the majority of trauma cases requiring chest exploration, the chest wall is the source of bleeding, most commonly the intercostal or internal thoracic arteries. Once identified, these can be easily controlled with suture ligatures. After control of obvious bleeding and evacuation of the clots and blood, a thorough exploration of the entire chest cavity should be performed.

Unstable rib fractures found at the time of surgery may require some debridement of sharp edges to prevent injury to the lung. Ideally, a thoracic surgeon should be present at the time of thoracic exploration to control bleeding from difficult areas such as the hilum of the lung, heart or great vessels. Patients with injuries between the level of the nipples and umbilicus may have injuries in both the chest and abdomen. If surgical exploration is mandated, proper positioning and draping of these patients is necessary so that access to both the cavities is possible.

Adequate drainage of the chest after control of bleeding is very important. Because chest drainage tubes are inserted under direct vision, the complication of retained haemothorax should occur extremely rarely. A minimum of two chest drains should be inserted, with one positioned posteriorly and the other positioned anteriorly, to the thoracic cavity base and apex respectively.

The role of thoracoscopy

In haemodynamically stable patients with traumatic haemothorax and continued bleeding, where cardiovascular injury has been excluded, the commonest causes of bleeding are intercostal vessel, mammary artery or lung lacerations. All these are amenable to videothoracoscopic control via diathermy, clips or staplers (Lang-Lazdunski et al, 1997; Manlulu et al, 2004). Many cardiothoracic surgeons have found thoracoscopy useful in the management of traumatic haemothorax, accelerating patients' recovery, reducing the length of hospital

stay and morbidity. It does, however, require specific expertise and is only performed in a specialist cardiothoracic centre.

Complications of haemothorax

There are three important complications of traumatic haemothorax:

- Retention of clotted blood
- Post-traumatic empyema
- Fibrothorax.

Retention of clotted blood

Although the majority of traumatic haemothoraces are managed by the insertion of a chest drain, some of the collected blood may remain only partially drained (*Figures 1* and *2*). The residual blood, potentially contaminated by insertion of a chest tube, can lead to complications such as empyema (if infected) or fibrothorax. Surgical evacuation of retained blood clot decreases this risk.

When a patient is identified as having retention of clotted blood in the pleural space, the following questions need to be addressed:

- Does the clot need to be removed
- When should it be removed
- How should it be removed?

Figure 1. Chest X-ray showing massive post-traumatic haemothorax.

Figure 2. Computed tomography scan of the same patient showing residual clotted blood after chest drain insertion.

If the residual clot occupies at least one third of the involved hemithorax for more than 48 hours after chest drain insertion, the clot needs to be removed.

The clot can be easily disrupted and removed by thoracoscopy up to 96 hours after initial injury. Between 5 and 7 days complete evacuation of the clot by thoracoscopy is possible in only a small group of patients. After 7–9 days, the clot adheres to the lung and pleura, making thoracoscopic removal difficult. If thoracoscopic removal is attempted after this period, it increases the risk of complications such as retained collections, air leaks. Therefore the optimal time to remove the retained clotted blood appears to be between 48 and 96 hours after initial injury by thoracoscopy.

The alternative methods used in managing the retained clotted blood include insertion of a second chest drain and intrapleural injection of fibrinolytic agents (streptokinase, urokinase). However, these are successful in only 40% and 60% of patients respectively (Inci et al, 1988).

Thoracotomy is indicated for evacuation of retained blood clots if the above measures fail or if the patient presents after 7 days of initial drainage of the haemothorax.

Post-traumatic empyema

Post-traumatic empyema occurs in 3–4% of cases following haemothorax (Battistella and Banfield, 2000). This complication can be minimized by using a meticulously sterile technique while inserting the chest drain. The risk of empyema increases with residual clotted blood, pulmonary contusions and bronchopleural fistula. As mentioned earlier, the administration of antibiotics to patients with haemothorax treated with chest drain insertion reduces the risk of empyema.

Empyema at the organizing stage requires surgical intervention such as thoracoscopic debridement or open thoracotomy and debridement. Decortication is required when thick pleural peel is present on the visceral pleura preventing re-expansion of the lung.

Fibrothorax

Fibrothorax is characterized by diffuse pleural thickening occurring weeks to months after haemothorax. This complication occurs in less than 1% of patients. The definitive treatment for fibrothorax is decortication of lung as above. Decortication should be postponed for several months following injury, as the pleural thickening diminishes with time in most of the cases.

Conclusions

Early intervention in the form of chest drain insertion or thoracoscopic drainange is required in patients with haemothorax to prevent secondary complications. BJHM

Conflict of interest: none.

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KEY POINTS

- Haemothorax is most commonly related to penetrating or non-penetrating chest trauma.
- Diagnosis is usually established with a chest X-ray.
- Thoracotomy is required in only 20% of patients.
- The most common complications of haemothorax are retention of clotted blood, post-traumatic empyema and fibrothorax.