REPORT

Bacterial susceptibility and resistance analysis of traumatic osteomyelitis

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Abstract: With the rapid development of industry, agriculture and transportation, the high energy trauma happened accordingly, thus greatly increased the incidence of traumatic osteomyelitis. The clinical traumatic osteomyelitis was mainly the local bone tissue inflammation caused by bacteria infection as trauma or iatrogenic causes. The delaying recovery could cause bone defection or bone nonunion. The purpose of this paper was to contribute new reference for the clinical prevention and treatment through tremendous of disease-causing bacteria susceptibility and resistance analysis of osteomyelitis.

Keywords: Traumatic Osteomyelitis, antibiotics, bacterial cultivation, drug resistance.

CLINICAL MATERIAL

Research object

53 cases with trauma osteomyelitis as study object were chosen from the First Affiliated Hospital of Xinxiang Medical University from January 2012 to December 2014. Among the 53 hospitalized patients, there were 45 cases of male, 8 cases of female, 25 cases of acute osteomyelitis and 28 cases of chronic osteomyelitis. The longest onset was 4 years, while, the shortest was 2 weeks. After trauma incidence, patients had received different forms of internal fixation or external fixation surgery. The pathogenic site were below, thighbone for 10 cases, tibia and fibula for 24 cases, humerus for 9 cases, radius for 4 cases, ulna for 5 cases, phalanges for 1 cases.

DIAGNOSTIC CRITERIA

Acute osteomyelitis

Symptom had occurred such as the local pain, high skin temperature, dark red of skin color, surrounding soft tissue swelling, purulent secretion, elevated white blood cells counts increase not less than (20~30)×109/L, obvious nuclear left shift, neutrophils rise obviously, routine blood leukocytes and neutrophils significantly increased, and quick increased anemia and erythrocyte sedimentation rate. X-ray film displayed or not displayed the bone insect-bite-like destruction or bone cladding formation. High-density dotted or flake-like lesion could be seen on CT lesion. There was no bone cortex or periosteal reaction.

Chronic osteomyelitis

The chronic osteomyelitis symptoms were repeated low temperature, local formed fistula or pus secretion, limb enlargement of local lesion, darker skin color. The lesion skin was easy to burst or ulcer. X-ray demonstrated that the bone density had increased, edge was irregular, and existed low density of narrow boundaries, or with different degree of ostenonecrosis, or bone defection. Many symptoms could be checked through CT, such as bone destruct, coarse edge, bulky trabecular structure or hyperplasia in medullary cavity, or scattered irregular translucent area. The adjacent soft tissue was with clear edge and uniform density, compared to opposite enlarged side. Routine leukocytes and neutrophils were significantly increased, and associated with rapid increase of anemia and erythrocyte sedimentation rate.

All the information from hospitalized patients with traumatic osteomyelitis information were consulted. The general information, diagnosis treatment, bacterial cultivation and drug sensitive test results of the chosen patients were elaborately recorded one by one.

METHOD

Specimen

The specimens were the localized puncture fluid of traumatic osteomyelitis lesion in patients, or wound secretion, which collected under strict asepic acquisition. The bacterial cultivation and drug sensitivity were performed on lesion tissue. The bacterial cultivation was performed within 2 hours after the specimen collection.

Bacterial cultivation and drug sensitivity

Bacterial isolation was conducted by standard method. The bacteria were cultivated in conventional Petri dish at 35° constant temperature incubator. Phoenix-100 automatic microorganism identification and drug sensitivity analysis system was utilized for the above

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identification. The standard from National Committee for Clinical Laboratory were adopted for determination. Experimental drugs were the antibiotics and antibacterials which commonly used in clinical field, such as β-lactam, cephalosporins, quinolones, carbapenems, amino glycosides, rifamycins, vancomycins and nitro furans. The antibiotics for each strain bacteria were different.

RESULT

Among the 53 cases of traumatic osteomyelitis patients, there were 39 cases with positive results for bacterial cultivation, positive rate was 84,91%. In total, there were 37 strains and 14 kinds of pathogenic bacteria, which had been cultivated. There were 3 strains of bacteria been cultivated in 1 case of patients, 2 strain of bacteria in 4 patients, single bacterial strain in 34 cases. There were 16 strain of gram-positive bacteria, 20 strain of gram-negative bacteria and 1 strain of fungi. 17 cases was detected to be positive for bacterial cultivation in 25 cases of acute osteomyelitis patients, positive rate was 68%; and 22 cases were checked to be positive for bacterial cultivation in 28 cases of chronic osteomyelitis patients, positive rate was 78.57%. In pathogenic bacteria distribution aspect, gram-positive bacteria contained 7 strain of staphylococcus aureus, counting for 18.92%, 3 strains of enterococcus faecalis, counting for 8.11%, 3 strains of alpha hemolytic steptococcus, counting for 8.11%, 2 strains of staphulococcus epidermidis, counting for 5.41%, 1 strain of staphylococcus saprophytic us, counting for 2.7%; gram-negative bacteria contained 5 strains of pseudomonas aeruginosa, counting for 13.51%, 4 strains of enterobacter cloacae, counting for 10.81%, 3 strains of escherichia coli, counting for 8.11%, 2 strains of acinetobacter baumannii, counting for 5.41%, 3 strains of klebsiella pneumoniae, for 8.11%, 3 strains of proteus mirabilis for 2.7%, 1 strain of morganella morganii for 2.7%, 1 strain of stenotromonas maltophilia for 2.7%, 1 strain of fungi for 2.7%. The main drug resistance rate of pathogenic bacteria was seen in table 1.

DUSCUSION

Antibiotics application in clinical field was the main treatment on traumatic osteomyelitis. While, the increased incidence of drug resistance hindered the progress of treatment. Therefore, the effective analysis of new bacteria strain changes and drug resistance had far-reaching significance on the reasonable instruction administration.

Bacterial infection

Through the bacterial infection analysis of traumatic ostemyelitis with 53 cases, the various strain of bacteria and various existed bacteria infection might be associated with bacterial mutation and advanced detection level. Data had demonstrated gram-positive bacteria occupied 43.24% of the total number of detected bacteria, including 43.75% for staphylococcus aureus, 18.75% respectively for enterococcus faecalis and alpha hemolytic streptococcus; gram-negative bacteria occupied 54.05% in the total detected bacteria, including 25% for pseudomonas aeruginosa, 20% for escherichia coli and 15% for enterobacter cloacae. Gram-negative bacteria occupied higher percentage in bacteria strain of traumatic osteomyelitis. The staphylococcus aureus occupied the dominating part. Traumatic osteomyelitis was caused by bone tissue infection due variety of reasons. Traumatic osteomyelitis usually happened on long bone of lower limbs and adolescents. The disease onset was from months to years. It was due to mixed bacterium infection of pathogenic bacteria, staphylococcus aureus and hemolytic streptococcus occupied more than 80%, pseudomonas aeruginosa and escherichia coli had much less percentage (Liu, 2010). From the medical records, positive rate of gram-positive bacteria was higher, and the staphylococcus aureus still had higher rate in gram-positive bacteria. Through the analysis, it may related to the surgical operation and internal fixation after trauma occurred. Meanwhile, the widely application of gram-positive antibiotic caused the consequences of gram-positive bacteria being depressed, and gram-negative bacterial being assisted, which need more attention.

Bacterial infection percentage change

The literature reports in China had reported that the main pathogenic bacteria infection rate from high to low of pyogenic osteomyelitis were: Staphylococcus aureus, pseudomonas aeruginosa, hemolytic streptococcus, escherichia coli, bacillus proteus vulgaris, staphylococcus epidermidis, citrobacter, viridans streptococcus, and other bacteria. Aureus infection rate decreased, pseudomonas aeruginosa infection rose to the second, which indicated that osteomyelitis infection type had significantly changed, endogenous normal flora might from the conditional pathogenic bacteria of surrounding environment, and became the main pathogenic bacteria (Yan *et al*., 2005). The main bacterial infection rate of this group were below, staphylococcus aureus for 18.92%, pseudomonas aeruginosa for 13.51%, enterobacter cloacae for 10.81%, escherichia coli for 8.11%, enterococcus faecalis for 8.11%. The infection rate of staphylococcus aureus and enterococcus faecalis were high in gram-positive bacteria. The infection rate of pseudomonas aeruginosa and enterobacter cloacae were high in gram-negative bacteria. Other pathogen infection rate was basically relative balance (Lu *et al*., 2007). The above date was slightly different with previous reports. And it suggested that traumatic osteomyelitis bacteria strain had changed. There was no doubt that *Staphylococcus aureus* still ranked on the top. The high pathogenic gram-negative bacteria infection was different, and the rest bacteria still presented the trend of various equilibrium infection.

Table 1: Main drug resistance rate of pathogenic bacteria

Antibacterial agents	*Staphylococcus aureus*	*Enterobacter cloacae*	*Pseudomonas aeruginosa*	*Escherichia coli*
levofloxacin	-	44%	34.3%	82.9%
tetracycline	11.4%	56.8%	100%	80.8%
aztreonam	-	57.3%	44.3%	57.3%
amoxicillin	42.9%	-	33.3%	-
ciprofloxacin	23.3%	55.3%	11.6%	88.6%
Compound sulfanomides	22.9%	66.7%	90%	85.7%
rifampicin	0%	-	0%	-
chloramphenicol	-	90%	88.7%	18.7%
vancomycin	0%	-	0%	-
cefepime	100%	-	34.3%	100%
ceftazidime	90%	20.3%	-	62.9%
ampicillin	82.7%	-	44.3%	52.3%
imipenem	-	3.27%	0%	0%
cefazolin	-	56.3%	100%	100%

Note: ”-” means no related cultivation

Germ negative result analysis

In this study, 39 cases of patients were with positive bacteria cultivation in 53 cases of traumatic osteomyelitis, the rest 14 cases all was positive results. The reason of false-negative was that the exclusive of few cases without bacterial infection and inappropriate specimen area. The other reason might be: A. Due to long-term usage of antibiotics, L type bacteria with cell wall defect had formed. And the conventional method was not easy to detect and be false dismissed, which need further detection; b. Anaerobic bacteria cultivation was not performed and to be false dismissed. Therefore, the isolated cultivation of L type bacteria and anaerobic bacterial should be conducted for the wound with negative results, which could reduce the false dismission, and achieve more susceptibility results. The early selection of reasonable medication could obtain good curative effect.

Antimicrobial effect on pathogenic bacteria

Traumatic osteomyelitis was often accompanied by a large area of bone skin defects and serious complication of bone nonunion. The sensitive and effective antibiotics even could not be discovered to counter the emerged drug resistance bacteria strain. In the antibiotic susceptibility of this study, tetracycline and polypeptin had the highest sensitive rate against positive bacteria, other antibiotics had higher drug resistance rate, even reached 90%. Aminoglycosides and sulfonamides had higher drug resistance against negative bacteria. The drug resistance of cephalosporin antibiotics was more serious. The past literature reported that the drug sensitivity of amikacin, norfloxacin, cefalomicina and gentamicin were higher than 50%. While, large changes had give rise in recent years, the drug resistance rate of bacterial had increased, and brought obstacle to the clinical treatment of osteomyelitis. Based on above drug sensitivity study on staphylococcus aureus and other gram-positive bacteria, rifampicin and vancomycin had the highest sensitivity. In the drug sensitivity research of escherichia coli and other gram-negative bacteria, the carbapenem antibiotic and quinolones had relatively higher sensitivity, cephalosporin antibiotic had relatively higher drug resistance, few individual reached 100%. Based on the serious drug resistance of bacteria, the advisable method could be combination application of antibacterial drugs based on the bacteria strain and drug sensitivity results for orthopaedic surgeon, in order to achieve better curative effect. Antibacterial drug combination could reduce the dosage of single drug, shorten the treatment period, and reduce the emergence of drug-resistant bacteria (Chen *et al*., 2002). Some scholars had demonstrated how to choose antibiotic treatment through animal experiments, coral artificial bone combined with rifampin had better infection prevention of local injury than gentamicin, which was the effect method for bacterial infection prevention of various of open bone injury (Meng *et al*., 1006). Few professors suggested that the combination of vancomycin and rifampicin could be the advisable treatment, which was cured 12 cases of othopaedic trauma patients who infected by MRSA. Since then, that was rare clinical reported (Zhao *et al*., 2001). In the First Affiliated Hospital of Xinxiang Medical University, the combination of vancomycin and rifampicin was applied on the treatment of traumatic osteomyelitis had achieved precise curative effect, and deserved the widely promotion.

In short, timely understanding of bacterial change and drug sensitivity analysis had significance on the treatment of traumatic osteomyelitis, which should attach great importance to. In view of the corresponding results, antibacterial drug indication should strictly pay attention to, in order to formulate rational and effective treatment.

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