e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2023; 15(12); 141-145

Original Research Article

A Retrospective Comparative Evaluation of Predictive Factors of Empyema in Children with Parapneumonic Pleural Effusion

Samiksha Sharma[1], Khodaija Mahvish[2], B.K Singh[3]

[1]Senior Resident, Department of Pediatrics, NMCH, Patna, Bihar, India
[2]Senior resident, Department of Pediatrics, NMCH, Patna, Bihar, India
[3]Professor and HOD, Department of Pediatrics, NMCH, Patna, Bihar, India

Received: 10-08-2023 Revised: 14-09-2023 / Accepted: 12-10-2023
Corresponding author: Dr. Samiksha Sharma
Conflict of interest: Nil

Abstract

Aim: The aim of the present study was to investigate the prognostic factors of empyema in children with parapneumonic pleural effusion.

Methods: This retrospective observational study was conducted at Department of pediatrics for one year. The principles of data confidentiality based on the Helsinki statement were observed. The medical records of all the patients under 14 years who were hospitalized with a diagnosis of bacterial pneumonia, pleural effusion, and empyema were examined.

Results: Empyema associated with parapneumonic pleural effusion was detected in 50 patients (33.34%) of 150 hospitalized children. 66 (44%), and 84 (56%) of these patients were boys and girls, respectively. Mean and standard deviation age of study participants were 37.9 ±17.9 months with the range of 1 to 16 months. Comparison of paraclinical laboratory parameters measured in the studied children showed that there was a significant statistical relationship between occurrence of empyema and some paraclinical measures such as leukocytosis (WBC> 15000 µl), neutrophilia > 12000 µl, Thrombocythemia (platelet=450000 µl), hypoalbuminemia (Alb <3 g/dL), high ESR and positive blood culture. The results of multivariate logistic regression modelling showed that the history of ibuprofen consumption increased the chance of empyema in children with parapneumonic pleural effusion by about 7 times (OR = 7.18; 95% CI: 1.36 to 37.83; P = 0.02). Also, having the symptoms of tachycardia (OR = 17.18; 95% CI: 1.64 to 178.82; P = 0.01), and leukocytosis (OR = 5.64; 95% CI: 2.12 to 15.25; P= 0.003) increases the empyema incidence.

Conclusion: Based on the findings of this study, a history of ibuprofen use, tachypnea, and leukocytosis are predictive factors for empyema in children with pleural effusion from community-acquired pneumonia (CAP). It is, therefore, helpful to design a scoring system to predict the incidence of empyema in patients with parapneumonic pleural effusion.

Keywords: Children, Empyema, Parapneumonic pleural effusion, Pneumonia.

Introduction

According to the radiological picture, patients with community-acquired pneumonia (CAP) can be divided into two groups: those with and those without pleural effusion. Subsequently, the biochemical and microbiological analyses of the pleural fluid and its macroscopic appearance provide criteria for the classification of patients with pleural effusion into two new subgroups: patients with uncomplicated parapneumonic effusion (UPE) and patients with empyema/complicated parapneumonic effusion (E/CPE). [1] This classification has important consequences regarding management and patient outcomes. Thus, while those with UPE are treated with antibiotics alone, patients with E/CPE require pleural drainage with or without fibrinolytics or thoracic surgery. [2,3] In addition, the latter also have a worse prognosis, particularly when the adequate management is delayed. [4] Despite the relevance of this event, few studies have focused on analysing and comparing the characteristics of these subgroups of patients.

Complicated parapneumonic effusions and empyema are key complications of community acquired pneumonia necessitating prolonged treatment, intercostal drainage and frequently surgical management, leading to prolonged hospital stay. [5-7] In 1980, Light and colleagues established the criteria that are now used to define complicated parapneumonic effusions but found no reliable clinical or radiological features to predict

which patients with community-acquired pneumonia will develop complicated parapneumonic effusions orempyema. [8] Only small studies have been available to date.

The treatment of parapneumonic effusion (PPE) may be conservative or surgical. The optimal choice of therapy depends on the stage of PPE which may be assessed by the clinical and laboratory findings. Delayed or inadequate treatment of PPE is a common cause of progression of its stage. However, other risk factors that may play a role in the prognosis or evolution of the disease are not clear. There are many studies that report fibrinolytic therapy (FT) is successful in the treatment of empyema in adults, but there are not as many studies in children. [9-12]

The aim of the present study was to investigate the prognostic factors of empyema in children with parapneumonic pleural effusion.

Materials and Methods

Our descriptive-retrospective cross-sectional study was conducted at Department of Pediatrics, Nalanda Medical College and Hospital, Patna, Bihar, India for one year. The principles of data confidentiality based on the Helsinki statement were observed. The medical records of all the patients under 14 years who were hospitalized with a diagnosis of bacterial pneumonia, pleural effusion, and empyema were examined. Patients with community acquired pneumonia (CAP) who had focal infiltrates in chest X-ray and were diagnosed with pleural effusion were entered into the study. In the present study, 150 medical records related to children admitted. who suffered from parapneumonic pleural effusion following community-acquired pneumonia (CAP) were investigated.

The patients were excluded if the cause of pneumonia was nosocomial, aspiration, cystic fibrosis, or of a viral origin. The patients were divided into two groups based on biochemical and microbiological analyses of pleural fluid and macroscopic evidence; one with uncomplicated parapneumonic effusions and one with complicated parapneumonic effusions (empyema). The criteria for the diagnosis of complicated parapneumonic effusions (empyema) were pleural effusion with macroscopic presence of pus, a positive gram stain or culture of pleural fluid, a pleural fluid pH under 7.2 with normal peripheral blood pH, lactate dehydrogenase (LDH)>1000 IU/mL, and glucose < 60 mg/dL. [13]

Data Collection

The general data included: baseline characteristics, height, weight, history of an underlying disease, pre-hospital antibiotic therapy and pre-hospital ibuprofen use, duration of illness, vital signs at admission, and having risk factors of aspiration. The laboratory data included: the number of white blood cells, platelets, neutrophils, acidosis, serum albumin, serum levels of acute phase proteins (CRP), erythrocyte sedimentation rate (ESR), and serum Na level measured at admission, blood culture results and pleural fluid culture were collected using a checklist which was compiled by a pediatrician from the patients' medical records.

Data Analysis

All statistical analyses were conducted in SPSS software version 22.0. Qualitative (categorized) variables were summarized by frequency (percentage). Quantitative variables with normal distribution were summarized by mean (standard deviation), and for summarize of Quantitative variables without normal distribution we used median and interquartile range (IQR).

The possible relationship between empyema occurrence and each of quantitative and qualitative variables was examined by independent T test and Chi-square tests, respectively. Finally, in order to control the effect of potential confounders, significant variables in univariate analysis were entered in a logistic regression model and the results were reported by the odds ratio (OR), and its corresponding 95% confidence interval (CI). P-value less than 0.05 was considered a significant level.

Results

Table 1: Comparison of baseline and clinical characteristics in children with or without empyema because of parapneumonic pleural effusion

Variables		Outcome		P-value
		Non- empyema (n =100)	Empyema (n =50)	
Age (month), Median ± IQR		35.0±45.0	37.0±44.0	0.84
Gender	Female	58 (58%)	26 (52%)	0.76
	Male	42 (42%)	24 (48%)	
Weight (Kg)		18.42 ±11.29	18.08±7.98	0.86
Height (Cm)		102.46±25.56	102.48± 22.12	>0.94
Tachycardia	Yes	65 (65%)	39 (76%)	0. 1
	No	35 (35%)	11 (24%)	

Tachypnea	Yes	40 (40%)	26 (52%)	<0.001
	No	60 (60%)	24 (48%)	
Fever (temperature >38.0 °C) on admission	Yes	40 (40%)	26 (52%)	0.2
	No	60 (60%)	24 (48%)	
Underlying diseases	Yes	38 (38%)	15 (30%)	0.18
	No	62 (62%)	35 (70%)	
Pre-treatments with ibuprofen	Yes	15 (15%)	24 (48%)	<0.001
	No	85 (85%)	26 (52%)	
Antibiotic therapy before admission	Yes	35 (35%)	28 (56%)	0.72
	No	65 (65%)	22 (44%)	
Risk factors for aspiration	Yes	10 (10%)	10 (20%)	0.2
	No	90 (90%)	40 (80%)	
Duration of the disease (day)	1-7	40 (40%)	18 (36%)	0.7
	7-14	45 (45%)	18 (36%)	
	>14	5 (5%)	14 (28%)	

Empyema associated with parapneumonic pleural effusion was detected in 50 patients (33.34%) of 150 hospitalized children. 66 (44%), and 84 (56%) of these patients were boys and girls, respectively. Mean and standard deviation age of study participants were 37.9 ±17.9 months with the range of 1 to 16 months.

Table 2: Laboratory data associated with the empyema in children with parapneumonic pleural effusion

Variables		Non- empyema (n =100)	Empyema (n =50)	P- value
WBC > 15000 µl	Yes	25 (25%)	31 (62%)	<0.001
	No	75 (75%)	19 (38%)	
Neutrophils > 12000 µl	Yes	23 (23%)	24 (48%)	0.001
	No	77 (77%)	26 (52%)	
Platelet > 450000 µl	Yes	24 (24%)	27 (54%)	0.001
	No	76 (76%)	23 (46%)	
CRP	Negative	32 (32%)	16 (32%)	0.2
	1+	40 (40%)	15 (30%)	
	2+	14 (14%)	15 (30%)	
	3+	14 (14%)	4 (8%)	
Acidosis	Yes	6 (6%)	0	0.07
	No	80 (80%)	46 (92%)	
Albumin < 3 g/dL	Yes	15 (15%)	17 (34%)	0.004
	No	35 (35%)	10 (20%)	
Na <135 mmol/L	Yes	9 (9%)	12 (24%)	0.1
	No	70 (70%)	32 (64%)	
ESR	< 50 mm/hr	32 (32%)	6 (12%)	0.005
	50-75 mm/hr	15 (15%)	7 (14%)	
	75-100 mm/hr	20 (20%)	7 (14%)	
	> 100 mm/hr	33 (33%)	30 (60%)	
Blood Culture	Positive	5 (5%)	10 (20%)	0.04
	Negative	95 (95%)	40 (80%)	
Pleural fluid culture	Positive	0	3 (6%)	0.12
	Negative	95 (95%)	47 (94%)	

Comparison of paraclinical laboratory parameters measured in the studied children showed that there was a significant statistical relationship between occurrence of empyema and some paraclinical measures such as leukocytosis (WBC> 15000 µl), neutrophilia > 12000 µl, Thrombocythemia (platelet=450000 µl), hypoalbuminemia (Alb <3 g/dL), high ESR and positive blood culture.

Table 3: The results of the multivariate logistic regression analysis on the Predictive factors associated with empyema in children with parapneumonic pleural effusion

Variables	Odds Ratio	95% CI	P-value
Pre-treatments with ibuprofen	7.18	1.36 – 37.83	0.03
Tachypnea	17.18	1.64 – 178.82	0.01
WBC>15000	5.64	2.12 – 15.25	0.004

The results of multivariate logistic regression modeling showed that the history of ibuprofen consumption increased the chance of empyema in children with parapneumonic pleural effusion by about 7 times (OR = 7.18; 95% CI: 1.36 to 37.83; P = 0.02). Also, having the symptoms of tachycardia (OR = 17.18; 95% CI: 1.64 to 178.82; P = 0.01), and leukocytosis (OR = 5.64; 95% CI: 2.12 to 15.25; P= 0.003) increases the empyema incidence.

Discussion

According to radiological evidence, patients with pneumonia are divided into two groups: either with or without pleural effusion. Patients with pneumonia and pleural effusion are also divided into two subgroups based on biochemical and microbiological analysis of pleural fluid as well as macroscopic criteria: either with uncomplicated parapneumonic effusion or with complicated parapneumonic effusion. The second subgroup, which has the acute condition of effusion of pleura, is called empyema. [1] As a complication of bacterial pneumonia, empyema is now a controversial topic in the field of research related to respiratory-lung diseases due to its significant morbidity and mortality in children. [14,15]

Empyema associated with parapneumonic pleural effusion was detected in 50 patients (33.34%) of 150 hospitalized children. 66 (44%), and 84 (56%) of these patients were boys and girls, respectively. Mean and standard deviation age of study participants were 37.9 ±17.9 months with the range of 1 to 16 months. Comparison of paraclinical laboratory parameters measured in the studied children showed that there was a significant statistical relationship between occurrence of empyema and some paraclinical measures such as leukocytosis (WBC> 15000 µl), neutrophilia > 12000 µl, Thrombocythemia (platelet=450000 µl), hypoalbuminemia (Alb <3 g/dL), high ESR and positive blood culture. The results of our study are consistent with those of Elemraid et al. In 2015, and Byington et al. In 2002, who reported that children with empyema had a significant history of ibuprofen use before hospitalization. [16,17] There are many theories, from simple to complex, about the reason for the relationship between the history of ibuprofen and empyema. A simple explanation for this connection is that children generally do not have a favorable general condition before the onset of empyema and are constantly involved in conditions such as high fever, so they use ibuprofen to temporarily relieve such conditions. A more complex relationship can be explained by the fact that high fever in diseases such as pneumonia has a regulatory mechanism in infection control so that many pneumococcal bacterial species have a temperature-sensitive property and die between 40 and 41 degrees. [18,19]

As a result, conditions are dramatically prepared for empyema occurrence. [20] In our study, the disruption of these regulatory mechanisms of the fever process in the face of some conditions such as pneumonia due to pre-hospital ibuprofen use could be a reasonable justification for the association between pre-hospital ibuprofen use and empyema occurrence. In our experience, we found the statistical relationship between tachypnea and empyema. The results of multivariate logistic regression modeling showed that the history of ibuprofen consumption increased the chance of empyema in children with parapneumonic pleural effusion by about 7 times (OR = 7.18; 95% CI: 1.36 to 37.83; P = 0.02). Also, having the symptoms of tachycardia (OR = 17.18; 95% CI: 1.64 to 178.82; P = 0.01), and leukocytosis (OR = 5.64; 95% CI: 2.12 to 15.25; P= 0.003) increases the empyema incidence.

Conclusion

Based on the findings of this study, a history of ibuprofen use, tachypnea, and leukocytosis are predictive factors for empyema in children with pleural effusion from community-acquired pneumonia (CAP). It is, therefore, helpful to design a scoring system to predict the incidence of empyema in patients with parapneumonic pleural effusion. This system can be used as a screening tool in children with empyema for an early intervention and finding the most effective and the least dangerous treatment strategy

References

1. Porcel JM. Pearls and myths in pleural fluid analysis. Respirology. 2011 Jan;16(1):44-52.
2. Colice GL, Curtis A, Deslauriers J, Heffner J, Light R, Littenberg B, Sahn S, Weinstein RA, Yusen RD. Medical and surgical treatment of parapneumonic effusions: an evidence-based guideline. Chest. 2000 Oct 1;118(4):1158-71.
3. Sahn SA. Use of fibrinolytic agents in the management of complicated parapneumonic effusions and empyemas. Thorax. 1998 Aug 1;53(suppl 2):S65-72.
4. Lindstrom S, Kolbe J. Community acquired parapneumonic thoracic empyema: predictors of outcome. Respirology. 1999 Jun;4(2):173-9.
5. Taryle DA, Potts DE, Sahn SA. The incidence and clinical correlates of parapneumonic effusions in pneumococcal pneumonia. Chest. 1978 Aug 1;74(2):170-3.
6. Davies C, Gleeson F, Davies R. BTS guidelines for the management of pleural infection. Thorax. 2003 May;58(Suppl 2):ii18.
7. Davies CW, Kearney SE, Gleeson FV, Davies RJ. Predictors of outcome and long-term survival in patients with pleural infection. American journal of respiratory and critical care medicine. 1999 Nov 1;160(5):1682-7.

8. Light RW, Girard WM, Jenkinson SG, George RB. Parapneumonic effusions. The American journal of medicine. 1980 Oct 1;69(4):507-12.
9. Nadkarni V, Theroux M, Padman R, Klein J. Intrapleural streptokinase as adjunctive treatment for persistent empyema in pediatric patients. Chest. 1993 Apr 1;103(4):1190-3.
10. Celebi S, Hacimustafaoglu M, Sarimehmet H, Gurpinar A, Ildirim I. Parapneumonic effusions in children: Clinical assessment and management. ANKEM Derg. 2001; 15:699-709.
11. Handman HP, RAUMAN P. The use of urokinase for loculated thoracic empyema in children: a case report and review of the literature. The Pediatric Infectious Disease Journal. 1993;12(11):958-9.
12. Moulton JS, Benkert RE, Weisiger KH, Chambers JA. Treatment of complicated pleural fluid collections with image-guided drainage and intracavitary urokinase. Chest. 1995 Nov 1;108(5):1252-9.
13. Chen JS, Huang KC, Chen YC, Hsu HH, Kuo SW, Huang PM, Lee JM, Lee YC. Pediatric empyema: Outcome analysis of thoracoscopic management. The Journal of thoracic and cardiovascular surgery. 2009 May 1;137(5): 1195-9.
14. Bender JM, Ampofo K, Sheng X, Pavia AT, Cannon-Albright L, Byington CL. Parapneumonic empyema deaths during past century, Utah. Emerging infectious diseases. 2009;15(1):44.
15. Phelan PD, Olinsky A, Robertson CF. Respiratory illness in children: Blackwell scientific publications; 1994.
16. Play for S, Smyth A, Stewart R. Increase in incidence of childhood empyema. Thorax. 1997;52(10):932.
17. Elemraid MA, Thomas MF, Blain AP, Rushton SP, Spencer DA, Gennery AR, et al. Risk factors for the development of pleural empyema in children. Pediatric pulmonology. 2015;50(7):721-6.
18. Enders JF, Shaffer MF. Studies on Natural Immunity to Pneumococcus Type III: I. The Capacity of Strains of Pneumococcus Type III to Grow at 41 C. and Their Virulence for Rabbits. The Journal of Experimental Medicine. 1936;64(1):7.
19. Strouse S. Experimental studies on pneumococcus infections. The Journal of Experimental Medicine. 1909;11(5):743.
20. Menon P, Kanojia RP, Rao K. Empyema thoracis: Surgical management in children. Journal of Indian Association of Pediatric Surgeons. 2009;14(3):85.