

Analysis of clinical status and risk factors of blood infection of *Klebsiella pneumoniae* in hospital

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CITATION

Author Name. (2025). Article title. Journal of Infrastructure, Policy and Development. 9(x): X.
<https://doi.org/10.24294/jipdxxxx>

ARTICLE INFO

Received: Date Month Year

Revised:

Accepted: Date Month Year

Available online: Date Month Year

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Abstract: Objective To analyze the clinical status and risk factors of patients with blood infection caused by *Klebsiella pneumoniae*. Methods 110 patients with blood infection in clinical departments of our hospital from May 2022 to May 2023 were reviewed, and 130 strains of Enterobacteriaceae bacteria were isolated from blood flow samples, 110 of which were *Klebsiella pneumoniae* (cKP). *Staphylococcus aureus* ATCC29213, *Streptococcus pneumoniae* ATCC49619, *Escherichia coli* ATCC25922, *Enterococcus faecalis* ATCC29212 and *Pseudomonas aeruginosa* ATCC27853 were used as quality control strains to analyze the distribution, clinical characteristics, risk factors and drug resistance of *Klebsiella pneumoniae*. Results Among 130 strains of Enterobacteriaceae, 110 strains of *Klebsiella pneumoniae* (cKP) were mainly distributed in hematology, surgery and other departments. Compared with other departments, the number of *Klebsiella pneumoniae* in department of hematology and surgery was significantly increased, and the difference was statistically significant ($P < 0.05$). There was no significant difference in the distribution of *Klebsiella pneumoniae* among other departments ($P > 0.05$). A total of 110 cases of *Klebsiella pneumoniae* infection were included in this study, of which 60.91% were male, 59.09% were over 60 years old, 33.64% had blood infection as the primary focus, and the infection method was mainly hospital-acquired, accounting for 69.09%. The results of single factor analysis showed that the risk factors of *Klebsiella pneumoniae* infection were primary lesion, treatment, acquisition, underlying disease, urinary tract intubation and blood type. Multivariate Logistic regression analysis showed that nosocomial infection, liver disease, diabetes, urinary tract intubation and blood type were independent risk factors for bloodstream infection of *Klebsiella pneumoniae*. The resistance rate of *Klebsiella pneumoniae* to piperacillin was the highest (39.92%). The resistance rate of the first to fourth generation of cephalosporins was 6.21% to 41.25%, of which the lowest resistance rate of cefotetan was 6.21%, and the highest resistance rate of cephalosporin was 41.25%. 42 ESBLs strains were detected among 110 *Klebsiella pneumoniae* strains, and the positive rate was 38.18%. Conclusion Physicians should pay special attention to the infection of *Klebsiella pneumoniae* caused by diabetes, blood type, urinary tract intubation, and pay attention to the diagnosis, treatment and infection control.

Keywords: *Klebsiella pneumoniae*; Blood infection; Clinical status; Risk factor

Blood infection is an infectious disease that seriously threatens the life and health of patients. In recent years, with the extensive application of invasive medical device operation technology, especially the extensive use of intravascular catheter technology in clinical practice, the incidence of blood infection has gradually increased^[1]. *Klebsiella pneumoniae* is the second major opportunistic pathogen of nosocomial infection, second only to *Escherichia coli*, and is relatively common in clinic. Relevant medical scholars reported on primary invasive liver abscess with metastatic endophthalmitis caused by *Klebsiella pneumoniae* in 1986, and subsequently paid more and more attention to it in clinic^[2]. *Klebsiella pneumoniae* is a Gram-negative bacterium, belonging to the Enterobacteriaceae, *Klebsiella* genus. It has obvious capsular, no flagella and no movement, and is widely distributed in the natural environment, including soil, water, medical instruments, as well as the intestinal tract, respiratory tract and urogenital tract of humans and animals^[3]. It can cause community-acquired infections and nosocomial infections, including pneumonia, urinary tract infection, sepsis and wound infection, which seriously threaten public life and health^[4], and has gradually become the most important clinical opportunistic bacteria. Therefore, strengthening the study of *Klebsiella pneumoniae* has important significance for clinical rational drug use and monitoring. This study analyzed the clinical status and risk factors of *Klebsiella pneumoniae* blood infection from January 2022 to December 2022, aiming to provide evidence for clinical prevention and treatment.

1 Materials and methods

1.1 General Information

A total of 110 patients with blood infection in various clinical departments of our hospital from May 2022 to May 2023 were randomly selected, and 130 strains of Enterobacteriaceae bacteria were isolated from their blood flow samples. *Staphylococcus aureus* ATCC29213, *Streptococcus pneumoniae* ATCC49619, *Escherichia coli* ATCC25922, *Enterococcus faecalis* ATCC29212, *Pseudomonas aeruginosa* ATCC27853 and other quality control strains were purchased from the Clinical Laboratory Center of the National Health and Family Planning Commission. This study has been approved by the hospital Ethics committee. The purpose, content, methods and precautions of this study have been informed to patients in advance, and informed consent has been signed on the principle of mutual voluntary agreement.

1.2 Methods

1.2.1 Specimen collection

Venous blood was extracted from the patient, injected into a sterile blood culture vial and cultured using a blood culture apparatus (Supplier: BioMerieux).

INC.; Model: BavT/Alert 3D) transseed-positive specimen from blood plate.

1.2.2 Drug resistance detection

According to the “National Clinical Inspection Operation Procedures”, various types of clinically collected specimens were separated and cultured using primary isolated media, and strict aseptic operation was performed. The bacteria were cultured on blood AGAR plate and MacConkey plate to form a single colony. The species were identified by Biomerieux mass harmonics. A single bacterial colony was selected from a sterile cotton swab and prepared into a bacterial suspension with a concentration of 0.50 ~ 0.55 MCG. The drug susceptibility test was completed by VTTEK-2Compact fully automated instrument using AST-GN67 and AST-XNO4 drug susceptibility cards from Biomeriex, France. The sensitivity of this report was determined based on the bacterial break point of American Institute for Clinical and Laboratory Standardization (CL.SI) M100-27^[5]. The drug sensitivity method used for cefoperazone/sulbactam was K-B method, and the break point was determined by referring to the break point of cefoperazone against enterobacter bacteria.

1.3 Statistical Methods

The collected data were analyzed by SPSS 23.0 software. Measurement data were expressed as ($\bar{x} \pm s$) and T-test was adopted. Counting data is represented by [n (%)] and c2 test is used. $P < 0.05$ indicated that the difference was statistically significant. Logistic regression analysis was used to analyze the correlation, and the drug sensitivity data were analyzed by whonet5.6 software.

1.4 Observation Indicators

(1) Distribution; (2) Clinical features; (3) risk factors; (4) Drug resistance.

2 Results

2.1 Distribution

Among the 130 strains of Enterobacteriaceae, 110 strains of Klebsiella pneumoniae (cKP) were mainly distributed in hematology, surgery and other departments. Compared with other departments, the number of Klebsiella pneumoniae in department of hematology and surgery was significantly increased, and the difference was statistically significant ($P < 0.05$). There was no significant difference in the distribution of Klebsiella pneumoniae among other departments ($P > 0.05$).

Table 1. Distribution of Klebsiella pneumoniae in clinical departments [n (%)]

Administrative office	Infectious disease department	ICU	Department of surgery	Department of hematology	Cardiovascular medicine	Interventional therapy department	Other departments
Number of cases	8(7.27)	9(8.18)	24(21.82)	36(32.73)	4(3.64)	5(4.55)	24(21.82)
c2	1.33	0.92	0.81	10.93	0.55	0.27	0.19
P	>0.05	>0.05	<0.05	<0.05	>0.05	>0.05	>0.05

2.2 Clinical Features

A total of 110 cases of *Klebsiella pneumoniae* infection were included in this study, and the results showed that 60.91% of the infected patients were male, 59.09% of the infected patients were over 60 years old, 33.64% of the infected patients had blood infection as the primary focus, and the infection mode was mainly hospital-acquired, accounting for 69.09%, as shown in **Table 2**.

Table 2. Clinical characteristics of *Klebsiella pneumoniae* patients [n (%)]

Clinical features	Sort	Number of cases
Sex	Male	67(60.91)
	Female	43(39.09)
Age/year	≤ 60	45(40.91)
	>60	65(59.09)
Primary lesion	Hepatic abscess	7(6.36)
	Pulmonary infection	28(25.45)
	Blood infection	37(33.64)
	Biliary tract infection	12(10.91)
	Urinary tract infection	20(18.18)
	Abdominal infection	2(1.82)
	Intestinal infection	3(2.73)
	Perianal abscess	1(0.91)
	Invasive therapy	45(40.91)
Treatment mode	Surgical treatment	37(33.64)
	chemotherapy	28(25.45)
Mode of infection	Community acquisition	34(30.91)
	hospital-acquired	76(69.09)
	Cardiovascular disease	31(28.18)
	Liver disease	13(11.82)
	diabetes	20(18.18)
Underlying disease	tumor	43(39.09)
	Blood disease	19(17.27)
	Biliary tract disease	6(5.45)
	Pulmonary disease	11(10.00)
	Other	0(0.00)
	No	33(30.00)
	Recovery	9(8.18)
Prognosis	Turn for the better	68(61.82)
	Death	16(14.55)
	Loss of contact	14(12.73)
	Automatic discharge	3(2.73)
Whether the urinary tract is intubated	Yes	94(85.45)
	No	16(14.55)
Blood type	A	58(52.73)
	B	22(20.00)
	AB	14(12.73)
	O	16(14.55)

2.3 Risk Factors

2.3.1 Single factor analysis

Variables were assigned, and the results of univariate analysis showed that the primary lesion, treatment method, acquisition method, underlying disease, urinary tract intubation or not, and blood type were risk factors for blood infection with *Klebsiella pneumoniae*, as shown in **Table 3**.

Table 3. Results of single factor analysis [n (%)]

Clinical features	Sort	Number of cases	c2	P
Sex	Male	67(60.91)	0.62	>0.05
	Female	43(39.09)		
Age/year	≤ 60	45(40.91)	0.27	>0.05
	>60	65(59.09)		
Primary lesion	Hepatic abscess	7(6.36)	0.88	<0.05
	Pulmonary infection	28(25.45)		
	Blood infection	37(33.64)		
	Biliary tract infection	12(10.91)		
	Urinary tract infection	20(18.18)		
	Abdominal infection	2(1.82)		
	Intestinal infection	3(2.73)		
	Perianal abscess	1(0.91)		
	Invasive therapy	45(40.91)		
	Surgical treatment	37(33.64)		
Treatment mode	chemotherapy	28(25.45)	11.32	<0.05
	Community acquisition	34(30.91)		
Mode of infection	hospital-acquired	76(69.09)	14.38	<0.05
	Cardiovascular disease	31(28.18)		
	Liver disease	13(11.82)		
	diabetes	20(18.18)		
	tumor	43(39.09)		
Underlying disease	Blood disease	19(17.27)	8.86	<0.05
	Biliary tract disease	6(5.45)		
	Pulmonary disease	11(10.00)		
	Other	0(0.00)		
	No	33(30.00)		
Prognosis	Recovery	9(8.18)	1.36	>0.05
	Turn for the better	68(61.82)		
	Death	16(14.55)		
	Loss of contact	14(12.73)		
	Automatic discharge	3(2.73)		
Whether the urinary tract is intubated	Yes	94(85.45)	28.47	<0.05
	No	16(14.55)		
Blood type	A	58(52.73)	10.03	<0.05
	B	22(20.00)		
	AB	14(12.73)		
	O	16(14.55)		

2.3.2 Results of multivariate Logistic regression analysis

The results showed that hospital-acquired disease, liver disease, diabetes, urinary tract intubation, and blood type were independent risk factors for *Klebsiella pneumoniae* blood infection, as shown in **Table 4**.

Table 4. Results of multivariate Logistic regression analysis

Risk factor	β	SE	Wald χ^2 value	P value	OR(95%CI)
Hospital-acquired	3.496	0.958	12.775	0.001	32.134(4.926, 188.439)
Liver disease	1.935	0.784	6.158	0.016	12.369(0.993, 27.436)
Diabetes	2.013	0.833	4.586	0.023	7.728(0.996, 31.583)
Whether the urinary tract is intubated	4.015	0.873	12.749	0.001	34.037(4.926, 188.047)
Blood type	1.84	0.803	5.738	0.021	6.127(1.298, 24.035)

2.4 Drug resistance

2.4.1 Drug resistance of *Klebsiella pneumoniae*

Through the detection of 32 common antibacterial agents, the results showed that *Klebsiella pneumoniae* had the highest resistance rate to piperacillin (39.92%). The resistance rate of the first to fourth generation of cephalosporins was 6.21% to 41.25%, of which the lowest resistance rate of cefotetan was 6.21%, and the highest resistance rate of cephalosporin was 41.25%. The resistance rate, intermediation rate and sensitivity rate of 110 strains of *Klebsiella pneumoniae* to 32 kinds of antibiotics are shown in **Table 5**.

Table 5. Drug resistance of *Klebsiella pneumoniae* [n (%)]

Drug name	Drug resistance	Intermediary agent	Sensitivity	Drug name	Drug resistance	Intermediary agent	Sensitivity
Piperacillin	39.92	8.93	51.26	Aztreonam	28.14	0.22	71.89
Amoxicillin / Clavulanic acid	14.56	14.12	70.88	Donipenem	6.10	0.00	93.53
Cefoperazone/Sulbactam	6.92	7.54	85.91	Ertapenem	5.63	0.37	93.87
Ampicillin/sulbactam	35.43	4.51	60.53	Imipenem	5.22	0.93	93.56
Ticacillin/clavulanic acid	18.44	11.72	70.45	Meropenem	6.03	0.00	94.66
Piperacillin/Tazobactam	10.61	5.95	84.23	Amikacin	4.92	0.00	95.91
Cephalothiphene	40.15	1.44	59.73	Gentamicin	20.26	0.35	80.17
Cefazolin	38.9	0.00	61.55	Tobramycin	14.82	14.53	71.51
Cefuroxime	38.8	2.64	60.13	Ciprofloxacin	21.15	3.28	76.59
Ceftazidime	20.4	2.15	77.90	Levofloxacin	17.94	5.83	76.98
Ceftriaxone	35.9	0.00	64.45	Moxifloxacin	37.13	0.92	62.54
Cefotaxime	35.9	0.3	64.18	Norfloxacin	18.43	3.92	78.54
Cefazoxime	14.6	1.32	84.51	Cotrimoxazole	30.44	0.00	69.92
Cefepime	14.1	2.91	83.52	tetracycline	34.64	1.53	64.45
Cefotetan	6.21	0.46	94.13	Tigacycline	5.58	2.45	92.63
Cefpoxime	35.5	0.62	64.37	ESBL	36.88		63.54
Cefuroxime axetil	37.8	3.92	59.16				

2.4.2 Drug resistance of ESBLs-producing *Klebsiella pneumoniae*

Among 110 strains of *Klebsiella pneumoniae*, 42 strains were detected to produce ESBLs, with a positive rate of 38.18%. The drug resistance of ESBLs-producing *Klebsiella pneumoniae* was shown in **Table 6**.

Table 6. Drug resistance of ESBLs-producing *Klebsiella pneumoniae* [n (%)]

Drug name	Drug resistance	Intermediary agent	Sensitiveness	Drug name	Drug resistance	Intermediary agent	Sensitiveness
Piperacillin	95.31	0.00	4.72	Aztreonam	73.45	0.83	26.14
Amoxicillin / Clavulanic acid	35.22	35.18	30.33	Donipenem	14.35	0.00	86.27
Cefoperazone/Sulbactam	16.92	15.84	68.24	Ertapenem	14.28	0.65	85.81
Ampicillin/sulbactam	88.34	6.50	5.72	Imipenem	13.34	0.81	86.14
Ticacillin/clavulanic acid	47.9	29.83	22.92	Meropenem	14.64	0.00	85.76
Piperacillin/Tazobactam	25.81	14.33	60.72	Amikacin	12.00	0.00	88.36
Cephalothiphene	99.31	0.66	0.66	Gentamicin	49.63	0.00	50.71
Cefazolin	99.11	0.00	1.99	Tobramycin	37.92	34.63	27.97
Cefuroxime	95.82	3.72	0.85	Ciprofloxacin	52.14	7.25	41.32
Ceftazidime	54.94	4.61	41.25	Levofloxacin	43.74	13.83	42.95
Ceftriaxone	96.93	0.00	3.41	Moxifloxacin	87.14	0.85	12.56
Cefotaxime	96.92	0.00	3.42	Norfloxacin	45.73	8.87	46.26
Cefazoxime	42.56	3.34	55.13	Cotrimoxazole	74.65	0.00	25.92
Cefepime	38.24	7.85	55.1	Tetracycline	79.63	0.75	19.87
Cefotetan	15.64	0.83	83.95	Tigacycline	10.92	4.31	85.56
Cefpoxime	96.12	0.84	3.76	Cefuroxime axetil	95.87	3.75	0.84

3 Discussion

Klebsiella pneumoniae is a gram-negative bacterium that often exists in the respiratory tract and digestive tract of the human body. In general, it does not cause disease, but when the human body has low resistance or due to other reasons, it can cause related system infections, including lung infection, urinary tract infection and blood infection [6]. Once *Klebsiella pneumoniae* intrudes into the blood system, the bacteria itself and the toxins released will cause a series of clinical symptoms, such as fever, chills, tachycardia, etc. If not treated in time, severe cases will develop into shock, multiple organ failure, etc., resulting in death [7]. *Klebsiella pneumoniae* was first isolated in the late 19th century by pathologist Friedrich Lander from the lung tissue of a pneumonia patient, hence the name Friedlander's bacillus. It is distributed in nature and medical environment and has strong adaptability [8]. It is also widely found in animal, plant, human and hospital environment. It is easy to cause infection among people with low immunity and is one of the most common pathogenic bacteria causing nosocomial infection [9].

In recent years, the infectious diseases caused by *Klebsiella pneumoniae* have been studied and reported in many countries and regions. Epidemiological data show that *Klebsiella pneumoniae* has a high incidence in Asian popu-

lations, suggesting that there may be differences in host genetic susceptibility or different pathogen exposure levels in different regions^[10-12]. *Klebsiella pneumoniae* is a common opportunistic pathogen of nosocomial infection, and its infection rate is second only to *Escherichia coli*, becoming the second largest opportunistic pathogen^[13]. Since 1986, a Taiwan scholar reported primary invasive liver abscess caused by *Klebsiella pneumoniae* accompanied by metastatic endophthalmitis, which has attracted extensive attention from clinicians and scholars^[14]. In recent years, two trends in *Klebsiella pneumoniae* infection have become increasingly serious, resulting in global public health concerns: the first is the increase in antibiotic resistance of *Klebsiella pneumoniae*, especially the production of extended spectrum-lactamases (ESBLs); The second is the emergence of hypermucoviscous *K. pneumoniae* (HvKP), which causes severe infection^[15-16]. For patients with *Klebsiella pneumoniae* culture in the blood, clinicians tend to use antibiotics earlier, and use the dose and time is longer. With the widespread use of antibiotics in clinical treatment, more and more bacteria produce antibacterial hydrolase and produce resistance to antibiotics, which leads to the failure of clinical infection treatment and leads to the delay of the disease course. In recent years, the nosocomial infection rate caused by *Klebsiella pneumoniae* has gradually increased, and the increase of multi-drug resistant strains leads to treatment failure. The resistance mechanism mainly includes: (1) β -lactamase production; (2) biofilm formation; (3) Absence of outer membrane porin. In addition, the active exportation mechanism of antibiotics and horizontal spread of drug resistance genes are the main causes of multiple drug resistance^[17-19]. Compared with classical *Klebsiella pneumoniae*, clinical infections caused by highly virulent *Klebsiella pneumoniae* (HvKP) infection have the following characteristics: (1) HvKP can cause disease in healthy young individuals, including liver abscess, pneumonia, encephalomyelitis and other serious community-acquired diseases; (2) Some patients with HvKP infection have metastatic infection of other tissues and organs of the body, including lung, pleura, prostate cancer, bone, joint, kidney, spleen, muscle, fascia, soft tissue skin, eyes, and central nervous system. Transmission of HvKP between hosts with intact immune systems is one of its most typical features, and this ability to transfer infection is rarely seen in gram-negative bacteria in the absence of host factors, such as agranulocytosis. (3) HvKP has a high mucinous phenotype, which can be defined by “wire drawing test”^[20-22]. In addition, the influence factors of nosocomial *Klebsiella pneumoniae* blood infection are also the focus of current research. Inpatients are affected by factors including self, medical treatment and environment, and there are many factors affecting nosocomial infection, including primary disease, invasive operation and multi-site infection, which can lead to nosocomial infection^[23-24]. Relevant studies have shown that risk factors such as primary disease, age, irrational use of antibiotics, invasive procedures, bacterial resistance and multi-site infection are all related to the occurrence of nosocomial infections^[25-27]. A prospective investigation found that the risk factors of nosocomial infection, including distur-

bance of consciousness, ICU admission, invasive procedures, preventive use of antibiotics, etc. were the main risk factors of nosocomial infection by univariate analysis^[28]. The above are the results of single factor analysis. However, the clinical analysis of risk factors should take into account whether there is correlation between risk factors and affect the researchers' exploration of the risk factors of nosocomial infection. Therefore, it is necessary to adopt multi-factor analysis method to analyze the risk factors of nosocomial infection. By using multi-factor analysis, researchers found that disturbance of consciousness, use of antibiotics, invasive procedures, age, length of stay, etc. were independent risk factors for nosocomial infection^[29].

According to the data released by CHINET China Bacterial Resistance Monitoring results in 2017, *Escherichia coli* ranked first in major clinical isolates in 2017, followed by *Klebsiella*. *Klebsiella* ranked first among the pathogenic bacteria isolated from 7633 respiratory tract specimens^[30]. The results of this study showed that among the 130 strains of enterobacteriaceae isolated in our hospital, *Klebsiella pneumoniae* was 110, accounting for 84.62, ranking first, which was consistent with the above conclusions. In recent years, due to the widespread use and non-standard use of antibiotics, the resistance of *Klebsiella pneumoniae* has become increasingly serious, and many of them are multi-drug resistant and pan-drug resistant strains, which bring many difficulties for clinical use^[31-32]. The resistance mechanism of *Klebsiella pneumoniae* is very complex. Currently, it is considered that the most important mechanism is the production of plasmid-mediated enzymes, which can weaken the antibacterial effect of antibiotics, such as β -lactam and aminoglycoside enzymes, which can make β -lactam and aminoglycoside antibiotics resistant. Plasmids can also mediate the development of other drug resistance in bacteria, such as JM45 plasmid mediated pandrug-resistant *Klebsiella pneumoniae*^[33-35]. In addition, other mechanisms of drug resistance include biofilm generation, loss and mutation of outer membrane proteins, and overexpression of efflux pumps^[36-37]. Relevant medical studies have shown that patients with blood infection have a high drug resistance rate of *Klebsiella pneumoniae*, and effective clinical measures should be actively taken to control its spread^[38-39]. In this study, the clinical risk factors and drug resistance of patients with blood infections caused by *Klebsiella pneumoniae* were analyzed. The results showed that the blood infections of *Klebsiella pneumoniae* were mainly hospital-acquired, indicating that *Klebsiella pneumoniae* played an important role in hospital-acquired diseases. Infections caused by *Kleptococcus pneumoniae* include abdominal diseases (hospital-acquired liver abscess, spleen abscess, spontaneous bacterial peritonitis) endophthalmitis, central nervous system diseases (meningitis), chest diseases (pneumonia, empyema), skeletal muscle and soft tissue infections, urinary tract infections, co-infections, bacteremia, the most common of which is hospital-acquired liver abscess. In this study, 33.64% of patients with *Klebsiella pneumoniae* infection had primary lesions from blood infection, suggesting that patients with underlying diseases related to the blood

system are risk factors for *Klebsiella pneumoniae*. Studies have shown that hyperglycemia can inhibit the adhesion, chemotaxis, phagocytosis and sterilization of neutrophils, thereby increasing the risk of infection ^[40-41]. This study shows that diabetes is a major risk factor for *Kleptococcus pneumoniae* and is prone to endophthalmitis. Therefore, controlling blood glucose level can prevent the occurrence of metastatic complications caused by *Kleptococcus pneumoniae*. In addition, the results of this study also showed that urinary tract intubation was an independent risk factor for the isolation of *Klebsiella pneumoniae* in the blood, and the results were consistent with relevant research conclusions ^[42]. In addition, it has been reported that urinary tract intubation is related to the occurrence of urinary tract infection. Long-term urinary tract intubation can easily cause congestion and edema of urinary tract mucosa, and even cause mucosal damage, destroy the natural defense barrier of urinary tract mucosa, and provide conditions for bacteria to invade the blood system ^[43]. At the same time, mucosal congestion and bleeding caused by long-term urinary tract intubation create favorable conditions for bacteria to colonize in the urethra, which is the main way for the excretion of most metabolites in the human body. Under the premise of applying a variety of drugs, bacteria colonized in the urethra have long-term contact with metabolites of a variety of drugs, and under the stimulation of these metabolites, Bacteria evolved in a direction conducive to their own growth, that is, gradually developed tolerance to drugs ingested by the human body ^[44]. In this study, *Klebsiella pneumoniae* infection in the blood or colonization of the urethra may have occurred due to damage of urethral mucosa during urethral intubation ^[45]. In this study, multivariate Logistic regression analysis showed that the relative risk of type A blood was 6.298 (with type O blood as the reference level), indicating that the probability of isolation of *Klebsiella pneumoniae* in type A blood was significantly higher than that in type O blood, while the relative risk of type B and AB were 0.731 and 0.734, showing no correlation (with type O blood as the reference level). At present, there are relatively few reports about the correlation between blood type and *Klebsiella pneumoniae* at home and abroad, and this part of the mechanism needs to be further studied.

32 kinds of common antibacterial drugs were tested in our hospital. Among these drugs, the resistance rate of *Klebsiella pneumoniae* to piperacillin was the highest (39.92%). The resistance rate of the first to fourth generation of cephalosporins ranged from 6.0% to 39.3%, the lowest resistance rate of cefotetan was 6.21%, and the highest resistance rate of cephalothioephene was 41.25%. Drug resistance rate, intermediate rate and sensitivity rate of 110 strains of *Klebsiella pneumoniae* to 32 kinds of antibiotics. 42 strains of ESBLs were detected in 110 strains of *Klebsiella pneumoniae*, and the positive rate was 38.18%. The drug resistance of ESBLs-producing *Klebsiella pneumoniae* was indicated. Drug-resistant *Klebsiella pneumoniae* infection has become a serious problem in anti-infective treatment, and carbapenemase producing (KPC) strains are also increasing year by year. The highly resistant strains of *Kleptococcus pneumoniae* after

obtaining resistance genes will become another “superbug” that leads to clinical infection.

This study focuses on the clinical, risk factors and drug resistance of *Klebsiella pneumoniae* bacteremia isolates. Through the laboratory detection and summary of *Klebsiella pneumoniae*, it suggests that doctors should pay special attention to the infection caused by high *Klebsiella pneumoniae* in clinical work, such as diabetes, blood type, urinary tract intubation, and pay attention to the diagnosis, treatment and infection control of infection. In the future, it is of great significance to further study the pathogenic mechanism of *K. pneumoniae* to correctly understand the infection caused by *K. pneumoniae* and reduce the harm of *K. pneumoniae*.

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