Clinical Profile of Admitted Children with Pleural Effusion: A Tertiary Care Center Experience

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Abstract

Background: Pleural effusion is a problem commonly encountered by chest physicians. Management of pleural effusions depends on their origin whether exudates or transudates, simple or complicated. This study was carried out to find out types of effusion and their etiology.

Methods: A Prospective study of 60 patients were analyzed for clinical and laboratory profile, origin and type of fluid, etiology of pleural effusion in pediatric patients.

Results: Majority of the patients were in 1-4 years age group (42%). Fever, cough and respiratory distress were most common clinical symptoms in all type of effusion. Empyema was most common type of effusion followed by tuberculosis and para-pneumonic effusion cases. All of the exudative cases satisfied Lights criteria.

Conclusion: Pleural effusions are mostly exudative in origin in pediatric age. Pneumococci (30%) was more frequent among causative micro-organisms in recent time.

Keyword: pleural effusion, empyema, tuberculosis, para-pneumonic effusion.

Introduction

Pleural effusion is a problem commonly encountered by chest physicians, accounting for approximately 4% of all attendances to the chest clinic\(^1\). Pleural effusion primarily occurs because of imbalance in hydrostatic and oncotic pressure, increased capillary permeability and impaired lymphatic drainage\(^2\). Pleural fluid accumulates...
when too much fluid either enters or too little fluid exits, out of pleural space\textsuperscript{2}. Though Pleural effusion occurs less frequently than adults they also differ significantly in etiology from adults\textsuperscript{2}. It is important to classify pleural fluids into exudates and transudates because this is indicative of underlying pathophysiological process involved, such a distinction allows appropriate investigations to be instigated enabling better patient management\textsuperscript{3}. Light et al has established criteria for demonstrating high degree of diagnostic accuracy for differentiating transudates and exudates\textsuperscript{4}.

Pediatric pleural effusions present a changing profile over time, both in terms of etiological subgroups and causative microorganisms in parapneumonic effusions\textsuperscript{2}. The changing spectrum of causative agents in pediatric parapneumonic effusions is among the current topics on the subject \textsuperscript{2,5}. The causative agent may be difficult to estimate empirically because of changes in frequency of microbial agents over years, incomplete sensitivity and specificity of different methods in detecting the agents and increasing incidence of sterile empyemas as a result of wide utility of broad spectrum anti-microbial agents\textsuperscript{2,5,6,7,8,9}. Reviews of causative agents over long periods of time help reveal this changing profile of causative microorganisms and would be clinically useful.

Most common cause of Pleural effusion in children is bacterial pneumonia, other causes are tuberculosis, dengue, heart failure, nephrotic syndrome, diaphragmatic abscess, rheumatic and rheumatoid diseases, uremia and pancreatitis\textsuperscript{10}. In various study it has been reported that, incidence of parapneumonic effusion ranges from 20\% to 91\% with an increase in morbidity and mortality\textsuperscript{11}. Incidence of childhood empyema increased in UK in the mid to late 1990\textsuperscript{12}. Parapneumonic effusion is more common in boys than girls and more frequently encountered in infants and young children\textsuperscript{13}. Non bacterial infectious agents such as virus and Mycoplasma pneumonias are the common causes of pleural effusion in children throughout the world\textsuperscript{14}.

It is justified to know the clinical presentation in order to avoid delays in diagnosis that may influence treatment and outcome. The current study was conducted to provide a general descriptive information on pediatric pleural effusion cases admitted at department of paediatric respiratory medicine (pulmonology) in Dhaka Shishu (Children) Hospital to find out the frequencies of effusion subtypes and etiologies.

**Materials and methods**

A prospective cross sectional study was carried out on patients diagnosed provisionally as pleural effusion and admitted in the department of pediatric respiratory medicine (pulmonology) from January 2019 to December 2019. A total number of sixty (60) admitted patients with pleural effusion were included in this study. These included patients in whom pleural effusions were the reason for referral as well as those with a clinical finding after admission for other presenting symptoms. Patients with low amounts of pleural fluid collections for whom diagnostic or therapeutic sampling was not required were excluded from the study. The patients were diagnosed by detailed history taking, physical examination and confirmed by chest radiography, ultrasonography (USG) of chest, CT scan of chest and aspiration of pleural fluid of one(1) year to seventeen (17) years age of either sex were selected purposively. Aspirated Pleural fluid was examined for physical appearance, and was sent to institutional laboratory for microscopic examination gram staining, AFB staining, Gene X-pert, immunochromatography and biochemical examination like protein and sugar. Some important biochemical analysis such as serum and pleural fluid LDH, pleural fluid ADA analysis were performed from outside center. The parents were explained about the purpose of the study. Both the written & verbal consents were taken from the parents. When parents did not give consent for any particular case next case was
selected. The exclusion criteria were very sick children, age below six months and above seventeen years, previously treated pleural effusion cases, cases having any other chronic illness or co-morbid situation, parents don't give consent for the study. All information's were recorded in pre-tested semi-structured questionnaire. Ethical clearance was taken from institutional ethical committee.

Results
Age distribution of cases, 25 (42%) were within 4 years, 22 (36%) were between 4 to 8 years, 13 (22%) were between 9 to 17 years of age. (Table 1)

**Table 1:** Distribution of study population according to age

| Age (years) | Number | Percentage |
|-------------|--------|------------|
| 1-4         | 25     | 42         |
| 5-9         | 22     | 36         |
| 10-17       | 13     | 22         |
| Total       | 60     | 100        |

Among admitted patients proportion was found to be higher in male children, 80% (48) and 20% (12) of children were female.

![Sex distribution of children](image1)

**Figure 1:** Sex distribution of children (n= 60)

Completely immunized were 37(55%), partially immunized 15(25%), and 8(12%) were not given immunization. (Figure 2)

![Distribution of immunization status of the children](image2)

**Figure 2:** Distribution of immunization status of the study population (n=60)
Nutritional status (according to WHO classification), 33(55%) cases were severely malnourished, 19(32%) were moderately and 8(12%) were mildly malnourished (Figure 3).

![Nutritional status of the studied children](image)

**Figure 3:** Nutritional status among the studied children (n=60)

Clinical presentation, all of the studies children (100%) had history of fever and cough was present in 55 (91.6%), cough in 27 (90%), followed by respiratory distress in 53 (88.3%), chest pain in 23 (38.3%), history of weight loss in 18 (30%) and contact with TB patient in last 1 year 09 (15%) cases (Table 2).

**Table 2:** Clinical presentation of studied children

| Presenting features          | Case | Percentage |
|------------------------------|------|------------|
| Fever                        | 60   | 100        |
| Cough                        | 55   | 91.6       |
| Respiratory distress         | 53   | 88.3       |
| Chest pain                   | 23   | 38.3       |
| History of weight loss       | 18   | 30         |
| Contact with TB patient in last 1 year | 09 | 15 |

Regarding physical signs, all 60 (100%) children had both dullness on percussion diminished breath sound with ot without reduced vocal resonance, followed by 50 (83.3%) children with chest recession, 49 (81.66%) children with mediastinal shifting and diminished chest movement on 45 (75%) children (Table 3).

**Table 3:** Physical signs of studied children (n=60)

| Clinical signs          | Number | Percentage |
|-------------------------|--------|------------|
| Diminished chest movement | 45     | 75         |
| Chest recession         | 50     | 83.3       |
| Mediastinal shifting    | 49     | 81.6       |
| Dullness on percussion  | 60     | 100        |
| Diminished breath sound ± vocal resonance | 60 | 100 |

Among the study population, 31 (51.7%) had left sided pleural effusion followed by right sided pleural effusion in 25 (41.7%) and 4 (6.6%) children had bi-lateral pleural effusion (Table 4).

**Table 4:** Site of pleural effusion among study population (n=60)

| Involvement | Case | Percentage |
|-------------|------|------------|
| Left        | 31   | 51.7       |
| Right       | 25   | 41.7       |
| Bi-lateral  | 04   | 6.6        |

Out of 60 patients of pleural effusion, empyema 24 (40%), tubercular 18 (30%), para-pneumonic 16 (26.7%) and malignancy 2(3.3%) (Figure 4).
Pleural fluid was exudative in origin in 58 (96.7%) and transudative in 2 (3.3%) patients.

| Diagnosis       | Pleural fluid protein/ Serum protein | Pleural fluid LDH/ Serum LDH | Pleural fluid ADA (IU/L) |
|-----------------|-------------------------------------|-----------------------------|--------------------------|
|                 | <0.5      | >0.5 | <0.6 | >0.6 | <50 | >50 |
| Empyema         | 24        |      | 24   |      | 18  | 06  |
| Tubercular      | 18        |      | 18   |      | 18  |      |
| Para-pneumonic  | 16        |      | 16   |      | 12  | 04  |
| Malignancy      | 2         |      | 2    |      | 2   |      |

Figure 4: Etiologies of pleural effusion of the study population (n=60)

Figure 5: Distribution of nature of pleural effusions among studied children (n=60)

Table 5: Comparison of biochemical parameters in different types of pleural effusions
Exudates were observed in majority of cases (96.7%), it was (100%) in empyema, tubercular and parapneumonic effusion. Pleural fluid protein / serum protein ratio was >0.5 in 96.7% of all patients, it was 100% in empyema, tubercular effusion and parapneumonic effusion whereas, it was <0.5 in 3.3% of malignancy patients.
Pleural fluid LDH /Serum LDH ratio was >0.6 in 96.7% of patients and 100% in empyema, tubercular effusion and para-pneumonic effusion. Thus, in all of the patients Lights criteria for exudates were satisfied. Both the sensitivity and specificity of pleural fluid/serum protein ratio and pleural fluid / serum LDH were 100% as shown in Table 5.

In 46.67% of patients pleural fluid ADA was >50 I.U. majority of patients in this category was of tuberculosis (64.2%). The sensitivity, specificity, positive predictive value and negative predictive value of ADA (>50 I.U.) in tuberculosis were 100%, 76.19%, 64.29% and 100% respectively (Table 5)

A total of 18 patients of tubercular pleural effusion, gastric lavage for AFB was positive in 4 patients. Monteuex test was positive (>10mm) in 9 patients of tubercular effusion. B.C.G. was not administered in 8 patients of tubercular effusion. Pleural fluid culture was positive in none of the 60 patients. The only organism isolated was Pneumococcus, performed via immunochromatography in 18 (30%) patients.

Discussion
Pediatric pleural effusion is most commonly seen in males and younger children15. Male patients were more than females and most common age group in this study was also 1 to 4 years (32%) followed by 5 to 9 years (22%) whereas in Maulik study 32% patients were in 6 to 10 years and in Hasan et al 50% of patients were within 4 years10,16. In this study male cases were more, probably due to greater attention to the male children. Males were (80%) and females (20%). Male predominance was also seen in Hasan et al, Maulik and Memon et al study10,16,17 .

On comparing different types of pleural effusion in this study empyema (40%) was more common than tubercular pleural effusion (30%) and para-pneumonic effusion (26.7%). But Maulik study found parapneumonic effusion to more common 38.23% was more common than tubercular pleural effusion (23.50%), a similar finding as in Maher et al study10,16,18 . Yilmaz et al and Hasan et al showed that the malnutrition was a common association with effusion in children16,19. In our study 56% of the cases were found to be severely malnourished whereas Hasan et al found 40% of the cases severely malnourished16. In this study fever, cough and respiratory distress were predominant presenting features. Restricted chest movement, subcostal recession, dullness on percussion and diminished breath sound were common physical findings. Presenting features were similar to findings in Hasan et al and to another study done in Ethiopia16,20.

Barnes study found that 96% of the cases were diagnosed by ultrasonography though in this study, X-ray chest and thoracentesis were the main diagnostic tools for the diagnosis21. We also did CT scan of chest in some cases with diagnostic dilemma.

All of the patients satisfied Lights criteria for transudate and exudates in this study. Family history of tuberculosis was positive in 50% of patients of tubercular effusion as in Merino et al study (25.7%), whereas it was 55.5% in Boloursaz et al, 46% in Chiu study, 25% in Maulik study and 68% of patients in Siddiqui et al10,22-24.

Sensitivity and specificity of various parameters (ratios) were tested to differentiate between transudate and exudates it was found that ratios of Pleural fluid and serum protein, and pleural fluid and serum LDH were all 100% sensitive and 100% specific. Gastric lavage for AFB was positive in 22.2%. Pleural fluid yield for bacterial culture was 100% negative growth whereas in Maulik study it was 11.76% and Narayanaappa et al found it to be 40%10,25. But organism isolated via immunochromatography was Pneumococcus
30% of the cases. None of the studies used the method of pleural fluid immunochromatography.

**Conclusion**

Pleural effusion was most common in younger age. Empyema was most common cause among all types of effusion. Fever, cough, respiratory distress and chest pain were the common presentations. Physical findings of effusion were present in all cases. Left sided pleural effusion was more than the right sided. Majority of effusion were exudative in origin than transudates and all of them satisfied light’s criteria. Causative microorganism were identified in 30% overall, with S. pneumoniae. A changing profile of the causative agents showed the relative frequency of S. aureus and H. influenza to be decreased, whereas pneumococci were more frequent in recent time.

**Declarations**

**Ethical consideration**

This study was approved by the ethical committee of the DSH. Moreover, the researchers were duly concerned about the ethical issues and the ethical issues were maintained in according to the current Declaration of Helsinki.

**Consent of Publication:** Not applicable

**Availability of data and material:** Data and materials supporting study findings in the manuscript will not be shared. It was not in accordance with participants’ written informed consent. However, it can be shared with the reviewer team on request.

**Conflict of Interests:** The authors declare that there is no conflict of interests regarding the publication of this paper.

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**Reference**

1. Dev D, BasranGs Pleural effusion: A clinical review, Monalde. Ach Chest Dis 1994; 49: 25-35.
2. Efrati O, Barak A. Pleural effusions in the pediatric population. Pediatr Rev.2002; 23:417-425.
3. Paramothayan NS, Barron J. New criteria for the differentiation between transudates and exudates. J ClinPathol. 2002;55:69-71.
4. Light RW, Mac Greger MI, Luchsinger PC, Ball BC. Pleural effusions: the diagnostic separation of transudates and exudates. Ann Intern Med. 1972;77(4): 507-513.
5. Givan DC, Eigen H. Common pleural effusions in children. Clin Chest Med 1998; 19: 363-371.
6. Alkrinawi S, Chernick V. Pleural infection in children. Semin Respir Infect 1996; 11: 148-154.
7. Chonmaitree T, Powell KR. Parapneumonic pleural effusion and empyema in children. Review of a 19-year experience, 1962-1980. ClinPediart 1983; 22: 414-419.
8. Lewis KT, Bukstein DA. Parapneumonic empyema in children: diagnosis and management. Am Fam Physician 1992; 46: 1443-1455.
9. Mocelin HT, Fischer GB. Epidemiology, presentation and treatment of pleural effusion. Pediatr Resp Rev 2002; 3: 292-297.
10. Maulik P. Saliya, Gurudutt S. Joshi. Profile of children with pleural effusion in...
an urban tertiary care hospital. *International Journal of Contemporary Pediatrics* 2017;5: 1857-1860.

11. Moreira GDO, Ribeiro JD, Tresoldi ATZ. Utility of a scoring system & indicative variables of assessing the neck for pleural drainage in pediatrics patients with parapneumonic pleural effusion. *Journal Brasileiro de Pneumologia*. 2005; 31: 205-211.

12. Saglari S, Harries KA. Empyema: The use of broad range 16S rDNA PCR for pathogen detection. *Chest* 2004; 155: 26-30.

13. Freij BJ, Kusmiesz H, Nelson JD parapneumonic effusion and empyema in hospitalized children; a retrospective review. *AJR* 1984; 3: 578-591.

14. Hendren WH. Haggery RJ. Staphylococcal pneumonia in infancy and childhood. *JAMA* 1958; 168:6-16.

15. Afshar-Parimama S, Izadi M, Azudani R. Pleural effusion in children: A review article and literature review. *Int J Med Rev* 2016;3(1):365-370.

16. Hasan M, Islam R, Matin A, Khan R, Rahman M, Karim A. Clinical profile of children with pleural effusion admitted in a tertiary care hospital of Bangladesh. *J Shaheed Suhrawardy Med Coll*. 2012; 4(1):7-9.

17. Memon AB, Sheikh SJ. The etiology of pleural effusion, Hyderabad experience. *Pak J Med Sci*. 2007;23(1):86-87

18. Maher MH, Farshi MR, Bilan N, Binazar MJ, Dereshki AT, Babak A. Evolution and outcomes of Pediatric pleural effusions in over 10 years in northwest Iran. *Int J Pediatr*. 2014;2(3.2):41-6.

19. Yilmaz E, Dagon Y, Aydinoglu AH, et al. Parapneumonic empyema in children: Conservative approach. *Turk J Pediatr* 2002; 44:138-8.

20. Hailu S. Pediatric thoracic empyema in an Ethiopian referral hospital. *East Afr Med J* 2000; 77: 618-621.

21. Barnes NP, Hull J, Thomson AH. Medical management of parapneumonic pleural disease. *Pediatric Pulmonology* 2005;39: 127-136.

22. Boloursaz M, Khalilzadeh S, Abbaszadeh M, Velayati A. Tuberculous pleural effusion in children. *Iran J Pediatr Soc*. 2010;2(1):15-19.

23. Chiyu CY, Wu JH, Wong KS. Clinical spectrum of tuberculous pleural effusion in children. *Pediatr Int*. 2007;49:359-62.

24. Siddiqi EU, Uddin S, Naz F. The importance of contact history in childhood tuberculosis. *Pak J Pharmacol*. 2006; 23(2):25-29.

25. Narayanaapa D, Rashmi N, Prasad NA, Anil K. Clinico-bacteriological profile and outcome of empyema. *Indian Pediatr*. 2013;50(8):783-785.