

Pneumonia

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Abstract

Pneumonia is still an important cause of morbidity and mortality worldwide in young and elderly individuals. Management depends on the likely aetiology and severity, which also form the basis of national and international guidelines. This article provides a summary of the key aspects of pneumonia, including aetiology, pathology, diagnosis and management, and highlights recent changes in UK guidelines. In addition, preventive strategies such as vaccination and the potential role of newly discovered biomarkers in the management of pneumonia are discussed.

Keywords Antibiotics; bacterium; community-acquired pneumonia; pneumonia; productive cough; *Streptococcus pneumoniae*; vaccine; viral pneumonia

Introduction

The World Health Organization (WHO) defines pneumonia as a form of acute respiratory infection that affects the lung parenchyma and oxygenation. Diagnosis is based on clinical appearance confirmed by a chest X-ray showing new shadowing. The primary causes are bacteria, but other microorganisms can also cause it. Pneumonia is classified as: community-acquired pneumonia (CAP); hospital-acquired pneumonia (HAP) when it occurs 48 hours after admission to hospital; and ventilator-associated pneumonia (VAP) when HAP develops more than 48 hours after endotracheal intubation. Management depends on the likely causative pathogen and the clinical condition of the patient.

Epidemiology

The incidence of pneumonia varies according to geographical location, healthcare setting and population. Lower respiratory tract infections including pneumonia are the fourth most common cause of death globally. The incidence of pneumonia was last estimated by the WHO in 2008, with 450 million cases and 4 million deaths annually. CAP is the most common cause of infection-related mortality worldwide, the estimated incidence in Europe and North America being 5–11 per 1000 adults.¹

In the UK, the annual incidence of CAP is between 0.5% and 1%. Most cases are managed in the community; hospitalization is required for 22–42% of patients, with an increased mortality

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Key points

- Pneumonia is still an important cause of morbidity and mortality in elderly individuals despite the widespread use of vaccines in this group and in children
- Clinical severity scores such as CURB-65 must be used in conjunction with clinical judgement; they often underscore younger patients (<30 years old)
- When choosing treatment, know local patterns of aetiology (most common being pneumococcus and influenza) and resistance but do not forget *Mycobacterium tuberculosis* and atypical organisms
- Be aware of the 'Sepsis-6' guidelines
- HIV testing of all patients with community-acquired pneumonia should be encouraged
- The National Institute for Health and Care Excellence published a pneumonia guideline in 2014, and the British Thoracic Society published community-acquired pneumonia guidelines in 2009

rate of 5–14%. Admission to the intensive care unit (ICU) is necessary for 1.2–10.0% of hospitalized patients; in this circumstance, the mortality rate can increase to more than 30%. More than half of pneumonia-related deaths occur in patients over 84 years of age.² However, according to British Thoracic Society (BTS) audits, a decrease in the 30-day mortality rate has been shown since 2009.

Pathology and pathogenesis

Pneumonia is caused by the invasion and overgrowth of pathogens in the lung parenchyma, resulting in intra-alveolar exudates. Pathogens usually enter the lower respiratory tract by micro-aspiration. Pneumonia can develop when the natural defence mechanisms (innate or acquired) are defeated and/or particularly virulent pathogens penetrate the lungs. Alternative ways of acquiring it are via the bloodstream from other sites or by direct spread from an infected source. Infection can also spread from the lungs, causing complications such as bacteraemia, sepsis, meningitis, empyema and septic embolism. As a result of acute inflammatory response to pneumonia, certain immune cells, such as neutrophils, migrate into the lung air space to kill pathogens (by phagocytosis and neutrophil extracellular traps composed of a chromatin meshwork containing antimicrobial proteins, which ensnare and kill extracellular bacteria).

Although the most common causes of pneumonia are bacteria (Table 1), especially *Streptococcus pneumoniae*, influenza plays an important role by allowing bacterial invasion. Studies have shown that reducing the rate of influenza (e.g. by vaccination strategies) can reduce the burden of bacterial pneumonia.³

Aetiology of community-acquired pneumonia in a Spanish study ($n = 1463$)

| Bacteria | Percentage |
|---------------------------------|------------|
| <i>Streptococcus pneumoniae</i> | 42 |
| <i>Haemophilus influenzae</i> | 5 |
| <i>Moraxella catarrhalis</i> | 0.3 |
| <i>Staphylococcus aureus</i> | 2 |
| 'Atypical' bacteria | 18 |
| <i>Legionella pneumophila</i> | 8 |
| <i>Mycoplasma pneumoniae</i> | 4 |
| <i>Chlamydia pneumoniae</i> | 3 |
| <i>Coxiella burnetii</i> | 2 |
| Gram-negative enteric bacilli | 2 |
| <i>Pseudomonas aeruginosa</i> | 3 |
| Viruses | 10 |
| Mixed | 14 |
| Other | 4 |

Table 1

The incidence of CAP increases with age and in the winter months. The aetiology and mortality rate vary according to geographical location. Certain factors and co-morbidities can also predispose patients to developing pneumonia (Table 2).

Diagnosis and management

National and international guidelines are available to advise on the management of pneumonia. A recent comparison of the two core UK guidelines (BTS 2009 and National Institute for Health and Care Excellence (NICE) 2014) showed that there were no discrepancies in terms of the key aspects of CAP management. Minor differences were noted in the timings of patient reviews, duration of antibiotic therapy in low-severity cases and legionella testing; adherence to the NICE 2014 guidelines is recommended.⁴

Signs and symptoms

Productive cough is the most common presenting symptom of bacterial pneumonia. The colour of the sputum can suggest the responsible pathogen, for example rust-coloured sputum with *S. pneumoniae*, green sputum with *Pseudomonas aeruginosa*, redcurrant-jelly sputum with *Klebsiella* and bad-smelling or bad-tasting sputum with anaerobes.

No individual clinical finding can form the diagnosis of pneumonia. A sudden onset of symptoms and rapid illness progression are associated with bacterial pneumonia. Viral pneumonia usually presents with a slow onset of upper respiratory tract infection and wheezing and is more common in children.

Chest pain, dyspnoea, haemoptysis, decreased exercise tolerance and abdominal pain from pleuritis are also highly indicative of pulmonary progress. Fever, rigors or shaking chills, and malaise are also common in pneumonia. For unclear reasons, the presence of rigors often suggests pneumococcal pneumonia. Other non-specific symptoms include myalgia, headache, abdominal pain, nausea, vomiting, diarrhoea, weight loss and altered sensorium. The very young and the very old can present with non-specific symptoms.

A detailed history should extend to recent foreign travel, co-morbidities and social factors to aid the diagnosis and identify the most likely causative agent.

On examination, abnormal pulmonary findings with reduced expansion, crackles, bronchial breathing, reduced breath sounds and lymphadenopathy are the most common findings. High or low temperature, tachypnoea, use of accessory muscles, tachycardia, central cyanosis and altered mental status also frequently occur.

Investigation

Investigations are not necessary for classic uncomplicated, low-severity CAP in the community.

In hospital, a plain chest radiograph (Figure 1) will differentiate lobar and bronchopneumonia and it can reveal cavitation, effusion or air bronchograms. Lobar consolidation is often caused by pneumococcal pneumonia. Further imaging, for example ultrasonography or computed tomography, can be warranted in certain situations. Blood tests, including full blood

Factors associated with community-acquired pneumonia

Co-morbidities

- Previous pneumonia
- Chronic obstructive pulmonary disease, asthma
- Heart failure
- Diabetes mellitus
- Cerebrovascular disease/stroke or dementia
- Immunosuppression (cancer, HIV infection)
- Chronic liver disease
- Chronic renal disease
- Aspiration risk factors (seizure disorders, dysphagia/reflux)

Social factors

- Smoking
- Alcoholism
- Poor dental hygiene
- Poor nutritional status
- Drug use

Other factors

- Contamination of air conditioning or warm water systems (*Legionella pneumophila*)
- Overcrowded institution (*mycobacteria*)
- Non-human hosts
 - Cats, goats (*Coxiella burnetii*)
 - Birds (*Chlamydia psittaci*)
 - Rabbits, rodents (*Francisella tularensis*, *Yersinia pestis*)

Table 2

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