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Research Article

Prospective comparative study of video assisted thoracoscopic surgery versus conventional thoracostomy drainage in emyema thoracis in paediatric age group

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ABSTRACT

Background: Approximately 1.2 million people per year are affected by pneumonia in the United States. In paediatric patients, thoracis empyema complicates pneumonia 36% to 57% of the time with a range of incidence between 0.4 and 6.0 cases per 1000 paediatric admissions. Many retrospective case series have suggested that children who experience failure of conventional chest tube therapy exhibit improvement after thoracotomy or video assisted thoracoscopic surgery (VATS), especially if the procedure is performed early, based on these reports, many paediatric surgeons have come to consider primary VATS a better approach for children suffering from thoracis empyema, A recent meta-analysis suggested that primary surgical intervention for paediatric thoracis empyema effusions was best which was prospective, randomized study done by Waite et al in adults.
Methods: The present prospective study was conducted in a large teaching hospital that is a tertiary centre, department of surgery pediatric surgery unit, Pt. J. N. M. medical college & Dr. B.R Ambedkar hospital, Raipur (C.G.), India, in the year 2010. Using a random number method, patients were assigned either to a primary conventional thoracostomy arm or to a VATS arm. Those randomly assigned to the conventional thoracostomy arm had chest rube placement within 24 hours of empyema detection. If the chest radiograph obtained within 24 hours of the procedure showed significant clearing, then the thoracostomy tube was left in place until it drained <1 mL/per day for >24 hours. If there was incomplete resolution of the effusion on the follow-up chest radiograph [obvious locations] and the patient was not clinically improving, then the patient was evaluated for rescue VATS or open thoracotomy. A sample size of 30 was chosen to have an 80% power to detect a predicted deference of 4 days in the mean length of hospitalization.
Results: In this study, 30 patients included between 0 to 18 years of age youngest patient was 1 year and the oldest was 14 years. Six patients (20%) were between 2 to 3 years of age. In this study, 20 (67%) were male and 10 (30%) patients were females. Out of all 30 patients, in this study 20 (67%) were male and 10 (30%) patients were females. **[**Sixteen (53.3%) patients had right sided disease and fourteen (46.6%) had left sided disease, no patient was found having bilateral disease. All the thirty patients were empyema Thoracis. Using a random number method, patients were assigned either to a primary conventional thoracostomy arm or to a VATS arm.
Conclusions: In the present study we found that empyema thoracis can be successfully treated by thoracoscopic decortications if encountered in early phase of the disease process. To conclude early intervention of empyema thoracis with thoracoscopic decortications seems to be the worldwide accepted modality of choice.

Keywords: Conventional thoracotomy, Thoracis empyema, Video assisted thoracoscopic surgery

INTRODUCTION

Approximately 1.2 million people per year are affected by pneumonia in the United States. In pediatric patients, thoracis empyema complicates pneumonia 36% to 57% of the time with a range of incidence between 0.4 and 6.0 cases per 1000 paediatric admissions. Although thoracis empyema is a relatively common entity, optimal management remains controversial.[1-3] Therapeutic options include antibiotics, thoracocentesis, thosracostomy tube drainage, fibrinolysis, video-assisted thoracoscopic surgery (VATS), and thoracotomy.

In 1962, the American thoracic society (described the formation of an empyema thoracis along a3-stage continuum. Based on the disease pathophysiology, all empyema processes are exudates resulting from an inflamed pleural membrane from an adjacent pneumonia. In the early exudative phase (stage 1), the empyema thoracis has a normal glucose and pH. The intermediate fibrinopurulent phase (stage 2) is heralded by an increase in fibrin. Polymorphonuclear neutrophils, and lactic dehydrogenase, with decreases in glucose and pH. Because of the fibrin deposition, loculation of fluid began to form in the pleural space. Finally, in the late organizing phase (stage 3), fibroblastic growth extending from the visceral and parietal pleurae causes the formation of a restrictive pleural peel that entraps the lung and impairs its function.[4]

Historically, the treatment of thoracis empyema has most often included a primary non-operative regimen (antibiotics and thoracocentesis or chest tube drainage). Although antibiotic administration and chest tube thoracostomy may be adequate therapy for early (stage I) thoracis empyema, the presence of loculations and fibrinous adhesions often limits the success of this therapy. Many times it is difficult to clinically and radiographically differentiate between stages 1 and stage 2 diseases. Thus, this primary nonoperative approach frequently results in prolonged hospitalizations.[5]

Many retrospective case series have suggested that children who experience failure of conventional chest tube therapy exhibit improvement after thoracotomy or VATS, especially if the procedure is performed early, based on these reports, many paediatric surgeons have come to consider primary VATS a better approach for children suffering from thoracis empyema, A recent meta-analysis suggested that primary surgical intervention for paediatric thoracis empyema effusions was best which was prospective, randomized study done by waite et al in adults.[6] However, to our knowledge there has never been a prospective paediatric study to confirm this hypothesis. The purpose of this study was to prospectively compare multiple variables in paediatric patients undergoing primary VATS versus conventional thoracostomy drainage of thoracis empyema.

METHODS

Inclusion criteria

Any patient between the ages of 0 to 18 year admitted with bacterial pneumonia and an associated thoracis empyema was considered, for enrolment into the study. These patients underwent a plain x-ray chest and USG thorax and USG guided aspiration to document thoracis empyema parenchyma disease and degree of pleural involvement.

Criterion for exclusion

Hospital-acquired pneumonia, previous drainage procedure, uncorrected cardiac disease, known immune-compromise, malignancy, pre-existing bronchopleural fistulas, contraindication to fibrinolytic therapy, or suspected non-bacterial infection. All of the patients received appropriate antibiotics for the most likely pathogens before enrolment.

Using a random number method, patients were assigned either to a primary conventional thoracostomy arm or to a VATS arm. Those randomly assigned to the conventional thoracostomy arm had chest tube placement within 24 hours of empyema detection. If the chest radiograph obtained within 24 hours of the procedure showed significant clearing, then the thoracostomy tube was left in place until it drained <1 mL/per day for > 24 hours. If there was incomplete resolution of the effusion on the follow-up chest radiograph [obvious locations] and the patient was not clinically improving, then the patient was evaluated for rescue VATS or open thoracotomy.

Patients randomly assigned to the surgical arm had primary video-assisted thoracoscopic drainage of the chest within 24 hours of diagnosis of a thoracis empyema. To accomplish this, patients were placed under general endotracheal anesthesia. A hydroparoscope introduced into the pleural space was used to irrigate the pleural cavity and disrupt loculation with blunt dissection technique. Debridement was continuing until the pleura surfaces of the lung were sufficiently clear. The lung was then fully reexpanded. At the conclusion of the procedure, a chest tube was placed through one of the existing port sites used for the VATS procedure. The chest tube was left in place until it drained <1 mL/ kg per day and there was documented resolution of the parapneumonic effusion. In the case of persistent effusion or patient was clinically not improving hence was submitted for open thoracotomy.

Primary variables compared between groups were length of hospital stay and duration of chest tube drainage. Secondary variables included fever duration, days of oxygen and narcotic use, number of radiographic procedures, number of drainage procedures, and procedure sedation time.

A sample size of 30 was chosen to have an 80% power to detect a predicted deference of 4 days in the mean length of hospitalization. Statistical analysis were made with the Mann-Whitney test or, where appropriate, a fisher's exact and p :≤ 0.05 was considered statistically significant.

RESULTS

In this study, 30 patients included between 0 to 18 years of age youngest patient was 1 year and the oldest was 14 years. Six patients (20%) were between 2 to 3 years of age and one patients, in this study 20 (67%) were male and 10 (30%) patients were females. Out of all 30 patients, in this study 20 (67%) were male and 10 (30%) patients were females (Table 1 and 2).

Sixteen (53.3%) patients had right sided disease and fourteen (46.6%) had left sided disease, no patient was found having bilateral disease (Table 3).

Table 1: Observation of age distribution of patients with empyema.

Age in year	0-1	1-2	2-3	3-4	4-5	Total
No. of patients	2 (6.66%)	4 (13.3%)	6 (20%)	1 (3.3%)	3 (10%)	16
Age in Year	5-6	6-7	7-8	8-9	9-18	Total
No. of patients	4 (13.3%)	1 (3.3%)	3 (10%)	1 (3.3%)	5 (16.6%)	14

Table 2: Sex distribution of patients.

Sex	No. Of patients with empyema
Male	20 (67%)
Female	10 (33%)

Table 3: Involvement of side of chest in thoracis empyema.

Side of Chest	No. Of Cases
Right	16 (53.3%)
Left	14 (46.6%)

Table 4: Clinical presentation of thoracis empyema.

Clinical presentation	Fever	Cough	Dyspnoea	Chest Pain
No. Of Patients	30 (100%)	30 (100%)	26 (86.6%)	28 (93.3%)

Table 5: Total leucocytic count in empyema thoracis.

Total Leukocyte Count	No. Of patients
<11, 000	14 (46.6%)
11,000-15,000	12 (40%)
15,000-20,000	3 (10%)
>20, 000	1 (3.3%)

All the patients (100%) presented with fever, this was expected in all patients with empyema and fever was high grade in 18 (60%), moderate in 10 (33.3%) and low grade in 2 (6.6%) patient who were finally diagnosed as tuberculosis. Out of thirty, all patients (100%) had cough and is most of them cough was irritating and sometimes in bouts, half of the patient had associated expectoration which was mucoid and rest has mucopurulent and patients had no hemotysis. Out of thirty 26 (86.6%) patients had dyspnoea, which was most of them had even at rest and 28 (93.3%) patients had chest pain more on stress or cough (Table 4).

Table 6: Microorganism present in this study of empyema thoracis.

ORGANISM	NO. of Patients
Streptococcus spp.	0(0%)
Staphylococcus	4(13.3%)
E.coli	1(3.3%)
Pseudomonas	1(3.3%)
Mycobacterium	2(6.6%)
Others	0(0%)
Sterile	22(73.3%)

Table 7: Offered procedure in empyema thoracis.

	PROCEDURE OFFERED	
Diagnosis	PRIMARY VATS	Primary Thoracostomy (ICD)
Empyema	13 (43.3%)	17(56.6%)

Out of thirty patients, 14 (46%) patients had anemia and more that 50% patients had loss of appetite. X-ray chest and Ultrasonography done in all the patients (100%) and CT scan were not done. Pus culture-out of 30 patients 22 (73.3%) culture are sterile and in other following microorganisms were presents Staphylococuss ssp. O, acid fast bacilli 2 (6.6%), E. coli 1 (3.3%) and Pseudomonas ssp. 1 (3.3%). All the thirty patients were

empyema Thoracis. Using a random number method, patients were assigned either to a primary conventional thoracostomy arm or to a VATS arm. Out of thirty patients, 13 (43.3%) patients had primary VATS and 17 (56.6%) patients had primary. In VATS arm only 3 (23%) out of 13 patients required conversion into open thoracostomy. Average operative time 1 hours and average blood loss was 60 to 70 ml during VATS. In all patient 2 intercostal tube were kept. Post operatively all patients who had primary VATS were comfortable, injection thremadol was given after completion of the procedure and repeated after 8 to 12 hours. Postoperative fever occurs in all patients in primary VATS. On an average of 2 to 5 days, and in primary thoracostomy fever also occurs in all patients on average of 4 to 6 days. Chest tube removed on an average 7 days in VATS arm while in a primary thoracostomy arm longer time (16 days) required for chest tube removal and hospital stay around 10 days in primary VATS and in primary thoracostomy hospital stay 16 days. Number of chest x-ray after primary VATS is only 3 but in a thoracostomy arm minimum 4 to 5 x-ray done to see the lung expansion and residual collection (Table 5 to 14).

Table 8: Operative procedure during VATS in empyema thoracis.

Operative procedure	VATS
Debridement	5 (38.4%)
Decortication	6 (46.15%)
Both	2 (15.3%)

Table 9: Conversion rate in open thoracotomy in both Procedure done in empyema thoracis.

Procedure	VATS	ICD
Not converted to open thoracotomy	10 (76.9%)	4 (23.5%)
Converted to open thoracotomy	3 (23.07%)	13 (76.4%)
P value(Fishers test)- 0.0086		

Table 10: ICD removal after primary VATS and primary thoracostomy in days.

Operation	0-5	6-10	11-15	16-20
Primary vats	10 (76.9%	3 (23%)	0	0
Thoracostomy (ICD)	0	6 (35.5%)	4 (23.5%)	7 (41.17%)
Chi-square 21.86 P value-<0.0001				

DISCUSSION

Pus culture was done in 30(100%) patients, in which staphylococcus species zero, E.coli 1(3.3%), pseudomonas aures 1 (3.3%) and sterile 22 (73.3) present. Aashish K. Gupta et al, in total 60 patients, sterile I7 (28.3%), Staphylococcus aureus 12 (20%), Penumcoccus 11 (18.3%), Klebsilla 5 (8.3%), E.coli 13 (21.7%) and Mix organism are 6(10%).[1] JA Carey et al in total 22 (11.76%) patients was streptococcus pneumonia.[2] TN. Hiliiardet total 48 patients, in which 70.83% sterile, Staphylococcus ssp.[3] 12.5% and Streptococcus ssp. 8.33%. Hoff et al, in a series of 61 children, reported that resolution of the disease process were more prolonged in patients managed by chest tube alone (16.8 days in hospital) than resolution after thoracostomy (6.7 days, P<0.001).[7] Carey et al reported a series of 22 children with empyema are referred to a paediatric cardiothoracies unit.[2] Those children who had immediate thoracotomy (18 cases) were afebrile and had their chest tube removed by 2 days and fever resolved within 48 hours. Their mean hospital stay was 4 days. Atexions et al reported a series of 44 children undergoing early thoracotomy revealed very short duration of fever (mean 1 day) and an average of 3 days until chest tube removed.[6] This series authors point out that their mean hospital stays were shorter than series of children manage with VATS. Ashish k. Gupta et al reported a series of 60 paediatric thoracis empyema cases thoracotomy and decortication revealed a more rapid recovery with a decrease number of chest tube days and decreased length of hospital stay success rate 96.6%.[1] Jeffery et al reported a 25 studies of 363 patient undergoing primary thoracotomy had a lower aggregate in hospital mortality (0% VS 3.3%) reintervention rate (2-5% VS 23.5%), length of stay (10.8 VS 20.0 days), duration of thoracotomy (4.4 VS 10.6 days), compared with patients who underwent non-operative therapy.[8] Using a random number method, patients were assigned either to a primary conventional thoracostomy arm or to a VATS arm. Out of Thirty patients, 13 (43.3%) patients had primary VATS done and 17 (56.6%) patients had primary thoracostomy done. And following procedure done during primary VATS decortications 6 (46%), debridement 5 (38.4%) and in 2 (11.7%) both procedure was done. In VATS arm only 3 (23%) out of 13 patients required conversion into open thoracostomy while in primary thoracotomy. Average operative time 1 hr. and average blood loss was 60 to 70 ml during vats. In all patient 2 intercostal tube were kept.

Table 11: Post-operative fever after primary VATS and primary thoracostomy in days.

S.No.	Procedure	Fever		
		0-3	3-5	>5
1	VATS	11 (84.6%)	2 (15.2%)	0 (0%)
2	ICD	6 (3.5%)	8(47%)	4 (23.5%)
Chi-square 8.48 P value 0.0144				

Table 12: Hospital stay after primary VATS and primary thoracostomy.

Sr. No	Operation	Hospital Stay			
		<10	11-15	16-20	>20
1	VATS	11 (84%)	0 (0%)	2 (15.3%)	0 (0%)
2	ICD	3 (17.6%)	3 (17.6%)	10 (58.8%)	1 (5.8%)
Chi-square 13.61 P value- 0.0035					

Table 13: Number of chest X-Rays after primary VATS and primary thoracostomy.

Sr. No	Operation	No. Of Chest X-Ray		
		0-2	3-5	>5
1	VATS	11(84.6%)	2(15.3%)	0 (0%)
2	ICD	2(11.7%)	14(82.3%)	
Chi-square 15.98 P value 0.0003				

Table 14: Demographic of the two treatment groups.

Variable	VATS (N=13)	ICD (N=17)	P value
Conversion rate to open Thoracotomy	24%	76%	0.0086
Length of stay (days)	9.385 +_3.47	16,+-4.54	0.005
Days of tube drainage	6.3+-3.119	11.53,+-4.11	0.0007
Fever duration (days)	4.059+-1.638	9.385,+-3.477	0.0005
No. of CXRs	2.385+-0.76	3.765,+-1.033	0.0012 SS
Procedure time (min)	6.+-0.0	30.59,+-2.425	

Post operatively all patients who had primary VATS were comfortable, injection thremadol given after completion of the procedure and repeated after 8 to 12 hrs. Postoperative fever occurs in all patients in primary VATS. On an average of 2 to 5 days, and in primary thoracostomy fever also occurs in all patients on an average of 4 to 6 days. Chest tube removed on an average 7 days in VATS arm while in a primary thoracotomy arm longer time (16 days) required for chest tube removal and hospital stay around 10 days in primary VATS and in primary thoracostomy hospital stay around 16 days. Number of chest x-ray after primary VATS is only 3 but in a primary thoracostomy arm minimum 4 to 5 x-ray done to see the lung expansion and residual collection.

CONCLUSION

In the present study we found that empyema thoracis can be successfully treated by thoracoscopic decortications if encountered in early phase of the disease process. Many prospective randomized studies of thoracospic decortications have shown that due to absence of rib retraction done during thoracotomy there is disease in the incidence of postoperative pain, analgesia requirement, less number of procedure and x-ray there is minimal pulmonary dysfunction early ICD removal and decrease hospital stay. In our series of 30 patients there was no morbidity and no morality. The complication reported in the literature due to thoracoscopic decortication are pneumothorax after chest tube removal, prolonged air leakage, parenchymal injury phrenic and intercostals nerve injury and air embolism. To conclude early intervention of empyema thoracis with thoracoscopic decortications seems to be the worldwide accepted modality of choice.

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