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ORIGINAL STUDY

Early Outcome of Video-assisted Thoracoscopic Surgery Management of Chronic Empyema

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Abstract

Objectives: **To evaluate the use of video-assisted thoracoscopic surgery (VATS) for chronic empyema regarding its effectiveness, duration of surgery, postoperative pain, and possible complications.**

Background: **Empyema thoracis is a common disease that may be complicated with multiloculated chronic empyema. Different surgical techniques are used in the treatment of empyema like thoracoscopic debridement and open thoracotomy decortication to provide lung re-expansion and restore good respiratory function.**

Methods: **A prospective observational study conducted from September 2015 to August 2017 included 29 patients diagnosed to have chronic empyema indicated for elective thoracoscopic debridement. The visual analog score was used to assess postoperative pain.**

Results: **Our study results revealed that the operation duration (in minutes) mean ± SD was 105.17 ± 22.93. Six patients 6 (20.4%) were converted to conventional thoracotomy incision; total hospital stay mean ± SD was 8.79 ± 5.75, and the pain score mean ± SD was 45.17 ± 20.63.**

Conclusion: **Based on short-term follow-up, the Use of VATS in the management of empyema is recommended based on good surgical results including short operative duration, satisfactory pleural debridement, and total lung inflation along with marked patient satisfaction regarding small wound size, postoperative pain, and short hospital stay.**

Keywords: Decortication, Empyema thoracis, Video-assisted thoracoscopic surgery

1. Introduction

Empyema thoracis refers to a buildup of pus in the pleural cavity caused by bacterial infection, which is the most common cause. Other causes of empyema include prior chest surgeries, esophageal conditions, and abdominal infections.[1] In 1962, the American Thoracic Society divided pleural empyema into three stages, with the early stage leading to the next if therapy is ineffective: stage I (early exudative), stage II (fibro-purulent), and stage III (late organized).[2] In stage III, the lung becomes restricted by a rigid fibrous layer, making it difficult for the lung to expand even after the removal of all pleural fluid. Treatment options vary depending on the stage of the disease and aim to control infection, remove pus, and allow the lung to expand. Early-stage treatment typically involves chest tube drainage and antibiotics, while later-stage treatment involves surgical removal of the thick pleural tissue and loculation.[2]

Chest tube drainage and antibiotics in the early stage and surgical management by debridement and decortication by removing the thick pleura and the loculation from the visceral layer of the lung, the diaphragm, the chest wall, and the mediastinum in the late organized stage.[3] The introduction of video-assisted thoracoscopic surgery (VATS) in 1991 established a bridging role between medical and aggressive surgical management, and it has assumed greater importance in the treatment of complicated parapneumonic effusion and empyema.[4–7] The role of VATS in the management of chronic empyema is still controversial.[8] The

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cosmetic satisfaction of the patients with thoracotomy wounds favors more minimally invasive incisions.[9] The study aims to evaluate the use of VATS in the treatment of chronic empyema regarding its effectiveness, duration of surgery, postoperative pain, and possible complications.

2. Methods

This prospective, observational study included 29 patients who suffered from thoracic empyema from September 2015 to the end of August 2017. Patients were treated with VATS debridement with at least a follow-up period of 1 month.

All patients were presented to the Cardiothoracic Surgery Department, Faculty of Medicine, Menoufia University. All patients consented to the surgery. Approval from the Ethics Committee of the Faculty of Medicine, Menoufia University was taken.

This study included patients complaining of cough, fever, and shortness of breath with evidence of loculated empyema on chest radiograph and computed tomography (CT) and not responding to conservative treatment. This study excluded patients with previous thoracic surgery or previous pleurodesis, inability to tolerate single-lung ventilation, and contraindication for general anesthesia. In all cases, the diagnosis was established on clinical grounds (fever, cough, dyspnea; and chest pain), chest radiograph, and computed tomography. Thoracentesis with a 14-gauge cannula was undertaken in all patients on hospital admission. The pleural fluid samples were sent for biochemical analysis (sugar, protein, pH, lactic dehydrogenase) and Gram stain.

In all, 29 patients underwent VATS decortication. Surgery was performed under general anesthesia, using a double-lumen endotracheal tube for selective one-lung ventilation. Based on the preoperative CT scan, suitable intercostal sites were selected for port placement: the first port was positioned so that the empyema was not approached, normally in the third intercostal space in the axillary region. From this camera port, adhesions could be resolved bluntly with fingertips after a look into the thoracic cavity through a thoracoscope. After achieving enough space, a second and a third port were placed, normally below the first one, under thoracoscopic vision to avoid injury to the underlying lung parenchyma. The exact position depended on the local intrathoracic situation. With a camera port and 2 working ports, the empyema can be safely approached.

Because of the good visualization, the adherent peel was carefully removed from the visceral pleural surface, and the lung was freed circumferentially from the apex to the diaphragm. Complete decortication of the visceral pleura and the fissures was obtained with an endoscopic dissector device and a peanut dissector. The parietal pleura was removed. The thoracic cavity and the surface of the lung were cleaned, and re-expansion of the lung was possible. Conversion to thoracotomy and open decortication was considered if it was not possible to completely dissect the peel from the underlying lung surfaces.

At the end of the procedure, two chest tubes (28 F and 32 F) were placed. In all patients, re-expansion was considered complete only if the lateral surfaces of the lung could reach the chest wall, and the inferior surface reached the diaphragm. VATS patients were mobilized when tolerated on the first postoperative day. Chest physiotherapy is given twice daily, starting the morning after the operation. Drains are removed only after cessation of air leakage and daily drainage volume was <100 mL. Antibiotic therapy was continued postoperatively, as guided by microbiologic analysis of intraoperative specimens.

Postoperative data such as the numerical rating scale (NRS) was used for evaluating the intensity of postoperative pain assessing no pain (NRS = 0), mild pain (NRS = 1−3), moderate pain (NRS = 4−6), and severe pain (NRS = 7−10). Pain intensity was assessed during admission; after the operation, blood loss, operative time, length of hospital stay, chest tube duration, conversion to thoracotomy, and complications were obtained. Postoperative clinical evaluation was conducted within 1 week of surgery and 4 weeks' postoperative follow-up with chest radiograph and clinical examination.

Data management: Data were collected, tabulated, and statistically analyzed using an IBM personal computer with the Statistical Package of the Social Sciences (SPSS), version 23 (SPSS Inc. Released by 2015. IBM SPSS statistics for Windows, version 23.0, Armonk, NY: IBM Corp.), where the following statistics were applied. Descriptive statistics with quantitative data were presented in the form of mean ($\overline{X}$), standard deviation (SD), and range. Qualitative data were presented in the form of numbers and percentages (%). χ^2 test was used to study the association between two qualitative variables. The level of significance was set at a P value of less than 0.05.

3. Results

This study included 29 patients, with ages varying from 7 to 66 years, where the age mean ± SD was 41.52 ± 14.43. There were 23 (79.3%) male patients

Table 1. Demographic data of the studied group.

Variable	Video-assisted thoracoscopic surgery (VATS) No (%)
Sex	
Male	23 (79.3%)
Female	6 (20.7%)
Age	
Mean ± SD	41.52 ± 14.43
Median (range)	44.00 (7–66)

SD, standard deviation; VATS, video-assisted thoracoscopic surgery.

Table 2. Conversion to thoracotomy of the studied group.

Variable	Conversion to thoracotomy Number (%)
No	23 (79.3)
Yes	6 (20.4)

and 6 female patients (20.7%) (Table 1). Operative duration mean ± SD was 105.17 ± 22.93 min. Six (20.4%) patients underwent conversion from VATS to open thoracotomy (Table 2). As regards the duration of chest drain after the procedure mean ± SD was 7.97 ± 4.476 days (Table 3). The postoperative pain score means ± SD was 45.17 ± 20.63 (Table 4). In this study, seven (24.1%) patients had postoperative complications in the form of wound infection, chest infection, bleeding, air leak, and wound dehiscence. Two patients needed further management and underwent thoracotomy decortication, and one patient underwent right lower lobe resection (Table 5). The length of hospital stay after the procedure (mean ± SD) was 8.79 ± 5.75 days (Table 6). No patients were admitted to the ICU postoperatively.

4. Discussion

The aim of surgical treatment for advanced phases of empyema is to drain all loculated collections and to enable full lung expansion by removal of pleural peel from the lung surface. Decortication by an open thoracotomy is proven superior to medical treatment for advanced empyema.[10] Compared with

Table 3. Operation time and chest tube drainage duration.

Variable	Video-assisted thoracoscopic surgery (VATS)
Operation duration(min)	
Mean ± SD	105.17 ± 22.93
Median (range)	100 (60–150)
Chest tube time (post)	
Mean ± SD	7.97 ± 4.476
Median (range)	7 (3–21)

SD, standard deviation; VATS, video-assisted thoracoscopic surgery.

Table 4. Postoperative pain score.

Pain score	Video-assisted thoracoscopic surgery (VATS)
Mean ± SD	45.17 ± 20.63
Median (range)	40.00 (20–90)

SD, standard deviation; VATS, Video-assisted thoracoscopic surgery.

Table 5. Postoperative complications.

Complications	Video-assisted thoracoscopic surgery (VATS) No (%)
Wound infection	1 (3.4)
Chest infection	1 (3.4)
Bleeding	1 (3.4)
Air leak	1 (3.4)
Wound infection	1 (3.4)
Non-inflated lung	2 (6.9)

VATS, video-assisted thoracoscopic surgery.

thoracotomy, the potential advantages of VATS decortication in empyema management over open thoracotomy include less pain and perioperative morbidity, better visualization of the entire pleural cavity, and extending decortication to patients with poor respiratory reserve.[11] In our study, the results showed that the operative time was 105.17 ± 22.93 min. Stefani et al.[12] reported that the operation time was 146 min. Muhammed et al.[13] reported that the operation time was 84.68 ± 23.98 min. Angelillo et al.[14] reported that the operation time was 119 + 32.5 min, which was the most similar result as our study. Regarding the conversion rate to thoracotomy, our study showed that six patients underwent conversion from VATS to open thoracotomy, so the rate of conversion was 20.4%. Stefani et al.[12] reported that all cases in their series with evident pleural thickening, the presence of fever, and a delay above 20 days from diagnosis to surgery required conversion to open approach. Lardinois et al.[15] found that delayed referral and Gram-negative microorganisms were significant independent predictors for conversion to thoracotomy; the probability was found to rise from 22 to 86% between an interval of 12 and 16 days from the onset of symptoms to surgery. Similarly, Casali et al.[16] found a significant difference in time from the onset of symptoms to surgery when studying VATS vs open cohorts, of 12 ± 6 versus 32 ± 22 days, respectively, suggesting that delayed cases were

Table 6. Postoperative hospital stay.

Hospital stay	Video-assisted thoracoscopic surgery (VATS)
Mean ± SD	8.79 ± 5.75
Median (range)	8.00 (3–26)

SD, standard deviation; VATS, video-assisted thoracoscopic surgery.

more likely to require a thoracotomy. Luh and colleagues[17] reported their series of VATS decortication and found a mean preoperative length of stay of 11.4 days in patients who achieved successful VATS debridement, in comparison to a stay of 18.4 days in those who required conversion or re-intervention. The significantly higher conversion rate demonstrated with delayed intervention likely reflects the progression of the disease. This was confirmed by their report of a 21.3% conversion rate for stage 3 disease, compared with 3.5% for stage 2 empyema. Similarly, Shahin et al.[18] reported a higher conversion rate in patients with stage 3 empyema: 19% versus 3.5% for stage 2. As regards the duration of chest drainage after the procedure, in our study it was 7.97 ± 4.476 days. Muhammed et al.[13] reported that chest tube drainage was 5.72 ± 3.27 days. Other studies showed that postoperative pain that was reduced in the VATS group and less pain than in open thoracotomy.[19,20] As regards the duration of hospital stay after the procedure, in our study the length of hospital stay after the procedure mean ± SD was 8.79 ± 5.75 days. Solaini et al.[21] reported that the hospital stay was 7.1 days. Another study by Kim et al.[22] reported that the hospital stay duration was 5 ± 0.7 days. In our study pain score was 4.5 ± 2.1; however, Sun et al. reported that moderate to severe pain was 12.7% within the first 24 h and 15.6% within the first 48 h after surgery and the average of NAS was 4 for patients with moderate-to-severe pain versus 2 (1−2) for patients without moderate-to-severe pain.[23] Regarding postoperative complications, our study showed that seven patients had postoperative complications (24.1%). The complications were wound infection, chest infection, bleeding, air leak, and wound dehiscence. Two patients had a conversion to thoracotomy decortication due to extensive adhesions, and one patient underwent right lower lobe resection and there was no mortality. Solaini et al.[21] reported in their study that the postoperative morbidity was 11%. Cardillo et al.[19] reported in their study that the postoperative morbidity was 18.3%. The rate of postoperative morbidity in VATS was strongly related to wound size and good pain control that facilitated good respiratory function and decreased the risk of collapse and chest infection. The good visualization of the field in VATS decreased the bleeding.

4.1. Conclusion

Based on a short-term follow-up, our study confirmed that VATS was associated with a short operative time, early removal of chest tubes, accepted postoperative pain and satisfaction of the patient with the cosmetic appearance of the wound size, and a short postoperative hospital stay with no postoperative mortality.

Author contribution

Hesham Hassan Ahmed: Writing, methodology, discussion, and statistics. Mohammed Hamdi: Writing, methodology, discussion. Hesham A Greda: Revised the manuscript and approved the final draft. Amr Allama: Collected and interpreted the results. Mohammed G Abdellatif: Designed the work and revised the manuscript

Conflict of interest

No conflict of interest.

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