ORIGINAL RESEARCH PAPER

Paediatric Surgery

EFFICACY OF VIDEO-ASSISTED THORACOSCOPIC SURGERY (VATS) IN CHILDREN WITH EARLY EMPYEMA THORACIS IN COMPARISON TO OPEN THORACOTOMY

KEY WORDS: Early empyema thoracis, Thoracoscopy, VATS, Thoracotomy, Decortication

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ABSTRACT

Background/Purpose: VATS is more effective in early empyema which includes exudative and early fibrinopurulent phase. This study evaluates the role of VATS and compares the results with open decortication cases done during the same period for early empyema thoracis. **Method:** A prospective study was done on children with empyema thoracis who underwent VATS from March 2017 to March 2020 in a single large center. The collected data included age, clinical presentation, radiological investigation, pleural fluid analysis, intraoperative findings, histopathological findings and post operative course. The length of stay and the post-operative time taken for clinical and radiological lung expansion was compared with cases of open decortication done for early empyema during the same period of study **Results:** Of the198 cases of empyema, 54 cases underwent VATS and open decortication was done in 130 children. Postoperatively patients became afebrile in 2 ± 1.2 days in VATS and 7 ± 3.2 days in open decortication. Clinical and radiological expansion was earlier in VATS with 3 ± 2.1 and 6 ± 2.2 days respectively. **Conclusions:** The prospective study concludes that VATS is more effective and less invasive than open thoracotomy for early empyema thoracis in decreasing the morbidity and has better cosmesis.

SUBJECTS AND METHODS:

This prospective study was done on 198 patients of early empyema thoracis who attended to Niloufer hospital, Department of pediatric surgerybetween March 2017& March 2020. The children age range is between 2 ½ months & 11yrs (Mean age 3.8yrs) with 112 male and 86 female children. Of the 198 cases, VATS was performed in 54 children, open decortication in 130 and only intercostal tube drainage in 14 patients.

The inclusion criteria for considering as early empyema thoracis included presence of symptoms for 2weeks, finding of loculations, (on CT or USG chest) and absence of thickened pleura. The exclusion criteria of early empyema thoracis are symptoms more than 2weeks, absence of loculations (on CT or USG chest) and presence of thickened pleura. Damaged lung due to previousthoracic surgery, bronchopleural fistulas and deformed hemithorax on CT scan were excluded from the study.

Empyema thoracis was diagnosed by the presence of pus on pleural fluid aspiration. The patients were evaluated with chest x-ray, pleural fluid analysis, ultrasonography and contrast enhanced computed tomography of chest. These investigations were done to visualize the extent of the disease, loculated collections, thickened pleura, shift of the mediastinum and about the status of opposite lung. The diagnosis of early empyema was considered by the presence of loculations on ultrasonography. Chest ultrasonography was the preferred imaging modality in this study as it allows adequate imaging of the pleural space, showsthe presence of loculated areas, and does not expose the child to radiation. Depending on the stage of the disease and the duration of the symptoms, a decision was taken regarding the type of intervention and the necessity of intercostal drain insertion. The patients with early empyema were posted for VATS at the earliest operation theatre list. Patients who were not in respiratory distress were posted for primary VATS and debridement. Primary VATS was done in 11 of the 54 cases. The patients were operated under general anaesthesia with a single lumen endotracheal tube. Parenteral antibiotics were given for 4 to 7days during the postoperative period.

VATS was performed in a lateral position with two 5 mm ports. Primary port was placed through the intercostal drainage site or in case of primary VATS in the fifth or sixth intercostal space in mid-axillary line. A zero degree wide angle scope was introduced. The carbon dioxide insufflation pressure was maintained between 4-6 mm Hg at a flow rate of 1 liter/minute. The placement of a second port was based on thoracoscopic findings. The Initial dissection was done under vision with creation of space by carbon dioxide insufflation. Adhesions were released with the tip of the scope or suction cannula.

The pleuralcavity was debrided of all fibrinous and purulent material and the lung was inspected. Conversion to open decortication was done if the lung was entraped and not expanding. After irrigation and haemostasis, one or two chest tubes were placed through the trocar incisions. Depending upon the requirement, long open surgical instrument was introduced directly through the ports for removal of the peel.

During the postoperative period patients received chest physiotherapy and breathing exercises. Chest radiograph was done on the 2nd post-op day, to visualize the condition of the ipsilateral and contra lateral lung. The criteria for removal of chest tube included absence of purulent material in the drain, drainage less than 20ml per day, adequate expansion of the ipsilateral lung and no air column movement seen in the intercostal tube drain. Parenteral antibiotics were given during the hospital stay and later switched on to oral antibiotics at discharge. Early ambulation and respiratory exercises were encouraged. Patients were followed up for 3-4 weeks with chest x-rays as per the requirement.

The data collected from VATS and open decortication patients included preoperative symptoms along with duration, imaging, thoracocentesis, and laboratory results.

Additionally, operative findings, cultures, histopathology findings, length of stay (LOS) and post-operative time taken for lung expansion were collected. Results are reportedas mean & median ± Standard Deviation, unless noted otherwise. The results of open decortication cases were analysed and compared statistically with VATS cases.

RESULTS

The observations and results of VATS patients done for early empyema were analysed statistically and the durations were calculated as median with two standard deviations. The study included 54 VATS patients, with age ranging from 2months to 11years and the mean age was 3.8yrs. The mean time interval from onset of symptoms to presentation was 10 ± 2.2 (3-14) days. The commonest presentation of VATS patients was fever with cough (90%). 54% of patients were breathless with varying severity and 22% of them required oxygen at the time of presentation.

Streptococcus pneumonia was found in 6 VATS patients while Staph aureus was present in 4 cases. No organism was grown in 82% of the patients possibly because of antibiotics given prior to admission.

Table 1 Operative findings ofVATS

Intra Op findings	No. of patients (%)	No. Of conversions to open thoracotomy
Thin pus without loculations	04(7%)	Nil
Thin pus with loculations	42(78%)	Nil
Thick pus with loculations	18(34%)	Nil
Thin pleural peel	28(52%)	Nil
Thick pleural peel	06(12%)	6
Unhealthy underlying lung	09(16%)	4

Table 2 Postoperative period followingVATS

Post operative symptoms & signs	Duration (no. of days)
Patients afebrile	2 ±1.2 days
Air leaks	2±1.7 days
Pleural drainage	4±1.8 days
Lung expansion Clinically	3±2.1 days
Lung expansion Radiologically	6±2.2 days
Post op hospital stay	6±2.4 days

Note: Duration was calculated as median time interval ± 2 standard deviation

Table 3 Comparative study of VATS cases with open decortication patients

Post operative symptoms & signs	Duration (no. of days) In VATS cases	Duration (no. of days) In open decortication cases
Patients afebrile	2 ±1.2 days	7±3.2 days
Air leaks	2±1.7 days	6±2.8 days
Pleural drainage	4±1.8 days	7±3.6 days
Lung expansion Clinically	3±2.1 days	7±2.4 days
Lung expansion Radiologically	6±2.2 days	9±1.2 days
Post op Hospital stay	6±2.4 days	10±7.2 days

Note: Duration was calculated as median time interval ± 2 standard deviation

The present study of 54 VATS patients were analysed and compared with 130 cases of open decortications done during March 2008 and March 2013. The median time interval to become afebrile was 2 ± 1.2 days in VATS and 7 ± 3.2 days following open decortications. Air leaks stopped at a median time interval of 2 ± 1.7 days and pleural drainage continued for 4 ± 1.8 days. On contrary, air leaks stopped at a mean interval of 6 ±2.8 days and pleural drainage for 7 ± 3.6 days following open decortication. The lung expanded clinically 3 ± 2.1 days and radiologically 6 ± 2. decortications cases with a median interval of 10 ± 7.2days when compared to VATS with a median interval of 6 ± 2.4 days 2 days earlier in VATS cases. The post operative hospital stay was longer in open

Table 4 Outcome of VATS in children with empyema thoracis

The present study done at our hospital was compared with various other studies involving VATS done for empyema thoracis. The number of patients in this study is more than the number of cases reported by various authors[7,8,9,10]. The post operative median intercostal tube drainage period of VATS for early empyema is 4 ± 1.8 days which is much less than the period reported by other series. Similarly the post operative hospital stay was also less with a median time interval of 6 ± 2.4 days

DISCUSSION

According to American Thoracic Society (ATS)[2], untreated or incompletely treated parapneumonic effusion changes from the initial exudative phase to fibrinopurulent and then to the organised phase, there by restricting the expansion of lung[7,11]. The demarcation between these stages is arbitrary and ill-defined. Keeping this aspect in view, early intervention by minimally invasive procedure like VATS will stop the sequel of going into the organised phase. This would allow the lung to expand and there by decrease the morbidity. This prospective study done at our hospital evaluates the role of VATS in 54 patients with early empyema thoracis. Early empyema includes exudative and initial fibro purulent stage. This can further be identified radiologically by presence of loculations seen on Ultrasonography. The study also compares the results of VATS with open decortications done during the same period.

Early referral of children with respiratory symptoms suggestive of parapneumonic effusion will make treatment by primary VATS possible. The microbiology of childhood empyema dictates the appropriate antibiotic selection. *Streptococcus pneumoniae ,Staphylococcus aureus*,and *Haemophilus influenza*, remain the most common pathogenscultured in empyema[13-17]. In ourpatients, *Streptococcus pneumoniae*& *Staphylococcus aureus* were the only two pathogens isolated. A majority of our patients (82%) did not have any positive cultureresults, and this may be explained by the fact that all our patients had been receiving antibiotics before obtaining cultures.

The ultrasound findings of early empyema correlated well with the intraoperative findings like thin or thick pus with loculations. It was observed in the study that ultrasound was more useful in early empyema as it is equally informative as CT scan. CT scan is more useful in late empyema and to know the status of the underlying lung. Ultrasound is economical and is not associated with exposure to radiation, as well as contrast hazards. Park and associates[18]have shown sonography to be superior to CT in evaluating the natureof pleural fluid in their study of 31 patients. Donnelly LF et al [19] study in children has shown that CT is not specific indiagnosing empyema. The present study observes that initial ultrasongraphy is superior to CT chest in early empyema.

The present series showed 6 patients with thick pleural peel and 4 patients with unhealthy underlying lung required conversion of VATS to open thoracotomy. In a study by Shi-Ping Luh *etal*[26]., of 234 patients with empyema in adults treated by VATS only 6.8% required conversion to open procedure. These observations highlight the beneficial role of VATS in early empyema. Wait *etal*.,[20] in their randomized controlled trial of empyema thoracis, showed that VATS was found to be more effective than ICD drainage or fibrinolytic therapy in empyema. Schultz *etal*[12] also showed a significantly shorter length of hospital stay in their study.

Eleven patients were treated by primary VATS. In these patients, there was no conversion to open decortication, as

compared to the VATS patients done after initial intercostal tube drainage, in whom the conversion rate was higher (18%). The time of removal of the ICD was significantly less in patients who underwent VATS as a primary procedure with a mean duration of 4 ± 1.8 days. This is in comparison to patients with ICD prior to VATS in whom the time interval of ICD removal was significantly prolonged ranging from 5-15 days. Beth A Kurt et al[21] in their prospective randomised trial suggested that primary VATS is superior to conventional thoracostomy drainage.It is observed in this study that intervention with VATS, in particular primary VATS, in patients with early presentation, decreased the total hospital stay and there by the morbidity.

During this study of 54 VATS patients, comparative analysis was done with 130 cases of open decortications, performed during the same period. The observations emphasises that VATS is superior to open Thoracotomy in terms of early clinical and radiological improvement. Our observations are well supported with various other studies [22,23,24,25] which showed VATS is more effective than open Thoracotomy.

The present series stresses the efficacy of VATS in early empyema and is noted to be superior to open thoracotomy in terms of clinical and radiological expansion of lung. Primary VATS in particular, is more beneficial, as it decreases the total hospital stay and morbidity. Ultrasound is equally informative as CT scan in diagnosing early empyema characterized by loculation. The study concludes that VATS is more effective than tube drainage and less invasive than open thoracotomy in early empyema thoracis.

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