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Epidemiological study on non-drug-resistant *Acinetobacter*

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ABSTRACT

Objective. To explore the prevalence of non-drug-resistant *Acinetobacter,* in order to provide a theoretical basis for clinical anti-infection treatment of non-drug-resistant *Acinetobacter.*

Methods. The medical records of inpatients in various departments of the hospital were retrospectively sorted out, and the data covered many aspects of human body such as blood, saliva, sputum and tissue. Immediately after collection, samples were labeled and stored in a refrigerator at 8°C to investigate clinical distribution and prevalence.

Results. Among the 158 strains of non-drug-resistant *A. baumannii,* 30 strains were obtained from sputum samples (18.98%). The second most common type was 11 strains in urine (6.96%); 44 blood samples, accounting for 27.85%. The age distribution was as follows: 8 strains (11.39%) were minors under 18 years of age; There were 20 plants (12.66%) aged from 18 to 30 years old; 75 strains (47.47%) were over 60 years old. Nine of the 158 non-resistant strains were included, accounting for the highest proportion of *A. Boumani,* followed by *A. Boumani* Hospital and *A. Boumani* Pittsburgh. At present, the bacterial strain is mostly detected in blood samples, and is mainly distributed in middle-aged and old patients over 50 years old, and is relatively popular in ICU and FMW departments.

Conclusion. The drug-resistant *A. baumannii* in hospital specimens tends to accumulate in ICU, and the nosocomial infection caused by this disease is mainly concentrated in the elderly and patients with various basic diseases, with a high detection rate. *Acinetobacter* strains are generally resistant, and polymyxin B and minocycline are often the first choice of therapy.

Keywords: non-resistant, *acinetobacter*, epidemic

INTRODUCTION

Acinetobacter is a bacterium that is ubiquitous in natural and clinical environments, and their living areas are very wide, from natural ecological environments such as soil, water, insects, to medical equipment, medical facilities and other medical places, they can be found. *Acinetobacter* plays an important role in the development of human society. In recent years, due to the overuse of antibiotics, many *Acinetobacter* began to develop resistance, which has brought great challenges to clinical treatment. In the past decades, scholars around the world have been committed to finding new antibacterial drugs to combat *Acinetobacter*, and have made some progress. Among them, the epidemic of non-drug-resistant *Acinetobacter* has aroused widespread concern around the world. This article will review the current research and countermeasures on *Acinetobacter* resistance at home and abroad. The overuse of antibiotics is the main cause of the problem of antibiotic resistance in *Acinetobacter*. Due to the overuse of antibiotics and the increasing number of drug-resistant strains, drug-resistant

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bacteria are widely prevalent in the world. Antibiotics are considered key drugs in the fight against bacterial infections, but due to the inappropriate use of antibiotics, bacteria develop resistance to them and further spread. Therefore, how to reasonably use the existing antibiotic resources to control the occurrence and development of *Acinetobacter* resistance has become an urgent issue to be solved.

Acinetobacter, as a common opportunistic pathogen, has brought many challenges to clinical treatment. In recent years, with the deepening of the understanding of *Acinetobacter*, more drug-resistant strains of *Acinetobacter* have appeared in the world. To study the epidemic trend of non-drug-resistant *Acinetobacter*, the aim is to gain an in-depth understanding of the mode of transmission, epidemic patterns, prevention and control methods of this type of bacteria. At present, the distribution of non-resistant *Acinetobacter* in human population has not been reported, but it has been analyzed and discussed in some literatures. In-depth study on the epidemic trend of non-drug-resistant *Acinetobacter* can provide a solid scientific basis for clinical treatment, and provide a powerful decision-making basis for the formulation of effective prevention and control strategies.

An in-depth study was conducted on the epidemiological properties of non-drug-resistant *Acinetobacter*, including its geographical distribution, mode of transmission and vulnerable populations. The pollution status of non-drug-resistant non-moving bacteria in hospital environment was detected by plate coating method. Through careful monitoring of the distribution of bacteria in various regions and different environments, we can better understand their epidemic patterns and transmission trends. The results showed that the strain existed in all regions of China. Those *Acinetobacter* that did not develop resistance were isolated, cultured, and identified, and their biological properties and resistance mechanisms were analyzed in depth. The molecular biology method was used to test the drug resistance of some strains in animals. Advanced technologies such as bacterial culture and gene sequencing were used to carry out in-depth research on its genetic background and variation pattern. The results showed that the strain had extensive infection in hospitals of China and it increased year by year, mainly occurred in hospitalized patients, with significant regional characteristics. It is expected that we can have a deeper understanding of the transmission path and epidemic mode of this type of bacteria, so as to provide scientific support for the development of effective prevention and control strategies. The experimental results not only enriched the information about the non-resistant strains in the published literature, but also laid a foundation for further work. In addition, these research results will help enhance clinicians' understanding and treatment skills of non-drug-resistant *Acinetobacter*, thus providing a strong decision basis for the scientific use of antibiotics. The results can not only be used to guide the selection of antimicrobial agents, but also help doctors to understand the causes of drug-resistant strains to a certain extent, so as to effectively control the occurrence of infection. In addition, the research will promote research and development in related fields and promote cooperation and development among cross-disciplines.

The epidemiological study of non-drug-resistant *Acinetobacter* spp. is of great importance in preventing the spread of such bacteria. In recent years, a large number of related studies against this pathogen have been carried out by scholars in China and abroad. Through the epidemiological investigation, laboratory research and comprehensive analysis of prevention and control strategies, it is expected to provide a new direction and means to solve the problem of drug resistance of *Acinetobacter*. However, in the process of research, may encounter a variety of difficulties, such as rapid variation of bacteria and complex transmission path. At the same time, a unified and standardized standard testing system and evaluation tools have not been established yet, making it difficult to accurately assess the potential risks and hazard degrees. Therefore, it is necessary to deepen international cooperation and communication to jointly face this global public health challenge. A large number of explorations have been conducted by Chinese scholars in the aspects of *Acinetobacter* resistance and its related factors, detection technology of multiple resistant strains, prevention and control strategies, etc. Future research can focus on areas such as genomics and protein omics of non-drug-resistant *Acinetobacter* sp. in order to gain a deeper understanding of bacterial resistance and transmission mechanisms. In view of the existing problems at home and abroad, we should strengthen the construction of basic and related technical platforms, establish a unified and effective drug resistance monitoring system, and carry out a large-scale epidemiological investigation. At the same time, we need to strengthen cooperation between clinical and scientific research to ensure that the research results can be applied in practice, so as to improve the prevention and treatment of infectious diseases. In addition, there is a need to enhance public awareness of the rational use of antibiotics in order to reduce their overuse and to fundamentally prevent the development and transmission of resistance by bacteria.

This paper mainly reviewed the research progress on non-drug-resistant *Acinetobacter* in China

and abroad in recent years, aiming to provide reference for further related work. Through interdisciplinary cooperation and collective efforts, it is expected that *Acinetobacter* non-resistant can be effectively prevented and controlled, thereby providing a solid guarantee for human health.

MATERIALS AND METHODS

Specimen collection

This study selected samples from multiple departments in the hospital, including patients in intensive care unit (ICU), surgery and internal medicine. These sections represent different patient groups and different disease states. In order to properly evaluate the risk factors that may be involved in the sample, a comprehensive survey of all participants and relevant personnel was conducted using the questionnaire survey method, and based on the survey data, possible problems were analyzed. The study underwent a rigorous ethical review process leading to ethical approval (ethical approval number NMRR ID-22-00958-BJG) prior to initiating sample collection. Samples were collected by medical specialists and strictly following aseptic procedures. In order to ensure the accuracy and reliability of the experimental data, all samples should be stored in the laboratory, and regular safety checks should be conducted, so that the necessary precautions can be taken in time to reduce the risk of infection or poisoning. The data collection of this research mainly focuses on blood, saliva, sputum and tissues of the human body. Samples should be labeled immediately after collection and stored in a refrigerator at 80°C to ensure DNA stability and integrity for subsequent DNA extraction.

Culture and separation of microbial samples

Using flat line method

Isolate bacteria at 80°C and store in refrigerated containers. Next, all necessary tools and materials will need to be prepared on the sterile operating table in the laboratory to prevent external contamination. After the inoculation rings were heated using an autoclave, samples were taken and labeled on pre-prepared agar plates. The culture solution was immersed in cotton balls soaked in alcohol, and then filtered through a covered test tube. The scribing technique is to gently draw the lines of the seed ring on a fixed medium using the plate technique. The specific steps of scribing were as follows: according to the drawing, 4-5 lines were drawn on the surface of agar as a first area, and then the culture dish was rotated to 70 degrees, followed by heating the inoculation ring, 4-5 lines were drawn across the first area as a second area, and third and fourth areas were drawn according to the same design. Be sure to avoid connecting the scribed line from the last area to the first area, as shown in Figure 1.

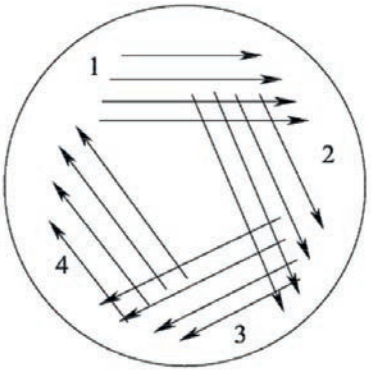

FIGURE 1. Using plate marking method

The strip agar plates were invert and incubated overnight at 37°C. in a thermostatic incubator.

Using liquid culture method

The medium used for overnight culture of the bacteria was studied and the necessary equipment and materials were prepared on a sterile operating table in the laboratory. Subsequently, 5 ml of previously prepared pre-heated liquid medium was transferred to the sterile line. The sterilized petri dish was placed in a beaker of sterile alcohol. The rings were first heated by a flame sterilizer, followed by the selection of a colony from the ring for blocking and incubation at 37°C overnight. Subsequently, rotation was performed on a thermostatic oscillator at a rate of 60 rpm.

Strain preservation

Combine approximately 500μL of liquid bacteria with 500 μL of a 50% glycerol bacterial solution and store at 8°C.

Drug sensitivity test

Bacterial identification was performed using a full-automatic microbial mass spectrometer with the Brook MALDI Biotyper system and the control strains were *E. coli* ATCC25922, *Enterococcus faecalis* ATCC29212, *Staphylococcus aureus* ATCC29213, and *Pseudomonas aeruginosa* ATCC27853. In susceptibility test, results were identified using Meria Gram-negative bacteria susceptibility cards AST-N334 and AST-N335 produced by Meria Biology Co., Ltd., which contain the following antibiotics: piperacillin tazobactam, cefoperazone sulbactam, ceftriaxone, cefepime, ceftazidime, levofloxacin, ciprofloxacin, amikacin, gentamicin, trimethoprim-sulfamethoxazole, tobramycin, tetracycline, minocycline, aztreonam, doxycycline, tigecycline and polymyxin. The K-B method was used for the review of drug sensitivity results. The drug susceptibility results were determined according to the resistance interpretation standard of the Institute for Clinical and Labo-

ratory Standards (CLSI). CRAB means that the isolate is not sensitive to any one of carbapenems such as imipenem, meropenem, doripenem or ertapenem.

Statistical analysis

SPSS 26.0 software was used for analysis. Measurement data were expressed as mean standard deviation, and inter-group comparison was examined by independent sample t test. Enumeration data were expressed as case numbers and percentages, and inter-group comparison was performed using Chi-square test. P <0.05 was considered as the difference with statistical significance.

RESULTS

Distribution of specimen types

Of the 158 non-resistant *A. baumannii* strains, 30 strains (18.98%) were derived from sputum specimens. 11 urine (6.96%); 44 blood samples (27.85%). See Table 1 and Figure 2 for details.

TABLE 1. Specimen species distribution was presented

Specimen type	Number of cases	Composition ratio (%)
blood	44	27.85
urine	11	6.96
swab	15	9.49
trachea	19	12.03
sputum	30	18.99
other	39	24.68

Age distribution

The age distribution of the 158 *A. baumannii* strains was as follows: 8 (11.39%) (minors under 18 years old), 20 (12.66%) at the age of 18-30 years old, and 75 (47.47%) at the age of over 60 years old. See table 2 for details.

Distribution of departments

See Table 3 and Figure 4 for the departmental distribution of 158 non-drug-resistant *A. baumannii* strains.

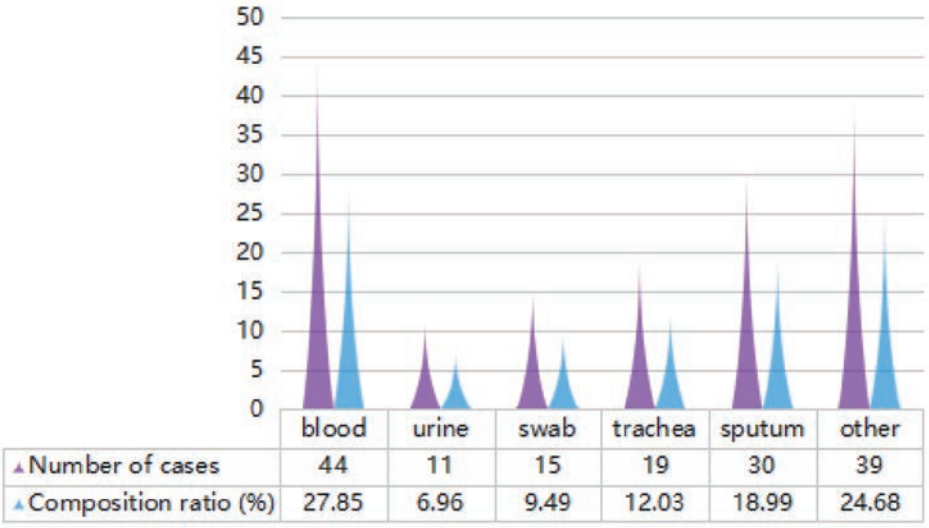

FIGURE 2. Specimen species distribution was presented

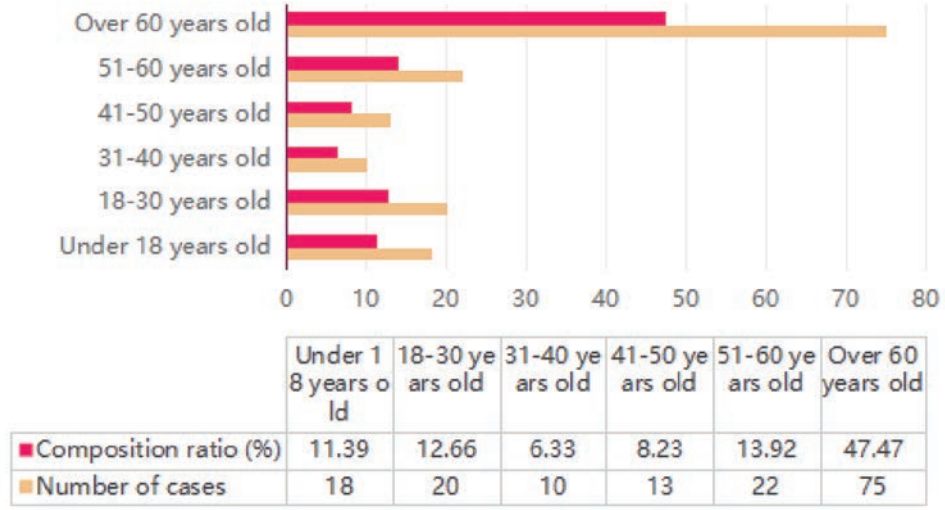

FIGURE 3. Age distribution of Acinetobacter baumannii infection was presented

TABLE 2. Distribution of *Acinetobacter baumannii* infection at age was presented

Age interval	Number of cases	Composition ratio (%)
Under 18 years old	18	11.39
18-30 years old	20	12.66
31-40 years old	10	6.33
41-50 years old	13	8.23
51-60 years old	22	13.92
Over 60 years old	75	47.47

TABLE 3. Distribution of *Acinetobacter baumannii* infection in various departments was presented

Distribution department	Number of cases	Composition ratio (%)
Acute Internal Medicine	1	0.63
AIM	6	3.80
BD	1	0.63
BILIK 7	1	0.63
CAPD UNIT	2	12.66
CC4	2	12.66
CHILDREN	1	0.63
ICU	28	17.72
ED	5	3.16
ETD	11	6.96
Female Ward	1	0.63
FEW	1	0.63
FMW	4	2.53
FOW	2	12.66
FWD	1	0.63
Gastroenterology	2	12.66
General Medical	4	2.53
GMW	8	5.06
GSW	12	7.59
Hematology	2	12.66
ISO	2	12.66
JPL	1	0.63
K2B	1	0.63
KK	3	1.90
Klinik Pakar Dermatology	1	0.63
Maternity	1	0.63
Melur	2	12.66
MEW	1	0.63
MMW	5	3.16
MOW	9	5.70
MW	1	0.63
Neurology Ward	1	0.63
HDW EXT:2150	2	12.66
OPD	1	0.63
OPD/KK Tamparuli	1	0.63
Pakar Dermatology	1	0.63
Plastic	1	0.63
PMW	1	0.63
FOW	1	0.63
R2	1	0.63
R7	1	0.63
Rafflesia Ward	1	0.63
Uphill Medical Chronic	1	0.63
URO	1	0.63
TN WARD	1	0.63
Urology	1	0.63
Wad 12 HMBP	1	0.63
other	19	12.03

Analysis of drug sensitivity results

Antibiotic resistance and susceptibility in the analysis of 158 non-resistant samples were determined as follows.

0 amoxicillin/clavulanic acid resistance and 2 sensitivities were present in the blood samples. There

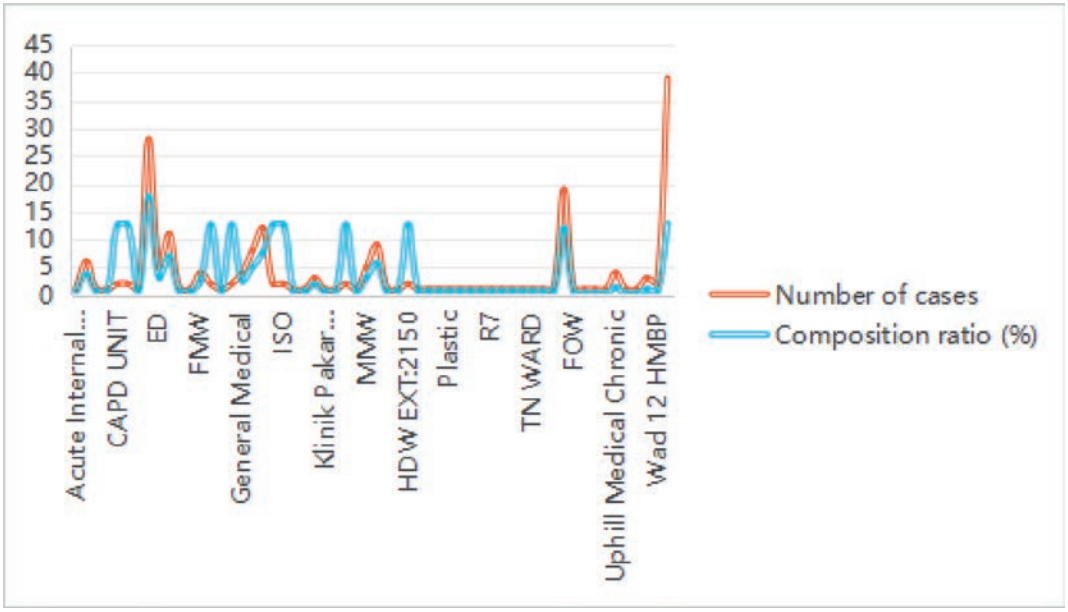

FIGURE 4. Age distribution of Acinetobacter baumannii infection was presented

were 0 case of drug resistance and 0 case of sensitivity in urine. Among the swab samples, 0 case was drug-resistant and 0 case was sensitive. There were 0 case of drug resistance and 0 case of sensitivity in trachea. There were 0 case of drug resistance and 0 case of sensitivity in sputum. In other groups, there were 0 case of drug resistance and 0 case of sensitivity.

Blood samples showed (+) ampicillin/sulbactam resistance in 6 cases and sensitivity in 24 cases; There were 2 cases of drug resistance and 8 cases of sensitivity in urine. Among the swab samples, one case was drug-resistant, and 10 cases were sensitive. Endotracheal drug resistance 5 cases, sensitive 9 cases. There were 3 cases of drug resistance and 25 cases of sensitivity in sputum. In other groups, there were 13 cases with drug resistance and 26 cases with sensitivity.

The blood samples showed piperacillin/tazobactam resistance in 9 cases and sensitivity in 28 cases. In urine, 1 case was resistant and 10 cases were sensitive. There were 2 cases of drug resistance and 11 cases of sensitivity in the swab. Endotracheal drug resistance in 9 cases, 10 cases sensitive. There were 6 cases of drug resistance and 24 cases of sensitivity in sputum. In other groups, there were 13 cases with drug resistance and 23 cases with sensitivity.

Cefotaxime was resistant in 7 cases and sensitive in 7 cases. In urine, 1 case was resistant and 3 cases were sensitive. Two cases were drug-resistant and two cases were sensitive in swab samples. There were 7 cases of endotracheal drug resistance and 1 case of sensitivity. The sputum was drug-resistant in 4 cases and sensitive in 4 cases. There were 14 cases of drug resistance and 10 cases of sensitivity.

10 cases were resistant to ceftazidime and 31 cases were sensitive. In urine, 1 case was resistant and 10 cases were sensitive. There were 2 cases of drug resistance and 11 cases of sensitivity in the swab. Endotracheal drug resistance in 9 cases, 10 cases sensitive. There were 4 cases of drug resistance and 26 cases of sensitivity in sputum. In other groups, there were 13 cases with drug resistance and 26 cases with sensitivity.

Seven cases were resistant to (+) ceftriaxone and 0 case was sensitive in blood samples. There was 1 case of drug resistance and 0 case of sensitivity in urine. Among the swab samples, there were two cases with drug resistance and zero case with sensitivity. There were 7 cases of drug resistance and 0 case of sensitivity in trachea. There were 4 cases of drug resistance and 0 case of sensitivity in sputum. There were 14 cases of drug resistance and 0 case of sensitivity.

There were 0 case of (+) cefoperazone resistance and 0 case of sensitivity in blood sample; There was 1 case of drug resistance and 0 case of sensitivity in urine. Among the swab samples, 0 case was drug-resistant and 0 case was sensitive. There were 2 cases of drug resistance in trachea and 0 case of sensitivity. One case was drug-resistant and 0 case was sensitive in sputum. One case was drug-resistant, and 0 case was sensitive.

Cefepime was resistant in 7 cases and sensitive in 23 cases. In urine, 1 case was resistant and 9 cases were sensitive. Among the swab samples, there were 2 cases with drug resistance and 8 cases with sensitivity. There were 7 cases of drug resistance and 10 cases of sensitivity in trachea. There were 4 cases of drug resistance and 26 cases of sensitivity in sputum. In other groups, there were 12 cases with drug resistance and 23 cases with sensitivity.

Imipenem was resistant in 8 cases and sensitive in 35 cases. There were 2 cases of drug resistance and 9 cases of sensitivity in urine. Among the swabs, there were 2 cases with drug resistance and 12 cases with sensitivity. Endotracheal drug resistance in 10 cases, sensitive in 9 cases. Five cases were drug-resistant and 25 cases were sensitive in sputum. There were 14 cases of drug resistance and 25 cases of sensitivity.

Nine cases were resistant to meropenem and 34 cases were sensitive. There were 2 cases of drug resistance and 9 cases of sensitivity in urine. Among the swabs, there were 2 cases with drug resistance and 12 cases with sensitivity. Endotracheal drug resistance in 10 cases, sensitive in 9 cases. Five cases were drug-resistant and 25 cases were sensitive in sputum. There were 14 cases of drug resistance and 25 cases of sensitivity.

One case was resistant to amikacin and 43 cases were sensitive. In urine, 1 case was resistant and 10 cases were sensitive. Among the swab samples, one case was drug-resistant, and 12 cases were sensitive. Endotracheal drug resistance 1 case, sensitive 18 cases. There were 2 cases of drug resistance and 27 cases of sensitivity in sputum. In other groups, there were 4 cases with drug resistance and 35 cases with sensitivity.

Gentamicin was resistant in 4 cases and sensitive in 38 cases. In urine, 1 case was resistant and 10 cases were sensitive. Among the swab samples, one case was drug-resistant, and 12 cases were sensitive. Endotracheal drug resistance 1 case, sensitive 17 cases. There were 4 cases of drug resistance and 26 cases of sensitivity in sputum. In other groups, there were 4 cases with drug resistance and 35 cases with sensitivity.

Four cases were resistant to ciprofloxacin and 40 cases were sensitive. There were 3 cases of drug resistance and 7 cases of sensitivity in urine. There were 2 cases of drug resistance and 11 cases of sensitivity in the swab. Endotracheal drug resistance 1 case, sensitive 18 cases. There were 4 cases of drug resistance and 26 cases of sensitivity in sputum. In other groups, there were 8 cases with drug resistance and 31 cases with sensitivity.

Six cases were trimethoprim/sulfamethoxazole resistant blood samples, and 32 cases were sensitive. There were 0 case of drug resistance and 10 cases of sensitivity in urine. There were 0 case of drug resistance and 11 cases of sensitivity in that swab. There were 0 case of tracheal drug resistance and 17 cases of sensitivity. There were 3 cases of drug resistance and 27 cases of sensitivity in sputum. In other groups, there were 2 cases with drug resistance and 34 cases with sensitivity. See Table 4 and Figure 5 for details.

DISCUSSION

Over the past few years, *A. baumannii* has emerged as one of the leading pathogens of hospital-acquired infections. Its drug resistance mechanism is very complex. At present, it is not clear what factors caused the strong tolerance of *A. baumannii* to glucocorticoids, β-lactams and aminoglycosides drugs. Due to the wide and large-scale application of antibiotics in the medical field, the resistance of *A. baumannii* to carbapenems is also continuously in-

TABLE 4. Antimicrobial susceptibility profiles of non-resistant samples

Antibiotic		Blood (44)	Urine (11)	Swab (15)	Trachea (19)	Sputum (30)	Other (39)
Amoxicillin/Clavulanic Acid	R	0	0	0	0	0	0
	S	2	0	0	0	0	0
	I	42	11	15	19	30	39
(+) Ampicillin/Sulbactam	R	6	2	1	5	3	13
	S	24	8	10	9	25	26
	I	14	1	4	5	2	0
Piperacil-lin/Tzaobactam	R	9	1	2	9	6	13
	S	28	10	11	10	24	23
	I	7	0	2	0	0	3
Cefotaxime	R	7	1	2	7	4	14
	S	7	3	2	1	4	10
	I	30	7	11	11	22	15
Ceftazidime	R	10	1	2	9	4	13
	S	31	10	11	10	26	26
	I	3	0	2	0	0	0
(+) Ceftriaxone	R	7	1	2	7	4	14
	S	0	0	0	0	0	0
	I	37	10	13	12	26	25
(+) Cefoperazone	R	0	1	0	2	1	1
	S	0	0	0	0	0	0
	I	44	10	15	17	29	38
Cefepime	R	7	1	2	7	4	12
	S	23	9	8	10	26	23
	I	14	1	5	2	0	4
Imipenem	R	8	2	2	10	5	14
	S	35	9	12	9	25	25
	I	1	0	1	0	0	0
Meropenem	R	9	2	2	10	5	14
	S	34	9	12	9	25	25
	I	1	0	1	0	0	0
Amikacin	R	1	1	1	1	3	4
	S	43	10	12	18	27	35
	I	0	0	2	0	0	0
Gentamicin	R	4	1	1	1	4	4
	S	38	10	12	18	26	35
	I	2	0	2	0	0	0
Ciprofloxacin	R	4	3	2	1	4	8
	S	40	7	11	18	26	31
	I	0	1	2	0	0	0
Trime-thoprim/Sulfamethoxazole	R	6	0	0	0	3	2
	S	32	10	11	17	27	34
	I	6	1	4	2	0	3

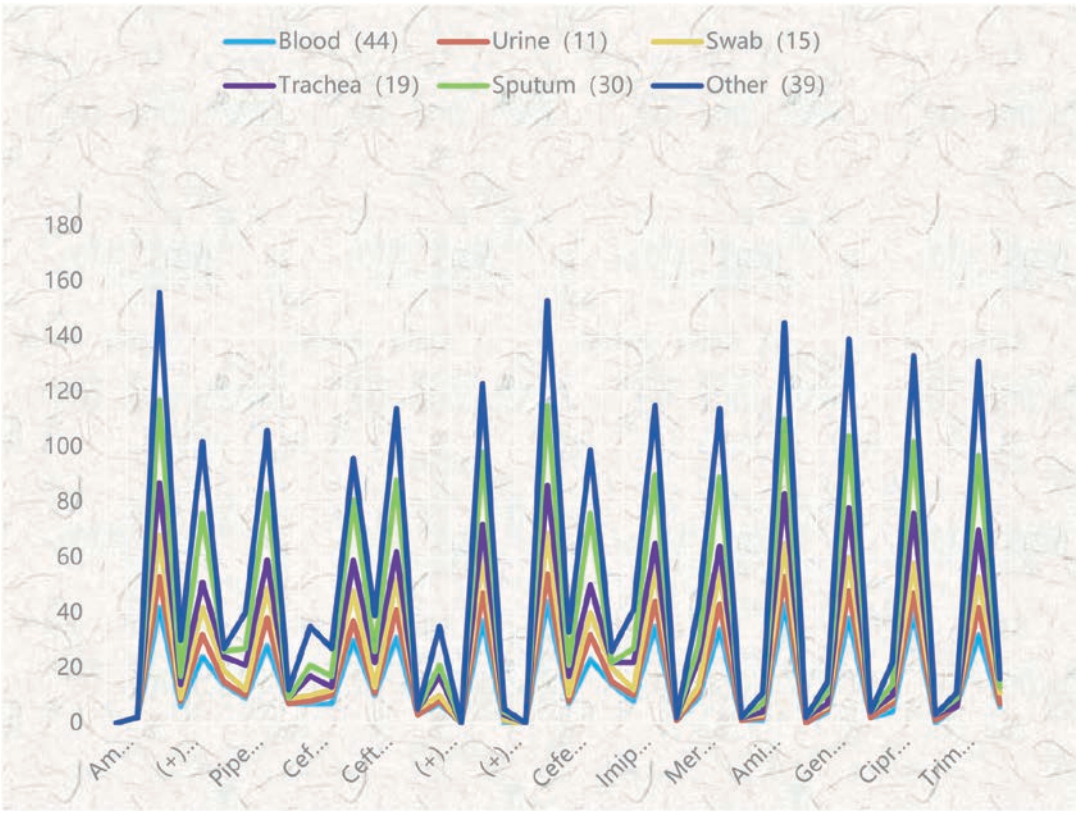

FIGURE 5. Antimicrobial susceptibility profiles of non-resistant samples

creasing. It has become one of the important pathogenic bacteria of nosocomial infection. By 2017, the pathogen had been identified by the World Health Organization as a significant threat to human health. Elderly patients are prone to multi-drug resistant strain infection due to their physio pathological characteristics. A retrospective study of single centers showed that *A. baumannii* had a relatively high detection rate of central venous catheter-related bloodstream infections in emergency intensive care units, especially the resistance of carbapenems was as high as 50.0%, which further increased the risk of death for hospitalized patients. It also suggested that the elderly or those combined with basic diseases were more likely to develop *Acinetobacter* baumannii infection. Therefore, it is essential to have an in-depth understanding of the prevalence and associated risk factors of *A. baumannii* in the elderly population as well as in multidrug-resistant bacterial infections. The purpose of this study was to investigate the epidemiological characteristics of *Acinetobacter baumannii* infection in different age groups, combined with basic or secondary chronic kidney disease, abnormal blood glucose, hemodialysis time and other elderly groups, and analyze its possible influencing factors. This study showed the distribution characteristics of 158 *A. baumannii* in different age groups: 8 *A. baumannii* (11.39% of adolescents under 18 years of age), 20 A. baumannii (12.66%) between 18 and 30 years of age, and 75 *A. baumannii* (47.47%) aged 60 years and over. Analysis of different age groups showed that the elderly were more likely to develop multi-resistant strains. Previous scientific studies have pointed out that the use of chemotherapeutic drugs may increase the mortality rate of drug-resistant bacterial infections in the population aged 65 or older complicated with diabetes and cerebrovascular problems. This experiment further confirmed that the probability of carbapenem-resistant strains in elderly patients was significantly higher than that in other age groups. Consistent with the findings of previous studies, elderly men become a high-risk population for *Acinetobacter* infection, mainly due to their long-term smoking habits resulting in the weakening of respiratory defense mechanisms and decreased body resistance to infection. In addition, there are more endogenous proteases in the elderly patients, which can decompose antibiotics to produce resistance. In addition, they require multiple hospitalizations and contact with the hospital environment due to the fact that they suffer from multiple underlying diseases, which is also a reason for colonization of resistant bacteria. In addition, with the increasing number of elderly population and the increasing number of elderly patients, these factors have contributed to the increase in the rate of infection with drug-resistant bacteria. When the immune system is inhibited, the likelihood of infection increases. Therefore, in the elderly, if there are not enough antibiotics to prevent pulmonary infection, it is likely to cause death. Their dependence on commonly

used antimicrobial agents in clinical therapy has increased because of the relatively limited choice of drugs available for treatment after infection with drug-resistant bacteria.

In this study, 30 sputum samples representing 18.98% of the 158 drug-resistant *A. baumannii* samples were detected. There were 11 urine samples in total, which accounted for 6.96%; a total of 44 blood samples were collected, representing 27.85% of the total. This indicated that most of the clinically isolated strains were resistant to antibiotics, and there were significant differences among different regions, age and gender populations. The study by Jie Jianru and her team also clearly indicated that sputum (91.4%) was the main sample source for *Acinetobacter* infection. In addition, it was confirmed that the infection rate of *A. baumannii* could be increased in patients with low immune function and malnutrition. The results of this study showed that *A. baumannii* infection in the medical environment may lead to hospital-acquired diseases such as ventilator-associated pneumonia and blood flow infection, of which chronic lung disease is the most common cause, usually with a high mortality rate, which has a serious negative impact on the prognosis of hospitalized patients. At the same time, due to the unreasonable application of antibiotic treatment, many Gram-negative bacteria have gradually become one of the important pathogenic bacteria. Therefore, strengthening the rational use and management of antimicrobial agents, as well as preventing the emergence of drug-resistant bacteria, is particularly crucial. With the extensive application of broad-spectrum antibiotics in recent years, the types of pathogenic bacteria have changed greatly, and methicillin-resistant *S. aureus* has become one of the new pathogenic bacteria with the highest infection rate in hospital. Carbapenem-resistant bacterial infection not only adversely affects the clinical prognosis of hospitalized patients with underlying pulmonary disease, but also has a serious negative effect on the prognosis of drug-resistant bacterial infections that occur after cardiac surgery, especially in patients with multi-resistant bacterial infections. This situation not only aggravates the financial burden and pressure on medical resources of hospitalized patients, but also leads to the prolongation of total hospitalization time and finally leads to the rise of mortality rate.

Tigecycline and polymyxin have shown remarkable efficacy against *Acinetobacter spp.* Although the current clinical guidance recommends the use of a combination regimen based on tigecycline or polymyxin for the treatment of patients with *Acinetobacter* infection, previous studies have shown that the damage of tigecycline to the liver, kidney, and nervous system, as well as the emergence of drug resistance, still poses a great challenge to clinical anti-infective therapy. Therefore, how to reduce or avoid unreasonable application of antibiotics has become an urgent problem to be solved. This review article summarizes the latest research results of domestic and foreign scholars in drug selection for *Acinetobacter* bacterial infection in recent years, aiming to deepen the understanding of adverse reactions and related risk factors caused by *Acinetobacter* infection, and promote the rational use of antibiotics in clinical practice. In the study, compared with those hospitalized patients infected with non-carbapenem-resistant *A. baumannii,* the all-cause mortality of those hospitalized patients infected with *A. baumannii* increased significantly by 16.0% and 4.5%, respectively. It also indicates a much lower mortality rate in inpatient cases infected with *A. baumannii* when compared to non-carbapenem-resistant *A. baumannii* infections. At the same time, there are significant differences between hospitalized patients infected with *Acinetobacter* depending on age, gender, combined underlying disease, and immune status. Among these differences, there may be multiple causes for changes in *Acinetobacter* infection rates and hospital stay. In addition, compared with the control group, the probability of serious diseases such as hospital-acquired infection, hospital-acquired pneumonia and pulmonary fungal infection was significantly increased in the inpatient period infected with *Acinetobacter* sp., and the probability of death was significantly reduced in the inpatient period. According to previous research data, from 2005 to 2014, the detection rate of *Acinetobacter* in China increased from 32.8% to 65.8%. The average hospitalization cost caused by *Acinetobacter* infection increased by more than 90,000 yuan, and the number of hospital days increased by 22. Among them, *A. baumannii* mainly caused by *Klebsiella pneumoniae* was one of the main causes for the above results. In addition, due to the prevalence of *Acinetobacter* infection in clinical practice, the incidence of complications caused by *Acinetobacter* infection is relatively high. The detection rate of *Acinetobacter* infection in this study is subtly different from previous studies. It was also found that more than half of the patients did not show obvious symptoms, and most of the patients were caused by dirty diet or invasive operations caused by other diseases. These limited certain aspects of the study given the relatively small number of cases covered in this study and the lack of in-depth analysis of hospital costs. In addition, there is still insufficient experience in the treatment of *Acinetobacter* infection at present. In addition, factors such as the old age of the patient and the combination with basic diseases will lead to an increase in the mortality rate, resulting in a large deviation of the results. Therefore, it is necessary to include more data on cases and long-term prognosis after

Acinetobacter infection in order to strengthen the evidence support of relevant studies.

A neutral point of view should be taken when considering the combined use of antibiotics. At present, broad-spectrum antibacterial drugs combined with anti-tuberculosis drugs are mainly used. When multiple drugs are used in combination, they show a wide range of antibacterial activities, and some of them may have additive or synergistic effects, which is considered as a key prerequisite for the treatment of severe infection. At the same time, we should also pay attention to its potential risks and problems, such as the unreasonable use of antimicrobial agents, resulting in the increase in drug-resistant strains, the aggravation of toxic reactions, etc. In clinical practice, drugs must be selected carefully and antibacterial drugs must be selected wisely. When the presence of cross-resistant strains is found, the dosing regimen should be appropriately adjusted. Inappropriate drug combinations may lead to drug-drug conflicts, thereby increasing the risk of adverse reactions. Therefore, for different kinds of infection, appropriate antibiotics should be used for treatment to improve the efficacy and reduce side effects. When deciding whether to use antibiotics, the decision should be made according to the actual situation of the patient and the goal of treatment. For common infections, only one treatment is required. In patients with severe disease, two or three drugs have shown enough antibacterial effect, while four or five drugs are unnecessary. Because this therapy often makes pathogenic bacteria resistant to certain antibiotics, it brings difficulties to clinical medication and even delays the condition. Therefore, extreme caution must be exercised in determining the treatment and consideration must be given to the need for multiple antibiotics and antibacterials to be used simultaneously in different situations. Some conditions can be treated with one antimicrobial agent alone, and some conditions can be treated with more than two agents at the same time. Concurrent use without thinking, prolonged use, frequent replacement, or non-compliance with the results of drug susceptibility testing not only exacerbate the condition, but may trigger the development of drug-resistant bacteria. In addition, due to the abuse of some antibiotics, also make the drug-resistant bacteria produced a large number of strains. In clinical practice, inappropriate use of antibiotics has become very common, which has caused deep public concern and anxiety. In order to enable doctors to better understand the problem of rational selection of antimicrobial agents and the correct use of drugs, should first be clear when a drug should be used? In vitro susceptibility testing of antibacterial agents is only a reference standard for pharmaceutical applications and if empirical dosing is effective, no further drug modifications are necessary. The tolerance of bacteria to drugs is gradually increasing, which has attracted widespread attention in the global medical community. At present, all countries in the world are facing serious challenges, including the problem of drug resistance. Since the first successful isolation of multidrug-resistant *Acinetobacter* species from samples in the UK in 1998, the species has been widely distributed worldwide. With the extensive application of antibacterial drugs in clinical practice and increasing abuse, bacteria have produced more resistance genes, resulting in strong tolerance of bacteria to certain antibiotics. The effects of the same kind of antibiotics on the same strain may vary in the same region or country, indicating that bacteria have complex metabolic pathways. It is a common law that bacteria produce resistance genes and enzymes. Within the same species, the differences in resistance between species were not significant. Therefore, it can be considered that the main reason for the development of drug resistance is the changes of hydrolase and other biosynthetic enzymes secreted by bacteria themselves. In recent years, excessive use of antibiotics has resulted in the emergence of a large number of clinically resistant strains. Some strains even develop multiple phenotypes with resistance, while most bacteria exhibit only a single type of resistance. The drug resistance of piperacillin with and without enzyme inhibitors is very similar, indicating that the production of hydrolase by bacteria may be large or variable. In addition, the resistance of some bacteria to some commonly used drugs is also related to this trend. Therefore, the selection of appropriate antibacterial drugs is particularly crucial in the clinical treatment. Excessive use of antimicrobial agents causes a series of serious problems that not only result in a waste of health resources and an increase in the burden on patients, but also accelerate the formation and development of bacterial resistance. In addition, with the continuous emergence of new technologies, new processes and new methods, as well as the improvement of people's understanding of the disease, the efficacy of some traditional antibacterial drugs is reduced or even ineffective. In the current clinical practice, carbapenems are mainly used to treat infection, but long-term drug use may lead to the development of drug resistance of a large number of pathogenic bacteria, which makes the existing antibacterial drugs become difficult to deal with. In addition, infectious diseases are becoming more and more complex and diverse due to the continuous emergence of drug-resistant strains and unreasonable combination therapy. *Acinetobacter* exhibits significant resistance to a wide range of commonly used antibiotics with few effective anti-

infective agents other than imipenem and meropenem. Therefore, how to select the appropriate antibacterial drugs has always been a hot research topic, and finding new antibacterial drugs with high efficiency and low toxicity has become the top priority. In recent years, due to the extensive use of broad-spectrum antibiotics in clinical practice, Gram-negative bacterial infection has gradually become one of the main pathogenic bacteria, and its incidence rate is increasing year by year, showing the development trend of multi-resistance. Such a situation is extremely dangerous, and if the antibacterial effects of the two drugs are reduced, a situation in which treatment is not possible may arise. Therefore, such as Controlling drug resistance of *Acinetobacter* has become a hot topic in the medical community. The drug resistance of *Acinetobacter* has attracted widespread attention because it has a variety of complex resistance mechanisms. At the same time, the transmission of plasmid-mediated resistance genes in the medical environment plays a decisive role in the formation of drug resistance.

Macroscopically, *A. baumannii* infection leads to increased resistance to carbapenems, which brings great clinical burden and medical cost risk to hospitalized patients. Due to the low immunity of the elderly, multi-drug resistance is easy to occur and the treatment is difficult. Therefore, early diagnosis and ensuring normative drug use are of paramount importance. In this study, we analyzed the drug resistance of *A. baumannii* and its risk factors in the elderly. The results of this study indicate that older men have become a high-risk group for *Acinetobacter* infection. In addition, it has also been found that the bacterium can be transmitted through a variety of pathways. In the process of anti-infection treatment for the protozoa of the disease, we should attach great importance to the early diagnosis and monitoring, timely adjust the drug treatment plan, and formulate personalized drug administration plan according to the results of the drug sensitivity test, to reduce the mortality rate. With the increasing use of antibiotics in clinical practice and the increasing number of drug-resistant strains, the efficacy of traditional antibacterial drugs has gradually declined. In order to increase the survival rate of carbapenem-resistant bacterial infections, the initial empirical antibacterial therapy becomes crucial, and therefore, the selection and application of the antibacterial drugs recommended in the guidelines becomes particularly critical. In addition, factors such as patient compliance and antibiotic application indications should be paid attention to avoid unnecessary waste of medical resources. In addition, in order to improve the cure rate, it is necessary to strengthen the prevention and control of drug-resistant bacterial infection in the hospital, improve the hospital infection knowledge training of medical staff, ensure hand hygiene, strictly implement the contact prevention and isolation measures, and actively cut off the transmission way, and protect the susceptible population. These are the key measures.

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