Lower Respiratory Tract Infection in Children

Synonyms: chest infection, bronchitis, bronchiolitis, pneumonia

Lower respiratory tract infection (LRTI) is infection below the level of the larynx and may be taken to include bronchiolitis, bronchitis and pneumonia. The presentation of these conditions will depend on age, infecting organism and site of infection.

For laryngotracheobronchitis, see separate Croup article.

Epidemiology

Overall epidemiological data are poor because accurate diagnosis is limited by diagnostic methodology. The estimated incidence of LRTI is 30 per 1,000 children per year in the UK. UK data for children seen at hospital with pneumonia (clinical findings and CXR) in 2001-2002 found overall incidence rates of 14.4 per 10,000 in children aged 0-16 years per annum and 33.8 for those aged ≤5 years [1]. Boys were more often affected than girls, as were children born between 24-28 weeks when compared to those born at term.

Haemophilus influenzae infection is now quite rare amongst UK children because of immunisation.

Pathophysiology

There is no hard and fast definition of LRTI that is universally agreed upon. Essentially, it is inflammation of the airways/pulmonary tissue, due to viral or bacterial infection, below the level of the larynx. Remember that gastro-oesophageal reflux may cause a chemical pneumonitis. Moke and chemical inhalation may also cause pulmonary inflammation.

Viral infections[2]

About 45% of children hospitalised with pneumonia have a viral aetiology[3]. This includes:

- Influenza A
- Respiratory syncytial virus (RSV)[4]
- Human metapneumovirus (hMPV)[2]
- Varicella-zoster virus (VZV) - chickenpox.

Bacterial infections

These constitute about 60% of hospitalised pneumonia cases [3]:

- Streptococcus pneumoniae (the majority of bacterial pneumonias).
- H. influenzae.
- Staphylococcus aureus.
- Klebsiella pneumoniae.
- Enterobacteria - eg, Escherichia coli.
- Anaerobes.
Atypical organisms

- *Mycoplasma pneumoniae* (14% of all cases of hospitalised pneumonia in children[3]).
- *Legionella pneumophila*
- *Chlamydophila pneumoniae* (9% of hospitalised pneumonia in children[3]).
- *Coxiella burnetii.*

Secondary bacterial infection

This is relatively common following viral upper respiratory tract infection (URTI) or LRTI.

Presentation

Most often, LRTI is accompanied by fever and may be preceded by a typical viral URTI. It is important to assess all children with a fever accurately. National Institute for Health and Care Excellence guidance on the management of feverish illness in children has been produced[5]. Bacterial pneumonia should be considered in children when there is persistent or repetitive fever above 38.5°C together with chest recession and a raised respiratory rate[1].

In all age groups be aware that:

- Audible wheezing is not seen very often in LRTI (although it is common with more diffuse infections such as in *M. pneumoniae* and bronchiolitis).
- Stridor or croup suggests URTI, epiglottitis or foreign body inhalation.

History

Age and the type of LRTI will affect the symptoms and history.

- **Newborn and neonates** present with:
  - Grunting.
  - Poor feeding.
  - Irritability or lethargy.
  - Tachypnoea sometimes.
  - Fever (but neonates may have unstable temperatures, with hypothermia).
  - Cyanosis (in severe infection).
  - Cough (but this is unusual at this age).

  In this age group beware:
  - Particularly of streptococcal sepsis and pneumonia in the first 24 hours of life.
  - Chlamydial pneumonia, which may be accompanied by chlamydial conjunctivitis (presents in the second or third week).

- **Infants** present with:
  - Cough (the most common symptom after the first four weeks).
  - Tachypnoea (according to severity).
  - Grunting.
  - Chest indrawing.
  - Feeding difficulties.
  - Irritability and poor sleep.
  - Breathing, which may be described as ‘wheezy’ (but usually upper airway noise).
  - History of preceding URTI (very common).

  In this age group beware:
  - Atypical and viral infections (especially pneumonia) may have only low-grade fever or no fever.

- **Toddlers/preschool children:**
  - Again, preceding URTI is common.
  - Cough is the most common symptom.
  - Fever occurs most noticeably with bacterial organisms.
  - Pain (chest and abdominal) occurs more often in this age group.
  - Vomiting with coughing is common (post-tussive vomiting).

  Be aware that:
  - Lower lobe pneumonias can cause abdominal pain.
  - Severe infections will compromise breathing more.
Older children:
- There will be additional symptoms to those above.
- More expressive and articulate children will report a wider range of symptoms.
- Constitutional symptoms may be more vividly described.

Be aware that:
- Atypical organisms are more likely in older children.

Examination

- General points:
  - Examination can be difficult in young children (particularly auscultation).
  - A careful routine of observation is essential to identify respiratory distress early.
  - Pulse oximetry can be very useful in evaluation. Typically - in pneumonia, for example - oxygen saturation may be 95% or less.
  - High fever over 38.5°C may occur often.
  - Look for other diseases (for example, rashes, pharyngitis) with careful systematic examination.

The following are signs of respiratory distress:
- Cyanosis in severe cases.
- Grunting.
- Nasal flaring. In children aged under 12 months this can be a useful indicator of pneumonia.
- Marked tachypnoea (see below).
- Chest indrawing (intercostal and suprasternal recession).
- Other signs such as subcostal recession, abdominal 'see-saw' breathing and tripod positioning.
- Reduced oxygen saturation (less than 95%).

If this does not respond to oxygen and general support of the child's own respiratory effort, intubation is likely to be required. Intubation is required when the child's own breathing becomes ineffective (with, for example, hypoxia, rising carbon dioxide and reduced level of consciousness).

- Observation:
  - Further careful observation in good light, with the chest and abdomen uncovered, is essential.
  - Count respirations and note the respiratory rate (RR) - in breaths per minute. Tachypnoea is measured as:
    - RR >60/minute age 0 to 5 months.
    - RR >50/minute age 6 to 12 months.
    - RR >40/minute age over 12 months.
  - Observe the infant's feeding (to uncover decompensation during feeding).
  - Observe the chest movements (for example, looking for splinting of the diaphragm).

- Auscultation:
  - Examine with warm hands and a stethoscope.
  - Take the opportunity to examine a quiet sleeping child.
  - Concomitant upper respiratory noises can be identified by listening at the nose and chest.
  - Crackles and fever indicate pneumonia.
  - Crackles in the chest may indicate pneumonia, particularly when accompanied by fever.

- Percussion:
  - Identifies consolidation.
  - Consolidation is a later and less common finding than the crackles of a pneumonia.
  - Later in older children there may be dullness to percussion over zones of pneumonic consolidation.
  - Bronchial breathing and signs of effusion occur late in children and localisation of consolidation can be difficult to diagnose.

Differential diagnosis

- Asthma.
- Inhaled foreign body.
- Pneumothorax.
- Cardiac dyspnoea.
- Pneumonitis from other causes:
  - Extrinsic allergic alveolitis
  - Smoke inhalation
  - Gastro-oesophageal reflux

Investigations

- General points:
  - Few tests are particularly useful or required.
  - The most useful tests give quick and meaningful results.
• FBC:
  - White cell count is often elevated. Although this may be very noteworthy in certain infections (like pneumococcal pneumonia), it is useful only as a general guide to the presence of infection.
  - It is important in very ill children who may be immunocompromised.

• Microbiological studies:
  - Rarely indicated or of help in general practice.
  - Blood cultures are seldom positive in pneumonia (fewer than 10% are bacteraemic in pneumococcal disease).
  - Blood and sputum cultures should generally be reserved for atypical or very ill patients (particularly those who may be immunocompromised).

• Imaging:
  - CXR is not routinely indicated in outpatient management.
  - CXR cannot differentiate reliably between bacterial and viral infections.

• Other tests:
  - Tuberculin skin testing if tuberculosis is suspected.
  - Cold agglutinins when mycoplasmal infection is suspected (but only 50% sensitive and specific).
  - Urine latex agglutination tests may ultimately diagnose certain organisms but the tests take time and are rarely of use acutely.

• Diagnostic procedures:
  - Drainage and culture of pleural effusions may relieve symptoms and identify the infection.

Although pulse oximetry and blood CRP may be useful to assess whether a child presenting with a cough may have a serious LRTI, there is no strong evidence for these or any other specific indicators having a significant influence on prognosis in children with acute cough and respiratory tract infection in primary care[7].
Management

Decision to admit
Most children with LRTI and pneumonia can be treated as outpatients, with oral antibiotics. Older children can be managed with close observation at home if they are not distressed or significantly dyspnoeic and the child's carer(s) can cope with the illness. Viral bronchitis and croup do not require antibiotics and mild cases can be treated at home.

Admission is advised for severe LRTI. This is indicated by:\[1\]:

- Oxygen saturation <92%.
- Respiratory rate >70 breaths/minute (≥50 breaths/minute in an older child).
- Significant tachycardia for level of fever.
- Prolonged central capillary refill time >2 seconds.
- Difficulty in breathing as shown by intermittent apnoea, grunting and not feeding.

Presence of comorbidity - eg, congenital heart disease, chronic lung disease of prematurity, chronic respiratory conditions such as cystic fibrosis, bronchiectasis or immune deficiency should also prompt consideration of admission.

Admission should also be considered for:

- All children under the age of 6 months.
- Children in whom treatment with antibiotics has failed (most children improve after 48 hours of oral, outpatient antibiotics).
- Patients with troublesome pleuritic pain.

Physiotherapy has no place in treatment of uncomplicated pneumonia in children without pre-existing respiratory disease.

Before admission
Be sure to offer the child and their carer(s) general support, explanation and reassurance.

- Respiratory support as required, including oxygen.
- Pulse oximetry to guide management is helpful.
- Severe respiratory distress with a falling level of consciousness and failure to maintain oxygenation indicates a need for intubation.

In hospital

- Resuscitation and respiratory support as required.
- Intravenous access and fluids in severe cases.
- CXR confirmation of the diagnosis and identification of effusions and empyema.
Medication

- Antipyretics (avoid aspirin due to the danger of Reye’s syndrome).
- Antibiotic treatment:
  - It can be difficult to distinguish between viral and bacterial infection and young children can deteriorate rapidly, so consider antibiotic therapy (depending on presentation) and likelihood of bacterial aetiology.
  - Amoxicillin in a child-friendly formulation, should be used first-line, unless there is reason to suspect a penicillin-insensitive organism (particularly pneumococcal disease). Evidence shows that children with non-severe community-acquired pneumonia who receive amoxicillin for three days, do as well as those who receive it for five days [8].
  - If a child is genuinely allergic to penicillin, consider using a cephalosporin, macrolide or quinolone, depending on any local antibiotic prescription guidelines, patterns of resistance and suspected organism.
  - Vancomycin may be added to treatment of toxic-looking children when there is a high rate of penicillin resistance.
  - Aciclovir is used for herpes virus pneumonia.

Delayed antibiotics [9]

- One study looked at patients aged 3 years and older in UK primary care judged not to need immediate antibiotics for respiratory tract infections to compare four strategies of delayed prescription: re-contact for a prescription, post-dated prescription, collection of the prescription, and be given the prescription (patient led).
- During the trial, a strategy of no antibiotic prescription was added as another randomised comparison.
- The study found that strategies of no prescription or delayed antibiotic prescription resulted in:
  - Fewer than 40% of patients using antibiotics.
  - Less strong beliefs in antibiotics.
  - Similar symptomatic outcomes to immediate prescription.
- It was concluded that, if clear advice is given to patients, there is probably little to choose between the different strategies of delayed prescription.

Complications and prognosis

- Complete resolution after treatment should be expected in the vast majority of cases.
- Bacterial invasion of the lung tissue can cause pneumonic consolidation, sepsicaemia, empyema, lung abscess (especially S. aureus) and pleural effusion.
- Respiratory failure, hypoxia and death are rare unless there is previous lung disease or the patient is immunocompromised.

Prevention

- Prevention of pneumococcal pneumonia and influenza by vaccination, for high-risk individuals with pre-existing heart or lung disease.
- Smoking in the home is a major risk factor for all childhood respiratory infection.
- There is insufficient evidence to recommend zinc supplementation for reduction of the incidence of pneumonia [10].

Further reading & references

5. Fever in under 5s - assessment and initial management; NICE Guideline (updated August 2017).

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