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Original Article

Paediatrics Section

Clinical Profile of Children with Pleural Empyema in Community Acquired Pneumonia: A Cross-sectional Study

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ABSTRACT

Introduction: Empyema as a complication of Community Acquired Pneumonia (CAP) has been reported in a sizeable number of cases. Epidemiological studies on the clinical profile and outcome of CAP with empyema can help in better diagnosis and management of paediatric patients.

Aim: To describe the clinical profile of empyema in paediatric patients with CAP attending the tertiary care hospital in Aurangabad, Maharashtra, India.

Materials and Methods: The present cross-sectional study was conducted in the Department of Paediatrics at MGM Medical College and Hospital, Aurangabad, Maharashtra, India, from March 2022 to March 2023. Total 82 CAP diagnosed cases of age between two months and 18 years were included. Group A (cases) consisted of 41 cases of CAP with empyema and group B (controls) consisted of 41 cases of CAP without empyema. Data obtained was compiled and compared using unpaired t-test and Chi-square test.

Results: The mean age in group A was 76.43±66.15 months and in group B was 45.29±59.19 months. Duration of fever was 8.9±2.84 days in group A and 4.7±0.97 days in group B. The nutritional status of study subjects was malnourished in 29 (70.73%) group A and 21 (51.22%) in group B. The study subjects among the group A were vaccinated for pneumococcal vaccine in 18 (43.9%), and in 29 (70.73%) of the group B. Neutrophil count and C-reactive Protein (CRP) levels were significantly higher, and lymphocyte count was significantly lower in CAP cases with empyema. All the study subjects recovered in the present study; however, the duration of hospitalisation was more in CAP cases with empyema.

Conclusion: The number of subjects with malnutrition was more whereas vaccinated with pneumococcal vaccine were less in CAP cases with empyema. High leucocyte, neutrophil counts and raised serum CRP were observed in CAP cases with empyema. Decortication, Video-assisted thoracoscopic surgery and intercostal chest drain insertion were the treatment modalities used in CAP cases with empyema.

Keywords: C-reactive protein, Dyspnoea, Neutrophil, Pneumococcal vaccine

INTRODUCTION

The CAP is considered a significant contributor to morbidity and mortality globally in the paediatric age group [1]. Empyema is a severe bacterial infection with purulent fluid collection in the intrapleural space. The most common cause of empyema in children is pneumonia. The development of empyema in children with pneumonia is known to prolong hospitalisation and increase mortality [2-5]. The epidemiological data regarding the clinical profile and outcome of empyema in CAP can significantly contribute to the prompt diagnosis and management of paediatric patients, potentially reducing the adverse outcomes. Earlier studies have stressed the importance of data regarding the clinical profile, risk factors, treatment and outcome of complications like empyema thoracis in CAP. The researchers have reported the role of factors like serum CRP and leucocyte count in developing empyema in children with CAP [6,7]. Angurana SK et al., described the observations from one of the most extensive studies in the Indian subcontinent. The changes in the clinical profile and treatment modalities over a decade have been highlighted in the study results [8].

Data from various geographical regions are needed to understand the epidemiology of empyema thoracis in children. Thus, the present study describes empyema's clinical profile in paediatric patients with CAP attending the tertiary care hospital in Aurangabad, Maharashtra, India.

MATERIALS AND METHODS

The present cross-sectional study was conducted in the Department of Paediatrics, MGM Medical College and Hospital Aurangabad, Maharashtra, India, from March 2022 to March 2023. The Institutional Ethics Committee (IEC) approved the study protocol prior to its commencement (vide letter number MGM-ECRHS/2020/54 dated 21/12/2020).

Sample size: Convenience sampling was done, and 82 subjects were enrolled and divided into two groups of 41 each. Group A (cases) consisted of 41 CAP cases with empyema and group B (controls) consisted of 41 children with CAP with no evidence of empyema.

Inclusion criteria: Children aged two months and 18 years diagnosed with CAP with empyema were included as group A (cases). Children aged two months to 18 years diagnosed with CAP with no evidence of Empyema were included as group B (controls).

Exclusion criteria: Cases with pulmonary tuberculosis, congenital heart disease, immune deficiency disorder- primary or secondary, malignancy, recurrent empyema thoracis, earlier tube thoracostomy before referral to our tertiary care centre were excluded from the study.

Study Procedure

The CAP was diagnosed by the presence of any opacity (alveolar or interstitial) in the chest radiograph plus any one of the following: i) Fever ≥38.3°C; ii) Tachypnoea as per the age group i.e., children aged less than two months: respiratory rate ≥60 breaths/min; between 2 months and 11 months: respiratory rate ≥50 breaths/min; 1-4 years: respiratory rate ≥40 breaths/min; 5-12 years: respiratory rate ≥30 breaths/min; more than 12 years: respiratory rate ≥20 breaths/min; and iii) the presence of rhonchi and/or crackles and/or wheezing [9]. The diagnosis of children with Empyema was based on the aspiration of pus (leucocytes >50000/mm^3) from the pleural cavity or bacteria

isolated from the pleural fluid [10]. The diagnostic or therapeutic aspiration of pleural fluid was done in cases with clinical suspicion of empyema and a moderate or larger size of effusion on radiograph i.e., >10 mm rim of fluid [10].

A detailed history was taken, and a clinical examination was done. Specific details such as age, sex, clinical features, nutritional status, immunisation status, drug history, haematological investigations, management modality and hospital stay were noted. The data obtained was then compiled and assessed. Nutritional status was defined as malnutrition when weight-for-height or Body Mass Index (BMI)-for-age <2 Standard Deviation (SD) was observed. Moderately wasted and severely wasted children were considered to be malnourished. The growth charts relevant to age were used from World Health Organisation (WHO) and Indian Academy of Paediatrics [11-13].

STATISTICAL ANALYSIS

The statistical analysis was done. Unpaired t-test and Chi-square test was used to compare the groups. Statistical significance was assumed if the p-value was less than 0.05.

RESULTS

The mean age in group A was 76.43±66.15 months and in group B was 45.29±59.19 months. Maximum number of cases was in the age group 1-5 years [Table/Fig-1]. Males in group A was 16 (39.02%) and in group B was 24 (58.53%). Females in group A was 25 (60.97%) and in group B was 17 (41.46%).

Age group (years)	Group A n (%)	Group B n (%)
>1	3 (7.32)	16 (39.02)
1-5	21 (51.22)	15 (36.59)
>5-18	17 (41.46)	10 (24.39)

[Table/Fig-1]: Age distribution of patients.

Fever and cough were the most common symptoms in both the groups. The mean±SD duration of fever in group A (Cases) was 8.9±2.84 days, and in group B (Controls) was 4.7±0.97 days. The difference was statistically significant (p-value <0.0001, unpaired t-test) [Table/Fig-2].

Clinical features	Group A n (%)	Group B n (%)	p-value
Fever	21 (51.22)	34 (82.93)	0.002*
Dyspnoea	19 (46.34)	9 (21.95)	0.012*
Cough	21 (51.22)	41(100)	<0.001*
Chest pain	15 (36.59)	2 (4.88)	0.0004*

[Table/Fig-2]: Clinical features in group A and group B.
*The p-value <0.05 was considered statistically significant
Chi-square test; *The p-value in bold font indicates statistically significant values

The nutritional status of study subjects was observed to be malnourished in 29 (70.73%) individuals in group A and in 21 (51.22%) individuals in group B [Table/Fig-3]. The vaccination status in the study groups is shown in [Table/Fig-4]. Among the group A (Cases), pneumococcal vaccination was found to be done in 18 (43.9%) subjects whereas among the group B, it was found to be done in 29 (70.73%) subjects. Acetaminophen was prescribed in all cases. Most of the cases without empyema were managed by amoxycillin [Table/Fig-5].

Nutritional status	Group A n (%)	Group B n (%)	p-value
Normal	12 (29.27)	20 (48.78)	0.07
Malnourished	29 (70.73)	21 (51.22)	
Total	41 (100)	41 (100)	

[Table/Fig-3]: Nutritional status in group A and group B.
Chi-square test

Vaccination given	Group A n (%)	Group B n (%)	p-value
Pneumococcal vaccine	18 (43.9)	29 (70.73)	0.01*
Measles rubella vaccine	25 (60.98)	23 (56.1)	0.65
Pentavac	25 (60.98)	32 (78.05)	0.09
Influenza vaccine	2 (4.88)	2 (4.88)	0.66

[Table/Fig-4]: Vaccination status in group A and group B.
*The p-value <0.05 was considered statistically significant; Chi-square test used

Drug prescription	Group A n (%)	Group B n (%)
Acetaminophen	41 (100)	41 (100)
NSAID	6 (14.63)	33 (80.49)
Ceftriaxone	8 (19.51)	9 (21.95)
Amoxycillin	7 (17.07)	24 (58.53)
Piperacillin plus Tazobactam	8 (19.51)	5 (12.2)
Ampicillin-Cloxacillin	5 (12.2)	---
Piperacillin + Tazobactam + Amikacin	8 (19.51)	1 (2.44)
Cefpodoxime	2 (4.88)	---

[Table/Fig-5]: Drug prescription in group A and group B.
NSAID: Non steroidal anti-inflammatory drug

White Blood Cells (WBC), neutrophils and CRP levels were significantly higher in group A (p-value <0.05) [Table/Fig-6]. White blood cell count had a good sensitivity (97.56%) and a poor specificity (48.78%) at a cut-off of 11,000 cells/cumm. CRP had a good sensitivity (92.68%) and a modest specificity (85.3%) at a cut-off of 55 mg/dL. Neutrophil count (%) had a good sensitivity (92.68%) and a poor specificity (65.85%) at a cut-off of 58%.

Variable	Group A (n=41)	Group B (n=41)	p-value
Hb (gm%) (Mean±SD)	10.44±1.54	10.61±1.65	0.63
WBC (per mm^3) (Mean±SD)	15333.4±4261.61	11836±5433.72	0.0017*
Neutrophil (%) (Mean±SD)	68.41±8.12	49.82±18.09	<0.0001*
Lymphocyte (%) (Mean±SD)	26.43±8.08	43.39±17.89	<0.0001*
CRP (mg/L) (Mean±SD)	90.85±32.54	30.32±54.16	<0.0001*

[Table/Fig-6]: Haematological investigations in group A and group B.
Hb: Haemoglobin; WBC: White blood cells (Leucocytes); CRP: C-reactive protein
Unpaired t-test; *The p-value <0.05 was considered statistically significant

All cases of CAP cases without empyema were managed conservatively. Decortication was done in 21 cases, video-assisted thoracoscopic surgery in 13 cases, and intercostal chest drain insertion was used as a treatment modality in four CAP cases with empyema [Table/Fig-7].

Management modality	Group A n (%)	Group B n (%)
Conservative	3 (7.32)	41 (100)
Intercostal chest drain insertion	4 (9.76)	0
Video-assisted thoracoscopic surgery	13 (31.71)	0
Decortication	21 (51.22)	0

[Table/Fig-7]: Management modality in group A and group B.

All cases recovered in both groups. The hospital stay duration in group A and group B is shown in [Table/Fig-8]. Forty (97.56%) cases with empyema has a hospital stay duration of more than 10 days.

DISCUSSION

In the present study, the mean duration of fever was longer in CAP with empyema cases. Cough, dyspnoea and chest pain were the common complaints in CAP cases with empyema. Malnourished

Hospital stay	Group A n (%)	Group B n (%)
Less than 5 days	0	17 (41.46)
5 days to 10 days	1 (2.44)	18 (43.9)
More than 10 days	40 (97.56)	6 (14.63)
Total	41 (100)	41 (100)

[Table/Fig-8]: Hospital stay in group A and group B.

children were more in the CAP with empyema group. The children with pneumococcal vaccination were less in cases of CAP with empyema. Neutrophil count and CRP levels were significantly higher in CAP cases with empyema. Among the 41 cases of CAP with empyema, decortication was done in 21 cases, video-assisted thoracoscopic surgery in 13 cases, and intercostal chest drain insertion was used as a treatment modality in four cases.

Like in the present study, fever and cough were common complaints in earlier studies. Sharma IK et al., study reported that fever cough and breathlessness were the common presenting complaints in children with empyema [14]. Saleem AF et al., studied the clinical presentation of empyema thoracis in children at a tertiary care centre in Pakistan. Fever, dyspnoea and cough were observed as the major presenting symptoms in children more than a month to 15 years of age diagnosed with empyema thoracis [15]. Dass R et al., study from North East India reported that fever was the most frequent presentation (96.7%), followed by cough (90%), breathlessness (66.7%) and chest pain (26.7%) [16].

The present study findings in relation to nourishment status, vaccination status, haematological investigation results and management modalities employed in cases of CAP with empyema align with earlier studies [6-8,17-21].

Decortication, video-assisted thoracoscopic surgery and intercostal chest drain insertion were the treatment modalities in CAP cases with empyema in the present study. As reported in the literature, these treatment modalities have been recommended and observed to be beneficial in empyema [10,22,23]. Bekele A and Alayande BT studied the empyema cases in low resource settings and highlighted that the diagnosis of empyema is delayed due to low index of suspicion among the physicians, delayed presentation and lack of diagnostic tools. Further, they stressed the importance of early antibiotics utilisation and optimal use of intercostal chest tube drainage for better outcomes at a modest cost. The surgical management was suggested by the study investigators when antibiotic treatment and intercostal chest tube drainage do not achieve complete resolution [24].

Grisaru-Soen G et al., investigated the risk factors for empyema in children with pneumonia and reported that fever, dyspnoea and chest pain were the common presenting complaints and most of the patients required chest tube drainage while decortication with the VATS were the other treatment modalities [25]. The study findings from similar studies has been described in [Table/Fig-9] [6,14-16,20,21].

Author's name and year	Place of study	Sample size	Parameters assessed	Conclusion
Sharma IK et al., (2021) [14]	North India	60 empyema patients aged 0-14 years	Nutritional status, clinical features	Malnourishment in 65% subjects. Fever was most common symptom followed by cough and breathlessness
Saleem AF et al., (2014) [15]	Pakistan	112 patients of empyema thoracis	Clinical features and management	Fever, cough and dyspnoea were common symptoms. Majority of patients required some surgical intervention
Dass R et al., (2011) [16]	North East India	150 patients of empyema thoracis	Clinical features and management	Fever was most common symptom followed by cough and breathlessness. Ampicillin and cloxacillin used as first line treatment in 57.3% cases. Decortication was the surgical procedure used in 9.3% cases
Meganathan P and Awasthi S (2019) [6]	India	30 cases of Community Acquired Pneumonia (CAP) with pleural effusion/ empyema and 118 controls of CAP without pleural collection	Predictors of complicated parapneumonic effusion/empyema in CAP	The acute phase reactant and blood count related predictors of complicated parapneumonic effusion/ empyema were serum CRP >20 mg/dL, Hb <10 g/dL and TLC >10,000 cells/cumm
Bilan S et al., (2020) [20]	Iran	47 cases of CAP with empyema under 14 years of age	Predictive factors of empyema in CAP	Leucocytosis was the predictive factor associated with empyema
Falguera M et al., (2011) [21]	Spain	261 patients of empyema/complicated parapneumonic effusion	Predictive factors of empyema/ complicated parapneumonic effusion	Leucocytosis was the predictive factor associated with empyema
Present study	Maharashtra, India	41 patients of CAP with empyema. 41 patients of CAP without empyema	Nutritional status, clinical features and management	Malnourishment observed in 70.7% empyema cases. Fever, cough and breathlessness were common symptoms. High leucocyte, neutrophil counts and serum CRP while the lymphocyte counts were low. Decortication, video-assisted thoracoscopic surgery and intercostal chest drain insertion were the treatment modalities used

[Table/Fig-9]: Description of similar studies from literature [6,14-16,20,21].

Limitation(s)

A single-centre study with an observational design and a limited sample size which affects the generalisability of the study. The matching of the cases and controls for confounding factors could not be done in this study. However, it adds to the literature the clinical profile and outcome of CAP cases with and without empyema from the region.

CONCLUSION(S)

The CAP paediatric cases with empyema predominantly had dyspnoea and chest pain as presenting complaints in addition to fever and cough. The number of subjects with malnutrition was more in empyema group whereas fewer empyema cases were vaccinated with pneumococcal vaccine. CAP cases with empyema had high leucocyte, neutrophil counts and serum CRP while the lymphocyte counts were low. Decortication, video-assisted thoracoscopic surgery and Intercostal chest drain insertion were the treatment modalities used in empyema cases and the recovery was observed in all the study subjects.

Future studies from multiple centres and robust study designs in a larger sample may help better understand CAP and empyema in the paediatric age group.

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