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Study of the Effect of Bacterial Resistance Monitoring in Clinical Microbiology Testing

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Abstract: *Objective:* To observe and analyze the effect of bacterial resistance monitoring in clinical microbiology testing. *Methods:* 600 microbial specimens collected in our hospital in the past year (April 2021 to April 2022) were used as the test subjects of this study. The specimens were divided into Group A (control group) and Group B (research group), with 300 cases in each group. Group A consisted of blood culture specimens, while Group B consisted of sputum specimens. After the tests were completed, the rates of unfavorable and favorable results, bacterial species distribution, and bacterial drug resistance of the specimens in both groups were compared. *Results:* Among group A specimens, 29 cases were positive (9.67%) and 271 cases were negative (90.33%); among group B specimens, 99 cases were positive (33.00%) and 201 cases were negative (66.00%); the difference between the two groups of data was statistically significant ($P < 0.05$). As for the distribution of the types of bacteria, there were 472 cases of Gram-negative bacteria and 128 cases of Gram-positive bacteria. *Conclusion:* Bacterial resistance monitoring is helpful in clinical microbiology testing. Through proper monitoring, bacterial resistance can be well understood. In this way, patients get to receive appropriate treatment measures and suitable antibacterial prescriptions, thereby improving the patient outcome.

Keywords: Bacterial resistance monitoring; Clinical microbiology testing; Application value

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1. Introduction

The identification of bacterial species is the starting point for bacterial resistance monitoring. Identifying bacterial species can help clinicians understand the type of infectious bacteria and provide a basis for subsequent antimicrobial susceptibility testing and resistance mechanism research. Commonly used bacterial species identification methods include morphological identification, biochemical reaction tests, immunological detection, and gene sequencing. Each of these methods comes with different advantages and disadvantages. Among them, gene sequencing is highly accurate and sensitive, making it the most popular method for bacterial species identification. Research on drug resistance mechanisms is one of the key aspects of bacterial resistance monitoring. Bacterial resistance mechanisms primarily involve the production of inactivating enzymes, alterations in drug targets, and heightened expression of efflux pumps. By analyzing the results of bacterial gene sequencing, genes related to drug resistance and their mechanisms of action can be discovered. New antibacterial drugs can be developed based on different resistance mechanisms to overcome the shortcomings of existing drugs. In addition, understanding the resistance mechanisms of bacteria can also help develop targeted infection control measures. Developing infection control measures is one of the essential applications of bacterial resistance monitoring. Infection control measures mainly include the rational use of antibiotics, strengthening hospital infection control, and improving patients' awareness of personal hygiene. Rational use of antibiotics can reduce unnecessary antibiotic use and prevent bacterial resistance. Strengthening hospital infection control requires improving the awareness of medical staff and reducing the occurrence of hospital infections. Publicity and education can improve the patient's awareness of personal hygiene. Research related to the transmission and epidemiology of drug resistance is one of the essential applications of bacterial resistance monitoring. By understanding the routes of transmission and the characteristics of drug-resistant bacteria, we can effectively prevent and control the spread of drug-resistant bacteria. Epidemiological investigation and analysis can be done through descriptive studies, cohort studies, or case-control studies. Descriptive studies can reveal the distribution and prevalence characteristics of drug-resistant bacteria; cohort studies can evaluate the effectiveness of infection control measures; case-control studies can identify risk factors for drug resistance. Random abuse of antibacterial drugs in clinical practice will directly lead to increased bacterial resistance, thereby significantly reducing the efficacy of the drugs [1-6].

Hence, it is essential for healthcare professionals to meticulously choose and judiciously administer antimicrobial drugs. Additionally, they should conduct thorough microbial testing and monitor bacterial resistance meticulously to gain an accurate understanding and assessment of various bacteria's resistance to antimicrobial drugs. Appropriate measures should then be taken based on the specific circumstances [7]. In view of this issue, we used 600 microbial specimens collected from our hospital as samples to conduct experiments to analyze whether bacterial resistance monitoring is helpful in microbiological testing.

2. Materials and methods

2.1. General information

Six hundred microbial specimens collected from our hospital in the past year (i.e., April 2021 to April 2022) were used as the test subjects of this study. The specimens were divided into Group A (control group) and Group B (research group), with 300 cases in each group. Group A consisted of blood culture specimens, while Group B consisted of sputum specimens. In Group A, 160 specimens were from males and 140 specimens were from females, aged 42.21 ± 5.37 years on average. In Group B, 155 specimens were from males and 145 were from females, aged 42.53 ± 5.45 years old on average. There was no significant difference in the general information of the two groups of specimens ($P > 0.05$).

2.2. Method

Group A consisted of blood culture specimens, while Group B consisted of sputum specimens. All specimens underwent drug susceptibility tests, in which the specimens were isolated according to conventional methods, the pathogenic bacteria was identified and the antibacterial concentrations were detected.

2.3. Observation indicators

(1) The negative and positive rates of specimens from groups A and B were compared.

(2) The distribution of bacterial species in groups A and B specimens was observed (ten different species of bacteria, including *Klebsiella pneumoniae*, *Escherichia coli*, *Acinetobacter*, *Enterobacter*, etc.

(3) The bacterial resistance monitoring results of samples from Groups A and B were compared and analyzed.

2.4. Statistical methods

All data were analyzed and processed using SPSS 21.0. Count data were presented as percentages (%), and the chi-square test was employed. A significance level of P<0.05 was used to determine statistical significance.

3. Results

3.1. Positive and negative rates of specimens from the two groups

Among group A specimens, 29 cases were positive (9.67 %) and 271 cases were negative (90.33 %); among group B specimens, 99 cases were positive (33.00 %) and 201 cases were negative (66.00 %); the difference between the two data groups was statistically significant ($P < 0.05$), as shown in **Table 1**.

Table 1. Comparing the positive and negative rates of specimens between the two groups [n (%)]

Group	Number of specimens	Positive rate	Negative rate
Group A (Control group)	300	29 (9.67%)	271 (90.33%)
Group B (Research group)	300	99 (33.00%)	201 (67.00%)
P	-	< 0.05	< 0.05

3.2. Distribution of bacterial species

The distribution of bacterial species in the total specimens is shown in **Table 2**. There were 472 cases of Gram-negative bacteria and 128 cases of Gram-positive bacteria.

Table 2. The distribution of bacterial species in the two groups of specimens (*n* [%])

Pathogenic strains		Distribution
Gram-negative bacteria	Total	472 (78.67%)
	Klebsiella pneumoniae	55 (11.65%)
	Pseudomonas aeruginosa	84 (17.96%)
	Escherichia coli	78 (16.53%)
	Citrobacter	75 (15.89%)
	Acinetobacter	67 (14.19%)
	Proteus	63 (13.35%)
	Enterobacter	50 (10.59%)
Gram-positive bacteria	Total	128 (21.33%)
	Coagulase-negative Staphylococci	60 (46.87%)
	Staphylococcus aureus	44 (34.38%)
	Enterococci	24 (18.75%)

3.3. Drug resistance monitoring results

The bacterial resistance monitoring results of the two specimen groups allowed us to make accurate assessments and comparisons of the resistance levels of various bacteria to penicillin, ampicillin, and other drugs. Refer to

Table 3 for details.

Table 3. Comparing the bacterial resistance monitoring results of the two groups of specimens (%)

Antibacterial drugs	*Staphylococcus aureus*		*Coagulase-negative staphylococci*		*Enterococci*	*Enterobacter*	*Pseudomonas aeruginosa*	Proteus
	MRSA	MSSA	MRCNS	MSCNS				
Penicillin	100.00	92.14	100.00	96.76	17.66	11.31	51.47	0.00
Ampicillin	100.00	89.55	100.00	90.12	20.24	9.72	55.78	91.49
Cefazolin	53.45	9.21	51.74	9.48	31.35	41.88	0.00	59.58
Ceftazidime	51.03	18.74	60.05	12.16	6.87	32.60	13.52	53.11
Levofloxacin	38.27	5.57	42.26	16.23	6.29	21.54	17.86	17.56

4. Conclusion

With the continuous development of China's medical technology, clinical research on antibiotics has become increasingly intensive, greatly reducing the probability of infectious diseases and reducing patient deaths [8]. The pollution and deterioration of the environment will promote the growth of bacteria. When bacteria produce drug-resistant genes, the efficacy of the drugs used will decrease, endangering the lives of patients. In order to achieve the goal of reducing bacterial resistance, staff should strengthen clinical microbial testing, establish relevant rules and regulations to standardize work requirements, and strictly conduct drug resistance monitoring. The changing trends of bacterial resistance should be grasped so that antibiotics can be used appropriately [9]. The resistance of our various bacteria to penicillin, ampicillin, and other drugs was clearly depicted through resistance monitoring, which means that this is a feasible way to understand bacterial resistance [10], thereby providing patients with safe and feasible treatment measures and standardizing the use of various antibacterial drugs, which will help improve the treatment effect of the disease and control the deterioration of the disease.

4.1. Identification of bacterial species

Bacterial species identification is an integral part of clinical microbiology testing, mainly by identifying and classifying bacteria through microbiological methods. Bacterial species identification includes morphological identification and molecular biology identification. Morphological identification is mainly based on bacterial morphology, staining reaction, culture characteristics, and other indicators, while molecular biological identification mainly uses gene sequencing, DNA-DNA hybridization, and other technologies for identification. Through the identification of bacterial species, doctors can understand the infecting bacteria and formulate corresponding treatment plans [11-13].

4.2. Antimicrobial susceptibility tests

Antimicrobial susceptibility tests are used to detect the sensitivity of bacteria to different antimicrobial drugs. The tests mainly include the disk diffusion method, dilution method, and E-test method. The disk diffusion method is a commonly used antimicrobial drug sensitivity test method. The method involves paper disks saturated with antimicrobial agents on a lawn of bacteria seeded on the surface of an agar medium and observing the size of the inhibition zone of bacteria to different antimicrobial drugs, thereby judging the bacterial response sensitivity to different antimicrobial drugs. The dilution method detects the minimum inhibitory concentration (MIC) of bacteria by gradually diluting the concentration of antibacterial drugs to determine the sensitivity of bacteria to different antibacterial drugs [14]. The E-test method is a new antimicrobial drug sensitivity test method. Its principle is to coat a bacterial suspension on a bacterial culture medium and then place test strips containing different concentrations of antimicrobial drugs on the bacterial suspension. The sensitivity of bacteria to different antibacterial drugs is then determined by observing the color change between the test strip and bacterial culture results.

4.3. Bacterial resistance detection

Bacterial resistance detection is a method and technology for detecting bacterial resistance to certain antibacterial drugs. Bacterial resistance testing mainly includes phenotypic testing and genotypic testing. Phenotypic testing is performed to determine whether bacteria are resistant to specific antibacterial drugs by observing the growth of bacteria on culture media containing antibacterial drugs [15]. Genotype testing uses molecular biology techniques such as gene sequencing to detect the presence of genes related to drug resistance in bacteria, thereby determining the bacteria's resistance to certain antibacterial drugs. Through bacterial resistance detection, doctors can understand whether the resistance of infectious bacteria to antibacterial drugs, thereby avoiding using ineffective drugs.

4.4. Monitoring the efficacy of antibacterial drugs

Monitoring the efficacy of antimicrobial drugs is an essential means to evaluate the effectiveness of antimicrobial drug treatment. Doctors regularly collect patient samples for microbiological testing to understand the antibacterial effect of antibacterial drugs on infectious bacteria so they can promptly adjust the type and dosage of drugs. In addition, doctors also need to pay attention to patients' adverse reactions and take appropriate treatment measures promptly. By monitoring the efficacy of antimicrobial drugs, doctors can ensure that the most appropriate antimicrobial drugs and doses are used to achieve the best therapeutic effect.

4.5. Track disease progress

Tracking the progress of the disease is to understand the changes in the patient's condition through regular clinical examinations and microbiological tests to provide a basis for formulating and adjusting treatment plans. Doctors can comprehensively assess the patient's infection by observing the patient's clinical manifestations and laboratory test results combined with microbiological test data. Doctors can then adjust the treatment plan based on the progress of the disease, select more effective antibacterial drugs, and take other necessary treatment measures, such as surgery. By tracking disease progression, doctors can better control the development of infectious diseases and improve treatment effectiveness.

4.6. Early diagnosis and treatment

Early diagnosis and treatment are crucial to controlling infectious diseases. In the early stages of the disease, doctors can quickly determine the type and degree of infection through microbiological tests and other auxiliary examination methods, so sensitive antibacterial drugs can be selected for treatment as early as possible. In addition, intervention and treatment in the early stage of the disease can effectively reduce the risk of disease exacerbation, relieve patients' pain, and improve treatment effects. Therefore, early diagnosis and treatment are crucial for controlling and treating infectious diseases.

In summary, applying bacterial resistance monitoring to clinical microbiology testing can play a positive role and is worthy of promotion.

Disclosure statement

The author declares no conflict of interest.

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