Education and Practice

Approach to a child with recurrent pneumonia

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ABSTRACT

Pneumonia, or inflammation of the lungs parenchyma associated with consolidation of alveolar spaces, is a substantial cause of morbidity and mortality in childhood particularly among children below 5 years of age. It is one of the common causes of admission to the paediatric ward. The aim of this article is to provide a guide to a systemic approach for diagnosis and treatment of children with recurrent pneumonia while not over investigating those with common but usually unrecognised conditions such as asthma or recurrent simple viral infections.

Keywords:

Pneumonia; Recurrent; Cough; Chest infection; Lobar; Persistent.

INTRODUCTION

Recurrent Pneumonia (RP) is defined as two or more episodes of pneumonia in 12 months or three episodes altogether with radiographic clearance in between [1,2]. It should be differentiated from persistent pneumonia, which is defined as persistence of symptoms and radiological changes for 6 weeks or more despite treatment [3]. It is often difficult to determine whether pneumonia is persistent or recurrent, unless there has been a symptom-free interval during which chest radiographs have documented clearing of the pneumonia infiltrations [3]. Inappropriate or incomplete treatment is considered as a common reason of recurrent or persistent pneumonia. Radiological technical variability and interpretation of the chest X ray (CXR) may add to the difficulties. The incidence of recurrent pneumonia in children is unclear [1].

Children with recurrent chest infection can be a significant diagnostic challenge. The assessment of these children is demanding: it requires close attention to the history and examination, and in selected cases, extensive investigations.

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CLINICAL EVALUATION

Clinical evaluation starts by careful history. One must first of all confirm the diagnosis by obtaining a good history regarding any previous chest infections, duration, hospital admission and length of treatment (Table 1).

Table 1 - Important points in the history of a child with recurrent pneumonia

History	Explore the following	What do they imply
History of present illness	• Detailed cough history, pattern, relation to food or exercise, following colds and colour of sputum if productive. • Frequent posseting with occasional cyanosis post feeds • Paroxysmal cough	• May point towards GORD, asthma, reactive airway disease or pneumonia • Suggest laryngospasm or GORD • May suggest foreign body inhalation
Systemic review	• Frequent loose and offensive bowel motions with failure to thrive	• Suggestive of cystic fibrosis in Caucasian children
Birth history	• Term or preterm? • Required intubation? • Delay in passage of meconium	• Rule out chronic lung disease • Would suggest CF
Past medical history	• Age at which infections commenced	• If at younger age, may indicate congenital malformations
	• Any pattern of previous infections	• If following viral illness may suggest reactive airway disease
	• History of recurrent chest infections requiring admissions, nocturnal cough	• To confirm the diagnosis of RP and to exclude pneumonia
	• History of persistent diaharroea, cutaneous infections/abscess/boils etc.	• Suggestive of immunodeficiency
	• Other associated conditions such as dextrocardia	• Primary ciliary dyskinesia

	• History of exposure to chronic cough • History of continuous streaming runny nose with history of multiple perforated ear drum or multiple grommet insertion	• To rule out pulmonary T.B • Primary ciliary dyskinesia
Family and Social history	• Family history of Chronic coughs. • Family history of immunodeficiency • History of exposure to environmental tobacco smoking	• ? T.B • Rule out immunodeficiency • Would imply reactive airway disease or asthma
Drug History	• Use of Immunosuppressant • Use or prolonged courses of steroid	• Would indicate Immunodeficiency
Vaccination history	• Is the vaccination up-to-date	• For T.B, Pertussis, Hib

CF – Cystic fibrosis; GORD – Gastroesopghageal reflux disease; Hib – *Haemophalus influenzae* type b; RP – Recurrent pneumonia; T.B- Tuberculosis

History should include the age of the child when he encountered his first chest infection, as this might point towards associated congenital anomaly or a hereditary disorder. Detailed information regarding the cough nature, duration and pattern is of paramount importance. Nocturnal or early morning cough may be caused by bronchial asthma. In fact, several studies found that the commonest cause of RP is bronchial asthma. Studies done in Spain, Turkey and Haiti found that the incidence of asthma in children diagnosed with RP is 30%, 32% and 79%, respectively [1]. Paroxysmal cough is associated with foreign body in the respiratory tract while cough related to feeds or swallowing is important as it suggests gastroesophageal reflux, swallowing dysfunction or simply a poor feeding technique. A croupy cough implies involvement of the glottis or epiglottis. Presence of wheeze is also important, but not necessary to diagnose asthma or large airway obstruction, as in foreign body. Past history of recurrent skin infections or ear infections could be clues to an underlying immunological abnormality. History of immunosuppressant use or long courses of steroids is also important. Premature delivery and the need of home oxygen should also be explored as this might point towards chronic lung disease or bronchopulmonary dysplasia (BPD). Growth history is also helpful especially in those patients with pulmonary tuberculosis (TB) and, in Caucasian population, cystic fibrosis (CF). Family history of asthma, allergies, CF, immunological disorder or recurrent infections is also important. Social history is important too. Parental smoking increases the risk of all respiratory tract infections, particularly lower respiratory tract infections in children [4]. Paediatricians should always cease any opportunity of highlighting the risk of second hand smoking and recurrent chest infections in children. Presence of any pets in the house would suggest allergy and needs to be disclosed. Immunization history and demographic information of parents could also help with the diagnosis.

CLINICAL EXAMINATION AND INVESTIGATIONS

The second step in clinical evaluation should be clinical examination and investigations. Again this should be complete involving all the systems. A general look of the patient will give a good idea about any dysmorphic features, growth and the development of the child. Of course weight, height and head circumference and plotting these on the appropriate centiles is necessary. Presence of digital clubbing will help directing the rest of exam and the investigations as it may imply an underlying chronic suppurative lung disease or a cyanotic heart disease possibly with left-to-right shunt. Pallor, if found could also help, but central cyanosis is invaluable in diagnosis if detected. We should also remember that ENT exam is an important part of the respiratory system examination. Presence of nasal polyps is a well-known association with CF. One could also notice signs of rhinitis on nasal exam, as well as presence of allergic silhouette. Chronic rhinitis and hay fever may be associated with bronchial asthma. Posterior nasal dribbling is a known cause of recurrent chest infection. Ear exam should note presence of grommets or perforated eardrums. This will help in suspecting an underlying immunological problem.

Thorough chest exam looking for deformities scars from previous surgeries and listening for air entry crackles and wheeze will help in identifying the site of the infection, and obviously, this will be helpful when comparing to the previous records.

There are two main clinical groups that are described to have recurrent pneumonia:

Unilobar (localized disease) pneumonia

Recurrent pneumonia (RP) could affect the same or a different lobe, of which the causes and management are different (Figure 1).

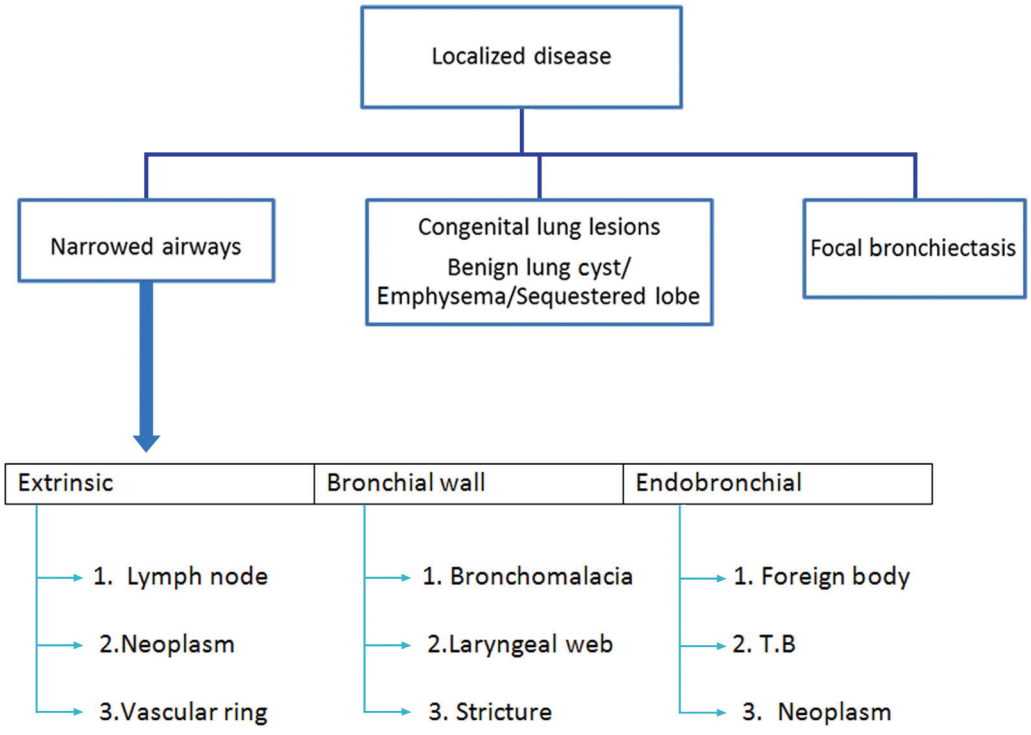

Figure 1 - Causes of unilobar disease

The differential diagnosis of a child with persistent or RP involving a single lobe of the lung may be due to intra or extra luminal bronchial obstruction and structural malformation of the bronchus, with the intra luminal obstruction being the commonest [3]. In children, the most important cause of intra luminal obstruction is a foreign body (Figure 2).

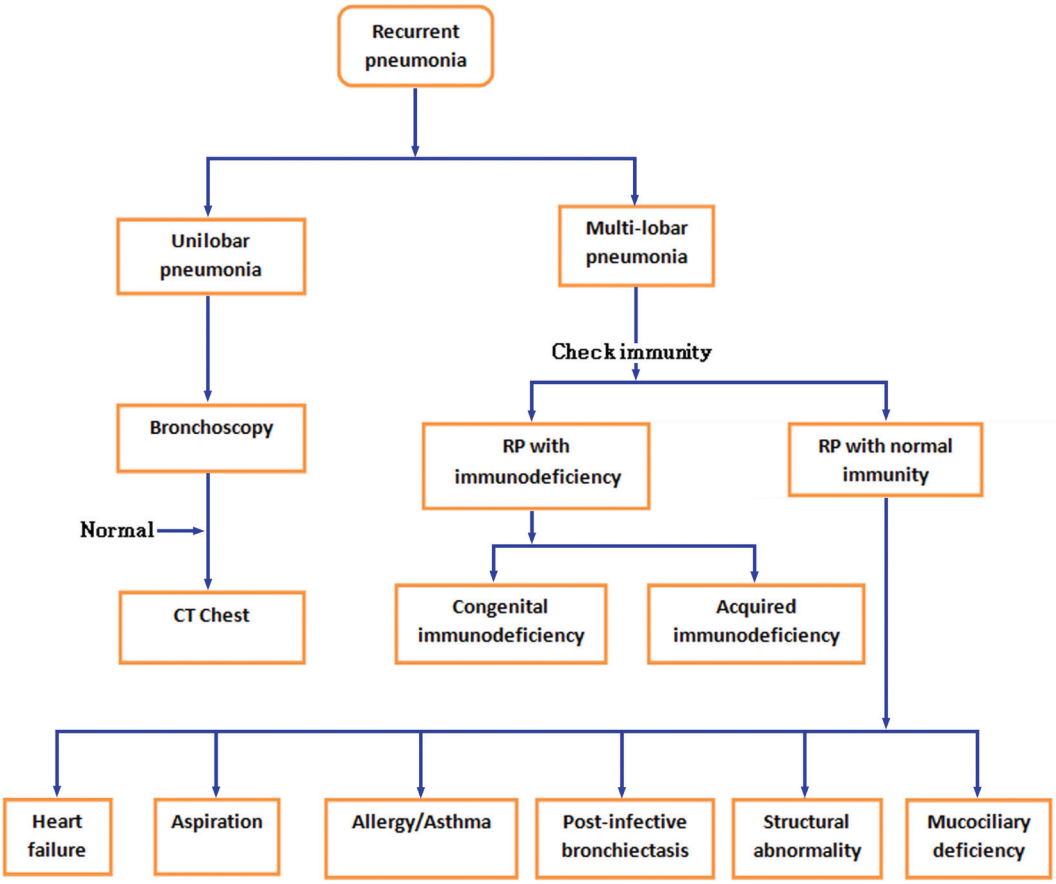

Figure 2 – Algorithm showing diagnostic approach to a child with recurrent pneumonia

The possibility of an inhaled foreign body (FB) should be considered in any young child who develops a persistent productive cough, particularly if there has been an acute onset after an episode of choking. First step in diagnostic workup is the flexible bronchoscopy. It is useful both in diagnosis and therapy. If no FB is found then broncho- alveolar lavage (BAL) or biopsy should be taken in other cases of endobronchial obstruction. Also a tracheal bronchus may be diagnosed by bronchoscopy. If bronchoscopy is normal then a chest computed tomography (CT) should be done. This will identify presence of extra luminal obstruction. When there is a space occupying lesion in CT scan, a bronchogenic cyst or sequestered lobe is suspected. An aortogram will be helpful to confirm the diagnosis of sequestered lobe.

Recurrent multi-lobar pneumonia

Multi-lobar pneumonia is either associated with normal or impaired immunity; which is either acquired or congenital. Some parents clearly describe a cough which first appeared with an acute infection

and which persisted for weeks or months since then. This is common after *Bordetella pertussis* (whooping cough) and *M. pneumonae* infections. With these pathogens the cough, which may be paroxysmal, may yield clear or white mucus. It is the result of the bronchial hyper-reactivity and impaired mucociliary clearance that follow the inflammation associated with these infections. The cough normally subsides within 2–6 months [5].

Prolonged infection e.g. pertussis, mycoplasma, respiratory syncytial virus (RSV) is a common cause of RP in developing countries. Post infective bronchiectasis is also known to follow pertussis, measles and TB [6].

In developed countries, aspiration is considered to be the commonest cause of RP [2]; this could be due to tracheoesophageal fistula, gastroesopghageal reflux disease (GORD) or due to oropharyngeal incoordination. Reflux should be confirmed by oesophageal PH study, while video fluoroscopy should be used to confirm dyscordination. Technetium milk scan, esophagoscopy and biopsy may be used if PH study is not conclusive, although in many cases the history would be sufficient.

Despite recent advances in care, many children referred with recurrent chest infections or a persistent cough will be shown to have undiagnosed asthma. Closer attention to the history reveals that most, but not all, have recurrent episodes of cough, wheeze and breathlessness. This is often associated with the characteristic trigger factors of upper respiratory tract infections (URTIs), exercise, cold air, emotional upset, or exposure to pets and other aero-allergens [4]. Asthma was the main reason of RP in studies from Italy, Turkey, Haiti, and Spain [7]. Peaked expiratory flow rate (PEFR) variation of 20% with good response to bronchodilator should be enough to diagnose asthma in older children.

If immunodeficiency state is suspected, then immunological work up should be carried out. This includes complete blood count (CBC) with immunoglobulin profile and IgG subsets to check for any immunoglobulin deficiency. Hyper gamma globulinemea is an important predictor of HIV infection. If that is normal, then antibodies response to tetanus, *Haempophilus Influenzae* type B and pneumococcal vaccine will detect any functional immunodeficiency status. Complement, and T and B subsets should also be done.

Workup for pulmonary TB is important. This includes sputum microscopy and culture, gastric aspirate, Manteaux test and even bronchoscopy and bronchoalveolar lavage. The latter sometimes aids in capturing the diagnosis by identifying endobronchial calcification and granuloma, which can be confirmed on cytology. In some areas, interferon gamma release assay (Quantiferon) is available and would add an important diagnostic value.

Cystic fibrosis is the commonest cause of chronic suppurative lung disease in Caucasian children; diagnosis is by sweat test and confirmation by genetics studies, where cystic fibrosis transmembrane regulator (CFTR) mutations can be identified. Although more common in Caucasians, it is also well described in the Middle East. In a study in the United Arab Emirates the commonest gene defects were found to be delta F508 and S549R (T->G) [8]. Abdul Wahab et al described a homozygous I1234V mutation in exon 19 in Qatari Bedouin tribe [9]. Paediatricians should be aware of existence of CF in children with recurrent chest infections, albeit rare when compared to other common infections.

Other tests to be considered include oxidative burst test previously known as nitro blue tetrazolium test (NBT) for chronic granulomatous disease and HIV serology. Ciliary ultrastructural evaluation can be completed after doing nasal and bronchial brushings and studying them under electron microscopy. Functional ciliary evaluation using ciliary beat frequency measurement can explain conditions

where the utrastructure is normal; however, there is dysfunctional rhythm of ciliary beat which results in ineffective airway clearance. Exhaled nitric oxide is also helpful as a screening tool for primary ciliary dyskinesia (PCD).

Owayed et al [2], in a study done in Canada, found the commonest cause of RP was oropharyngeal discordination. In such cases speech and language therapy is indeed very helpful. If any suspicion still exists, then video fluoroscopy will be the next step.

Other diagnoses to be considered include alpha-1 antitrypsin deficiency and pulmonary haemosidrosis; however, although rare in children the latter usually presents with a triad of anaemia, haemoptysis and pulmonary infiltrates. Non-pulmonary causes like left-to-right shunt should also be considered.

It is well appreciated that some of the above tests and evaluations can be very costly particularly in the Developing World healthcare systems; however in the majority of cases the diagnosis is made based on history and clinical examination. Nevertheless, it is equally important to raise the awareness, especially of young paediatricians, of the recent advances made in reaching a diagnosis for aetiology of RP in children if not clarified by conventional tests.

Remember, number of factors must be considered if a patient did not respond to treatment. These include development of empyema or bacterial resistance or non-bacterial aetiology like viral, or aspiration of FB or food [10]. Bronchial obstruction from endobronchial lesion, FB and mucous plug might also be a cause as well as a pre-existing diseases like immune deficiency, pulmonary sequestration, congenital malformation, cystic fibrosis and other non-infectious causes like bronchiolitis obliterance and aspiration.

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