A hospital study of community acquired pneumonia in the elderly

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Abstract

Studies on community acquired pneumonia in the United States in patients over the age of 65 years have shown that Gram negative bacilli account for an appreciable proportion of cases, in addition to usual pathogens such as *Streptococcus pneumoniae* and *Haemophilus influenzae*. There have been no reports of community acquired pneumonia in the elderly in the United Kingdom. We undertook such a study to determine the clinical features, aetiology, and outcome. Seventy three patients (38 men) with ages ranging from 65 to 97 (median 79) years were studied prospectively. Pneumonia was defined as an acute lower respiratory tract infection with new, previously unrecorded shadowing on a chest radiograph. Patients with severe chronic illness in whom pneumonia was an expected terminal event were excluded. Nearly all the patients (96%) had respiratory symptoms or signs but many had features that might obscure the true diagnosis of pneumonia. Over half the patients had non-respiratory symptoms and over a third had no systemic signs of infection. A pathogen was identified in 43% of patients, most commonly *Streptococcus pneumoniae*, *Haemophilus influenzae* and influenza B virus. Gram negative bacilli were not seen. The mortality rate was high (33%). Early deaths were due to infection whereas later deaths were associated with other factors, such as stroke (two patients) and pulmonary embolism (two patients). Prognostic indicators for mortality were apyrexia, systolic hypotension, increasing hypoxaemia, and new urinary incontinence. As the range of pathogens causing pneumonia was the same in the elderly in this study as in other age groups it is suggested that initial antibiotic treatment for patients in this age group should always cover *S pneumoniae* and *H influenzae*.

Acute pneumonia in the elderly is common and numbers will increase as the elderly population expands. Mortality is high, ranging from 24%[1] to 31%[2] in hospital series from England and America. In the United States a review of published reports on community acquired pneumonia in the elderly found *Streptococcus pneumoniae* to be the commonest pathogen,

being present in 40–60% of cases; Gram negative bacilli accounted for 6–37% of infections.[3] The aetiology of community acquired pneumonia in the elderly in Britain has not been reported, and we have therefore studied the cause and outcome of pneumonia in elderly patients admitted to a district general hospital prospectively over a six month period.

Methods

PATIENTS
For the purpose of the study pneumonia was defined as an acute lower respiratory tract infection with new, previously unrecorded shadowing on a chest radiograph. All patients aged 65 years or over admitted to the eight medical wards and six health care of the elderly wards at the City Hospital, Nottingham, from November 1987 to May 1988 with suspected pneumonia were visted by one of the investigators (PV, JG, and DB) as soon as possible. A record was made of a standard history and examination. Patients with severe, chronic illness or disability in whom pneumonia was an expected terminal event were excluded from the study.

INVESTIGATIONS
Sputum specimens were obtained before the administration of antibiotics whenever possible. Transtracheal injection of saline[4] was performed when sputum was not produced spontaneously. Blood was taken for culture and also for a full blood count and differential white cell count; erythrocyte sedimentation rate (ESR); measurement of urea, electrolytes, C reactive protein, and immunoglobulins; and liver function tests. Samples of sputum, urine, and serum were stored at −20°C for later testing for pneumococcal capsular antigen. Throat swabs were taken for virus isolation. Serum was collected at admission, on day 10, and at about six weeks and tested for complement fixing antibody to influenza virus A and B, respiratory syncytial virus, adenovirus, *Coxiella burnetti*, *Chlamydia psittaci* and *Mycoplasma pneumoniae*. Immunofluorescence testing for antibodies to *Legionella pneumophila* serogroup 1 was perfomed. A posteroanterior chest radiograph, with a lateral view whenever possible, was taken at admission, on day 10, and at monthly intervals until the shadowing had cleared.

Patients were reviewed regularly in hospital and followed at monthly intervals after discharge until clinical recovery and resolution of radiographic shadowing were complete.

Necropsy was performed whenever possible,

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specimens being collected for further microbiological culture and assay for pneumococcal capsular antigen.

MICROBIOLOGICAL METHODS

Sputum, blood, throat swabs, and any other specimens were cultured by standard techniques. Pneumococcal capsular antigen was sought by counter current immunoelectrophoresis and latex agglutination.

Criteria for laboratory diagnosis of "definite" and "probable" pathogens were those used in the British Thoracic Society study of community acquired pneumonia[5] (see appendix).

STATISTICAL ANALYSIS

Clinical features and investigations thought likely to contribute to mortality were analysed by means of the χ^2, Wilcoxon rank sum, and Mann-Whitney U tests.

Results

PATIENTS

Consecutive patients who appeared to fulfil the criteria for a diagnosis of pneumonia were studied. Of 101 patients initially entered, 28 were subsequently excluded (11 had long standing shadowing on the chest radiograph, six segmental or lobar collapse, four carcinoma of the lung, two pulmonary emboli, and two left ventricular failure; single patients had pulmonary eosinophilia, thoracic aneurysm, and radiation fibrosis). The remaining 73 patients (38 male) who fulfilled the criteria were studied in detail. In only 32 (44%) was a diagnosis of respiratory tract infection mentioned by the referring general practitioner.

All patients were white with ages ranging from 65 to 97 (median 79) years. Sixty one patients came from their own home and 12 from residential care. Twenty were current smokers and 27 were ex-smokers (smoking status was unknown in six), and 15 drank alcohol regularly (alchohol consumption was unknown in 26). Seven patients were known to have been in hospital within the past year; 45 had been in hospital previously at some time.

On average three patients were admitted each week with pneumonia, though 39 (53%) of the patients were admitted in December and January.

CLINICAL DETAILS

Symptoms had been present for one to 30 (median seven) days. Clinical features are recorded in tables 1 and 2. Symptoms were obtained from patients or relatives in 69 cases.

Records of physical signs were complete except that respiratory rate on admission was obtained from only 61 patients.

Only 19 patients had previously been in good health. Fifty four patients had a history of chest disease, chronic bronchitis being the most common (34 cases). Fifty one patients had other chronic illnesses under current medical supervision, most commonly cardiovascular and neurological conditions. Fifty five patients were having regular medication, including corticosteroids in eight cases; 28 patients had received antibiotics before admission, most commonly ampicillin. Only three of these patients subsequently had a positive bacterial culture.

GENERAL INVESTIGATIONS AT ADMISSION TO HOSPITAL

In patients for whom results were available the white cell count was raised above $11 \cdot 0 \times 10^9/l$ in 66%, the ESR was over 25 mm in one hour in 70%, the C reactive protein concentration was over 200 mg/l in 55%, and serum IgM was low in 15%.

Arterial oxygen tension (Pao_2) with the patient breathing air was under $8 \cdot 0$ kPa in 17 of the 23 patients in whom it was measured; 15 of these then received controlled oxygen therapy.

RADIOLOGY

Three patients died before a chest radiograph could be taken, but pneumonia was confirmed at necropsy. Among the remaining 70, one lobe was affected in 52, two lobes in 13, three lobes in four, and four lobes in one patient. The right lower lobe was affected in 42 patients.

Shadowing on the chest radiograph had cleared by day 10 in five patients. In 40 survivors who were available for follow up radiographic shadowing had cleared by about six weeks in 15 and by about 10 weeks in a further seven patients (55% in total).

COLLECTION OF SPECIMENS

Sputum was available from 62 patients, being obtained spontaneously from 46 and after transtracheal injection of saline in a further 16. Blood cultures were available in all patients, viral throat swabs in 56, and specimens from the acute phase of the illness for serological examination in 68 with matching convalescent specimens at six to eight weeks in 55 of these patients. Pneumococcal capsular antigen was sought in sputum (52 cases), serum (66 cases), urine (54 cases), pleural fluid (three cases), and necropsy lung tissue (three cases).

Table 1 Symptoms at presentation

	No	%
Upper respiratory symptoms	23	32
Lower respiratory symptoms	69	95
Non-respiratory symptoms	40	55
Confusion	31	42
Fever	20	27
Falls	12	16
"Off legs"	7	10
Recent incontinence	5	7
Diarrhoea	4	5

Table 2 Physical signs at presentation

	No	%
Pyrexia > 37°C	44	60
Pulse rate > 100/min	45	62
Blood pressure		
Systolic < 100 mm Hg	12	16
Diastolic < 60 mm Hg	29	40
Respiratory rate		
> 30/min	19	26
> 20/min	55	75
Focal chest signs	70	96
Confusion	34	47

Table 3   Pathogens causing pneumonia in 73 elderly
patients

	No (%) of cases	"Definite" pathogen	"Probable" pathogen
Streptococcus pneumoniae	22 (30)	9	13
Haemophilus influenzae	5 (7)	–	5
Legionella pneumophila	2 (3)	2	–
Influenza B virus	5 (7)	5	–
Respiratory syncytial virus	1 (1·4)	1	–

AETIOLOGY

A "definite" or "probable" pathogen was identified in 31 (43%) patients; four of these had evidence of two infective agents. Evidence of bacterial infection was present in 28 cases and of viral infection in five cases (table 3).

Pneumococcal infection was diagnosed in 22 patients, including six who were bacteraemic. Diagnosis was based solely on the finding of pneumococcal capsular antigen in 11 cases, and there was good agreement between the results of counterimmunoelectrophoresis and latex agglutination tests for the detection of pneumococcal capsular antigen. Four patients with pneumococcal pneumonia died, including two who were bacteraemic. Two of six patients with positive sputum cultures had a history of chronic bronchitis.

H influenzae was isolated from the sputum in five patients, four of whom had a history of chronic bronchitis. One patient died. Legionella pneumophila serogroup 1 infection was diagnosed in two cases. There were no cases of mycoplasma or psittacosis infections or of Q fever. Coliforms were cultured from the sputum of 12 patients, all of whom had received antibiotics before sputum collection. In no case was the coliform the predominant organism seen with Gram staining or thought to be pathogenic. Five of these patients had evidence of pneumococcal infection in addition. Eleven of the 12 patients had been independent and living in their own home; four of them died.

No additional microbiological diagnoses were made at necropsy. Postmortem lung tissue from a patient with known pneumococcal infection was positive for pneumococcal capsular antigen.

TREATMENT AND PROGRESS

Fifty six patients were treated with ampicillin or erythromycin or both. Twelve received a cephalosporin, either alone or in combination with another antibiotic. Two patients received assisted ventilation, one of whom died, and two further patients had a minitracheostomy to aid sputum clearance.

Twenty four patients (33%) died within six weeks—15 in the first week, one in the second week, and eight after that. In 13 cases necropsy confirmed the diagnosis of pneumonia. Nine of the deaths that occurred in the first week and one on day 15 were attributed to pneumonia at necropsy, and two later deaths were attributed to a stroke and two to pulmonary embolism.

Univariate analysis for mortality showed apyrexia, systolic hypotension, increasing hypoxaemia, and new urinary incontinence to be statistically significant prognostic

indicators. Alcohol consumption correlated negatively with mortality. Neither pre-existing chronic disease nor age was related to death.

Respiratory complications included pleural effusion (8 cases), empyema (1), and a lung abscess (1). Other complications were new atrial fibrillation (8), renal failure requiring alteration in treatment (4), pulmonary emboli (3), pericarditis (1), and infective endocarditis (1).

The average length of hospital stay in survivors was 21 days (range 4–69) days. Of the 40 survivors available for follow up at six weeks, only 18 (45%) had returned to their normal activities.

Discussion

We found that pneumonia in the elderly was a common cause of hospital admission, particularly during the winter months, and that it did not affect only severely debilitated individuals. Although only 14% of the patients had previously been in good health, most were leading independent lives in their own homes.

The presentation of pneumonia in our patients was often atypical, over half having prominent non-respiratory symptoms, a factor that may have influenced the finding that the referring general practitioner volunteered a diagnosis of chest infection in only 44% of cases. In addition, other features of infection, such as fever, tachycardia, and neutrophilia, were absent in over one third of patients. Respiratory symptoms, a raised respiratory rate, and chest signs were, however, present in virtually all patients on admission, emphasising the importance of a full examination in the "unwell" elderly patient.

The pattern of bacterial pathogens is very similar to that reported in younger adults.[5-7] The proportion of only 43% in whom a pathogen was identified in our series is similar to the proportions in some series[8] but less than in others.[5-7] This relates to incomplete availability of sputum and urine specimens and preadmission antibiotic treatment in over a third of cases in this study, whereas in a previous community study[7] virtually all specimens were collected before any antibiotics had been given. S pneumoniae was the most common pathogen, the diagnosis being made by detection of pneumococcal capsular antigen alone, usually in sputum, in half the patients, indicating the value of this test. Although pneumococcal capsular antigen is occasionally detected in patients without pneumonia—for instance, in chronic bronchitis—it is usually taken as evidence of active pneumococcal infection in the presence of pneumonia. The mortality was high (18%), raising the question of whether pneumococcal vaccination in the elderly may be of benefit.[9]

The second most common bacterial pathogen was H influenzae. Since this organism is found in the oropharynx of 60% of patients with a history of chronic bronchitis, some of the sputum samples may have been contaminated. Nevertheless, studies using transtracheal aspiration have established H influenzae as a pathogen in pneumonia in the elderly.[3]

We did not find convincing evidence of Gram negative bacillary pneumonia, and coliforms cultured from the sputum of 12 patients were thought to be oropharyngeal contaminants rather than pathogens. This differs from the finding of Ebright and Rytel[1] that seven of 33 cases of community acquired pneumonia in elderly patients admitted from their own home were due to Gram negative bacilli, but these all had serious underlying illness. Studies on severely ill and debilitated patients using transtracheal aspiration have also shown a high incidence of Gram negative bacilli.[3] Gram negative bacilli would appear to cause pneumonia in elderly patients who are debilitated and prone to aspiration from the oropharynx, but their presence in the previously independent elderly patients we studied probably represents contamination from oropharyngeal colonisation.[10]

In young adults atypical infections account for up to 24% of cases of pneumonia.[5 11] During the winter and spring of our study we found only two cases of sporadic L pneumophila and no other cases of atypical pneumonia. Studies covering a longer period may have shown a seasonal variation. With stratification for age two earlier studies, in 1982 and 1987, show that atypical infections are uncommon in the elderly (table 4). These studies also support our finding that S pneumoniae and H influenzae are the major pathogens in both young and elderly people.

The mortality of 33% was much higher than the figures of 5·7-15% reported in younger age groups[5 6] but similar to the proportion in a previous study of elderly patients.[2] We found two peaks of mortality. Necropsy findings suggested that early deaths (in the first week) were due to pneumonia, whereas deaths after the second week were due to secondary events such as stroke and pulmonary embolism. Correction of atrial fibrillation, which developed in 11% of cases, together with adequate hydration and prophylactic subcutaneous heparin, might reduce the later mortality.[12] Apart from atrial fibrillation and pleural effusions needing aspiration specific complications were uncommon. Apyrexia, systolic hypotension, and increasing hypoxaemia have been reported before as adverse prognostic indicators and are compatible with severe

infection,[25] as is new urinary incontinence, in an elderly patient. Other factors did not achieve statistical significance but might do so in larger studies. Notable among these are age and also confusion, which was shown to be an important prognostic indicator by Starczewski.[2] We were surprised that increasing age was not associated with a higher mortality; but, given that the prevalence of chronic disease did not rise with age in our study—which in the general population would be contrary to expectation—and that only a small proportion of patients developing pneumonia in the community are actually admitted to hospital,[7] possibly only the fitter very old patients are selected for hospital admission by their general practitioners. Moreover, we did not study patients in whom pneumonia was an expected terminal event, and this may have influenced the effect of age. Whether low IgM concentration (nine patients) is important as a risk factor is not clear. The association of alcohol consumption with reduced fatality has been reported before[5] but its mechanism and importance are also not clear.

Our findings suggest that community acquired pneumonia in the elderly should be treated primarily with antibiotics directed against Streptococcus pneumoniae and Haemophilus influenzae. Atypical infections are uncommon. In patients who are debilitated, in whom aspiration is likely, Gram negative bacilli should be considered. Additional treatments such as rehydration, controlled oxygen therapy, and possibly prophylactic heparin treatment are also likely to be important.

Appendix: Criteria for laboratory diagnosis of infection[5]

Definite pathogens are defined as follows:

1 Any organism isolated from blood or pleural fluid.

2 Streptococcus pneumoniae when pneumococcal capsular antigen is detected in serum or urine.

3 Any virus, Legionella pneumophila, Mycoplasma pneumoniae, and Chlamydia psittaci when there is a fourfold rise in antibody titre in serological testing.

Probable pathogens are defined as follows:

1 Streptococcus pneumoniae when the organism or pneumococcal capsular antigen is isolated from sputum only.

2 Haemophilus influenzae and Staphylococcus aureus when isolated from sputum.

3 Other bacteria when they are the predominant organism on Gram stains in addition to being isolated from sputum.

4 Legionella pneumophila when a single convalescent titre is >128.

5 Mycoplasma pneumoniae when a single convalescent titre is >64.

Table 4 Pathogens causing community acquired pneumonia in our previous studies in the UK after stratification for age[6 7]

	Age range 12–64 y (n=239): No (%) of cases	Age range 65–79 y (n=124): No (%) of cases
Streptococcus pneumoniae	117 (49)	67 (54)
Haemophilus influenzae	17 (7)	19 (15)
Legionella spp	16 (6·7)	4 (3·2)
Staphylococcus aureus	4 (1·6)	1 (0·8)
Gram negative bacilli	2 (0·8)	2 (1·6)
Atypical infections*	15 (6·3)	2 (1·6)
Influenza virus	15 (6·3)	11 (8·8)
Other viruses	12 (5)	4 (3·2)
Other pathogens	3 (1)	1 (0·8)
No pathogen found	66 (28)	43 (34·7)

*Mycoplasma pneumoniae, Chlamydia psittaci, Coxiella burnetti.

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