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Role of uniportal video-assisted thoracic surgery in the treatment of pleural empyema

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Abstract

Empyema is a grave disorder marked by the buildup of purulent fluid in the pleural cavity, typically resulting from a pulmonary infection. Incidence and prevalence of pleural empyema vary depending on geography, aetiology, age and host immune status. Aetiology is determinant for clinical therapeutic choices while the surgical approach to pleural empyema is determined by its evaluative stage and it is required in the 36–65% of patients.The incidence of streptococcal empyema decreased markedly with the introduction of antibiotics, and *Staphylococcus aureus* emerged as the predominant pathogen. More recently, gram-negative and anaerobic bacteria have become important pathogens. In spite of current medical advances, thoracic empyema continues to be a challenging problem, associated with significant morbidity and mortality rate reaching 20% in adults.Three stages in the natural course of empyema determine the suitable option for treatment; stage I (purulent stage) usually managed by intercostal tube drainage under cover of appropriate antibiotic therapy, stage II (fibropurulant stage) and stage III (organizational stage) may need more invasiveness than intercostal tube to remove the pleural peel and allow lung re-expansion. However, because of the heterogeneity of the disease process, there is no single definitive treatment.(Empyema is conventionally treated with open thoracotomy or tube thoracostomy, both of which are invasive operations that carry the risk of complications and require longer recovery periods. Advancements in minimally invasive thoracic surgery have resulted in the emergence of uniportal video-assisted thoracoscopic surgery (VATS) as a highly successful option for treating empyema. This essay seeks to investigate the utilization of uniportal VATS surgery in the treatment of empyema, examining its benefits, procedures, and results.

Keywords: Pleura; Empyema; Thoracic surgery; Video-assisted thoracoscopic surgery.

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1. Introduction

Empyema often denotes the presence of purulent accumulations inside the pleural cavity. The term originates from the Greek word empyein, which signifies "generating pus". Hippocrates initially documented thoracic empyema's grave character over 2400 years ago. Despite this, the necessity for surgical intervention was acknowledged, and open drainage was the sole viable therapy until the late 19th century [1]. The natural progression of empyema can be divided into three stages, each requiring a different treatment approach. In stage I, which is characterized by the presence of pus, intercostal tube drainage is typically used along with appropriate antibiotic therapy. In stage II, known as the fibropurulant stage, and stage III, referred to as the organizational stage, more invasive procedures may be necessary to remove the pleural peel and facilitate lung re-expansion, surpassing the use of intercostal tube drainage. Due to the diverse nature of the condition, there is no one definite therapy [2]. The two most often employed surgical techniques for treating empyema are video-assisted thoracic surgery (VATS) and thoracotomy. During both stages II and III, the first alternative assumes a more prominent role and yields superior outcomes in comparison to thoracotomy. In 'stage III', the second approach is frequently employed since it has a high success rate in cases when a more extensive decortication is necessary, notwithstanding the prevalence of the VATS technique. The status of the uniportal-VATS (U-VATS) approach for controlling pleural infection is still undetermined [3].

2. Management of pleural empyema with video-assisted thoracic surgery (VATS)

The effectiveness of VATS in treating pleural empyema has been confirmed by recent studies. Stages II and III were traditionally treated by thoracotomy, which allowed for the safe execution of a protracted decortication [4]. Video-Assisted Thoracic Surgery (VATS) is just as successful as open decortication in treating Stage III empyema in a large

percentage of patients, according to research done by Waller and colleagues in 2001. Reduced discomfort and shorter hospital stays are two advantages of VATS, which are the results of a less intrusive technique. The surgeon's mastery of VATS, which requires a certain amount of time for learning and adaptation, is largely responsible for the high correlation between a conversion rate of up to 40% and the chronic stage of empyema [5]. Many studies have shown that thoracoscopic decortications are more effective than thoracotomy in terms of patient outcomes. After reviewing 68 articles on the subject, Chambers et al. (2010) settled on 14 for their thorough evaluation. Regarding postoperative discomfort, complications, morbidity, 30-day mortality, and length of hospital stay, the research found that VATS (Video-Assisted Thoracic Surgery) performed better than open surgery.

Figure 1. Adoption of new techniques; uniportal video-assisted thoracic surgery for treatment of empyema at our institution [16].

Figure 2. Intraoperative findings and uniportal-VATS debridement of empyema septa. VATS, video-assisted thoracic surgery.

Figure 3. Uniportal-VATS decortication of visceral pleura. VATS, video-assisted thoracic surgery.

Research also showed that the two surgical methods did not vary significantly in terms of recurrence rate [6-8]. The effectiveness and superiority of VATS over open decortication were confirmed in a later meta-analysis that also reached the same conclusions [9]. Turning VATS into a thoracotomy may be necessary in certain cases. The use of the U-VATS technique in pleural empyema management, however, has been the subject of few investigations. The function of uniportal VATS in pleural empyema therapy. Now, U-VATS is considered a cutting-edge thoracoscopic technique that is both novel and minimally invasive. Pain after surgery may be lessened with this technique, which involves penetrating the chest via a single intercostal gap [9, 10]. Uniportal Video-Assisted Thoracic Surgery, or U-VATS, is a tool that proficient thoracic surgeons may use to do a wide variety of procedures, including bronchoplasties and sleeve lobectomies. An increasing number of institutions has documented the use of U-VATS. As they begin their training, their patients mostly undergo modest surgeries including pleural biopsies, wedge resections, and U-VATS debridement and decortications for empyema [11, 12]. Unfortunately, there is a lack of research that particularly looks at how this method works for different phases of empyemas and how well it treats them. Bongiolatti et al. [13] described a case of pleural empyema treated with U-VATS decortication after preoperative ultrasonography for staging. For empyema in stages II (40%) or III (60%), 53% of patients (34 patients) had open decortication, whereas 47% underwent uniportal thoracoscopic pleural decortication. After successfully removing all dead tissue and the top layer of bone, the treatment was repeated on all patients [14]. Elsayed HH and colleagues compared the non-surgical treatment of early empyema and VATS drainage in a study. Disparities were found to be statistically significant across a number of factors. With a p-value of 0.004 and a 95% confidence interval of 10.3-25.5, the VATS group had a significantly shorter hospital stay. The total cost per patient was significantly lower in the VATS group (P<0.001). During the follow-up period, the VATS group required less decortication (P=0.047) and had less therapy-associated morbidity (P=0.039). Group B, which had the VATS procedure, had better results overall. At 7% vs. 0%, P=0.094, there was no statistically significant difference in mortality rates between the two categories [15]. Compared to thoracotomy, U-VATS reduced chest tube length, hospital stay time, and problems. Based on a mix of imaging and clinical staging, the authors state that U-VATS decortication is a safe and successful procedure for patients who are carefully chosen. When it comes to treating pleural empyema, U-VATS is a dependable and successful treatment, especially for cases that are classed as stage II and III. Postoperatively, the aforementioned approach has shown significant benefits, including less pain, faster recovery, and better cosmetic results [5, 14]. Since the early 1990s, our clinic has predominantly employed thoracoscopy to extract pleural and pericardial effusions. Over time, we have advanced towards doing VATS lobectomy and uniportal VATS surgeries, as seen in Figure 1. Since 2016, we have provided regular VATS lobectomy for appropriate cases, as well as other VATS procedures including VATS segmentectomy, VATS thymectomy, and VATS decortication, thoracoscopic repair of chest wall deformities, and complex major thoracic surgeries such as sleeve resections, complex airway reconstruction, and radical mesothelioma surgeries. The execution of these therapies can be carried out without any inherent danger [16].

3. Uniportal-VATS technique for treatment of empyema

Undergoing general anesthesia and using single lung ventilation with the use of a double-lumen endotracheal tube are essential components of Uniportal-VATS therapy for empyema. The next position the patient is placed in is lateral decubitus, with the elbows bent and reaching for the crown of the head. Care is used while making a single 3–4 cm incision so as not to damage the muscle fibers and therefore cut through the muscle. On the flip side, a film of connective tissue separates the serratus anterior muscle's connections to the ribs, which causes the neighboring muscles to move. A surgical incision is performed along the mid-axillary line, specifically at the fifth intercostal gap. In order to introduce a 10 mm 30° thoracoscope and endoscopic equipment, a wound protector is used to widen the incision and provide protection [9]. The surgery included tearing the septum on purpose, draining the diaphragmatic and parietal pleura of any adhesions and inflammatory fluids, and then extending to the very top of the chest cavity. The objective was to liberate the lung from its inherent restrictions by constructing a pleural space devoid of any compartments or obstructions. During the operation, the decortication grasper and suction device were bent and extended. Their two pivot points make it possible to employ many instruments at once from a single entry point [5, 17]. We collect samples for microbiology and histopathology. Rinsing the visceral pleura many times with warm physiological solution helps remove any remaining fluid and organized pus while protecting the lung structure as much as possible (Figure 2). The decortication procedure involves making many incisions in the visceral pleura or excising its thicker layer. Thoracoscopy guides the reinstitution of lung tissue expansion, also known as lung inflation, which is used to assess the success of decortication (Figure 3) [17]. Injecting 3 milliliters of ropivacaine (4.75 mg/mL) into three or four intercostal spaces above and below the incision while being seen via an endoscope is the procedure for the extra pleural paravertebral intercostal nerve block. After one or two chest tubes (20, 24, or 28 Fr) are introduced via the same incision and full lung re-expansion has been achieved, the treatment is deemed complete. When considerable excision of the visceral and parietal pleura is necessary due to severe empyema, this procedure is performed [9]. Following the resolution of air leakage or the observation that the drained fluid is clear and has a volume less than 200 mL in a 24-hour period, the removal of the chest tube may be scheduled according to surgical considerations. In addition to radiographic improvement with full lung re-expansion, clinical criteria such as the absence of fever and lower levels of inflammatory mediators play a role in the decision-making process.

4. Conclusions

The utilization of Uniportal VATS surgery has significantly transformed the treatment of empyema, providing a less invasive method that yields enhanced results and higher levels of patient contentment. The benefits of this approach include less surgical discomfort, quicker recovery periods, improved drainage, and equivalent or greater results

compared to conventional procedures. This procedure signifies a notable breakthrough in the realm of thoracic surgery and holds the potential to establish itself as the customary method for treating empyema. Nevertheless, it is crucial to conduct more research, provide comprehensive training to surgeons, and carefully choose suitable patients in order to guarantee the secure and efficient application of this technology in various clinical situations.

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