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Original Research Article

Clinical profile and underlying causes of recurrent pneumonia in children: a hospital based study

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ABSTRACT

Background: Recurrent pneumonia (RP) remains a challenge for the pediatrician. There are limited data on RP specially in developing countries. Identification of underlying cause of RP is crucial for managing the patients.
Methods: This retrospective study was conducted in pediatric pulmonology ward of Bangladesh medical university from January 2023 to December 2024 to observe the clinical profile and to recognize the underlying causes of RP in children. Total 65 undiagnosed cases of RP children aged 1 month to 18 years were enrolled in this study.
Results: Out of the 253 children with pneumonia around 26% had experienced recurrent episodes. Most of the patients presented before the age of 6 months. Cough was present in 65 (100%), fever in 60 (92.3%), followed by breathing difficulty in 50 (76.9%). Tachypnea was observed in 39 (60%), crackles in 43(65.07%) and wheezing in 13 (17.4%) cases. A considerable number, 85.7% belonged to low socioeconomic class. Leukocytosis (55%) and raised ESR (64.6%) were the most common lab findings. Bronchopneumonia (40%) was the common findings in chest x-ray and in CT scan consolidation (39.02%) followed by interstitial pneumonitis (29.2%) were the predominant findings. Underlying causes were detected in 92% cases, of which most predominant causes were cystic fibrosis (35.3%) followed by congenital heart disease (CHD) (16.9%) and congenital airway disease (12.3%).
Conclusions: Cystic fibrosis was the predominant underlying cause followed by CHD and congenital airway abnormality. Children of RP should be carefully evaluated for cystic fibrosis and CHD.

Keywords: Children, Recurrent pneumonia, Clinical profile, Underlying causes

INTRODUCTION

Pneumonia is one of the major causes of death especially under the age of 5 years. According to WHO, in 2019 pneumonia killed 740180 children under the age of 5 which accounts for 14% of deaths.[1] In Bangladesh yearly 26,766 children of under 5 deaths occurred due to pneumonia which accounts 24% of total death.[2] RP is defined as the occurrence of at least two episodes of pneumonia in a single year and three episodes ever, with radiological clearance between episodes.[3] Only a small proportion of children with community acquired pneumonia suffer from RP accounting for 7.7-9%. Early childhood pulmonary infection can trigger inflammation, causing activation of CD4+ T cells, macrophages and increase IL-8 expression, which ultimately results in damage to the ciliary epithelium and infiltration of the surrounding parenchyma.[4] As a result, RP in children has detrimental impact on the structure and function of the lungs and increases the risk of chronic lung diseases and other respiratory diseases.[5] Common causes due to this infection are congenital malformations of upper and lower airway and cardiovascular system, recurrent aspirations, defects in clearance of airway secretions particularly cystic fibrosis, ciliary dyskinesia, or immunodeficiency disorder. Information about the

underlying predisposing causes of RP in children is scarce. Surprisingly, a limited number of primary studies are available regarding this infection in children in the developing world.[8-10] The purpose of this study is to describe the clinical profile and to identify the underlying causes of RP in children in a tertiary care hospital of Bangladesh.

METHODS

This retrospective study included 65 undiagnosed cases of recurrent pneumonia as defined by the RP criteria, who were hospitalized in pediatric pulmonology ward between January 2023 and December 2024. Children aged 1 month to 18 years who were admitted with recurrent episodes of pneumonia with radiological evidence and whose underlying causes were unknown, were included in this study. Children whose underlying causes were known (CHD, neurological disabilities, cystic fibrosis, immunodeficiency disorder) were excluded from the study. The diagnosis of pneumonia was established based on cough, chest indrawing and/or difficult breathing, tachypnea was defined RR≥60 for less than 2 months old; ≥50 for 2 months<12 months old; ≥40 for children 12-60 months old; ≥30 in children older than 60 months. Recurrent pneumonia was defined as two episodes of pneumonia in 1 year or 3 episodes in any timeframe with radiological clearance in between episodes.

Data were collected from medical record files by standardized data extraction form regarding patient demographic characteristics, including age, gender, age of onset of symptoms, number of hospitalizations, immunization status, contact with known case of tuberculosis, history of foreign body aspiration, weight on admission, clinical and radiologic findings, investigations for suspected underlying diseases. The study was done after taking approval from the appropriate ethical committee.

Complete blood count and plain chest X ray were done as a primary tool in all cases. HRCT was done in selected cases. For confirmation of cystic fibrosis in suspected cases we did sweat chloride test and sometimes genetic analysis. To see the immune status serum immunoglobulin profile, flow cytometry and HIV antibody assay were done in suspected Primary and acquired immunodeficiency disorders. Color doppler Echocardiography to exclude CHD. To exclude tuberculosis Mantoux test, sputum gene Xpert, stool for Xpert ultra were done. Pulmonary function test was done to exclude asthma when permissible. Fiber optic laryngoscopy to see the airway anomaly.

Statistical analysis

Data were analysed using SPSS version 25. 0, to express categorical variables percentage and numbers were employed and numerical variables were presented as mean and standard deviation (SD).

RESULTS

Among 253 pneumonic patient recurrent pneumonia was diagnosed in 65 children in this study period. Most of the children were below 1 year (40%). Around 2/3rd (43) cases were male and 1/3rd (22) were female. Most (86.1%) of the patients belonged to lower socioeconomic classes. The 29 (46.6%) cases had experienced 2 times hospitalization, 19 (29.2%) had 3 times hospital admission, 17 (26.9%) also required >3 times. Mean age of presentation was 23±20 months. Twenty-two (33.3%) presented before 6 months of age. The 14 (21.5%) presented between 6-12 months and after 12 months 29 (46.1%) patient developed sign/symptoms (Table 1).

All patients (100%) were presented with cough. Fever was present in maximum cases 60 (92.3%). Other presentations were breathing difficulty, weight loss/ failure to gain weight, wheezing and feeding problem in 50 (76.9%), 28 (43%), 13 (17.4%), 5 (6.3%) respectively. On clinical examination, 39 (60%) of the patient had fast breathing, crackles and wheezing were detected in 43 (65.07%), and 13 (17.4%) cases respectively (Table 2).

Echocardiography detected CHD in 11 cases. Among them ASD was most common (7.9%), followed by PFO, PDA, VSD, and other CHD in 3 (4.6%), 2 (3.1%), 1 (1.5%), 3 (4.6%) respectively (Table 3).

Among lab parameters, Anemia was present in 16 (27.6%) cases. ESR was raised in 42 (64.5%) cases. Leukocytosis present in 35 (55.5%) cases and leucopenia found in 2 (3.07%) cases.

Sweat chloride test was positive in 23 (35.3%) cases. CMV infection detected in 6 (9.3%) cases, among them CMV DNA was detected in 4 (6.1%) cases.

Fibro optic laryngoscopy done in 3 cases and laryngomalacia was detected in one case. Bronchoscopy was required in two suspected cases of FB and tamarind seeds were found inside.

The chest radiograph showed evidence of pneumonia in all cases. Most of the cases had patchy opacity in chest X ray 26 (40%). Lobar pneumonia was present in 20 (30.7%) cases. Other radiological findings were interstitial pneumonia, collapse, bronchiectasis, hyperinflation, congenital anomaly in 6 (9.23%), 5 (7.6%), 5 (7.6%), 2 (3.17%), 3 (4.6%) respectively.

HRCT was done 41 cases. Abnormalities detected were consolidation, interstitial pneumonitis, bronchiectasis, collapse, congenital anomaly in 16 (39.02%), 12 (29.2%), 9 (21.9%), 6 (14.6%), 2 (4.8%) respectively (Table 3).

Among study cases, most common cause of recurrent pneumonia is cystic fibrosis having 23 (35.3%) cases followed by CHD 11 (16.9%). Recurrent wheezing, CMV pneumonitis, immunodeficiency, congenital airway

disease, FB aspiration comprises 8 (12.3%). Six (9.3%), 5 (7.69%), 4 (6.1%), 2 (3.07%) and 2 (3.17%) respectively. Others undiagnosed cases are around 9.23%. Among the congenital airway disease, we have found single case of tracheo-esophageal fistula, congenital diaphragmatic hernia, congenital bulla, and 2 cases of laryngomalacia.

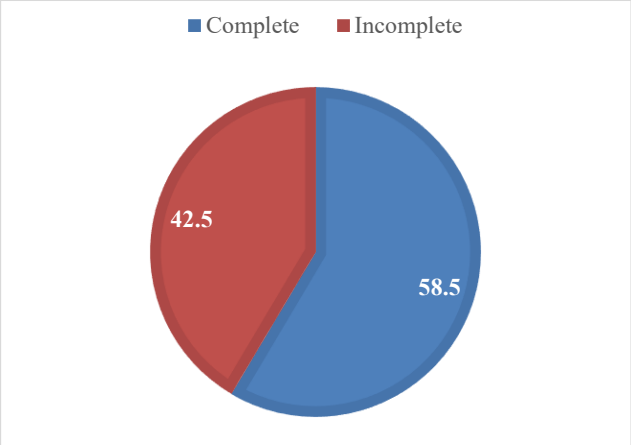

Figure 1: Distribution of study cases according to immunization status.

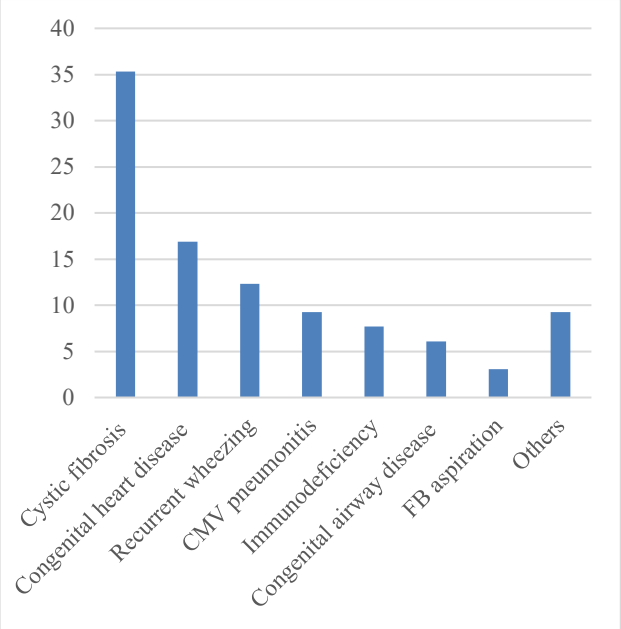

Figure 2: Underlying causes of recurrent pneumonia in study cases (%).

Table 1: Demographic characteristics (n=65).

Variables		N	Percentage (%)
Age (in years)	<1	26	40
	1-5	20	30.76
	>5	19	29.23
Gender	Male	43	66.6
	Female	22	33.3
Socio economic status	Low	56	86.1
	Middle	4	6.3
	High	5	7.6
No. of hospitalization	2 times	29	44.6
	3 times	19	29.2
	>3 times	17	26.9
Age of onset (in months)	<6	22	33.3
	6-12	14	21.5
	>12	29	46.1

Table 2: Clinical characteristics and lab findings of study cases (n=65).

Variables		N	Percentage (%)
Clinical features	Fever	60	92.3
	Cough	65	100
	Weight loss/failure to gain weight	28	43
	Breathing difficulty	50	76.9
	Tachypnea	39	60
	Breath sound		
	Crackles	43	65.07
	Wheezing	13	17.4
	Murmur	8	11.1
	History of consanguinity	8	12.6
	History of contact with TB patient	3	4.7
	History of foreign body aspiration	2	3.2
	History of sib death	3	4.7

Continued.

Variables		N	Percentage (%)
	Feeding problem	5	6.3
Echocardiographic findings	ASD	5	7.9
	VSD	1	1.5
	PFO	3	4.6
	PDA	2	3.1
	Others	3	4.7
Lab findings	CBC		
	Anaemia	18	25.3
	Leukopenia	2	3.07
	Leukocytosis	35	55.5
	Raised ESR	42	64.6
	MT	4	6.3
	Sweat chloride test (+ve)	23	35.3
	CMV IgM	6	9.3
	CMV IgG	20	30.7
	CMV DNA	4	6.1
	PID panel	5	7.9
	Immunoglobulin profile abnormality	1	1.5
FOL (3)	Normal	2	
	Laryngomalacia	1	1.5
Bronchoscopy		Tamarind seed found in 2 cases	

Table 3: Radiographic finding among study cases (n=65).

Findings		N	Percentage (%)
Chest x-ray	Lobar pneumonia (consolidation)	20	30.7
	Bronchopneumonia (patchy opacity)	26	40
	Interstitial pneumonia	6	9.23
	Collapse	5	7.6
	Bronchiectasis	5	7.6
	Hyperinflation	2	3.17
	Congenital anomaly	3	4.6
HRCT (41)	Normal	3	7.3
	Consolidation	16	39.02
	Collapse	6	14.6
	Bronchiectasis	9	21.9
	Interstitial pneumonitis	12	29.2
	Congenital anomaly	2	4.8

DISCUSSION

This retrospective study was conducted in paediatric pulmonology division of BMU from January 2023 to December 2024.

This study focused on clinical profile and identification of underlying cause of recurrent pneumonia which is one of the significant causes of referral to higher center. In this study, around 26% of pneumonic children had recurrent attack similar to the study carried out by Mohammad et al which showed 21%.[11] This high rate is due to the fact that our hospital is a referral hospital.

Mean age at presentation of recurrent pneumonia was 23±20 months similar to the study conducted by Sen et al.[12] The probable cause behind this is due to genetic origin of the diseases and we found the CF was the most common underlying cause (35.3%).

History of consanguinity was found in 12.6% cases which can also be explained the genetic origin of the disease.

The most common symptom was cough (100%) similar to Hossain et al present in all patients, followed by fever (92.3%), breathing difficulty (76.9%), tachypnea (60%) weight loss or failure to gain weight (43%). These findings are similar to other previous studies by Sen et al and by Hossain et al crackles were the most observed finding in 65.07% of cases, then wheezes (17.4%).[12,13] Abnormal heart sounds were found in 11.1% which is comparable with Abdou and Ahmed et al who found

crackles in 86%, wheeze 60% and abnormal heart sound in 13% cases.[14] The presence of crackles indicates significant pulmonary involvement.

Regarding immunization, most of the patients 38 (58.5%) received routine immunization under expanded program of immunization schedule, but 27 (41.5%) patients had incomplete immunization which is lower than the study carried out by Sen et al.[12] This incomplete immunization was possibly due to recurrent episodes of pneumonia which required frequent hospitalization.

In this current study we found cystic fibrosis (35.3%) is the predominant underlying disease most of which were confirmed by positive sweat chloride test and only 3 cases by genetic analysis of cystic fibrosis which is little higher than the study by Sen et al though prevalence of CF is low in our country.[12] The reason behind this is due to the availability of diagnostic procedure as well as most of the cases were referred here from different hospitals.

Amany and Mahitab found CHD in 12.5% cases and according to Bolusaz et al.[11,15] CHD was detected in 20.17% cases similar to our study where we found it is the second most common cause of recurrent pneumonia (16.9 %). All of the CHD had left to right shunt with increased pulmonary blood flow which increases the susceptibility of respiratory tract infection.

Recurrent wheezing was another important cause of RP (30.64%) by Ozdemir et al which is a little bit higher (12.3%) from the current study (22%).[9]

Aspiration syndrome is one of the common causes of RP reported by most of the studies.[8,16-18] Despite of being exclusion of cerebral palsy from our study 3 patients had aspiration pneumonia, 2 patients with FB aspiration whom bronchoscopic extraction of FB was done and 2 patients with GERD which is very low in comparison to other studies. We found a single case of tracheoesophageal fistula confirmed by history and barium study align with the study conducted by Sen et al.[12] We found 5 patients with laryngomalacia of which 2 patients had concomitant Down syndrome who experienced recurrent episodes of pneumonia.

Owayed et al found immune disorder in 10% cases and Sen et al found in 8% cases similar to our study. We found primary immunodeficiency in 5 (7.9%) among which 2 have concomitant CF and 1 have ASD.[12,19]

Though CMV infection is a rare cause of recurrent pneumonia in children, we found CMV pneumonitis in 9.3% cases. Djatnika et al reported a series of cases of CMV pneumonitis presented with recurrent chest infection.[20]

Most of the patients had leukocytosis (55.5%) with raised ESR (64.6%) similar to the study by Barakat et al These findings indicate the bacterial etiology of pneumonia.[15]

Regarding radiologic findings, in chest Xray we found bronchopneumonia in 40% followed by lobar consolidation, interstitial pneumonia and bronchiectasis in 30.7%, 9.25% and 5% cases respectively and these findings are consistent with the findings reported by Barakat et al.[15] According to HRCT consolidation (39.02%) was observed in most of the cases followed by interstitial pneumonitis (29.2%), bronchiectasis (21.9%) and collapse (14.6%) which are quite similar to findings stated by Sen et al.[12] Bronchiectatic change was found in 9 cases among which CF was found predominant cause in 6 patients, FB was found in 2 patients.

The etiology was undetermined in 15.7% cases despite of careful history and thorough investigations. This agreed with Capanoglu et al who reported that 16.3% and Saad et al also mentioned that 10-20% of studied cases the causes of RP could not be identified.[16,21]

The difference of findings between the current study with the previous studies can be explained by differences in inclusion criteria, availability of diagnostic workup and limited healthcare awareness.

The limitations of the study include its retrospective nature, single center study which may not reflect the exact picture of the whole country. Investigations were done selectively for the individual patient which is an important cause of undiagnosed cases.

CONCLUSION

The current study highlights the clinical profile and underlying causes of RP in children. Around 26% of admitted children with pneumonia have recurrent episodes and children <1 year are suffering more frequently. The most common underlying causes of RP were cystic fibrosis, CHD, recurrent wheezing, CMV pneumonitis, immunodeficiency, congenital airway disease and aspiration syndrome. This study will help our country's pediatrician to identify the causes of RP thereby right action can be taken within the earliest possible time.

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Ethical approval: The study was approved by the Institutional Ethics Committee

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