



A STUDY ON CLINICAL PROFILE OF EMPYEMATHORACIS IN A TERTIARY CARE CENTRE

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ABSTRACT

Introduction: An empyema Thoracis is a purulent collection in the pleural space. It is a disease that, despite centuries of study, still causes significant morbidity and mortality. Empyema thoracis in children is very commonly seen all over the world, more frequently as a complication of pneumonic infections. In paediatric patients, empyema thoracis complicates pneumonia 36% to 57% of the time with a range of incidence between 0.4 and 6.0 cases per 1000 pediatric admissions. It constitutes approximately 5- 10% of cases seen by pediatrician in India. Light *et al* (1980) proposed 3 lights criteria for diagnosis which is still acceptable universally. **Aim & Objective:** To find out the clinical profile, average hospital stay, complication and outcome following management & long term sequale on follow up in patients of empyema thoracis between the age group of 1 month-14 years with special reference to organism isolated & their sensitivity pattern. **Method:** It is a prospective study. All the children fulfilling the inclusion criteria were taken into study. details examinations, history, clinical examination was done. The data obtained were analysed. **Observation:** Incidence of empyema thoracis was 0.39 among all cases admitted during study period. Male children are more commonly affected. Pneumonia was the most common predisposing factor associated in more than 54% of cases. Duration of Fever in present study 51% were found less than 7 days. Raised temperature (98 %), tachypnea (87 %), intercostals tenderness (82%) were the most common clinical signs. 80 cases (85%) improved by ICTD along with antibiotics, 8 cases required only aspiration and antibiotics. **Conclusion:** Empyema thoracis was most common in 1-5 years children with male preponderance. Higher incidence was seen in spring season and in malnourished children. Light's criteria is a sensitive diagnostic criteria for diagnosing empyema in children. Staphylococcus aureus was the predominant causative organism. Vancomycin, linezolid, imipenam, piperacillin & tazobactam, ceftriaxone are still the sensitive antibiotic in most of cases. Appropriate antibiotics for at least 2 weeks and early instillation of intercostals tube drainage must be done in every case to drain the pus and to prevent septicaemia, as it is a important cause of mortality.

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INTRODUCTION

Empyema thoracis in children is very commonly seen all over the world, more frequently as a complication of pneumonic infections. In paediatric patients, empyema thoracis complicates pneumonia 36% to 57% of the time with a range of incidence between 0.4 and 6.0 cases per 1000 paediatric admissions [1,2]. It constitutes approximately 5- 10% of cases seen by paediatrician in India [3,4]. Acute respiratory infections are the most common illness of childhood accounting 50% of all illness in under-fives and 30% in the 5-12 years age groups, largely involving the upper respiratory tract. However, about 5% involve the lower respiratory tract resulting in serious diseases, especially the bacterial pneumonia[5].Forty percent of bacterial pneumonia are said to be complicated by parapneumonic effusions, 10% of whom would evolve into empyema [6]. Possible reason for this include delay in initiating treatment, prolonged oral treatment in the community with antibiotics inadequate drug level in the

pleural space and delayed presentation, or unusual casual organism[7].

Paediatric empyema has a much more favourable prognosis compared to adult cases. Several factors have been postulated, one is bacteriology. The bacteriology of pleural infection is complex and has changed over time. Identifying the causative organism(s) is important to guide antimicrobial therapy. A wide range of microbes have been cultured from empyema, and mixed organisms do occur. Relative frequencies of causative microbes vary over time and with geographic locations, source of infection, and among hosts. Up to 40% of empyema fluid failed to reveal any microorganisms by conventional culture, and antibiotics have to be prescribed empirically. Different postulations to explain the low culture rate include antibiotic treatment before sample collection, potential presence of bio film in the pleura, poor sensitivity of conventional culture techniques in acidic pleural fluid, or pus developing as an excessive immune response after the causative organism(s) has already been eliminated[3-5].

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Children of poor socio-economic status and below 3 years of age are most commonly affected. Staphylococcus aureus is the most common causative organism. A high index of suspicion helps in diagnosis. X-ray chest and CT scan are most useful modalities for diagnosis and follow up. With the above background, the present study was conducted to assess the clinicoetiological profile of paediatric empyema thoracis in hospitalized patients [6,7].

Light *et al* (1980) proposed 3 lights criteria for diagnosis which is still acceptable universally 1) pleural fluid protein to serum protein ratio more than 0.5, 2) pleural fluid LDH to serum LDH ratio more than 0.6, 3) pleural fluid LDH more than 2/3 of upper normal level of serum LDH [8].

Most empyemas in childhood follow acute bacterial pneumonia. Rarer causes include spread from other sites of sepsis such as from septic emboli, lung abscess, subphrenic abscess, osteomyelitis of a rib or as a result missed inhaled foreign body.

Empyema thoracis as according to American thoracic society is classified into three stages [9]. 1. Exudative stage, 2. fibrinopurulent stage, 3. stage of organisation.

Prior to antibiotic era empyema was a very common complication of children suffering from pneumonia but with the introduction of sulphamide, penicillin & cephalosporin, the incidence of empyema has diminished and staphylococcus aureus replaced pneumococci as major causative organism [1].

The management of thoracic empyema in children continues to evoke controversies from the past five decades. Treatment options include antibiotics alone or in combination with thoracentesis, tube thoracostomy (chest drain), intra pleural fibrinolytics, thoracoscopy and open decortications [6]. Reported series illustrate the striking variability in therapeutic approach in different centres, but provide little evidence in establishing the ideal treatment. Some favour early thoracotomy and decortications of the lung, Where as others advocate conservative management with antibiotics and closed tube drainage. Recently, intrapleural fibrinolytic agents (urokinase and streptokinase) have been used to facilitate closed tube drainage. Poor or gradually declining response to treatment with evolution of drug resistant strains of organisms like methicillin resistant staph aureus (Baranwaetal2003) many a time needs a multiple antibiotic combination and facilitates progressive drug resistance in various organisms [4]. Therefore a time to time study is required to know the changing aetiology, organisms isolated, culture sensitive of antibiotics and outcome following management of the disease as it varies from place to place as reported by various workers and there is no unanimity regarding this.

AIM AND OBJECTIVE

To find out the clinical profile, associated risk factors average hospital stay, complication and outcome following management & long term sequale on follow up inpatients of empyema thoracis between the age group of 1 month-14 years with special reference to organism isolated & their sensitivity pattern. Material and Method: This study was conducted in the paediatric department of S.C.B. Medical College and S.V.P.P.G.I.P (shishu bhawan), Cuttack during the period from September 2016 to August 2018 after obtaining

clearance from institutional ethical clearance committee. This study was designed to find out the clinical profile, average hospital stay, complication and outcome following management & long term sequale on follow up inpatients of empyema thoracis between the age group of 1 month-14 years with special reference to organism isolated & their sensitivity pattern. The study is also designed as to find out any risk factors associated with complication or death.

Inclusion Criteria

1. Children between the age group of 1 month to 14 yrs with confirmed empyema (by clinical examination/radiographs/ultrasound) were included in this study.
2. Cases were defined by the presence of pus in the pleural cavity.
3. Cases where aspirated pleural fluid was non-purulent, a positive gram stain or a positive culture were also included in this study.

Exclusion Criteria

Post-traumatic and post-surgical empyema patients are excluded from the study. 2. Parents/ caregivers who refused to give consent for the study.

MATERIALS

The total number of patients studied was ninety five between age group of 1 month -14 years from the hospitalized patients during the above said period. The cases were diagnosed by physical examination, X-ray chest and supplemented by diagnostic thoracentesis.

METHODS

It is a prospective study. Selection of Cases: All the patients admitted to the paediatric indoor during the above said period with clinical suspicion of empyema, like with presenting complain of continued/remittent fever, toxemia, cough and breathlessness were studied. These cases were subjected to detail history taking, examination and routine investigations with radiological studies. If after all these investigations empyema was suspected a diagnostic thoracentesis was done.

Diagnosis of empyema was done in those cases where on diagnostic thoracentesis clear pus was aspirated. In doubtful cases diagnosis was done as per light's criteria of exudates [8].

In each case a detail history was collected with specific reference to the present and past illness, family history, history of contact with tuberculosis, immunization and history of growth and development.

Then a detail anthropometric examination was done which include data like weight, height, head circumference, mid arm circumference and chest circumference. The cases of malnutrition were identified by taking the Indian Academy of Paediatric classification for malnutrition into account. In each selected case a detailed head to toe examination was done with special reference to pallor, clubbing, cyanosis, lymphadenopathy etc. Then a detail respiratory system examination including inspection, palpation, percussion, auscultation was do for any signs of empyema or consolidation with searching for features of complication like pyopneumothorax or thickened pleura.

Routine examination of stool, urine along with mantoux test was done in each case. The haematological investigation like haemoglobin percentage, erythrocyte sedimentation rate, total leucocytes count, peripheral blood smear for differential count and blood picture done each cases and various values were compared with normal laid down by Nelson textbook of paediatrics 20th edition[9]. Serum protein and LDH was sent in every suspected case to know about lights criteria fulfilment. Blood culture was sent with all the precautions to prevent contamination. Preferably blood culture sent before the 1st dose of IV antibiotic given in our hospital.

Radiological studies particularly PA and lateral view of chest were taken in each case. In all clinically suspected cases diagnostic thoracentesis was performed under local anaesthesia 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, biochemistry for pH, LDH, glucose, protein, microbiology for gram stain, AFB stain and culture sensitivity.

Blood Examination: 1. Haemoglobin estimation was done by Sahali's method 2. Total leucocytes count was done in improved Neubauer chamber in the conventional method. 3. Differential leucocyte count was done by staining the blood film with leishman's stain in conventional method. 4. E.S.R was determined by westergreen method. 5. Blood culture.-on the day of admission preferably before 1st dose of iv antibiotics 5ml of blood collected and added to 50ml of 0.5% glucose broth and sent to the laboratory. The broth was incubated at 37°C and inspected daily for signs of microbial growth for at least 72 hours. When visible growth appears (slight haziness), a small amount of broth was removed with a sterile loop and subcultures were performed by streaking on appropriate media after examination of gram smear of broth. The plates were then incubated at 37°C for 24 hours. And then colonies were identified and the organisms were detected finally by biochemical and serological reactions wherever necessary. Negative cultures were declared after 3 consecutive subcultures at 24hrs intervals. Sensitivity testing- for the sensitivity of the causative organism to antibiotics, the filter paper discs impregnated with different antibiotic solutions, of a particular concentrations were placed on blood agar plates, streaked with the blood culture and incubated overnight. For each antibiotic, a circular area of inhibition around the disc denotes sensitivity of organism.

Pleural Fluid Examination: Collection

The skin over 5th to 9th intercostals space on the posterior axillary line was sterilized and pleural fluid was aspirated by a sterilized syringe and collected in a sterile vial and sent to the laboratory for cytology, biochemical, gram stain and culture sensitivity study.

Culture Method: All specimens were inoculated into blood agar plates and incubated and colony characters are studied as in blood culture described earlier.

Other Investigation: Pulmonary function test - it was done in more than 8 years of child after 15 days of treatment also at 2 months at follow up to know any complication like thickened pleura. Sputum examination and gastric lavage examination for gram staining and ZN staining/CBNAT were done in

selected cases. Culture and sensitivity of pus from pyoderma, impetigo, CSOM were done when required.

Etiological diagnosis was established on the basis of the organism grown either in pleural aspirate or blood culture.

Management of Cases

Initially intravenous antibiotics like Ceftriaxone 80-100 mg/kg day two divided doses /Amoxicillin-clavulanic acid started in the dose of 100 mg/kg/day in three divided doses and Amikacin in the dose of 15-20 mg/kg/day in two divided doses were started. If any suspected staphylococcal pneumonia, Vancomycin was given as an infusion in the dose of 60 mg/kg/day in four divided doses. Appropriate antibiotics were added according to culture sensitivity reports. Those in severe distress underwent immediate ICD and those who were not were evaluated by USG and managed accordingly. Those diagnosed to have non loculated empyema on USG underwent ICD.

Statistical Analysis: Statistical analysis in the above study was done by using spss 25 and social science statistics. Univariate analysis was done by 2x2 contingency table with fishert test to calculate p value. P value less than 0.05 was taken as statistically significant.

Observation

Table 1 Age & Sex Distribution

Age	Male	Female	Total	Percentage	Mean age of presentation	P value
< 1 year	3	2	5	5.3%	Mean age in month =68.46 ± 39.33 month	0.669
1-5 year	26	19	45	47.4%		
5-10 year	18	16	34	35.7%		
10-14 year	7	4	11	11.6%		
Total	54	41	95	100%		

Maximum number of cases is of age between 1-5 year (47.4%). 5 cases are below 1 year of age (5.3%). 34 cases were between 5-10 years of age (36%) Mean age of presentation was 68.46 ± 39.33 month in present study. P value was 0.669 (not significant).

Table 2 Predisposing Factor

Predisposing Factor	No of Cases	Percentage
pneumonia	52	54.7%
Poor orodental hygiene	19	20%
Skin infection /CSOM	9	9.5%
Measles	7	7.4%
Sickle cell disease	5	5.3%
Immunodeficiency	2	2.1%
Connective tissue disorder	1	1%
Malnutrition	Normal	34 35% (death 1)
	Grade I	20 21%
	Grade II	19 20%
	Grade III	17 18% (death 1)
	Grade IV	5 5% (death 1)

History of pneumonia was associated in more than 54% of cases. Sickle cell disease was associated in 5 cases. History of measles in recent past was present in 7.4% of cases. Poor orodental hygiene was found in 20% cases and Skin infection/ csom found in 9.5 % cases. 6 out of 95 (64.2%) cases had some degree of malnutrition. While 5 cases (5.3%) have severe degree of malnutrition. To know whether grade of Malnutrition has any prognostic significance, those patients died or requiring Surgical treatment was taken as poor outcome. But though the incidence of poor outcome is more in

cases of malnutrition, but it is not statistically Significant (p value was 0.107 which was not significant).

Table 3 Seasonal Distribution

Month	No of cases	percentage
January- March(Spring)	32	33.7
April- June(Summer)	13	13.7
July-September(Rainy)	24	25.26
October-December(Winter)	26	27.34

Out of 95 cases 32 cases were found during spring (January – March) , 26 cases found during winter (October – December) season, 24 cases during rainy (July – September) and 13 cases were found during summer (April – June) .

Table 4 Presenting Symptoms

Symptoms	No of Cases	Percentage
<7 days	48	51(death 1)
Fever 7-14 days	23	27(death 1)
>14 days	21	22(death 1)
Cough	92	97%
Breathlessness	82	86.3%
Chest pain	39	41%
Vomiting and diarrhoea	11	10.5%
Refusal to feed	14	14.75%
Chills and Rigor	8	8.4%
Pain abdomen	5	5.26%
Weight loss	24	25.2%

Fever (99%) and cough (97%) are the most common presenting Symptoms .Breathlessness (86.3%) and chest pain was the presenting complain in nearly 41% of cases.

Table 5 Presenting Sign

Signs	No of cases	Percentage
Raised Temperature	92	97.9
Tachypnoea	82	86.5
Intercostals tenderness	78	82.1
Decreased chest movements	76	80
Pallor	40	42.1
Mediastinal shift	40	42.1
Toxaemia	29	30.5
Consolidation	31	32.6
Lymphadenopathy	16	16.8
Hepatosplenomegaly	12	12.73

Raised temperature, intercostals tenderness and tachypnea are the most common clinical signs elicited. Clinically pallor was visible in 40 (42%) of cases. Lymphadenopathy and hepatosplenomegaly was associated with 17% and 13% of cases respectively.

Table 6 Side of Involvement

Side of Involvement	No of Cases	Percentage
Right	64	67%
Left	26	27.4%
Bilateral	5	5.6%

64 cases out of 95 cases having right pleural sac involvement.67 % of cases had right side empyema while 27.4% cases had left sided empyema.5 case had bilateral empyema .

Table 7 Hematological Parameter

Hematology	Number of cases	Percentage	Remark if any
<5	12	12.8	Pvaluefor anemia
HB mg/dl	5-8	18	18.9
	9-11	45	47.3
	>11	20	21
DC	N>70%	65	68.4
	L>40%	29	30.5
TLC	>15000	74	78

≤15000 ESR	21 >20 in 1 st hour	22 40	-
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Severe degree of anaemia (Hb<5gm%) was associated in 12.8% of cases out of which 1 died and 2 required surgical treatment. To know whether anaemia was poor prognostic factor, those patients with Hb >8 gm% and those with Hb <8 gm% were compared with the outcome .Those patients died or requiring surgical treatment was calculated as poor outcome .and Hb <8gm% was statistically Significantly associated with poor outcome . (p value lessthan0.05).

P value was calculated using2x2contingency table by fisher test. Nearly 78% of cases are associated with TLC >15,000. Mean TLC in present study is 16,075± 4271. Neutrophilia (N>70 %) was seen more than 68 % of cases. Lymphocytosis (L>40%) was also seen 30.5% of cases. ESR>20 at 1st hour was seen in 40% of cases.

Table 8 Bacteriological Examination of Pleural Pus (Pleuralfluid Macroscopy & Gramstain ANALYSIS)

Pleural fluid	Types	No of cases	Percentage
Gram stain	Gm + ve cocci	26	27.4%
	Gm -ve bacilli	19	20
Macroscopy	Pus	83	87%
	Seropurulent	12	13%

Out of 95 cases organism was isolated in 45cases. Out of which 26 cases were gm stain +ve cocci. And 19 cases were gm -ve bacilli. So nearly 58% of isolated organism is gm +ve cocci.

Table 9 Biochemical Parameter

Pleural fluid Biochemical parameters	Criteria	No of patients	Percentage	Mean & SD
PH	< 7.2	78	82%	Mean PH = 6.76 ± 0.26
	7- 7.2	10	11%	
	>7.2	7	7%	
Glucose(mg/dl)	< 40	70	73.7%	Mean glucose = 25.8 ± 11.4
	> 40	25	26.3%	
LDH (IU/L)	200- 500	15	15.8%	Mean LDH = 1177± 437
	500- 1000	7	7.4%	
Protein (g/dl)	> 1000	73	77%	4.17 ± 0.62
	< 3	3	3.2%	
Cell count	> 3	92	96.8%	4052 ± 1853
	> 1500	81	85.3%	
Neutrophil	< 1500	14	14.7%	77.27 ± 8.31
	>70%	78	82%	
	< 70%	17	18%	

93% are associated with pleural fluid pH less than 7.74% cases were found < 40 mg/dl of Glucose , 97% associated with more than 3 gm/dl Protein. 86% cases were found > 1500 cell in pleural fluid and 82% cases associated with more than 70% neutrophil. In pleural fluid investigation of our study Mean PH was 6.76 ± 0.26 , mean glucose was 25.8 ± 11.4gm/dl, mean protein was 4.17± 0.618 gm/dl and mean LDH was 1177 ± 437 while mean cell count was 4052 ± 1853 and mean Neutrophil was 77.27 ± 8.31

Table 10 Isolation of Bacterial Agent On Culture Report.

Organism isolated	No of cases	Percentage of cases	% of total organism isolated
Staph .Aureus	21	22.1%	46.6%
Strept . pneumoniae	3	3.2%	6.6%
E. coli	8	8.4%	17.7%
Klebsiella spp	6	6.3%	13.3%
Pseudomonas Aeruginosa	3	3.2%	6.6%
Enterococcus spp	2	2.1%	4.6%
Acinetobacter spp	2	2.1%	4.6%
No growth	50	52.6%	0

Culture & sensitivity isolation of organism is possible from pleural fluid in 47.4% of cases. S aureus is the most common organism isolated in 21 cases that is 46.6% of total. Gm-ve organism isolated in 19 cases that is 20% of total cases, and 42% of organism isolated cases.

Table 11 Light's Criteria

Light's Criteria	No of Cases Having Positive Criteria	Percentage of Total
1,2and3 (all3+ve)	58	61 %
2criteria+ve	21	22 %
1criteria+ve	16	17 %
Not satisfying any criteria	-	-

Out of 95 cases 58cases (57 %) were found to be +ve for all 3 light's criteria. While 22% and 17 % were tested +ve for 2 out of 3 and 1 out of 3 criteria respectively. None of the tested cases were -ve for all 3 criteria.

Table 12 Duration of Intercostal Tube Drainage

Duration of Intercostal tube Drainage	No of Cases	Percentage	Average Duration of ICTD
<1week	4	4.2%	14.6±7.3 days
1-2week	30	31.5%	
>2week	36	38%	
>4week	10	10.5%	

36 (38 %) out of 95 cases those required intercostal tube drainage were for 2 to 4wks. 10 cases even required intercostal tube drainage for more than 4wks. Those 10 cases eventually progressed to develop thickened pleura, and also found restrictive pattern PFT in follow up. Average duration of ICTD in present study is 14.6±7.3 days.

Table 13 Associated Radiological Findings

Associated Radiological Findings	No of Cases	Percentage
Consolidation	31	32.6%
Collapse	14	14.8%
Pyopneumothorax	34	35.8%
Hilar lymphadenopathy	10	10.52%
Mediastinal shift	40	42.1%
Multiloculated	8	8.4%
Pneumothorax	8	8.4%

Consolidation was found in 33% of empyema cases and collapse in nearly 15% of cases. Pyopneumothorax was associated in nearly 36% of cases with x- ray finding. Hilar lymphadenopathy was associated with nearly 10% of cases. 8 cases was multiloculated diagnosed in USG finding.

Table 14 Complications

Complication	No of Cases	Percentage
Pyopneumothorax	34	36%
Collapse	14	15%
Pneumothorax	8	8.4%
Bronchopleural fistula	5	5.26 %
Septicemia	6	6.3%
Subcutaneous emphysema	8	8.4%
Thickend pleura	10	10.5%

Septicaemia was associated with 6cases out of which 2died. Pyopneumothorax which was not present initially but developed during hospital stay or following ICD in 34cases. Thickened pleura developed in 10 cases (>7% cases) and those 7 cases were required surgical treatment.

Table 15 Antibiotic Culture Sensitivity Report

Name of Antibiotic	No of Cases Showing Sensitivity	%of Positivity out of 45 c/s +ve cases
Vancomycin	23	51%
Teicoplanin	22	49%
Ceftriaxone	11	24.4%
Linezolid	22	49%
Cefoperazone + Sulbactam	11	24.4%
Colistin / polymyxin B	6	13%
Meropenam/imipenam	19	42%
Piperacillin + Tazobactam	9	20%
Ampicillin / amikacin	5	11%

Out of 95 cases of empyemathorax 45 cases are 0culture sensitivity positive. Out of which in 23 cases organism is sensitive to vancomycin (51%). Next commonest sensitive antibiotics linezolid / teicoplanin which is sensitive in 22cases (49%). Imipenam / Meropenam sensitive to 19 cases (42%).Cefoperazone + Sulbactam was also sensitive in 11 cases (24.4%).

All Gm + ve cocci were 100% sensitivity to Vancomycin, Linezolid, Teicoplanin. All Gm -ve bacilli were 100% sensitivity to Imipenam/ Meropenam & 50% sensitivity to Cefoperazone + Sulbctm, all non fermenters (Pseudomonas + Acinetobacter) 100% sensitivity to Polymyxin B, Colistin, Imipenam

Table 16 Duration of Hospital STAY

Average Duration of Hospitl stay	No of Cases	Percentage	Average duration of hospital stay
<15days	48	50.5%	14.6 ±8.4days
15-30days	37	39%	
>30days	10	10.5%	

Most of the cases (48, 50%) stayed in the hospital between 2weeks. 10.5% of cases required to stay at hospital more than 1month, out of which 7cases required surgical treatment in the form of decortication or thoracotomy. Average duration of hospital stay in all cases 14. 6 ±8.4days

Table 17 Response To Various Modalities of Treatment

Treatment	No. of cases	% in present study
Aspiration +antibiotics	8	8.5%
ICT drainage + antibiotics	80	84.5%
ICT drainage + decortication + antibiotics + VATS	7	7%

There is good response to treatment in patient with ICT drainage along with antibiotics 84.5%

Table 18 Outcome

Outcome	Number of cases	Percentage
Cured	81	85.3
Death	3	3.2
LAMA	4	4.2
Surgical tt(decortication)	4	4.2
Surgical tt(thoracotomy& VATS)	3	3.1

Out of 95 cases, 81 number of patients got cured , 3 cases died. 7 cases required surgical treatment in the form of decortications in 4 cases and thoracotomy, / VATS in 3 case. 4 patients got LAMA.

Table 19 Pulmonary Function Test (Done in More than 8 Years of age)

PFT	Restrictive	Obstructive	Normal
15day	4	-----	6
2month	6	-----	4

Pulmonary function test or spirometry was done in more than 8 year of cases at 15 days and 2 month of follow up. Out of which 4 cases at 15 day follow up and 2 cases at 2 month follow up showed restrictive pattern of PFT. Out of these 5cases all are associated with thickened pleura.

DISCUSSION

This prospective study of Empyema thoracis in children aged 1 month- 14 years at our centre found good pulmonary outcome with conservative therapy alone. 95 children of empyema thoracis who admitted in our hospital were included in our study.

Total patients admitted during study period in SCB MCH & SVPPGIP were 23800 and incidence of empyema thoracis in 1 month – 14 years children was 0.39 .

Age Distribution

In present study maximum number of cases are of age between 1-5 year (47.5%). 5cases are below 1 year of age (5.3%). 34 (36%) cases are between 5- 10 years of age. From 1 month to 14 year all age groups are involved. Mean age of presentation is 68.46 ±39.33 months in present study.

Dass R *et al* (2011) in a study over a period from January 2006 through June 2010 of 160 cases of empyema thoracis in children of northeast part of India noted that mean age of presentation was 4.74±3.53 years and two third of the children were under 5 years [10]. Rao M S P *et al* (2017) in a study over 2 year from November 2014 – December 2016 of 72 cases 58% were 1-5 years [11].

Laishram N *et al* (2015) in a study over a period from March 2013 to February 2014 found that 64% cases of empyema under 1-5 year [12]. In the present study out of 95 cases 54 cases were male child. Male to female ratio in present study was 1.3:1. Dass R *et al* (2011) in study of empyema thoracis over a period from January 2006 through June 2010 observed male to female ratio 1.42:1 [10]. Rao P *et al* (2017) in their study over 2 year on childhood empyema found male:female ratio is 1.2:1 [11]

Predisposing Factors

In present study history of pneumonia was associated in more than 54 % of cases. Sick cell disease was associated in 5 cases. History of measles in recent past was present in 7.4% of cases. 61 out of 95 (64.2%) cases had some degree of malnutrition. 21% cases were showing grade I malnutrition, 20 % cases showed grade II malnutrition, 18% of cases had grade III malnutrition. While 5 cases (5.2%) had severe degree of malnutrition.

Asindi *et al* (1992) in their study of empyema in children demonstrated that empyema is associated with almost all cases with pneumonia and also measles is a significant risk factor for pneumonia [13]. A.K.Baranwal (2003) in their study of 265 cases over 10 years noted that preceding history of pustules was present in 31 patients (13%) [4]. Lower incidence of measles in present study is probably due to increased literacy among parents with also increased rates of measles and MMR

vaccination in children. A.K.Baranwal (2003) in their study of 265 cases over 10 years noted that sixty two percent of patients were malnourished. Severe malnutrition (weight below 60% of the 50th centile of the Harvard standard) was seen in only 14% of cases. Rao M S P *et al* (2017) showed in their study 58% cases were under- nourished [11].

Seasonal Distribution

In present study out of 95 cases 32 cases were found during spring (January – March), 26 cases found during winter (October – December) season, 24 cases during rainy (July – September) and 13 cases were found during summer (April – June) similar to other study.

Kothapolly. S *et al* (2010) showed in their study 27.5% were clustered in winter season (October to December) and the spring (January to March) (30%) accounting for almost 57.5% of the cases. Decreased incidence was noted in summer [14]. Langley M *et al* (2012) reported that the peak incidence occurred in spring with over 50% confined from November to April [15]. Ramireddy K *et al* (2013) 31 cases were admitted during the winter season, from Nov to Feb comprising of 53.45% [16]. The remaining total period of 8 months had incidence of 27 cases comprising of 46.55%.

Clinical Features

In present study fever (99%) and cough (97%) were the most common presenting symptoms. Breathlessness and chest pain were the presenting complain in nearly 86% of cases each. Dass R *et al* (2011) in their study on 150 children in northeast India found that fever was the commonest presentation (96.7%) followed by cough (90%), breathing difficulty (66.7%), chest pain (26.7%) and pain abdomen (10.7%) [11]. Perumal B *et al* (2017) in their study found fever (97%), cough (84%), difficulty breathing (80%) [17] and also in a study by Rao *et al* (2017) fever, cough & breathlessness were major symptom [11].

Clinical Signs

In present study raised temperature, intercostal tenderness and tachypnea were the most common clinical signs elicited. Decreased chest movement was found in 80% of cases. Clinically pallor and mediastinal shift was visible in 40 (42%) of cases. Lymphadenopathy and hepatosplenomegaly were associated with 17% and 13% of cases respectively.

Narayan appa *et al* (2013) showed in their study 76% children had tachypnea, 86% had decreased chest movements similar to present study [18]. Features of consolidation was found in 32% of cases in our study, but the rates are higher in other studies like Saleem *et al* (2010) [1]. Probably the finding in present study might be due to more post pneumonic empyemas than parapneumonic empyemas.

Side of Involvement

In present study 64 empyema cases out of 95 cases were having right side pleural sac involvement. 67% of cases had right side empyema while 27.4% cases had left sided empyema, 5 case had bilateral empyema. Right side empyema more commonly found in present study which agrees with the observation of Baranwal AK *et al* (2003) [4], Dass R *et al* (2011) [10]. Rao MsP *et al* (2017) [11] & Ramireddy *et al* (2013) [16].

Hematological Investigation

Mean Hb in present study of empyema patients is 9.62 ± 2.6 gm/dl. In the present study anaemia (with Hb < 11 gm%) was noted in nearly 80% of cases. Anaemia having (Hb < 5 gm%) was associated in 13% of cases out of which 1 died and 2 required surgical treatment

To know whether anaemia was poor prognostic factor, those patients with Hb > 8 gm% and those with Hb < 8 gm% were compared with the outcome. Those patients died or requiring surgical treatment was calculated as poor outcome. Hb < 8 gm% was statistically significantly associated with poor outcome (p value equals 0.0057).

Anaemia was found in 78.3% cases in the series of L.S.Arya *et al* (1982)[19], 90% in the series of Beg *et al* (1986)[20] and 46.5% in the study of R.Padmini *et al* (1990)[21]. Jain *et al* (2015)[22] on investigation, mean Hb was 9.48 with SD of 2.13. 96. The high incidence of anaemia in this study could have been due to associated malnutrition leading to nutritional anaemia, also due to poor hygienic condition the children might be having parasitic infestation which might have aggravated the degree of anaemia.

In the present study nearly 78% of cases are associated with TLC > 15,000. Mean TLC in present study is $16,075 \pm 4271$. Neutrophilia (N > 70%) was seen more than 68% of cases. Lymphocytosis (L > 40%) was also seen 30% of cases. ESR is increased in 40% cases more than 20 in 1st hour.

Leucocytosis and neutrophilia was also a constant feature in the series by B.R. Santhanakrishnan *et al* (1983)[23], MH Beg *et al* (1986)[20] and R. Padmini *et al* (1990)[21]. Saleem *et al* (2010)[1] Median TLC was 19000/mm³ and ESR was 25.

Jain *et al* (2015)[22] mean leucocyte count was 17293 with SD of 8830 with predominant cell being neutrophils (70%). ESR > 20 at 1st hour was seen in 40% of cases in the present study. This is likely due to associated moderate to severe anaemia. Mean ESR was 16.6.

Bacteriological Examination of Pleural Pus

Out of 95 cases examined for gram stain, organisms were isolated in 45 cases which was nearly 48% of cases. Out of which 26 cases were gm stain +ve cocci. And 19 cases were gm -ve bacilli. So nearly 58% of isolated organism was gm +ve cocci. S aureus was the most common organism isolated in 21 cases that is 47% of total. Gm -ve organism isolated in 19 cases that was 20% of total cases and 42% of organism isolated cases. Historically S.aureus has been the most frequent cause of empyema in children. Saleem *et al* (2010) [1] in their study of 114 cases noted culture positivity in 53% cases and staphylococcus being most common organism isolated in 40% of cases, pseudomonas 4% and klebsiella in 9% cases. According to Laishram *et al* (2015)[12] S aureus 20%, Rao *et al* (2017) [11] S. aureus was 51% and Toppo *et al* [24] it was 70% similar to present study.

Biochemical Findings of Pleural Pus

Pleural fluid macroscopy in present study showing pus in 83 cases (87%) and seropurulent in 12 cases (13%) similar to a study by S kothapolly *et al* (2010)[14] showing 87.5% pus and 12.5% seropurulent. All cases were subjected to light's criteria, 58 cases (61%) were found to be +ve for all 3 light's criteria. While 22% and 17% were tested +ve for 2 out of 3 and 1 out of 3 criteria respectively. None of the tested cases

were negative for all 3 criteria. In 77% of cases pleural fluid LDH was above 1000 IU/l and nearly 93% are associated with pleural fluid pH less than 7.74% cases were found < 40 mg/dl of Glucose, 97% associated with more than 3 gm/dl Protein. 86% cases were found > 1500 cell in pleural fluid and 82% cases associated with more than 70% neutrophil. In pleural fluid investigation of our study Mean PH was 6.76 ± 0.26 , mean glucose was 25.8 ± 11.4 gm/dl, mean protein was 4.17 ± 0.618 gm/dl and mean LDH was 1177 ± 437 while mean cell count was 4052 ± 1853 and mean Neutrophil was 77.27 ± 8.31 . These findings were consistent with those of Light W.R *et al* (2007) [8].

Organism Isolated from Culture & Antibiotic Sensitivity

Most common organism isolated is staphylococcus aureus. Gm +ve coccus like staphylococcus, enterococcus & pneumococcus are usually sensitive to vancomycin linezolid and teicoplanin group of antibiotic in most cases. Gm -ve organisms sensitive to imipenam, cefoperazone + sulbactam, piperacillin in most cases among non fermenters like pseudomonas, acinetobacter sensitive to imipenam, polymyxin B, colistin. Out of 95 cases of empyema thoracis 45 cases are culture sensitivity positive. Out of which in 23 cases organism is sensitive vancomycin (51%). Next commonest sensitive antibiotic is linezolid & Teicoplanin which is sensitive in 22 cases (49%). Imipenam was sensitive in 42% of cases. 25% of cases shows sensitivity towards cefoperazone + sulbactam.

Ampicillin and sulbactam combination to be effective against staphylococcus aureus as reported by N Belet *et al* [25] Peterson LR (2006) [26] in their meta analysis study found that semi-synthetic anti-staphylococcal penicillins (e.g. cloxacillin, flucloxacillin, dicloxacillin) are the standard therapy with demonstrable success, at an acceptable cost. Available evidence is against the use of gentamicin in pleural empyema due to its low penetrability. Other empyema-causing organisms are mostly sensitive to chloramphenicol, broad-spectrum, affordable and easily available antibiotic. The results of our study are almost similar to above study except that in our study high rate of resistance to penicillins and high rate of sensitivity towards ceftriaxone and vancomycin. This results may be due to overuse of antibiotics over the years leading to development of resistant strains like MRSA. Narayanappa *et al* (2013) [18] showed in their study Of 15 (30%) cases of pleural fluid culture proven Staphylococcus aureus isolation, 4 (26.6%) were methicillin resistant Staphylococcus aureus (MRSA).

All 15 isolates were sensitive to linezolid and amikacin, 12(80%) to clindamycin, 5 isolates to ceftriaxone and only 3(20%) to penicillin. 12(80%) isolates were resistant to penicillin, followed by 5(66%) to erythromycin and 3(20%) to ciprofloxacin. Out of 20 pleural fluid culture proven cases of empyema, 4 (8%) isolates were Pneumococci.

All were sensitive to linezolid and amikacin and 3(75%) isolates were sensitive to penicillin. One isolate showed growth of Pseudomonas which was sensitive to ceftazidime, cefotaxim, amikacin, ciprofloxacin and resistant to tetracyclines all most similar to our study.

Associated Radiological Findings

In present study pyo pneumothorax was associated in nearly 36% of cases with x-ray finding. Mediastinal shift was found 42% of cases. Hilar lymphadenopathy was associated with

nearly 10% of cases. 8 cases were multiloculated diagnosed in USG finding. Associated features of consolidation and collapse on X-ray were found in nearly 32% & 16% of cases respectively. Out of the 8 multiloculated cases 7 required surgical management. Pneumothorax was developed in 8% of cases.

These findings are consistent with findings of King S *et al*[27]. But studies of Padmini R *et al*[16] showed lower rates of pyopneumothorax in their study. The higher rates of pyopneumothorax in the present study may be explained as, some of the cases may be iatrogenic.

In a study by Agarwal N *et al* (2017)[28] of total case 65, 24 pt have pyopneumothorax (37%), 6% subcutaneous emphysema almost similar to present study.

Complication

Septicemia was associated with 6 cases (6.3%) out of which 2 died. Pyopneumothorax which was not present initially but developed during hospital stay or following ICD in 34 cases (36%). Thickened pleura developed in 10 cases (>10% cases) and those 7 cases were required surgical treatment. Collapse was seen in 15% of cases. Bronchopleural fistula and subcutaneous emphysema were found in 5 & 8 cases respectively. Similar study to present study by Dass R *et al* (2011)[10] in their study found that the commonest complications were collapse (18%), thickened pleura (16.7%), pericardial effusion (8%), and bronchopleural fistula (3.3%). Laishram N *et al* (2015) [12] found in their study 16% of cases was showing pyopneumothorax, 8% was pneumothorax, 4% was having subcutaneous emphysema.

Agarwal N *et al* 9(2018)[28] showed in their study of 65 cases were associated with empyema as follows Pyopneumothorax was having 24 cases (37%), bronchopleural fistula 18(28%), [14 at admission, 4 developed later], pneumothorax 12 cases (12.5%) and subcutaneous emphysema were having 3 cases. (4.5%)

Outcome of Treatment

Most of the cases (48, 51%) stayed in the hospital less than 15 days, 10.5% of cases required to stay at hospital more than 30 days, out of which 7 cases required surgical treatment in the form of decortications or thoracotomy. 39% stayed in hospital 15-30 days. Average duration of hospital stay in all cases 14.6 ± 8.4 days (table 20). Out of 95 cases 86% of cases got cured. 3 cases died, 7 cases required treatment in the form of decortications in 4 cases and thoracotomy in 3 cases. 4 patients got LAMA. Baranwal A K *et al* 2003[4] in their study found that average duration of hospital stay was nearly 3 wks and mortality was nearly 3%. Dass R *et al* (2011) [10] found that surgical procedures involved in their case series were decortications (14 cases, 9.3%) and mortality was 3.3%. Saleem M *et al* (2014) [1] found that over all mortality in empyema cases was 2.63%.

The high mortality rate in the present series may be due to small sample size and associated risk factors like PEM, septicaemia etc. Similar study to present study by Agarwal N *et al* (2018) [28] having 46% case stayed at hospital within 1-2 weeks, 34% stayed 2-4 weeks at hospital among them 5 required surgery (7%) and death occurs 7% of case.

Pulmonary Function Test

Pulmonary function test or spirometry done in more than 8 year of cases at 15 days and 2 month of follow up. Out of which 4 cases at 15 day follow up and 6 cases at 2 month follow up showed restrictive pattern of PFT. Out of these all cases were associated with thickened pleura.

McLaughlin and colleagues[29] 82 measured lung function in 10 children sampled from the empyema cases collected in Boston over 11 years. All the children they studied had required chest tubes, and two had also undergone decortication. They stated that five patients had a mild restrictive defect.

Summary

Incidence of empyema thoracis was 0.39 among all cases admitted during study period in SCB MCH & SVPPGIP (Shishubhaban).

Maximum number of cases are of age between 1-5 years (47.4%). Mean age of presentation was 68.46 ± 39.33 months. Male children are more commonly affected (57%). Male to female ratio being 1.3:1. Pneumonia was the most common predisposing factor associated in more than 54% of cases. 20% case was associated with poor oral hygiene. H/o skin infection / CSOM was associated in 10% of cases. 8% cases had h/o sickle cell disease and 5% case was associated with measles. Malnutrition was associated in 61 out of 95 cases (64.2%). While grade III and grade IV malnutrition were associated in 18% and 5% cases respectively. 32 cases (33.7%) of empyema occurred during January-March (spring season) and 26 cases (27.4%) during October to December (winter season), while 24 cases were found during rainy season. 5 cases had bilateral empyema. Fever (99%) and cough (97%) were the most common presenting symptoms followed by breathlessness (86.2%) and chest pain (41%). Weight loss was found in 26% of cases. Vomiting and diarrhoea (11%) and refusal to feed was also presenting feature in 14% of cases. Duration of fever in present study 51% were found less than 7 days, 27% was found 7-14 days of fever. Mean duration of fever was 9.4 ± 5.77. 21 cases were associated with fever more than 14 days of duration. Out of those 21 cases 5 required surgical treatment in the form of thoracotomy or decortications. Raised temperature (98%), tachypnea (87%), intercostal tenderness (82%) were the most common clinical signs elicitable. Decreased chest movement was seen in 80% cases, pallor and mediastinal shift were seen in 42% cases each. Lymphadenopathy and hepatosplenomegaly were found in 17% and 13% of cases respectively. Right side pleural sac was most commonly involved with 67% cases. Anaemia Hb < 11 gm% was noted in 79% of cases with severe anemia. Hb < 5 gm% was noticed in 13% of cases. Mean HB was 9.62 and SD was 2.6 in this study. Those cases having anemia (HB < 8 gm%) were found significant in relation to poor outcome. (p value = 0.0057) Nearly 78% of cases are associated with TLC > 15,000. Neutrophilia (N > 70%) was seen more than 68% of cases. Lymphocytosis (L > 40%) was also seen 30% of cases. ESR > 20 at 1st hour was seen in 40% of cases in the present study. Mean TLC in present study was 16075 and SD was 4271. Out of 95 cases examined for gram stain, organisms were isolated in 45 cases which is nearly 47% of cases. Out of which 26 cases were gram stain +ve cocci. And 19 cases were gram -ve bacilli. So nearly 58% of isolated

organism was gm +ve cocci. S aureus was the most common organism isolated in 21 cases that was 27% of total case, 47% of organism isolated. Gm- ve organism isolated in 19 cases that was 20% of total cases, and 42 % of total organism isolated. Pleural fluid macroscopy analysis was showing 87% case having Pus and 13% having seropurulent In nature and biochemical analysis showed serum LDH Level > 1000 iu/ l in 77% of cases .And nearly 82% of cases pleural fluid pH Was less than7. All the cases tested for Light's criteria was found +ve for at least 1out of 3 criteria while 61% of cases were found to be +ve for all 3 criteria. Out of which in 23cases organism is sensitive to Vancomycin (51%). Next commonest sensitive antibiotic is linezolid / Teicoplanin which is sensitive in 22cases (49%). Imipenam / meropenam sensitive to 19 cases (42%) .Cefoperazone + sulbactam was also sensitive in 11 cases (24.4%). All Gm + ve cocci were 100% sensitivity to vancomycin, linezolid, teicoplanin. All Gm -ve bacilli were 100% sensitivity to imipenam/ meropenam & 50% sensitivity to cefoperazone + sulbactam, All non fermenters (pseudomonas + acinetobacter) 100% sensitivity to polymyxin B, colistin, imipenam. 36 out of 95 cases were required intercostals tube drainage for 2 to 4wks. 10 cases even required intercostals tube drainage for more than 4 weeks. All case eventually progressed to develop thickened pleura, and also found restrictive pattern PFT in follow up.30 cases were required ICTD for 1-2 weeks.Average duration of ICTD in present study is 14.6±7.3 days.. Most of the cases (48 ,51%) stayed in the hospital between 1 to14 days. 10.5% of cases required to stay at hospital more than 1 month, out of which 7cases required surgical treatment in the form of decortications or thoracotomy. Average duration of hospital stay in all cases 14.6 ±8.4 days. Septicemia was associated with 6 cases (6.3%) out of which 2 died. Pyopneumothorax which was not present initially but developed during hospital stay or following ICD in 34 cases (36%). Thickened pleura developed in 10 case s (>10% cases) and those 7cases were required surgical treatment .Collapse was seen in 15% of cases. bronchopleural fistula and subcutaneous emphysema were found in 5 & 8 case respectively. 80 cases (85%) improved by ICTD along with antibiotics, 8 cases required only aspiration and antibiotics, and 7 case cured by ICTD + antibiotics along with surgical method like decortications, thoracotomy and VATS. 3cases died with a mortality rate of 3.2 %. 4 cases required surgical treatment in the form of decortications (4.2%) and 3 case had under went thoracotomy & VATS. Cases with anemia (Hb<8gm%),fever more than14days duration as presentation were significantly associated with poor out come in the form of death or requiring surgical treatment.(p value<0.05) .Though in grade III and grade IV malnutrition patients the incidence of poor out come was more, but it is not statistically significant (pvalue>0.05).

CONCLUSION

From the study we conclude that , incidence of empyema thoracis in paediatrics population was 0.39 those were admitted in SCB MCH & SVPPGIP during the study period. Empyema thoracis was most common in 1-5years children with male preponderance. Higher incidence was seen in spring season and in malnourished children. Right side empyema was more common. The pneumonia cases showing persisting signs of intercostals tenderness, raised temperature and tachypnea should be suspected for empyemathoracis .Poor orodental

hygiene and Sickle cell disease and measles were important predisposing factors.

Light's criteria is a sensitive diagnostic criteria for diagnosing empyema in children. Staphylococcus aureus was the predominant causative organism. Vancomycin, linezolid, imipenam, piperacillin & tazobactam , ceftriaxone are still the sensitive antibiotic in most of cases.

Empyema thoracis is a common and life threatening disease if not treated properly. Since Gram positive aerobes are the most common cause so patients can be given empirical therapy targeting these while investigations for other etiologies should be continued.

Majority of cases of empyema in children are post pneumonic. Early diagnosis, prompt and effective treatment of respiratory infections, particularly pneumonia will reduce the morbidity and mortality among Pediatric population.

Anemia (Hb<8gm%), long duration of fever (>14days), multiloculated pleural effusions were poor prognostic factors leading to death or prolonged hospital stay leading to surgical treatment. The incidence of poor outcome was also high in the children having poor nutritional status.

Appropriate antibiotics for at least 2weeks and early instillation of intercostals tube drainage must be done in every case to drain the pus and to prevent septicemia, as it is an important cause of mortality. Those cases not responding to above treatment should receive alternative treatment in the form intra pleural fibrinolytics or decortications/ thoracotomy or VATS.

Abbreviations

CRP	:	Creactiveprotein
CSOM	:	Chronic suppurative otitis media
C/S	:	Culturesensitivity
CT	:	Computerized tomography
DC	:	Differential count
ESR	:	Erythrocyte sedimentation rate
Gm	:	Gram
Hb	:	Hemoglobin
IAP	:	IndianAcademyofPediatrics
ICTD	:	Intercostal chest tube drainage
LAMA	:	Left against medical advice
LDH	:	Lactate dehydrogenase
PCR	:	Polymerase chain reaction
PEM	:	Protein energy malnutrition
PFT	:	Pulmonary function tests
SK	:	Streptokinase
TLC	:	Total leucocyte count
Tt	:	Treatment
UK	:	Urokinase
VATS	:	Video assisted thoracoscopic surgery
Zn	:	Zeihl-neelson
A/W	:	Associated with
PIPZO	:	Piperacillin + Tazobactam

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