



Risk factors of carbapenem-resistant Gram-negative bacteria pneumonia and mortality

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ABSTRACT

This experiment aimed to study the risk factors of carbapenem-resistant Gram-negative bacteria pneumonia and death. For this aim, a total of 181 patients with Gram-negative bacterial pneumonia treated from March 2020 to March 2022 were retrospectively selected and divided into the drug-resistance group (n = 96) and the non-drug resistance group (n = 85) according to the carbapenem resistance. According to the prognosis, the drug resistance group was divided into the survival group (n = 82) and the non-survival group (n = 14), respectively. The risk factors of single and multi-factor carbapenem-resistant Gram-negative bacteria pneumonia and death were studied. Results showed that univariate analysis showed that the rates of recent surgery, respiratory failure, shock, indwelling catheterization and disturbance of consciousness were significantly higher in the drug-resistant group than in the non-drug-resistant group. The univariate analysis also showed that the rates of coronary heart disease, diabetes, shock, renal insufficiency, deep venous catheterization and respiratory failure were significantly higher in the non-survival group than in the survival group. Multivariate analysis showed an increased risk of carbapenem-resistant gram-negative pneumonia in patients who had used carbapenem-resistant antibiotics, hypertension, coronary heart disease, and malignancy in the previous 90 days. Patients with carbapenem-resistant gram-negative pneumonia who had coronary heart disease, diabetes mellitus, shock, renal insufficiency, deep venous catheterization, and respiratory failure were at increased risk of death. In conclusion, recent surgery, respiratory failure, shock, indwelling catheterization, and disturbance of consciousness are risk factors for carbapenem-resistant Gram-negative bacteria pneumonia. Coronary heart disease, diabetes mellitus, shock, renal insufficiency, deep venous catheterization and respiratory failure are risk factors for death from carbapenem-resistant gram-negative bacteria pneumonia.

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Introduction

The high incidence of Gram-negative pneumonia is elderly patients, especially in spring and winter, seriously threatens the health of the elderly and is also one of the important causes of death in the elderly. In recent years, with the widespread use of antimicrobial agents, a variety of drug-resistant bacteria are increasing, resulting in a great threat to the health of patients. Infectious diseases caused by drug-resistant polygram-negative bacteria are a global public health problem, which is one of the main factors causing nosocomial infections(1-2). Carbapenems, as an important means to resist Gram-negative bacteria infection, can destroy meropenem and other antibiotics, break the amide bond in the ring, and thus lead to the disappearance of the activity of antibiotics. Carbapenem β -lactam antibiotics have the characteristics of the strongest antimicrobial activity, the most extensive antimicrobial activity, stability, low toxicity and a wide range of hydrolysis. Common carbapenems include metalloenzymes and oxacillin enzymes(3-4). Some scholars in the study point out that due to the use in recent years of a large number of penicillium carbon alkene the emergence of drug resistance of gram-negative bacilli, carbon black alkene beta-lactam makes the treatment of gram-negative bacteria infection

has made great progress, but also lead to more outstanding, the drug resistance of gram-negative bacteria for clinical anti-infection treatment and hospital infection control has brought great difficulties (5-6). With the widespread and irrational use of carbapenem-resistant gram-negative bacteria pneumonia, including carbapenem-resistant *Enterobacter*, *Pseudomonas aeruginosa*, *Acinetobacter baumannii*, etc., has gradually been reported worldwide (7-8). For resistance to carbon penicillium alkene gram-negative bacteria pneumonia whether different bacteria with these different characteristics, is a common occurrence and death, there are no clear reports, based on this, the article retrospective study penicillium carbon alkene resistant gram-negative bacterium pneumonia cases, the resistance to carbon penicillium alkene gram-negative bacteria to explore the risk factors and prognosis of pneumonia, To provide an effective clinical basis for the prognosis and mortality of these patients.

Materials and Methods

General information

A total of 186 patients with Gram-negative bacterial pneumonia treated in the Second People's Hospital of Wuhu from March 2020 to March 2022 were retrospec-

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tively selected and divided into drug resistance group (n = 96) and non-drug resistance group (n = 85) according to carbapenem resistance. According to the prognosis, the drug-resistance group was divided into the survival group (n = 82) and the non-survival group (n = 14). There was no significant difference in the baseline data of all patients ($P > 0.05$).

Inclusion criteria: at least one clinical specimen culture result was Gram-negative bacilli; Meeting the diagnostic criteria for nosocomial acquired pneumonia; Age 18 years; Family members and patients were informed and signed consent forms.

Exclusion criteria: hospital stay less than 48 hours; The bacteria in the specimen were judged to be contaminated; Patients with severe liver and renal impairment; Pulmonary tuberculosis; Pulmonary neoplasms; Complicated with invasive pulmonary fungal infection; Pulmonary edema; Drug-induced and radiation-induced lung injury; Pulmonary embolism; Unauthorized discharge from hospital; Patients with fixed value; Patients with incomplete clinical data; Enterobacter sp, Pseudomonas aeruginosa and Acinetobacter baumannii detected in the specimens were judged to be contaminated or brought in by the community; The cause of death was unknown. Strains repeatedly isolated from the same patient during hospitalization; Mixed infections.

Data collection

From the hospital infection in the system to collect all the clinical data of the object of study, including 90 days before the use of antibiotics, patients with using penicillium carbon alkene antibiotics, use of penicillium carbon alkene, hypertension, coronary heart disease, malignant tumor, shock, renal insufficiency, deep venipuncture, respiratory failure, recent surgery, indwelling catheter and related diseases, such as respiratory disorder.

Group status

Carbapenem-resistant gram-negative bacteria pneumonia was divided into a drug-resistant group and a drug-resistant group according to the drug sensitivity of the alveolar lavage fluid culture. The differences between the two groups were analyzed. Carbapenem-resistant Gram-negative bacteria pneumonia was further divided into a survival group and a non-survival group according to the 30-day death rate.

Source of strains

The carbapenem gram-negative bacteria treated in our hospital from March 2020 to March 2022 were collected, and the duplicate strains isolated from the same patient were removed, and the sensitivity of the drug was subsequently tested according to the same method

Specimen processing

Sputum samples and specimens received were screened for pictures. After sputum samples were qualified by internal microscopy, the digestive solution was used for digestion for 25min. Then blood and macconkey medium were separated and inoculated by streaking. All other specimens were aseptic and stripped into MacConkay plate and blood plate. The isolation training was based on the culture at 35°C for 24h, and the bacterial growth was carefully observed.

Bacterial identification and drug sensitivity test

All the strains selected in this study were identified by Zhuhai Meihua MH120 microorganisms. For the drug susceptibility test, the disk diffusion method combined with the MIC method was used to test the strains.

Relevant definitions

According to the American National Committee for Clinical Trial Standards(9), Strains resistant to any of meropenem, ertapenem, or imipenem were determined to be carbapenem-resistant Gram-negative bacteria, and Acinetobacter baumannii and pseudomonas aeruginosa in ertapenem and naturally resistant bacteria were excluded.

Statistical treatment

SPSS18.0 statistical software was used for data processing and analysis. Measurement data with normal distribution were expressed as mean \pm standard deviation ($\bar{x} \pm s$), and measurement data without normal distribution were expressed as median (interquartile range). Univariate analysis: t-test (normal distribution) or Mann-Whitney rank sum test (non-normal distribution) was used to test the significance of measurement data between groups. χ^2 test was used to test the significance of the difference between the two groups for the count data. Multivariate analysis: Variables with statistically significant differences in univariate analysis were included in Logistic regression. ($P < 0.05$) was considered statistically significant.

Results

Characteristics of patients with gram-negative pneumonia in drug-resistant and non-drug-resistant groups

As shown in Table 1, there was no significant difference in gender and age between the two groups ($P > 0.05$). Compared with the drug-resistant group, the non-drug-resistant group had fewer cases of antibiotics, carbapenem antibiotics, non-carbapenem antibiotics, hypertension, coronary heart disease, and malignant tumors in the geriatric department, nephrology department, and the previous 90 days ($P < 0.05$).

Risk factors for carbapenem-resistant gram-negative bacteria pneumonia

As shown in Table 2, recent surgery, respiratory failure, shock, indwelling catheterization, and disturbance of consciousness were risk factors for carbapenem-resistant Gram-negative bacteria pneumonia.

Characteristics of patients with carbapenem-resistant gram-negative bacteria pneumonia

As shown in Table 3, there was no significant difference in gender and age between the two groups ($P > 0.05$). Compared with the survival group, the non-survival group had fewer cases of antibiotics, carbapenem antibiotics, non-carbapenem antibiotics, hypertension, coronary heart disease, and malignant tumors in the geriatric department, nephrology department, and the previous 90 days ($P < 0.05$).

Risk factors for death in patients with carbapenem-resistant gram-negative bacteria pneumonia

As shown in Table 4, coronary heart disease, diabetes mellitus, shock, renal insufficiency, deep venous catheter-

Table 1. Characteristics of patients with Gram-negative bacterial pneumonia in the drug-resistant and non-drug-resistant groups.

Characteristics of the	Drug resistance group (96 cases)	Non-drug resistance group (85 cases)	T/x ²	P
male	46	45	0.455	0.500
female	50	40		
age	66.25 +/- 6.07	65.58 +/- 5.00	0.804	0.422.
Old families,	12	20	0.514	0.621
Renal medicine	10	27	0.325	0.527
Antibiotics for the previous 90 days	10	11	0.374	0.654
Carbapenems antibiotics	6	13	0.278	0.601
Non-carbapenem antibiotics	4	19	0.507	0.701
Coexisting underlying diseases				
hypertension	4	5	0.432	0.512
Coronary heart disease (CHD)	5	3	0.561	0.361
A malignant tumor	5	2	0.248	0.632

Table 2. Risk factors for carbapenem-resistant Gram-negative bacteria pneumonia.

variable	Regression coefficient	Standard error	WaldX2 value	P	The OR value	95%CI
Recent surgery	1.359	0.698	2.012	0.001	0.351	0.120 ~ 0.867.
Respiratory failure	0.114	0.521	0.039	0.001	0.125	0.027 ~ 0.697
shock	0.001	0.561	0.000	0.001	0.854	0.642 ~ 0.967
Indwelling catheter	0.654	0.425	2.654	0.100	0.354	0.412 ~ 0.752
Disturbance of consciousness	0.156	0.412	0.412	0.052	0.851	0.889 ~ 0.996

Table 3. Characteristics of patients with carbapenem-resistant gram-negative bacteria pneumonia.

Characteristics of the	Survival group (82 cases)	Non-survival group (14 cases)	T/x ²	P
male	48	8	0.010	0.922
female	34	6		
Age (years)	65.01 +/- 2.56	66.56 +/- 3.01	0.044	2.040
Old families,	15	1	0.520	0.326
Renal medicine	15	2	0.214	0.301
Use of antibiotics within the previous 90 days	19	4	0.104	0.620
Carbapenems antibiotics	10	3	0.253	0.651
Non-carbapenem antibiotics	9	1	0.341	0.600
Coexisting underlying medical conditions				
hypertension	2	2	0.410	0.201
Coronary heart disease (CHD)	3	2	0.145	0.321
A malignant tumor	4	1	0.241	0.365

Table 4. Risk factors for death in patients with carbapenem-resistant Gram-negative bacteria pneumonia.

variable	Regression coefficient	Standard error	WaldX2 value	P	The OR value	95%CI
Coronary heart disease (CHD)	2.101	0.654	8.324	0.001	0.621	0.314 ~ 0.845
diabetes	1.589	0.701	6.321	0.005	0.989	0.352 ~ 0.995
shock	2.103	0.785	6.654	0.001	0.321	0.127 ~ 0.785
Renal insufficiency	0.854	0.599	2.041	0.150	0.531	0.412 ~ 0.862
Deep vein catheterization	2.236	0.865	6.214	0.001	0.645	0.241 ~ 0.899
Respiratory failure	0.897	0.624	1.324	0.120	0.214	0.014 ~ 0.387

zation, and respiratory failure were risk factors for death in patients with carbapenem-resistant gram-negative bacteria pneumonia.

Discussion

Gram-negative bacilli are rod-shaped bacteria with eo-

sin gram-stained bacteria. As an important cause of human infectious diseases, Gram-negative bacilli play an important role in infectious diseases(10-11).Klebsiella pneumoniae, Pseudomonas aeruginosa, Proteus, Escherichia coli, Haemophilus influenzae, and Salmonella are common Gram-negative bacilli(12-13).Some scholars have pointed out in the study that the pathogenic ability of Gram-ne-

gative bacteria is related to its lipopolysaccharide layer. Lipopolysaccharide can stimulate innate immunity in the human body and express this immune response through the activation of the immune system. For example, redness and swelling are caused by the generation of cell groups, which are caused by the presence of LPS in the cell wall epidermis of Gram-negative bacteria, so most antibiotics can effectively inhibit such cells(14-15). Carbapenem-resistant drugs, as a kind of spectral antibiotics commonly used in clinical practice, have good antibacterial effects on most diseases caused by bacterial infections(16). Carbapenem-resistant enterobacteria, commonly referred to as super-bacteria in clinical practice, are relatively resistant to most antibiotics. Patients infected with these bacteria are difficult to treat and have a high mortality rate(17-18).

Some scholars have pointed out in their studies that the reasons for the retrograde translocation of GI fixed bacteria are the impairment of the systemic defense mechanism of carbapenem-resistant gram-negative bacteria pneumonia, combined with the use of acid-suppressive drugs after the occurrence of stress ulcer or the disease itself(18-19). In recent years some scholars pointed out that in the study of elderly patients with gram-negative bacteria pneumonia is increasing, and the prevalence is high, the structure of the medical special environment for patients of pathogenic bacteria screening, vulnerable to infection in patients with drug-resistant bacteria, therefore in the treatment of anti-infection, shall promptly carry out bacterial culture and drug susceptibility test, in order to achieve good treatment effect and reduce the generation of drug-resistant strains(20-21). To strengthen the management of nosocomial infection, firstly strengthen the nutrition of patients, secondly improve the patients' immunity, reduce the invasive examination, and protect the patients' inherent natural immunity guarantee(22-23). In this study, recent surgery, respiratory failure, shock, indwelling catheterization, and disturbance of consciousness were found to be risk factors for carbapenem-resistant gram-negative bacteria pneumonia, which was similar to the above results. In addition, recent surgery, respiratory failure, shock, indwelling catheterization, and disturbance of consciousness were also found to be closely related to the occurrence of carbapenem-resistant Gram-negative bacteria pneumonia in this study, which is expected to be the relevant indicators of carbapenem-resistant Gram-negative bacteria pneumonia in the future.

Recent studies have found that coronary heart disease, diabetes, shock, renal insufficiency and deep venous catheterization are the main risk factors for death from carbapenem-resistant Gram-negative bacteria pneumonia(24-25). Some scholars have pointed out in the study that patients with coronary heart disease often suffer from cardiac insufficiency under the blow of refractory infection, resulting in death(26-27); Diabetic patients with vascular diseases of other organs, severe acute complications of diabetes will increase the mortality of patients. It is necessary to strengthen the monitoring of diabetic patients to prevent complications(28-29). Shock patients themselves are in a state of circulatory failure and the condition is poor, so it is an important cause of death in patients with carbapenem-resistant gram-negative bacteria pneumonia(30-31). Renal insufficiency is a clinical syndrome caused by the decline of renal function. Active treatment and active prevention can reverse or delay the progression of renal insufficien-

cy(32-33). When patients have deep vein catheterization, it needs to be open to the large veins of the body, so as to promote drug-resistant bacteria into the blood. When drug-resistant bacteria enter the blood, it will cause the occurrence of bloodstream infection in patients. When operating deep vein vessels, no bacterial infection should be strictly observed to prevent cross-infection between patients due to errors of medical staff(34-43). In this study, coronary heart disease, diabetes, shock, renal insufficiency, deep vein catheterization, and respiratory failure were found to be closely related to the risk factors for death from carbapenem-resistant gram-negative bacteria pneumonia.

Although the risk factors of carbapenem-resistant gram-negative bacteria pneumonia and death were found to be closely related to recent surgery, respiratory failure, shock, indwelling catheterization, disturbance of consciousness, coronary heart disease, diabetes, renal insufficiency and deep vein catheterization. However, due to the small number of cases retrospectively selected in this study, the data in this study may be biased. A large number of patients with carbapenem-resistant Gram-negative bacteria pneumonia should be selected for clinical trials in the later stage, so as to provide certain data for clinical treatment in the later stage, so as to benefit more patients with carbapenem-resistant Gram-negative bacteria pneumonia.

In conclusion, recent surgery, respiratory failure, shock, indwelling catheterization, and disturbance of consciousness are risk factors for carbapenem-resistant Gram-negative bacteria pneumonia. Coronary heart disease, diabetes mellitus, shock, renal insufficiency, deep vein catheterization and respiratory failure were all risk factors for death from carbapenem-resistant gram-negative bacteria pneumonia.

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