Today's Treatment

Diseases of the respiratory system

Pneumonia

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Inflammation of the lung may be caused by allergic reactions (alveolitis), chemical or physical agents (pneumonitis), and infections (pneumonia). The present review deals only with pneumonia, defined as an acute inflammation of the lung due to invasion by micro-organisms.

Causative agents

The classical division into lobar and bronchial pneumonia is now of little practical value—management chiefly depends on whether the pneumonia occurs in a healthy person or in a patient already sick from other causes. Pneumonia arising at home in a previously healthy person, perhaps with an upper respiratory infection or an influenza-like illness, is usually caused by *Streptococcus pneumoniae*, a virus, or *Mycoplasma pneumoniae*. *Staphylococcus aureus* is an important cause of pneumonia during influenza epidemics, and pneumonia in previously fit children can result from *Haemophilus influenzae* infection. Rare causes of pneumonia in otherwise healthy people include psittacosis (caused by a chlamydia), Q fever (caused by rickettsia), and legionnaire's disease (caused by a bacterium).

When chronic disease has lowered the patient's local bronchial defences or general resistance pneumonia can be caused by various organisms, including some with no special affinity for the lungs. Conditions predisposing to such infection are chronic bronchopulmonary disorders, diabetes, malnutrition, alcoholism, prolonged immobilisation, and suppression of immunity either by disease—for example, leukaemia—or by treatment—for example, corticosteroids after an organ transplant. Inhaling organisms from the alimentary tract may cause pneumonia in patients with mouth infections, neurogenic dysphagia, or oesophageal reflux.

The organisms most often responsible for pneumonia in patients with pre-existing disease are *Strep pneumoniae*, *Staph aureus* (often penicillin resistant), and, in patients with bronchitis especially, *H influenzae*. Less common causes are *Strep pyogenes*, *Mycobacterium tuberculosis*, *Klebsiella* spp, and Gram-negative bacilli such as *Pseudomonas aeruginosa*, *Escherichia coli*, and *Proteus* spp. Coliform organisms contribute especially to pneumonia of alimentary origin but are sometimes recovered from the sputum of patients already receiving antibiotics, when they are more often part of the secondary throat flora. When

pneumonia is complicated by lung abscess, anaerobic bacteria often predominate. Immunosuppressive drugs pave the way for "opportunistic" infection of the lung by organisms that rarely cause pneumonia in other circumstances. These include bacteria such as nocardia, cytomegalovirus, fungi (candida and aspergillus), and protozoa (*Pneumocystis carinii*). In all these cases infection with two or more organisms is common.

Diagnosis

Pneumonia should be suspected in any patient who develops cough with fever, especially when accompanied by rigors, pleuritic pain, dyspnoea, rapid breathing, or cyanosis. Focal signs of consolidation or pleural friction are often delayed or absent, and the elderly or infirm may have no fever. The sputum may be purulent in patients with pre-existing bronchial disease and profuse, watery, and "rusty" in those with an overwhelming infection. In other cases sputum may be difficult to obtain during the early stages of the disease, especially when coughing is inhibited by pleuritic pain. Nevertheless, an attempt should always be made to collect a sample of sputum for microscopy and culture before an antibiotic is given. If necessary the patient may be encouraged to cough while lying with the painful side upwards; with each cough the attendant firmly supports the affected side with both hands. The sputum sample should be collected in a sterile container and delivered to the nearest laboratory within two hours. In hospital, and especially when the patient has not responded to standard antibiotic treatment, secretions may be recovered by laryngeal swab, percutaneous tracheal puncture, or even needle aspiration of the lung. If the pneumonia is complicated by pleural effusion a sample of this should be withdrawn for microscopy and culture.

Before antibiotics are given blood also must be taken for culture and determination of differential white cell count and agglutinins (virus, mycoplasma, etc). A sample of 12 ml of blood is withdrawn under sterile conditions, 2 ml being injected into each of two blood culture bottles, 4 ml into an anticoagulant tube, and 4 ml into a plain tube for dispatch to the virus reference laboratory (a second sample will be needed for virus studies during convalescence to show whether there is a rising antibody titre).

Antibiotic treatment can then be prescribed while the remaining investigations are arranged. These should include postero-anterior and lateral chest radiographs to show any consolidation and rule out conditions that can either simulate pneumonia—for instance, pulmonary infarction, collapse, and pneumothorax—or predispose to it—for instance, bronchiectasis, neoplasm, and tuberculosis). An electrocardiogram may help to exclude myocardial ischaemia, show whether there is any right ventricular strain, or elucidate a dysrhythmia. If facilities

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are available a sample of arterial blood should be obtained for PCO_2 and PO_2 measurements, especially from patients with chronic lung disease, to indicate whether oxygen treatment is necessary (and safe). The respiratory rate (as well as the heart rate and temperature) should be recorded at four-hourly intervals, or more often in the seriously ill.

Treatment

Treatment of pneumonia includes eradicating infection, correcting hypoxia, relieving cough and pleuritic pain, and managing complications. The decision whether to move the patient to hospital will obviously depend on such factors as the length of the journey and whether there is a competent attendant at home. Clinical indications for transfer include signs of respiratory failure such as cyanosis, drowsiness and confusion, lack of any response to antibiotic treatment within 48 hours, fever persisting for more than four or five days, and certain complications (see below). Although these are more likely in patients with pre-existing lung disease, they may also occur in previously symptomless people with some unusually virulent infection or undetected impairment of resistance.

INFECTION

Treatment of the infection with antibiotics should start at the earliest possible moment—which ideally is immediately after samples have been taken for culture but, necessarily, before the results are available. Choice of the initial antibiotic (see table) is based on clinical judgment combined with any microscopic evidence available. The relevant clinical criteria include the severity of the illness and, in particular, whether there are any signs of bacteraemia—for example, rigors, “shock,” and extrapulmonary infection—or respiratory failure—for example, extreme dyspnoea, cyanosis, confusion, and impaired consciousness. Other important factors are the previous health of the patient (both general and respiratory), whether he is currently taking (or has recently taken) antibiotics, and whether he is at home or in hospital. Microscopic examination of sputum or pleural fluid with appropriate stains provides clues to the nature of the prevailing organism—coccal or bacillary, Gram-positive or Gram-negative, or acid-fast or otherwise. Pus cells in the sputum confirm that infection is bacterial rather than viral.

There is now such a variety of potent and relatively safe broad-spectrum antibiotics that most doctors are reluctant to choose a drug effective only against the most “likely” organism. For example, pneumonia in a previously healthy person with

pus cells and diplococci in the sputum is almost certainly due to *Strep pneumoniae*, and the antibiotic of choice is benzylpenicillin. But when flu-like symptoms are more prominent than focal symptoms or signs and the sputum is scanty, with no organisms or pus cells, a virus, mycoplasma, or other non-bacterial infection is likely, which may respond to either tetracycline or erythromycin (see table). As organisms resistant to penicillin, tetracycline, and erythromycin can cause a life-threatening pneumonia even in previously healthy people, however, initial treatment should always include a broad-spectrum antibiotic such as amoxycillin 500 mg thrice daily (or co-trimoxazole two tablets thrice daily for patients allergic to the penicillins) until the result of sputum cultures is known.

Pneumonia complicating pre-existing lung disease or developing in a patient already in hospital is unlikely to respond to benzylpenicillin or the tetracyclines, and such patients may already have been treated with either amoxycillin or co-trimoxazole. They should take either amoxycillin, 500 mg, or co-trimoxazole, two tablets (whichever the patient has not recently received), thrice daily. Microscopy of the sputum may help. Clumps of Gram-positive cocci will alert the doctor to the possibility of a penicillin-resistant staphylococcal infection and the need for flucloxacillin, while Gram-negative rods would justify gentamicin (see below). A few patients with chronic bronchitis who present with pneumonia will be known to have had persistent infection with *H influenzae*, resistant to both amoxycillin and co-trimoxazole, and for these chloramphenicol, 500 mg six-hourly, may justifiably be prescribed.

Acute fulminating pneumonia accompanied by signs of respiratory or circulatory failure is usually caused by penicillin-resistant staphylococci or Gram-negative organisms. Such patients should have emergency intravenous treatment with flucloxacillin, 500 mg six-hourly, and either gentamicin or tobramycin, 120 mg eight-hourly. For patients allergic to penicillin, cephaloridine, 1 g eight-hourly, or lincomycin, 600 mg eight-hourly, can be given (again intravenously) instead of flucloxacillin to deal with Gram-positive bacteria such as *Staph aureus* and *Strep pneumoniae*.

The optimum duration of antibiotic treatment depends on the response of the patient and the nature of the infection. Generally, the initial drug regimen should not be changed for at least 48 hours and then only if the patient has shown no sign of clinical improvement. When the identity and antibiotic sensitivity of any organisms cultured are known, the antibiotics may be changed accordingly. Treatment should then be continued for a minimum of five days or until the patient has been afebrile for 48 hours, whichever is the longer. If fever, purulent sputum, or other evidence of infection continues for more than a few days further cultures should be prepared in case infection by a different organism has supervened. Five days' treatment may

Antibiotics for pneumonia

Antibiotic	Dose (by mouth unless shown otherwise)	Indications	Side effects and contraindications
Amoxycillin or ampicillin	500 mg thrice daily 1 g four times daily	First choice, except in cases of penicillin allergy and for patients not responding to these antibiotics	Drug rash
Co-trimoxazole	2 tablets thrice daily	First choice in cases of penicillin allergy and for patients not responding to ampicillin (also effective against <i>Pneumocystis carinii</i>)	Drug rash
Gentamicin or tobramycin	80-120 mg 8-hourly IV 80-120 mg 8-hourly IV	Fulminating pneumonia (with flucloxacillin) and for Gram-negative infections with bacteraemia or resistant to other antibiotics	Impaired renal or vestibular function
Flucloxacillin	500 mg 6-hourly IV	Fulminating pneumonia (with gentamicin) and for penicillinase-producing staphylococcus infections	Drug rash
Lincomycin or cephaloridine	600 mg 8-hourly IV 1 g 8-hourly IV	Substitutes for flucloxacillin in cases of penicillin allergy	Impaired renal function (cephaloridine)
Chloramphenicol	500 mg four times daily	Haemophilus infection resistant to other antibiotics	Marrow suppression
Erythromycin	500 mg four times daily	Non-bacterial pneumonia—for instance, mycoplasma pneumoniae, psittacosis, Q fever, and legionnaire's disease	Tetracycline only: pregnancy, childhood, hepatic failure
or oxytetracycline	500 mg four times daily	Tuberculous pneumonia	Isoniazid: peripheral neuropathy
Isoniazid	100 mg thrice daily		Rifampicin: hepatic failure
Rifampicin	450-600 mg daily		Streptomycin: Impaired renal or vestibular function
Streptomycin	500 mg twice daily IM		
Metronidazole	400 mg 8-hourly	Anaerobic infections (as in lung abscess)	

IV = Intravenously.
IM = Intramuscularly.

be enough in an otherwise healthy patient with pneumonia localised to one part of the lung, but otherwise it should be continued for 7-10 days. Several weeks' treatment may be needed for widespread destructive pneumonia with abscess formation—for example, staphylococcal—and in tuberculous infection the drugs are given for 6-12 months or longer.

HYPOXIA

Oxygen is needed only when the arterial oxygen tension falls to less than 10 kPa. If blood gas measurements are not available oxygen should be given to patients who are breathless and to those with either tachypnoea or tachycardia out of proportion to fever. Cyanosis may not be detected, especially in artificial light, until the P_{aO_2} is already dangerously low; so the doctor should not be reassured by its apparent absence.

The optimum method of oxygen delivery, like the choice of antibiotic, depends on the previous health of the patient. Acute severe pneumonia in a patient without chronic airflow obstruction should be treated with oxygen delivered at a rate of 6-8 l/min through a well-fitting mask. Some patients prefer nasal catheters to a mask, and this method of delivery is usually adequate in milder cases. When pneumonia complicates chronic airflow obstruction due to bronchitis, asthma, or emphysema, hypoxia may be profound but there is often chronic hypercapnia as well (P_{aCO_2} greater than 6.5 kPa). In this case the respiratory centre may have become insensitive to further rises in P_{aCO_2} and dependent instead on the drive of hypoxia. Liberal amounts of oxygen may thus diminish respiratory effort and lead to increasing carbon dioxide narcosis. Oxygen should then be delivered in amounts sufficient to preserve the function of vital organs such as the brain, heart, and kidneys but not enough to depress respiration. This can usually be achieved with an oxygen concentration of about 28-30% delivered by a mask in which the oxygen flow draws air in from the atmosphere by the Venturi principle (Ventimask). Patients who will not tolerate a mask may obtain a similar concentration of oxygen from nasal catheters with an oxygen flow rate of 2-3 l/min. Even with this low concentration of oxygen, a close watch must still be kept for carbon dioxide narcosis with half-hourly observations of respiratory rate and level of consciousness.

COUGH AND PLEURITIC PAIN

In the early stages of pneumonia cough is usually unproductive and sometimes painful. Pain may not only exhaust the patient but also aggravate hypoxia by causing rapid shallow breathing with inadequate alveolar ventilation. If pain is not relieved by local application of heat and a simple analgesic such as dihydrocodeine tartrate (DF 118) or dextropropoxyphene

hydrochloride (Distalgic) then pentazocine hydrochloride (Fortral), 50-100 mg, may be used. Linctus codeine (BNF) is prescribed for cough or, alternatively, either pholcodine BPC, 4 ml, or methadone linctus BPC, 4 ml.

Most drugs that effectively abolish cough or relieve pain are potentially addictive and may also depress the respiratory centre. The most potent of these drugs, notably morphine and pethidine, should therefore be used only for severe symptoms and over a short period and must not be given to patients with chronic airways disorders, especially asthma.

COMPLICATIONS

Complications of pneumonia that may need treatment during the acute illness include pleural effusion and empyema, respiratory and cardiac failure, and the extrathoracic manifestations of bacteraemia.

Aspirating a pleural effusion may be necessary for diagnosis (see above), and to relieve dyspnoea or treat empyema. Generally, an effusion should be aspirated if its radiographic size suggests that it could be located without difficulty. If the fluid is turbid 1 megaunit of benzylpenicillin should be injected into the pleural cavity after a sample has been saved for microscopy and culture. Further aspirations, with instillation of the appropriate antibiotic (determined by the fluid culture results) are carried out until no more fluid can be recovered. The patient is then either better or in need of surgical drainage. Empyema is today a rare complication of pneumonia except in patients already ill from other causes.

Respiratory failure may be of two types: acute fulminating pneumonia with "flooding" of the lungs and pneumonia complicating diseases associated with chronic airflow obstruction. In the first type life is threatened by a profound hypoxia due to the massive exudation in the lungs themselves. In addition to antibiotics and oxygen, this condition justifies corticosteroids (intravenous hydrocortisone, 200 mg four-hourly) to suppress the excessive inflammatory reaction. Pneumonia is also a common precipitating cause of respiratory and cardiac failure in patients with pre-existing lung or heart disease; these complications are treated in the usual way with bronchodilators, digitalis, diuretics, and so on. Tracheal intubation to aspirate secretions from the airways and intermittent positive-pressure respiration may be needed as life-saving measures in the most severe cases.

Bacteraemia in the acute stage of pneumonia may cause "shock" with hypotension and peripheral circulatory failure. This calls for supportive measures such as intravenous infusions and possibly corticosteroids as well as the appropriate antibiotics. Metastatic infections such as cerebral abscess, meningitis, and peritonitis are now rare complications of pneumonia and their management is beyond the scope of this review.

In looking for treatable causes of presenile dementia we are asked to exclude normal-pressure hydrocephalus. What is a simple screening test for this condition, and when discovered how may it be treated?

There is no simple or inexpensive test for recognising communicating hydrocephalus. The best hope is clinical suspicion. The dementia is normally of recent onset, usually less than a year. The mental impairment is accompanied or preceded by apraxia of gait, which is not quite like the ataxia caused by cerebellar disease or defects in proprioception. It is commonly described as unsteady or uncertain. An early feature is incontinence, which is usually out of proportion to the degree of dementia. There may be a history of head injury, meningitis, or subarachnoid haemorrhage. Cerebrospinal fluid (CSF) pressure is normally below 200 mm of CSF.¹ Only computerised tomography or air studies can diagnose the condition with certainty. The latter are dangerous and may provoke rapid deterioration, with akinetic mutism. The insertion of a ventriculoatrial shunt improves some patients—

probably those whose disturbance of gait preceded the mental change. Some patients improve rapidly after 20-30 ml of cerebrospinal fluid has been removed, and these are the ones who will benefit by shunting.²

¹ *Lancet*, 1977, **2**, 1011.

² Fisher, C. Miller, *Lancet*, 1978, **1**, 37.

House dust mite allergy is a common cause of suffering. Is there any commercially available insecticide that is effective against the house dust mite yet non-toxic to man?

There was interest a few years ago in finding an insecticide suitable for use in the home against the house dust mite. Although several insecticides were effective, none were suitable without further development by the manufacturers. We know of no further work on them, and there is no commercially available product.