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The Analysis for Drug Resistance of *Pseudomonas aeruginosa* and Control Measures for Hospital Infection Prevention

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This paper is mainly to discuss the drug resistance of *pseudomonas aeruginosa* and control measures of hospital infection, which will provide scientific basis for effective control of infection. The identification is performed with automatic bacteria analyzer and drug susceptibility system, and 13 kinds of antimicrobial drug susceptibility tests are carried on 485 strains of *pseudomonas aeruginosa* .The drug resistance of *pseudomonas aeruginosa* on cefazolin is as high as 100%, cefotaxime and cefoperazone also shows high drug resistance, with its rate reaching as high as 58.9% and 51.6% , followed by gentamicin , oxygen fluorine oxazine penicillin and aztreonam, whose rate of resistance is 31.3%, 32.9% and 31.3% respectively. With a large number of broad-spectrum antibiotic commonly used, the drug resistance of antibiotic commonly used in *pseudomonas aeruginosa* is on the rise in general , which also has emerged the trend of multiple drug resistance. Therefore the hospital should make reasonable plan to fight infection, put forward practical and effective management measures to control patients with abuse situation of antibacterial drug through study.

Key words: *Pseudomonas aeruginosa*; Hospital infection; Control measures; Drug resistance analysis

Pseudomonas aeruginosa (PA) is gram-negative bacilli of low pathogenicity, which is widely distributed in nature, soil, water, air, and skin, respiratory tract and intestinal tract of normal people. The bacteria is a kind of conditional pathogenic bacteria, only under certain conditions can it cause disease. Long-term application of hormone, immune inhibitor, chemotherapy, radiation therapy etc will make patients be immunocompromised, which could cause serious and even fatal infection; moreover, the patients are also prone to suffer from this fungus infection after surgery or some treatment operation (tracheotomy, indwelling catheter, etc.), so the *Pseudomonas aeruginosa* has become one of the important pathogens of nosocomial infection. But due to the strong drug resistance of *Pseudomonas aeruginosa*, the *Pseudomonas aeruginosa* (MDR - PA) infection of multiple drug resistance in intensive care unit (ICU) is increasing especially in hospital in recent years, the resistant rate has increased gradually and drug resistance is extensive, which has brought great challenge to clinical selection of antibiotics. So strengthening the related study about *Pseudomonas aeruginosa* could provide scientific basis for clinically rational selection of antibiotics effectively, so the prevalence situation of *Pseudomonas aeruginosa* infections and related progress of clinical treatment strategies is summarized now.

The present status of *Pseudomonas aeruginosa* infection and clinical treatment strategies

Pseudomonas aeruginosa is the representative culture of genus pseudomonas species, it could generate blue-green pyocyanin on the agar plate, green fester will form when it is infected with wounds. This bacteria is movable

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and gram-negative bacteria with no capsule, buds, which is of different forms, arranged in pairs or in form of short chain, it is obligate aerobe, the optimum growth temperature is 37°C, pathogenic *Pseudomonas aeruginosa* can still grow at 42°C, according to which it can be identified with fluorescent pseudomonas and so on. *Pseudomonas aeruginosa* is stronger in resistance to the external environment, it has long-term survival ability in wet place, which is not sensitive to ultraviolet light, it could be exterminated under hot and humid condition at 55°C for 1 hour .

Clinical Characteristics and Pathogenic Mechanism of *P. aeruginosa* Infections

Pseudomonas aeruginosa is one of the most common pseudomonas existing in human body, such bacteria is commonly associated with virulence which has stronger bacteria existing in focus of infection, but occasionally it can also induce organization infection alone exposed to external part. Infection usually occurs in the hospital, and such bacteria could be usually found in washing tank, antiseptic solution and containers of urine storage, the bacteria can be passed on to patients by health care providers, particularly in burning and children's intensive care unit, which is one of the pathogens that ranks the top 5 in infection within hospital. *Pseudomonas aeruginosa* infection can occur in many anatomical part, including the lungs, skin, subcutaneous tissue, bone, urinary tract, surgical part, heart valves and blood etc. Infection specimens of *Pseudomonas aeruginosa* are mainly sputum, urine, hydrothorax, secretion and ascites, most of which are sputum specimens.This is related with the lungs infection which could be easily induced by *Pseudomonas aeruginosa*, especially the *Pseudomonas aeruginosa* of hospital-acquired pneumonia ranks the top of the pathogenic bacteria. *Pseudomonas aeruginosa* infection may have close relationship with the following reasons: (1) patients are in a critical condition and have been hospitalized for long time, weak health and low immune function , coupled with the long-term extensive use of antimicrobials, have made normal flora be destroyed, which will increase the infection opportunity of *Pseudomonas aeruginosa*. (2) In the clinical treatment, the use of invasive diagnostic devices such as intubation, breathing machine, etc., could make the body's normal mucosal barrier be broken, which is also the risk factors of *Pseudomonas aeruginosa* infection.In addition to the infection acquired in hospital, HIV infected people in the community may easily obtain the bacteria infection, and once it is infected by *Pseudomonas aeruginosa*, it often can appear the signs of advanced HIV infection. Pathogenic mechanism of *Pseudomonas aeruginosa*: the interaction between the virulence factor of eudomonas aeruginosa and host immune reaction determines the severity degree of the infection and types. Because of the different environmental conditions and host immune status, *Pseudomonas aeruginosa* can cause the chronic infection of the body, as well as a highly lethal acute infection. In the respiratory tract, *Pseudomonas aeruginosa* can lead to acute fulminant ventilator associated pneumonia (VAP), it also can make the patients with chronic obstructive pulmonary disease develop into chronic infection of cystic fibrosis (CF), thus cause the progressive impairment of lung function. Bacteria could interact with control signal molecules (such as cytokines) of host's immune system through surface receptors of soluble cell (such as toll - like receptor), evade the removal effect of the host immune system, thus affect the severity degree of the disease.

MATERIALS AND METHODS

Source of Bacterial Strain

485 plants of nonredundant *Pseudomonas aeruginosa* were extracted from the urine, sputum, fester, blood, throat swab and coelomic fluid of the patients who visited Sino-Japanese fellowship hospital of Jilin university between January 2012 and December 2012

Antibiotics Paper and Culture Medium

Antibiotics pieces such as Amine kanamycin, levofloxacin, piperacillin/tazobactam, imipenem, ticarcillin/clavulanic acid, ceftazidime, cefepime, piperacillin, aztreonam, CPFX (Ciprofloxacin), tobramycin, gentamicin, cefotaxime, blood plate, MacConkey panel, MH panel are all bought from microbial technology co., LTD. (Oxoid company products) of Dijing in Guangzhou.

Standard Strains

Quality control bacterial strain of *Pseudomonas aeruginosa* ATCC27853 are purchased from clinical testing center in Jilin province.

Bacterial Strain Identification

All bacterial strain have applied the identification instrument of Microscan Walkaway 96 fully automatic bacteria from DADE companies in the United States for authentication.

Test for Antibiotic Sensitivity

Drug sensitive test is performed through using the K - B disc diffusion method, judgment results are determined by all test operation and interpretation standards according to CLSI 2010 standard, drug susceptibility paper is bought from Ox - oid of British company. Statistical analysis of drug sensitivity test is performed with Whonet5.5 for showing its results.

Group Forming Criterion

MDRPA groups: 6 classes of antibiotics including penicillin antibiotic, cephalosporin antibiotics, lactam antibiotics, carbapenems, fluoroquinolone antibiotics and aminoglycoside antibiotics) are usually applied clinically , the material which is drug resistant to more than three kinds of antibiotics is determined to be multiple drug resistant *Pseudomonas aeruginosa*, which is marked as MDRPA group. Non MDRPA groups: select the *Pseudomonas aeruginosa* which is detected to be sensitive to more than 3 kinds of antibiotics in the same phase are marked as a non MDRPA group.

Investigation Method

The project of retrospective investigation (the patients who are consistent with hospital infection, case survey) includes: age, gender, check-in desk, whether he has basic diseases (diabetes, coronary heart disease, obstructive lung disease, hypertension, cerebrovascular accident, tumor, anemia, liver disease, etc.), hospitalization days, the situation of antibiotics application(the applied types and number of days), whether other types of pathogenic bacteria infection (staphylococcus aureus, klebsiella pneumoniae and escherichia coli, baumanii, fungus) are combined, the presence of invasive operation (including vitro drainage tube, sputum suction, oxygen uptake, trachea cannula,catheter intubation,pulverization,stomach tube of nasal feeding ,deep vein intubation etc). If a patient is detected with *Pseudomonas aeruginosa* for many times, then the first detection result would be extracted.Diagnosis standard is according to the "standard of hospital infection diagnosis" published by the health department in our country.

Statistical Method

Summarizing analysis is performed with statistical software of SPSS19.0 version to all data.Single factor analysis: measurement data (the data is conforming to normal distribution) is performed with t-test or rank-sum test (Mann-Whitney U, the data conforms with abnormal distribution), X^2 test is applied on enumeration data, the difference at $P < 0.05$ is considered to be statistical significance.Multiple-factor analysis: after performing single factor analysis, the difference of variables which have statistical significance is performed with logistic regression statistic analysis, the ratio between specific value of calculation (OR) and 95% confidence interval.

RESULTS

Distributed Situation of *P. aeruginosa* in Each Department

Neurosurgery takes the largest proportion in the distribution situation of department which contains extracted 485 plants of *Pseudomonas aeruginosa*, which has 126 plants occupying 26.17%; the second is respiration medicine, its 75 plants occupy 15.37%; the order of other departments are 43 plants in Hepatopancreatobiliary Surgery Department (8.65%), 38 plants in department of orthopaedics (7.64%), 33 plants of chest surgery (6.43%), 21 plants in Cardiology Department (4.23%), 20 plants in Neurology Department (4.01%), 18 plants in urinary surgery (3.71%), 16 plants in ICU department (3.30%), 13 plants in colorectum department (2.68%), other departments (2.47%), 11 plants in stomach enterochirurgia (2.27%), 10 plants in otorhinolaryngological department (2.06%), 9 plants in kidney disease of internal department (1.85%), 8 plants in vascular surgery (1.65%), 8 plants in gerontology department (1.65%), 7 plants in department of tumor blood (1.44%), 6 plants in VIP department (1.24%), 5 plants in hand surgery (1.03%), 4 plants in rheumatism immunity branch (0.82%), 1 plant in cardiac surgery (0.41%). See (Fig. 1).

Distributed Situation of *P. aeruginosa*'s Specimen Source

Among the extracted 485 plants of *Pseudomonas aeruginosa*, sputum specimens has

the largest proportion, its 324 cases occupy 66.80%, the rest cases includes 68 cases of catheter tip (14.02%), 31 cases of urine (6.32%), 11 cases of extract secreta (2.27%), 11 cases of puncture fluid (2.27%), 10 cases of drainage liquid (2.06%), 7 cases of ascites (1.24%), 6 cases of alveolar wash (1.24%), 6 cases of blood (1.24%), 5 cases of wound secretion (1.03%), 2 cases of cerebrospinal fluid (CSF)(0.41%) and so on. The details is in (Fig. 2).

Drug Resistance Situation of *Pseudomonas aeruginosa* to 13 Kinds of Antibiotics

Through observing the drug resistance situation about 485 plants of *P. aeruginosa* to 13 kinds of antibiotics, the results indicate the

Table 1. Drug resistance situation of *Pseudomonas aeruginosa* to 13 kinds of antibiotics

Name of antibiotics	Drug resistance (%)	Intermediary agent (%)	Sensitivity (%)
Amikacin (BBK 8)	10.8	6.1	83.1
Levofloxacin	14.9	8.2	76.9
Cefepime	16.2	10.8	73
CPFX(Ciprofloxacin)	16.4	6.7	76.9
Piperacillin/Tazobactam	17.1	0	82.9
Tobramycin	17.9	1.5	80.6
Ceftazidime	18.8	8.9	72.4
Piperacillin	20.7	0	79.3
Gentamicin	21	6.9	72.1
Imipenem	26.8	4.3	68.9
Ticarcillin/ clavulanic acid	28.3	0	71.7
Aztreonam	44.9	0	55.1
Cefotaxime	94.2	0	5.8

Table 2. Single-factor analysis for combing underlying disease and infection of multi-drug resistant *Pseudomonas aeruginosa*

Coexistent disease	Non MDRPA		MDRPA		X^2	P
	N	%	n	%		
Gender (male)	242	65.1	79			
	69.9	0.91				P>0.05
Hospital stays?d?	11		21		16.9	P<0.05
	4-21		9-43			
Coronary heart disease	121	32.5	44	38.9	1.58	P>0.05
Diabetes	97	26.1	32	28.3	0.21	P>0.05
Hypertension	176	47.3	75	66.4	12.66	P<0.05
Chronic obstructive pulmonary disease	147	39.5	39	34.5	0.92	P>0.05
Chronic obstructive pulmonary disease	101	27.2	42	37.2	4.16	P?0.05
Tumor	108	29.0	25	22.1	2.07	P>0.05
Anemia	39	10.5	6	5.3	2.78	P>0.05
Hepatic and gall diseases	153	41.1	38	33.6	2.04	P>0.05

Table 3. Multiple-factor analysis for nosocomial infection of multi-drug resistant *pseudomonas aeruginosa*

Risk factor	B value	SE value	Wald value	P value	OR value	95%credibility interval (CI)
Trachea cannula	0.874	0.432	6.106	0.002	2.043	1.213-4.264
Carbapenems	1.013	0.401	8.214	0.005	2.157	1.157-5.391
The days of using antibiotics	1.125	0.397	7.357	0.017	3.469	1.662-7.843
Constant	5.363	1136.063	28.726	0.088	0.790	

medicine with low drug resistance rate includes amikacin (BBK 8)(10.8%), levofloxacin (14.9%)and cefepime (16.2%), while imipenem, aztreonam, cefotaxime have high drug resistance rate, which is 26.8%, 44.9% and 94.2% respectively. (Table 1).

Single-Factor Analysis for the Nosocomial Infection of Multi-Drug Resistant *Pseudomonas aeruginosa*

113 plants of multi-drug resistant *Pseudomonas aeruginosa* are screened out from 485 plants of *Pseudomonas aeruginosa* with drug sensitive test, and there are 372 plants of non-multi-drug resistant *Pseudomonas aeruginosa* infections, which are MPDRPA group and non MPDRPA group respectively, the difference situation of two groups on various factors is compared. Single factor analysis results indicate that through combing such factors like hypertension, the cerebrovascular accident, hospital stays, using penicillium carbon alkene antibiotics and quinolone antibiotics, the types of applied antibiotics ≥3, the applied days of antibiotics, sputum suction, respirator, trachea cannula, deep vein intubation, intubation tube of nasal feeding, catheter, mixed infection of fungi, mixed infection of acinetobacter baumannii, mixed pneumonic klebsiella bacteria, merged infection pathogense ≥3 and so on, we could see there are statistical differences in the distribution of MDRPA group and non MDRPA group (P<0.05) (Table 2).

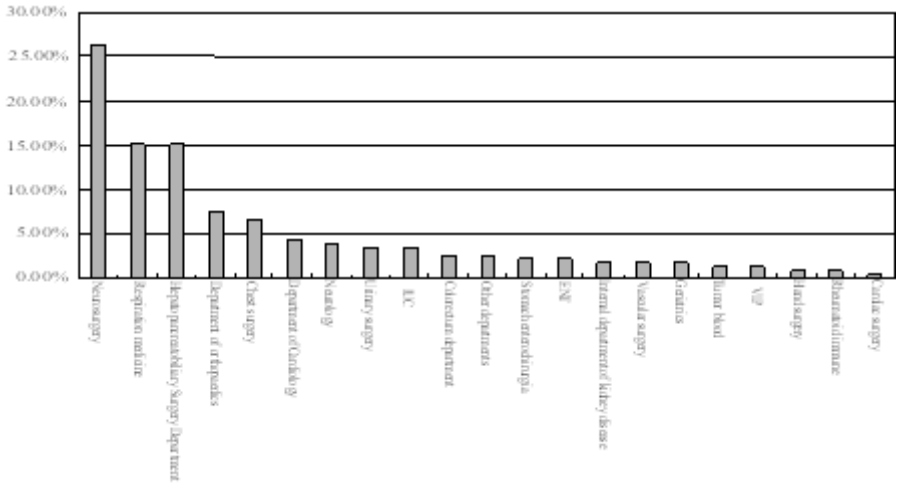

Fig. 1. Distributed situation of *Pseudomonas aeruginosa* in each department

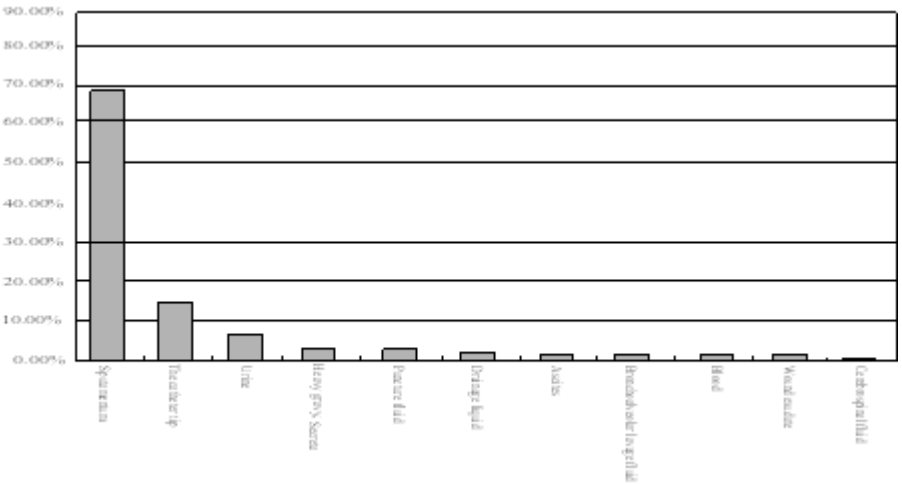

Fig. 2. Distributed situation of *Pseudomonas aeruginosa's* specimen source

Multiple-Factor Analysis for Nosocomial Infection of Multi-Drug Resistant *P. aeruginosa*

This paper has performed multi-factor and unconditioned logistic regression analysis,standard 0 = 0.05 is selected.The results show that: the used days of antibiotics, using carbapenems, trachea cannula are independent risk factors of multi-drug resistant *Pseudomonas aeruginosa*. See (Table 3).

DISCUSSION

Infection Status Quo Analysis for *P. aeruginosa*

Pseudomonas aeruginosa is conditional pathogenic bacteria, which is distributed in nature and intestinal tract, skin and respiratory tract of healthy people. Under normal circumstances, *Pseudomonas aeruginosa* will not infect any organization in human body, but when the human body immunity is low (patients with long-term hormone and tumor chemotherapy, AIDS patients, immune inhibitors after organ transplantation) or after medical treatment operation (tracheotomy, kidney dialysis and urethral intubation) or after severe trauma(burn, after major surgery, serious compound injury), *Pseudomonas aeruginosa* almost can infect any organization in the human body. Due to various iatrogenic invasive operation and unreasonable application of antibacterial agents ,the drug resistance of *Pseudomonas aeruginosa* has become increasingly serious, and detection rate of multiple drug resistant *Pseudomonas aeruginosa* has increased year by year, which has become the problem of clinical treatment.

Through performing diagnoses for 485 plants of *Pseudomonas aeruginosa* extracted from hospital, we know that the main administrative office distribution of *Pseudomonas aeruginosa* infections are 126 cases in neurosurgery (25.98%), 73 cases of respiration medicine (15.05), which are different from the fact that ICU administrative office occupies larger proportion in domestic document literature, it may due to that there is independent ICU ward in each administrative office in hospital.324 plants are detected in sputum specimens, which occupies 66.80% and has the highest proportion, the second is 68 cases of catheter tip, which occupies 14.02%, it is in accordance with the height of domestic related literature. Due to most of the patients admitted by neurosurgery are cerebral hemorrhage, severe head injury and open injury, patients are more serious, infection opportunity has increased for retention of endotracheal intubation, various drainage tube and long term use of respirator after operation. Patients in respiratory medicine have more underlying diseases and long hospital stays, and the long term and repeated use of one or more antibiotics could easily cause infection of *Pseudomonas aeruginosa* and other opportunistic pathogen. The monitoring should be performed on the key department and crowd according to the epidemiologic feature of *Pseudomonas aeruginosa* infections clinically. For the invasive operation which could easily cause *Pseudomonas aeruginosa* infections,medical care personnel should execute in accordance with the requirements for aseptic operation. The key of preventive measures lies in cutting off transmission route, isolating infection source, eliminating hazards and protecting vulnerable groups.

Drug Resistance Situation of *P. aeruginosa*

Resistance mechanisms of *Pseudomonas aeruginosa* are complex and various, drug resistance gene could be obtained by gene mutation or horizontal gene transfer, which would generate various antibiotics modification enzyme and lactamase, high expression of efflux pump, the change of outer membrane permeability and targeted change of drug effect and so on, which usually is not caused by certain single factor, but some kinds of mechanism of synergy would cause drug resistance, thus make *Pseudomonas aeruginosa* represent multi-drug resistance (MDR). The mechanism of drug resistance includes (1) various types of ²- lactamase mediated by plasmid or chromosome will make ²-lactam antibiotics which has permeated into thallus lose activity through destroying the amido bond in β-lactam ring. (2) Low outer membrane permeability (OprD2 deficiency) will reduce the amount of antibiotics which enters into bacteria, thus causes drug resistance. (3)Excessively active efflux system would make the cytomembrane of *Pseudomonas aeruginosa* produce biofilm composed of glycoprotein with rich adhesion property, prevent and control the entering of white blood cells, macrophages, antibody and antibacterial agents into bacterial biofilm for killing bacteria, which is

the important reason of causing antimicrobial resistance of antibacterial agents. (4) Through compounding modification enzyme of aminoglycosides (phosphotransferase, acetyl transferase and adenine nucleotide translocase) and changing the gene of coding quinolone antibacterial drugs on the bacterial action target, it has resulted into the structural modification of enzyme a!, IV, and made medicine could not stably combine with enzyme - DNA complex.

The Analysis for Related Risk Factor of Multi-Drug Resistant *P. aeruginosa* Infections

Totally 113 plants of multiple resistant bacteria were detected in 485 plants of *Pseudomonas aeruginosa* through drug sensitive test, which occupies 23.3%. Single factor analysis results indicate that, combing hypertension and cerebrovascular accident, hospital stays, using quinolone antibiotics, carbapenems, the used types of antibiotics e" 3, the days of using antibiotic, sputum suction, deep vein intubation, trachea cannula, intubation tube of nasogastric feeding, catheter intubation, using respirator, mixed infection of acinetobacter baumannii, mixed infection of klebsiella pneumonia, mixed infection of fungi, species number of merged infection pathogens e" 3 have statistical differences in the comparison between MDRPA group and non MDRPA group ($P<0.05$), which is related with the generation of multi-drug resistant *Pseudomonas aeruginosa* infections. The above variables with statistical significance is performed with statistical analysis of Logistic Regression, we know from the calculation ratio (OR) and 95% confidence interval that: the days of antibiotic use, using carbapenems, trachea cannula are the independent risk factors of generating multi-drug resistant *Pseudomonas aeruginosa*.The reason why the days of using antibiotic is taken as the independent risk factor generated by multi-drug resistant *Pseudomonas aeruginosa* maybe that long term use of antibiotics will cause the imbalance of human body's normal flora. Falagas etc has found from research that, the long term use of antibacterial agents is the main hazards of generating multi-drug resistant *Pseudomonas aeruginosa*. While the patients in long term use of antibiotics are critical patients, who are usually combing with many underlying disease (coronary heart disease, hypertension, diabetes, chronic respiratory disease, kidney failure, cerebrovascular disease, tumour etc). Such kinds of patients themselves have heavy state of illness, low immunity, long hospital stays,and they are more easily to access various invasive operation (tube cutting, deep vein intubation, respirator), and *Pseudomonas aeruginosa*, thus multi-drug resistant *Pseudomonas aeruginosa* infections have occurred. The use of carbapenems is also one of the related important factors in causing multi-drug resistant *Pseudomonas aeruginosa* infections. As strong antibacterial drugs in curing gram-negative bacterium, imipenem has been widely used clinically, it not only acts as therapeutic, but also is the inductive agent of resistant *Pseudomonas aeruginosa*. The data indicates that widely applying imipenem could cause the increase of poly-resistance *Pseudomonas aeruginosa*. The main reason of why currently known *Pseudomonas aeruginosa* generates drug is resistant to carbapenems is that: small molecule carbon alkene drugs selectively enters into the specific channel of thallus, namely the OprD2 duct of outer membrane protein gene in *Pseudomonas aeruginosa*, when the adventitia OprD2 of outer cell wall lose, small molecule carbon alkene drugs would be restrained in the process of entering into thallus due to the change of bacteria membrane permeability. So it is currently known that the deficiency of outer membrane protein gene OprD2 or decreasing expression is the main mechanism of resistant carbon alkene drugs.

CONCLUSIONS

The research verifies that unreasonable use of carbapenems like imipenem is the important reason of causing *Pseudomonas aeruginosa* being drug resistant to β-phthalein amine antibiotics and other antibiotics. Thus, in order to reduce the drug resistance of *Pseudomonas aeruginosa* and the appearance of drug resistant strain, we should strictly control the adaptation disease of applying penicillium carbon alkene antimicrobial, and avoid the abuse of such drugs. In this study, the trachea cannula is also taken as one of the independent risk factor for the multi-drug resistant *Pseudomonas aeruginosa* infections, sputum occupies 67% when looked from specimen source, while the distribution of infected patients mainly focuses on neurosurgery and respiration medicine. These two administrative offices mainly contain critical patients, spontaneous breathing ability has weakened, and even disappear, many patients

need to establish artificial airway for performing mechanical ventilation, the establishment of artificial airway and mechanical ventilation has damaged the natural defense barrier of body's respiratory system, in addition,the germ accumulates on the surface of intubation tube ,thus forms biological membrane, which could protect germ to be free of antibacterial agents and host defense, such factors will increase the opportunity of making respiratory tract infection infected by *Pseudomonas aeruginosa* greatly. There are scholars at home and abroad else proposing the explanation of "infection route of stomach - lung",stress ulcer could be usually caused by mechanical ventilation, so clinician takes drugs of acid suppression for prevention. Acid suppression drugs will increase the PH value in gastric juice, and weaken the sterilizing effect of gastric juice, increase the danger of bacterial colonization in digestive tract. In addition to placing the tube for a long time, the stomach tube will weaken the esophageal sphincter function, easily cause gastroesophageal reflux, engraftment bacteria in stomach could follow reverse engraftmenta of "digestive tract-the upper respiratory tract-lower respiratory tract"and cause respiratory infections. The research results also show: invasive operation like trachea cannula and ventilator etc would damage the mucosal epithelium, make the natural barrier of the upper respiratory tract be destroyed, in addition to frequent sputum suction, which could provide a channel for migration of pathogenic microorganisms. On the other hand, due to the weakening or disappearance of pharyngeal reflex, opening of artificial airway, physiology environment change of airway, as the intubation time is extended, local and systemic immune function of patients decline, trachea cannula will bring the *Pseudomonas aeruginosa* in pharynx oralis into weasand, then it merges with airway secretions and the trachea of wetting liquid to form "slime paste" which will deposite and adhere to the inner wall of endotracheal tube and the periphery of air sac. When the balloon is deflated ,the inner wall of trachea cannula and periphery of air sac is extremely easy to flow backwards into lower respiratory tract, which could easily lead to the infection of multiple drug resistant *Pseudomonas aeruginosa*. To sum up, through analyzing the drug resistance status of *Pseudomonas aeruginosa* infection and associated risk factors of multi-drug resistant *Pseudomonas aeruginosa* infections, this paper has proposed that we should strengthen the monitoring of key administrative office and crowd, rationally use antibacterial agents, strictly control the application indications of invasive technique, strictly enforce sterile operation specification in the process of operation, thus control the occurring of nosocomial infection and reduce the generation of drug-resistant strain.

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