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Review Article

Thoracoscopic Evacuation in Traumatic Retained Haemothorax

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Abstract

Chest trauma is a critical problem in today's world due to a large number of blunt and penetrating trauma and because it results in numerous complications. One-fourth of deaths are particularly related to chest trauma. Haemothorax is the most frequent complication from chest trauma, which has no exact incidence. The more chronic effect of haemothorax is due to the significant amount of retained clot and empyema formation, entrapped lung, and fibrothorax, although most chest injuries can be managed with observation. Risks for retained hemothoraces are thought to be such as failure to recognize, inadequate placement of chest tube, inappropriate care of chest tube, and use of inadequate diameter tubes. When initial tube thoracostomy does not evacuate a haemothorax, options for management include a second tube thoracostomy, video-assisted thoracoscopy (VATS), or intrapleural fibrinolytic therapy. Early evacuation of retained haemothorax exhibited improvement in clinical outcomes

Keywords: *VATS; Trauma; Thoracostomy; Retained Haemothorax*

Traumatic retained haemothorax

Haemothorax is defined as the collection of blood at the pleural cavity. this bloody effusion should contain a hematocrit value of at least 50% of the hematocrit of peripheral blood for differentiation of a haemothorax from a sanguineous pleural effusion. Several sources may be responsible for traumatic haemothorax following blunt trauma injuries (sudden and intense impact) and Penetrating trauma. Multiple rib fractures are the most common chest wall injuries that cause a pulmonary contusion, pulmonary laceration, pulmonary pseudocyst, and pulmonary hematoma.

Stab wounds or gunshots injuries are the most vigorous aspects of penetrating trauma, that cause: Pulmonary laceration, Intercostal vessel laceration, an internal mammary artery laceration, Cardiac injury, and traumatic diaphragmatic injury [1,2].

As early in 1998, Carrillo and Richardson found that haemothorax classically progresses in three manners: complete spontaneous reabsorption of blood within quite a few weeks, progression to fibrothorax, or infection with empyema formation. retained haemothorax is still considered the most common complications associated with increased morbidity, mortality, and hospital costs [3].

Retained haemothorax is often defined as residual pleural blood > 500 ml in volume, blood occupying greater than one-third of the thoracic cavity, or the presence of blood in the pleural cavity that could not be drained through the initial assessment after 72 hours of thoracostomy treatment, late clotted haemothorax may occur even in the absence of any abnormal initial clinical findings.

Retained hemothoraces are thought to develop due to several factors, such as early failure to identify the haemothorax as a significant

problem in the course of lung injury, inadequate placement of the tube, unfortunate care of the tube thoracostomy, and the use of tubes of inadequate diameter [4,5].

Retained haemothorax could be anticipated earlier if associated with the initial blood drainage volume (median, 400 ml), the number of tubes placed (two or more), the length of time with the tube in place (median, 5 days) and the need for mechanical ventilation. Possible mechanisms of development of delayed hemothorax are fractured ribs with pulmonary laceration, lesion of the diaphragm or intercostal vessel, some authorities sense that if three or more rib fractures are present then clotted haemothorax is unavoidable [5,6].

Epidemiology of traumatic retained haemothorax

Roughly 2/3 of the patients have a chest trauma with variable severity from a simple rib fracture to penetrating injury of the heart or tracheobronchial commotion. Blunt chest trauma is most common with 90% prevalence, of which less than 10% require the surgical intervention of any kind. Mortality is second highest after the head injury, which emphasizes the importance of initial supervision [7,8].

In 2005 at the United States National Hospitals thoracic injuries represent about 5% to 15% of all injuries treated in the acute care situation. Most blunt thoracic injuries are considered minor, and two-thirds of patients with rib fractures are treated as outpatients. Minor thoracic injuries cause substantial morbidity and pain, but rarely death. However, in Egypt, injuries burden is significant as it was the fifth cause of death in 2004. Also, it is considered as a hidden epidemic due to underreporting. In a study conducted between 2002 - 2009 chest injuries (17.7%) is considered as the second cause of mortality after head injuries (34.6%) of listed deaths by cause of injury at trauma unit. chest trauma is responsible for more than 20 to 25% of all traumatic death in a study published in 2017 [9].

The particular occurrence of haemothorax is not recognized, but the percentage of retained haemothorax differs in numerous research studies; incidence rates from 5 to 30% have been reported [3].

Failure to evacuate blood from the pleural space adequately after trauma may result in extended hospitalization and complications retained haemothorax has been reported to occur in up to 18% of patients initially treated with tube thoracostomy by Helling., *et al.* and most studies report a rate of Retained post-traumatic hemothoraces to occur in 1% to 20% of patients managed with tube thoracostomy [4,5,10].

Management of traumatic retained haemothorax

Three major effects of traumatic haemothorax are found, two acute and a chronic third one. The acute effects of a haemothorax are both of hypovolemia and disturbance of the respiratory mechanism. Suitable management of chest trauma rests on the patient's vital signs. A thoracostomy tube and thoracotomy are performed to control bleeding when patients are stabilized; the next step is to treat complications. The additional chronic effect of haemothorax is due to a substantial amount of retained clot and empyema [11].

Traumatic injuries managed with tube thoracostomy include pneumothorax, haemothorax, and a hemopneumothorax. In most cases, this treatment, together with respiratory therapy and pain management, suffices. Some of chest trauma patients require an urgent thoracotomy as in massive haemothorax due to major vascular injuries, pulmonary laceration, also due to multiple fracture ribs or Flail chest and Cardiac tamponade. Other patients require elective thoracotomy due to retained hemothorax or empyema [5,8].

During the 2-year period (2009 - 2011), DuBose., *et al.* described the common practice used to manage retained haemothorax including simple observation which is the first tactic for managing approximately 30% of patients with retained haemothorax, that result in a resolution rate of up to 82%, tube thoracostomy (18.6%), image-guided placement of a small-bore chest tube (5.2%), VATS (33.5%) and open thoracotomy (7.3%) [12].

Thoracostomy tube

Thoracostomy drain placed in the pleural cavity to drain, air, blood, chyle and empyema from the chest. It is also aimed to prevent drained air and fluid from returning to the pleural space, restore negative pressure in the pleural space and to re-expand the lung. The idea of draining constituents from the thoracic cavity has been acknowledged for thousands of years. The oldest well-known reference to

thoracic drainage dates back to the fifth century B.C.E. Hippocrates (c. 460-370 B.C, the first mention of a chest tube practice may occur in Wolfram von Eschenbach's Parzival, inscribed between 1210 and 1220 [13,14].

A method for sucking wounds by silver tube attached to a piston syringe which replaced a human mouth was described In 1707 by Dominique Anel, in the late 1950s, Maloney and Gray discussed thoracostomy tube technique as equivalent in efficacy to repeated needle aspirations, in 1961, a catheter made of plastic was first introduced by Sherwood Medical, in 1992, Lilienthal reported the postoperative use of chest tube.

Currently, chest tubes are made from clear plastic (vinyl or silastic). They have multiple side holes to allow effective drainage of fluid and air and have centimeter markings to help note the depth of insertion. A radiopaque strip in the tube allows for easy visualization on chest radiography [13,14].

Tube malposition, drain blockage, dislodgment of thoracostomy tube, re-expansion pulmonary edema, subcutaneous emphysema, cardiac and vascular injuries, and Bronchocutaneous fistula are considered technical Complications of chest tube, there are also infective complications as introducing additional bacterial contaminants, increasing the of empyema and Surgical site infection can range from cellulitis to necrotizing soft tissue infection [15-17].

Tube thoracostomy drainage is the primary mode of treatment for acute traumatic haemothorax that is essential to minimize morbidity and achieving draining of the pleural space, expansion of the lung and allow assessment of continuing blood loss. In the early stages, an intercostal tube drain can be effective, but once the blood has clotted this is unsuitable as it only achieves partial drainage [15-17].

Video-assisted thoracoscopic surgery (VATS)

A type of advanced thoracic surgery performed using a small video camera that is introduced in the patient's chest through small incisions, the technique might be diagnostic or therapeutic.

The camera and instruments are inserted through discrete holes(a single flexible trocar, or by means of 2-3-4 trocars) in the chest wall also known as "ports" which can be accomplished through a 2 cm single skin incision [18].

History of VATS always belong to Hans Christian Jakobaeus the founder of the procedure, he was the first to use "cystoscopy" for the examination of serous cavities and Tuberculous adhesions in 1910. Since 1945 many researchers used this technique to explore the thoracic cavity, Biopsy became the only "operative "procedure within the pleura, this technique was called "Jakobaeus operation", in 1991 Lewis had defined again the use of Thoracoscopy for many pulmonary disease treatments [19].

The technological improvements made a great deal to thoracoscopy in recent years due to video cameras and light sources.

The first chief meeting on VATS was held in January 1992 in SanAntonio, Texas in conjunction with the Society of Thoracic that encourage the increase of diagnostic and therapeutically indications for multiport video-assisted thoracoscopic surgery (VATS).

The advancement and development of the instruments and light sources, including a decrease in the size and number of ports, have a major effect in spreading use of VATS. The uniportal access was defined initially by Rocco and colleagues when they demonstrated that the uniportal practice is a safe and effective tactic for primary and secondary spontaneous pneumothorax [19,20].

Stating this, there could be some explanations why uniportal VATS was a success in the field of thoracic surgery, resemblance to reach the target lesion as open thoracotomy, single incision or through thoracostomy tube incision so one intercostal space is involved, no time loss in applying trocar compared with the typical three or two ports VATS, easy to operate as the surgeon ahead of the patient and the assistant can be either in front or alongside the surgeon and technological progression simplify the performance of the surgeon like articulated staplers, energy devices for hemostasis and dissection with adequate optics. this could be describe increasing interest in using uniportal VATS approach in different types of disease [21,22].

Since the 1990s, because of the advance in techniques and instruments, VATS is now widely accepted by most trauma surgeons with Indications in severely injured patients as penetrating injury in a stable patient, persistent hemothorax, persistent air-leakage, empyema and suspicion of diaphragmatic rupture. Considering some contraindication as hemodynamic instability, adhesion secondary to infection or previous surgery and history of bleeding diathesis [3,8].

The want conversion to classical thoracotomy must not be considered an obstacle especially in hemodynamic instability, intraoperative bleeding and introduction of Instruments into lung parenchyma, that also considered as a technical complication of VATS [3,21].

The essence of judgment between the stranded treatment of retained haemothorax (reinsertion of tube thoracostomy) and a new technique (VATS) is to find a suitable technique to reduce hospital visit and hospital fee [23].

Lin HL., *et al.* 2014 reported incidence of retained haemothorax is more with blunt trauma due to laceration of great vessels, acceleration-deceleration injury of lung parenchyma and the most common cause was the displacement of fractured ribs. He also reported different results of mean tube drainage days after VATS which was 8.2, 11.6, 19.8 that depends on the time between trauma and VATS evacuation. In managing retained hemothoraces there is a strong positive linear correlation between the operative time and the duration between first tube and VATS evacuation as Elkhayat and associates described [23]. Also many authors recommend the use of VATS through the first 3 days of injury as Vassiliu and associates to prevent the dense adhesion formation that may cause conversion to thoracotomy, and others report that the initial intervention (< 48 hours) with VATS as Meyer and associates may be more efficient and economical [24,25].

Ahmad., *et al.* demonstrated that the outcome of VATS in retained haemothorax is directly dependent on the timing of intervention, with a conversion to open surgery rate diminished from 15.8% to7.7% if surgery is completed by the 6th post-traumatic day [26].

In a previous study conducted between March 2009 to May 2013 Elkhayat H., *et al.* 2017 reported that need for conversion to open thoracotomy all related to traumatic patients with a total rate of 20% [21].

Meyer DM., *et al.* 1997 found that the patients went through VATS had a shorter duration of tube drainage 2.53 days versus 4.50 days of reinsertion of tube thoracostomy, shorter hospital stay after the procedure 3.6 days versus 7.2 days. In a study conducted between 2006 and 2007 Morrison CA., *et al.* found that the mean hospital stay was 10.8 days using only VATS [27]. Migliore M., *et al.* 2015 also reported mean hospital stay after VATS evacuation was 5.7 days [28]. lack of chest physiotherapy, inappropriate control of pain can cause Longer drainage days [23].

Conclusion

With knowing the complication of thoracostomy tube and mistreating cases of traumatic retained haemothorax, at the other hand the technological improvement, the excellent training of surgeons, there is an increasing interest in using VATS in trauma patients. VATS procedure offers short hospital break, reduces hospital charge and even cosmetically better with less complication.

Conflict of Interest

No financial interest or any conflict of interest exists.

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