



ORIGINAL ARTICLE

Short-Term Outcome of Video Assisted Thoracoscopic Decortication in Empyema Thoracis

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Abstract

Background: Video-assisted thoracoscopic surgical decortication (VATS Decortication) is one of the technique for treating empyema thoracis. **Objective:** The purpose of the present study was to assess radiologic and functional short-term outcomes of VATS decortication in comparison with open decortication among empyema thoracis patients. **Methodology:** This comparative type of observational study was done at Department of Thoracic Surgery at National Institute of Diseases of Chest and Hospital (NIDCH), Dhaka, Bangladesh from July 2018 to June 2019 for a period of one year. Patients with empyema thoracis in stage II or III were included. Short-term outcomes were measured according to collection of chest drain tube in post-operative observational days (PODs), post-operative lung expansion, time taken for chest drain tube removal, postoperative hospital stay and post-operative pain (numeric rating scale) observations up to discharge from hospital. **Result:** A total number of 70 patients were recruited. The mean age was 36.20 ± 12.50 years. In post-operative phase apical chest drain tube collection followed by VATS procedure was found significantly lower than that of open decortication (2nd POD: $p=0.04$; 3rd POD: $p=0.039$). Both the apical ($p=0.001$) and basal ($p=0.039$) chest drain tubes were removed earlier in patients with VATS decortication. Again, patients with VATS decortication had to stay less days in post-operative time ($p=0.01$). The mean post-operative pain scores was significantly higher among the patients underwent open decortication ($p<0.001$). **Conclusion:** VATS decortication has shown better outcome in terms of collection of chest drain tube in post-operative days, time taken for chest drain tube removal, post-operative hospital stay and post-operative pain in managing patients with empyema thoracis. [*Journal of Current and Advance Medical Research, July 2021;8(2):100-105*]

Keywords: VATS decortication; empyema thoracis; short-term outcome

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Introduction

Empyema thoracis is a collection of pus in pleural space which may be free-flowing or loculated¹. The first case of empyema was described by Hippocrates about 2,400 years ago². Currently, the increased incidence of nosocomial infections, acquired immunodeficiency and antibiotic-resistant germs reflects in a dramatic increase of pleural empyema cases resulting in a challenging management and therapeutic approach³. Empyema thoracis remains a significant cause of morbidity and even mortality in modern thoracic practice.

According to the American Thoracic Society classification⁴, pleural empyema are staged into three distinct stages and these occur usually over a 3 to 6 week period. For management purposes, two stages are recognized as an acute process and an organizing phase. The three phases of empyema are exudative (stage I), fibrinopurulent (stage II), and organizing (stage III).

The incidence of empyema thoracis is increasing day by day in both children and adults in Bangladesh. Most of them are treated in different hospitals in Bangladesh by both conservatively and surgically. Surgically empyema can be managed by tube thoracostomy alone, and in some cases needs decortications either by open or VATS (video-assisted thoracoscopic surgery) decortications. Operations for empyema thoracis are conventionally performed by open thoracotomy, but for the last few decades' minimally invasive approach like VATS decortication becoming popular in the management of empyema thoracis⁵. In Bangladesh, no consensus is currently in place on which the surgical option is better.

This study seeks to evaluate whether VATS decortication shows better short-term outcome over open decortication in empyema thoracis. This study was done at department of Thoracic Surgery of the National Institute of Diseases of the Chest and Hospital. Research work on this particular issue in our country is a demand of time.

Methodology

This prospective comparative type of observational study was carried out in the department of Thoracic Surgery of National Institute of Diseases of the Chest and Hospital (NIDCH) from July 2018 till June 2019 after obtaining approval from Institutional Review Board of NIDCH and informed written patient consent. The study encompassed 70 patients of empyema thoracis in stage II or III, according to inclusion-exclusion criteria, who were

planned for decortication. The study patients were divided into two groups (35 patients in each group). Group-I (VATS decortication) and Group-II (Open decortications). All patients were selected purposively for the operation by the surgeon. In this study for evaluation of short-term outcome we considered patients different aspects during his post-operative hospital stay. This duration ended when he or she was decided to be discharged from the hospital by surgeon who conducted the procedure. Depending upon history, clinical examination (chest deformity) and radiological examination patients were staged into stage II and stage III. On radiological examinations stage II pleural empyema included fibrinopurulent effusion with loculation, encapsulated or non-encapsulated, air-fluid level, thin and thick pleural peel, inter lobar and diaphragmatic adhesions; and stage III included pleural thickening with entrapment of the underlying lung. This study included all the cases of empyema thoracis that need decortication. The analysis excluded patients who needed decortication with resectional lung surgery, VATS decortications that needed to convert into open decortications during the procedure, refuse to give informed written consent/unwilling, malignant effusion or visceral pleural malignancy (diagnosed either preoperatively or post-operatively), bilateral lung diseases (e.g. bilateral tuberculosis), associated other injuries except chest injury like head injury, limb injury and so one.

Pre-Operative Management Protocol: After admission of the patients, patients were evaluated properly (both clinically and radiologically). Patient were treated with intravenous antibiotics and for recovery of the symptoms tube thoracostomy or aspiration were carried out when needed and fluid sent for study and evaluation. No fibrinolytic therapy was used in any patient. All patients were subjected for CT scan of chest. If CT scan of chest showed encysted effusion or empyema, thickened pleura or trapped lung; then patient were subjected for decortication (VATS or Open decortication).

Surgical Technique (Open Decortication and VATS Decortication): All patient underwent general anaesthesia using double-lumen endotracheal tube for selective ventilation and were then placed in the lateral decubitus position.

Open decortication: A postero-lateral serratus anterior-sparing thoracotomy with rib spreading/nicking (but without rib resection) was performed. Evacuation of fluid done. All fibrin septae were cut and fissures were dissected free. A complete decortication (including parietal peeling off and parietal pleurectomy) was carried out to enable lung expansion to be obtained in all patients. An assessment was then made of the ability to re-expand

the underlying lung by ventilation to a positive pressure of 30 cm H₂O. To facilitate removal of the visceral cortex continuous positive airways pressure (CPAP) was applied to the operative lung during dissection. Chest wall bleeding was managed using electro cautery and, in some instances, packing. At the end of the procedure, two large bore (apical-28 FG and basal- 32 FG) chest tubes were placed through separate incisions.

VATS Decortication: The procedure was performed by means of small incision VATS (both single and multiple port). No rib retractor or spreader was used. Fluid evacuation, deloculations and septal breakdown were done under endoscopic vision by use of the sucker, a ring clamp and endoscopic forceps. Adherent peel was carefully removed from visceral pleural surface and the lung was freed circumferentially from the apex to the diaphragm and hilum to hilum. Complete decortication of the visceral pleura and the fissures was performed by use of an endoscopic dissector device and a peanut dissector as in open decortications. To facilitate removal of the visceral cortex continuous positive airways pressure (CPAP) was applied to the operative lung during dissection. Parietal peeling off and parietal pleurectomy done. Chest wall bleeding was managed using electro cautery and, in some instances, packing. The operating surgeon assessed the adequacy of lung re-expansion by temporary inflation of the affected lung to a positive pressure of 30 cm H₂O. Conversion to thoracotomy and open decortication was considered if it was not possible to dissect completely the peel from the underlying lung surface which were excluded from the study. At the end of the procedure, two chest tubes (apical-28 FG and basal-32 FG) were placed through separate incisions.

Post-Operative Care and Observations: Patients were extubated in the operating room and were transferred to a thoracic surgery recovery area as per anaesthesia protocol. Pain relief was obtained by analgesia and respiratory physiotherapy was instituted. Patients were usually monitored there till both the chest drain tube removal and wound stitches off. Air leak, colour and amount of the collection in the chest drain and wound regularly monitored. Criteria for removal of the apical chest drains were absence of air leak and for basal chest

drain were less than 100 ml of serous drainage during a 24 hours period for consecutive 2-3 days. Serial chest X-rays were done on 1st post-operative day, after apical chest drain tube removal, before basal chest drain tube removal and before discharge. A postoperative questionnaire-based, survey was conducted for all patients. Postoperative pain and paresthesia experienced was documented using 11-point numeric rating scale (NRS-11). All patient got the same analgesics protocol for the pain management (Pethidine and Ketorolac) during the post-operative days.

Statistical Analysis: Data were processed and analyzed using SPSS (Statistical Package for Social Sciences) version 21. The test statistics used to analyze the data were Chi-square (χ^2) and Student's t-Test. For all analytical tests, the level of significance was set at 0.05 and $p < 0.05$ was considered significant. The summarized data were presented in the form tables and charts.

Result

In this study, between July 2018 and June 2019, 35 patients were treated by VATS decortication and 35 by open decortication. Among the study population mean age was 36.2 ± 12.50 years, majority were male (81.4%). Most of the patients had stage II empyema (68.6%) in both VATS and open decortication group. Table 1 showed data regarding patient demographics (age and sex) and preoperative and postoperative diagnoses including stage of empyema (stage II of stage III).

Table 1: Patients' Data According to Surgical Approach

| Variables | Type of Operation | | P value |
|--------------------------------|-------------------|------------|---------|
| | VATS | Open | |
| Age (Years) | 35.2±11.64 | 37.1±13.39 | 0.513 |
| Gender | | | |
| • Male | 28 (80.0%) | 29(82.9%) | 1.00 |
| • Female | 7 (20.0%) | 6 (17.1%) | |
| Empyema Thoracis Stages | | | |
| • Stage II | 27(77.1%) | 21(60%) | 0.198 |
| • Stage III | 8(22.9%) | 14(40%) | |

In post-operative observations non expansion of lung found in both VATS decortication (5.71%) and open decortication (8.57%) group ($p=1.00$).

Table 2: Outcome of Two Procedure (VATS Decortication and Open Decortication) in Empyema Thoracis

| Parameters | Type of Operation | | P value |
|--|-------------------|--------------|---------|
| | VATS | Open | |
| Per Operative Lung Re-Expansion Status | | | |
| • Adequate | 33 | 35 | - |
| • Inadequate | 2 | 0 | |
| Post-Operative Expansion of Lung | | | |
| Expanded | 33(94.3%) | 32(91.4%) | 1.00 |
| Not Expanded | 2(5.71%) | 3(8.57%) | |
| Collection (ml) in Apical Chest Drain Tube | | | |
| • Observational Day 1 | 251.4±37.60 | 232.6±37.60 | 0.234 |
| • Observational Day 2 | 134.0±47.29 | 155.7±38.97 | 0.040 |
| • Observational Day 3 | 62.8±31.20 | 77.4±26.49 | 0.039 |
| Collection (ml) in Basal Chest Drain Tube | | | |
| • Observational Day 1 | 464.3±95.15 | 469.1±71.75 | 0.810 |
| • Observational Day 2 | 332.3±83.38 | 345.7±54.30 | 0.428 |
| • Observational Day 3 | 218.3±69.5 | 243.4±50.63 | 0.089 |
| • Observational Day 4 | 131.4±59.7 | 138.0±38.48 | 0.586 |
| • Observational Day 5 | 66.0±37.03 | 99.4±102.26 | 0.073 |
| Re-exploration | | | |
| • Needed | 0(0%) | 1(2.8%) | - |
| • Not Needed | 35(100%) | 34(97.2%) | |
| Duration of Removal of Apical Chest Drain (Days) | 3.28 ± 0.66 | 3.88 ± 0.67 | 0.001 |
| Duration of Removal of Basal Chest Drain (Days) | 5.48 ± 2.73 | 6.51 ± 0.95 | 0.039 |
| Post-operative hospital stay (Days) | 8.82 ± 4.70 | 11.14 ± 2.04 | 0.01 |
| Pain Score (by Numeric Rating Scale NRS-11) | | | |
| Observational Day 1 | 9.14 ± 0.73 | 9.91 ± 0.28 | 0.001 |
| Observational Day 2 | 6.94 ± 0.80 | 8.14 ± 0.55 | 0.001 |
| Observational Day 3 | 4.45 ± 0.91 | 5.97 ± 0.45 | 0.001 |
| Observational Day 4 | 2.40 ± 0.77 | 3.97 ± 0.45 | 0.001 |
| Outcome of Chest X-ray (4 observational days) | | | |
| • Satisfied | 33(50.8%) | 32 (49.2%) | 1.000 |
| • Not satisfied | 2(40%) | 3 (60%) | |
| Post-Operative Complication | | | |
| • Yes | 3 (8.57%) | 3 (8.57%) | - |
| • No | 32 (91.43%) | 32 (91.43%) | |

In post-operative observations apical chest drain tube collection followed by VATS procedure was

found significantly lower than that of open decortication on both 2nd POD- $p=0.04$ and 3rd POD - $p=0.039$). Basal Chest drain tube collection was similar in all five observational days ($p>0.05$). Both the apical ($p=0.001$) and basal ($p=0.039$) chest drain tubes were removed earlier in patients with VATS decortication. Again, patients with VATS decortication had to stay less days in post-operative time ($p=0.01$). Regarding post-operative pain assessment it showed that the mean pain scores were significantly higher among the patients underwent open decortication than VATS decortication ($p<0.001$) in all four post-operative observations. In the early postoperative period, expansion of the lung, evident in Chest X- ray and clinically, showed no association with the procedure undertaken (whether VATS or open decortication). Table 2 depicts data of intraoperative details and postoperative events of all patients who were included in the study.

Discussion

Empyema thoracis is a condition commonly managed by the contemporary thoracic surgeon. Although the underlying principles of early drainage and complete decortication facilitate lung expansion have not changed over last 40 years, technological advances have allowed for surgeons to treat these conditions with lower perioperative mortality and morbidity. Other groups like Chan et al⁶ and Cheng et al⁷ have demonstrated the feasibility of VATS for management of empyema with favorable results for those undergoing VATS decortications. Potential advantages of thoracoscopic approach include improved visualization, less surgical trauma, and improved postoperative quality of life outcome.

This study was undertaken to compare short-term outcome associated with VATS decortications and open decortication managing patients with empyema thoracis. During this study total 70 patients were included who undergone two different surgical procedures. Among them mean age of the respondents was 36.2 year (ranges 14 to 63 years) years with majority of male (57, 81.4%), female 13. The study population (70) were grouped into two group with 35 patients in each group designated as group-I open decortications and group-II VATS decortications. The outcome were evaluated during both per and post-operative conditions. In this present study, mean age in VATS decortication group was 35.1 year and open decortication group was 37.1 year, $p=0.513$. Males were predominant in both VATS (80.0%) and open (82.9%) decortications; females were 20.0% and 17.1% respectively ($p=1.00$). There was no significant difference in the age and sex distribution of the two groups. Previously to evaluate the comparative merits of thoracoscopic versus open decortication in the

surgical management of patients with chronic post-pneumonic pleural empyema, a prospective comparative study done by Cardillo et al⁸, 180 males, 128 females, mean age 56.3 years (range: 17 to 82 years), with chronic post-pneumonic pleural empyema who underwent decortication after failure of conservative treatment. Male/female was 79/44 cases and 95/90 cases in open decortications and VATS decortications respectively, p-value 0.03. Age (year) ranges in two groups were 57 (17 to 79) and 55.8 (31 to 82), p value 0.3. In a prospective study by Waller and Rengarajan⁹, 48 patients (male 34, female 14) included, male: female was 10:2 in thoracotomy group and 24:12 in VATS decortication group, mean age (year) was 43.5 in thoracotomy group and 45.4 in VATS decortication group. There were no significant difference in the age and sex distribution of the groups. Again, in a retrospective study by Tong et al¹⁰, the outcome of 420 consecutive patients undergoing VATS or Open decortications for benign conditions reviewed. 94 patients were in open decortication group and 326 patients were in VATS decortication group, mean age (year) was 53 and 55 respectively (p value 0.4), male 63(67%) and 238(73.0%) (p value 0.3) respectively. There is no significant association between age and sex in these above mentioned studies which is consistent with our study.

This study showed that, total 48 respondents were in stage II and 22 respondents were in stage III empyema thoracis. In both VATS decortications and open, stage II empyema thoracis respondents were more common, 27(77.1%) patients in VATS decortication group, 21(60%) patients in open decortication group (p=0.198). Stage III empyema respondents were less in both VATS decortication and open decorticate on group, 8(22.9%) patients and 14(40%) patients respectively (p=0.198). There was no significant intergroup difference in underlying empyema stage and operative procedure. In a previous study done by Cardillo et al⁸, reported in videothoracoscopy group, 118 patients were in stage-II empyema thoracis and 67 patients were in stage-III empyema thoracis (n 185), and in open thoracotomy group, 85 patients were in stage-II empyema thoracis and 38 patients were in stage-III empyema thoracis (n:123) (p= 0.3). In this study and other studies showed that stage II empyema thoracis is more common.

This present study found that most of the patients had per-operative adequate lung inflation during the procedure except two, who were found during VATS decortication procedure. During the study apical Chest drain tube except 1st POD, all the subsequent days showed higher collection (ml) in open decortication procedure patients (2nd POD- p=

0.04 and 3rd POD -p =0.039). In all the five post-operative observational days of measurement higher basal chest drain collection (ml) in open decortication procedure patients than those having VATS decortication. Basal chest drain tube collection (ml) in all five postoperative observational days no statistically significant difference (p>0.05). It was observed the time taken (in days) for removal of both apical and basal chest drain tubes were longer in those patients having open decortication (3.8 and 6.5 days respectively) than those having VATS decortication (3.2 and 5.4 days respectively) (p<0.05). In a previous study done by Tong et al.¹⁰, the median length that patients had indwelling chest tubes was 6 days for open decortication group and 4 days for VATS decortication group (p=0.008). Drain et al.¹¹, reported the successful management of empyema thoracis by VATS decortications in 52 patients. The mean drainage time was 3.9 days (range 2–10 days; median–4 days). Wait et al¹² found that chest tube drainage was 5.8 days in VATS group and 9.8 days in open decortication group (p=0.03). Solaini et al¹³ found that the duration of chest tube drainage was 6 days (ranges 3-25 days) in VATS group and 7.1 days (range 5 to 17 days) in thoracotomy group. All of these results are consistent with our result. This current study and other previous studies found that time taken for removal of chest drain is shorter in case of VATS decortication patients.

This present study found that percentage of the lung expansion during post-operative time was similar in both procedures, VATS decortication 94.3% and open decortication 91.43% (p=1.00). Waller and Rengarajan⁹, in their study found that postoperative lung expansion was 98.6% and 98.8% in VATS decortication and open thoracotomy group respectively. In our study, among all the respondents only one needed re-exploration who's operative procedure was open decortication. In a previous study by Cardillo et al⁸ showed that after VATS decortication three patients (1.6%) (n=185) showed recurrent empyema and underwent re-do surgery in post-operative days. No recurrence was seen in patients undergoing thoracotomy.

It was also found that duration of post-operative hospital stay was longer in those patients having open decortication (11.14 days) than those having VATS decortication which was 8.8 days (p=0.01). In previous study¹⁴ they found for the thoracoscopic decortication group the post-operative hospital stay was five days and eight days for the open decortication. Again, A prospective study by Waller and Rengarajan⁹ found VATS decortication showed significantly reduced hospital stay (mean 2.9 days; P=0.004). Again in a prospective study by Cardillo et al⁸ found hospital stay in open decortication was 10

days and 8.6 days in VATS decortication group ($p=0.02$). Tong et al¹⁰ found the median postoperative length of stay 7 days for VATS decortication group versus 10 days for open decortication group ($p<0.001$). This present study results are similar with these results.

This study also shows among the respondents the mean pain score (depending on comparative pain scale chart NRS-11) were higher among the patients undergone open decortication than VATS decortication in all post-operative observational visits ($p<0.05$). All patient received same analgesics protocol (Inj. Pethidine and Inj. Ketorolac). In a previous study done by Cardillo et al⁸ reported VATS ($n=185$) having significantly better results than open decortication ($n=123$) in terms of pain ($P=0.0001$). Again, Chan et al⁶ also found less post-operative pain in VATS group then in open decortication group ($p=0.04$). All of these results are consistent with our result.

In this present study incidence of post-operative complications, such as non-expansion of lungs, wound infection, pneumonia, encystation/residual collection and bronchopleural fistula, same (8.57%) in both group. In VATS group one had wound infection, one with encystations/residual collection and one had bronchopleural fistula. On the other hand among the open decortication group two suffered from non-expansion of lungs and one suffered from wound infection. Tong et al¹⁰ showed less post-operative complications in VATS decortication compared to open decortication group. In previous study, Cardillo et al⁸ found 25.2% (31/123) in open thoracotomy patients and 18.3% (34/185) in a VATS decortication patients ($p=0.01$) have post-operative complications. Finally, 30-day mortality was 0% in both groups.

In terms of all variables taken in this study VATS decortication patient showed similar or better outcome then open decortication patients which corresponds with other previous studies.

Conclusion

This study showed VATS decortication provides satisfactory postoperative radiological and clinical lung expansion. VATS decortication provides statistically better outcome as compared to open decortication in terms of post-operative hospital

stay, post-operative pain, chest drain tube collection and removal of chest drain tube. So, in the light of our present study, it may be concluded that the minimally invasive approach like VATS decortication is a better procedure for empyema thoracis stage II and stage III, and may be practiced in every center/hospital. But the long-term results in regard to the restoration of pulmonary function and the limits of this technique still need to be defined better and large scale study can be done for better outcome assessment.

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