

The Effectiveness and Quality of Life in Pediatric Population with Stage III Empyema Undergoing Open Decortication

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Abstract

Introduction: Empyema thoracis is a common medical condition in which children have a typical presentation of fever, cough and respiratory distress. There are three developmental stages of empyema thoracis. Treatment options include thoracentesis, chest tube placement, fibrinolytic therapy, video-assisted thoracoscopic surgery and open thoracotomy and decortication. This condition affects the quality of life of the patients. Aim of our study was to assess the effectiveness of open decortication and quality of life in patients with stage III empyema.

Method: Study was conducted in 18 Children with stage III empyema. Data were collected using a pre-designed and pretested questionnaire. The follow up assessment was done by PedsQL 4.0 instrument scale. Physical Function, Emotional Function, Social Function as well as School Function of the patients were assessed at 1, 2 & 3 months.

Result: The majority of the patients were in the age group of 8-12 years. Pus culture in 12 patients (66.7%) was sterile. One-third of patients required postoperative ventilation. None of the cases was reoperated or readmitted to the hospital. Mean duration of hospital stay of patients was 10.89±3.51 days. Physical Function, Emotional Function, Social Function as well as School Function of the patients in follow up at 1,2 & 3 months showed constant decline in all the domains of PedsQL.

Conclusion: Our study concluded that Open decortication is the standard treatment for stage III empyema. Functional results were also excellent, as all patients returned to the normal activities that they performed before surgery.

Key words: Empyema, Open decortication, Pediatric empyema thoracis

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Introduction

Empyema thoracis is a common medical condition in which children have a typical presentation of fever, cough and respiratory distress [1]. Children with poor nutritional status of deficient immunity are more commonly affected and follow a bout of pneumonia which may have been particularly virulent [2]. Other conditions associated with emphysema are, tuberculosis, penetrating chest trauma, infected hemothorax, after pulmonary resection or iatrogenic during thoracentesis or intercostal tube insertion [3]. Emphysema thoracic is associated with high mortality (15%) in the absence of prompt management [2,4]. There are three developmental stages of empyema thoracis; **Stage I**, the acute or exudative stage, is characterized by a thin serous fluid with minimal debris. **Stage II**, the fibrinopurulent stage, is characterized by a thicker fluid and thick fibrin strands. **Stage III**, the organizing stage, is characterized by a thick fibrous peel and scar formation [5]. Singh M, Singh SK, Chowdhary SK. Management of empyema thoracic in children.

Stage-1 may respond to antibiotic treatment (non-operative management) with or without chest tube drainage; Stage-2 and Stage-3 respond to the decortication (operative management) [6]. However, there is inconclusive evidence about the treatment modalities of empyema thoracis in children; [6] Options for treatment include antibiotic therapy, thoracentesis, chest tube placement, fibrinolytic therapy, video-assisted thoracoscopic surgery (VATS) and open thoracotomy and decortication. Open thoracotomy and decortication require general anesthesia, endotracheal tube (single or double lumen) insertion, and requirement of mechanical ventilation throughout the procedure. The lowest pneumothorax recurrence rate (approximately 0-1%) is the most important advantage of open thoracotomy and parietal pleurectomy [7].

This condition affects the quality of life of the patients which is assessed using Pediatric Quality of Life Inventory (PedsQL), a modular scoring system which is designed to integrate generic and disease specific measures, and includes both self- and proxy-reports.

It takes into account the biomedical endpoints, like response rate and survival, and also focuses on behavioral and emotional problems for capturing the daily health-related problems [8].

Despite recent advances, the appropriate management is controversial [2,6]. Presently, Cheng YJ et al. [7] advocates treatment of chronic empyema with minimally invasive techniques, such as video thoracoscopy. One school of thought is that thoracotomy and decortication involve an increased risk of morbidity and mortality [8]. Importantly, there are also reports which indicate that morbidity and mortality are low when using this procedure. To that end, thoracotomy and decortication is still considered to be the best treatment for chronic empyema [9].

Aim of the treatment is to increase the lung volume by freeing the trapped lung with surgical removal of the thickened pleura. Improvement of lung volume, perfusion and diffusion capacities are the benefits of lung decortication mentioned in several reports in the literature [10]. An improvement in quality of life after decortication has not been studied in detail. Insufficient data in the literature regarding the quality of life in stage III empyema in the pediatric population. So, the aim of this study was to determine the quality of life in stage III empyema after open decortication in the pediatric population and also to assess the effectiveness of open decortication in patients with stage III empyema.

Methodology

The present study was conducted in our department from 1st December 2019 - 31st August 2021. The sample size was calculated with help of Epi Info (TM) 7.2.2.2. Data were collected using a pre-designed and pretested questionnaire containing demographic variables, blood investigations, microbiological tests, radiological tests, and hospital course. Total 18 children with stage III empyema were included in the study. The follow up assessment was done by Peds QL 4.0 instrument scale after taking copyright permission. The study was conducted during global pandemic of COVID, so less number of cases were there.

Children with in the age group of 3-12years with stage III empyema i.e., organized empyema more than 3 weeks were included, whereas, those who had empyema that was associated with trauma, tuberculous empyema, hydatid disease, or foreign body presence were excluded from the study. During the course of study, we have assessed the improvement during the post operative phase by:

- Intravenous pain killers on postoperative day1, followed by diclofenac dermal patch from postoperative day 2 were given,
- Chest physiotherapy along with spirometry was done,
- Pain in follow-up period was assessed by WONG-BAKER'S FACES PAIN SCALE [11]. Postoperatively follow-up of patients was done on 4 weeks, 8weeks and 12weeks.

The data was analysed using SPSS version 24 software. Categorical variables were presented as frequency and percentages, continuous variables were presented as the mean and standard deviations. Chi-square (χ^2) and Z-test was used to test the association of different categorical variables. The t-test was used to compare the means, $p < 0.05$ will be taken to be statistically significant.

Observation and Results

The present cross-sectional study was conducted in the Department of Pediatric Surgery, at our institute among 18 children with stage III empyema under the age group of 3-12 years and either sex.

Table 1: Demographic details, disease distribution and postoperative characteristics (N=18).

Variables		N (%)
Demographic details		
Age Group (Years)	3-4	5 (27.8)
	5-7	3 (16.7)
	8-12	10 (55.6)
	Mean \pm SD (Range)	7.94 \pm 3.40 (3-12)
Sex	Male	8 (44.4)
	Female	10 (55.6)
Disease distribution		
Disease	Right Empyema Thoracis	10 (55.6)
	Left Empyema Thoracis	8 (44.4)
	Sterile	12 (66.7)
Pus Culture	<i>S. Pneumoniae</i>	4 (22.2)
	<i>K. Pneumoniae</i>	1 (5.6)
	<i>MRSA</i>	1 (5.6)
Duration of Disease (Days)	≤ 45	9 (50)
	> 45	9 (50)
	Mean \pm SD (Range)	44.72 \pm 13.27 (20-70)
Post-operative characteristics		
Need of Post-Operative Ventilator (Days)	Yes	6 (33.3)
	No	12 (66.7)
Need of Postoperative Oxygen (Days)	Yes	16 (88.9)
	No	2 (11.1)
Readmission Required	Yes	0
	No	18 (100)
Reoperation Required	Yes	0
	No	18 (100)

The majority of the patients, 10 (55.6%), were in the age group of 8-12 years, the mean age of patients was 7.94 \pm 3.40 Years. Majority of them were females, 10 (55.6%). Ten (55.6%) of them had right empyema thoracic, 9 ailing for ≤ 45 days and other 9 were suffering for > 45 days, the mean duration of disease was (44.72 \pm 13.27 days). While pus culture in 12 patients (66.7%) was sterile, in 4 patients (22.2%) culture was *S. Pneumoniae* positive, and culture in other 1 patient was *K. Pneumoniae* positive and in yet another it was *MRSA* positive. (Fig.: 1.1)

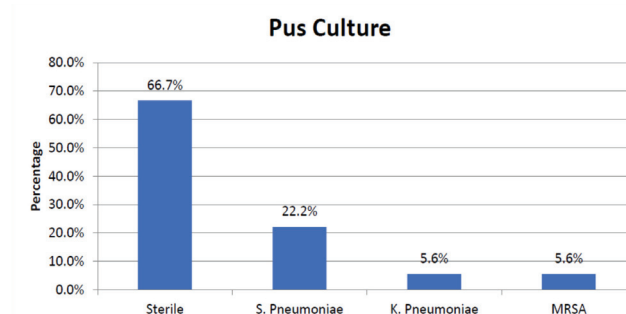


Fig.1: Pus Culture wise distribution of studied patients

One-third of patients, 6 (33.35) required postoperative ventilation, while 16 patients (88.9%) needed postoperative oxygen, two others did not need it. None of the cases was reoperated or readmitted to the hospital. [Table 1].

Majority of the sterile pus culture sample was from the age-group of 8-12 years (44.8%). Likewise, the need of postoperative ventilation was least required for the age group of 8-12 years (44.8%). However, postoperative oxygen therapy was mostly

required for the age-group of 8-12 years (44.8%). Although, p-values with respect to all the three age groups implies that age wise variation with respect to these parameters was not significant.

On perusal of the data, we observe that the mean duration of hospital stay of patients was 10.89 ± 3.51 days, mean days of postoperative ventilation was 1.5 ± 0.79 days, mean duration of postoperative oxygen support was 4.19 ± 2.49 days and ICD

removal was after 6.11 ± 1.41 days.

The duration of disease, duration of hospital stays, need of oxygen days as well as ICD removal days were maximum in the patients of age group of 5-7 years and need for ventilator was maximum in the patients belonging to age group 8-12 years. The difference observed in the duration of hospital stay between the groups was statistically significant.

Table 2: Mean studied variables distributed in various age groups

Variables	Total (n=18)	Age Group (Years)			F value*	P value
		2-4 (n=5)	5-7 (n=3)	8- 12 (n=10)		
Disease Duration (days)	44.72±13.27	38.20±15.01	51.67±17.56	45.90±11.08	1.062	0.370
Duration of Hospital Stay (Days)	10.89±3.51	10.00±1.58	15.33±4.16	10.00±3.23	3.846	0.045
Need of Ventilator (Days)	1.50±.79	0.60±.89	1.00±1.00	30.00±0.67	0.968	0.402
Need of Oxygen (Days)	3.72±2.49	4.00±2.55	5.33±2.89	3.10±2.38	0.965	0.403
ICD Removal (Days)	6.11±1.41	5.60±1.14	8.00±1.00	5.80±1.23	4.679	0.26

*Independent sample t test

Table 3: Age wise distribution of mean PedsQL score at various follow up

Variables	Total (n=18)	Age Group (Years)			F value	P value
		2-4 (n=5)	5-7 (n=3)	8- 12(n=10)		
1 Month Post-operative	Physical Function	23.17±4.98	21.00±6.59	26.00±1.73	23.40±4.65	0.964 0.404
	Emotional Function	12.78±4.76	8.60±3.29	14.00±0.00	14.50±4.95	3.453 0.058
	Social Function	10.50±4.46	6.00±2.83	10.00±0.00	12.90±4.04	6.691 0.008
	School Function	11.67±6.18	6.20±2.95	7.33±1.15	15.70±5.21	9.814 0.002
2 Month Post-operative	Physical Function	13.22±4.26	11.60±5.50	12.33±2.08	14.30±4.11	0.722 0.502
	Emotional Function	6.61±2.75	5.40±2.61	5.67±.58	7.50±3.03	1.217 0.324
	Social Function	5.94±3.28	3.60±1.52	5.33±1.15	7.30±3.71	2.591 0.108
	School Function	5.56±3.42	4.00±1.87	4.00±1.73	6.80±3.99	1.597 0.235
3 Month Post-operative	Physical Function	4.50±4.42	4.40±4.62	3.33±1.15	4.90±5.15	0.132 0.878
	Emotional Function	1.50±2.43	1.00±2.24	0.67±1.15	2.00±2.83	0.462 0.639
	Social Function	1.39±2.45	1.40±2.19	0.00±0.00	1.80±2.90	0.592 0.566
	School Function	1.44±3.26	1.20±1.64	0.00±0.00	2.00±4.22	0.423 0.662

*One way ANOVA test

Table 3 lists out functions like Physical Function, Emotional Function, Social Function as well as School Function of the patients after recovery from ailment after a period of 1, 2 & 3 months respectively to see the change in the pediatric quality of life (PedsQL).

There was a constant decline in all the domains of PedsQL from 1-month to 3-month follow-up. Age wise distribution of mean PedsQL showing pediatric quality of life score at various follow. After 1-month Post-operative Physical Function was 26.00 ± 1.73 , being maximum in the age group 5-7 years. Emotional function was 14.50 ± 4.95 maximum for the age group 8-12 years. Social Function was 12.90 ± 4.04 maximum for the age group 8-12 years. School Function was maximum 15.70 ± 5.2 for age group 8-12 years. The difference was statistically significant for social and school function. However, there was no significant difference in the mean PedsQL score between all the three age-groups at second and third month follow up. [Table 3]

On gender-wise comparison PedsQL score after treatment, we observe that the females have performed much better in respect of all the above parameters, thereby showing a better pediatric quality

of life (PedsQL) as compared to male patients 3 Month Post-operative, however, the difference was not statistically significant.

Discussion

The mainstay of treatment of pyogenic pleural empyema is control of ongoing infection and the prevention of recurrent infection. Early drainage by chest tube drainage or through a thoracotomy and open decortication is the early management of complicated pleural effusion or empyema [12]. Early treatment of pleural empyema avoids complications, extensive operations, and lengthy hospital stays. In some patients due to delayed diagnosis and referral chronic empyema will develop. In such patients, open thoracotomy and decortication are the standard treatment. Open procedures in some reports have also shown higher morbidity and mortality [13]. So we decided to study the quality of life and clinical outcome of open decortication in the management of stage-III empyema in pediatric patients.

In our study there were 18 patients in the age range between 3 to 12 years; with Mean age of patients was 7.94 ± 3.40 years. In a similar study, Sahina A et al. [12] reported the ages ranged from 1.25 to 15

years, with a median age of 4.3 years and Goyal V et al. [13] showed a mean age of 5.44 years in the study group.

Goyal V et al. [13] reported that 48.6% were male and 51.4% were females in their study. While Sahina A et al [12], Singh AP et al. [14] and Angurana SK et al. [15] reported a higher proportion of male patients in their respective studies. In this study, 44.4% were males and 55.6% were female patients.

Our study shows the duration of disease, 50.0% ailing for ≤ 45 days and the other half were suffering for >45 days. The mean duration of the disease was 44.7 days. Jaiswal LS et al. [16] and Angurana SK et al. [15] reported a lower median duration of symptoms before thoracotomy, 24 days and 12.2 days, respectively. In our study duration of the disease is higher may be due to delayed referral from distant remote areas.

We found that 55.6% of patients were suffering from right empyema thoracic. Similarly, Goyal V et al. [13] and Singh AP et al. [14] in their study reported that there were 57% and 55% right empyema, respectively. Angurana SK et al. [15] also reported a higher incidence of right lung empyema (63.0%) which are similar to our findings.

This study shows the Pus Culture in 66.7% of patients was sterile, in 22.2% patients' culture was *S. Pneumoniae* positive, and Culture in other 5.6% patient was *K. Pneumoniae* positive and in yet another, it was *MRSA* positive. Angurana SK et al. [15] study showed *Staphylococcus aureus* as the most common isolate (66.7%). *MSSA* accounted for 56.3%, *MRSA* 10.3%, *Streptococcus pneumoniae* 14.3%, *Klebsiella pneumonia* 10.3% and *Pseudomonas aeruginosa* 8% of isolates. Goyal V et al., [13] Sahina A et al. [12] reported the most frequently identified micro-organism was *S. aureus*, 34.2 percent, and 14.6 percent, respectively. Pleural fluid is sterile due to wide spread early use of antibiotics as was also seen in our study as the patients due to late presentation and use of antibiotics before presentation to hospital.

In the present study, 33.3% of patients required postoperative ventilation with a mean postoperative ventilator duration of 1.5 ± 0.79 days. Similarly, Reichert M et al. [17] reported the need for postoperative ventilation was 29.6%. In our study 88.9% of patients needed post operative oxygen with a mean duration of post-operative oxygen support was 4.19 ± 2.49 days. Singh AP et al. [14] reported a similar mean duration of ICD removal of 4 days which is in concordance with our findings of removal after 6 days.

The mean duration of hospital stays of patients was 10.9 days in our study. Goyal V et al. [13] and Andrade-Alegre R et al. [18] reported similar post-procedure stays of 9.5 and 10 days, respectively. While Angurana SK et al. [15] reported a comparatively longer duration of hospital stay of 17.2 days.

The Pediatric Quality of Life Inventory (PedsQL) is a modular instrument that was designed to take into account not only the biomedical endpoints, such as response rate and survival but also to focus on behavioral and emotional problems in order to capture the daily health-related problems that pediatric patients with cancer have [12]. There was a constant decline in all the domains of PedsQL from 1-month to 3-month follow-up. After 1-month Post-operative Physical Function was maximum in the age group 5-7 years, emotional function, social function, and school function were maximum for the age group 8-12 years. There was a significant difference in the social and school function between the three age groups. However, there was no significant difference in the mean PedsQL score between all the three age groups at second and third month follow up. Mollberg NM et al. [19] reported at 1 month postoperatively, a non-significant decline in global health QoL, physical, role, cognitive and social function scores.

In our study we observed the gender wise PedsQL score showing the variation in the pediatric quality of life in respect of physical function, emotional function, social function as well as school function after treatment. We observed a non-significant improvement in the PedsQL score in females compared to male patients at the 3 Month Post-operative.

The instruments used to measure quality of life in different studies were also highly variable and often non-comparable with each other, thus making it difficult to quantify the effect of each surgical approach on quality of life. Another source of variability was that quality of life measurement was often performed at baseline and then after surgery at different time points, from 1 to 6 months, and occasionally at 1 year. The use of different quality of life measures at different times limited the number of studies included in comparisons. Patients included in the quality-of-life studies were very heterogeneous in age, stage, and comorbidities. Also, whenever the quality-of-life questionnaires are used, the ill (and lowest quality of life) may be excluded, who are unable to respond, or those with better performance status who prefer to continue with their daily activities rather than remain involved in clinical studies [20].

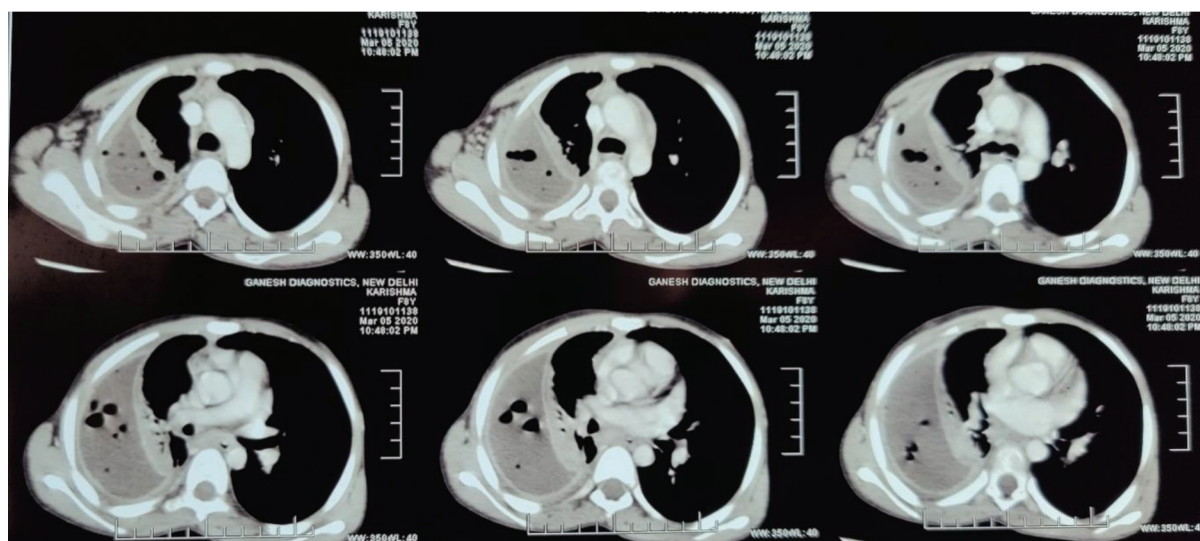


Figure 2: Axial Section of CT scan left side Empyema Thoracis

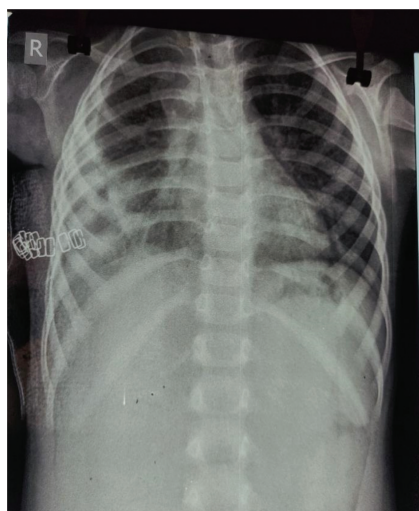


Figure 3 : Post operative X-Ray chest right side Empyema

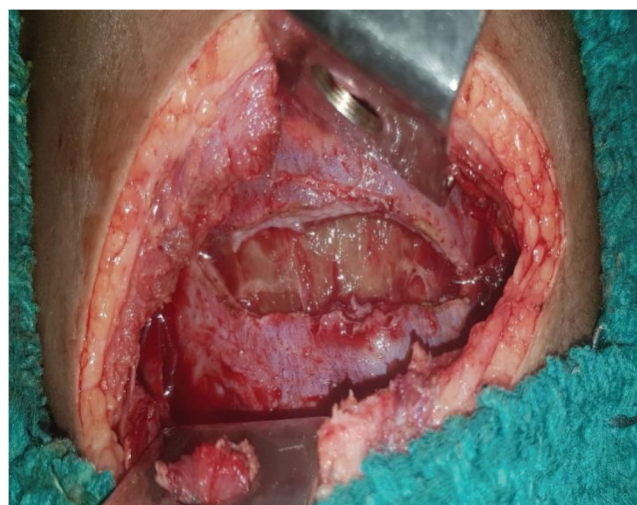


Figure 4: Intraoperative image

Limitations

The present study had several limitations; Major limitation to our study was that it was conducted during COVID crisis. Globally all hospital were closed for routine cases and only emergency cases were dealt on that time. Initial calculated sample size was 36 but due to COVID pandemic sample size curtailed and only 18 patients were enrolled during study period. Our study was single centered and limited time duration so the number of cases was relatively small, although all patients were operated on by a single surgeon using the same approach and technique. In our study, we opted the open decortication there was no other technique for comparing.

Conclusion

Our study concluded that the open decortication was found to be an excellent surgical procedure with low morbidity and mortality. Functional results were also excellent, as all patients returned to the normal activities that they performed before surgery. There was a significant improvement in the general condition of the patient and chest radiograph in the postoperative period. Open decortication is the standard treatment for stage III empyema. Very few studies regarding the quality of life in patients with empyema thoracis are mentioned in Indian literature, our study is one step closer to the assessment of the quality of life in patients with empyema thoracis.

Conflict of Interest:	Author declare no COI
Ethics:	There is no ethical violation as it is based on voluntary anonymous interviews
Funding:	No external funding
Guarantor:	Dr. Atul Kumar Meena, will act as guarantor of this article.

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