Original Article

Healthcare-associated Pneumonia: Clinical Features and Retrospective Analysis Over 10 Years

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Abstract

Background: Healthcare-associated pneumonia (HCAP) is associated with drug-resistant pathogens and high mortality, and there is no clear evidence that this is due to inappropriate antibiotic therapy. This study was to elucidate the clinical features, pathogens, therapy, and outcomes of HCAP, and to clarify the risk factors for drug-resistant pathogens and prognosis.

Methods: Retrospective observational study among hospitalized patients with HCAP over 10 years. The primary outcome was 30-day all-cause hospital mortality after admission. Demographics (age, gender, clinical features, and comorbidities), dates of admission, discharge and/or death, hospitalization costs, microbiological results, chest imaging studies, and CURB-65 were analyzed. Antibiotics, admission to Intensive Care Unit (ICU), mechanical ventilation, and pneumonia prognosis were recorded. Patients were dichotomized based on CURB-65 (low- vs. high-risk).

Results: Among 612 patients (mean age of 70.7 years), 88.4% had at least one comorbidity. Commonly detected pathogens were *Acinetobacter baumannii*, *Pseudomonas aeruginosa*, and coagulase-negative staphylococci. Initial monotherapy with β-lactam antibiotics was the most common initial therapy (50%). Mean age, length of stay, hospitalization expenses, ICU admission, mechanical ventilation use, malignancies, and detection rate for *P. aeruginosa,* and *Staphylococcus aureus* were higher in the high-risk group compared with the low-risk group. CURB-65 ≥3, malignancies, and mechanical ventilation were associated with an increased mortality. Logistic regression analysis showed that cerebrovascular diseases and being bedridden were independent risk factors for HCAP.

Conclusion: Initial treatment of HCAP with broad-spectrum antibiotics could be an appropriate approach. CURB-65 ≥3, malignancies, and mechanical ventilation may result in an increased mortality.

Key words: *Acinetobacter Baumannii*; Antibiotic Resistance; Community-acquired Pneumonia; CURB-65; Healthcare-associated Pneumonia; *Pseudomonas Aeruginosa*

Introduction

Life expectancy is improving in China, and the number of long-term elderly residents in nursing homes or hospitals is increasing.[1] Many elderly people develop pneumonia away from the hospital, but many have been in close contact with the hospital environment or stayed in nursing homes or similar hospital environments before developing pneumonia.[2-4] Healthcare-associated pneumonia (HCAP) has features that are different from those of community-acquired pneumonia (CAP).[5-9] The guidelines from the American Thoracic Society (ATS)/ Infectious Diseases Society of America (IDSA) state that the risk of infections with *Staphylococcus aureus*, Gram-negative Bacilli, *Pseudomonas aeruginosa,* and other multidrug-resistant (MDR) bacteria was high in HCAP.[9]

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The main pathogenic mechanisms for HCAP are aspiration pneumonia, bacterial pneumonia secondary to influenza, and drug-resistant pneumonia secondary to endovascular treatment such as dialysis, and pneumonia caused by opportunistic microorganism during treatment with an immunosuppressive agent or anticancer drug.[10] Shindo *et al.* suggested that empiric anti-infective therapy against HCAP should include antibiotics against drug-resistant bacteria.[11]

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However, Chalmers *et al*. observed that high mortality was mainly related to the baseline characteristics of the patient, not with drug-resistant infections, and that it would not be necessary to adopt the therapeutic regimens recommended by the ATS/IDSA guidelines.[12]

Although HCAP has been extensively studied, previous studies have shown that HCAP was associated with more frequent drug-resistant pathogens and higher mortality than CAP, but there was no clear evidence that this was due to inappropriate antibiotic therapy.[13] Keeping these discrepancies in mind, it would be valuable to clarify the definitions and pathogens responsible for HCAP to avoid the blind empirical use of broad-spectrum antibiotics. This retrospective study was conducted to elucidate clinical features, pathogens, therapy, and outcomes of HCAP for an appropriate and effective initial anti-infective therapy.

Methods

Study design and subjects

In this observational study, adult patients (≥18 years) with HCAP who were admitted in the Department of Respiratory Medicine, Chinese PLA General Hospital between November 1, 2001 and October 31, 2011 were retrospectively evaluated. All patients were screened according to the International Classification of Diseases (ICD) guidelines ICD-9 (480.0–487.9) and ICD-10 (J09–J18.9).

According to Kohno *et al.*,[10] HCAP was defined as: (1) Pneumonia diagnosed in a resident of an extended care facility or nursing home; (2) pneumonia diagnosed in a person who has been discharged from a hospital within the preceding 90 days; (3) pneumonia diagnosed in an elderly or disabled person who is receiving nursing care; or (4) pneumonia diagnosed in a person who is receiving regular endovascular treatment as an outpatient (dialysis, antibiotic therapy, chemotherapy, or immunosuppressant therapy) . Patients who met the diagnostic criteria for pneumonia and HCAP were included in the study. For patients with HCAP after repeated hospital admissions, only the first admission was analyzed in the present study.

Exclusion criteria were: (1) Pneumonia occurred more than 48 h after hospital admission; (2) patients who already had pneumonia when transferred from other hospitals or departments; or (3) patients who had lung lesions before admission and the possibility of new lung lesions (shadows shown on imaging studies) originating from old lesions.

This study was approved by our local Ethical Committee. The need for individual consent was waived by the committee because of the retrospective nature of the study.

Outcomes

The primary outcome was 30-day all-cause hospital mortality after admission. Pneumonia outcome was the secondary outcome, and was defined by a physician as: (1) Cured (complete disappearance of pneumonia symptoms; lung X-ray back to normal or obvious improvements; blood tests back to normal); (2) improvement (symptoms improved compared with baseline; no new signs or symptoms; improvement or no new deterioration in lung X-ray; improvements of laboratory tests); (3) no improvement (no changes or worst symptoms; new signs or symptoms; progression on X-ray; deterioration or no improvement in laboratory parameters); (4) death; or (5) unknown (patient was transferred to another hospital or discharges without cure).

Data collection

Patient demographic characteristics (age, gender, clinical features, and preexisting diseases), date of admission, discharge and/or death, hospitalization costs, laboratory results, and microbiological results within 48 h after admission, chest imaging, and risk assessment by CURB-65 were analyzed.[14]

The CURB-65 score is calculated based on five indicators measured within 24 h of admission: Confusion, blood urea >7 mmol/L, respiratory rate >30 breaths/min, systolic blood pressure <90 mmHg or diastolic blood pressure <60 mmHg, and age >65 years.[4,14-16] Low-risk was defined as a CURB-65 score ≤2, and high-risk was defined as a CURB-65 score ≥3. Therapies (including the use of antibiotics), admission to Intensive Care Unit (ICU), the use or need for mechanical ventilation, and pneumonia prognosis were recorded. Data were managed using EpiData 3.1 (EpiData Association, Odense, Denmark). All data were anonymized, and there was no mean to trace back the patients' identity.

Statistical analysis

All analyses were performed using SPSS 19.0 (IBM, Armonk, NY, USA). Categorical variables were analyzed using the Chi-square test or the Fisher's exact test, as appropriate. Continuous variables were compared using the Student's *t*-test when the variables were normally distributed and the Mann–Whitney *U*-test when the variables were not normally distributed. The contribution of each potential risk factor was denoted by an odds ratio (*OR*) and associated 95% confidence interval (95% *CI*). A multivariate Logistic regression analysis was performed for variables associated with 30-day mortality according to the univariate analysis ($P < 0.10$). $P < 0.05$ was considered statistically significant.

Results

Patient characteristics

During the study period, 9686 patients were admitted with pneumonia and 612 (6.32%) patients were included in the study [Tables 1 and 2]. Among 336 patients who stayed in nursing homes or care centers, 104 patients had at least one of the following characteristics: (1) History of hospitalization; (2) antibiotics use; and/or (3) chemotherapy or hemodialysis. The remaining 232 patients had none of these features, except for having stayed in a nursing home.

Table 1: Demographic and general characteristics of the patients

Demographic and general characteristics	*n* (%)
Living in nursing homes or care centers	336 (54.9)
Hospitalized ≥2 days within 90 days	326 (53.3)
Received intravenous antibiotic therapy, chemotherapy or trauma care within 30 days	127 (20.8)
Long-term hemodialysis	21 (3.4)
Age distribution (in years)	
<45	62 (10.1)
45–54	34 (5.6)
55–64	58 (9.5)
65–74	119 (19.4)
≥75	339 (55.4)

Of the study population, 73.5% (n = 450/612) were male. Mean age was 70.7 ± 16.0 years. Of the study population, 88.4% (n = 541/612) had comorbidities including ischemic cardiomyopathy, cerebrovascular disease, diabetes, chronic obstructive pulmonary disease, chronic renal failure, malignant tumors, and neurological disorders. Of the study population, 11.8% (n = 72/612) were bedridden, 3.3% (n = 20/612) required nasogastric feeding, 13.9% (n = 85/612) were smokers, and 9.0% (n = 55/612) drank alcohol. In this study, 12.9% (n = 79/612) of the patients had received intravenous antibiotic therapy within 30 days before admission and 17.7% (n = 108/612) of the patients had received oral or intravenous corticosteroids, immunosuppressive agents, or cytotoxic drugs within 30 days of admission.

The main clinical manifestation and signs were fever/cough and pulmonary rales. Among the evaluable cases (n = 543), 97.6% (530/543) had pulmonary consolidation, and 13.4% (73/543) had pleural effusion on a chest X-ray or computed tomography, scan.

Severity of pneumonia

The study population was divided in two based on the CURB-65 scores: Low-risk group (CURB-65 score ≤2) and high-risk group (CURB-65 ≥3).[17,18] Of the study population, 94.4% (578/612) of the patients were low-risk, among whom 48.7% (281/578) had a score of 1. The remaining 5.56% was high-risk (34/612) [Figure 1]. There was a negative linear correlation between the CURB-65 score and the proportion of cured and improved patients [Table 3].

According to the CURB-65 score, patients were much older in the high-risk group than in the low-risk group, and had a tendency to have longer duration of being bedridden (32.4% vs. 9.5%, Chi-square test, P < 0.001). The incidence of the nephritic syndrome and nervous system diseases were also higher in the high-risk group.

Pattern of microbiological findings

Laboratory sputum cultures were obtained from 198 patients and blood cultures were obtained from 17 patients. The most common microorganisms detected were *P. aeruginosa* followed by *Acinetobacter baumannii* and *Stenotrophomonas* narrow food *Aeromonas*. Since most methicillin-resistant *Staphylococcus aureus* (MRSA), *P. aeruginosa, A. baumannii*, and *Stenotrophomonas* narrow food *Aeromonas* are drug-resistant bacteria, if the result of sputum or blood culture was positive for any of these, the patient was classified in the drug-resistant group (n = 77); otherwise, the patient was classified in the drug sensitive group (n = 108). According to multivariate

Table 2: Clinical characteristics of the patients

Clinical characteristics	*n* (%)
Symptoms or signs	
Fever	491 (80.2)
Cough	486 (79.4)
Pulmonary rales or signs of consolidation	344 (56.2)
Phlegm	159 (26.0)
Dyspnea	143 (23.4)
Shivering	96 (15.7)
Cyanosis	63 (10.3)
Gastrointestinal symptoms	43 (7.0)
Chest pain	42 (6.9)
Comorbidities	
Ischemic cardiomyopathy	191 (31.2)
Cerebrovascular disease	135 (22.1)
Diabetes	127 (20.8)
Chronic obstructive pulmonary disease	110 (18.0)
Chronic renal failure	89 (14.5)
Malignant solid tumors	78 (12.7)
Other neurological disorders*	70 (11.4)
Gastrointestinal disorders	59 (9.6)
Hematologic malignancies	37 (6.0)
Chronic heart failure†	35 (5.7)
Interstitial lung lesion	34 (5.6)
Organ or bone marrow transplant recipients	29 (4.7)
Interstitial lung disease	23 (3.8)
Rheumatic autoimmune disease	18 (2.9)
Hypohepatia	16 (2.6)
Nephrotic syndrome	14 (2.3)
Imaging study findings	
Pulmonary parenchymal lesion	530 (97.6)
Interstitial lung changes	52 (9.6)
Pleural effusion	78 (14.4)
Other factors	
Smoking‡	85 (13.9)
Alcohol consumption	55 (9.0)
Indwelling nasogastric tube	20 (3.3)
Bedridden for long duration§	72 (11.8)

*Other neurological diseases included Parkinson's disease, multiple sclerosis, and Alzheimer's except for cerebrovascular disease; †Included congenital heart diseases, valvular heart diseases, tuberculosis and pulmonary vascular inflammation, and granulomatous disease; ‡Based on WHO definition of smoking (1997), patients were stratified into groups: (1) Regular smoking, referring to daily smoking of 1 cigarette or more; (2) Occasional smoking, referring to weekly smoking of more than 4 cigarette, but with average daily smoking of <1 cigarette; and (3) No smoking; §Patient who could not manage daily activities all by himself, including wearing clothes, moving, taking actions, toileting, eating, and bathing, and need help from others.

Table 3: Differences in clinical outcomes between the low–risk and high–risk groups

Treatment outcome	Low-risk group (n = 578)	High-risk group (n = 34)	P
Age (years) (mean ± SD)	70.1 ± 16.30	79.7 ± 5.94	0.001
Smoking, n (%)	79 (13.7)	6 (17.6)	0.691
Drinking, n (%)	51 (8.8)	4 (11.8)	0.784
Long-term invalidity and being bedridden, n (%)	55 (9.5)	11 (32.4)	<0.001
ICU admission rate, n (%)	77 (13.3)	13 (38.2)	0.002
Mechanical ventilation, n (%)	88 (15.2)	15 (44.1)	0.002
Length of stay (days) (mean ± SD)	24.3 ± 27.8	41.1 ± 74.1	0.003
Total hospital expenses ($\times 10^5$ yuan) (mean ± SD)	4.22 ± 6.82	8.20 ± 8.72	0.001
Average daily hospital expenses (yuan) (mean ± SD)	1638.4 ± 1536.2	3024.2 ± 2690.7	<0.001
30 days outcome	–	–	<0.001
Survival, n (%)	493 (85.3)	24 (70.6)	0.021
Death, n (%)	77 (13.3)	6 (17.6)	0.647
Cannot be judged, n (%)	8 (1.4)	4 (11.8)	0.003
Clinical outcome	–	–	<0.001
Cured or improved, n (%)	467 (80.8)	17 (50.0)	<0.001
Deterioration or death, n (%)	97 (16.8)	10 (29.4)	0.06
Cannot be judged, n (%)	14 (2.4)	7 (20.6)	<0.001

ICU: Intensive Care Unit.

Logistic regression analysis, history of cerebrovascular disease (*OR*: 2.001, 95% *CI*: 1.333–3.006, P = 0.001), long-term invalidity, and being bedridden (*OR*: 2.195, 95% *CI*: 1.267–3.803, P = 0.005) were considered independent risk factors for drug-resistant bacterial infections [Table 4].

According to the CURB-65 score, *Pseudomonas* (including *P. aeruginosa*), and *S. aureus* were detected mostly in the high-risk group, followed by *Acinetobacter* (including *A. baumannii*), *Stenotrophomonas* narrow food *Aeromonas*, and *Enterococcus*.

Clinical outcomes

Overall, 79.0% (483/612) of the patients were cured or improved. Of the population, 16.3% (100/612) died during hospitalization, and the 30-day mortality was 13.6% (83/612). The outcome of the remaining patients could not be determined because of treatment interruption or transfer to other hospitals. Most commonly, 54.3% (332/612) of the patients received 3rd-generation or 4th-generation cephalosporins as initial monotherapy and 34.0% (208/612) of the patients received cephalosporins and quinolones as initial combination therapy. Only 12.9% of the patients (n = 79/612) received the initial treatment according to the guidelines; 30-day mortality and prognosis were not different between these patients and patients who did not receive initial treatment according to guidelines, suggesting that the initial antibiotic selection did not make any difference in the outcomes of this specific population of patients. Among the study population, 14.7% (90/612) patients had prior admission in an ICU, and 16.8% (103/612) had received mechanical ventilation.

According to the CURB-65 score, the ICU admission rate was higher in the high-risk group (38.2% vs. 13.3%, P = 0.002), as well as mechanical ventilation (44.1% vs. 15.2%, Chi-square test, P = 0.002). Meanwhile, the length of hospital stay was shorter, and hospitalization expenses were lower in the low-risk group compared with the high-risk. In addition, the lower-risk group had a higher 30-day survival rate and better clinical outcome than the high-risk group (Chi-square test, P < 0.001) [Table 4].

Table 4: Multivariate Logistic regression analysis of risk factors for drug–resistant pathogens

Items	*OR*	95% *CI*	P
History of cerebrovascular disease	2.001	1.333–3.006	0.001
Long-term invalidity and being bedridden	2.195	1.267–3.803	0.005

History of hospitalization, antibiotic use before pneumonia, and comorbidities were also included in the model (all P > 0.05). *OR*: Odds ratio; 95% *CI*: 95% Confidence interval.

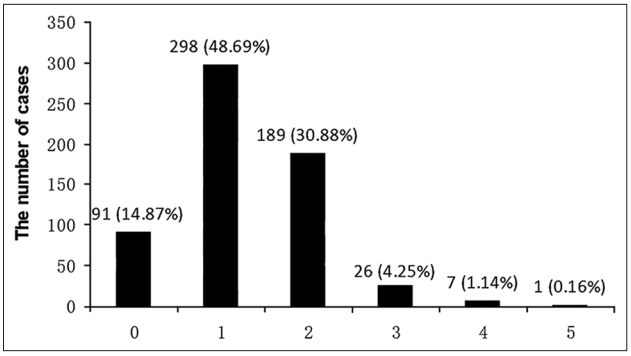

Figure 1: CURB-65 scores of patients with healthcare-associated pneumonia (n = 612).

Risk factors for mortality

Risk factors for 30-day mortality were investigated. According to the multivariate analysis, higher 30-day mortality was significantly associated with mechanical ventilation (*OR*: 16.768; 95% *CI*: 10.034–28.020, P < 0.0001), CURB-65 score ≥3 (*OR*: 2.577; 95% *CI*:

1.083–6.135, $P = 0.032$), and malignant tumors (*OR*: 2.608; 95% *CI*: 1.406–4.837, $P = 0.002$) [Table 5].

Discussion

The objective of this study was to elucidate the clinical features, pathogens, therapy, and outcomes of HCAP, and to clarify the risk factors for drug-resistant pathogens and prognosis. Results showed that among 612 patients, 88.4% had >1 comorbidity. Commonly detected pathogens were *A. baumannii*, *P. aeruginosa*, and coagulase-negative staphylococci. Monotherapy with penicillin or derivatives was the most common initial therapy (50%). Mean age, length of stay, hospitalization expenses, ICU admission, mechanical ventilation use, malignancies, and detection rate for *P. aeruginosa,* and *S. aureus* were higher in the high-risk group compared with the low-risk group. CURB-65 score ≥3, malignancies, and mechanical ventilation were associated with an increased mortality. Logistic regression analysis showed that cerebrovascular diseases and being bedridden were independent risk factors for HCAP.

The main strength of this study is the large sample size. In addition, the sample is representative of the elderly ex-military population in China. However, this study suffers from some limitations. As a retrospective study, all data were obtained from the patients' medical records, and the cases could be excluded without complete information. This could have led to selection bias. Many of the samples for bacterial culture were sputum, which might reduce the accuracy of the results. In addition, bias could be present due to the upper respiratory colonization of bacteria or specimen contamination. Only 34 bacterium species could be studied for antimicrobial susceptibility, and the assessment of MDR bacteria were not possible. Over 10 years of data were used for analysis, and this possibly could represent some era-related limitations as treatment, emerging pathogens, and patient population may change over time. Finally, the number of variables assessed using logistic regression model was limited, which could lead to bias.

Although most studies defined HCAP according to the ATS/IDSA HCAP definition,[11,17,19,20] there are still some conflicts about the definition of HCAP.[21-24] In this study, most patients were from military nursing homes. In most studies, patients with HCAP were older compared with patients with CAP.[11,19,25-27] However, the average age of patients with HCAP <60 years in the study by Zilberberg *et al*.[28] In this study, the gender proportions (mostly male) were different from these previous studies.[11,19,25-27] This could be because most of the patients in the present study were retired male soldiers. The average age (≥70 years) of this study population was consistent with many other studies.

Table 5: Results of the multivariable Logistic regression analysis for 30–day mortality

Items	*OR*	95% *CI*	*P*
Mechanical ventilation	16.768	10.034–28.020	<0.001
CURB-65 score ≥3	2.577	1.083–6.135	0.032
Malignant tumor	2.608	1.406–4.837	0.002

Long-term invalidity/bedridden, history of hospitalization, antibiotic use before pneumonia, and comorbidities were also included in the model (all $P > 0.05$). *OR*: Odds ratio; 95% *CI*: 95% confidence interval.

Nasal feeding is common in patients with HCAP, and that 58.2% of them experienced at least one aspiration event.[11] Chalmers *et al*. showed that aspiration risk was high in patients with HCAP because of the swallow dysfunction caused by neurological disorders and obstructive esophageal disease as risk factors of aspiration,[12] but this is controversial.[20] In this study, patients with HCAP were stratified using the CURB-65 score, and more patients in the high-risk group were bedridden compared with the low-risk group, which might be related to age and complications.

Many patients with HCAP have multiple comorbidities.[11,19,26] In this study, 88.4% of the patients had similar comorbidities. The incidence of Parkinson's syndrome or multiple sclerosis (11.4%) was high, and 33.5% suffered from cerebrovascular diseases and neurological disorders. Regurgitation and aspiration of the gastric fluid are more likely since proton-pump inhibitors, or histamine type 2-receptor antagonists would cause the pH value to rise, leading today's bacteriosis. In this study, patients with cancers were predisposed to HCAP due to agranulocytosis caused by the tumor or chemotherapy (18.8%). Furthermore, 5.1% of the patients with HCAP had a nephrotic syndrome or rheumatic autoimmune diseases due to immunosuppressant therapy.

Some studies found that a large proportion of patients with HCAP have altered consciousness.[11,19] Bilateral lung lesions and multiple lobes lesions were more common in HCAP.[17] This study showed that fever, cough, and pulmonary rales were the main symptoms and signs of HCAP.

In the ATS/IDSA guidelines (2005), it is proposed that broad-spectrum antibiotics should be used to treat MDR bacteria as soon as possible. Kollef *et al*. showed that *S. aureus* and *P. aeruginosa* were the most common pathogenic bacteria in HCAP.[27] This was confirmed by Yamagishi and Mikamo.[29] Micek *et al*. showed that MRSA and *P. aeruginosa* were the most common bacteria in HCAP, which accounted for 30.6% and 25.5%, respectively.[25] They also noted that *Acinetobacter* and intestinal flora were common in HCAP. This study also suggests that patients with HCAP were always infected with drug-resistant bacteria, consistent with earlier study reports. However, outcomes were not different between patients who received antibiotics according to guidelines and patients who did not, suggesting that the initial antibiotic selection did not make any difference in the outcomes of this specific population of patients with HCAP.

According to Shindo *et al*.,[11] the risk of drug-resistant infection would rise in patients who received more than 2 days of broad-spectrum antibiotics treatment within 90 days and who received nasal feeding. Shorr *et al*. reported

that the history of hospitalization, nursing home residence, long-term hemodialysis, and many stays in the ICU were risk factors for drug-resistant infections.[24] Brito and Niederman found that 90 days of hospitalization, antibiotic use in the previous 6 months and immune suppression were risk factors for infection.[30] Interestingly, in this study, it was found that there was no relation between drug-resistant bacteria and risk factors such as prior hospitalization, antibiotic use, immunosuppression, and nasal feeding. However, cerebrovascular diseases and prolonged bedridden state were independent risk factors for drug-resistant infections.

In the study by Carratalà *et al.*,[19] 75.4% of patients with HCAP received initial monotherapy, commonly penicillin or derivatives, followed by quinolones and their combination therapy. In the study by Grenier *et al.*,[20] 61.6% of the patients with HCAP were treated with initial monotherapy and more ICU patients were treated with combination therapy (58%). In the study by Sugisaki *et al.*,[26] 90.2% patients with HCAP received β-lactam antibiotics as monotherapy, and the combination therapy were also based on β-lactam and clindamycin. A large proportion of patients with HCAP received inappropriate, which resulted in MDR infections, but their prognosis was not altered or improved with changes of antibiotics.[9,19,25,28] In the study by Chalmers *et al.*,[12] the univariate analysis showed that patients with HCAP had a high all-cause 30-day mortality (14.8% vs. 7.5%, $P = 0.002$). With the consideration of HCAP heterogeneity, the use of antibiotics should be based on local pathogen characteristics and risk factors of MDR infection, and the combination of broad-spectrum antibiotics may not be appropriate for all HCAP patients.[21,30,31] In this study, most patients with HCAP were treated with monotherapy as an initial treatment, mainly cephalosporin (64%).

Many studies have confirmed that the all-cause 30-day mortality of HCAP was high.[11,19,27] A multivariate regression analysis showed that the high mortality of HCAP was due to the patient's underlying disease but not to HCAP itself.[12] In this study, CURB-65 score ≥3, the presence of a malignant tumor, and the need for mechanical ventilation were independent risk factors for prognosis. When stratifying the patients into low- and high-risk populations based on the CURB-65 score, high-risk patients had significantly worst outcomes compared with low-risk patients.

In conclusion, the risk of HCAP was high in elderly patients who were in a prolonged bedridden state and with comorbidities. In addition, long hospital stays, high hospitalization expenses, and drug-resistant bacteria such as *A. baumannii* and *P. aeruginosa* were more common among the high-risk patients. The ICU admission rates and mechanical ventilation use were higher in the high-risk group than in the low-risk group. The initial treatment of HCAP with a combination of broad-spectrum antibiotics could be an appropriate choice. To understand the actual association between HCAP and mortality rate, further and larger multicenter research is warranted.

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Conflicts of interest

There are no conflicts of interest.

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