e-ISSN: 0975-5160, p-ISSN: 2820-2651

Available online on www.ijtpr.com

International Journal of Toxicological and Pharmacological Research 2024; 14(2); 82-87

Original Research Article

A Comparative Study on Multiple Treatment Modalities of Empyema Thoracis in Children

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Received: 11-12-2023 / Revised: 12-01-2024 / Accepted: 11-02-2024
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Conflict of interest: Nil

Abstract

Background and Objectives: Empyema thoracis is a condition in which pus and fluid from infected tissue collects in the pleural cavity. Childhood empyema is an important complication of bacterial pneumonia. The incidence of empyema is increasing worldwide. Despite being recognized since the ancient times, the appropriate management of paediatric empyema thoracis remains controversial. To study the clinical and bacteriological profile, various therapeutic options in childhood empyema thoracis in a tertiary care hospital.

Methods: The present descriptive study was done at Darbhanga medical college and Hospital darbhanga. 50 patients were included in the age group of less than 12 years with the diagnosis of empyema. All the patients were analyzed for the clinical course of the disease, radiological investigations, pleural fluid biochemical and microbiological parameters, and various treatment options. Short term follow up was done for complications and sequelae.

Conclusion: Management of primary empyema continues to be controversial in terms of duration of antibiotic therapy and the indications for and timing of surgery. There should be a changing trend towards Intrapleural instillation of streptokinase with the emphasis laid on minimizing the duration of hospital stay & duration of ICD tube insitu to bring down expenditure, psychological stress and more importantly nosocomial infections due to multidrug resistant organism in fibrinopurulent stage of empyema thoracis.

Keywords: Empyema, Children, Pneumonia, Intercostal drainage, Intrapleural streptokinase..

Introduction

The clinical condition of empyema has been recognized since the days of Hippocrates. [1] Suppurative or pyogenic infection of pleural space is Empyema thoracis. Empyema is never a primary disease, often it is difficult to arrive at primary focus of infection, though pleural cavity is the root of pus, respiratory and cardiovascular systems are severly affected. Empyema thoracis is still a common entity in developing countries along with high incidence of pneumonia because of multiple factors. [2] Empyemas are a significant cause of morbidity but, fortunately, not mortality in children and at times can be a therapeutic challenge. Part of the problem has been the lack of evidence from paediatric trials, and it is inappropriate simply to extrapolate adult data to children. There are differences between adult and paediatric pleural infections. The principal one is that, since it is rare for children to have an underlying lung disease, the final outcome is almost always excellent. Furthermore, adult empyema carries a 20% mortality rate which is related to comorbidity (for example, malignancy, immunodeficiency, prolonged hospital stay and nosocomially acquired infection). [3] Incidence of empyema was 0.8% of total pediatric admissions. [2] Effusions occur in atleast 40% of bacterial pneumonias, with upto 60% of effusions resulting in the formation of empyema in all age groups. Recent studies have noted an increase in the incidence of empyemas in children. [4] In developed countries, the microbiological profile has changed over the past five decades [4] with increasing incidence of penicillin resistant streptococcus pneumonia [5] and methicillin resistant staphylococcus. [6] However, the scenario is very different in2 developing countries where empyema is associated with significant morbidity and consumption of scarce hospital resources. Optimal management in children is controversial, especially the duration of parenteral antibiotics and the role of surgery. [3] Current treatment of empyema in children is highly variable due to in part both provider experiences and a wide spectrum of clinical presentations. [7] Newer therapies such as fibrinolysis3 and Video Assisted Thoracoscopic Surgery [8] have made the issue even more complex. Chronic empyema is the outcome of

improper management in the acute stage. The disability produced by persistence of chronically infected pleural space is very grave. With this scenario in mind, we decided to conduct this study in our epidemiological setup to define the clinical course, bacteriological profile, radiological features, various modalities of treatment and their outcome. This would guide us to use appropriate antibiotics and management strategies. [9]

Objectives

- To evaluate various therapeutic options in management of pediatric empyema cases.
- To make a protocol for management of pediatric empyema thoracis.

Material and Method

The present descriptive clinical evaluation study was done at Darbhanga medical College and Hospital Darbhanga Laheriasarai, Bihar Study duration of Two years. 50 children in the age group less than twelve (12) years who were admitted with the diagnosis of empyema were included in the study.

Inclusion Criteria

- Children in the age group less than 12 years with the diagnosis of empyema, (frank pus on thoracocentesis) were included in the study.
- Diagnosis was based on history, clinical examination, supported further by the evidence of chest x-ray, ultrasonography, computed tomography scan (wherever feasible) and diagnostic thoracocentesis.

Exclusion Criteria

- Patients not willing to be included in study group.
- Post-surgical empyema.
- Post-traumatic empyema.
- Children with age group more than 12years.

50 suspected cases of empyema after admission had a detailed history taking as per the proforma, with emphasis on duration of symptoms, previous medication, contact history of tuberculosis and course of illness before admission.

Patients were examined thoroughly for vital signs, nutritional status and respiratory signs of empyema thoracis. Suspected cases were confirmed after chest x-ray and ultrasonography. In all clinically suspected cases diagnostic thoracocentesis was performed under local anesthesia with 2% xylocaine using sterile disposable syringe (needle size- 18 G), which was introduced through 5th intercostal space in mid axillary line or area of maximal dullness, appearance of pus clinches the diagnosis. About 5 ml of pus was drawn in each case and sent for cytology, ADA, LDH, glucose, protein, microbiology for gram stain, AFB stain and culture sensitivity.

All the patients were advised for follow up at 1, 3 and 6 months. Those who came for follow up were assessed for lung expansion and deformities of the chest wall by clinical examination and chest x-ray if necessary.

Descriptive Statistics: The Descriptive procedure displays univariate summary statistics for several variables in a single table and calculates standardized values (z scores). Variables can be ordered by the size of their means (in ascending or descending order), alphabetically, or by the order in which we select the variables (the default).

Frequencies: The Frequencies procedure provides statistics and graphical displays that are useful for describing many types of variables.

Crosstabs: The Crosstabs procedure forms two-way and multiway tables and provides a variety of tests and measures of association for two-way tables. The structure of the table and whether categories are ordered determine what test or measure to use.

Independent Sample 't' Test: The Independent-Samples T Test procedure compares means for two groups of cases. Ideally, for this test, the subjects should be randomly assigned to two groups, so that any difference in response is due to the treatment (or lack of treatment) and not to other factors.

Results

Table 1: Age distribution of empyema in children (n=50)

Age in years	No. of Patients	%
< 1 year	3	6
1 – 4 years	31	62
5 – 9 years	14	28
10 – 12 years	2	4
Total	50	100.0

31/50 (62%) of affected patients were between 1 to 4 years. 3 (6%) cases were seen in infancy. Youngest child was 1 months old and the oldest was 12 years old.

Table 2: Gender distribution (n=50)

Gender	No. of cases	%
Male	27	54
Female	23	46
Total	50	100.0

27/50 were males and 23/50 were females. Male to female ratio was 1.17: 1.

Table 3: Clinical presentation of the cases at admission

Clinical presentation	Number(n=50)	%
Fever	50	100
Cough	41	82
Hurried Breathing	39	78
Sputum production	24	48

All patients had fever. Cough and hurried breathing was seen in 41/50 (82%) and 39/50 (78%) cases respectively. Sputum production was seen in 24/50(48%) cases. Fever was the predominant symptom in 30 cases (60%) and cough in 10 cases (20%).

Table 4: Treatment prior to admission.

Prior treatment	No. of Patients(n=50)	%
Yes	32	64
No	18	36
Total	50	100.0

32/50 (64%) cases had received either oral or parenteral antibiotic treatment prior to admission.

DURATION OF HOSPITAL STAY

Table 5: Duration of hospital stay – mean and standard deviation

Treatment group	No. of Patients	Mean no. of days	Standard deviation	Std. Error Mean
ICD	27	17.3	4.772	0.909
ICD with fibrino-lytics	23	11.6	4.979	1.038

Table 6: Duration of hospital stay – t test for equality of means

	t-test for Equality of Means			
Duration of hospital stay	t	Df	Significance (2 tailed)	Mean Difference
	4.14	48	0.00014	5.6876

The mean duration of hospital stay in ICD group was 17.3 days whereas in ICD with fibrinolytics group it was only 11.6 days, which was statistically significant($p<0.05$).

DURATION OF TUBE INSITU

Table 7: Duration of tube insitu – mean and standard deviation

Treatment group	No. of Patients	Mean no. of days	Standard deviation	Std Error Mean
ICD	27	12.8	3.154	0.607
ICD with fibrinolytics	23	8.8	3.284	0.685

Table 8: Duration of tube insitu – t test for equality of means

	t-test for Equality of Means			
Duration of tube in situ	T	Df	Significance (2 tailed)	Mean Difference
	4.45	48	0.0001	4.0268

The mean duration of chest tube insitu in ICD group was 12.8 days whereas in ICD with fibrinolytics group it was only 8.8 days, which was statistically significant($p<0.05$)

DURATION OF ANTIBIOTIC TREATMENT

Table 9: Duration of antibiotic treatment – mean and standard deviation

Treatment group	No. of Patients	Mean no. of days	Standard deviation	Std Error Mean
ICD	27	15.6	4.019	0.773
ICD with fibrinolytics	23	10.8	3.737	0.779

Table 10: Duration of antibiotic treatment – t test for equality of mean

	t-test for Equality of Means			
Duration of antibiotic treatment	T	Df	Significance (2 tailed)	Mean Difference
	4.38	48	0.0001	4.8406

The mean duration of antibiotic treatment in ICD group was 15.6 days whereas in ICD with fibrinolytics group it was only 10.8 days, which was statistically significant($p<0.05$)

Table 11: Failure rate – cross tabulation

		ICD		ICD with fibrinolytics		Total	
Failure	No	21 (77.8)		21	(91.4)	42	(84%)
	Yes	6	(22.2%)	2	(8.6%)	8	(16%)

Table 12: Failure Rate- Phi Coefficient

	Value
Phi coefficient	0.1817
No. of Valid cases	48
Not significant	

The failure rate in ICD group was 22.2% (6/27) compared to only 8.6% (2/23) in that ICD with Fibrinolytics group, but it was not statistically significant($p>0.05$

Table 13: Incidence of complications in childhood empyema

Complications	No. of Patients	%
No complications	31	62
Complications	19	38
Subcutaneous emphysema	9	18
Tube Blockage	7	14
Blood loss	1	2
Air Leak	2	4

Table 14: Follow-up

Outcome	No. of Patients (n=50)	%
Good Lung Expansion	48	96
Collapse	2	4
Pleural Thickening	0	0
Total	50	100.0

48/50 (96%) had good lung expansion on follow-up. Two had persistent collapse who improved further on physiotherapy.

Discussion

Lower respiratory tract infections (LRTI's) are a leading cause of morbidity and mortality in children throughout the world. In developing countries poverty, HIV infection and lack of universal access to new vaccines contribute to the high incidence of severe and complicated pneumonia. Parapneumonic effusion and empyema most frequently occur as a complication of bacterial pneumonia.8 Due to poor facilities for culture, delay in seeking medical opinion and indiscriminate use of antibiotics, it is very difficult to isolate microorganisms in Indian conditions. There are no universally accepted guidelines for management of empyema thoracis. It is another issue of controversy with multiple options and the literature assists little in establishing the ideal treatment. We had 50 children with empyema treated in this department over eighteen months with the aim of studying the clinical course of the disease, bacteriological profile and various treatment options.

Age Incidence

The age incidence has undergone a change over the years. Pre-antibiotic era had a higher group of affected infants while later years showing increased affection of preschool children (Gerald et al9).

Table 15: Comparison of age incidence

Baranwal AK et Al[10]	M Langley et al [12]	Bose K et al [13]	Present study
2003	2008	2015	2016-2018
1-5 years	3-5 years	1-4 years	1-4 years

In the present study, 31(62%) patients were between 1 to 4 years and 3(6%) were infants. Gerald et al69 and Baranwal AK et al reported similar incidence. Langley et al M[12] however found 3 to 5 years to be the commonly affected group. The higher incidence in children aged 1 to 4 years can be partly explained due to the increased susceptibility to staphylococcal and streptococcal pneumonia, which are the common cause of empyema.

Sex Incidence

Childhood Empyema has been found to be more common in males. Many past series also reported their predominance. Present study also showed male preponderance of 1.17:1.

Table 16: Comparison of sex incidence

Baranwal AK et al [10]	Easthem et al [11]	Langley M et al	Present study
2003	2004	2008	2016-2018
M: F(2.4:1)	M: F(2.3:1)	M: F(1.04:1)	M: F(1.17:1)

Seasonal Variation

Varied opinions regarding the seasonal prevalence of childhood empyema was noted in the past series.

Table 17: Comparison of seasonal variation

Baranwal AK et al 70	Barnes et al [14]	Langley M et al	Present study
2003	2005	2008	2016-2018
May to August	October to December	Nov – April	January - march
Summer	Winter	Spring	Spring

In the present study 37(74%) of them presented in the months of January toJune accounting for majority occurring in the spring and early summer. Only 6(12%) presented in the months of July to September. Few earlier studies have reported most cases in winter and early spring, probably due to the increased spread of infections due to overcrowding, ill ventilation, chilling breeze and soaking rain. All children were started on antibiotics soon after admission, initially with an antibiotic which covers both gram positive and gram-negative organisms and changing later based on the culture sensitivity report. We started Amoxicillin-Clavulanic acid (100 mg/kg/day in three divided doses) and an aminoglycoside (15-20 mg/kg/day in two divided doses). All cases with staphylococcal empyema responded to Vancomycin (40 mg/kg/day in 4 divided doses). None of the cases were resistant to Vancomycin. Streptococcal empyema responded to Amoxicillin-Clavulanic acid in our study. Duration of antibiotic ranged from 12-20 days depending on clinical condition and antibiotic susceptibility. The duration of chest tube in situ represents the efficacy of the intervention in clearing the pleural cavity of the collection and also represents the morbidity to the patient in terms of pain suffered and restricted mobility of the patient. The mean duration of the chest tube in situ was 12.8 days in ICD group whereas it was only 8.8 days in that of ICD with fibrinolytic group which was statistically significant ($p<0.05$). The duration varied from 11 days to 28 days in ICD group and from 7 to 16 days in case of Fibrinolytics. One patient in ICD group had the longest duration of tube in situ i.e. 28 days - the tube was in situ for 20 days following the ICD and remaining 8 days subsequent to thoracotomy because of the failure of the primary intervention. In such cases of failures this duration was calculated as the total number of days after which the patient is free of chest tubes. Similarly, patients with failures had obviously longer duration of chest tube in situ.

All 50 patients were followed up after the discharge at 1 and 3 months. All of them were evaluated clinically and radiographically. Most of the patients 48/50(96%) were asymptomatic and had good lung expansion. 2/50(4%) had persistent collapse. All the decorticated patients had normal lung functions.

A study done by Baranwal et al (2003) reported on follow up that, all children were doing well. None had clinically significant restrictive disease.

Timing of Surgery

All over the world, these days there is an emphasis on minimising the length of the hospital stay. Early intervention is being recommended strongly in view of this. Prolonged hospitalisation taxes the patient in the form of increased expenditure, psychological trauma and stress, and may even invite multidrug resistant nosocomial infections. In the above scenario a clinical protocol involving minimal investigations and earlier therapeutic intervention is required. Thus, it is important to have some protocol to decide the ideal time period for operative intervention.

Conclusion

Empyema continues to be prevalent in our country particularly in the lower socioeconomic strata due to the delay in seeking medical care, inappropriate antibiotics and dosages and duration of antibiotic treatment. Indiscriminate use of antibiotics might have increased the overgrowth of multiresistant organisms, there on leading to chronicity and morbidity of empyema. Empyema fluid is diagnostic for pathogens if appropriate handling and early cultures but in the present scenario with prior antibiotic treatment, the fluid is sterile most of the times. Pleural fluid biochemical parameters would also vary depending on the stage of empyema, severity and previous antibiotic therapy. Ultrasonography is non-invasive, gives no radiation, is easily available and is an ideal investigation for staging, detecting loculations and planning the treatment. CT thorax is preferred in complicated empyemas.

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