CASE SERIES

Clinical analysis of application of antibiotic bone cement spacer combined with membrane induction technology in treatment of osteomyelitis after femoral intramedullary nail operation — A case series

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Abstract

Clinical analysis of antibiotic bone cement spacer combined with membrane induction technology in the treatment of osteomyelitis after intramedullary nail fixation operation for femoral shaft fracture was retrospectively performed on 12 cases in Department of Orthopaedics Centre, Renmin Hospital, Hubei University of Medicine from February 2013 to November 2016. The healing time of bone defect, infection recurrence and other complications were observed. Membrane induced series treatment scheme was given to all patients. Membrane-induced sequence therapy consisted of the first stage which included complete debridement, removal of the original internal fixation of intramedullary nail, intraoperative preparation of antibiotic bone cement rod into the medullary cavity and full drainage. The second stage included replacement of the interlocking intramedullary nail after infection control and autologous iliac bone graft was then used at the bone defect. Follow-up visits for bone situations were conducted for all the cases and the duration was 12-35 min (25.75 min on average). Fractures of all patients healed clinically. The healing duration was 4-11 min (7.33 min on average).After treatment, patients had no significant shortening of the limbs and their gait was normal at 12 months follow-up. This study is of femoral shaft fracture with no involvement of the joints and range of movement was not measured. No apparent relevant complications were seen.

Keywords: Infection, Fracture, Osteomyelitis, Bone cement.

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Introduction

In recent years, with the extensive application of intramedullary fixation, osteomyelitis occurs occasionally after femoral intramedullary nail operation.[1] Compared with traditional treatment methods, antibiotic bone cement spacer has obvious advantages in treatment of osteomyelitis caused by infected intramedullary nail. The appropriate diameter can be chosen according to the size of the medullary space. In this way, the fracture end can be stabilized and it is convenient to remove the intramedullary nail. Meanwhile, the dead space can be thoroughly wiped out and high-concentration antibiotic can be locally applied. From February 2013 to November 2016, our department carried out this method to treat 12 patients who were infected following intramedullary nail operation and satisfying results were obtained.

Case Report

There were 8 male and 4 female patients, with the age group of 28-63 years and on average 44.75±2.73 years. Initial injury causes included 7 cases of road traffic accidents, 2 cases due to a fall from a height and 3 due to crashing objects. All cases were treated with intramedullary nail fixation. Chronic infection duration

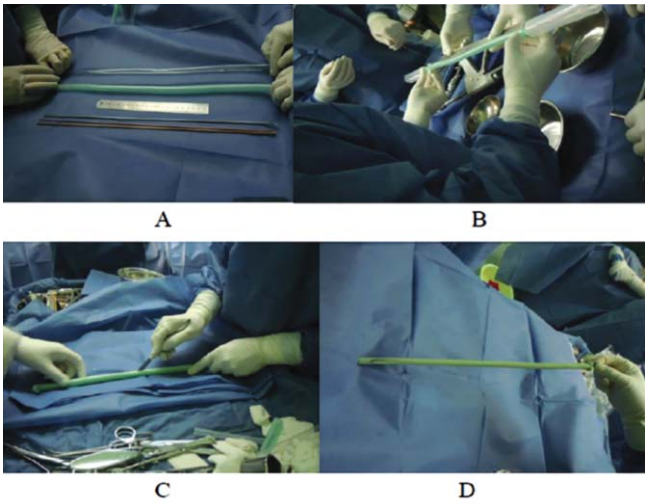

Figure-1: Medical rubber tube whose diameter was similar to original intramedullary nail and whose length was same with original intramedullary nail was chosen. 1 elastic nail (A) was taken. After 40gm bone cement powder was mixed evenly with 4g vancomycin, the bone cement thruster was used to inject the mixed bone cement in the rubber tube, and the elastic nail (B) was imbedded in the silicone tube. When bone cement started solidification, the rubber tube (C) was split. For the convenience of taking out, the far end of elastic nail was imbedded in the medullary space (D) after it was bent.

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Table-1: Twelve cases of osteomyelitis patients.

Patient number	Sex/ Age (years)	The first time Fixation	Defect size (cm)	Microbiology	Anti-infection spacer	Bone union (month)	Follow-up (month)	Return to work
1	M/39	Plate and screw	4.5?cm	MRSA	Vancomycin	6.5	24	Yes
2	F/41	Plate and screw	3.5?cm	Staph	Vancomycin	6.0	16	Yes
3	M/47	Plate and screw	3.0cm	MRSA	Vancomycin	7.5	19	Yes
4	M/43	Nail	2.5cm	Streptococcus	Vancomycin	7.0	24	Yes
5	M/57	Plate and screw	4.5cm	Enterobacter	Gentamycin	11.0	22	Yes
6	F/53	Nail	4.0cm	Staph+ Enterobacter	Gentamycin + vancomycin	8.5	12	Yes
7	M/37	Nail	3.5cm	Streptococcus	Vancomycin	4.0	31	Yes
8	M/29	Plate and screw	3.5cm	MRSA	Vancomycin	7.0	34	Yes
9	F/63	Plate and screw	4.5cm	MRSA	Vancomycin	7.5	35	Yes
10	M/44	Nail	3.0cm	Staph	Vancomycin	6.0	29	Yes
11	F/56	Plate and screw	4.5cm	MRSA	Vancomycin	9.0	30	Yes
12	M/28	Nail	4.0cm	Staph	Vancomycin	8.0	33	Yes
X±s			3.68±0.68			7.33±1.75	25.75±7.46	

MRSA: Methicillin-resistant Staph. Aureus.

Figure-2: Male patient, 37 years old, fracture of left femoral shaft due to traffic accident; X-ray films (A, B) were re-examined 1m after the operation. Porosis could be seen in quantity locally 3m after the operation (C, D). After a half year, the follow-up visit showed fracture was healed smoothly, and internal fixation was changed (E, F).

was 4 -14 min and the average duration was 7.6±3.07 min. Twelve cases received follow-up visits and the duration of follow-up visit was 12 - 35 min (25.75 min on average). The healing time was 4 - 11 min (7.33 min on average), details of 12 patients are shown in Table-1. Sinus tract relapse or new formation of sinus tract did not appear for most of the cases (Figure-1 and Figure-2 show typical cases).

The original internal fixator was taken out and the medullary space enlarging tool was used to enlarge the space to 1mm larger than the original intramedullary nail. The infected and necrotic tissues as well as the suspicious infected tissues were removed thoroughly. Complete debridement was performed in the affected area including the bone defect lesion and within 1cm of the edge. After 40gm of bone cement powder (PALACOS®) was mixed evenly with 4gm of Vancomycin (for cases infected with klebsiella pneumoniae, 1.6gm of Gentamicin was added), the monomer was added. The bone cement thruster was used to inject the mixed bone cement in the silicone tube with the appropriate diameter. The elastic nail was imbedded in the middle of a rubber hose. After the wound was washed again, operation zone was closed. After debridement, the wound was sutured as far as possible. For un-sutured wounds, (vacuum sealing drainage, VSD) is a new method for treating various complex wounds and deep drainage. This method uses special dressings containing drainage tubes to fill the wounds and seal them with bio-semipermeable membrane to promote wound healing through controllable negative pressure. Negative pressure suction was used to protect it. The diseased limbs were protected with supporting tools, both were fixed by the external fixing frame. Bone grafting and internal fixation was conducted after 3 minutes of the first operation. Bacterial culture of the lesions was done to determine whether the infection has resolved or not. After the bone grafting strip was taken out from the anterior or posterior superior iliac spine, it was imbedded in place of the bone defect. After the intramedullary nail was fixed, locking of the bone was carried out for patients with unstable fracture end. Joint function training was started within 1 week after the bone grafting operation.

To make sure that the infective bone defect is cured, no general or local symptoms and signs should remain, sinus tract should heal without ulceration and X-ray films will

promote no sequestrum formation with the bone having good continuity and integrity. However, relapse is indicative of occurrence of previous signs and symptoms, sinus tract and secreta formation in the diseased limbs and X-ray films promoting unhealed bone with absorbed bone graft.

Discussion

Infection after intramedullary nail fixation of the femoral shaft fracture is a very severe complication. According to relevant literatures, the probability of infection after intramedullary nail fixation is 1%.[2] Treatment principle is inclusive of thorough debridement, dead space filling, maintaining sufficient drainage, stabilizing the fracture end and applying sufficient sensitive antibiotics. Infection treatment of femoral shaft fracture after intramedullary nailing fixation often faces a series of clinical problems, such as wide infection range, difficulty in debridement, removal of intramedullary dead space, poor effect of local antibiotics, fixation in the late stage of fracture and long time for bone defect repair. There are diversified treatment methods but there is no effective treatment scheme. Caesar et al.[3] applied closed double-cavity drainage system for continuous lavage to treat osteomyelitis and the cure rate reached 85.3%. However, liquid leakage, blockage and nosocomial infection may easily occur following this method. Although these methods have become effective but some problems still exist, such as long treatment cycles, multiple operations, instability of broken end, inability to eliminate dead space, easy infection and relapse. Patzakis et al's.[4] research on 26% of osteomyelitis patients with positive bacterial culture in the first debridement showed lingering presence of the bacteria in the secondary debridement as well. Tan et al.[5] reported cases of chronic osteomyelitis treatment by filling up the cavity with free skin flaps of latissimus dorsi muscle but contracture may easily occur after successful transplantation. Penn-Barwell et al.[6] controlled the spread of infection in the medullary space through debridement and embedding antibiotic bone cement beads after medullary space enlargement; this method has been proven effective. Hiroshi et al.[7] applied self-made antibiotic bone cement rod to clinically treat osteomyelitis infected after tibial intramedullary nail fixation which has been successful in achieving certain effects. However, there are just a few clinical reports about application of antibiotic bone cement rod in the intramedullary nail fixation after femoral shaft fracture.

Antibiotic bone cement rod is mainly applicable to treatment of infection after femoral intramedullary nail operation.[8] In this study, after the antibiotic bone cement rod was removed according to the standard treatment, infection and relapse did not occur. For the non-union and bone defect cases, bone grafting was conducted after the infection was controlled.

Conclusion

Antibiotic bone cement spacer is an effective method to treat osteomyelitis infected medullary space after intramedullary nail operation for femoral shaft fracture. It can control infection spread through occupying and eliminating dead space and locally releasing high-concentration antibiotic after debridement. Judging from the follow-up visits of the cases, the application of antibiotic bone cement rod is simple and it is an effective method to treat infection after intramedullary nail operation.

Ethical Approval: The study was approved by the Institutional Ethics Committee of our hospital and written informed consent was obtained from all participants.

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Conflicting of Interest: None to declare.

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