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2010-09-03
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Respirology (2001) **6**, 323–330

ORIGINAL ARTICLE

Prognostic factors in severe community-acquired pneumonia in patients without co-morbid illness

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Prognostic factors in severe community-acquired pneumonia in patients without co-morbid illness

FELDMAN C, VILJOEN E, MORAR R, RICHARDS G, SAWYER L, GOOLAM MAHOMED A. *Respirology* 2001; **6**: 323–330

Objectives: We wished to determine the prognostic factors and the impact of initial empirical antibiotic therapy on the outcome of severe community-acquired pneumonia in patients without underlying co-morbid illness.

Methodology: This is a retrospective record review of consecutive patients with severe community-acquired pneumonia who were divided into those with and without underlying co-morbid illness.

Results: There were 182 patients including 112 primary (no co-morbid illness) and 70 secondary (underlying co-morbid illness) pneumonias. The overall mortality was 41.8% and there were no differences in APACHE II score or mortality when comparing cases with primary (37.5%) and secondary infections (48.6%). The mortality was significantly higher in patients with negative microbiology. Univariate analysis identified a number of parameters and various antibiotic regimens, which appeared to be associated with a significantly poorer outcome. On multivariate analysis multilobar pulmonary consolidation, need for mechanical ventilation, inotropes and dialysis were documented to be independent predictors of mortality. Only in their absence could different antibiotic regimens be shown to have an apparent impact on outcome and further analysis suggested that the reason for these differences related predominantly to differences in the severity of the infection.

Conclusions: Markers of disease severity appear to be the most important predictors of outcome in patients with severe community-acquired pneumonia.

Key words: APACHE II score, community-acquired pneumonia, empirical antibiotic therapy, outcome.

INTRODUCTION

Community-acquired pneumonia continues to be an important cause of morbidity and mortality in both the Third world and in developed countries.[1–3] The syndrome of severe community-acquired pneumonia (SCAP) describes severely ill patients with pneumonia who have an especially high mortality, a wider spectrum of microbial aetiology requiring broader initial antimicrobial chemotherapy and who would potentially benefit from early intensive care unit (ICU) admission.[3–5]

While much attention has been paid to negative prognostic factors in severe pneumonia,[6–18] relatively few studies have addressed the question of the impact of the initial antibiotic choice on outcome.[6,9,12,17] Most importantly, all of these studies on outcome have included in their analysis patients with underlying co-morbid and/or potentially fatal illnesses.[6,9,12,14,17]

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Received 25 December 2000; revised 20 June 2001; accepted for publication 13 July 2001.

Such underlying disorders have themselves been shown to impact negatively on prognosis and therefore may obscure the analysis of possible benefit of initial antibiotic therapy on the outcome.[19-21]

In the current study we investigated prognostic factors in patients with SCAP, with the primary aim of determining the impact of initial, empirical antimicrobial chemotherapy on the outcome of patients without significant underlying co-morbid illness.

PATIENTS AND METHODS

This was a retrospective record review of consecutive non-immunocompromised cases with SCAP admitted to the Hillbrow Hospital ICU, Johannesburg, South Africa, between January 1988 and December 1995. The study was approved by the Committee for Research on Human Subjects of the University of the Witwatersrand.

Community-acquired pneumonia was defined as an acute lower respiratory tract infection, acquired in the community, associated with clinical and radiographic evidence of consolidation of part or parts of one or both lungs. All cases were defined as being severe because they were admitted to an ICU,[2-5] most usually for mechanical ventilation and/or for intensive medical and nursing monitoring and care. No case received any antibiotics prior to admission to the hospital and all were admitted to the ICU within 24 h of admission to the hospital.

Pneumonia was classified as primary if there were no significant underlying disorders predisposing to this infection or secondary in the presence of underlying significant co-morbid or potentially fatal illness (including chronic cardiorespiratory disorders, chronic renal failure, connective tissue disorders, diabetes mellitus, multiple myeloma, leukaemia, previous splenectomy, and significant alcoholic disease), as described previously.[21,22] Cases with newly diagnosed active pulmonary tuberculosis were excluded from the study.

The ward and ICU charts of each patient were reviewed, as were the results of specimens submitted to the microbiology laboratory. The following data were recorded for the subsequent analysis of prognostic factors, as described previously:[10] gender and age, the absence or presence and nature of underlying co-morbid illness, the APACHE II score, the presence or absence of multilobar consolidation, confusion, chest pain, tachypnoea (>30 b.p.m.), tachycardia (>120 b.p.m.), low diastolic blood pressure (<60 mmHg), hypoxaemia (pO_2 < 8 kPa), extremes of white cell count derangement (<4 or $>20\times10^9$/L), low serum sodium (<130 mmol/L), raised urea (>7 mmol/L), low serum albumin (<30 g/L), liver function derangement (at least one value of serum enzymes twice the upper limit of normal), need for mechanical ventilation, inotropic support or renal dialysis (for complications of the acute infection), the antibiotics used for the initial 48 h and the ICU outcome of each patient.

The microbiological data recorded were acquired primarily from culture results of blood and/or lower respiratory tract secretions (good quality specimens of sputum or endotracheal aspirates of individuals taken on admission to the hospital or ICU and prior to the initiation of antibiotics). The assessment of the quality of the sputum specimens was undertaken using the Bartlett classification, based on the presence or absence on lower power magnification of more than 25 polymorphonuclear leucocytes, less than 10 squamous epithelial cells, and mucus, as described previously.[23] Any additional available data (e.g. serological testing for so-called 'atypical' bacterial pathogens, i.e. *Legionella pneumophila, Mycoplasma pneumoniae, and Chlamydia pneumoniae* or the various respiratory viruses) were recorded in individual cases.

Statistical analysis

All statistical analyses assessed the influence of all of the above parameters (i.e. prognostic factors, ICU treatment variables and different antibiotic regimens) on outcome, comparing data in survivors and non-survivors. For the univariate analysis this comparison was undertaken for the group as a whole, as well as for the individual subgroups with primary or secondary infection. Categorical variables were analysed using the χ^2 or Fisher's exact (two-tail) test and continuous variables were analysed using the Mann–Whitney *U*-test (two-tail).

The different antibiotic groups studied were triple antibiotics (beta-lactam plus aminoglycoside plus macrolide), combination therapy with a beta-lactam and an aminoglycoside, combination therapy with a beta-lactam and a macrolide and beta-lactam therapy alone, since these were the most commonly used antibiotic treatment regimens in the ICU. Initial analysis had documented that the two most commonly used beta-lactam agents were penicillin G and the first generation cephalosporin, cephradine. In addition, it was noted that there was no difference in the outcome in any of the categories of patients when comparing the use of either of these two agents individually and therefore they were classified together for the subsequent analyses, designated simply as 'beta-lactam' therapy.

Importantly, the analysis of antibiotics and outcome was conducted initially for the whole cohort (i.e. both culture-positive and -negative cases) and then additionally subanalysed for the culture-positive group alone. This allowed an accurate assessment of the use of each individual antibiotic and its appropriateness to the microbiological findings. Thus, in both the univariate and multivariate analyses it was ensured that the assessment took into account concordance of antibiotic use with the culture results, for those cases with positive microbiology.

In addition, one way analysis of variance (ANOVA) was used to compare the APACHE II scores (as a marker of the severity of illness) in patients treated with these different antibiotic regimens, to determine whether severity of illness was a confounding factor for either the antibiotic choice or the outcome of the infection. One way analysis of variance was also used

to compare APACHE II scores in patients with different infective aetiologies of pneumonia. For the analysis of the microbiological groups we compared patients in whom no organisms were cultured with cases in whom *Streptococcus pneumoniae* or *Klebsiella pneumoniae* was isolated.

For the multivariate analysis, stepwise logistic regression was used. Several multivariate models were constructed which included and excluded the APACHE II score and included or excluded the treatment variables, namely mechanical ventilation, inotropic support and renal dialysis.

RESULTS

Patient characteristics

A total of 182 cases with SCAP were admitted to the ICU during the study period, of whom 112 had primary and 70 had secondary infections. There were 141 males and 41 females in the whole group with an age (mean ± SD) of 44.2 ± 12.7 years (range 14–78 years). The mean APACHE II score was 14.7 ± 7.7, with a range of 1–44.

Of the patients with primary infections, there were 87 males and 25 females with an age (mean ± SD) of 41.9 ± 11.6 years (range 14–65 years). The mean APACHE II score was 14.8 ± 7.6 (range 1–35). The microbiological data are shown in Table 1. Of these cases, 85 (77%) required mechanical ventilation, 65 (59%) had severe sepsis requiring inotropic support of the blood pressure and 22 (20%) required dialysis.

Of the patients with secondary infections, there were 54 males and 16 females with an age (mean ± SD) of 48.1 ± 13.5 years (range 14–78 years). The age of these patients was significantly higher ($P=0.0036$) than that of the patients with primary infection. The mean APACHE II score was 14.7 ± 7.9 (range 2–44). The microbiological data are shown in Table 2.

The underlying disorders (sometimes multiple) that characterized this group as having secondary infections included the following: diabetes mellitus ($n=18$), chronic respiratory conditions ($n=17$), old fibrocavitatory tuberculosis ($n=16$), chronic cardiac disease ($n=14$) and various other disorders, including chronic liver, renal, haematological, and connective tissue disorders ($n=16$). Of these cases, 63 (96%) required mechanical ventilation, 61 (87%) had severe sepsis requiring inotropic support of the blood pressure and five (7%) required dialysis.

Table 3 shows some of the patient characteristics, with a comparison of initial presenting features in the patients with primary and with secondary infections. Significant differences noted when comparing the two groups were a lower age ($P=0.0036$), less initial diastolic hypotension ($P=0.00019$) and hypoxaemia ($P<0.0001$), less frequent need for mechanical venti-

Table 1 The microbiological data of 112 patients with primary community-acquired pneumonia

Microorganism	Total no. isolates	Blood culture	Sputum culture	Serology	Mortality
Streptococcus pneumoniae	43	34	5	4	11 (25.6%)
Klebsiella pneumoniae	14	8	6	0	5 (35.7%)
Other Gram-negative*	2	2	0	0	0 (0%)
Haemophilus influenzae	3	0	3	0	1 (33.3%)
Mixed Gram-negative	2	1	1	0	2 (100%)
*Staphylococcus aureus**	5	1	4	0	3 (60%)
'Atypical pathogens'**	2	0	0	2	1 (50%)
Viruses	1	0	0	1	0 (0%)
Total	72*	46	19	7	

*Two patients had positive cultures for both Gram-negative pathogens and *Staphylococcus aureus*, giving a total of 72 isolates in 70 patients. The mortality for these 70 patients in whom a microorganism was isolated was 30% (21/70).

** *Legionella pneumophila* (1), *Mycoplasma pneumoniae* (1).

Table 2 The microbiological data of 70 patients with secondary community-acquired pneumonia

Microorganism	Total no. isolates	Blood culture	Sputum culture	Serology	Mortality
Streptococcus pneumoniae	17	15	2	0	5 (29.4%)
Klebsiella pneumoniae	7	5	2	0	2 (28.6%)
Other Gram-negative	7	2	5	0	1 (14.3%)
Haemophilus influenzae	1	0	1	0	1 (100%)
Mixed Gram-negative	0	0	0	0	0 (0%)
Staphylococcus aureus	4	1	3	0	2 (50%)
'Atypical pathogens'	0	0	0	0	0 (0%)
Viruses	0	0	0	0	0 (0%)
Total	36	23	13	0	11 (30.6%)

Table 3 Clinical characteristics of the study patients

Parameter*	Combined group	Primary infection	Secondary infection
No. cases	182	112	70
Age range**	14–78	14–65	14–78
Age > 60 years	20/172 (11.6%)	8/102 (7.8%)	12/70 (17.1%)
Gender (male : female)	141 : 41	87 : 25	54 : 16
Multilobar consolidation	123/173 (71.1%)	75/106 (70.8%)	48/67 (71.6%)
Bacteraemia	67/182 (36.8%)	44/112 (39.3%)	23/70 (32.9%)
Treatment			
Inotropes** (initial)	126/180 (70.9%)	65/110 (59.1%)	61/70 (87.1%)
Mechanical Ventilation**	148/177 (83.6%)	85/111 (76.6%)	63/66 (95.5%)
Dialysis** (acute)	27/181 (14.9%)	22/112 (19.6%)	5/69 (7.2%)
Days in ICU median (range)			
Survivors	11 (1–65)	10 (1–65)	13 (1–29)
Non-survivors	5 (1–55)***	8 (1–39)	4.5 (1–55)***

*Values of individual parameters were unknown in some cases.
** Parameters showing significant differences between the two sub-groups of patients ($P<0.05$–$P<0.0001$).
*** $P<0.005$ versus survivors.

lation ($P=0.02076$) and initial inotropic support ($P=0.00013$) and more frequent need for dialysis ($P=0.03951$) in the group with primary infections. In both the combined group and in the group with secondary infections, the duration of the ICU stay was significantly shorter for the non-survivors compared with the survivors.

Mortality

The mortality for the group as a whole was 41.8% (76/182), being 31.5% (34/108) in cases with positive microbiology and 56.8% (42/74) in cases with negative microbiology ($P=0.00079$).

The overall mortality for the group with primary infections was 37.5% (42/112). The mortality for those patients in whom a microorganism was isolated was 29% (20/69) compared with 51.2% (22/43) in those with negative microbiology ($P=0.02687$). The mortality for the group with secondary infections was 48.6% (34/70), which was not significantly different from that of patients with primary infection. The mortality was 35.9% (14/39) for those cases with positive microbiological results and 64.5% (20/31) for those with negative data ($P=0.02958$).

Prognostic factors

The negative prognostic factors documented on univariate analysis for each of the subgroups of patients with pneumonia are shown in Table 4. The most commonly used antibiotic treatment regimens as well as their apparent impact on the outcome of the patients with SCAP in the different patient groups are shown in Table 5.

Triple antibiotic therapy was not associated with any difference in the outcome of cases treated with this regimen compared with cases receiving any other treatment regimen, in any of the patient groups. The survival of patients treated with the combination of a beta-lactam and an aminoglycoside was better than those not treated with this antibiotic regimen, being 50/64 (78%) versus 56/117 (47.9%); $P=0.00008$ for the group as a whole, 30/37 (81.1%) versus 38/74 (51.4%); $P=0.01325$ for the group with primary infections and 20/27 (74.1%) versus 18/43 (41.9%); $P=0.0035$ for the group with secondary infections, respectively. The survival of patients treated with the combination of a beta-lactam and a macrolide compared to cases not treated with this antibiotic regimen was generally poorer, being 9/26 (34.6%) versus 99/156 (63.5%); $P=0.00875$ for the group as a whole, 7/17 (41.2%) versus 63/95 (66.3%); $P=0.0599$ for the group with primary infections and 2/9 (22.2%) versus 36/61 (59.0%); $P=0.06953$ for the group with secondary infections, respectively. The use of single agent beta-lactam therapy compared to any other treatment regimen was not associated with any difference in outcome in any of the patient groups.

Multivariate analysis of the data in the subgroup with primary infections documented that multilobar consolidation, need for mechanical ventilation, inotropic support and dialysis were the most important variables impacting on outcome. Using this same model but excluding the treatment variables (i.e. mechanical ventilation, inotropic support and dialysis), resulted in multilobar consolidation and combination antibiotic therapy with a beta-lactam and an aminoglycoside appearing to have the most significant impact on outcome. Similar data were also shown in the multivariate models constructed for the group as a whole.

APACHE II score

The APACHE II score was significantly higher in non-survivors than in survivors, for the group as a

Table 4 Factors noted on univariate analysis to be associated with a poorer prognosis in patients with community-acquired pneumonia

Prognostic Factor	Non-survivors *vs* survivors*	Significance (*P* value)	Odds ratio
Combined group of 182 patients with community-acquired pneumonia			
Multilobar consolidation	59/71 vs 64/102	0.00384	2.9155
Low diastolic blood pressure	36/74 vs 29/107	0.00439	2.5510
Mechanical ventilation	71/74 vs 77/106	0.00004	8.9286
Inotropic support	66/74 vs 60/105	<0.00001	6.1728
Dialysis	18/74 vs 9/107	0.00510	3.4965
Primary community-acquired pneumonia ($n=112$)			
Multilobar consolidation	36/42 vs 39/64	0.00381	3.8462
Mechanical ventilation	40/43 vs 45/68	0.00108	6.8027
Inotropic support	39/43 vs 26/67	<0.00001	15.3846
Dialysis	14/43 vs 8/69	0.00823	3.6765
Secondary community-acquired pneumonia ($n=70$)			
Extremes of white cell count**	5/30 vs 16/37	0.03300	0.2625
Mechanical ventilation	31/31 vs 32/38	0.02917	>10.0000

*Number of patients in whom the prognostic factor was present, comparing non-survivors vs survivors.
**Paradoxically, less extremes of white cell count derangement were associated with a poorer outcome.

Table 5 Outcome of patients with severe community-acquired pneumonia receiving specific empiric antibiotic treatment regimens compared with those receiving any other treatment regimen (univariate analysis) and APACHE II score

Antibiotic regimen	Combined group	Primary infection	Secondary infection
Triple therapy			
No. treated	56	36	20
APACHE II score	13.2	13.6	12.3
Outcome	No difference	No difference	No difference
Combination therapy of beta-lactam and aminoglycoside			
No. treated	64	37	27
APACHE II score	13.7	13.1	14.2
Outcome	Better	Better	Better
Combination therapy of beta-lactam and macrolide			
No. treated	26	17	9
APACHE II score	18.5	18.4	18.8
Outcome	Worse	Marginally worse	Marginally worse
Beta-lactam alone			
No. treated	26	16	12
APACHE II score	15.1	16.6	13.4
Outcome	No difference	No difference	No difference

whole (17.5 ± 8.1, range 1–44 *vs* 12.8 ± 6.9, range 1–28; $P<0.0001$), as well as for those with primary infections (17.5 ± 8.3, range 1–35 *vs* 13.1 ± 6.7, range 1–28; $P=0.0091$) and with secondary infections (17.6 ± 7.8, range 5–44 *vs* 11.9 ± 6.9, range 2–28; $P=0.0018$). The APACHE II scores for the entire group of patients are shown as a histogram in Fig. 1, with a comparison of the values in survivors and in non-survivors.

Similar patterns of distribution of the APACHE II score and outcome were seen in the subgroups with primary and secondary infection (data not shown).

The APACHE II score for the different antibiotic treatment groups are shown in Table 5. The APACHE II score was consistently highest in the group of patients who had received combination therapy with a beta-lactam and a macrolide antibiotic. On ANOVA, the APACHE II score in this group of patients was found to be significantly higher than that of patients receiving any of the other treatment regimens (Bonferroni corrected P-value <0.05).

The APACHE II scores of those patients with different infective aetiologies of pneumonia (all patients) were as follows: *Klebsiella pneumoniae* 14.4 ± 8.5, *Streptococcus pneumoniae* 15.4 ± 7.4, and negative culture 15.1 ± 8.1. On ANOVA there were no significant differences in the APACHE II scores between these groups.

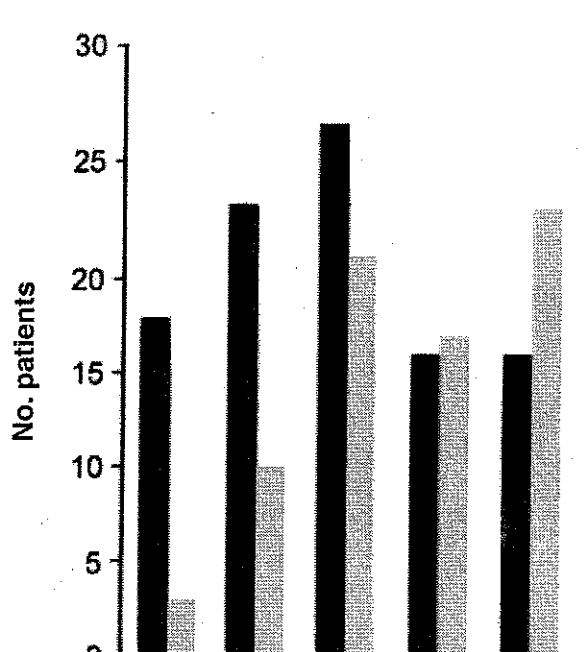


Figure 1 The APACHE II scores of the entire group of patients, presented as a histogram, with a comparison of values in survivors (■) versus non-survivors (▒).

DISCUSSION

Significant findings in our study of patients with SCAP were that the prevalence of previously documented negative prognostic factors was similar in patients with and without co-morbid illness, as was the APACHE II score and mortality. However, for the group as a whole as well as for both subgroups, the mortality was significantly higher in cases with negative microbiology. Multilobar pulmonary consolidation, and the need for mechanical ventilation, inotropic support and dialysis were noted to be independent predictors of outcome. Only in their absence, did different empirical antibiotic regimens appear to have an impact on outcome. However, further analysis suggested that these differences were largely related to differences in the severity of infection.

We divided our patients with pneumonia into two subgroups: cases without (primary) and with (secondary) underlying co-morbid illness. While some initial negative prognostic features were more common in the group with secondary infection others were more common in the group with primary infection, so that overall these differences did not relate to any difference in outcome of the two groups.

The overall mortality of SCAP in the present study was relatively high. An important observation was that the mortality of cases with negative microbiology was significantly higher than that of cases in whom a positive culture was obtained for each of the subgroups of patients. This difference in mortality was unrelated to the APACHE II score, which was not significantly different in these subgroups.

Only one study of SCAP has found that increasing the rate of aetiological diagnosis is associated with a reduced mortality.[24] Pachon *et al.* found that the diagnosis of a causative organism did not improve the outcome,[12] while the British Thoracic Society[10] noted that there was a trend for the mortality to be higher in those cases in whom no pathogen was found. The reasons for the higher mortality in the bacteriologically negative cases in the current study are uncertain. It is possible that some of them represent undiagnosed and untreated 'atypical' infections consequently associated with an increased mortality.[25] Alternatively it has been suggested that the finding of a microorganism may allow the tailoring of initial antimicrobial therapy with improved outcome.[10] However, we only investigated antibiotic therapy in the initial 48 h and a number of studies of ventilator-associated pneumonia have documented that it is the appropriateness of initial empirical therapy that impacts on outcome, rather than the changes made to antibiotic therapy once microbiological data become available.[26,27]

On univariate analysis, the APACHE II score accurately predicted mortality. However, in only one of the multivariate models did APACHE II score appear as an independent indicator of poor prognosis and this would correlate well with the recognition that while the APACHE II score is a good indicator of severity of illness and mortality in groups of patients, it is a poor indicator of severity of illness or even outcome in the individual case.[28,29]

The need for mechanical ventilation was one of the most important factors associated with a poorer prognosis. The importance of the need for mechanical ventilation and its impact on outcome of SCAP has been shown in several of the studies of pneumonia in the ICU. In fact it has been suggested that the differences in patient mortality in the various ICU studies, despite apparently similar patient populations, may relate to the need for mechanical ventilation among the patients.[4,8,11,13,14,17]

Multilobar pulmonary consolidation also featured prominently as an important negative prognostic indicator in the current study. In a recent meta-analysis of prognostic factors in pneumonia in general, multilobar pulmonary consolidation was shown to be an important negative indicator over a wide range of studies.[6] In addition, the need for inotropic support of the blood pressure and dialysis were important prognostic indicators in the current study. The need for inotropes has previously been shown to be significantly associated with death; this parameter most likely being a marker of more severe multisystem failure.[10,11] Few studies of SCAP have specifically looked at the need for dialysis as an important negative prognostic factor, but we have documented the importance of this both in the current and in our previous study.[11]

Triple antibiotic therapy was not shown to be associated with any difference in the outcome of any of the groups. Combination beta-lactam and aminoglycoside therapy was consistently associated with a

better outcome for all groups. Combination beta-lactam and macrolide treatment was associated with a marginally increased mortality in the group of primary and secondary infections, and a significantly increased mortality in the group as a whole. The use of single agent beta-lactam therapy alone was not associated with any difference in mortality.

A recent study has noted that ICU patients with severe infections who are treated initially with inappropriate antibiotics have a worse outcome.[30] In our analysis of antibiotics and outcome, we initially included both culture-positive and culture-negative cases, ensuring that we had characterized the culture-positive cases into the appropriate antibiotic treatment group, based on the concordance of the antibiotics used with the microbiology results. Since some patients in the culture-negative group may have unknowingly been inappropriately treated and therefore also incorrectly characterized, we repeated the analysis of antibiotic use and outcome in our patients with positive cultures only. This obviously required us to exclude a number of our patients and may have interfered with statistical analysis. Nevertheless, it was interesting to note that even in this subanalysis, the patients that had been treated with the combination of a beta-lactam and aminoglycoside had a significantly better outcome and there was a tendency for the patients treated with the combination of a beta-lactam and erythromycin to have a poorer outcome (data not shown).

Two recent studies have investigated the impact of different antibiotic regimens on the hospital stay and outcome of less severe cases of community-acquired pneumonia.[31,32] While these studies attempted to control for the severity of illness, it appeared in both studies that the different antibiotic regimens chosen by the attending physicians were based on their assessment of differences in the severity of infection of their patients.[31–33]

We investigated whether there were any differences in the severity of illness in the different treatment groups in the present study. It appeared that the beta-lactam/macrolide combination was more consistently used in sicker patients, as judged by the APACHE II score. Although our findings of an apparently higher mortality in the group of patients who received a macrolide appears to contradict that of the previously mentioned studies, in those studies macrolide use appeared to be much more common in cases with less severe illness.[31–33] Similarly, the apparent positive benefit of the combination of a beta-lactam and an aminoglycoside on outcome of SCAP in our study appeared also to be related, at least partly, to the less severe illness of this treatment group.

There are, however, a number of possible additional reasons why the combination of a beta-lactam and an aminoglycoside may have had a positive impact on the outcome of the cases in the present study. Most importantly, there were a large number of infections with *Klebsiella pneumoniae*, and many of these were bacteraemic. We and other investigators have documented previously that the outcome of such infections is far better in the sicker patient when empirical therapy has been with an appropriate beta-lactam and aminoglycoside combination rather than with any other treatment regimen.[34,35] Other studies have documented the positive benefit of early attainment of adequate blood levels of aminoglycosides in the successful therapy of Gram-negative pneumonia.[36]

It appears that clinicians may well select different antibiotic treatment regimens based on their assessment of the severity of pneumonia in the individual patient, the likely pathogen(s), and various laboratory test results.[33] We therefore analysed further the use of either aminoglycosides or erythromycin in the therapy of our patients in relationship to either raised initial urea or the need for dialysis, since we had the anecdotal impression that many of the clinicians in the unit may have chosen not to use an aminoglycoside in cases with renal dysfunction (data not shown). The only significant finding was that the use of aminoglycosides bore an inverse relationship to the need for dialysis in all patient groups. Thus aminoglycoside use may not have been important in its own right, impacting positively on the outcome of our cases, but simply have been a 'marker' of cases not requiring dialysis.

Finally, the multivariate analysis demonstrated that multilobar consolidation and the need for mechanical ventilation, inotropic support or dialysis were independent parameters associated with increased mortality in our patients with SCAP. The different antibiotic regimens did not appear as independent predictors of outcome. Only when these ICU treatment parameters were excluded from the analysis model could we demonstrate the apparent benefit of empirical antibiotic combination therapy on outcome.

In conclusion, in a study of patients with SCAP, the range of poor prognostic factors, the APACHE II score and the mortality were noted to be similar in cases with and without underlying co-morbid illness. Patients with negative microbiology had a significantly higher mortality. Apparent differences in outcome of patients treated with different antibiotic regimens appeared largely to be related to the severity of the pneumonia. Markers of severity of infection appeared to be the most important predictors of outcome.

ACKNOWLEDGEMENTS

The authors would like to thank Ms A Ilsley and Mrs Alida Schoeman for their help with data collection, Professor John Freesen for help with the statistics and Professor ED Bateman for reviewing the manuscript.

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