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Effect of antibiotic bone cement on treatment of traumatic tibial osteomyelitis.

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Abstract

Objective: To observe and analyse the effect of using antibiotic bone cement in treating patients with traumatic tibial osteomyelitis.
Methods: This study included 45 patients who were diagnosed with chronic traumatic tibial osteomyelitis. All the patients underwent complete debridement and focus clearance in one stage, as well as the insertion of self-made antibiotic bone cement in the focus area. They also underwent wound closure surgery using one stage closure or VSD technique according to the actual condition of the wound. For VSD cases, debridement should be made again after seven to ten days. The VSD, self-made antibiotic bone cement beads should be replaced according to the specific condition of the wound. And the free skin graft and tissue flap transfer plus additional plate fixation measures can be carried out. Then bone grafting can be implemented. Results: After the treatment, patients' infection in this study was effectively controlled, and the survival of skin grafts and the elasticity of skin were obtained, what's more, no recurrence occurred. The wound healing time of patients ranged from 15 d to 160 d, with an average time of 32.8 ± 4.6 d. Through the VAS pain scores before and after surgery, the results showed that postoperative advantage was obviously superior to the preoperative one. Through comparing the ADL scores before and after surgery, the results showed that postoperative effect was obviously better than the preoperative one. All patients were followed up for 6 months to 36 months, and the effect of bony union on the fracture ends was obtained with an average fracture healing time of 8.7 ± 2.6 months. Conclusion: Relatively satisfactory results can be achieved through using antibiotic bone cement in the treatment of traumatic tibial osteomyelitis. It has high safety and reliability, and is of great value for popularization and application.

Keywords: Antibiotic bone cement, Traumatic tibial osteomyelitis, Treatment effect.

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Introduction

Chronic traumatic tibial osteomyelitis is an infection of bone. It usually results in the defect of the surrounding soft tissue and the exposure of bone after the clearance of the focus area, so it involves a relatively complicated treatment process. The cause of osteomyelitis is usually a bacterial infection and rarely a fungal infection. It may occur *via* spread from the blood or from surrounding tissue. Risks for developing osteomyelitis include diabetes, intravenous drug use, prior removal of the spleen, and trauma to the area. The treatment of osteomyelitis often requires prolonged antibiotic therapy for weeks or months. In our study, we carried out a detailed observation and analysis of the clinical efficacy of antibiotic cement in the treatment of traumatic tibial osteomyelitis and the specific contents were as below.

Materials and Methods

Materials

This study included 45 patients who were diagnosed as cases of chronic traumatic tibial osteomyelitis. All patients received retreatment during the period between May 2013 and May 2017.The number of cases with tibial plateau fractures, tibial shaft fractures, and pilon fractures were 10, 30 and 5

respectively, and the number of cases with fractures on the left and the right side were 20 and 25 respectively. The patients included 28 males and 17 females, and their age ranged from 20 to 70 y old, with an average of 40.6 ± 2.3 y old. Patients' inclusion criteria were: with the history of open leg injuries or acute attacks; with sinus problems around the wound or tumor condition; the results that bacteria present in the cultures when increasing leukocytes and neutrophils through conducting laboratory studies [1]. Imaging findings showed partial destruction of the bone, periosteal reaction, bone hyperplasia, and so forth [2].

Methods

First, full preoperative preparation should be made. After all patients were admitted to the hospital, they should be taken to do full-length, right lateral radiographs at the affected limb to assess the force line of the lower limb. And the extent of osteonecrosis, the status of bone defect, blood routine and C-reactive protein and other indicators should be examined through the three-dimensional reconstruction of CT. Patients should strengthen their nutrition. A rigorous, comprehensive assessment of patients' condition should be made and served as the basis for making a scientific and rational plan for treatment [3]. After patients entered the hospital, he should be guided to take broad spectrum antibiotic combined with Chinese herbal decoction five flavoured disinfectant drink. Whether patients needed to use antibiotics or not should depend on their own actual condition. A reasonable grasp of the need for antibiotic treatment was necessary especially for patients with bacterial culture results outside the hospital [4,5]. Surgery should be performed under the condition that there was no surgical contraindication in patients' examination results. Secondly, surgery should be performed strictly in accordance with the surgical standard. All patients were treated with either a lumbar epidural or general anesthesia according to the extent of osteonecrosis, infection, skin, soft tissue, and bone defects. In this study, patients underwent different surgical protocols: debridement combined with focus clearance. For patients placed with the steel plate or the external fixator before the surgery, their fixture should be removed, and a thorough debridement of infection areas and nail paths should be performed [6]. And all sinus, granulation tissue and necrotic tissue should be resected so that the bone infection part could be completely exposed. The free dead bone, sinus and fracture in the infection area, and screw in the granulation tissue should be removed timely [7,8]. A rongeur or drill can be used to open the window, expose the pulp cavity fully, and perform a thorough debridement. For patients who were treated with tibial intramedullary nail, his tibial intramedullary nail should be removed, and the intramedullary pseudo capsule should also be removed with a larger size diffuser. Pulse should be taken to carry out local high pressure washing, the pith cavity should be washed thoroughly so that the inflammatory lesions and potential sinus could be removed at the largest degree [9]. External fixation: taking unilateral external fixation, hinged external fixation, fixed ring external fixation method in strict accordance with patients' actual situation of soft tissue and fracture ends. Insertion of antibiotic bone cement: implementing scientific and rational deployment in accordance with the standard that mixed up one pack 20 g bone cement with two 0.5 mg vancomycin, and then added polymethyl methacrylate reagents. When the mixture develops into paste state, using the mixture to make bone cement bead chain whose diameter was about 0.6 cm when the mixture developed into paste state, and using the steel wire to bind [10,11]. If there was a larger fracture defect after debridement, the entire bone cement should be placed in the defect site and filled in the tibial spinal cavity. VSD wound closure. The medical foam should be reasonably cut, placed in the wound surface or placed in the cavity according to the shape, size and range of the patient's wound to prevent the problem of remaining dead cavity. The skin and the edges of the material should be properly sutured, and the wound should be closed. The silicon tube in the foam material should be placed in a reasonable position. Negative pressure suction should be continuous operated. Skin and local blood should be wiped. The wound should be carefully covered with permeable membrane [12]. In about 7 d, VSD needed to be opened to launch wound bacterial culture again according to patients' actual situation. According to the result of bacterial culture, tissue flap transplantation and free skin grafting needed to be carried out, and the antibiotic bone cement beads, bone cement mass and VSD should be reasonably replaced. Wound Healing. Corresponding wound healing measures should be carried out according to patients' lesion location and their actual situation. These measures included free flap, sural nerve flap and cross leg flap, gastrocnemius or lateral head myocutaneous flap. After removing VSD, if patients presented good granulation growth and minor skin defects, then a stamp graft repair procedure can be implemented [13,14]. Skeletal reconstruction: routine examination of patients' blood routine, C-reactive protein and erythrocyte sedimentation rate should be carried out regularly. After acquiring the state of wound healing, if there was bone defect and non-union through X-ray examination, patients should be treated with measures such as retain or remove the external fixator combined with bone grafting and plate and screw fixation combined with bone grafting. Autogenous bone graft provision should strictly in accordance with patients' bone defect situation [15]. When a greater defect existed, homologous bone allograft can be considered.

Finally, it was the processing scheme after surgery. Routine examination, blood routine test, C-reactive protein and ESR should be carried out 1 w, 4 w, 8 w and 12 w after surgery. Clean dressing should be changed daily for all patients except for the VSD coverage cases. After the surgery, if patient's body temperature, blood routine did not have significant abnormalities, and no inflammation appeared around the wound or the location of the surgical wound, the stitches can be removed 15 to 21 d after the surgery [16]. Medical alcohol care of the fixed bone traction pinhole should be made every day to avoid needle infection. The affected limb, knee joint and ankle rehabilitation training can be carried out about one week after surgery, and patients can be assisted to do slow, non-weight-bearing walking.

Statistical analysis

Relevant data were analysed and processed by SPSS21.0 statistical software. The enumeration data were represented in the form of number and percentage, and examined by Chi-square test. Measurement data were expressed in the form of mean ± standard deviation and were examined by t test. $P<0.05$ suggests that the difference is statistically significant.

Results

Patients' overall treatment

Infection of patients in this study was controlled after treatment, skin graft survived, and no recurrence appeared. The number of cases of one stage wound closure, one stage wound healing and skin darkening and necrosis was six, fourteen and one respectively. After changing a medical prescription and Kangfuxin for local external use, all wound healed. There were 20 cases of skin flap transplantation, and 12 cases were treated with bone cutting and skin grafting. All the wound healing was satisfactory. The wound healing time ranged from 15 d to 160 d, with an average time of 32.8 ± 4.6 d. All patients were followed up for 6 months to 36 months, and the effect of bony union on the fracture ends was achieved. The average fracture healing time was 8.7 ± 2.6 months.

Comparison of patients' VAS and ADL scores before and after surgery

As shown in the table below, by comparing the VAS scores before and after the surgery, result showed that the VAS scores after surgery were significantly lower than those before surgery. By comparing the ADL scores before and after the surgery, result showed that advantage after surgery was superior to that before surgery (Table 1).

Table 1. *Comparison of patients' VAS and ADL scores before and after surgery.*

Time	The number of cases	VAS scores	ADL scores	t	P
One day before surgery	45	8	39.6 ± 7.5	-	-
One week after surgery	45	3	42.9 ± 15.3	0.314	0.769
Four weeks after surgery	45	3	68.8 ± 7.2	5.377	0.006
Eight weeks after surgery	45	2	76.9 ± 5.3	7.651	0.002
Twelve weeks after surgery	45	2	80.2 ± 6.6	7.703	0.002

Overall statistics of patients' satisfaction

As shown in Table 2 below, after the treatment of traumatic tibial osteomyelitis with antibiotic bone cement, patients had a favorable treatment effect. Overall treatment satisfaction was counted and a total satisfaction of 91.11% was achieved.

Table 2. *Overall statistics of patients' satisfaction (n (%)).*

The number of cases	Very satisfied	Satisfied	Not satisfied	Overall satisfaction
45	20	21	4	4191.11

Discussion

Chronic osteomyelitis had a longer course of disease. With the continuous deepening of the study, its main cause had changed from inappropriate treatment of acute hematogenous osteomyelitis and untimely and ineffective treatment to traumatic infection and spreading osteomyelitis. Traumatic osteomyelitis was one of the most important pathogenesis. It was common in the backbone of the long bones in young adults. *Staphylococcus aureus* and *Pseudomonas aeruginosa* were the main pathogenic bacteria [17].

Clinical studies showed that sensitive antibiotics treatment at an early stage could probably cure chronic osteomyelitis, however, some patients only took radical debridement, which was difficult to cure. Necrosis caused by bacteria remaining in the lesion area would affect the normal penetration of antibiotics, which was also an important factor that result in recurrence [18,19]. Therefore, the radical resection of the lesion was an important prerequisite for curing the disease. And by combining systemic or local antibiotics, the effect of treatment can be strengthened.

VSD closed negative pressure drainage could achieve better drainage for the wound, prevent the dead cavity problem, and effectively reduce the obstruction of the drainage tube. Continuous negative pressure drainage could obviously remove the necrotic tissue and exudate, reduce the time of bacteria attachment and absorb toxin so that another damage of the surface of wound could be avoided [20]. At the same time, it could promote the blood supply of the local wound and promote the good circulation. The biological membrane protection could prevent the wound from contacting with the external environment during the treatment, and then reduce the infection rate.

Antibiotic bone cements had many advantages during the treatment of bone and soft tissue infections. Firstly, it had a high concentration of local antibiotics, which was much higher than the total concentration obtained by systemic administration. Secondly, it had a slow release rate and could extend the duration, and the duration was 4 to 40 d. And the efficacy of the treatment would not be affected by local ischemic condition. Finally, it had relatively small toxicity and side effects. By local insertion of antibiotic bone cement, it could keep the local part in a good bactericidal environment and reduce the toxicity caused by systemic antibiotics. However, the problem that could not be ignored was that bone cement belonged to non-biodegradable material; it would become a foreign body after releasing drug. If it continued to

exist in body, it may have a bearing on fracture healing, so it should be removed in the two stages.

Conclusion

To sum up, the measures such as the application of vacuum sealing drainage in one stage complete focus clearance and the insertion of vancomycin bone cement in the local parts or the medullary cavity, and the two-stage flap transplantation or stamp skin grafting technique for wound closure combined with systemic sensitive antibiotics have significant treatment effect in treating traumatic osteomyelitis. This method can promote wound healing and has high safety and reliability; therefore, it is worthwhile to popularize this treatment method in clinical practice.

References

1. Liu G. Treatment of traumatic tibial osteomyelitis with antibiotic bone cement combined with antibiotics in external fixture. J Traum Surg 2017; 11: 226-227.
2. Wang S, Shi Y, Zhang L, Yang Y.Discuusion of clinical efficacy of antibiotic composite calcium sulfate artificial bone in treatment of traumatic tibial osteomyelitis. J Transl Med 2016; 24: 22-23.
3. Bian J. Surgical treatment of 79 cases of distal femoral trauma complicated with chronic osteomyelitis. Chinese Gene Med 2016; 12: 1783-1785.
4. Zhang J, Ye S, Wu J. Clinical evaluation of closed negative pressure drainage combined with antibiotic cement cement beads in the treatment of traumatic tibial osteomyelitis. Heilongjiang Med J 2016; 20: 720-722.
5. Abdel MS. Design and synthesis of some substituted thiazolo-(3, 2-a)-pyrimidine derivatives of potential biological activities. Saudi Pharm J 2016; 24: 119-132.
6. Zhu Y, Zhang D, Zhao G, Qi W, Sun Q, Zou J, Yang Y. Antibiotic bone cement combined with autogenous bone graft and ring external fixator for the repair of osteomyelitis after tibial defect. Chinese Tissue Eng Study 2015; 11: 3942-3946.
7. Chen W. Clinical observation on treatment of traumatic osteomyelitis with antibiotic bone cement beads with Tori disinfectant. Fujian Univ Trad Chinese Med 2015.
8. Zhang X, Chen Y, Long F, Kang J, Dong P, Rao Y, Yuan Z. Clinical analysis of antibiotic bone cement in treatment of traumatic tibial osteomyelitis. Chinese J Bone Joint Inj 2015; 22: 371-373.
9. Wroblewska K. Characterization of new eye drops with choline salicylate and assessment of their irritancy by in vitro short time exposure tests. Saudi Pharm J 2015; 23: 407-412.
10. Hazra M, Dasgupta Mandal D, Mandal T, Bhuniya S, Ghosh M. Designing polymeric microparticulate drug delivery system for hydrophobic drug quercetin. Saudi Pharm J 2015; 23: 429-436.
11. Wang F. Comparative analysis of the rate of antibiotic elution and antimicrobial efficacy of intramedullary nailing of different antibiotics. Hebei Med Univ 2015.
12. Wang L, Ha B, Zhao W, Yuan H, Zhao X. Clinical analysis of multiple antibiotic cement exclusion in the treatment of severe infection after knee replacement. Beijing Med 2015; 11: 23-25.
13. Yu S, Fu J, Li W, Huang K, Huang Q, Xie Z. Clinical analysis of Masquelet technique for treatment of osteomyelitis and bone defect of long bone. J Third Milit Med Univ 2014; 20: 1630-1634.
14. Yu S. Comparison of Masquelet technique with stage I bone transplantation for treatment of posttraumatic osteomyelitis of lower limb. Third Milit Med Univ 2014.
15. Ofori-Kwakye K. Development and evaluation of natural gum-based extended release matrix tablets of two model drugs of different water solubility by direct compression. Saudi Pharm J 2016; 24: 82-91.
16. Sun Z. Observation of the effect of using antibiotic bone cement in the treatment of infectious bone defect. Chinese Med Econom 2012; 14: 143-144.
17. Zhong Z. Clinical study of calcium sulfate loaded with antibiotics for treatment of posttraumatic osteomyelitis in children. Bone Science Society of Zhejiang Medical Association. Proc AcadAnn Meet Zhejiang Depart Orthop 2012.
18. Lu W. Clinical and biomechanical study of bone cement polyethylene lining technology. Southern Med Univ 2012.
19. Tang B. Clinical observation of antibiotic bone cement (PMMA) in the treatment of infectious bone defect. Jilin Univ 2010.
20. Attari Z. Enhanced ex vivo intestinal absorption of olmesartan medoxomil nanosuspension: preparation by combinative technology. Saudi Pharm J 2016; 24: 57-63.

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