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Original Research Article

Evaluation of persistent pneumonia and percutaneous needle aspiration of lung as a tool in the etiological evaluation of children with persistent pneumonia

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ABSTRACT

Background: Persistent pneumonia contributes to a significant proportion of morbidity and mortality due to lower respiratory tract infections. Very few studies have been done in this field worldwide. The present study was aimed at diagnosis of children with persistent pneumonia and the use of percutaneous transthoracic needle aspiration of the lung as a tool in the etiological evaluation.
Methods: A descriptive study was designed to study the children of one month to twelve years of age with persistent pneumonia admitted in various units and the Department of pulmonology, Institute of child health and hospital for children (ICH and HC), Egmore between January 2004-March 2006. The study sample was also obtained from other pediatric teaching hospitals in the city by informing them in advance regarding the nature and aim of study.
Results: The common complaints in the children were cough, fever, breathlessness, irritability, poor feeding and failure to thrive. The common clinical features were fever, tachypnea, dyspnea and the presence of crackes on auscultation. Malnutrition was found to be a common accompaniment. Lung aspiration revealed a specific bacterial etiology in 32% of the cases and identified one case of tuberculosis which was not detected in other earlier investigations. This procedure is a simple and the most direct way of obtaining a specimen from lung parenchyma without the risk of contamination from other floras.
Conclusions: The lung aspiration should be done if the advantage of a specific etiologic diagnosis outweighs the small risk associated with the procedure.

Keywords: Lung aspiration, Malnutrition, Persistent pneumonia, Percutaneous transthoracic needle

INTRODUCTION

Parenchymal lung diseases are a significant cause of morbidity and mortality, both in the developing as well as the developed world, especially in children. World wide pneumonia is estimated to cause the death of four million children under five years of age annually.[1] While acute lower respiratory tract infections (LRTIs) remain the most important cause of morbidity and mortality in the under fives in the developing countries, persistent and recurrent pneumonias are not uncommon.

The incidence of all RTIs in developing countries varies from 4.2-8.7 per child per year.[2] However the incidence rates of pneumonia are much lower about 10 per 1000 children per year.[2] Though only a small fraction of these turn out to be persistent pneumonia, still they contribute to a significant proportion of morbidity and mortality. No

community studies have reported the incidence of persistent or recurrent pneumonia.[3]

Persistent pneumonia implies a chronic non resolving pneumonia, often manifests as acute LRTIs and continues to persist for a varying period of time, irrespective of the treatment. Commonly encountered conditions like asthma, tuberculosis and foreign bodies can give rise to persistent lung infiltrates.[4] Swallowing abnormalities and gastroesophageal reflux can give rise to recurrent aspiration, leading on to persistent pneumonia. Congenital malformations of the airways may predispose the child to recurrent aspirations leading on to pneumonia. Congenital anomalies of the lung like sequestration, hypoplasia and cystadenomatoid malformations may also act as the underlying cause of persistent lung infiltrates.[4] Anomalies of the cardiovascular system, especially left to right shunts increase the risk of recurrent and persistent pneumonia.[4] Persistent lung infiltrates pose a significant challenge to the paediatricians.

Various techniques have been used to study these infections but none seems to be ideal because sputum is not usually available, results of throat cultures may be unrevealing and results of nasopharngeal cultures are frequently misleading because of high carrier rates of respiratory pathogen in this age group.[5] Though lung aspiration is a simple and the most direct way to obtain a specimen from lung parenchyma without risk of any contamination to identify the etiologic agent, it is hardly practiced. Compared to other invasive procedures like transbronchial lung biopsy, thoracoscopic lung biopsy and open lung biopsy, percutaneous needle aspiration is a minimally invasive procedure with good safety records that can provide adequate tissue sample for microbiological and cytological studies.[6] A number of studies have proved that percutaneous needle aspiration is simple, reliable, economic and a minimally invasive procedure with very good safety records in trained hands.

The present study was aimed at diagnostic work up of children with persistent pneumonia and percutaneous transthoracic needle aspiration of the lung as a tool in the etiological evaluation of children with persistent pneumonia where no underlying cause or contributory factor were found by other investigations.

METHODS

It was a descriptive study carried out at Department of Pulmonology, Institute of Child Health and Hospital for children (ICH and HC), Egmore for a period from January 2004 to March 2006.

Study population

Children between one month and twelve years of age with persistent pneumonia admitted in various units of ICH and HC. The study sample was also obtained from other pediatric teaching hospitals in the city by informing them in advance regarding the nature and aim of study.

Inclusion criteria

- Children between one month and twelve years of age having persistent pneumonia i.e., persistence of signs and symptoms pertaining to respiratory tract along with radiographic abnormalities for more than four weeks.
- Percutaneous transthoracic needle aspiration of the lung in children with persistent pneumonia where no underlying causes or contributory factors were found.

Exclusion criteria

Children below one month and more than twelve years of age were excluded from the study. Following were the exclusion criteria for performing percutaneuous lung aspiration with persistent pneumonia.

- Children with bleeding disorders.
- Children with severe pulmonary hypertension, contralateral pneumonectomy.
- Children with severe respiratory distress and poor general condition who cannot tolerate the procedure.
- Children with suspected Echinococcal cyst, possible arterio-venous malformations and emphysematous bullae in the anticipated path of the procedure.
- Children with retrocardiac pneumonitis.
- Children with both Mantoux and contact positivity were not subjected to lung aspiration as they are emperically started on antituberculous drugs based on Indian Academy of Paediatrics (IAP) consensus guidelines.

Manoeuvre

An informed consent was obtained from the parents or caretakers. Coagulation profile was done to rule out bleeding disorders as a part of preliminary work up. Anticoagulants and antiplatelet medications discontinued ideally for 7 days if the patient was already on them. An intravenous line, blood pressure monitor, ECG leads and an oxygen saturation monitor were placed. Care was taken to ensure that all emergency drugs were readily available.

The lung aspiration consisted of making a percutaneous puncture into the portion of the lung that showed by clinical and radiological examinations, the maximum pathological involvement. In case of bronchopneumonia, the right third or fourth intercostal space on the midclavicular line was used as the site of aspiration.7 An ordinary 10 ml plastic disposable syringe with a tightly fitting 22 / 24 guage needle, of length 1-1.5 inches, was used. The skin over the area was cleaned thoroughly with cetrimide and povidone iodine. One ml of sterile saline was taken in the syringe and the bevelled portion of the

needle was then inserted underneath the skin at the upper border of the lower rib to avoid the neurovascular bundle. The needle was quickly inserted as far as required to hit the desired focus. Care taken to avoid striking the great vessels, heart and other viscera. After reaching the desired focus, saline was injected and suction applied in an attempt to lavage the area. The needle was then withdrawn immediately maintaining the negative suction pressure. Following the withdrawal of the needle, firm pressure was applied over the puncture site for around five minutes followed by a tincture benzoin seal, so as to provide an effective seal, thereby reducing the complication of pneumothorax.

The material thus aspirated was sent immediately for microbiological and cytological studies. The specimens were sent for bacteriological diagnosis too. The aspirate was smeared and stained with Gram and Ziehl-Nielson stains and smears were also sent for cytological studies.

After the procedure the patient was placed puncture site down where possible to reduce the incidence of pnuemothorax. The vitals were assessed regularly for the next four hours and if stable, the child was transferred to the ward. A check x-ray was taken immediately after the procedure and was repeated whenever necessary to exclude the possibility of any clinically undetected complication.

All the data collected from the study were entered in MS excel and percentages were calculated. The results are presented in numbers and percentages.

RESULTS

Sixty nine children with persistent parenchymal lung infiltrates admitted in various wards of the hospital were analysed systematically with clinical features, basic investigations and radiological evidences.

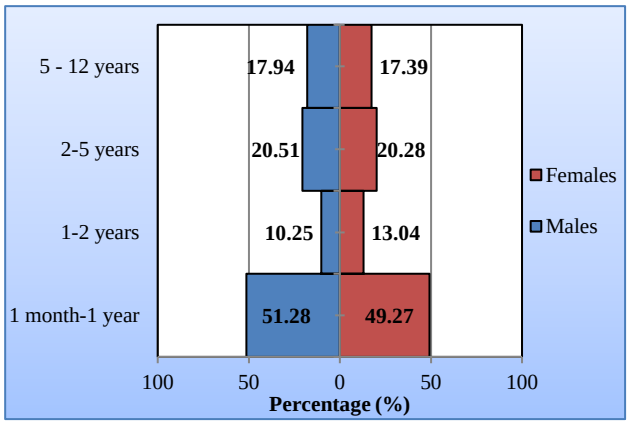

Figure 1: Demographic data of patients.

Figure 1 shows the distribution of patients according to their age and sex. Out of 69 patients, 39 (56.5%) were males and 30 (43.5%) were female children. Male children outnumbered female children in the one month - one year age group. This disparity was less prominent among other age groups. Male and female children ratio was 1.3:1.

As far as the age incidence is concerned, a majority of them belonged to the under-fives especially the under one age group. 34 children (49.7%) fell under the age group one month to one year. The minimum age in the studied children was 3 months and the maximum was eleven and half years.

Distribution of cases according to clinical symptoms and features is presented in Table 1. The majority of children had fever, cough, cold and breathlessness as the predominant presenting complaint. Irritability, poor feeding and failure to gain weight were the other common symptoms observed. History suggestive of recurrent aspiration or foreign body ingestion was not present in any child. Family history of asthma was not present in any child.

Table 1: Distribution of cases according to clinical symptoms and features (n=69).

	N	%
Symptoms		
Cough	56	81.15
Breathlessness	59	85.50
Irritability	54	78.26
Fever	52	76.00
Poor feeding	23	33.33
Bad child rearing practice (CRP)	16	23.18
Failure to thrive	16	23.18
Clinical features		
Tachypnea	62	89.85
Dyspnea	59	85.50
Crackles	56	81.15
Fever	47	68.11
Wheeze	31	44.92
Cardiac murmurs	5	7.24
Clubbing	4	5.79
Cyanosis	3	4.24
Septicemia	3	4.24
Hepatosplenomegaly	2	2.89

At least one bad child rearing practice (CRP) was present in 17 children who presented in infancy. Some of them had a combination of more than one bad child rearing practice. Male children were found to be at higher risk of CRP when compared to female children. Most children with history of bad CRP had an exposure to irritant fumes (7; 43.75%) followed by native medication (5; 31.2%), oil instillation into nose (4; 25.0) and nose blowing (3; 18.75%). Bad child rearing practice assumes importance because of the possibility of oil instillation/ nose blowing etc. leading on to lipoid pneumonia which can present as persistent lung infiltrates.

All the children studied had received at least one antibiotic prior to recruitment. 39 (56.52%) had been exposed to two or more antibiotics and 19 (27.52%) had been treated with 3 or more antibiotics. The mean duration of the antibiotic prior to recruitment was 24 days. Four children were emperically started on antituberculous drugs before reporting to the hospital.

Malnutrition was found to be a common accompaniment with persistent pneumonia. 42 children (60.86%) fell under the malnourished category according to Indian Academy of Paediatrics (IAP) classification. Classification of patients based on IAP grading is given in Table 2. A majority of them fell under the grade 1 and 2 categories. Five (7.28%) children belonged to the grade 4 category. The predominant age group which was found to be malnourished, was the under fives.

Table 2: Classification based on IAP grading (n=69).

Grades	1 month-1 year		1-5 years		5-12 years	
	n	%	n	%	n	%
Normal	12	5.29	7	30.43	8	66.66
1	6	7.64	6	26.08	2	16.66
2	9	6.47	6	26.08	1	8.33
3	3	8.82	3	13.04	1	8.33
4	4	1.76	1	2.94	--	--

The common clinical findings were dyspnea and tachpnea which were present in around 85-90% of the children. Fever was present in 47 (69.11%), crackles in 56 (81.15%) and wheeze in 31 (44.92%) children. Clubbing was present in 4 children (5.79%). 3 children (4.34%) showed cyanosis. Cardiac murmurs were suspected in five children. 3 cases (4.34%) showed clinical features suggestive of septicaemia.

Table 3: Tuberculosis screening (n=69).

Screening	Positive		Negative	
	n	%	n	%
Mantoux.	7	10.14	62	89.85
Contact screening	4	5.79	65	94.20
Both Mantoux and contact positivity	4	5.79	65	94.20
RGJ for AFB	4	5.79	65	94.20
BAL for AFB	1	1.76	55	98.21
BCG scar	66 (present)		3 (absent)	

RGJ-Resting gastric juice; AFB-Acid fast bacillus; BAL-Bronchoalveolar lavage; BCG-Bacillus Calmette Guerin

All 69 children were subjected for tuberculosis screening and the results are shown in Table 3. 7 children (10.14%) tested positive for Mantoux. A definite history of contact with an open case of tuberculosis within the past two years was present in 4 cases (5.79%). These children also showed Mantoux positivity. BCG scar was present in all except 3 cases. Parental screening was negative in all screened cases. Resting gastric juice for acid fast bacillus was positive in 4 children (5.79%). In these cases, Mantoux test and contact history were negative.

Barium swallow revealed the presence of radiologically demonstrable gastroesophageal reflux in 3 cases (4.24%). One child showed features of achalasia cardia. They were later confirmed by upper gastrointestinal endoscopy. Echocardiogram was done in all the children to rule out congenital heart diseases. Ventricular septal defect was detected in 2, patent foramen ovale in one and partial anomalous pulmonary venous connection in one. They were presumed to be the possible contributing factor for persistent pneumonia though they could not be directly implicated.

Radiological features were analysed in all the cases and the results are presented in Figure 2. 23 patients showed features of consolidation, 39 of bronchopneumonia and 7 showed pneumonitis in the retrocardiac region. These 7 children were not taken up for lung aspiration in view of the retrocardiac location of the lesion.

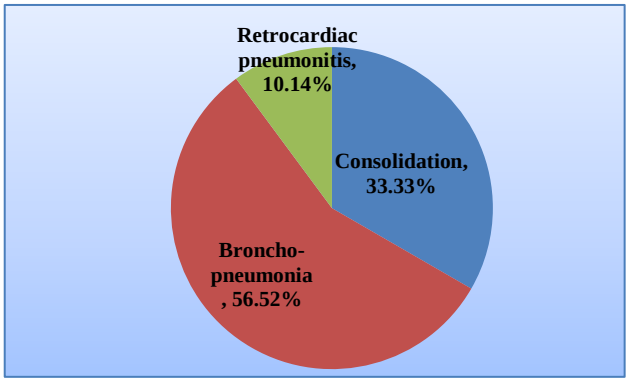

Figure 2: Findings of chest skiagram pattern (n=69).

Eleven children underwent CT thorax. CT picked up one case of sequestration lung masquerading as persistent pneumonia.

Immunoglobulin profile was done in 11 children in whom an underlying immunodeficiency was suspected. The profile was normal in all of them. Sweat chloride test for cystic fibrosis was done in four patients and it was within normal limits. All 69 children were screened for HIV status. Two children (2.89%) tested positive. Their parents were also found to be positive in HIV screening.

Bronchoscopy was performed in 56 children excluding those children who showed both contact and Mantoux positivity and in whom resting gastric juice was positive for acid fast bacillus (Table 4). Bronchoscopy showed evidence of pale mucosa and chronic inflammatory changes in 28 children. Purulent secretions were found in 23 cases. There were features suggestive of endobronchial tuberculosis like widening of the carina due to lymph node enlargement and presence of grayish white granulation tissues in the bronchial tree in 4 cases. These 4 children were negative for tuberculosis in all the

earlier screening methods. Bronchoalveolar lavage showed the presence of acid fast bacillus in one child.

Airway anomalies like tracheomalacia and bronchomalacia were present in 2 cases. Vegetable foreign body was identified in 2 cases. One interesting case of Asperigillosis demonstrated by the presence of whitish fleeting masses was encountered in one child which was later confirmed by biopsy.

Table 4: Clinical findings of bronchoscopy and lung aspiration.

Bronchoscopy findings (n=56)	n	%
Normal study	19	33.92
Pale mucosa/chronic inflammatory changes	28	50.00
Purulent secretions	23	41.07
Features suggestive of endobronchial TB	4	7.14
Tracheomalacia and Bronchomalacia	2	3.57
Foreign body	2	3.57
Aspergillosis	1	1.78
Findings of lung aspiration (n=34)		
Presence of pus cells	4	11.76
Gram positive coccus	1	2.94
Gram negative bacilli	2	5.88
Yeast cells	1	2.94
Presence of AFB	1	2.94

Lung aspiration was done in 34 cases where no possible etiology or contributory factors were found in earlier mentioned investigatory modalities (Table 4). Out of them, 7 children who showed pneumonia in the retrocardiac region were excluded based on exclusion criteria. In one child the procedure was not done because of severe respiratory distress and poor general condition. Gram staining showed the presence of pus cells in 4 cases. Gram positive cocci was found in one and Gram negative bacilli in two cases. Cytological studies revealed the presence of lipid laden macrophages in 5 cases (14.70%). These children also had a definite history of bad child rearing practice thus suggesting the possibility of lipoid pneumonia.

Table 5: Organisms found in bacterial culture of the aspirate.

Organism isolated	Total no. of cases (n=34)
H. influenza	3
Klebsiella	4
Staphylococcus aureus	2
Pseudomonas	1
E. coli	1
Mycobacterium tuberculosis	1
No growth	22
Fungal culture	--

Bacterial culture of the aspirate showed the presence of *Klebsiella* in four children (33.33%) followed by *H. influenza* in three (25%) (Table 5). There was no growth in 22 cases (64.70%). Fungal culture turned out to be negative in all the cultured specimens.

Antibiotic sensitivity pattern of culture positive cases is shown in Table 6. The antibiotics were changed in five patients based on the sensitivity reports and in the rest of the cases, no changes were made as they were already started on the antibiotics sensitive to that particular strain. Change in the antibiotic resulted in the improvement of all the five children both clinically and radiologically. In general, the gram negative organisms were more sensitive to cephalosporins and aminoglycosides and gram positive *S. aureus* was more sensitive to ciprofloxacin and amikacin.

Table 6: Follow up results.

Results	Total no. of cases	1 month -1 year	1-5 years	5-12 years
Symptomatic improvement	34	18	9	7
Symptomatic plus radiological improvement	16	4	10	2
Improvement after antibiotic change	5	3	2	--
Lost during follow up	11	6	3	2
No improvement	6	4	1	1
Died	2	2	--	--

Among 34 cases who underwent percutaneous lung aspiration, only one case of self limiting hemoptysis was encountered. Air leak complications were not seen in any case. There were no deaths associated with the procedure.

During follow up, around 50% of the cases showed symptomatic improvement (Table 6). Another 23% showed both symptomatic and radiological improvement. There was no improvement in 6 children and 5 out of these had lipoid pneumonia. 11 children were lost during follow up and 2 children died due to sepsis out of which one had a coexisting HIV infection.

DISCUSSION

Persistent pneumonia implies a chronic non resolving pneumonia. Though there is no universal consensus on when to label pneumonia as persistent, the presence of symptoms and radiographic abnormalities beyond a period of one month, should raise the possibility of an abnormal predisposing condition.

There are few reports on the underlying causes of persistent pneumonia in children. Most of the reports are on recurrent pneumonia. There are no recent reports

regarding lung aspiration in children with persistent pneumonia. The study done by Kumar et al in AIIMS was on children with malignancy on chemotherapy with persistent lung infiltrates.[7]

In this study, children presenting within the first year of life accounted for around 50% of the patients while another 33% presented between 1-5 years age group. Only 17% of the children were above 5 years of age. In the study conducted by Lodha et al in children with persistent pneumonia, the reported age distribution was similar. Male children contributed to 56.5% of the cases in our study. Lodha et al reported an even greater disproportion in sex distribution, male children comprising nearly 80%.[8]

In this study, the etiological work up revealed that tuberculosis still comprises a majority of cases of persistent pneumonia. It accounted for around 20% of the total cases. Recurrent aspiration due to various causes like gastroesophageal reflux and achalasia cardia accounted for 5.8% of the total cases. HIV infection, leading on to systemic immunodeficiency was probably the cause for persistent pneumonia in around 3% of the cases. Aspergillosis, foreign body aspiration, congenital airway anomalies and sequestration lung accounted for another 6% of the cases studied. Congenital heart diseases with left to right shunts could have been the possible contributory factor in around 6% of the cases as they could not be directly implicated as a cause for persistent pneumonia. Lipoid pneumonia as evidenced by the presence of lipid laden macrophages in the lung aspirate and bronchial washings accounted for another 7% of the cases. No specific contributory factors were found in 40 cases (58%).

Lung aspirate was carried out on children, where no possible underlying causes or contributory factors were found. The technique used in this study was similar to the one adopted by Kumar et al.[7] Lung aspirate revealed the bacterial cause for pneumonia in around 32% of the cases. The common isolates were *Klebsiella* (32.33%), *H. influenza* (25%) and *Staphylococcus aureus* (16.66%). Fungal culture was negative in all the cases. The smear study showed the presence of Gram positive organism in one and Gram negative species in two cases. The lung aspirate culture results correlated with the blood culture result in 3 cases and with the bronchoalveolar culture in 2 cases, reinforcing the fact that the same organism may not always be responsible in both infections.

Tuberculous etiology was identified in one case as the cause of persistent pneumonia (2.94%). It was interesting to note that this child was negative for tuberculosis in all the other preliminary tuberculosis related investigations carried out.

No organisms were isolated in 64.70% of the cases after lung aspiration. This may be due to the non infectious causes of pulmonary infiltrates, viral causes or other fastidious organisms which requires special media. It has to be remembered that even after a procedure as invasive as open lung biopsy the diagnosis may not be possible in upto 20% of the cases.[7] The lung aspiration conducted by Kumar et al in children with malignancy on chemotherapy showed a bacterial cause in around 53% of the cases and the organisms commonly encountered in their study were *Pseudomonas*, *E. coli* and *Klebsiella*.[7] The lung aspiration results modified the treatment pattern in five children which resulted in their improvement both clinically and radiologically. Antitubercular drugs were started in one child following isolation of acid fast bacillus in the lung aspirate.

As far as complications are concerned, pneumothorax which is reported in various studies, was not encountered in our study probably because we used a finer gauge needle when compared to other studies and probably because of the firm pressure and effective seal applied at the puncture site. Hemoptysis was observed in only one child which was managed conservatively. There were two deaths which were unrelated to the procedure. The absence of significant complications indicates the safety of the procedure.

CONCLUSION

Persistent pneumonia occurs predominantly in the under-five age group and more so in infancy. Male children were affected slightly more frequently than their female counterparts. The common complaints in the children were cough, fever, breathlessness, irritability, poor feeding and failure to thrive. The common clinical features were fever, tachpnea, dyspnea and the presence of crackes on auscultation. Malnutrition was found to be a common accompaniment.

Lung aspiration revealed a specific bacterial etiology in 32% of the cases. The lung aspiration also identified one case of tuberculosis which was not detected in other earlier investigations. The results of the lung aspiration modified the treatment in five cases resulting in the betterment of the patient. Antitubercular drugs were instituted in one child leading to the resolution of pneumonia. Thus, this procedure might be helpful in a small minority of children were etiology remains clueless. The study has also shown that this procedure is a simple and the most direct way of obtaining a specimen from lung parenchyma without the risk of contamination from other floras.

Finally, to conclude, the lung aspiration should be done if the advantage of a specific etiologic diagnosis outweighs the small risk associated with the procedure. It should be attempted in the small group of children with persistent pneumonia when trained hands and a good back up is available.

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