

## Community-Acquired Pneumonia Among the Elderly: Differences Between Patients Living at Home and in Nursing Homes

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**OBJECTIVE:** The etiology, presentation, and prognosis of community-acquired pneumonia (CAP) among nursing home residents are believed to differ from those of other groups. However, few Spanish studies have confirmed those assumptions or studied regional differences in CAP etiology.

**PATIENTS AND METHODS:** A prospective study which included all patients over 65 years of age admitted to our hospital with CAP was carried out over a period of 18 months (2002-2003). We examined clinical, analytical, and radiographic characteristics paying particular attention to functional status—using the Eastern Cooperative Oncology Group (ECOG) scale and Barthel and Karnofsky indices—and comorbidity. Two blood cultures, a *Legionella* antigen test in urine, and serology for atypical bacteria were used for the etiologic diagnosis; bacterial cultures of respiratory samples were also used in certain cases.

**RESULTS:** Ninety-one patients, 25 of whom were nursing home residents, were enrolled. The nursing home residents were older than the other patients (mean [SD] age of 82 [4] compared with 73 [5];  $P=.0001$ ) and had greater comorbidity ( $P=.0001$ )—with a significantly greater presence of diabetes mellitus, cerebrovascular disease, congestive heart failure, and dementia. They also had a poorer functional status (ECOG, 2.09 [0.9] compared with 0.93 [1.1],  $P=.001$ ; Barthel Index, 19 [33] compared with 77 [35],  $P=.001$ ; Karnofsky Index, 51 [17] compared with 78 [23],  $P=.001$ ). Regarding clinical characteristics, significant differences were found for respiratory rate (39 [11] compared with 27 [7] breaths/min;  $P=.001$ ), blood pressure (69.5 [20] compared with 79.2 [18] mm Hg;  $P=.029$ ), and temperature (36.6 [1.2] compared with 37.7 [1.1] °C;  $P=.001$ ). CAP patients from nursing homes presented a greater number of affected lobules in chest x-rays ( $P=.004$ ), more hypoxemia, acidosis, anemia, hypoalbuminemia, and greater scores of urea and creatinine. Fine Scale scores were also greater (134 [26] compared with 95 [28];  $P=.001$ ) as was mortality (7/25 compared with 3/66;  $P=.005$ ). Few

patients had an etiologic diagnosis and no significant differences were observed between the groups. The variable that predicted mortality in elderly patients in this series, according to stepwise logistic regression, was urea (adjusted  $R^2=0.452$ ).

**CONCLUSIONS:** In our sample population, nursing home residents were older, had greater comorbidity, and severe functional impairment. Under these circumstances the severity of CAP increases and becomes an important cause of mortality despite the fact that the etiologic agents do not appear to differ from those of the other patients.

**Key words:** Community-acquired pneumonia. Elderly. Nursing home.

La neumonía adquirida en la comunidad de los ancianos: diferencias entre los que viven en residencias y en domicilios particulares

**OBJETIVO:** La neumonía adquirida en la comunidad (NAC) de los ancianos que viven en una residencia se considera distinta del resto en cuanto a etiología, forma de presentación y pronóstico. Sin embargo, existen pocos estudios en nuestro país que confirmen estos aspectos, sin olvidar las diferencias etiológicas regionales de las NAC.

**PACIENTES Y MÉTODOS:** Se ha realizado un estudio prospectivo de 18 meses de duración (2002-2003), en el que se ha incluido a todos los pacientes mayores de 65 años que ingresaron por NAC en nuestro hospital. Se recogieron las características clínicas, analíticas y radiológicas haciendo especial hincapié en la situación funcional —escala del Eastern Cooperative Oncology Group (ECOG), índices de Barthel y Karnofsky— y en la comorbilidad. Para el diagnóstico etiológico se realizaron 2 hemocultivos, antígeno de *Legionella* en orina y serología de gérmenes atípicos; en los casos indicados también se practicó cultivo bacteriológico de muestras respiratorias.

**RESULTADOS:** Se incluyó a 91 pacientes, de ellos 25 procedían de residencias. Estos últimos tenían mayor edad ( $82 \pm 4$  frente a  $73 \pm 5$  años;  $p = 0,0001$ ), mayor comorbilidad global ( $p = 0,0001$ ) —como enfermedades aisladas eran significativamente más comunes la diabetes mellitus, la enfermedad cerebro-

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vascular, la insuficiencia cardíaca congestiva crónica y la demencia— y peor estado funcional (ECOG:  $2,09 \pm 0,9$  frente a  $0,93 \pm 1,1$ ,  $p = 0,001$ ; índice de Barthel:  $19 \pm 33$  frente a  $77 \pm 35$ ,  $p = 0,001$ ; índice de Karnofsky:  $51 \pm 17$  frente a  $78 \pm 23$ ,  $p = 0,001$ ). En cuanto a las características clínicas, encontramos diferencias significativas en la frecuencia respiratoria ( $39 \pm 11$  frente a  $27 \pm 7$  respiraciones/min;  $p = 0,001$ ), la presión arterial diastólica ( $69,5 \pm 20$  frente a  $79,2 \pm 18$  mmHg;  $p = 0,029$ ) y en la temperatura ( $36,6 \pm 1,2$  frente a  $37,7 \pm 1,1$  °C;  $p = 0,001$ ). En la radiografía de tórax, la NAC de residencia presentó mayor número de lóbulos afectados ( $p = 0,004$ ). Además, estos pacientes tenían mayor hipoxemia, acidosis, anemia, hipoalbuminemia y elevación de las cifras de urea y creatinina. Asimismo, la puntuación en la escala de Fine fue superior ( $134 \pm 26$  frente a  $95 \pm 28$ ;  $p = 0,001$ ) y presentaron mayor mortalidad ( $7/25$  frente a  $3/66$ ;  $p = 0,005$ ). En la mayoría de los pacientes no se pudo encontrar un diagnóstico etiológico, pero no se observaron diferencias significativas entre ambos grupos. La variable predictora de mortalidad de los ancianos de la serie —modelo de regresión (pasos sucesivos)— fue la urea ( $R^2$  corregida = 0,452).

**CONCLUSIONES:** En nuestra población, los ancianos que viven en residencias tienen mayor edad, pluripatología e importante deterioro funcional. En estas circunstancias la NAC adquiere especial gravedad y es una causa importante de mortalidad, pese a que los agentes etiológicos no parecen diferir de los habituales.

**Palabras clave:** Neumonía adquirida en la comunidad. Anciano. Residencia.

## Introduction

The changes in structure, function, and immunity which occur with age markedly increase the risk of pneumonia, an infection which is more severe among the elderly.<sup>1,2</sup> Old age is probably not the only determining factor of the poor prognosis of community-acquired pneumonia (CAP) among the elderly<sup>3-5</sup>; other as yet poorly defined factors such as comorbidity, malnutrition, or hidden clinical conditions that cause delays in diagnosis<sup>6,7</sup> could play an important role. When CAP affects nursing home residents, prognosis is even worse, generally due to the greater number of complications. Although some studies have found that the etiology of pneumonia in the nursing home elderly differs from the rest, with a predominance of gram-negative enteric bacilli and *Staphylococcus aureus*,<sup>8-10</sup> other studies have failed to find different pathogens.<sup>11</sup> Where all studies agree is that mortality is high among nursing home elderly with CAP, leading to the proposal of alternative empirical antibiotic therapeutic strategies.<sup>12</sup> However, most published results come from North America and very few studies have been carried out in Spain.

Given that there are regional differences in the etiology of CAP and in the number of nursing homes available, and given that customs between countries vary with regard to the elderly moving into nursing homes,

we believe that investigating these aspects in our population could reveal useful information for the treatment of this disease. The objective of this study, then, was to examine the way CAP presented and the clinical course and etiology of the disease among Spanish elderly, analyzing the differences between those in nursing homes compared with those living at home.

## Patients and Methods

### Patients

All CAP patients over 65 years of age admitted to the internal medicine department of our hospital were studied prospectively from January, 2003 to July, 2003. The hospital is a district hospital covering a population of about 130 000 on the Mediterranean coast.

New radiographic evidence of infiltrates together with fever or respiratory symptoms led to a diagnosis of pneumonia.

Given the objectives of the study, patients hospitalized within the 10 days prior to the diagnosis and patients for whom CAP was not the main cause of hospitalization were not included in the study.

### Methods

The patients enrolled were assessed by a member of the research team within 24 hours of hospital admittance. Records were examined carefully and information on a patient's normal residence, clinical presentation of the infection, comorbidities, and previous functional status was gathered. This last aspect was measured using 3 clinical scales: the Eastern Cooperative Oncology Group (ECOG) scale,<sup>13</sup> the Karnofsky index, and the Barthel index.<sup>14</sup> While the first 2 scales are normally used in oncology, the third is used in neurology and evaluates 10 basic activities of daily living, providing detailed information on the life of the elderly patient before the CAP infection. Pneumococcal vaccinations in the previous 10 years and influenza vaccinations in the previous year were also recorded whenever possible. All patients were given a basic physical examination and a chest x-ray, a complete blood test with biochemistry and arterial blood gas analysis was ordered. The Fine scale was used to grade the severity of the infection.<sup>15</sup>

The etiological diagnosis was based on a series of 2 blood cultures, a *Legionella* antigen test in urine, and serology for atypical bacteria tested on 2 occasions: on hospital admission and 4 weeks later. Whenever possible bacteriological sputum culture was requested and respiratory samples were cultured when necessary.

Empirical antibiotic treatment was prescribed according to the criteria of the attending doctor. Information on the progress of the patient was recorded until death or recovery, and special attention was paid to the appearance of complications.

CAP was diagnosed for any 1 of the following results: positive *Legionella* antigen urine test, growth of a pathogen in the blood cultures, a 4-fold higher antibody titer in the second serology sample compared with the first (seroconversion), or a single titer of immunoglobulin G of 1:256 or more for *Mycoplasma pneumoniae* and 1:512 or

more for *Coxiella burnetii*, *Legionella pneumophila*, *Chlamydia* species, influenza virus A and B, parainfluenza, adenovirus, and syncytial virus.

When the same pathogen was isolated in more than a single respiratory sample it was considered a possible pathogen.

### Statistical Analysis

Patients were classified according to whether they lived at home or in nursing homes. The  $\chi^2$  test was used to determine differences between qualitative variables and analysis of variance (ANOVA) was used for quantitative variables. ANOVA was used to determine the differences between CAP patients who died from those who recovered, and a stepwise regression analysis was applied to significant variables to reveal factors related to mortality. A *P* value less than .05 was considered significant.

### Results

The 91 patients over 65 years of age admitted to our hospital with CAP constituted the study group. Table 1 gives the patients' characteristics. Patients were divided into 2 groups according to their residence: 25 patients came from nursing homes and 66 patients lived at home. There were no differences between the sexes but nursing home residents were older. Nursing home residents also suffered greater comorbidity, common diseases being cerebrovascular disease, dementia, chronic congestive heart failure, and diabetes mellitus. Basic functional status, quantified on 3 clinical scales, was significantly worse for nursing home residents.

Differences between symptoms and between ways the pneumonia presented are shown in Table 2. Nursing home residents had fewer respiratory symptoms (cough, expectoration, pleuritic pain) and lower temperature; in contrast, they had more mental confusion. Time that elapsed between onset of symptoms and hospital admission did not differ between the 2 groups. Neither were there differences between the percentages of patients taking antibiotics before hospital admittance (31% for nursing home residents compared with 32% of those living at home).

Regarding clinical signs, significant differences were found for respiratory rate, temperature, and diastolic blood pressure. Chest x-rays revealed more lobules affected by CAP in nursing home residents. General analysis showed differences between the 2 groups for hemoglobin, glucose, albumin, urea, and creatinine. Regarding arterial blood pressure, the CAP of nursing home residents was associated with greater hypoxemia and acidosis. Consequently, nursing home residents scored higher on the Fine scale (134 [26] compared with 95 [28]; *P*=.0001) (Table 3).

A microbiological diagnosis was only available for 22 (24%) patients and there were no significant differences between the elderly living at home or in nursing homes, although no atypical pathogens were detected in the nursing home group. An etiological

TABLE 1  
Clinical Characteristics of Study Patients\*

	CAP Patients in Nursing Homes (n=25)	CAP Patients at Home (n=66)	<i>P</i>
Age, years <sup>†</sup>	82 (4)	73 (5)	.0001
Sex, male/female	10/12	30/36	NS
Associated comorbidity	23 (92)	30 (45)	.0001
Cancer	1 (4)	9 (13)	NS
Cerebrovascular disease	14 (56)	7 (10)	.0001
Congestive heart failure	10 (40)	4 (6)	.0001
COPD	3 (12)	16 (24)	NS
Dementia	14 (56)	7 (10)	.0001
Diabetes mellitus	14 (56)	10 (15)	.0001
Kidney disease	2 (8)	2 (3)	NS
Liver disease	3 (12)	4 (6)	NS
Pneumococcal vaccination	7 (28)	35 (53)	NS
Influenza vaccination	10 (40)	50 (75)	.0040
ECOG <sup>‡</sup>	2.09 (0.9)	0.93 (11)	.0001
Karnofsky Index <sup>‡</sup>	51 (17)	78 (23)	.0001
Barthel Index <sup>‡</sup>	19 (33)	77 (35)	.0001

\*Data are expressed as numbers (%) unless otherwise indicated. ECOG indicates Eastern Cooperative Oncology Group scale; COPD, chronic obstructive pulmonary disease; CAP, community-acquired pneumonia; NS, not significant.  
<sup>†</sup>Data expressed as means (SD).

TABLE 2  
Symptoms of Community-Acquired Pneumonia at Presentation\*

	CAP Patients in Nursing Homes (n=25)	CAP Patients at Home (n=66)	<i>P</i>
Respiratory symptoms			
Cough	5 (20)	36 (54)	.001
Expectoration	2 (8)	24 (36)	.017
Dyspnea	17 (68)	43 (65)	NS
Pleuritic pain	0 (0)	14 (21)	.031
Hemoptysis	2 (8)	3 (4.5)	NS
General symptoms			
Fever	10 (40)	47 (71)	.001
Confusion	10 (40)	10 (15)	.022
Diarrhea	2 (8)	4 (6)	NS
Flu-like illness	1 (4)	7 (10)	NS
Days of clinical course before hospital admittance <sup>‡</sup>	2.57 (2.56)	5.20 (6.81)	NS

\*Data are expressed as numbers (%) unless otherwise indicated. NS indicates not significant; CAP, community-acquired pneumonia.  
<sup>‡</sup>Data are expressed as means (SD).

diagnosis was reached for 6 (24%) nursing home patients: 2 blood cultures were positive for *Streptococcus pneumoniae*, 3 for *Streptococcus aureus* and 1 for enteric gram-negative bacilli in more than 1 respiratory sample. In the CAP group of elderly living at home, an etiological diagnosis was available for 16 (24%) patients: 2 urine cultures were positive for *Legionella* antigen in urine; 4 blood cultures were positive for *S pneumoniae*; 4 for *Staphylococcus* species; 3 serologies for *Chlamydia* species (1 for influenza A virus and 1 for B virus). No patient with CAP from *S pneumoniae* reported pneumococci vaccination in previous years.

Clinical course, length of hospitalization, and complications are specified in Table 4. The CAP of

TABLE 3  
Clinical, Analytical, and Radiographic Findings at Presentation of Community-Acquired Pneumonia\*

	CAP Patients in Nursing Homes (n=25)	CAP Patients at Home (n=66)	P
Temperature, °C	36.6 (1.2)	37.7 (1.1)	.001
Heart rate, beats/min	99 (44)	105 (21)	NS
Respiratory rate, breaths/min	39 (11)	27 (7)	.0001
Systolic blood pressure, mm Hg	132.79 (42)	138.9 (28)	NS
Diastolic blood pressure, mm Hg	69.5 (20)	79.2 (18),029	
Hemoglobin, g/dL	11.77 (2)	13.1 (1.99)	.006
White blood cell count, µL	16 214 (11 324)	13 402 (5 913)	NS
Urea, mg/dL	100 (50)	55 (33)	.0001
Creatinine, mg/dL	1.80 (0.99)	1.35 (0.64)	.033
Albumin, g/dL	3 (0.39)	3.63 (0.79)	.001
Glucose, mg/dL	223 (196)	150 (74)	.02
PaO <sub>2</sub> , mm Hg	49 (10)	61 (11)	.003
PaCO <sub>2</sub> , mm Hg	43 (13)	38 (11)	NS
pH arterial	7.37 (0.12)	7.43 (0.01)	.013
No. of lobules affected in chest x-ray	1.53 (0.65)	1.16 (0.47)	.004
Pleural effusion <sup>†</sup>	1 (4)	8 (12)	.645
Fine Scale score	134 (26)	95 (28)	.0001
Fine classes			.011
I <sup>†</sup>	0	3 (4.5)	
II <sup>†</sup>	0	9 (13.6)	
III <sup>†</sup>	3 (12)	12 (18)	
IV <sup>†</sup>	12 (48)	34 (51)	
V <sup>†</sup>	10 (40)	8 (12)	

\*Data are expressed as means (SD) unless otherwise indicated. CAP indicates community-acquired pneumonia; NS, not significant.

<sup>†</sup>Data expressed as numbers (%).

nursing home residents caused higher mortality (7/25 compared with 3/66;  $P=.005$ ). Length of hospital stay, however, was the same, as were the number of in-hospital complications and modifications to initial empirical antibiotic treatment. Few patients had in-hospital complications which, when present, were similar for both groups: respiratory (14%), cardiac (5%), digestive (9%), thrombotic (10%), and others (2%). Death in most nursing home residents was attributable to complications that existed prior to hospital admittance and figured in the initial evaluation: oliguria and renal failure (1), hypotension and sepsis (3), heart failure (1), and severe respiratory insufficiency (2). Readmittance rate among the study elderly was 15% without differences between the groups; only 3% were readmitted because of persistence of pneumonia and 12% for other motives.

TABLE 4  
Clinical Course of Community-Acquired Pneumonia Cases\*

	CAP Patients in Nursing Homes (n=25)	CAP Patients at Home (n=66)	P
Treatment modifications of initial empirical antibiotic	4 (16)	13 (19)	NS
Length of stay, days <sup>†</sup>	8 (7.87)	8.54 (4.97)	NS
In-hospital complications not present on admittance	8 (32)	22 (33)	NS
ICU admittance	0	2 (3)	NS
Deaths	7 (28)	3 (4.5)	.005

\*Data are expressed as numbers (%) unless otherwise indicated. CAP indicates community-acquired pneumonia; NS, not significant; ICU, intensive care unit.

<sup>†</sup>Data are expressed as means (SD).

When patients were grouped in function of whether CAP was the cause of death or not (10 cases compared with 81, respectively), ANOVA revealed significant differences for the following variables: age, previous functional status, diastolic blood pressure, respiratory rate, hemoglobin, urea, creatinine, pH, and Fine severity scale score, in addition to place of residence (Table 5). When these variables were examined with a stepwise linear regression model with mortality as the dependent variable, the predictor of mortality was shown to be serum urea (adjusted  $R^2=0.452$ ). When analytic parameters were not introduced into the same

TABLE 5  
Differential Characteristics Between Elderly Patients  
Who Died From Community-Acquired Pneumonia  
and the Remaining Patients (Univariate Analysis)\*

	Died (n=10)	Survived (n=81)	P
Age, years	83 (8)	72 (9)	.090
Residence <sup>†</sup>	7 (28)	3 (4)	.005
Barthel index	40 (43)	77 (36)	.021
Diastolic blood pressure, mm Hg	64 (18)	78 (18)	NS
Respiratory rate, breaths/min	40 (10)	28 (8)	.007
Serum haemoglobin, g/dL	10 (2)	13 (1.9)	.001
Serum urea, mg/dL	166 (29)	54 (28)	.0001
Serum creatinine, mg/dL	2.7 (1)	1.3 (0.5)	.0001
Arterial pH	7.3 (0.1)	7.4 (0.002)	.044
Fine scale score	134.6 (27)	99.2 (30)	.014

\*Data are expressed as means (SD). NS indicates not significant

<sup>†</sup>Data are expressed as numbers (%).

regression model, mortality depended on the Fine severity score (adjusted  $R^2=0.169$ ) and age (adjusted  $R^2=0.242$ ).

## Discussion

Our study confirmed the high mortality rate of CAP among elderly nursing home residents (28%) while among other elderly patients the rate was much lower (4%). Reasons that could explain this difference are that at present, nursing home residents in the Spanish population are much older, have multiple pathologies, and greater functional impairment. CAP infection becomes particularly severe in these patients, despite the similarity of the etiological agents in these and other CAP patients, and leads to fatal complications. The clinical picture, moreover, is atypical, with few respiratory symptoms, lower temperature, and more mental confusion. Although these patients do not experience delays between onset of symptoms and hospital admittance, the fact is that their clinical condition and analytical and radiographic features on admission are worse and they tend to be classified as type 4 or 5 on the Fine severity scale.

The risk factors of poor progression or death from CAP found in the present study are consistent with those described previously<sup>16</sup>: living in a nursing home, advanced age, previous impaired functional status, low diastolic blood pressure, increased respiratory rate, reduced hemoglobin, increased urea, increased creatinine, respiratory acidosis, and a high score on the Fine severity scale. Although some authors, such as Lim and MacFarlane,<sup>16</sup> have not found age to be an independent predictor of mortality, in our patients age was related to the probability of dying. Comorbidity was not shown to be an independent predictor of mortality in the multivariate analysis but previous functional status measured by any of the standard general condition scales was very important. The clinical indices of poor CAP progression proposed by the British Thoracic Society<sup>17</sup> which include diastolic hypotension, tachypnea, and high levels of ureic nitrogen, were validated by Ewig et al<sup>5</sup> and show high specificity with a negative predictive value of nearly 94%. It follows that the predictive factor of poor prognosis isolated in our elderly patients with CAP was high levels of urea.

In a recent study carried out in 4 Spanish hospitals where factors determining long hospital stay due to CAP<sup>18</sup> were analyzed, hospital stay was found to depend on hypoxemia and pleural effusion for low risk Fine scores, and on hypoxemia, diastolic hypotension, pleural effusion, more than 1 lobule affected in the chest x-ray, and hypoalbuminemia for high risk Fine scores. Regarding length of hospital stay for CAP patients from nursing homes, we found no difference with respect to CAP patients living at home (mean of 8 days). Neither were differences found between the two groups of patients in a study by Meehan et al,<sup>19</sup> where mean length

of stay was 7 days. Kaplan et al<sup>20</sup> analyzed the cost of CAP among the elderly in the United States of America and concluded that it was a high resource illness: mean length of hospital stay, 7.6 days and mean cost per episode, \$6949. Although pharmacoeconomics were not analyzed in this study, these figures appear consistent with the situation in our hospitals, indicating that CAP among the elderly is a serious public health problem that must be investigated further.

To summarize, in our population of elderly nursing home residents, CAP has a high mortality rate as patients are old and have, for several reasons, very poor basic functional status. We should standardize the use of general condition scales given their prognosis value among patients hospitalized with pneumonia.

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