

CAUSES OF RECURRENT PNEUMONIA AMONG CHILDREN

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ABSTRACT

Background: Respiratory tract infections remain the commonest cause of pediatric morbidity and mortality particularly in developing countries. A subgroup of these children has recurrent pneumonia which may be the presentation of an underlying more serious systemic or local pathology. **Objective:** To determine the frequency of underlying causes of recurrent pneumonia, among pediatric patients. **Patients and Methods:** This descriptive study was conducted in the department of Pediatrics, Sheikh Zayed Hospital/ Medical College, Rahim Yar Khan, from 1st January, 2011 to 31st December, 2011. All the patients presented to the department and diagnosed as recurrent pneumonia were included in the study. **Results:** During the study period of one year, recurrent pneumonia was diagnosed in 292 patients. An underlying illness could be identified in 282 (97%) while in 10 (3%) cases the underlying cause could not be diagnosed. Underlying illnesses included neurodevelopmental disability in 183 (63%) cases, recurrent bronchiolitis with aspiration pneumonia 30 (10%), congenital heart disease 23 (8%), bronchiectasis 07 (2.3%), bronchial asthma 07 (2.3%), anomalies of the respiratory system 05 (1.7%), cleft palate 05 (1.7%), gastroesophageal reflux disease 04 (1.3%), down syndrome without CHD 04 (1.3%), severe malnutrition 03(1%), ciliary dyskinesia 03(1%), foreign body 02 (0.6%), thalassemia 02 (0.6%) and nutritional rickets 02 (0.6%). **Conclusion:** Recurrent pneumonia is relatively common in our country as are recurrent respiratory tract infections. Common underlying illnesses included neurodevelopmental disability, recurrent bronchiolitis with aspiration pneumonia, congenital heart disease, down syndrome, bronchiectasis, bronchial asthma, anomalies of the respiratory system and cleft palate.

Key Words: Recurrent pneumonia, Neurodevelopmental disability, Congenital heart defects, Aspiration pneumonia, Children

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INTRODUCTION

For the last many decades, respiratory tract infections remain the leading cause of morbidity and mortality in children, especially under the age of 5 years.¹ On an average, a child is likely to have 6 to 10 respiratory tract infections per year.^{1,2} Mostly these are benign and self limiting infections; however, some times the child may be having potentially life threatening infections like epiglottitis, bacterial tracheitis, bronchiolitis and pneumonia. Among these, pneumonia is the commonest infection and is the major killer of under five children globally. Though even a single episode of pneumonia can prove fatal, however, it may occur repeatedly in some children creating difficult diagnostic and therapeutic challenge for the clinician.³

There are multiple causes and risk factors responsible for recurrence of pneumonia. Many of these are benign and simply managed such as

recurrent viral respiratory infections or bronchial asthma, however, in other cases there may be more serious underlying pathology such as neurodevelopmental disability, congenital heart defects, bronchiectasis, cystic fibrosis, immunodeficiency disorders and congenital structural anomalies of the respiratory tract etc. Henceforth, early and accurate diagnosis becomes an essentiality to distinguish the relatively benign from the more serious underlying cause, for optimal management and thus to minimize the risk of progressive or irreversible lung disease.⁴

There are certain general risk factors which predispose a child to have recurrent respiratory tract infections. Lower respiratory tract infections are more common in boys than girls for reasons that are not clearly understood.⁵ The peak incidence is at 6-12 months of age while a 2nd peak occurs when the child first mixes with large numbers of children at nursery or school; similarly, acute bronchiolitis occurs almost exclusively in the first 2 years of life and two-thirds of childhood deaths due to respiratory infections also occur in infancy.⁶ Infants born prematurely, and particularly those who develop chronic lung disease of prematurity after ventilation, frequently require hospital admission for respiratory infections in infancy and early years of life.^{6,7} The

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immunoprotective effect of breast feeding, the only natural way of infant feeding, against the occurrence of respiratory infections is a reality that has been well-known for the last many decades.⁷ The incidence of respiratory tract infections is more in industrialized than non-industrialized countries.⁸ Large family size and parental smoking increases the risk of all respiratory illnesses particularly lower respiratory tract infections. Both maternal smoking during pregnancy and postnatal passive exposure predispose the children of smokers to have recurrent respiratory infections.^{8,9} In few children with recurrent chest infections there may be a defect in the complex system of defence which normally protects the lungs from any hostile microbiological environment and collectively serve to prevent the entry or to remove foreign material from the lungs. These include physical defences such as coughing, sneezing and mucociliary clearance, resident cellular defences such as pulmonary macrophages, and a range of local humoral or secretory mechanisms e.g. Lysozyme and lactoferrin¹⁰⁻¹³ More specifically, in a country like Pakistan, the higher prevalence of macronutrient and micronutrient deficiencies, such as iron, vitamin A and D, zinc and many others, which in one or the other way, are ultimately linked with body defence against infections, may be one of the important reasons for higher occurrence of recurrent pneumonia. In fact, several of these deficiencies may co-exist and may interact with each other in the causation of recurrent infections.^{14,15} Amazingly, in spite of being a relatively common problem, there are very few studies on recurrent pneumonia, available in medical literature. Local data on this subject is even more limited. The objective of this study was to determine the relative frequency of various causes of recurrent pneumonia in a tertiary care hospital of southern Punjab.

PATIENTS & METHODS

This descriptive study was conducted in the department of Pediatrics, Sheikh Zayed Hospital/ Medical College, Rahim Yar Khan from 1st January, 2011 to 31st December, 2011.

All the patients presented to the department and diagnosed as recurrent pneumonia were included in the study. Written consent was taken from the parents and the topic was approved by the

institutional ethical committee. Recurrent pneumonia was defined as 2 episode of radiologically confirmed pneumonia within the same year, or 03 or more episodes over any time period with complete clinical and radiological resolution in between acute episodes.³

Aspiration pneumonia was diagnosed clinically by the presence of history of coughing, choking, gagging, apnea, becoming dyspnoeic / tachypnoeic / cyanotic during feeding and restlessness after feeding, while feeding was also observed.¹⁶ The presence of excessive drooling or pooling of secretions in oral cavity was also considered as a risk factor for aspiration. Radiologically recurrent aspiration pneumonia was diagnosed by the involvement of both lungs in all cases, presence of hyperinflation of both lung fields along with wide spread, particularly perihilar infiltrates and consolidation / collapse, mainly of right upper/ middle lobes. In all cases of suspected recurrent pneumonia detailed history especially regarding complaints of respiratory and cardiovascular system (fever, cough, excessive sweating, dyspnoea, tachypnoea and wheezing etc), birth history, feeding history, developmental history and family history was taken. Meticulous clinical examination including detailed examination of the oral cavity, respiratory, cardiovascular and central nervous system was carried out. Developmental and CNS examination was also repeated after recovery from pneumonia. Though in older children there was delay in gross motor milestones but in infants extensor spasm of neck & trunk muscles, demonstrated by both ventral and dorsal suspension, was the most sensitive sign for the diagnosis of cerebral palsy.

Investigations carried on all patients were CBC and X-Ray chest while blood C/S, serum biochemistry/electrolytes, ABGs, ECG, echocardiography, barium swallow, pulmonary function test, laryngoscopy, bronchoscopy, quantitative serum immunoglobulins (IgG, IgA and IgM) and CT scan chest/brain were carried out in selective cases. The data was entered and analyzed in SPSS version 15.

RESULTS

During the study period of one year, 14805 patients were admitted in Pediatric unit. Of these, 4442 (30%) were neonatal and 10363 (70%) were post-neonatal admissions. Recurrent pneumonia was diagnosed in 292 patients which accounted for 1.97% and 2.81%

of the total and post-neonatal admissions respectively. Of these 176 (60.27%) were males and 116 (39.73%) were females. An underlying illness could be identified in 282 (97%) while in 10(3%) cases the underlying cause could not be diagnosed. (Table-I). Almost in all cases of neurodevelopmental disability, on radiography, there was involvement of more than one lung lobe. Among the children with recurrent pneumonia having underlying neurodevelopmental disability, majority (92%) having cerebral palsy (Table II) whereas, 65% of patients were below one year of age, 26% were 1-5 years of age and 9% were above 5 years.

Among the patients with underlying cause congenital heart defects, 9 out of 23 were having ventricular septal defects (Table III). Among the patients with underlying anomalies of respiratory & gastrointestinal system, 5 out of 10 had cleft palate, 2 had laryngomalacia/tracheomalacia and one had tracheoesophageal fistulas, congenital cystic adenomatoid malformation and pulmonary sequestration each.

Table I: Frequency of underlying causes of recurrent pneumonias. (N = 292)

Cases	No. (%)
Neurodevelopmental disability	183 (63%)
Recurrent bronchiolitis with aspiration pneumonia	30 (10%)
Congenital heart disease	23 (8%)
Bronchiectasis	07 (2.3%)
Bronchial asthma	07 (2.3%)
Anomalies of the respiratory system	05 (1.7%)
Cleft palate	05 (1.7%)
Gastroesophageal reflux disease	04 (1.3%)
Down syndrome without CHD	04 (1.3%)
Severe malnutrition	03 (1%)
Ciliaillary dyskinesia	03 (1%)
Foreign body	02 (0.6%)
Thalassemia	02 (0.6%)
Nutritional rickets	02 (0.6%)
Immunodeficiency disorder	01 (0.3%)
Sickle cell anemia	01 (0.3%)
Undiagnosed	10 (3%)
Total	292

Table II: Number of cases of recurrent pneumonia with type of underlying neurodevelopmental disability. (n = 183)

Neurodevelopmental disability	No. (%)
Cerebral palsy	168 (92%)
Neurodegenerative brain disease	06 (3.2%)
Werdnig Hoffman disease	05 (2.7%)
Undiagnosed neuromuscular diseases	04 (2.1%)

Table III: Types of Congenital heart defects leading to recurrent pneumonia. (n = 23)

Ventricular Septal Defects	09
Patent Ductus Arterioses	02
Atrio Ventricular Septal Defects	04
Complex congenital heart defects	07
Atrial Septal Defects	01

DISCUSSION

The incidence for pneumonia in developing countries may go up to 10 per 100 children per year.¹⁷⁻

¹⁹ A sub group of these children has repeated episodes of pneumonia which often results from deficiencies in the local pulmonary / systemic host defenses or from underlying disorders that modify the lung defense.²⁰

In our study, neurodevelopmental disability was the commonest cause of recurrent pneumonia, present in 183(63%) patients. The mean age at diagnosis was 09 months. Abdullah F et al reported 114 (48%) cases³ while Rakesh L et al reported 10.5% cases in another study.²¹ The etiology of respiratory complications in children with neurodevelopmental disability is multi-factorial; in fact, several of these factors co-exist and may interact with each other to compromise the quality of life in these already handicapped children. These factors include recurrent aspiration, poorly functioning mucociliary accelerator, ineffective cough reflex, weak musculature, lack of exercise / physical activity, malnutrition and recurrent infections other than respiratory system to which these individuals are prone.^{22,23} Direct aspiration occurs directly from the oral cavity including feed / food materials (liquids & solids) and oral and upper respiratory secretions in to lower airways due to neuromuscular in-coordination and inadequate protective reflexes. In indirect aspiration the refluxate of gastroesophageal reflux is inhaled lower airways.

Recurrent bronchiolitis with recurrent aspiration leading to pneumonia accounted for 30(10%) cases with mean age of 06 months at diagnosis. Though not very well documented in literature, however, in our experience, tachypnea/dyspnea leading to aspiration of milk and other liquid feeds due to failure of “turn taking” between swallowing and breathing, necessitating hospital admission, is probably, the commonest complication of bronchiolitis. This may lead to secondary bacterial pneumonia. Recurrence

of bronchiolitis is common in some children in the first 2 years of life. The incidence of asthma seems to be higher for children hospitalized for bronchiolitis as infants, but it is still unclear whether this is casual or if children prone to asthma are more likely to be hospitalized with bronchiolitis.²⁴

Congenital heart defects were present in 23(8%) patients. Among these, 5 were cases of Down syndrome. The mean age at diagnosis was 13 months. Abdullah F et al reported 22(9.2%) cases in his study.³ Cardiac and pulmonary pathophysiologies are closely interdependent. Direct pulmonary complications of CHD are either by structural impact on the airways leading to atelectasis with secondary infection, abnormal pathophysiological mechanisms leading to increased lung fluid, aspiration of feeds due to tachypnea and malnutrition resulting from severity of the underlying conditions, anorexia, decreased intake, repeated CCFs and frequent infections.²⁵

Bronchiectasis was present in 7(2.3%) cases. Past history of measles and treatment of tuberculosis was present in 2 cases each while in 3 cases no predisposing factor could be identified. Bronchial asthma was present in 7(2.3%) patients. These were clinically diagnosed as having bronchial asthma due to the documented multiple episodes of reversible airway obstruction responsive to anti-asthma treatment. Pulmonary function tests also supported the diagnosis wherever applied. The other investigations were normal. The mean age at diagnosis was 4.5 years. Rakesh L et al in an Indian study reported 26% cases of bronchial asthma responsible for recurrent pneumonia, which is very high as compared to our study.²¹

Cleft palate 5 (1.7%) cases was the next common cause of recurrent pneumonia. Recurrent aspiration due to structural defects and impaired coordination is a very well known complication of cleft palate. In our study, the other two components of Pierre Robin syndrome, micrognathia and glossoptosis were also present in all cases. It is to be noted that in the presence of micrognathia and glossoptosis, the chances of aspiration are increased manifold.²⁶

Congenital anomalies of the respiratory system were present in 5(1.7%) patients. These were Laryngomalacia / tracheomalacia in 2 cases and

one case of tracheoesophageal fistulas, congenital cystic adenomatoid malformation and pulmonary sequestration each. Here the clinical clue to the diagnosis was early mean age at diagnosis (5 months) and recurrence of pneumonia at the same location. The number of cases was quite less as compared to the study conducted by Abdullah F, et al, who reported 18 cases of recurrent pneumonia due to congenital anomalies of the respiratory system.³ Gastroesophageal reflux disease was present in 4 (1.3%) cases with recurrent pneumonia. In these patients it is reported there was a notable association between feeding, subsequent vomiting leading to respiratory symptoms.²⁷ All these children were neurologically normal on history and clinical examination. The mean age at diagnosis was 7 months. Four (1.3%) cases of recurrent pneumonia had Down syndrome without CHD. The children with Down's syndrome are 12 times more likely to develop an infection compared with the general population, particularly, pneumonia.^{28,29} Primary ciliary dyskinesia accounted for 3(1%) cases with recurrent pneumonia. The diagnosis was essentially clinical on the basis of presence of situs inversus and recurrent infections of the respiratory tract. The mean age at diagnosis was 2 years. As the diagnostic tests of mucociliary clearance, such as the saccharin test and nasal nitric oxide test³⁰ are not available in our setup, we might have missed few cases of primary ciliary dyskinesia.

Severe malnutrition was present in 03(1%) cases. In these cases, all the other etiological investigations were unremarkable except the presence of severe malnutrition. In severe malnutrition the incidence of all types of infections is high in general and pneumonia in particular. In these children not only the pneumonia is more fatal but also its clinical diagnosis is difficult as WHO-recommended clinical signs are (age specific fast breathing and chest wall indrawing) less sensitive as predictors of radiographic pneumonia.^{14,15} The presence of foreign body in lungs was diagnosed in 2 (0.6%) cases of recurrent pneumonia. Though the history of foreign body inhalation was not present, however, the presence of recurrent pneumonia involving the same lobe of the right lung necessitated rigid bronchoscopy and foreign body was recovered from the right middle lobe of lung in both cases. 5% cases of recurrent pneumonia were due to the presence of foreign body in lungs in an Indian study.²¹ The mean

age at diagnosis was 13 months and is understandably quite right because toddlers are found of putting everything into mouth which sometimes may trickle down the airways. Two (0.6%) cases of recurrent pneumonia were having Thalassemia. In these cases, all the other investigations were unremarkable. Prospective studies in Thailand revealed that patients with thalassemia had more frequent episodes of both mild and severe infections.³¹ The presence of fluid overload in general and overloaded pulmonary circulation in particular due to chronic anemia may predispose a thalassemic child to have recurrent pneumonia.³²

Nutritional rickets was present in 2(0.6%) cases of recurrent pneumonia. Biochemical and radiological profile confirmed the diagnosis of rickets. In an Ethiopian study rickets was present in 210 of 500 cases of pneumonia compared with 20 of 500 controls (odds ratio 22.11).³³ A similar important observation of the association between nutritional rickets and childhood pneumonia was also made in another study also conducted in Ethiopia.³⁴ Sickle cell anemia was present in 1(0.3%) case of recurrent pneumonia. It has long been recognized that children with homozygous sickle cell anemia are at increased risk for pneumonia relative to other children, even with penicillin prophylaxis treatment.³⁵⁻³⁷

In 10 (3.4%) cases, in spite of comprehensive etiological evaluation available in our institute, no underlying cause could be identified. In children with recurrent pneumonia age and location of pneumonia recurrence may be important clues in discovering underlying illness. In the first few months of life, structural or functional anomalies of the airway usually present as repeated pneumonia of the same lung lobe. In infancy, gastroesophageal reflux may present as recurrent pneumonia. In infancy and early childhood neurodevelopmental disability, recurrent bronchiolitis with aspiration pneumonia, congenital heart defects, Down syndrome and malnutrition (both macro and micro) contribute to recurrent pneumonia. In early childhood bronchial asthma while in middle to late childhood bronchiectasis is the main causes for recurrent pneumonia. Almost in all cases of neurodevelopmental disability, on radiography, there was involvement of more than one lung lobe.

The other usual findings were presence of hyperinflation of both lung fields along with wide spread, particularly perihilar infiltrates and consolidation / collapse, mainly of right upper / middle lobes.

The direct demonstration of aspiration into airways was not possible because of the non-availability of Video fluoroscopic swallowing studies (VFSS), so the evidence of aspiration was indirect i.e. clinical plus radiological. Moreover, due to different financial and geographical constraints certain tests like sweat chloride test and complete immunological workup could not be performed, hence, we might have missed few underlying causes of recurrent pneumonia. While on the other hand, the radiological diagnosis of pneumonia in our study is susceptible to bias, as differentiation between atelectasis and consolidation is not always possible from x-ray chest, the diagnosis of pneumonia might have been overestimated.

CONCLUSION

Recurrent pneumonia is relatively common in our country as are recurrent respiratory tract infections. Common underlying illnesses included neurodevelopmental disability, recurrent bronchiolitis with aspiration pneumonia, congenital heart disease, down syndrome, bronchiectasis, bronchial asthma, anomalies of the respiratory system and cleft palate. Age and location of pneumonia recurrence may be important clues in discovering underlying illness. We have made an effort to explore the underlying causes of recurrent pneumonia. However, we suggest for more studies on the subject at resource rich tertiary care centers.

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