The Distribution and Antimicrobial Resistance of Common Bacteria of Nosocomial Infection

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Abstract: To investigate the distribution and antimicrobial resistance of nonfermentive bacteria in hospital, we provide scientific evidences of clinical to control the nosocomial infection. We retrospectively analyzed the distribution and the antimicrobial resistance of common nonfermentive bacteria isolated from inpatients during 2011.1-2012.12. Results showed that 2176 strains nonfermentive bacteria were isolated from inpatients during the two years. The top three were pseudomonas aeruginosa (53.68%), acinetobacter baumannii (20.13%), and Stenotrophomonas maltophilia (13.60%). The mority of them came from respiratory tract and distributed in ICU and neurosurgery ward, etc. The results of drug susceptibility showed that the antimicrobial resistances of three common kinds of nonfermentive bacteria were serious, and mority of them were increasing. To pseudomonas aeruginosa, the resistant rate of three generations of cephalosporins was over 50.00%. The resistance rate of cefoperazone/shubatan and piperacillin/shubatanni were 26.544% and 22.84% respectively in 2012; the resistant rate of carbapenem was about 25.00%. To acinetobacter baumannii, the resistant rate of three generations of cephalosporins was over 70.00%, but the resistant rate of cefoperazone/shubatan was 24.46% in 2012. The resistant rate of carbapenem were about 40.00%, there were significant difference compared with 2011 ($P<0.05$), which should be took attention. During two years, the resistant rate of minocycline was the lowest (about 11.00%). Stenotrophomonas maltophilia had high resistance to β-lactam antimicrobial drugs, but levofloxacin was 24.66% in 2012. The resistance rate of SMZ was about 5.00% and Minocycline was about 12.00% in the two years. Therefore, compared with pseudomonas aeruginosa, cefoperazone/shubatan and piperacillin/shubatan had a lower resistance, they could be used as experience. Polymyxin B might be used to treat the infection of multidrug resistance pseudomonas aeruginosa (MDRPAE); minocycline, polymyxin B and cefoperazone/shubatan should be chose lonely or jointly to resist infection of multidrug resistance acinetobacter baumannii(MDRAB) ; to Stenotrophomonas maltophilia, SMZ and Minocycline should be used firstly. Hospitals should strengthen the monitoring of multidrug resistance and rational using of antimicrobial drugs to prevent and control effectively the outbreak and prevalence of nosocomial infection.

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Key words: nonfermentive bacteria, nosocomial infection, antimicrobial susceptibility test, antimicrobial resistance

1. Introduction

Because of the extensive distribution and the natural resistance to many kinds of antimicrobial agents, the nonfermentive bacteria have become the main pathogenic bacteria in hospital infection. Moreover, with the increased using of antimicrobial agents in clinical, the antimicrobial resistance was increasing year by year, which has brought great difficulties to clinical anti-infection treatment. Therefore, we analyzed retrospectively the distribution and the antimicrobial resistance of common nonfermentive bacteria isolated from inpatients during 2011.1-2012.12, we hope to provide more effective ways to treat the infection of nonfermentive bacteria.

2. Material and Methods

2.1 Source of specimens

2176 strains bacteria isolated from inpatients' specimens from January 2011 to December 2012, including blood, phlegm, secretions, urine, etc. All kinds of specimens met the requirements.

2.2 Isolation and identification of bacteria

According to the third edition of The National Clinical Operation Procedure, Vitek 32 automatic measurement system for microbial bacteria was used. Some used DL system. Some of them used K-B antimicrobial susceptibility test. Some susceptibility paper came from Oxiod. Results would be interpretated according to the clinical laboratory standards formulated by standardization institution (CLSI).

2.3 Quality control

Pseudomonas aeruginosa ATCC27853 was provided by the Chinese pharmaceutical and biological products. The results were in the range of quality control.

2.4 Statistical analysis

WHONET 5.6 software for statistical analysis was used. Comparison between two groups used χ^2test.

3. Results

3.1 Distribution trends of nonfermentive bacteria

A total of 7735 strains bacteria were isolated

from inpatient's specimens in two years.Among them, the nonfermentive bacteria were 2176 strains, which accounted for 28.13% in the total number of bacteria .The top three kinds of nonfermentive bacteria were Pseudomonas aeruginosa (53.68%), Acinetobacter baumannii (20.13%) and Stenotrophomonas maltophilia (13.60%). The mority of them came from respiratory tract (83.27%) and distributed in ICU (32.90%) and neurosurgery ward (15.53%). The distributions will be illustrated respectively in Table 1 to 3.

3.2 Antimicrobial resistance

The antimicrobial resistance of three common nonfermentive bacteria in 2011and 2012 will be illustrated respectively in Table 4.

Table 1: The strains distribution of nofermentation bacteria (%)

Pathogenic bacteria	Number	Constituent ratio
pseudomonas aeruginosa	1168	53.68
Acinetobacter aumannii	438	20.13
Stenotrophomonas maltophilia	296	13.60
Acinetobacter lwoffi	86	3.95
pseudomonas fluorescens	62	2.85
Others nofermentation	126	5.79
total	2176	100

Table 2: The specimens distribution of nofermentation bacteria(%)

Specimens	Number	Constituent ratio
phlegm	1812	83.27
secretions	138	6.34
blood	136	6.25
urine	30	1.38
others	60	2.76
total	2176	100

Table 3: The Clinical distribution of nofermentation bacteria(%)

Wards	Number	Constituent ratio
ICU	716	32.90
Neurosurgery ward	338	15.53
Thoracic surgeons	208	9.56
Respiratory ward	154	7.08
Elder ward	146	6.71
Others wards	614	28.22
total	2176	100

Table 4: The antimicrobial resistance of three common kinds of nonfermentive bacteria to 14 kinds of antimicrobial agents in 2011 and 2012(%)

Antibacterial agents	Pseudomonas aeruginosa		Acinetobacter baumannii		Stenotrophomonas maltophilia	
	2011	2012	2011	2012	2011	2012
CAZ	48.80	54.80*	72.51	78.63	46.30	48.60
CTX	55.20	61.76$^{\Delta}$	75.86	82.12	…	…
CPS	52.31	54.71	76.80	78.90	…	…
FEP	43.50	44.5	69.50	71.60	…	…
CFS	20.50	26.54$^{\Delta}$	22.42	24.46	…	…
PIP	35.58	44.38*	70.88	78.90	…	…
PTZ	20.82	22.84	53.10	55.12	…	…
AMK	32.82	29.34	60.10	62.28	…	…
LEV	42.00	46.00$^{\Delta}$	80.20	86.28	21.42	27.90
SMZ	83.30	85.36	92.70	96.80	5.11	5.19
IMP	21.60	29.76*	30.23	44.65*	…	…
MRP	20.02	26.04$^{\Delta}$	30.10	40.09$^{\Delta}$	…	…
PB	10.90	12.90	12.80	14.60	…	…
MIN	…	…	10.82	12.92	12.81	13.27

Remarks: Δ P<0.05, *P<0.01, there was a significant difference in drug-resistant rate between 2011 and 2012.
… not recommended to use

4. Discussion:

The results showed that nonfermentive bacteria accounted for 28.13% in the total number of bacteria from 2011 to 2012, which implied that the nofermentation bacteria have become an important pathogen of nosocomial infection. So we should pay attention to the detection and controlling of nofermentation bacteria. Three common kinds of nonfermentive bacteria can cause many sites infection, but the respiratory tract is saw commonly (83.27%), and mainly distributed in ICU (32.90%) and Neurosurgery ward (15.53%). The top three were Pseudomonas aeruginosa (PAE), Acinetobacter baumannii(AB) and Stenotrophomonas maltophilia. They accounted for 53.68%, 20.13% and 13.60% respectively. Analysis of clinical information implied that the nonfermentive bacteria infection are usually associated with low immunity, mechanical ventilation, intrusion of medical apparatus and instruments, and closely related to factors such as the extensive using of antibacterial agents. There are many risk factors of nosocomial infection that often occur in the ICU and Neurosurgery wards (Wu Di, 2007). Given natural or acquired drug resistance, the nonfermentive bacteria are easy to causing cross infection. Invasive operation will increase the chances of infection and dysbacteriosis, which causes secondary infection.

In Table 4, the susceptibility results implied

that it was serious that Pseudomonas aeruginosa resisted to 14 kinds of antimicrobial angents, and drugs' resistances have a rising tendency. The resistant rate of cefotaxime was over 50.00%. That Pseudomonas aeruginosa resisted to cefoperazone/shubatan and piperacillin/shubatan were lower. They were 26.54% and 22.84% respectively in 2012, but to cefoperazone/shubatan, there was a significant difference compared with 2011($p<0.05$). So they can be used as experience, but not used as prioral drugs in the clinical treatment, because of inducing of β-lactam antimicrobial drugs. Pseudomonas aeruginosa produces β-lactamase and causes drug resistance, but combined with aminoglycoside and quinolones, they can reduce the resistant mutant prevention concentration (MPC) and mutant selection index (SI), thereby reducing the generation of drug-resistant mutants (Liu Mingtao, 2009). Amikacin has high sensitivity, but because of renal toxicity, the clinical doctors should use it carefully. The carbapenem drugs were used commonly to treat a serious infection of PAE because of no cross resistance to three generations of cephalosporins. However, with increased using of carbapenem drugs in clinical, drug resistance was increasing year by year because of producing carbapenemases .The resistant rates of imipenem and meropenem were 29.76% and 26.02% in 2012, there were significant difference compared with 2011($P<0.05$). Thus the clinical doctors should use it warily. Polymyxin B kept the lowest drug resistant rate of all tests, and did not produce cross resistance with other drugs (Gao Yanyu, 2010). Therefore, when clinical encounter multiple drug-resistant and even generic drug resistance strains, polymyxin B may obtain good effect. Pseudomonas aeruginosa is not only natural resistance to many kinds of antimicrobial agents, but also acquires drug resistance after using drugs. Its resistant mechanism is very complex, the main resistant mechanism were related to producing of antibacterial active enzymes, such as β- lactamase, metal enzymes, amino sugar passivation enzyme, and the lack or loss of outer membrane protein OprD2 or the active efflux system (Rodriguez Martinez JM, 2009). Given complex resistant mechanism, PAE is easy to planting, variation, and easy to causing infection in delay again and again, which make it very difficult in clinical treatment. These should be concerned highly.

As can be seen from the susceptibility results of Acinetobacter baumannii (AB), the β- lactam antibiotics resistance was serious. The resistant rate of third generation cephalosporin was over 70%, the resistant rate of cefoperazone/shubatan was 24.46% in 2012, the polymyxin B and minocycline were 14.60% and 12.92% respectively. There are different degrees of rising. The resistant rates of imipenem and meropenem were 44.65% and 40.09% in 2012, there were significant difference compared with 2011($P<0.05$). The others resistant rate were over 50.00%, which implied that drug resistance of AB were at a higher level, the MDRAB was also increasing. Some Acinetobacter baumannii resisted to imipenem and meropenem, but they were sensitive to polymyxin B and minocycline, which implied minocycline, polymyxin B and cefoperazone/shubatan should be first used to treat infection of AB. The main mechanism of resistance to aminoglycoside is producing aminoglycoside passivation enzyme (Li Shuli,2005); Acinetobacter baumannii resists to quinolones because of topoisomerase gene encoding gyrA and parC mutations, and leading to changes of topoisomerase and the active pump out (Shaotong Zheng, 2013). Acinetobacter baumannii's resistance to imipenem and meropenem were mainly producing carbapenem enzyme (Poirel L, 2006). In addition, membrane resistance was also the important mechanism of AB resistance to carbapenem (Wang Jinliang, 2005).

Stenotrophomonas maltophili resist naturally to many drugs. Currently, Minocycline, SMZ, Quinolones and CAZ were recommended as treatment drugs by CLSI. According to the results of drug susceptibility, Stenotrophomonas maltophilia resisted to SMZ and Minocycline were 5.19% and 13.27% in 2012, so they might be used firstly. The resistant rate of levofloxacin was about 25.00%, but because of their side effects, the joint application is sensible.

Through the analysis of the popular trend of nonfermentive bacteria, we found that the most effective measure is to prevent the cause of infection. Hospital should strengthen the management of antimicrobial agents, use rationally antimicrobial agents, strengthen the aseptic concept, strict disinfection equipment, and pay attention to hand hygiene, disinfection and isolation measures by reducing invasive procedures, shorten hospitalization time. So clinicans should strictly grasp the indications of antimicrobial agents' susceptibility results to prevent or slow down the occurrence of the resistant strains, so as to reduce the risk of hospital infection. It is an important sense to prevent and control the nosocomial infection of nonfermentive bacteria.

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References

[1] Wu Di, Chen Sheng ,pseudomonas aeruginosa on

carbon green alkene resistance mechanism of research [J] International Journal of Respiration , 2007, 27 (8) : 27.
[2] liu Mingtao, Sun en, Bi Shaoji, Studies of resistant mutants about combination drugs of pseudomonas aeruginosa in vitro [J] Journal of ShanDong University (medical science edition), 2009, 47 (9) : 25.
[3] Gao Yanyu, Yu RuJia Lv Xiaoju polymyxin B on multiple drug resistance of pseudomonas aeruginosa in vitro antimicrobial activity research [J] Western Medical Science, 2010, 22 (9) : 1609.
[4] Rodriguez Martinez JM, Poire L, Nordman P.Extended spectum cephalosporinases in pseudomonas aeruginosa [J]. Antimicrob Agents Chemother. 2009, 53 (5): 1766-1771.
[5] Li Shuli, LiYang, Hua Chuan, etc. The drug resistance of Multiple drug-resistants Acinetobacter baumannii and clinical countermeasure [J]. Chinese Journal of Nosocomiology, 2005, (12): 1438.
[6] Shaotong Zheng, Qiyun Fu, Junzhong Lu. The trends of common pathogens of nosocomial infection and changes of resistance to Quinolones [J]. Life Science Journal 2013; 10(3): 118-120.
[7] Poirel L, NordmannP. Carbapenem resistance in acinetobacter baumannii: mechanisms and epidemiology [J]. Clin Microbiol Infect, 2006, 12(9): 826-836.
[8] Wang Jinliang. Pay attention to the development trend of drug resistance of acinetobacter baumannii [J]. Chinese Journal of laboratory Medicine, 2005, 28 (4): 355.

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