The Efficacy of VATS and Intrapleural Fibrinolytic Therapy in Parapneumonic Empyema Treatment

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Background: Development of multiloculation–septation is a challenging entity in empyema patients. In this study, it is aimed to investigate the success rates of videothoracoscopic deloculation (VATS-D) and intrapleural fibrinolytic (IPFib) application after tube thoracostomy.

Methods: The study retrospectively examined the patients diagnosed with empyema with multiloculation and septation between January 2005 and December 2014. Among these patients, the study included those who received VATS-D or IPFib therapy.

Results: VATS-D (Group 1) was applied to 54 patients and IPFib (Group 2) was applied to 24 patients. The success of both procedures was evaluated considering the need of decortication in the following periods. In the VATS-D group, 4 (7.4%) patients required decortication via thoracotomy where it was 1 (4.1%) patient (p = 0.577) in the IPFib group. The length of hospital stay was 6.81 ± 2.55 (4–15) days in Group 1 compared to 14.25 ± 6.44 (7–27) days in Group 2 (p <0.001).

Conclusions: It was demonstrated that both of the methods applied in the study have high efficacy and are preferable methods based on the general conditions of patients. Additionally, the shorter length of hospital stays in patients received VATS-D was established as a significant parameter.

Keywords: empyema, fibrinolytic therapy, operation, videothoracoscopy

Introduction

Accumulation of fluid in the pleural cavity secondary to pulmonary infection is called parapneumonic effusion. Parapneumonic effusion may occur in about 20%–60% of the patients due to bacterial pneumonia.1 Effusion is treated by appropriate medical treatment in most of these patients; however, 5%–10% of them require drainage.1,2 Empyema and fibrin deposits may develop in the organization period. Such fibrin deposits may cause septations and multiloculation.3 Fibrin deposits and septations along with empyema increase the length of hospital stay and mortality.3,4 There are several methods to remove such multisepation that also decreases the efficacy of treatment.5 The treatment options at this stage include intrapleural fibrinolytic (IPFib) application through a chest drain and videothoracoscopic deloculation (VATS-D).6,7,8 VATS deloculation is defined as the debridement and removing of the septations followed by irrigation of the pleural cavity.5 This study investigated the success rates of IPFib and VATS-D.
Patients and Methods

In all, 78 patients with parapneumonic empyema with multiloculation and septation in the pleural cavity treated in our center between January 2005 and December 2014 were evaluated retrospectively. Among these patients, VATS-D (Group 1) was performed in 54 patients where tube thoracostomy was applied to 24 patients along with the daily administration of 250000 units of streptokinase to the intrapleural cavity for 5 days (Group 2). IPFib therapy was applied to patients who did not accept VATS and to patients whose current status was not eligible to a procedure under general anesthesia because of their septic condition or other comorbidities. The total blood count and coagulation parameters of the patients were checked before every IPFib therapy.

After the procedure, total drainage time and length of hospital stay were recorded. Decortication via thoracotomy was applied to the patients with insufficient pulmonary expansion after the follow-up (Fig. 1). The success rates of the procedures were compared based on the need of decortication via thoracotomy. Informed consent was obtained from every patient. The procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000 and 2008.

Statistical Analyses

The data were analyzed using Statistical Package for the Social Sciences (SPSS) 20 program. The quantitative data were analyzed using Kolmogorov–Smirnov test for the compatibility with normal distribution, and parametric methods were used to analyze the variables with normal distribution and homogeneous variations, and non-parametric methods were used to analyze the variables without normal distribution and homogeneous variations. Two independent groups were compared using Independent t-test and Mann–Whitney U-test. After the main factor was controlled for quantitative data, the correlations of the variables with each other were analyzed using Partial Correlation test, and the categorical data were compared using Pearson Chi-Square test and Fischer-Exact test. Quantitative data were expressed in mean ± std. (standard deviation) and median ± interquartile range (IQR) values in the tables. Categorical data were expressed in number (n) and percentage (%). The data were analyzed at the 95% confidence interval and p < 0.05 was considered significant.

Results

There were a total of 78 patients with a mean age 46.05 ± 15.9 (16–75) years. VATS-D was applied to 54 patients, whereas IPFib was applied to 24 patients. In all, 10 (18.5%) patients had chronic obstructive pulmonary disease (COPD), two (3.70%) patients had coronary artery disease and one (1.85%) patient had heart failure (Table 1).

In VATS-D group, three-port intervention was preferred in 24 (24.4%) patients, two-port in 19 (35.1%), and a single port in 11 (20.3%) patients. Postoperative histopathological results of 48 (89.8%) patients were revealed as non-specific pleuritis, where it was reported as necrotizing granulomatosis in six (11.1%) patients.
which was consistent with tuberculosis. Antituberculosis treatment was added to the current treatment of these six patients. Postoperative length of hospital stay was $6.8 \pm 2.5$ (4–15) days. There was no major complication and mortality at the postoperative follow-up. One patient was discharged with Heimlich valve, and remaining 53 patients were discharged upon drainage was terminated.

In the IPFib group, five (20.8%) patients had diabetes, five (20.8%) patients had COPD, and one (4.16%) patient had epilepsy and motor retardation. At admission, all patients first had tube thoracostomy in consequence of draining fluid in nature of pus after thoracentesis. Streptokinase was administered daily to those with ongoing septation among the patients followed-up. Satisfactory drainage was obtained in 23 patients. In all, 18 patients had five doses, two patients had four doses, and four patients had three doses of therapy. The introduction of fibrinolytic therapy could not be completed in six patients (25%) because of hemorrhagic drainage after third or fourth doses. After the procedure, the patients were evaluated through chest X-ray (Figs. 2 and 3). In all, 17 (70.83%) patients were discharged upon drainage was terminated. Six (25%) patients were discharged with Heimlich valve and the drainage was terminated at the outpatient clinic during follow-up. The mean length of hospital stay was $14.2 \pm 6.4$ (7–27) days.

Of the patients in the IPFib group, one (4.1%) patient developed pleural thickening in the follow-up period with partial response to treatment and required decortication via thoracotomy. Of the patients from the VATS-D group, four (7.4%) patients required decortication via thoracotomy in the follow-up. There is no statistically significant difference in treatment success between two groups ($p = 0.577$). The mean follow-up via tube thoracostomy was $17.3 \pm 9.0$ days in the IPFib group compared to $7.2 \pm 4.0$ days in the VATS-D group. The length of hospital stay for overall patients was $9.3 \pm 5.8$ days.

Based on the postoperative length of hospital stay (Group 1: 6.8 days, Group 2: 14.2 days), the statistical comparison of both groups revealed that the patients from the VATS-D group were discharged in a shorter period of time ($p < 0.001$).

**Discussion**

Parapneumonic effusion develops secondary to pulmonary infection, whereas complicated parapneumonic effusions are fluids that are not reabsorbed despite antibiotic therapy, requiring drainage. Pleural effusion is

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<th>Table 1 Patient demographics</th>
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<td><strong>Age</strong></td>
</tr>
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<td>VATS-D</td>
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<td>Postoperative length of hospital stay</td>
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IPFib: intrapleural fibrinolytic; VATS-D: videothoracoscopic deloculation; CAD: coronary artery disease; CHF: congestive heart failure; DM: diabetes mellitus; COPD: chronic obstructive pulmonary disease; MR: mental retardation
Fig. 2  Patient treated by VATS preoperative CT (A), X-ray (A1) image, and postoperative CT (B), X-ray (B1) image. VATS: video assisted thoracoscopic surgery; CT: computed tomography.

Fig. 3  Patient treated by intrapleural fibrinolytic therapy. Before intrapleural fibrinolytic therapy CT (A) and X-ray (A1) image, after intrapleural fibrinolytic therapy CT (B) and X-ray (B1) image. CT: computed tomography.
identified in 57% of the cases with bacterial pneumonia, and 10% of these result in complicated empyema.1, 2 The study by Light et al.10 reported seven classes of diagnosis and treatment for pleural effusions. Antibiotic therapy is satisfactory at the first two stages, where repeated thoracenteses are added to the treatment from the third stage, tube thoracostomy and antibiotic therapy are added to the treatment in the fourth stage of simple complicated parapneumonic effusion. The fifth stage is the complex complicated parapneumonic effusion in which there are multiloculation, and the sixth and seventh stages are the empyema stages characterized by pus and the presence of multiloculation. All patients included in the present study were at the stages of five, six, and seven, presenting with multiloculation. The drainage of the pleural cavity is important in complicated parapneumonic effusions. For this purpose, repeated needle aspirations, tube thoracostomy, videothoracoscopic methods, and open thoracotomy can be used.11

The multiloculation–septation is one of the most significant factors restricting the treatment in parapneumonic pleural effusion.10–12 The presence of empyema, which is characterized by fibrin deposits, bacterial, and inflammatory product accumulation after inadequate or inappropriate treatment, increases the length of hospital stay and mortality.5 IPFib application is effective in removing the septations and dissolving the fluid collection in the pleural cavity in such a condition.4, 13 In the randomized prospective study by Maskell et al.,6 intrapleural streptokinase application did not increase mortality, length of hospital stay, and proceeding to surgery. The randomized prospective study by Zuckerman et al.14 with 25 patients demonstrated that the intrapleural application of tissue plasminogen activator was effective in loculated complicated parapneumonic effusion and empyema. The study by Froudarakis et al.15 showed that the IPFib therapy to be administered in complicated parapneumonic effusion and empyema was 95% effective and well tolerated. The study by Shrestha et al.9 included a series of 37 patients who underwent VATS-D reported that VATS-D is an acceptable surgical method in treating early or advanced empyema, and the addition of VATS decortication specifically in the early period provides greater benefits. The retrospective study by Solaini et al.16 with 110 patients revealed that the VATS application is the first choice in empyema treatment which is at advanced stage and in which tube thoracostomy remains insufficient, and considerably reduces the thoracotomy need of such patients at the long-term follow-up. Bouros et al.17 achieved a success rate of 85% by applying VATS to 20 patients in whom intrapleural urokinase was administered due to complicated parapneumonic effusion and empyema but failed to obtain any response, and only three patients required thoracotomy after VATS. They recommended VATS application as a second-line therapy in patients who had IPFib and failed to obtain an adequate response. Shih-Ping Luh et al.18 achieved a success rate of 86.3% in 234 empyema patients who had VATS, and reported that specifically early application was associated with more successful outcomes in empyema and complicated parapneumonic effusions. In our study, VATS-D was applied in the early period. In the end, a success rate of 92.59% was achieved in the patients undergoing VATS-D. Furthermore, there was no significant difference in the presence of the need for decortication via thoracotomy between pleural infection patients who underwent IPFib and VATS-D (p = 0.577).

Maskell et al.6 revealed that intrapleural streptokinase application does not increase length of hospital stay. Rahman et al.19 reported that the intrapleural application of combined tissue plasminogen activator and DNase increased pleural drainage in patients with pleural infection as well as reduced the rate of proceeding to surgery and the length of hospital stay. Comparison of two groups of the present study showed significantly shorter duration of chest tube and less length of hospital stay and in the VATS-D group.

Undesired side effects such as fever, pain, allergic reactions, skin rash, and pleural hemorrhage may occur during the IPFib application.15, 19 Such side effects were not observed in the cases included in the present study.

In conclusion, both methods are observed to be techniques with high efficacy that can be administered to eligible patients; however, the VATS-D group was associated with better outcomes in terms of length of chest tube drainage and hospital stay. It is obvious that greater data would be obtained through future studies. Randomized prospective studies including larger series are required to establish the methods to be used in treating empyema with septation and the optimum timing of such methods.

Disclosure Statement

The authors declared no conflicts of interest with respect to the authorship and/or publication of this article.
References


