Application of antibiotic impregnated beads on the patients with tibial chronic osteomyelitis

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Abstract: To investigate the clinical efficacy of antibiotic impregnated beads on the tibial chronic osteomyelitis, so as to search for a more applicable method for the treatment. Through comparative analysis, we divided 72 patients with chronic tibial osteomyelitis who received treatment in hospital between January 2016 and December 2016 randomly into two groups: Control group (n=36) and the experiment group (n=36). Patients in the control group underwent closed lavage plus drainage for treatment, while those in the experiment group received the antibiotic impregnated beads. After treatment, we compared the times of treatment, average length of stay in hospital and the efficacy between two groups, and data were analyzed using SPSS 15.0 software. In the control group, average length of stay in hospital was ((3.3±0.9) months, average time of surgery was (2.9±1.8) times, cure rate was 25.0% and elimination rate of bacteria was 88.0%; in the experiment group, average length of stay in hospital was ((2.2±1.3) months, average time of surgery was (2.4±1.0) times, cure rate was 47.2%, and elimination rate of bacteria was 93.8%. Differences in the average length of stay in hospital, the cure rate and elimination rate of bacteria between two groups showed statistical significance ($p<0.05$). For tibial chronic osteomyelitis, antibiotic impregnated bead implantation can reduce the chance of secondary infection after operation and shorten the hospitalization time, showing a more promising effect than the closed lavage and drainage, and this method is worthy of being promoted in clinical practice.

Keywords: Antibiotic impregnated bead, tibia, chronic tibial osteomyelitis, efficacy.

INTRODUCTION

Osteomyelitis, a kind of the most ancient diseases, develops from the acute myelitis (Patzakis *et al*., 2003). With the continuous development in modern medical technology and the wide use of antibiotics, vascular osteomyelitis has a decline in incidence rate with an obvious increase in clinical cure rate (Blachut *et al*., 2007; Lerner *et al*., 2003). However, the development of traffic and construction also contributes to a gradual increase in the fracture caused by high-energy injuries, particularly the open fracture. Clinically, treatment for open fracture always involves the internal fixation, but a problem that needs to be resolved is the osteomyelitis caused by internal fixation, and most patients have evolved into the chronic osteomyelitis. Based on the work experience, tibial chronic osteomyelitis, the most frequent type in clinical practice, results in a slow recovery of fracture for the anatomic feature of tibia, thereby leading to a sustained high level of incidence rate (Patzakis *et al*., 2004; McGrory *et al*., 2009). Due to the obstruction in blood flow at the site of osteomyelitis and necrosis of focal tissues, general application of antibiotics usually gains poor efficacy and local administration can only obtain the promising outcome (Gross *et al*., 2002). In this study, we analyzed and compared 72 cases of tibial chronic osteomyelitis who were admitted to this hospital for treatment between January 2016 and December 2016 and divided them into the antibiotic impregnated bead group and the close lavage and drainage group, so as to compare the efficacy between these two methods to clarify the best method for treatment of tibial chronic osteomyelitis. Detailed information is reported as follows.

MATERIALS AND METHODS

Clinical data

Retrospective analysis was carried out among 72 patients of tibial chronic osteomyelitis who received treatment in this hospital between January 2016 and December 2016, and through comparative analysis, these patients were divided into two groups, i.e. the control group and the experiment group with 36 in each group. In the experiment group, there were 20 males and 16 females aged between 12 and 58 years old with an average of (22.1±6.8) years old; there were 25 patients aged within 18 years old with disease course ranged from 2 months to 6 years with an average of (10.2±3.1) months; according to the site of fracture, there were 8 patients with fractures of upper 1/3 tibia, 15 with fractures of middle 1/3 tibia and 13 with fractures of lower 1/3 tibia. In the control group, there were 20 males and 16 females aged between 12 and 56 years old with an average of (23.1±5.7) years old; there were 26 patients aged within 18 years old with disease course ranged from 2 months to 6 years with an average of (9.9±3.3) months; according to the site of fracture, there were 8 patients with fractures of upper 1/3 tibia, 16 with fractures of middle 1/3 tibia and 12 with fractures of lower 1/3 tibia. Patients above had been confirmed with local infection at the site of tibial fracture

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and the presence of sequestrum or osteosclerosis, and the trauma area ranged between 55.1×8.0 cm^2 and 11.0×16.5 cm^2. Particularly, in some patients, diseases had progressed into the cavernous bone defect. Comparison of the clinical data between two groups showed no statistical significance, suggesting that the data were comparable (table 1).

Treatment

Control group

(1) Firstly, remove the necrotic and infected tissues surrounding the lesions and shorten the affected tibia, followed by lavage and drainage;
(2) After treatment, intravenous injection of broad-spectrum antibiotics is performed with the auxiliary treatment, and after the laboratory report of bacteria culture, antibiotics that are sensitive to patients are given for individual treatment;
(3) Gentamicin dissolved in normal saline is used for local rinsing every day.

Experiment group

(1) Following debridement, antibiotic impregnated bead consisting of the gentamicin, bone cement and antibiotics, is implanted into the affected site;
(2) According to the drug sensitivity examination, dose of patient is evaluated, and beads are totally placed inside the trauma;
(3) After wound bleeding is stopped, a drainage tube is inserted inside the trauma for drain, and wound is closed layer by layer;
(4) Without any negative or positive pressure on drainage tube, removed the tube at 2 or 3 days after surgery, followed by intravenous injection of antibiotics.

Ethical approval

This protocol had been approved by the Ethic Committee of the Third People's Hospital of Qingdao and all subjects had agreed to participate in the study.

STATISTICAL ANALYSIS

SPSS 15.0 software was applied in analysis of data. Measurement data were presented as mean ± standard deviation ($\bar{x} \pm s$), and t test was adopted for intergroup comparison. In term of ratios, enumeration data were compared with chi-square test. $p<0.05$ suggested that the difference had statistical significance.

RESULTS

Length of stay in hospital and surgery times of patients

No statistical significance was identified in difference of the surgery times between two groups, while the comparison of length of stay in hospital between two groups showed statistically significant difference ($t=4.3145$, $p<0.05$; table 2).

Comparison of the cure rate between two groups

In the control group, the total cure rate of patients was 25.0%, while this in the experiment group was 47.2% (table 3).

Comparison of the elimination rate of bacteria between two groups

In the experiment group, the elimination rate was higher than that in the control group and the difference had statistical significance ($p<0.05$; table 4).

DISCUSSION

Continuous development in traffic gives rise to a sustained high accident rate, which also increases the incidence rate of fractures. Among the fractures, tibial chronic osteomyelitis is mainly caused by the bacterial infection secondary to the open fracture (Kaim *et al*., 2000 and 2007). Osteomyelitis usually manifest the inflammation, mainly concomitant with redness, swelling, warmth or pains and in some cases, patients may experience secondary suppuration. With similar symptoms, tibial chronic osteomyelitis differs in the rate of onset, which might attribute to the latency or the recurrence of pre-existed osteomyelitis. Pathogens that induce osteomyelitis are sensitive to a variety of broad-spectrum antibiotics, which makes them the preferred choice in treatment; however, obstruction in blood flow and necrosis of the affected site contribute to the poor outcome of general antibiotic treatment; thus, only focal administration of antibiotics can gain promising effect (Swiontkowski *et al*., 2009). In this study, through comparative analysis, we divided 72 patients with chronic tibial osteomyelitis who received treatment in this hospital between January 2016 and December 2016 randomly into two groups to investigate the clinical efficacy of antibiotic impregnated beads on the tibial chronic osteomyelitis, so as to search for a more applicable method for the treatment.

Results of this study showed that in the control group, cure rate was 58.3%, elimination rate of bacteria was 88.0%, average length of stay in hospital was ((3.3±0.9) months, and average time of surgery was (2.9±1.8) times; in the experiment group, cure rate was 86.1%, elimination rate of bacteria was 93.8%, average length of stay in hospital was ((2.2±1.3) months, and average time of surgery was (2.4±1.0) times. Differences in the average length of stay in hospital and the total cure rate between two groups showed statistical significance ($p<0.05$). Thus, the disadvantages of closed lavage and drainage include: (1) Long-term placement of drain tube may easily induce the obstruction, and the long-term lavage and drainage gains the incidence rate of recurrence and infection of patients; (2) Closed lavage can hardly rinse the sequestrum totally, resulting in the growth of bacteria inside the sequestrum; (3) Channel between the in-vivo and *in-vitro* environment established by drainage also gives rise to the secondary infection of patient; (4) Patients may also induce new complications, leading to the infection and in such cases, tubes should be removed, which prolongs the course of treatment and affects the prognosis (Patzakis *et al*., 2000; Holtom *et al*., 2008; McKee *et al*., 2002; Friedlaender *et al*., 2001). In the experiment group, we find that antibiotic impregnated beads have the following advantages: (1) Wounds are sutured directly after surgery, which can reduce the incidence rate of secondary infection; (2) beads, like the bone cement, can block the dead cavity of affected site, reducing the incidence rate of invasion of other pathogens into the dead cavity, and the infection; (3) Shorter length of stay in hospital makes postoperative nursing work more convenient; (4) Implantation of antibiotic impregnated beads can cover all affected sites, so as to increase the elimination rate of pathogens (Marsh *et al*., 2004; Cierny III *et al*., 2004; Siegel *et al*., 2000) .

CONCLUSION

Tibial chronic osteomyelitis, antibiotic impregnated bead implantation can reduce the chance of secondary infection after operation and shorten the hospitalization time, showing a more promising effect than the closed lavage and drainage, and this method is worthy of being promoted in clinical practice.

Table 1: Clinical data of patients

Item	Experiment group (n=36)	Control group (n=36)
Gender (n)		
Male	20	20
Female	16	16
Average of age (years)	22.1±6.8	23.1±5.7
Average of disease course (month)	10.2±3.1	9.9±3.3
Site of fracture		
Upper 1/3 of tibia	8	8
Middle 1/3 of tibia	15	16
Lower 1/3 of tibia	13	12

Table 2: Length of stay in hospital and surgery time between two groups

Item	Experiment group	Control group	t value	p value
Length of stay in hospital (month)	2.2±1.3	3.3±0.9	4.3145	<0.01
Surgery times (time)	2.4±1.0	2.9±1.8	1.2884	>0.05

Table 3: Comparison of the effective rate after treatment between two groups

Item	Control group (n=36)		Experiment group (n=36)	
	N	%	N	%
Effective	3	8.3	5	13.9
Excellence	9	25	9	25
Cure	9	25	17	47.2
Failure	15	41.7	5	13.9
Total Effective	21	58.3	31	86.1*

Note: * $\chi^2 = 6.3874$, p<0.05 vs. control group

Table 4: Comparison of the elimination rate of bacteria between two groups (%)

Pathogenic bacteria	Experiment group (n=36)			Control group (n=36)		
	Detection	Elimination	Elimination rate	Detection	Elimination	Elimination rate
Klebsiella	13	13	100	9	8	88.9
Staphylococcus aureus	13	12	92.3	12	10	83.3
Escherichia coli	12	11	91.6	17	15	88.2
Streptococcus pneumoniae	6	5	83.3	8	7	87.5
Other	4	4	100	4	4	100
Total	48	45	93.8	50	44	88

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