Pneumonia

There are separate articles on Aspiration Pneumonia, Pneumocystis Jirovecii Pneumonia and Lower Respiratory Tract Infection in Children.

Pneumonia is characterised by acute inflammation with an intense infiltration of neutrophils in and around the alveoli and the terminal bronchioles. The affected bronchopulmonary segment or the entire lobe may be consolidated by the resulting inflammation and oedema.

Risk factors[1]

- Age: especially infants, young children and the elderly.
- Lifestyle: smoking, alcohol.
- Preceding viral infections - eg, influenza predisposing to *Streptococcus pneumoniae* infection.
- Respiratory: asthma, chronic obstructive pulmonary disease (COPD), malignancy, bronchiectasis, cystic fibrosis.
- Immunosuppression, AIDS, cytotoxic therapy - increased risk of infection with *Staphylococcus* spp., tuberculosis, Gram-negative bacilli and *P. jirovecii*.
- Intravenous drug abuse, often associated with *Staphylococcus aureus* infection.
- Hospitalisation - often involving Gram-negative organisms.
- Aspiration pneumonia: patients with impaired consciousness, neurological disease such as cerebrovascular or Parkinson's disease, or patients with oesophageal obstruction are at risk of aspiration pneumonia which usually affects the right lung and is caused by anaerobes from the oropharynx.
- Underlying predisposing disease: diabetes mellitus, cardiovascular disease.

Community-acquired pneumonia

This is defined as the presence of symptoms and signs consistent with acute lower respiratory tract infection in association with new radiographic shadowing for which there is no alternative explanation.[2]

Pathogenesis

The most likely organisms are: *S. pneumoniae*, S. aureus, *Mycoplasma pneumoniae*, *Haemophilus influenzae*, *Chlamydophila pneumoniae* and respiratory viruses.[3] Mixed pathogens occur up to 25% of the time.

Epidemiology[4]

- 0.5-1% of people develop community-acquired pneumonia (CAP) in the UK every year.
- 5-12% of adults who present to GPs with symptoms of lower respiratory tract infection are diagnosed with CAP. 22-42% of these are admitted to hospital.
- The mortality rate is between 5% and 14%.
- 1.2-10% of adults admitted to hospital with CAP are admitted to intensive care units and for these patients the risk of dying is more than 30%. More than 50% of deaths related to pneumonia occur in people over the age of 84.
- CAP results in about 100,000 hospital admissions each year in England. . Most episodes occur during the autumn or winter[5]

Presentation

- Symptoms: cough, purulent sputum which may be blood-stained or rust-coloured, breathlessness, fever, malaise.
- Diagnosis is unlikely if there are no focal chest signs and heart rate, respiratory rate and temperature are normal.
- The elderly may present with mainly systemic complaints of malaise, fatigue, anorexia and myalgia. Young children may present with nonspecific symptoms or abdominal pain.
- Signs: tachypnoea, bronchial breathing, crepitations, pleural rub, dullness with percussion.

Assessing whether patients with CAP need hospital admission [4]

The decision to admit is based on a variety of factors, including severity of illness, age, underlying health problems and social circumstances.

- The National Institute for Health and Care Excellence (NICE) recommends use of the CRB-65 score in conjunction with clinical judgement.
- A 4-point score system is used, one point for each of:
    - Confusion (abbreviated mental test score 8 or less, or new disorientation in person, place or time).
    - Respiratory rate 30 breaths/minute or more.
    - Systolic blood pressure below 90 mm Hg (or diastolic below 60 mm Hg).
    - Age 65 years or older.
- Patients who have a CRB-65 score of 0 are at low risk of mortality and should be considered for home care.
- Consider hospital admission for all other patients, particularly those who have a CRB-65 score of 2 or higher.

Management

Patients with suspected CAP should be advised not to smoke and to rest and drink plenty of fluids. Other general measures include: [4] [6]

- Oxygen for hypoxia; ventilation if there is severe hypoxia.
- Fluids for dehydration.
- Analgesics: non-steroidal anti-inflammatory drugs (NSAIDs) and paracetamol - for mild pleuritic pain; more severe pain may require opiate analgesia but care is needed not to aggravate CO_2 retention.
- Nebulised saline may help expectoration.
- Chest physiotherapy has doubtful benefit. Physiotherapy may be more important in helping to mobilise the patient, but a Cochrane review found no effect on reducing mortality. [7]

Those who fail to improve after 72 hours of treatment should be advised to seek further medical advice. All cases that cause concern should be considered for hospital admission. Community patients should be advised to return if their symptoms do not resolve after three weeks.

Antibiotics[4] [8]

- Antibacterials are recommended in all suspected cases of pneumonia, starting as soon as possible.
- Antimicrobial therapy should be based on the patient's characteristics, the setting in which aspiration occurred, the severity of pneumonia, and available information regarding local pathogens and resistance patterns.
- Low-severity CAP:
    - Offer a five-day course of amoxicillin, reserving clarithromycin, erythromycin (in pregnancy) or doxycycline for patients allergic to penicillin or if atypical pathogen suspected. Stop antibiotic after five days unless microbiology results suggest a longer course or the patient is not clinically stable.
- Moderate-to-severe CAP:
    - Patients with moderate-to-severe CAP are normally treated in hospital. However, there may be occasions (eg, refusal of a patient to be admitted) when the GP will be required to provide treatment.
    - For moderate-severity CAP, treatment should be as per low-severity CAP pending microbiology results.
    - For high-severity CAP a five-day course of co-amoxiclav with clarithromycin or erythromycin (in pregnancy) should be offered. The oral or intravenous route can be used. Obviously the latter may prove challenging in the community.
    - Levofloxacin orally or IV is an option for patients allergic to penicillin.

Pneumonias due to atypical pathogens[3] [8]

Pathogenesis

Formally known as 'atypical pneumonias', these are most commonly due to pulmonary infection with:

- *M. pneumoniae*
- *C. pneumoniae*
- *Legionella pneumophila*

Other micro-organisms that cause similar patterns of presentation via pulmonary infection include:

- *Chlamydophila psittaci* (exposure to birds, particularly ill ones, is a useful clue in the history).
- *Coxiella burnetii* (presenting as Q fever).
- Viral pneumonias including influenza A, severe acute respiratory syndrome (SARS), respiratory syncytial virus (RSV), adenoviridae and pneumonitis due to varicella (chickenpox pneumonitis).

Epidemiology

Atypical organisms might be implicated in approximately 20% of CAP.[9]

Risk factors

- Mycoplasma and chlamydophila spread by person-to-person contact and spread is most common in closed populations - eg, schools, offices.
- Legionellae are found most commonly in fresh water and man-made water systems.

Presentation

- ***M. pneumoniae***:[10]
    - Vague and slow-onset history over a few days or weeks of constitutional upset, fever, headache, dry cough with tracheitic ± pleuritic pain, myalgia, malaise and sore throat.
    - This is like many of the common viral illnesses but the persistence and progression of symptoms is what helps to mark it out.
    - In otherwise healthy individuals, it usually resolves spontaneously over a few weeks.
    - The hacking, dry cough can be very persistent.
    - Extra-respiratory features include rashes such as erythema multiforme, erythema nodosum and urticaria; neurological complications like Guillain-Barré syndrome, transverse myelitis, cerebellar ataxia and aseptic meningitis; haematological complications such as cold agglutinin disease and haemolytic anaemia; joint symptoms like arthralgia and arthritis; cardiac complications such as pericarditis and myocarditis; rarely, may cause pancreatitis.

- ***C. pneumoniae***: [11]

    - Gradual onset, which may show improvement before worsening again; incubation period is 3-4 weeks.
    - Initial nonspecific upper respiratory tract infection symptoms lead on to bronchitic or pneumonic features.
    - Most of those infected remain quite well or are asymptomatic.
    - Cough with scanty sputum is a prominent feature.
    - Hoarseness is a common feature.
    - Headache affects the majority of symptomatic sufferers.
    - Fever is relatively unusual.
    - Symptoms may drag on for weeks or months, despite a course of appropriate antibiotics.
    - Where it causes significant problems, this may be due to secondary infection or co-existing illness - eg, diabetes.

- ***L. pneumophila***: [12]

    - This tends to be the most severe of the pneumonias due to atypical pathogens. See the separate Legionnaires' Disease article.
    - Focal outbreaks centred around poorly maintained air-conditioning or humidification systems (although this is often noted retrospectively by public health physicians).
    - 2-10 days' incubation period.
    - Initial mild headache and myalgia leading to high fever, chills and repeated rigors; non-chest symptoms often predominate early on.
    - Cough is nearly always present, initially unproductive but may lead to expectoration later.
    - Dyspnoea, pleuritic pain and haemoptysis are not uncommon.
    - Gastrointestinal upset, such as diarrhoea, nausea and vomiting or loss of appetite/anorexia, may occur.
    - There may be neurological complications such as confusion, disorientation and focal neurological deficit.
    - Arthralgia and myalgia are often reported.
    - Severe complications include pancreatitis, peritonitis, pericarditis, myocarditis, endocarditis and glomerulonephritis.

Signs

- Vital signs should be checked.
- Look for evidence of extra-thoracic involvement if an atypical pathogen is suspected.
- On the whole, chest signs are not helpful. Indeed, it is often the discordance between the chest signs and the illness of the patient, or the floridity of initial CXR appearance, that raises the suspicion of an atypical pathogen.

- Nonspecific chest signs and evidence of consolidation may be found but this is much less common than in the 'standard' pneumonias.
- There may be signs in other systems, due to complications of the infection.

Management

Pneumonias due to atypical pathogens are usually treated as for other CAP, at least initially. There is little value in serological testing for most patients with CAP.[3]

- Doxycycline, clarithromycin and erythromycin (the preferred option in pregnancy), have been shown to be effective in the treatment of all three most common infective organisms. They should be considered in all cases of pneumonia (including community-acquired) where atypical pathogens are suspected.[8]
- Resistance to macrolides is a growing concern.[13]
- Severe legionella infections may require rifampicin as well as a macrolide[12] .
- Fluoroquinolones are also effective against all three of the common infective organisms.[8]

Hospital-acquired pneumonia[4] [14]

This is defined as a new infection of lung parenchyma appearing more than 48 hours after admission to the hospital.

- It occurs mostly in patients who are severely debilitated, immunocompromised or mechanically ventilated.
- Infection occurring less than five days after hospital admission is usually caused by *S. pneumoniae.*
- Infection occurring after this time is usually caused by *H. influenzae* , methicillin-resistant *Staphylococcus aureus* (MRSA), *Pseudomonas aeruginosa* and other non-pseudomonal Gram-negative bacteria.
- Hospital-acquired pneumonia is often caused by multiple organisms.

Differential diagnosis

- Different organism responsible.
- Pulmonary oedema.
- Pleural effusion.
- Pneumothorax.
- Pulmonary embolus.
- Asthma.
- COPD.
- Bronchiectasis.
- Fibrosing alveolitis.
- Neoplasm.
- Sarcoidosis.
- Pneumonia complication - eg, empyema, lung abscess.

Investigations[4]

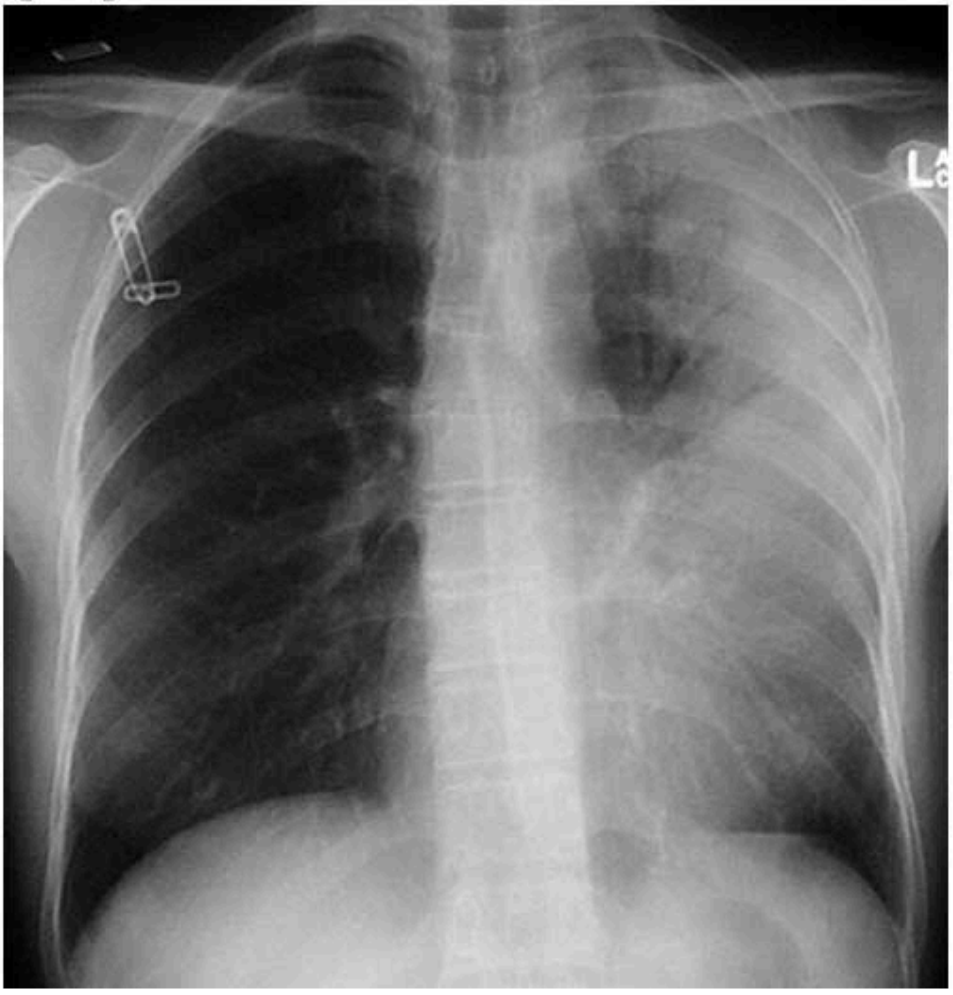
General investigations are not necessary for the majority of patients who are managed in the community. Pulse oximeters allow for simple assessment of oxygenation. When a patient is admitted to hospital:

- FBC with differential white cell count.
- CRP (to aid diagnosis and as a baseline measure).
- Renal function and electrolytes.
- LFTs.
- Blood cultures.
- Pneumococcal and legionella urinary antigen tests.
- CXR. (A follow-up CXR six weeks after recovery from pneumonia is recommended.)
- Sputum examination and culture.

- Pulse oximetry or blood gases.
- Aspiration of pleural fluid (for biochemistry and culture).

Left upper lobe pneumonia

(a)



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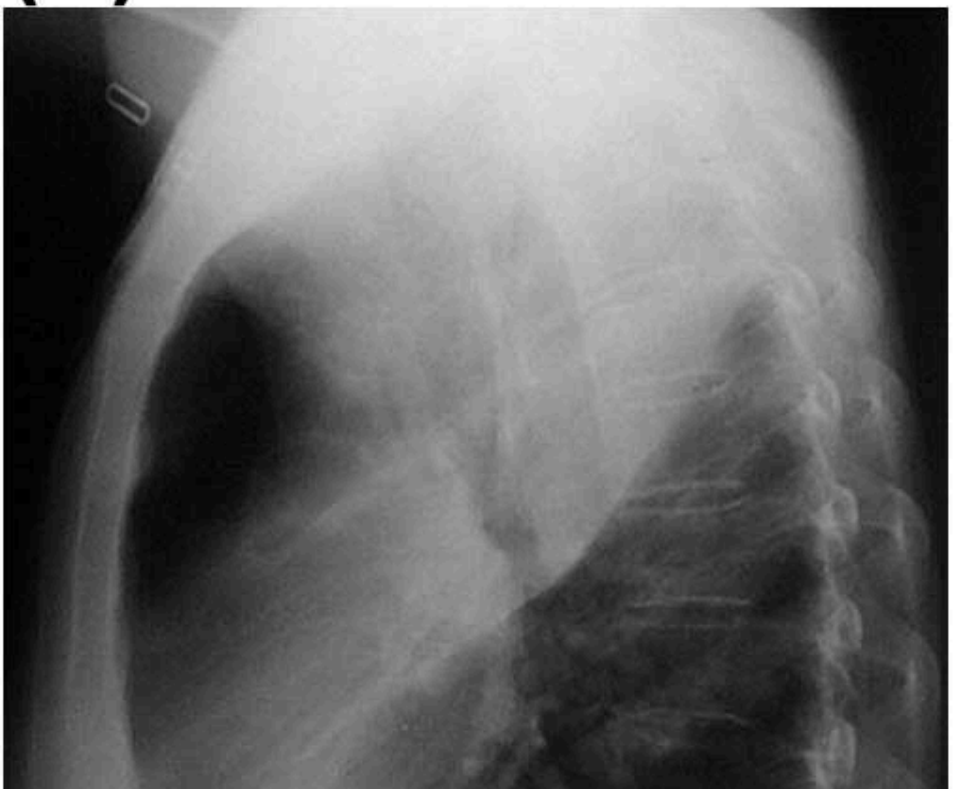

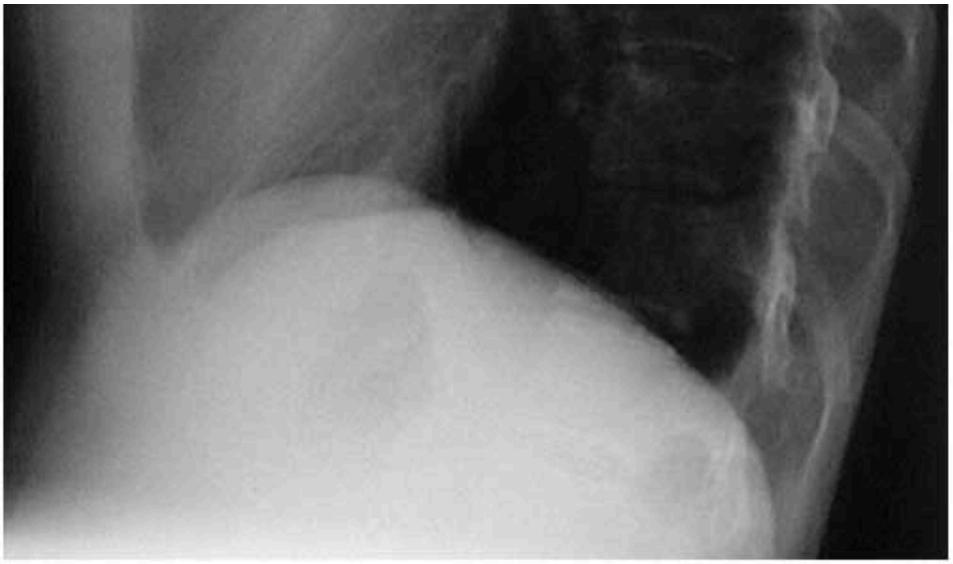

Complications

- Pleural effusion that is usually sterile.
- Empyema: a reactive effusion can occur but is trivial. Empyema is potentially more serious and presents as the persistence of fever and leukocytosis after 4-5 days of appropriate antibiotic therapy.
- Lung abscess: can occur in disease due to *S. pneumoniae* and is classically seen in patients with klebsiella or staphylococcal pneumonia.
- Pneumatocele.
- Pneumothorax.
- Pyopneumothorax - eg, following rupture of a staphylococcal lung abscess in the pleural cavity.
- Deep vein thrombosis.
- Septicaemia, pericarditis, endocarditis, osteomyelitis, septic arthritis, cerebral abscess, meningitis (particularly in pneumococcal pneumonia).
- Postinfective bronchiectasis.
- Acute kidney injury.

Prognosis

Mortality from CAP is less than 1% in those well enough to be managed in the community.[15] The mortality rate in patients admitted to hospital is 5-10% in those not requiring intensive care unit admission, as high as 25% in intubated patients and nearly 50% in intensive care unit patients requiring administration of vasopressor.[16]

Legionella has the most severe course and may cause significant morbidity if not treated early. A meta-analysis of patients on two different treatment regimes reported that those taking quinolones had a mortality rate of 4% and those taking macrolides had a mortality rate of 10.9%.[17]

Prevention

- Early appropriate antibiotic therapy reduces mortality and morbidity.
- Influenza and pneumococcal vaccination.
- Targeted risk reduction, such as smoking cessation.

Further reading

- Respiratory tract infections (self-limiting): prescribing antibiotics; NICE Clinical Guideline (July 2008)
- Pneumonia in adults; NICE Quality standard, January 2016
- Heo JY, Song JY; Disease Burden and Etiologic Distribution of Community-Acquired Pneumonia in Adults: Evolving Epidemiology in the Era of Pneumococcal Conjugate Vaccines. Infect Chemother. 2018 Dec;50(4):287-300. doi: 10.3947/ic.2018.50.4.287.

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