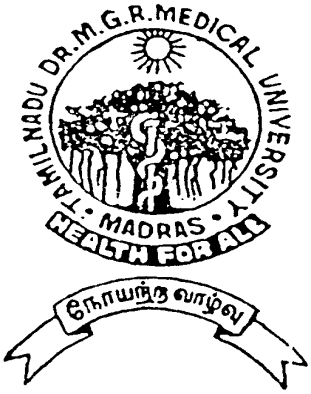
EVALUATION OF RECURRENT PNEUMONIA

IN CHILDREN

Dissertation submitted for

M.D DEGREE (PAEDIATRICS) BRANCH VII



INSTITUTE OF CHILD HEALTH

AND

HOSPITAL FOR CHILDREN

MADRAS MEDICAL COLLEGE

THE TAMILNADU Dr. M.G.R. MEDICAL UNIVERSITY

CHENNAI

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CERTIFICATE

This is to certify that the dissertation titled, **"EVALUATION OF RECURRENT PNEUMONIA IN CHILDREN"** submitted by Dr.S.BALAMURUGAN, to the Faculty of Paediatrics, The Tamilnadu Dr. M.G.R Medical University, Chennai, in partial fulfillment of the requirements for the award of M.D. Degree (Paediatrics) is a bonafide research work carried out by him under our direct supervision and guidance, during the academic year 2008-2011.

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This is submitted to the **Tamilnadu Dr. M.G.R. Medical University**, Chennai in partial fulfillment of the rules and regulations for the M.D. Degree Examination in Pediatrics.

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The Institutional Review Board (Ethical Committee) of Institute of Child Health and Hospital for Children, Chennai was held on 19.12.2008 at 2.00 PM at the Deputy Superintendent's chamber.

MEMBERS PRESENT: Dr.R.Kulandai Kasthuri, Chairperson

Members:
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Title: submitted a study entitled "Evaluation of Recurrent Pneumonia in Children".

The Institutional Review Board is satisfied with the amendment submitted by you on the said title. Hence the Board is pleased to approve the study.

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CONTENTS

INTRODUCTION

INTRODUCTION

Pneumonia accounts for a significant morbidity in children. Approximately 150 million new cases of pneumonia occur annually among children younger than 5 years worldwide, accounting for approximately 10- 20 million hospitalizations.(1) Of which, a subgroup suffer from recurrent pneumonia. Pneumonia in children usually recurs due to an underlying health problem. There may be some underlying illness predisposing them to such pneumonia recurrences. This study evaluates those underlying illnesses.

The WHO Child Health Epidemiology Reference Group estimated the median global incidence of clinical pneumonia to be 0.28 episodes per child-year.(1) This equates to an annual incidence of 150.7 million new cases, of which 11-20 million (7-13%) are severe enough to require hospital admission. Ninety-five percent of all episodes of clinical pneumonia in young children worldwide occur in developing countries.

Although the diagnosis is usually made on the basis of radiographic findings in developed countries, the World Health Organization (WHO) has defined pneumonia solely on the basis of clinical findings obtained by visual inspection and timing of the

respiratory rate.(2,3,4,5) It is important for the physician to understand that the typical causes and presentations of pneumonia in infants and children are variable, depending upon the child's age and underlying medical condition.

PATHOPHYSIOLOGY OF PNEUMONIA

Pneumonia results from inflammation of the alveolar space and may compromise air exchange. While often complicating other lower respiratory infections such as bronchiolitis or laryngotracheobronchitis, pneumonia may also occur via hematogenous spread or aspiration. Most commonly, this inflammation is the result of invasion by bacteria, viruses, or fungi, but it can occur as a result of chemical injury or may follow direct lung injury (e.g., near drowning).

Four stages of lobar pneumonia have been described. In the first stage, occurring within 24 hours of infection, the lung is characterized microscopically by vascular congestion and alveolar edema. Many bacteria and few neutrophils are present. The stage of red hepatization (2-3 d), so called because of its similarity to the consistency of liver, is characterized by the presence of many erythrocytes, neutrophils, desquamated epithelial cells, and fibrin within the alveoli. In the stage of gray hepatization (2-3 d), the lung is gray-brown to yellow because of

fibrinopurulent exudate, disintegration of red cells, and hemosiderin. The final stage of resolution is characterized by resorption and restoration of the pulmonary architecture. Fibrinous inflammation may extend into the pleural space, causing a rub heard by auscultation, and it may lead to resolution or to organization and pleural adhesions.

Bronchopneumonia, a patchy consolidation involving one or more lobes, usually involves the dependent lung zones, a pattern attributable to aspiration of oropharyngeal contents. The neutrophilic exudate is centered in bronchi and bronchioles, with centrifugal spread to the adjacent alveoli.

In interstitial pneumonia, patchy or diffuse inflammation involving the interstitium is characterized by infiltration of lymphocytes and macrophages. The alveoli do not contain a significant exudates, but protein-rich hyaline membranes similar to those found in adult respiratory distress syndrome (ARDS) may line the alveolar spaces. Bacterial super infection of viral pneumonia can also produce a mixed pattern of interstitial and alveolar airspace inflammation.

Miliary pneumonia is a term applied to multiple, discrete lesions resulting from the spread of the pathogen to the lungs via the

bloodstream. The varying degrees of immunocompromise in miliary tuberculosis, histoplasmosis, and coccidioidomycosis may manifest as granulomas with caseous necrosis to foci of necrosis. Miliary herpes virus, cytomegalovirus, or varicella-zoster virus infection in severely immunocompromised patients results in numerous acute necrotizing hemorrhagic lesions.

Factors that bypass or inactivate local defenses (e.g., tracheotomy tubes, immotile cilia syndrome) predispose the child to pneumonia. The result is loss of surfactant activity with local collapse and consolidation.

Pneumonia may be classified by the causative organism, the anatomic location, or the tissue response.

Pathogens implicated in pneumonia vary with the age of the child, the underlying patient-specific risk factors, immunization status, and seasonality.

In the neonate, pathogens that may infect the infant via the maternal genital tract include group B streptococci, Escherichia coli and other fecal coliforms, and C trachomatis. Group B streptococci most often is transmitted to the fetus in utero, usually as a result of colonization of

the mother's vagina and cervix by the organism. Affected infants commonly present within the first few hours after birth, but if infection is acquired during the delivery, the presentation may be delayed. The usual presenting symptoms include tachypnea, hypoxemia, and signs of respiratory distress. Physical examination may reveal diffuse fine crackles, and the chest radiograph may demonstrate a ground-glass appearance and air bronchograms.

Newborns may be affected by the bacteria and viruses that cause infections in older infants and children. Risk factors for infection include older siblings, group daycare, and lack of immunization, particularly against pertussis.

In the young infant, aged 1-3 months, continued concern about perinatally acquired pathogens mentioned above as well as the unusual Listeria monocytogenes remains. However, most pneumonia in this age group is community acquired and involves Streptococcus pneumoniae, Staphylococcus aureus, and non-typable Haemophilus influenzae.

Most lower respiratory disease in the young infant occurs during the respiratory virus season (spring to winter) and is viral in origin, particularly in the patient with clinical bronchiolitis. The most common

agents include parainfluenza viruses, influenza virus, adenovirus, metapneumovirus, and respiratory syncytial virus (RSV). Morbidity and mortality from RSV and other viral infections is higher among premature infants and infants with underlying lung disease.

Atypical organisms may also cause infection in infants. Of these, C trachomatis, Ureaplasma urealyticum, cytomegalovirus, and Pneumocystis carinii (PCP) are the most common. Pneumocystis pneumonia is generally limited to immunocompromised infants. Bordetella pertussis may affect infants. Only 80% of fully immunized children are protected against pertussis and immunity to this disease wanes in late adolescence. Since infants have not completed the vaccination series and because adults are a potential reservoir for infection, both groups are at risk. Streptococcus pneumoniae is by far the most common bacterial pathogen in this age group. Infection with Staphylococcus aureus may be complicated by lung abscess, pneumatocele parapneumonic effusions, and empyema.(6).

Viruses are a common cause of pneumonia among toddlers and preschoolers. The usual culprits are those previously discussed. Tsolia et al identified a viral infection among 65% of hospitalized children with community-acquired pneumonia.(7)

Streptococcus pneumoniae is by far the most common bacterial cause of pneumonia. Among hospitalized children, Streptococcus pneumoniae accounts for 21-44% of disease (8, 9, 10). In a recent study to evaluate the effectiveness of heptavalent pneumococcal conjugate vaccine in prevention of pneumonia in children younger than 5 years, Black et al showed a 32.2% reduction in the first year of life and a 23.4% reduction between 1-2 years, but only a 9.1% reduction in children older than 2 years.(11,12) Children in this age group are also at risk for infection by M pneumoniae.

M pneumoniae is a frequent cause of pneumonia among older children and adolescents. Mycoplasma accounts for 14-35% of pneumonia hospitalizations in this age group.(8,7,13). C pneumoniae can cause pneumonia in this age group. Older adolescents may have lost their immunity to pertussis and may become infected by this organism. Unlike the whooping cough in infants, pertussis in older patients usually causes a paroxysmal cough, which persists for more than 3 weeks and may last up to 3 months. Bacterial pneumonia in this age group most often is caused by Streptococcus pneumoniae.

Histoplasma capsulatum, which is found in nitrate-rich soil, usually is acquired as a result of inhalation of spores. Chicken coops and other

bird roosts and decaying wood are oft-cited sources. The infection is usually asymptomatic; however, infants and young children are at risk for symptomatic infection, which may cause respiratory distress and hypoxemia.

Blastomyces dermatitides is dimorphic yeast, which is found in certain geographic locations, most notably the Ohio and Mississippi River valleys. As with histoplasmosis, blastomycosis is acquired by inhalation of spores. Although 3 distinct forms of infection exist, the most common is acute pneumonia, which most often resolves without treatment. Cryptococcus neoformans is a common infection among pigeon breeders, but it is unusual in other immunocompetent individuals. Cryptococcosis may occur in as many as 5-10% of patients with AIDS. In immunocompetent patients, this organism causes no symptoms or a mild pneumonia and requires no treatment.

Mycobacterial pneumonia has recently been noted with increasing frequency in some inner-city areas. Children in homeless shelters and group homes and those with household contacts are at particular risk. Similarly, the diagnosis must be considered in immunocompromised children. RSV is a common cause of lower respiratory tract infection in children. Serious infections with this organism usually occur in infants

with underlying lung disease. Bacterial super infection may also complicate RSV pneumonia.

The herpes viruses rarely may cause pneumonia. In infants, the usual agent is herpes simplex, and, in older children, pneumonia may complicate common varicella infections.

Legionella species may cause pneumonia in immunocompromised children. Children with cystic fibrosis may be infected with various organisms such as Staphylococcus aureus, Pseudomonas aeruginosa, Burkholderia cepacia , and other multidrug-resistant organisms.

Not all pneumonia is caused by infectious agents. Children who have severe gastro esophageal reflux may develop chemical pneumonitis secondary to recurrent aspiration. Inhalation of certain chemicals or smoke may cause pulmonary inflammation. Additionally, children with impaired swallowing, gastrointestinal motility, or a gastrostomy tube may be prone to aspiration pneumonia.

RECURRENT PNEUMONIA

Pneumonia is clinically defined as a combination of respiratory symptoms (cough, dyspnoea, or tachypnoea) and signs (fever,

crepitations, focally-increased breath sounds, fremitus, or wheeze). Unfortunately, there are no guidelines, or universal agreement for the definitions of recurrent and persistent pneumonia.(14)

Suggested definitions include:(15) Recurrent pneumonia 2 episodes within the same year or 3 or more episodes over any time period. For a child to be diagnosed with recurrent pneumonia there must be complete resolution of clinical and radiological findings between acute episodes. Persistent or non-resolving pneumonia - when there is clinical and radiological evidence of pneumonia despite adequate treatment for a month.

Not all children with pneumonia receive chest radiographs, but a radiograph demonstrating pulmonary infiltrates is essential in defining an episode of pneumonia in cases of suspected persistent or recurrent pneumonia.(15 Comparison should be made to previous films to confirm the diagnosis of pneumonia and assess if the consolidation is localized to a single lobe, or whether multifocal disease is present as this has implications on the differential diagnosis and subsequent investigations.(15)

Unlike adults, there is no indication for routine follow-up of all otherwise healthy children with uncomplicated community acquired pneumonia. Those with clinical evidence or suspicion of recurrent or persistent pneumonia, or who are immunocompromised should have repeat films done at least 2-3 weeks after commencement of treatment. (16,17)

Round pneumonia is common in children and simulates a pulmonary mass. In these cases, follow-up radiography is important to confirm resolution and to exclude the presence of an underlying mass. Specific Risk Factors for Recurrent Pneumonia in Children.

Certain children have a higher-than-normal risk for pneumonia and pneumonia that returns. Conditions that predispose infants and small children to pneumonia include:

- Abnormalities in muscle coordination of the mouth and throat
- Asthma
- Certain genetic disorders such as Kartagener syndrome, which result in poorly functioning cilia, the hair-like cells lining the airways
- Cystic fibrosis
- Bronchopulmonary dysplasia and other chronic lung diseases

- Prematurity, especially during the first 6 - 12 months of life
- Sickle cell disease
- Gastro esophageal reflux disorder (GERD)
- Impaired immune system
- Inborn lung or heart defects

The indications for CT in children with lower respiratory tract infections include:(18,19).

1. Suspected complications of bacterial pneumonia (e.g. abscess)
2. To exclude an underlying abnormality in recurrent or persistent pneumonia.
3. Investigate the immunocompromised child with a normal or equivocal radiograph.

CT is the preferred method for investigating perilaryngeal or mediastinal compressive masses affecting the airway and has largely replaced conventional angiography for investigation of suspected vascular rings.(19)

CT results in significant exposure to ionizing radiation and care must be taken to minimize the effective dose.(19) High Resolution Computed Tomography (HRCT) is used for evaluating all forms of

bronchiectasis (including cystic fibrosis) and interstitial lung diseases in children.(19).

Upper gastrointestinal contrast studies are indicated if aspiration, reflux, or mediastinal compressive masses/vascular rings compromising the airway are suspected.(10,11,12)

REVIEW OF LITERATURE

REVIEW OF LITERATURE

1. Owayed AF and colleagues(23) performed a retrospective study to determine the frequency of underlying illnesses in children hospitalized with recurrent pneumonia and the percentage of those with known underlying illness before pneumonia recurrence.

The authors reviewed the charts for a 10-year period of all patients younger than 18 years who were admitted to a children's hospital with a diagnosis of pneumonia. From this group, children who had two or more episodes of pneumonia in one year or three or more episodes in their lifetime, plus children who had radiographic confirmation of pneumonia on admission, were included in the study (Table 1). Using a standard data extraction form, information was abstracted from the charts regarding patient age, sex, percentile body weight and the age at which an underlying illness was diagnosed. Also reviewed were the results of the diagnostic evaluations that included computed tomography of the chest, sweat chloride testing, echocardiography, barium swallow, laryngoscopy and bronchoscopy, esophageal pH manometry, quantitative serum immunoglobulin and testing for human immunodeficiency virus (HIV) infection.

Of the 2,952 charts reviewed, 238 children met the definition for recurrent pneumonia. Approximately 60 percent were males, and the mean age at diagnosis was 3.7 years (range: 2.5 months to 15.6 years). An underlying illness was diagnosed in 220 of these children. Aspiration syndrome was diagnosed as the cause of pneumonia in 114 children, an immune disorder in 24 and congenital heart disease in 22. Additional diagnoses included bronchial asthma in 19 children, congenital or acquired anomalies of the airway or lung in 18, gastro esophageal reflux in 13 and sickle cell anemia in 10. A predisposing factor for recurrent pneumonia could not be determined in 18 of the children.

More than one half of the children with aspiration syndrome had cerebral palsy. Of those with an immune deficiency, 13 had a malignant neoplasm, five had a dysgammaglobulinemia, five had HIV infection and one had autoimmune pancytopenia. Of significance, 178 of the 238 children had been diagnosed with an underlying illness before the first episode of pneumonia, and 25 children were diagnosed during their first episode of pneumonia. Only 17 children were diagnosed with an underlying disease after having recurrent pneumonia. Of these 17 children, seven had asthma, and four had aspiration syndrome, three had gastro esophageal reflux and two had airway anomalies. Only one child had an underlying immune disorder.

2 .An another study was conducted by Ankara University Medical School, Department of Pediatrics, Ankara, Turkey. (24). The aim of this study was to determine the relative frequency of underlying illnesses for recurrent pneumonia in children. Children who had two or more episodes of pneumonia per year, or three or more episodes in a lifetime were investigated retrospectively at Ankara University Medical School, Department of Pediatric Infectious Diseases, between January 1997 and October 2002. Out of 788 children hospitalized for pneumonia, 71 (9 per cent) met the criteria for recurrent pneumonia. An underlying illness was demonstrated in 60 patients (85 per cent). In this group, the underlying illness was diagnosed prior to pneumonia in 11 patients (18.3 per cent), during the first episode in 12 patients (20 per cent), and during recurrence in 37 patients (61.7 per cent). Underlying diseases were bronchial asthma (32 per cent), gastro esophageal reflux (15 per cent), immune disorders (10 per cent), congenital heart defects (9 per cent), anomalies of the chest and lung (6 per cent), bronchopulmonary dysplasia (4 per cent), cystic fibrosis (3 per cent), tuberculosis (3 per cent), and aspiration syndrome (3 per cent). No predisposing illness could be demonstrated in 11 patients (15%). In conclusion, approximately one-tenth of hospitalized children with pneumonia in our hospital had recurrent pneumonia. Most of these children had an underlying illness, which was demonstrated by intensive investigation. Bronchial asthma in children aged more than 2 years and

gastro esophageal reflux in children aged less than 1 year were the most common underlying illnesses for recurrent pneumonia.

3. An another study to identify underlying causes of recurrent pneumonia in children in a general hospital of Netherland in Western Europe(26) by analyzing retrospectively medical records of all children with recurrent pneumonia at our unit over a seven year period.

62 children were included. Despite extensive investigations, no cause could be identified in 19 of patients (30.6%). The most common underlying causes of recurrent pneumonia were psychomotor retardation or congenital abnormalities with reflux or aspiration in 16 (25.8%), immunodeficiency in 10 (16.1%), lung disease (bronchiectasis, airway stenosis, middle lobe syndrome) in 10 (16.1%), and other causes (congenital heart disease, immunosuppression and ectodermal dysplasia) in 7 patients (11.2%). Asthma was never identified as a cause in our study. Most underlying causes (27/43, 62.7%) were diagnosed prior to the first episode of pneumonia, except immunodeficiency and lung disease.

Conclusions: Unlike previous studies, a large number of patients in our study had recurrent pneumonia without a known underlying cause. In Western Europe, asthma is an unlikely cause of recurrent pneumonia in children. In children presenting with recurrent pneumonia without a

known underlying cause, investigations should focus on immunodeficiency and lung disease.

4.Another study on recurrent pneumonia in children in clinical profile and underlying causes was conducted by Lodha R, Puranik M, Natchu UC, Kabra SK , in Department of Pediatrics, All India Institute of Medical Sciences, Ansari Nagar, New Delhi, India**.(**25)

Abstract

AIM: To study the clinical profile and describe the predisposing causes of recurrent pneumonia in Indian children.

METHODS: The clinical details and the investigations of children presenting with recurrent pneumonia to the paediatric chest clinic services of a tertiary care centre in northern India were reviewed.

RESULTS: Seventy children (44M, 26F) presented with recurrent pneumonia over a period of 5 y. Based on the clinical features and the results of the investigations, underlying illness could be identified in 59 children (84%). The most frequent underlying cause for recurrent pneumonia was recurrent aspiration (24.2%), followed by

immunodeficiency (15.7%), asthma (14.2%) and structural anomalies (8.6%).

CONCLUSION: The underlying cause of recurrent pneumonia was identified in more than 80% of children. Recurrent aspirations were the most common cause.

Table1.Comparisons of studies of recurrent pneumonia in children

Author Name	Owayed AF Retrospective study	Lodha Natchu AIMS	Netherland western Europe
Duration of study	10 yrs	5yrs	7yrs
Age group	Below 18 yrs	Below 12yrs	Below 12yrs
Total no of cases	238	70	62
Aspiration syndrome	114(47.8%)	17(24.2%)	16(25.8)%
Immune disorders	24 (10%)	11(15.7%)	10(16%)
Cong heart disease	22(9.2%)	5(8%)	3(5%)
Br asthma	19(8%)	10(14.2%)	Nil
Congenital & acquired Anomaly of airway &lung	18(8.1%)	7 %(8.6%)	10(16.7%)
GERD	13(5.4%)	2(3%)	
Others	10(4.2%)	7(11.2%)	4(6.4)%
Cause undetected	18(7.5%)	11(16%)	19(30.6%)
Total	238(100%)	70(100%)	62(100%)

Others : sickle cell anaemia,cystic fibrosis,tuberculosis,ectodermal dysplasia etc.,

STUDY JUSTIFICATION

STUDY JUSTIFICATION

- Recurrent pneumonia though it is not a special entity, it is a manifestation of underlying disorder. Since the etiology is multi factorial including mechanical to immunological, the children with recurrent pneumonia require detailed investigation work up. Unfortunately many specialized procedures are not available in many hospitals, being a tertiary care hospital such problematic case are frequently find the place at ICH&HC.
- In our hospital, about 340 cases of pneumonia were admitted every year, but there was neither documentation nor a study regarding recurrent pneumonia.
- So we are in a position to evaluate incidence and predisposing causes in our hospital.
- Thereby we can educate the parents to prevent further recurrence and the admission rate can be reduced.

AIM AND OBJECTIVE OF THE STUDY

AIM AND OBJECTIVE OF THE STUDY

- To study the incidence of recurrent pneumonia in children

- To study the underlying predisposing factors of recurrent pneumonia in children admitted in a tertiary care children hospital in a developing country.

MATERIALS AND METHODS

MATERIALS AND METHODS

- **STUDY DESIGN** : Cross sectional study.

- **PLACE** : Institute of Child Health and Hospital for Children, Egmore, Chennai 600 008

- **STUDY POPULATION** : Children less than 12 years of age having recurrent pneumonia.

- **PERIOD OF STUDY** : 2 Years - October 2008 to September 2010.

- **INCLUSION CRITERIA** : Children less than 12 years of age, admitted for documented pneumonia 2 or more episodes in one year, 3 or more episodes in lifetime with radiological clearance between the episodes.

- **EXCLUSION CRITERIA** : Persistent pneumonia cases are excluded.

MANEUVER:

- Eligible children with defined criteria are registered for study.
- Using a standard data extraction form information is extracted from the charts regarding patient's age, sex , body weight, height and age at which an underlying illness is diagnosed.
- Diagnostic evaluation that is included are:

Clinical clues to diagnosis -

I. The association of respiratory symptoms with feeding in those with gastro esophageal reflux.

II. Recurrent infections at other locations and failure to thrive in the cases of immune disorder.

III. History of contact with TB patients

IV. Recurrences involving the same location in those with underlying pulmonary pathology.

V. Detailed clinical history relevant for as asthma.

a) Personal History of atopy, family history of atopy or asthma.

b) Trigger induced attacks, relief with bronchodilators.

c) Seasonal variations.

d) Non infectious attacks.

- **INVESTIGATIONS:**
  - Basic investigations
  - Monteux Test
  - Chest X rays
  - Resting Gastric Juice for AFB
  - Testing for HIV infection.
- The following investigations are carried out in relevant to clinical features.
  - Computed Tomography of Chest.
  - Immunoglobulin Assay
  - Barium Swallow to document Gastro esophageal reflux.
  - Flexible Fibroptic Bronchoscope.
  - Echocardiogram to detect cardiac anomalies causing pneumonia.
  - Sweat chloride test

CONSENT : Institutional consent was obtained from the parents after explaining the nature of study.

OBSERVATIONS

OBSERVATIONS

The total no of children hospitalized for pneumonia during the study period was 670. Fifty two children among them were identified to have recurrent pneumonia and were included in the study. Detailed works up with the available and necessary investigations are carried out. (Table 2).

TABLE 2

Hospital Admission of Pneumonia and Recurrent Pneumonia

Year	**Total Hospital Admission n(%)**	**Pneumonia cases n(%)**	**Recurrent Pneumonia in pneumonia cases n(%)**
Oct 2008 – Dec 2008	9279	82(0.8%)	6(7.3%)
Jan 2009 – Dec 2009	37,852	336(0.8%)	26(7.7%)
Jan 2010 – Sep 2010	28,613	252(0.9%)	20(8%)
Total	75744	670(0.9%)	52(7.8%)

Males outnumbered females with a ratio of 1.7:1. Thirty three (63.5%) of the total number of children were male and nineteen (36.5%) were female.

In our study, 82.6% of all patients were in the under five age group with more than 30% of total presenting in the very first year of life. Only nine (17%) of total no of children were in the 6 to 12years of age group.(Table 2, Fig 1, Fig 2)

TABLE 3

Age and sex incidence of recurrent pneumonia.

	Total(52) n(%)	**Male(33) n(%)**	**Female (19) n(%)**
<1 yr	16(31.2)	12(36.3)	4(21)
1-5 yr	27(51.5)	18(54.5)	9(47.3)
6-12 yr	9(17.3)	3(9)	6(31.5)

Figure 1. Sex distribution of study population

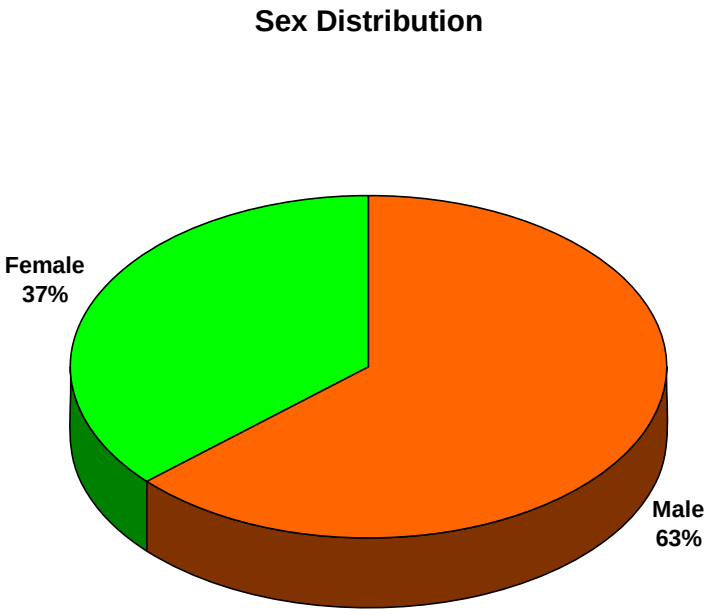
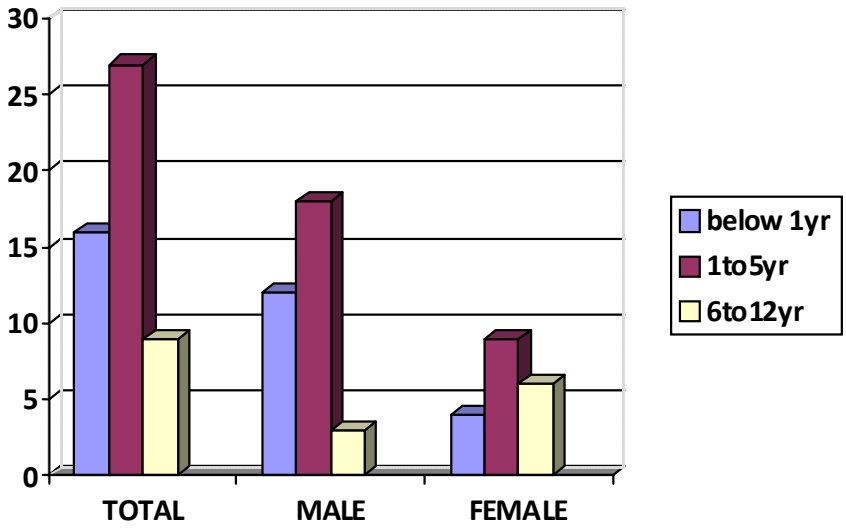


Figure 2. BAR DIAGRAM COMPARING THE DIFFERENT AGE GROUP AND SEX IN THE STUDY POPULATION.



Males outnumbered females by 300% in the <1 year age group and by 200% in the 1-5 year age group and by 300% in the 6-12 year age group.(fig 2)

Protein energy malnutrition was found to be a common accompaniment with recurrent pneumonia . Seventeen (33%) of children had normal nutritional status with regard to their weight for age according to Indian academy of paediatrics classification of protein energy malnutrition, while 15(29.4%) had grade1 PEM, 13(25.5%) had grade 2 PEM and 3(5.9%) had grade 3 PEM. Three (5.9%) children were found to have grade 4 PEM.(Table 4)

TABLE 3

Under Nutrition Associated With Recurrent Pneumonia

	Nutritional status *						**Total**
	Normal	**PEM**	**Gr I**	**Gr II**	**Gr III**	**Gr IV**	
Congenital airway anomaly	6	15	12	3			21
Oropharyngeal in coordination	3	9	4	3	1	1	12
Asthma	4	3		3			7
GERD	3	1		1			4
Others	2	6	2	3	1		8
Total	**18 (34.6%)**	**34%**	**18 (34.6%)**	**13 (25.0%)**	**2 (3.8%)**	**1 (1.9%)**	**52**

*As per IAP classification.

Cough was the universal complaint for all children. Breathlessness (86.5%) and fever (71.2%) were the next major complaint in 45(86.5%) and 37(71.2%) of the children respectively. History of aspiration (51.9%), wheezing (40.4%) and failure to thrive (53.8%) were the next major complaint of the studied children. Loss of appetite, loss of weight, seizures, recurrent infections at other locations of the body, haemoptysis were present in a lesser population of the children.

Contact history with tuberculosis patients and past history of tuberculosis were present in 3(5.8%) and 6(11.5%) of children respectively. BCG scar was present 49(94%) of children and absent in 3(5.8%) children.

Detailed history relevant for asthma was present in 13(25%) of children. History of bad child rearing practice, like, using irritant fumes, nose blowing, oil instillation and native medication were present in 12(23.2%) children.

TABLE 4

Clinical features in the studied population.

		N	%
Cough	**Yes**	**52**	**100.0**
Total		**52**	**100.0**
Breathing difficulty	**Yes**	**45**	**86.5**
	No	**7**	**13.5**
Total		**52**	**100.0**
Fever	**Yes**	**37**	**71.2**
	No	**15**	**28.8**
Total		**52**	**100.0**
Loss of appetite	**Yes**	**8**	**15.4**
	No	**44**	**84.6**
Total		**52**	**100.0**
Loss of weight	**Yes**	**14**	**26.9**
	No	**38**	**73.1**
Total		**52**	**100.0**
Haemoptysis	**Yes**	**1**	**1.9**
	No	**51**	**98.1**
Total		**52**	**100.0**
History of aspiration	**Yes**	**27**	**51.9**
	No	**25**	**48.1**
Total		**52**	**100.0**
History of wheezing	**Yes**	**21**	**40.4**
	No	**31**	**59.6**
Total		**52**	**100.0**
History of recurrent infections at other locations of body	**Yes**	**3**	**5.8**
	No	**49**	**94.2**
Total		**52**	**100.0**
History of failure to thrive	**Yes**	**28**	**53.8**
	No	**24**	**46.2**
Total		**52**	**100.0**
History of contact with TB patients	**Yes**	**3**	**5.8**
	No	**49**	**94.2**
Total		**52**	**100.0**
History of seizures	**Yes**	**9**	**17.3**
	No	**43**	**82.7**
Total		**52**	**100.0**
Past history of TB	**Yes**	**6**	**11.5**
	No	**46**	**88.5**
Total		**52**	**100.0**
Total		**52**	**100.0**

After detailed etiological work up, congenital airway anomaly was found as the underlying abnormality in 21(40%) children, oropharyngeal incoordination in 12(23.1%) children, asthma in 7(13.4%) children, gastro esophageal reflux disease in 4(7.6%) children and other causes in about 6 children. The underlying cause could not be detected in two cases.

The congenital airway anomaly included tracheomalacia of varied severity, laryngomalacia, bronchial airway anomaly, tracheal bronchus and lung aplasia. It was evaluated by using flexible fibroptic bronchoscopy. Congenital airway anomalies was more commonly present 12(44.4%) of 1-5 years of age of children.

Among the twenty one congenital airway anomaly affected children, 15 were boys and 6 were girls. Of the twelve oropharyngeal in coordinated children seven were boys and five were girls. Among the seven asthma affected children five were boys and two were girls.

Among 16 infants, congenital airway anomaly accounted for seven cases (43%) and oropharyngeal incoordination accounted for five cases (33.3%). Congenital heart diseases, trachea oesophageal fistula, gastro

oesophageal reflex disease accounted for one case each. The cause could not be found out with the available investigations in one child.

Among the twenty seven children from 1 to 5 years the most common underlying pathology was again congenital airway anomaly which was present in twelve children (44.4%). The next common illness detected was asthma in six (22.2%) children followed by oropharyngeal incoordination (14.8%). Three of them had gastro oesophageal reflex disorder and one had acquired airway anomaly due to healed endobronchial tuberculosis. The cause could not be identified in one child.

In above 5 years age group among 9 affected children 2 had congenital airway anomaly like right lung upper lobe aplasia, left bronchial stenosis in one child and segmental tracheomalacia middle 1/3 more in the right side. Two children had oropharyngeal incoordination. Two children had HIV infection. One child had SMA. One child had asthma. One had GERD. One had cerebral palsy. One child had seizures. (Table 5 & 6).

TABLE 5

Underlying illness associated with recurrent pneoumonia in studied population

Underlying illness	No. of Cases	%
Congenital airway anomaly	21	40.3
Oropharyngeal incoordination	12	23.0
Asthma	7	13.4
GERD	4	7.6
HIV infection	2	3.8
Healed EBTB with acquired airway anomaly	1	1.9
Congenital Heart disease with Marfan syndrome	1	1.9
TEF	1	1.9
Rickets with congenial Heart disease	1	1.9
Cause undetected	2	3.8
Total	52	100

TABLE 6

Underlying illness of recurrent pneumonia by age group

Underlying illness	Total (52) n (%)	0-12 months (16) n (%)	1-5 years (27) n (%)	6-12 years (9) n (%)
Congenital airway anomaly	21(40.3)	7 (43.8)	12 (44.4)	2 (22.2)
Oropharyngeal incoordination	12(23.0)	5(31.3)	4 (14.8)	3 (33.3)
Asthma	7(13.4)		6(22.2)	1 (11.1)
GERD	4(7.6)	1(6.3)	3(11.1)	
HIV infection	2(3.8)			2 (22.2)
Healed EBTB with acquired airway anomaly	1(1.9)		1 (3.7)	
Congenital Heart disease with Marfan syndrome	1(1.9)			1(11.1)
TEF	1(1.9)	1(6.3)		
Rickets with congenial Heart disease	1(1.9)	1(6.3)		
Cause not known	2(3.8)	1 (6.3)	1 (3.7)	

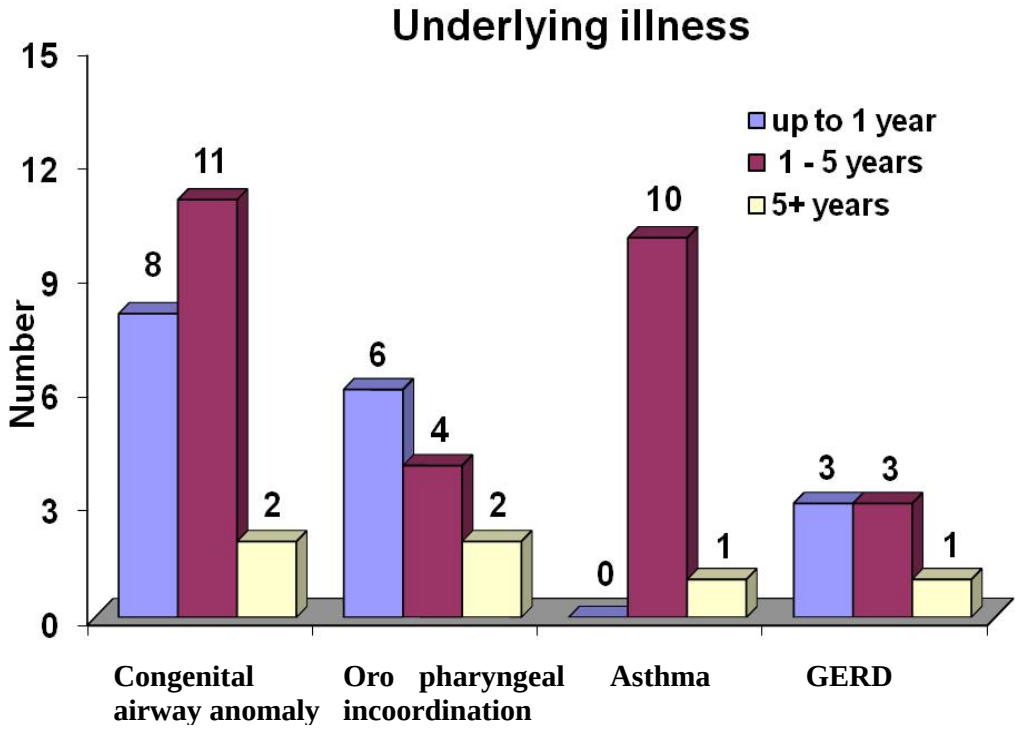


Figure 3. Bar diagram comparing the different underlying illness and age group.

Basic investigations were done in all children with recurrent pneumonia. Thirty eight children (73.1%) had anaemia . One child had anaemia with UTI. Three children had UTI and sepsis. Monteux test was done in all children. Fifty children (96.2%) found to be negative and 2 (3.8%) was positive.

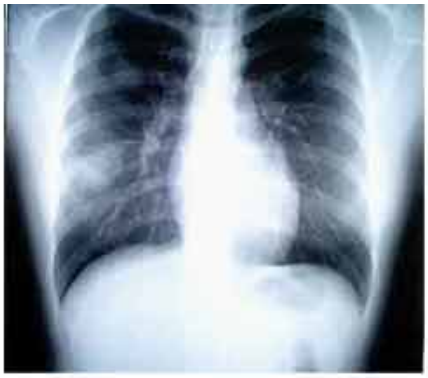
Analysis of the chest x rays of all the patients revealed that, single lobe involvement in 35(67.3%) was more than multiple lobe involvement in 17(32.7%) children. Lobar infiltrates of particular lobe was not indicative of any specicific etiological diagnosis.

Table 7

Radiographic involvement of lung lobes in recurrent pneumonia

Lobe	**N**	**%**
Single lobe	*35*	*67.3%*
Multiple lobe	*17*	*32.7%*
Total	***52***	***100.0%***

Figure 4: Sequential chest x rays of a 11 year child with HIV infection and recurrent pneumonia



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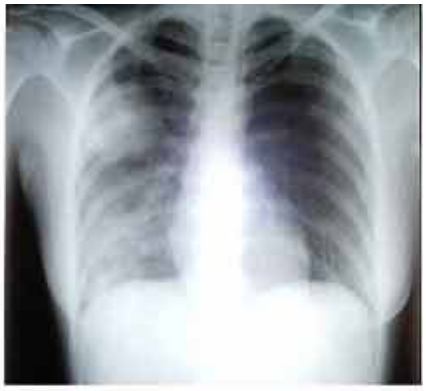

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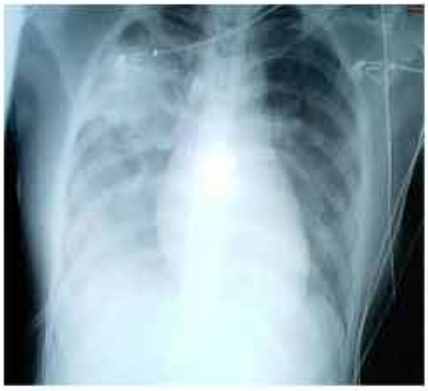

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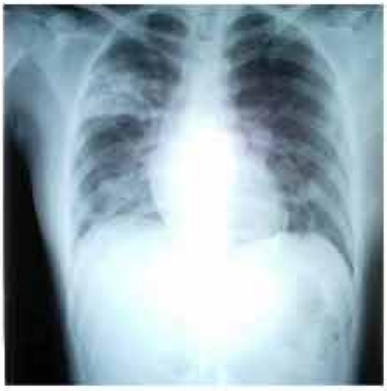

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Resting gastric juice for AFB was negative in all children. HIV ELISA test was reactive in 2(3.8%) children and Non reactive in the remaining children. Barium swallow radiography studies were normal in 44(84.6%) children and showed finding suggestive of GERD in 7(13.5%) children.

Sweat chloride test was done in 26 children which was normal.

CT chest was done in 26 children. Among the 26 children who undergone CT chest 8 had normal findings, consolidation was found in 17 children and one had features suggestive of bronchiolitis obliterating organizing pneumonia (BOOP). One child showed features suggestive of right lung upper lobe aplasia which was confirmed with FFBS findings. One child showed features suggestive of right lower lobe consolidation with lung cyst. FFBS showed narrowing of right lower lobe bronchus which might be due to external compression of the lung cyst. One child had features suggestive of interstitial pneumonia, which is followed by a measles episode, which was resolved latter and followed by left lower lobe pneumonia. BAL for BACTEC TB culture analysis was taken from the child by FFBS and it was found to be negative.

Out of the 52 children who were recruited to the study FFBS was performed in 50 patients. Two patients with HIV infection had lobar pneumonia which resolved with antibiotics, and so, FFBS was not performed in them. Among the remaining 50 patients airway anomalies and cricopharyngeal incoordination were identified in 21 patients. The common abnormalities that were detected were,

a) Tracheomalacia in eleven children(21.2%) (Figure 7)

b) Laryngomalacia nine children(17.3%) (Figure 5)

c) Bronchial airway anomaly in five children (9.6%)

Four children had mucous plug occluding the bronchial system which was removed.

A 9 month old girl who had recurrent pneumonia and respiratory symptom on feeding was investigated with barium swallow which fail to identify any abnormality. Later, on FFBS, the child was found to have TEF, underwent surgery for the same and improved well post operatively.

Another interesting anomaly diagnosed using FFBS was Pig's bronchus or Tracheal bronchus in a 8 months old child, who presented with recurrent pneumonia. (Figure 9)

Another interesting bronchial anomaly was noted in one child who was undergone FFBS and found to have the "all the bronchi originating simultaneously at left upper lobe bronchi level".

Figure 4

Normal Larynx

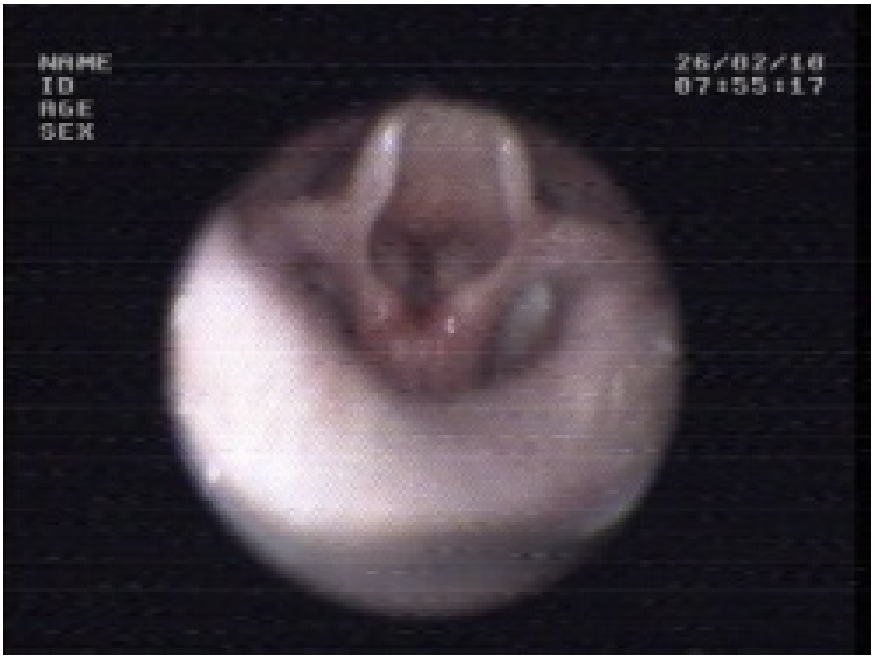

Figure 5

Severe Laryngomalacia

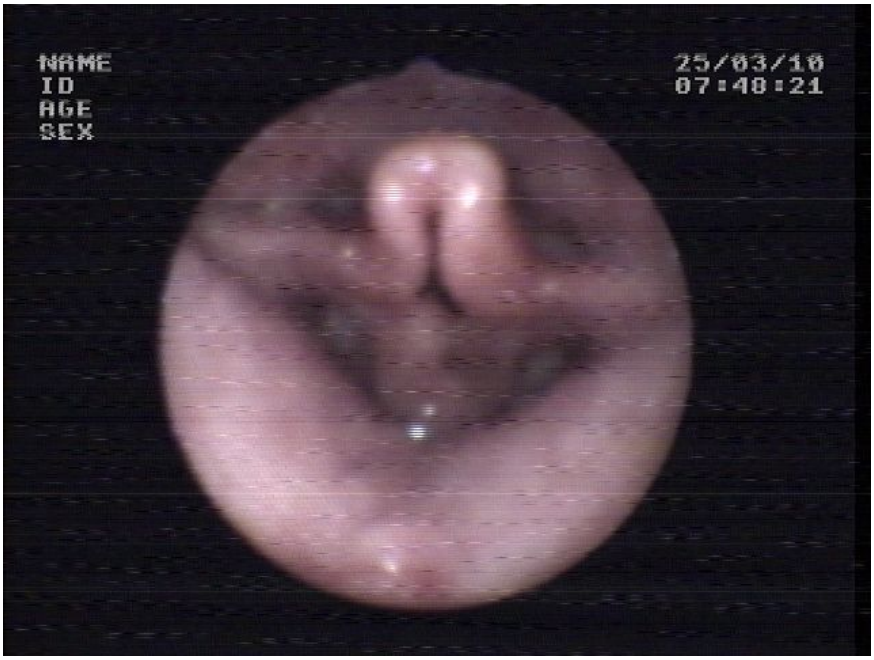

Figure 6

Normal Trachea

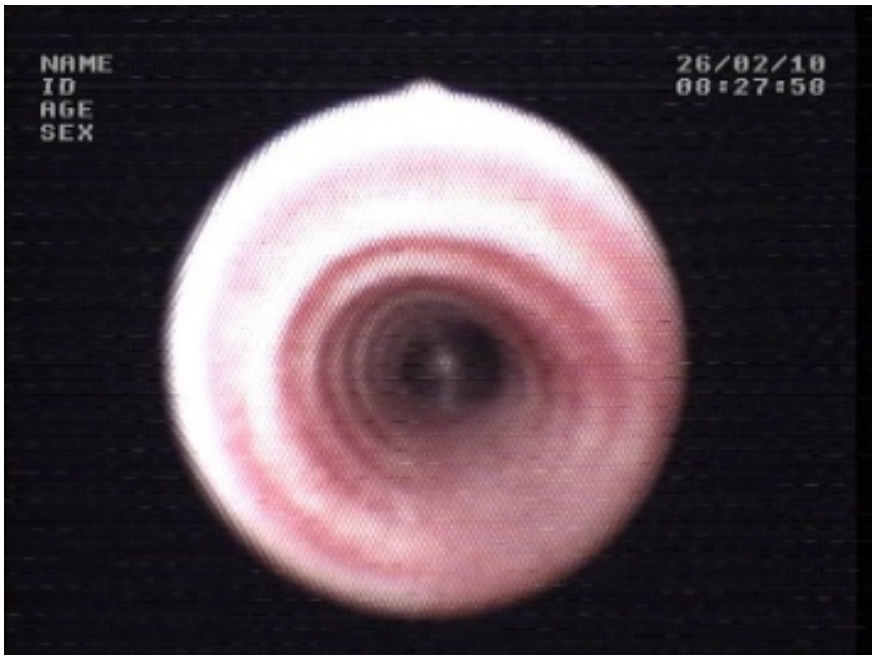

Figure 7

Tracheomalacia

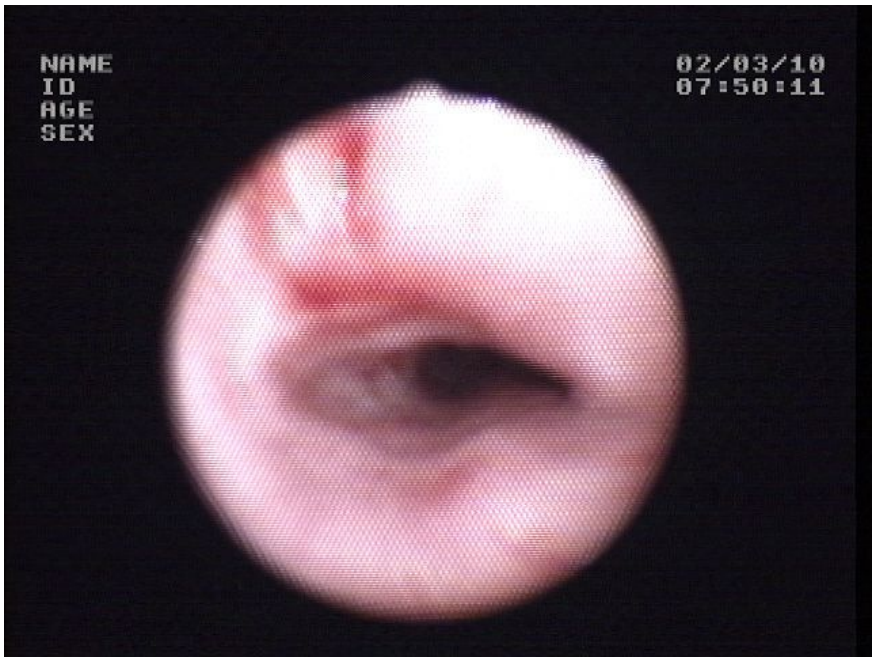

Figure 8

Normal Carina

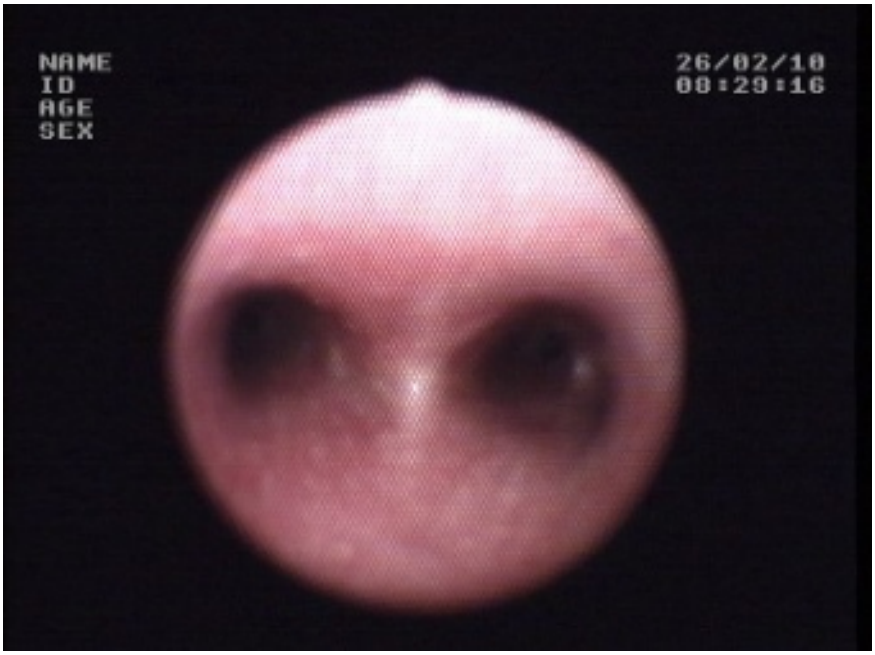

Figure 9

Pig Bronchus

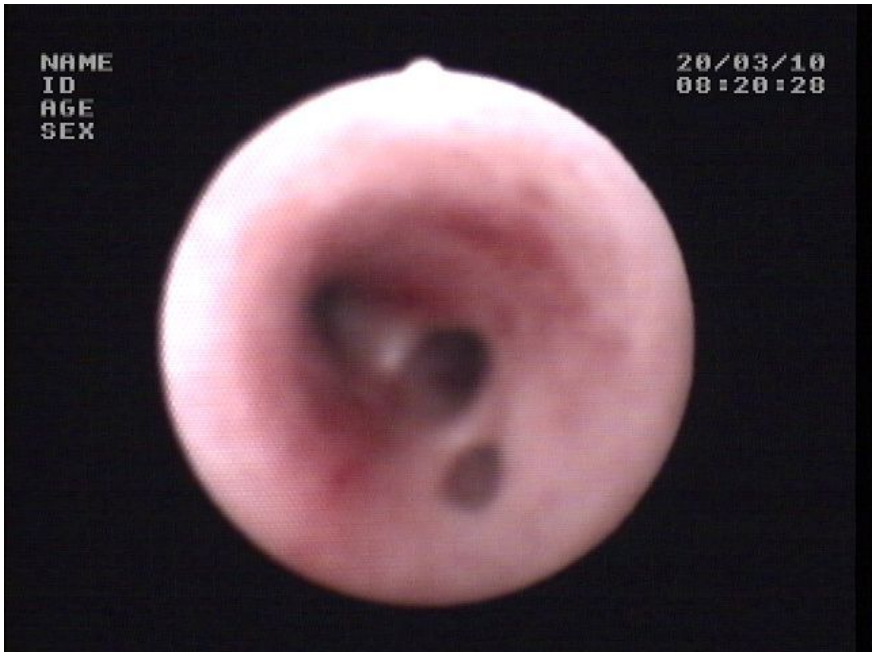

TABLE 8

Fibroptic bronchoscopy findings in recurrent pneumonia

FFBS Findings	N	%
Normal	25	48.2
Tracheomalacia	11	21.2
Laryngomalacia	9	17.3
Bronchial airway anomaly	5	9.6
Mucous plug	4	7.7
TEF	2	3.8
Cricopharyngeal incoordination	2	3.8
External compression	1	1.9
Not done	2	3.8
	52	

BAL was done for twenty seven patients. Among them AFB was negative in 26 patients. Among them two sample sent for BACTEC culture which was also found to have no growth. Bacterial culture and sensitivity was negative in 21 children positive in 2 children.

All the children recruited in the study underwent Echocardiogram, which was normal in 48 children and detected ventricular septal defect and mitral valve prolapsed in one child each.

Immunoglobulin assay done in sixteen children did not reveal any abnormality.

Sweat chloride assay done in twenty six children did not reveal any abnormality.

DISCUSSION

DISCUSSION

Recurrent pneumonia, though it is not a special entity, it is a manifestation of underlying disorder. There is no single common cause for recurrent pneumonia. The correct identification of the predisposing cause and its appropriate management is the corner stone in the management of these children. The underlying disorders associated with these pneumonias can be due to congenital malformations of upper or lower respiratory tract and cardiovascular system, recurrent aspiration, defects in the clearance of airway secretions, ciliary abnormalities and disorders of systemic or local immunity which may be congenital or acquired.

There are few reports on the underlying causes of recurrent pneumonias in children.

In our study, children presenting in the first year of their life, accounted for sixteen (30.2%) patients, while another 27(51.5%) presented between 1to5 years. Only nine (17.3%) of the children were above the 5 years to twelve years.

In the study by, by Abdullah F., Owayed MD, a medical record review of a tertiary care hospital, was performed on all children with recurrent pneumonia.(23) Children younger than 18 were admitted in that hospital. The mean age when the recurrent pneumonia was diagnosed was 3.7 years.

In our study during the two years, among 670 cases of pneumonia, 52(7.8%) met criteria for recurrent pneumonia.

The etiological work up in our study revealed that congenital airway anomaly at various locations of airway and lung were the underlying abnormality in nearly 40.4 %(21children) of 52 children. Next major underlying abnormalities were, oropharyngeal incoordination 12(23.1%) and Asthma 7(13.4%). GERD accounted for 4 cases (7.6%). HIV, TEF, Cerebral palsy, seizures, SMA, Rickets, congenital heart diseases, downs syndrome and BOOP were the other minor underlying abnormality in our study.

In below one year age group of sixteen children, congenital airway anomaly accounted for 7 cases. Oropharyngeal incoordinations including neurological diseases (5 cases) were the second most common underlying

abnormality. GERD was the next common cause occurring in 3 children. Other causes were SMA (1), Congenital diaphragmatic hernia (1), congenital heart disease (1), Rickets (1), TEF (2), tracheal bronchus (1).

Among eighteen children of 1to 5years age group congenital airway anomaly accounted for 12(44.7%) as the predisposing illness. Six cases of Asthma was the second leading predisposing factor. Oropharyngeal incoordination was present in 4 children of 1to 5 years group. GERD had presented in 3 cases. Healed EBTB, SMA, congenital heart disease and cerebral palsy were the cause in one case each.

In the above 5 years age group congenital airway anomaly (2 cases), oropharyngeal incoordination (3 cases), HIV (2 cases) were the underlying illness. SMA, Asthma, GERD, lung aplasia, BOOP were the underlying predisposing illness in one case each.

But in the study conducted by Abdullah F, Owayed MD, Douglas M(23) of 2952 with pneumonia, 238(8%) met criteria for recurrent pneumonia. Of these, underlying illnesses included, were oropharyngeal incoordination with aspiration syndrome 114 cases(48%), immune disorder 24 cases(10%), congenital cardiac defects 22 cases(9%), Asthma 19cases(8%), pulmonary anomalies 18 cases(8%), gastro esophageal

reflux 13 cases(5%) and sickle cell anemia 10 cases(4%). Clinical clues to diagnose were recurrent infections in other locations, failure to thrive in the cases of an immune disorder, recurrent wheezing in asthmatic children.

In another study by Ergin ciftic, Meltem Gunes in Turkish children in a university hospital retrospective study over 5 years, 788 children hospitalized for pneumonia, 71(9%) met criteria for recurrent pneumonia. An underlying illness was demonstrated in 60 patients (85 per cent). In this group, the underlying illness was diagnosed prior to pneumonia in 11 patients (18.3 per cent), during the first episode in 12 patients (20 per cent), and during recurrence in 37 patients (61.7 per cent). Underlying diseases were bronchial asthma (32 per cent), gastro esophageal reflux (15 per cent), immune disorders (10 per cent), congenital heart defects (9 per cent), anomalies of the chest and lung (6 per cent), bronchopulmonary dysplasia (4 per cent), cystic fibrosis (3 per cent), tuberculosis (3 per cent), and aspiration syndrome (3 per cent). No predisposing illness could be demonstrated in 11 patients (15 per cent). Bronchial asthma in children aged more than 2 years and gastro esophageal reflux in children aged less than 1 year were the most common underlying illnesses for recurrent pneumonia.

In another study conducted by P.HOVING, P.BRAND (Netherland)(26) by review of retrospective medical record, over 7 year period 62 children included. Despite extensive investigations, no cause could be identified in 19 of patients (30.6%). The most common underlying causes of recurrent pneumonia were psychomotor retardation or congenital abnormalities with reflux or aspiration in 16 (25.8%), immunodeficiency in 10 (16.1%), lung disease (bronchiectasis, airway stenosis, middle lobe syndrome) in 10 (16.1%), and other causes (congenital heart disease, immune suppression and ectodermal dysplasia) in 7 patients (11.2%). Asthma was never identified as a cause in their study. Most underlying causes (27/43, 62.7%) were diagnosed prior to the first episode of pneumonia, except immunodeficiency and lung disease. Unlike previous studies, a large number of patients in their study had recurrent pneumonia without a known underlying cause. In Western Europe, asthma is an unlikely cause of recurrent pneumonia in children. In children presenting with recurrent pneumonia without a known underlying cause, investigations should focus on immunodeficiency and lung disease as per their study.

In another study on recurrent pneumonia in children clinical profile and underlying causes was conducted by Lodha R, Puranik M, Natchu UC, Kabra SK , in Department of Pediatrics, All India Institute of

Medical Sciences, Ansari Nagar, New Delhi, India**.(25)** Seventy children (44M, 26F) presented with recurrent pneumonia over a period of 5 y. Based on the clinical features and the results of the investigations, underlying illness could be identified in 59 children (84%). The most frequent underlying cause for recurrent pneumonia was recurrent aspiration (24.2%), followed by immunodeficiency (15.7%), asthma (14.2%) and structural anomalies (8.6%).The underlying cause of recurrent pneumonia was identified in more than 80% of children. Recurrent aspirations were the most common cause.

SUMMARY AND CONCLUSION

SUMMARY AND CONCLUSION

- Around 8% of 670 pneumonia cases (52 cases) admitted were met with recurrent pneumonia criteria.
- Recurrent pneumonia occurred predominantly in the under five age group. More than 80% of the children in the study presented below the age of 5 years. Around 30% of the total presented in the first year of life.
- The male, female ratio is about 1.7: 1. It appears that male children (63%) were affected more frequent than their female counter parts (37%).
- The commonest underlying illness was congenital airway anomaly in 40% of recurrent pneumonia children. Congenital airway anomaly was the commonest underlying illness but more common in below 5 years age group and less common in 6- 12 year age group.
- Oropharyngeal incoordination including various chronic neurological disorder including cerebral palsy, seizure disorder with developmental delay and SMA was the second commonest underlying illness (23%). It appears that children with neuro muscular problems develop recurrent pneumonia more frequently.

Being a teriary care centre, many of the neuro muscular disorder cases frequently refered to this institute.

- Bronchial asthma accounted for 13% of underlying illness. Bronchial asthma was not emerged as an underlying illness in below 1 year age group. It is major component in 1 to 5 years age group.
- GERD HIV, congenital heart disease, TEF, Rickets, mucopolysacharidosis were other important minor contributions to recurrent pneumonia.
- Cough was the universal symptom in all children. Other common symptom in these children, breathlessness (86.5%), fever(71.2%), history of aspiration(51.9%), wheezing(40.4%) and failure to thrive(53.8%) were the other major complaint points towards etiological factor.
- Protein energy malnutrition was found to be a common accompaniment with recurrent pneumonia, presented in 65.4% of children.
- Anemia was present in 73% of cases. Single lobe involvement in chest x ray was more common than the multiple lobe involvement. Left lower lobe is more frequently involved.

- FFBS was very useful identifying the airway anomalies in recurrent pneumonia in children in 55% of children.
- Detailed history relevant for Asthma was present in 25% of children. History of bad child rearing practice like, using irritant fumes, nose blowing, oil instillation, native medications, wrong feeding habits were present in 23% of children.

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ANNEXURE

ANNEXURE I

ABBREVIATIONS

1.	AIDS	-	Acquired Immuno Deficiency Syndrome
2.	GERD	-	Gastro Esophageal Reflux Disease
3.	CT	-	Computerised Tomography
4.	HIV	-	Human Immuno Deficiency Virus
5.	TB	-	Tuberculosis
6.	AFB	-	Acid Fast Bacillus
7.	PEM	-	Protein Energy Malnutrition
8.	EBTB	-	Endo Bronchial Tuberculosis.
9.	TEF	-	Tracheo Esophageal Fistula
10.	FFBS	-	Flexible Fibroptic Broncho Scopy.

ANNEXURE II

PROFORMA FOR EVALUATION OF RECURRENT PNEUMONIA IN CHILDREN

1. Study No. : _____ 2. IP/OP No. _____
2. Name : _____ 4. Age _____ 5. Sex : M / F
6. Father's Name : _____ 7. Mother's Name : _____
8. Address : _____
_____ Phone : _____
9. Occupation : _____ 10. Income Rs. _____ P / M
11. Weight : _____ Kgs, 12. Height _____ CM, 13. Nutritional Status _____
14. No. of episodes of pneumonia with radiological clearance within 1 year _____ or life time _____
15. Clinical History :

a)	Cough	Yes / No	If 'Yes', duration: _____
b)	Difficulty in breathing	Yes / No	If 'Yes', duration: _____
c)	Fever	Yes / No	If 'Yes', duration: _____
d)	Loss of appetite	Yes / No	If 'Yes', duration: _____
e)	Loss of weight	Yes / No	If 'Yes', duration: _____
f)	Haemoptysis	Yes / No	If 'Yes', duration: _____
g)	H/o aspiration (association of respiratory symptoms with feeding	Yes / No	If 'Yes', duration: _____
h)	H/o Wheezing	Yes / No	If 'Yes', duration: _____
i)	H/o recurrent infection at other locations of body	Yes / No	If 'Yes', duration: _____
j)	H/o Failure to thrive	Yes / No	If 'Yes', duration: _____
k)	H/o contact c TB patients	Yes / No	If 'Yes', duration: _____
l)	H/o Seizures	Yes / No	If 'Yes', duration: _____
m)	Past H/o TB	Yes / No	If 'Yes', duration: _____
n)	BCG Scar	Yes / No	If 'Yes', duration: _____

o) Detailed clinical History relevant for Asthma

(i)	Personal H/o atopy, family H/o atopy or asthma	Yes / No
(ii)	Trigger induced attacks, relief with bronchodilators	Yes / No
(iii)	Seasonal variation	Yes / No
(iv)	Non-infections attacks	Yes / No

16. Past History:

17. Known history of Immunologic debilitating conditions

(i)	HIV	Yes / No
(ii)	Diabetes	Yes / No
(iii)	Cancer	Yes / No
(iv)	Renal Diseases	Yes / No
(v)	Immuno Suppressing drugs	Yes / No
(vi)	Poor Nutrition	Yes / No

18. H/o Bad child rearing practices:

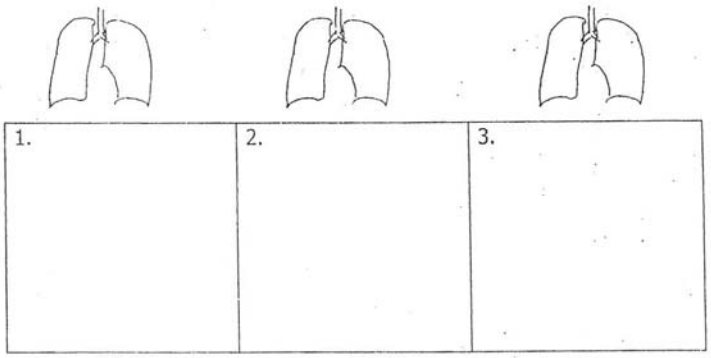
19. Any other relevant history:

20. Investigation

(i) Basic investigations:

(ii) Mantoux test _____ mm

(iii) Chest X-rays: Single lobe involvement / Multiple lobe involvement



(iv) Resting gastric Juice for AIB. Positive / Negative

(v) Testing for HIV: Reactive / Non reactive

(vi) Flexible fibroptic bronchoscopy: BAL - for culture sensitivity

(vii) Barium Swallow:

(viii) Sweat chloride Test:

The following investigation are carried out in relevant to clinical feature

(a) Computed tomography of chest:

(b) Echo cardiogram:

(c) Immunoglobulin assay: