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Analysis of Infection Distribution of *Pseudomonas aeruginosa* on Burned Patients and its Drug Resistancess

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Abstract

Objective: To investigate infection distribution of *Pseudomonas aeruginosa* on burned patients in our hospital as well as its drug resistance in order to provide reference of clinical use of antibiotics.

Methods: Statistically analysed 481 *Pseudomonas aeruginosa* and their drug sensitive test results from burned patients who were sent to hospital from January 2004 to December 2006.

Results: In our hospital, among those who were infected with pathogenic bacteria, the number of burned patients who suffered from *Pseudomonas aeruginosa* has increased each year. Such pathogen is resistant to a variety of broad-spectrum antibiotics at different degrees. From January 2004 to December 2006, the multiple drug resistance rate of *Pseudomonas aeruginosa* has also been increased.

Conclusion: *Pseudomonas aeruginosa* is one of the major multiple drug resistant pathogenic bacteria that infects burned patients. This research shows that using antibiotics on patients who are infected with *Pseudomonas aeruginosa* is still the best way to slow its drug resistance.

Keywords: *Pseudomonas aeruginosa*; Infection distribution; Drug resistance; Burn patients

Introduction

Pseudomonas aeruginosa (PA) is a kind of pathogenic bacteria which is commonly found to be infected by burned patients in our hospital. With the wide use of antibacterial, the problem of its drug resistance has also become increasingly acute. Infection caused by multiple drug resistant bacterial strain of PA sometimes spread in burn unit, which makes it more difficult to choose antibiotics during the process of burn treatment. To know its drug resistance on burned patients in our hospital, we analysed 1755 separated PA from January 2004 to December 2006 to provide reference to clinical use of antibiotics.

Materials and Methods

Clinical data

From January 2004 to December 2006, there were in total of 2365 burned patients sent to our hospital: 1606 males and 759 females, aging from 2 months to 95 years, average at 27.67 years old. Among them, 1807 were received germiculture and were separated 1755 pathogenic bacteria. All these samples came from clinical trial and referred to the diagnostic criteria of nosocomial infection [1]. According to the diagnosis, 481 *PA* were found. Their resistance to drug also appeared.

Specimen collection

Used asepsis tube to collect specimen under strict aseptic condition.

Culture and identification of bacteria as well as its drug resistance test

Strictly inoculated and cultured bacteria on M-H culture medium according to national clinical laboratory procedure. Drug sensitivity test: throughout the test, K-B method and method recommended by the USA National Clinical and Laboratory Standard Institute (NCCLS) were simultaneously applied [2]. *Pseudomonas aeruginosa* ATCC25923 was used as the standard of quality control; drug sensitivity (S) and resistance (R) were determined according to NCCLS judgement.

Analysis of risk factors and distribution sites

Utilized retrospective review to analyse infection factors, such as application of broad-spectrum antibiotics, use of hormone, length of hospital stays as well as invasive operation etc. [3].

Statistical analysis

Analysed selected data by using medical statistical software package SPSS (11.0). It is of statistical significance to use $p<0.05$ as inspection standard.

Results

Time distribution of *Pseudomonas aeruginosa*

From January 2004 to December 2006, there were totally 1755 pathogenic bacteria separated from clinical specimen from burned patients. Among them, 481 *Pseudomonas aeruginosa* were found. Within 3 years, the proportion of it in all pathogenic bacteria increased each year. Gram-negative bacteria, which is at the highest constituent ration in burn infection pathogens, increased its percentage from 23.4% to 32.2% (Figure 1).

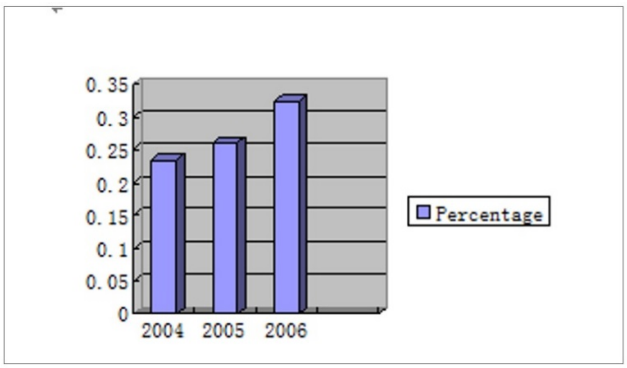

Figure 1: Percentage of *Pseudomonas aeruginosa* in all pathogens increased each year.

Infection area

Infection areas are mainly distributed as below: wound secretion (surgery area), respiratory secretion, blood, urine and other samples. Among them, wound and respiratory infection are mostly common to be seen, as shown by Table 1.

Distribution area	Wound secretion	Respiratory secretion	Blood	Urine	Others
n	338	76	37	11	19
%	70.27	15.80*	7.69*	2.29*	3.95*

Table 1: Infection area distribution of 481 *Pseudomonas aeruginosa* in hospital.

481 *Pseudomonas aeruginosa* drug resistance test result

It is shown by test that PA is highly resistant to broad spectrum antibiotics, and is also sensitive to penicillin compound preparation, cefoperazone/sulbactam and 4th-generation cephalosporin as well as enzyme alkenes hydrocarbon at different degrees (Table 2).

Name of antibiotics	Evaluated number	Sensitive number	Drug sensitivity rate (%)	Drug tolerant number	Drug tolerance rate (%)
Piperacillin/tazobactam	475	367	77.26	89	18.74
Meropenem	395	314	79.49	70	17.72
Piperacillin	479	173	36.11	145	30.27
Imipenem/cilastatin	401	289	72.07	75	18.70
Ceftazidime	475	320	67.37	101	21.26
Amikacin	462	267	57.79	129	27.92
Tobramycin	453	311	64.32	125	27.06
Gentamicin	462	54	11.69	324	70.13
Cefepime	455	243	53.41	102	22.42
Aztreonam	480	263	54.79	145	25.11
Cefoperazone/sulbactam	457	360	78.77	86	18.82
Cefotaxime	467	126	26.98	237	50.75
SMZ-TMP	475	96	20.21	333	70.11
Ciprofloxacin	470	162	55.16	151	31.79
Ceftriaxone	475	79	16.63	356	74.95
Amoxicillin/ Clavulanic acid	475	76	16.00	296	62.32

Ampicillin	479	38	7.93	419	88.21
Cefuroxime	432	112	25.93	98	45.83

Table 2: Analysis of 481 *Pseudomonas aeruginosa* vitro drug tolerance.

Multiple drug tolerance of 481 *Pseudomonas aeruginosa*

In this research, that PA is tolerant to one antibiotic is called single drug tolerance; that PA is tolerant to two antibiotics at the same time is called double drug tolerance. Therefore, that PA is tolerant to three or above antibiotics simultaneously is called multiple drug tolerance [4]. It is shown by Table 2 that from January 2004 to December 2006, multiple drug tolerance rate of PA increased each year (Table 3).

Drug tolerance	2004	2005	2006	Total
No tolerance	14.26	10.33	6.63	10.41
Single tolerance	26.05	34.57	29.88	30.17
Double tolerance	18.14	19.22	26.91	21.42
Triple tolerance	14.96	15.94	16.78	15.89
Quadruple tolerance	7.53	10.20	13.69	10.47

Table 3: Multiple drug tolerance of 481 *Pseudomonas aeruginosa* (%).

Discussion

Pseudomonas aeruginosa is Gram-negative pathogen of infection if being burned [3]. As for burned patients, its infection is one of the major causes for death [5]. In our hospital, the constituent ratio of PA in burn infection pathogens has increased year by year, and has become Gram-negative pathogen itself which is of high percentage. Such result is different from related reports in the literature. It is might because that different hospitals utilized different sources of bacteria strain and various antibacterial at different degrees.

In this study, bacteria strains are found mainly distributed in wound secretion (surgery area) and respiratory secretion. It is because that skin defect on burn wound results in lack of natural barrier, and then necrotic tissue and vacuole are produced. In this case, it is easy to have bacteria contamination and colonization. Thus, topical wound infection is easy to transfer to sepsis [6]. Hence, burn wound is better to be treated in time, especially be treated with early escharectomy, to keep it clean. It is also of high significance to keep free drainage and asepsis. Also, burned patients who suffer from respiratory infection are common to be seen. Apart from reason like inhalation injury, it is also related to tracheal intubation invasive operation, ventilator associated pneumonia [7], hypostatic pneumonia, and wound pain sputum accumulation etc. According to this, sputum evacuation is an important way to avoid nosocomial infection.

Pseudomonas aeruginosa is naturally insensitive to many antibiotics. What's worse, long-term clinical non-standard use of antibiotic aggravates its drug tolerance. In recent years, EBSLs bacteria strain has increased greatly in number and is multiplicity in drug tolerance, which makes the problem of drug resistance thornier. Reasons of it are as below: (1) Adventitia permeability of PA; (2) D2 defect of adventitia protein; (3) Unique drug efflux system of adventitia; (4) Production of β-lactamase; (5) Production of aminoglycoside-modified enzyme; (6) Change of target site; (7) Formation of bacterial biofilm [8]. Results from drug sensitivity test reveal that PA infected by burned patients in our hospital is highly sensitive to pure penicillin, 1st to 3rd generation cephalosporin, quinolones and aminoglycoside, and its tolerance rate is as high as 45%. It is sensitive to ceftazidime, cefepime, aztreonam, amikacin and tobramycin as well, with tolerance rate less than 30%, which thus can be used as initial drugs. Sensitivity rate of PA to piperacillin/tazobactam, cefoperazone/sulbactam and carbapenem is less than 20%, which means that these antibiotics are not only necessary choice to treat multiple infection but also important methods to slow or even depress PA itself to turn into multiple drug tolerant bacteria [9]. Decreasing drug tolerance of PA could increase treatment effectiveness of above mentioned drugs to multiple drug sensitivity. So it is thought that drug combination should be utilized during early effective treatment. Meanwhile, in terms of clinically controlling infection, improving drug effectiveness and reducing drug resistance of PA, it is of vital importance to actively treat primary disease and strengthen nutrition support in order to avoid superinfection. To sum up, PA infection is clinical treatment difficulty to burned patients. To reduce PA infection rate and increase recovery rate, the priority is to know better PA infection, strengthen standard treatment and nursing procedure as well as asepsis operation technique. At the same time, avoid PA infection or at least suppress its happening, particularly by paying attention to appropriate use of antibiotic. Clinician should also enhance detection of bacteria collected from burned patients, and adjust therapeutic regimen based on detection result. Though drug use based on sensitivity test is different from that on actual clinical control of infection, it is better and more effective than empirical medication.

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