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ORIGINAL ARTICLE

Clinical presentations and complications of parapneumonic effusion and pleural empyema in children presenting in a tertiary care setup.

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ABSTRACT… Objective: To evaluate the clinical presentations and complications of parapneumonic effusion (PPE) and pleural empyema (PE) in children presenting in a tertiary care setup in Karachi. **Study Design:** Cross-sectional study. **Setting:** Medical Units of National Institute of Child Health, Karachi, Pakistan. **Period:** July 2022 to June 2023. **Material & Methods:** Hospitalized children of either gender, aged between 1 month and 12 years diagnosed with PPE or PE on the basis of radiological findings were analyzed. Baseline laboratory investigations were done. Complications of PPE/PE were noted. Outcome was observed in the form of discharged, referred or mortality. **Results:** In a total of 86 with PPE/PE, 61.6% were boys while the overall mean age was 4.35±3.17 years. Common clinical symptoms included fever (100%), decreased air entry (86%), cough (75.6%), and respiratory difficulty (74.4%). Blood cultures revealed bacterial infections in 10.5% of cases, while most common isolates were Staphylococcus aureus and Pseudomonas. Positive pleural fluid cultures noted in 39.5% of cases while pseudomonas and staphylococcus aureus were the most common bacterial isolates. Most commonly used antimicrobials were Vancomycin, Ceftriaxone, Tazobactum+Piperacillin, and Linezolid. Tube thoracostomy was performed in 96.5% of patients. Most frequent complications of PPE/PE included residual organized empyema (36%), pneumothorax (9.3%), and sepsis (9.1%). Overall, the mortality was noted in 5.8% cases. **Conclusion:** Most frequent clinical presentations of PPE/PE include fever, cough, respiratory difficulty, and abdominal pain, with fever being universal. Staphylococcus aureus and Pseudomonas were the most common bacterial isolates. The most common complications were residual organized empyema, pneumothorax, and sepsis.

Key words: Cough, Fever, Parapneumonic Effusion, Pneumothorax, Pleural Effusion.

INTRODUCTION

Parapneumonic effusions (PPE) and pleural empyema (PE) are two of the most common consequences of community-acquired pneumonia (CAP) in children. Global data documents the incidence PPE and PE around 4-18 per 100,000 children.[1,2] In the recent years, there have been a documented rise in the incidence of PPE/PE, which may be attributed to several factors, including changes in bacterial virulence and antibiotic susceptibility.[3-5]

In countries where pneumococcal conjugate vaccination (PCV) is extensively used, Streptococcus pneumoniae is consistently the main cause of PPE/PE.[6] According to the literature, the second most common bacteria that cause PPE/PE among children is Streptococcus pyogenes, followed by Staphylococcus aureus, and in some countries, the incidence of PPE/PE caused by Staphylococcus aureus has an increasing trend.[7]

Among children, empyema thoracis and PPE have extensively been studied to assess their management and outcomes, but due to a significant rise in cases of complicated PPE and PE, there is a need to further appraise the clinical features, etiology, treatment approaches, and outcomes of children with empyema thoracis.[8] Therefore, we planned this study with the objectives to evaluate the clinical presentations

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and complications of PPE and PE in children presenting in a tertiary care setup in Karachi.

MATERIAL & METHODS

This cross-sectional study was conducted at all three medical units of NICH, Karachi, Pakistan, from July 2022 to June 2023. During the study period, a total 86 hospitalized children of either gender, aged between 1 month and 12 years diagnosed with PPE or PE on the basis of radiological findings were analyzed. The exclusion criteria were children with pleural effusion due to a non-infectious etiology such as malignancy or cardiac problems. Immunocompromised or chronically ill children were also excluded. Informed and written consents were obtained from the parents/guardians of the patients after a briefing on the objectives and safety of the study. They were also assured that the information they provided would be secured. Approval from the "Institutional Ethical Review Board" was acquired (IERB-10/2022, dated:14-07-2022).

After the enrolment, a thorough physical and clinical examination was performed in each child. Detailed medical history was also noted. Baseline investigations like CBC, serum electrolytes, urea and creatinine, CRP, serum albumin, and blood culture were evaluated. Aspirated pleural fluid was sent to the institutional laboratory for a detailed report. All the patients were followed until they were discharged from the hospital. An especially predesigned proforma was used to collect all of the relevant study data. Data analysis was done using "IBM-SPSS Statistics", version 26.0. Qualitative variables were represented as proportions. Numeric data were shown as mean and standard deviation.

RESULTS

In a total of 86 children with PPE/PE, 53 (61,6%) were boys. The mean age and body weight were 4.35±3.17 years (ranging between 3 months to 12 years) and 13.64±6.61 kg (ranging between 4.6 to 45.0 kg) respectively. The mean HR, RR, and temperature were 131.37±16.62 beats per minute, 36.56±8.24 respirations per minute, and 100.8±1.34 ^{0}F respectively. The mean SPO_2 levels were 96.41±2.84%. The most frequent chest findings were decreased air entry reported in 74 (86.0%) children. Table-I shows baseline characteristics of children.

Characteristics		Number (%)
Gender	Boys	53 (61.6%)
	Girls	33 (38.4%)
Age	<5	53 (61.6%)
	5-12	33 (38.4%)
Vaccination status	Unimmunized	24 92.9%)
	Partial	25 (29.1%)
	Full	37 (43.0%)
Previous history of hospitalization		8 (9.3%)

Table-I. Demographic and clinical characteristics of children with PPE/PE (n=86)

Fever was noted in all 86 (100%) children while cough, respiratory difficulty, and abdominal pain were the other most frequent clinical presentations, noted in 65 (75.6%), 64 (74.4%), and 8 (9.3%) children respectively. Descriptive details about the biochemical and laboratory parameters are shown in Table-II.

Parameters	Mean ± Standard Deviation
Hemoglobin (g/dl)	9.13±2.06
Total leukocytes count (10^9/L	18.22±9.93
Platelets (10^9/L)	622.86±321.59
Urea (mg/dl)	26.27±17.40
Creatinine (mg/dl)	0.27±0.10
Sodium (mEq/L)	137.14±4.80
Potassium (mEq/L)	4.86±4.45
Chlorine (mEq/L)	100.90±4.26
Total bilirubin (mg/dl)	0.50±0.69
Direct bilirubin (mg/dl)	0.22±0.36
Alanine Aminotransferases (U/L)	36.29±41.50
Albumin (g/dl)	2.92±0.52
C-Reactive protein (mg/dl)	11.71±9.07

Table-II. Biochemical and laboratory parameters (n=86)

In 9 (10.5%) children with positive blood culture, staphylococcus aureus, pseudomonas species, burkholderia cepacia, and acinetobacter species were the most common bacterial isolates, noted in 3, 3, 2, and 1 case respectively. Plural fluid examination reported positive culture in 34 (39.5%) cases while pseudomonas, staphylococcus aureus, and streptococcus pneumonie were the most frequent bacterial isolates, noted in 10 (11.6%), 8 (9.3%), and 4 (4.6%) children.

X-ray chest revealed involvement of right side in 51 (59.3%) children while left side and bilateral involvement were found in 30 (34.9%), and 5 (5.8%) children respectively. Vancomycin, Ceftriaxone, Tazobactum+Piperacillin, and Linezolid were the most commonly used antimicrobials. Tube thoracostomy was done in 83 (96.5%) patients while the mean duration of thoracostomy was 14.30±9.21 days. Decortication was needed in 6 (7.0%) children. Mechanical ventilation was required by 6 (7.0%) children. The most frequent complications of PPE/PE in children were residual organized empyema noted in 31 (36.0%) cases. Moreover, pneumothorax, and sepsis were the other commonly reported complications, observed in 8 (9.3%), and 7 (9.1%) cases respectively. The details about the complication of children with PPE/PE are shown in Figure-1. Mortality was reported in 5 (5.8%) children, 3 (3.5%)) children referred to other departments, while remaining 78 (90.7%) children were discharged successfully. The mean duration of hospital stay was 16.39±10.28 days (ranging between 1-66 days).

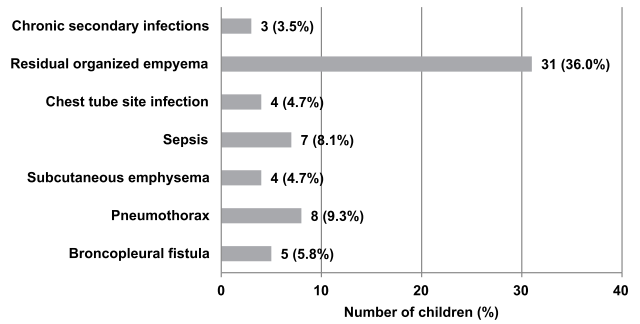

Figure-1. Complications in children with PPE/PE (n=86)

DISCUSSION

In this study, fever (100%), cough (75.6%), respiratory difficulty (74.4%), and abdominal pain (9.3%) were the other most frequent clinical presentations of PPE/PE. Poland by Krenke et al analyzing 323 children with PPE/PE, fever, and tachypnea as the most typical presenting symptoms which are in agreement to the present research.[9] A study done by Gomez-Go et al showed that fever, difficulty in breathing, and cough to be the most frequent signs and symptoms in PPE/PE cases, reported in 94.3%,73.6%, and 41.5% respectively.[10] The literature reports that regarding the aforementioned symptoms, no appreciable differences are observed between children with PPE or with PE.[10,11] Some researchers have shown the connection between PE and abdominal pain in children with CAP.[12]

The frequency of PPE/PE in children has significantly increased recently, and it has been revealed that S. pneumoniae is consistently the most frequent causative bacteria for pleural infections related to CAP.[9] In the present study, 9 children with positive blood culture were found and staphylococcus aureus, and pseudomonas species were the most common bacterial isolates. Literature shows that the etiology of PPE/PE has changed in the recent decades. Although, S. pneumoniae continues to be the most frequent cause of PPE/PE, other bacteria, such as S. aureus, are increasingly understood to be relevant contributors.[13,14] In this study, only 10.5% blood culture were deemed positive. Study by Krenke et al also revealed that only 10.9% children with PPE/PE were identified to have positive blood cultures.[9] Lahti et al reported similar statistics on the percentage of positive blood cultures (11%)[12], but other authors reported larger percentages (26%) of positive blood cultures as well.[15] In our research, the diagnostic result of pleural fluid cultures reported positive findings in 39.5% cases. The proportion of culture-positive specimens ranges between 19% to 36% in other investigations, demonstrating considerable variances in the percentage of positive pleural fluid results.[12,15] The present research reported a marked rise in PPE/PE cases brought on by S. aureus and pseudomonas species. The importance of biochemical pleural fluid analysis in pediatric patients has generally been considered less significant.[16] Pleural effusions in children usually come on from pulmonary infections, and the decision of treatment is only very rarely based on the findings of a pleural fluid investigation. Therefore, it is recommended by the experts that children with PPE may not be required to undergo biochemical testing of their pleural fluid.[16]

The treatment of PPE/PE involves both local management and antimicrobial medication. In

our study group, the most often administered antibiotics were Vancomycin, Ceftriaxone, Tazobactum+Piperacillin, and Linezolid. These decisions are in conformity with the most recent PIDS/IDSA recommendations as well as other centers' practical experience. Vancomycin or clindamycin have been recommended as first-line antibiotic therapy for seriously ill children.[16,17] This is because "methicillin-resistant S. aureus (CA-MRSA)" is becoming more common in the community.[12,18]

We found that the most frequent complications of PPE/PE in children were residual organized empyema noted in 36.0% cases. Moreover, pneumothorax, and sepsis were the other commonly reported complications, observed in 9.3%, and 9.1% cases respectively. Contemporary literature has shown that the most common complications of PPE/PE are bronchopleural fistula, (9%), pneumothorax (7.7%) and lung abscess (1.8%).[9] Researchers have shown that cases having complications of PPE/PE are generally reported to have relatively longer duration of hospitalization and intensive care admissions when compared to those who do not develop complications.[9] There is a dire need to timely identify and treat complications of PPE/PE to improve inflicted morbidity and morbidity of these ailments.

CONCLUSION

Most frequent clinical presentations of PPE/PE include fever, cough, respiratory difficulty, and abdominal pain, with fever being universal. Staphylococcus aureus and pseudomonas species were the most common bacterial isolates. The most common complications were residual organized empyema, pneumothorax, and sepsis, with a mortality rate of 5.8%. These findings underscore the significance of early recognition and management of PPE/PE in children, with an emphasis on appropriate antimicrobial therapy, tube thoracostomy, and vigilant monitoring to reduce complications and improve outcomes in this patient population.

REFERENCES

1. Sorg AL, Obermeier V, Liese JG, von Kries R. **Incidence trends of parapneumonic pleural effusions/empyema in children 2009 to 2018 from health insurance data: Only temporal reduction after the introduction of PCV13.** Vaccine. 2021; 39(26):3516-3519. doi:10.1016/j.vaccine.2021.05.005

2. Mahon C, Walker W, Drage A, Best E. **Incidence, aetiology and outcome of pleural empyema and parapneumonic effusion from 1998 to 2012 in a population of New Zealand children.** J Paediatr Child Health. 2016 Jun; 52(6):662-668. doi: 10.1111/jpc.13172

3. Liese JG, Schoen C, van der Linden M, Lehmann L, Goettler D, Keller S, et al. **Changes in the incidence and bacterial aetiology of paediatric parapneumonic pleural effusions/empyema in Germany, 2010-2017: A nationwide surveillance study.** Clin Microbiol Infect. 2019; 25(7):857-864. doi:10.1016/j.cmi.2018.10.020

4. Thomas MF, Sheppard CL, Guiver M, Slack MPE, George RC, Gorton R, et al. **Emergence of pneumococcal 19A empyema in UK children.** Arch Dis Child. 2012 Dec; 97(12):1070-2. doi:10.1136/archdischild-2012-301790

5. Saleem AF, Shaikh AS, Khan RS, Khan F, Faruque AV, Khan MA. **Empyema thoracis in children: Clinical presentation, management and complications.** J Coll Physicians Surg Pak. 2014; 24(8):573-576.

6. Ghritlaharey RK, Budhwani KS, Shrivastava DK, Srivastava J. **Tube thoracostomy: Primary management option for empyema thoracis in children.** Afr J Paediatr Surg. 2012; 9(1):22-26. doi:10.4103/0189-6725.93297

7. Amin M, Yousef Pour S, Navidifar T. **Detection of the major bacterial pathogens among children suffering from empyema in Ahvaz city, Iran.** J Clin Lab Anal. 2019; 33(4):e22855. doi:10.1002/jcla.22855

8. Ferguson J, Kazimir M, Gailey M, Moore F, Schott E. **Predictive Value of Pleural Cytology in the Diagnosis of Complicated Parapneumonic Effusions and Empyema Thoracis.** Pulm Med. 2020 May 20; 2020. doi:10.1155/2020/7175451

9. Krenke K, Urbankowska E, Urbankowski T, Lange J, Kulus M. **Clinical characteristics of 323 children with parapneumonic pleural effusion and pleural empyema due to community acquired pneumonia.** J Infect Chemother. 2016; 22(5):292-297. doi:10.1016/j.jiac.2016.01.016

10. Gomez-Go, GD, Gonzales L, Ong-Lim A, **Clinical profile and outcome of children with parapneumonic effusion.** Pediatr Infect Dis Soc Phillippines. 2012; 13(1):15-28.

11. Sakran W, Ababseh Zel D, Miron D, Koren A. **Thoracic empyema in children: Clinical presentation, microbiology analysis and therapeutic options.** J Infect Chemother. 2014; 20(4):262-265. doi:10.1016/j.jiac.2013.12.006

12. Lahti E, Peltola V, Virkki R, Alanen M, Ruuskanen O. **Development of parapneumonic empyema in children.** Acta Paediatr. 2007; 96(11):1686-1692. doi:10.1111/j.1651-2227.2007.00511.x

13. Grijalva CG, Nuorti JP, Zhu Y, Griffin MR. **Increasing incidence of empyema complicating childhood community-acquired pneumonia in the United States.** Clin Infect Dis. 2010; 50(6):805-813. doi:10.1086/650573

14. Schultz KD, Fan LL, Pinsky J, Ochoa L, Smith EO, Kaplan SL, et al. **The changing face of pleural empyemas in children: Epidemiology and management.** Pediatrics. 2004; 113(6):1735-1740. doi:10.1542/peds.113.6.1735

15. Grisaru-Soen G, Eisenstadt M, Paret G, Schwartz D, Keller N, Nagar H, et al. **Pediatric parapneumonic empyema: risk factors, clinical characteristics, microbiology, and management.** Pediatr Emerg Care. 2013; 29(4):425-429. doi:10.1097/PEC.0b013e318289e810

16. Balfour-Lynn IM, Abrahamson E, Cohen G, Hartley J, King S, Parikh D, et al. **BTS guidelines for the management of pleural infection in children.** Thorax. 2005; 60 Suppl 1(Suppl 1):i1-i21. doi:10.1136/thx.2004.030676

17. Bradley JS, Byington CL, Shah SS, Alverson B, Charter ER, Harrison C, et al. **The management of community-acquired pneumonia in infants and children older than 3 months of age: clinical practice guidelines by the Pediatric Infectious Diseases Society and the Infectious Diseases Society of America.** Clin Infect Dis. 2011; 53(7):e25-e76. doi:10.1093/cid/cir531

18. Mirrett S, Weinstein MP, Reimer LG, Wilson ML, Reller LB. **Relevance of the number of positive bottles in determining clinical significance of coagulase-negative staphylococci in blood cultures.** J Clin Microbiol. 2001; 39(9):3279-3281. doi:10.1128/JCM.39.9.3279-3281.2001.

AUTHORSHIP AND CONTRIBUTION DECLARATION

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1	Samrah Ibrahim	Data collection, Drafting.	
2	Misbah Anjum	Study Concept, Methodology.	
3	Muhammad Haris Patel	Proof reading, Critical review.	