

RESEARCH ARTICLE

Liquid nitrogen for cryotherapy treatment for osteosarcoma of the middle femur: A case report

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Abstract

Background: Osteosarcoma is the most common primary malignant bone tumor in children and adolescents. Cryotherapy liquid nitrogen has been used as an adjuvant treatment for tumors for some decades.

Case presentation: A 23-year-old male patient was admitted to our hospital, mainly due to progressive pain in his left thigh, and confirmed osteosarcoma by local biopsy. A total length of 28 cm tumor bone was completely resected at the region of above and below lesion 3 cm under the guidance of MRI. After removed part of the tumor tissue, tumor bone was dealt with liquid nitrogen for 20 minutes. Finally, the bone was fixed with intramedullary needles for reconstruction. Three months after surgery, the X-ray examination showed poor bone growth at both distal sides of osteotomy and disuse degeneration of knee joint. The patient was performed an incision on the lateral side of the distal left thigh to secure the locking plate, and followed up every 3 months. Two years after operation, there was no sign of local recurrence.

Conclusion: Liquid nitrogen for cryotherapy may be a feasible local therapy for large lesion of osteosarcoma in middle femur.

KEYWORDS

bone tumor, cryotherapy liquid nitrogen, middle femur, osteosarcoma, reconstruction

1 | INTRODUCTION

Osteosarcoma is the most common primary malignant bone tumor in children and adolescents. Since the concept of neoadjuvant chemotherapy was firstly proposed in the 1980s, the 5-year survival rate of osteosarcoma patients has increased from less than 20% to more than 60%.¹ The implementation of neoadjuvant chemotherapy, including poly methyl methacrylate (PMMA), phenol, ethanol, or liquid nitrogen, could effectively reduce the local recurrence rate of osteosarcoma, which might provide a foundation for the development of various limb salvage operations.² Many clinical studies have shown that limb salvage offers greater benefits to patients than amputation.³⁻⁶ All kinds of limb salvage techniques have their own

advantages and disadvantages at present. In this study, one case of osteosarcoma extensively involving femoral disruption was treated by liquid nitrogen for cryotherapy, which achieved a good therapeutic effect.

2 | CASE PRESENTATION

A 23-year-old male patient was admitted to our hospital in the middle of April 2017, mainly due to progressive pain in left thigh. After admission, the patients had abnormal lesion on left distal femur by the X-ray examination (Figure 1A). Then, the local metabolism and lesion region bone were analyzed by scan and

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FIGURE 1 (A) The X-ray examination showed abnormal lesion on left distal femur at the onset of the patient; (B) The bone scan of the patient; (C-D) MRI showed the involvement range of lesion

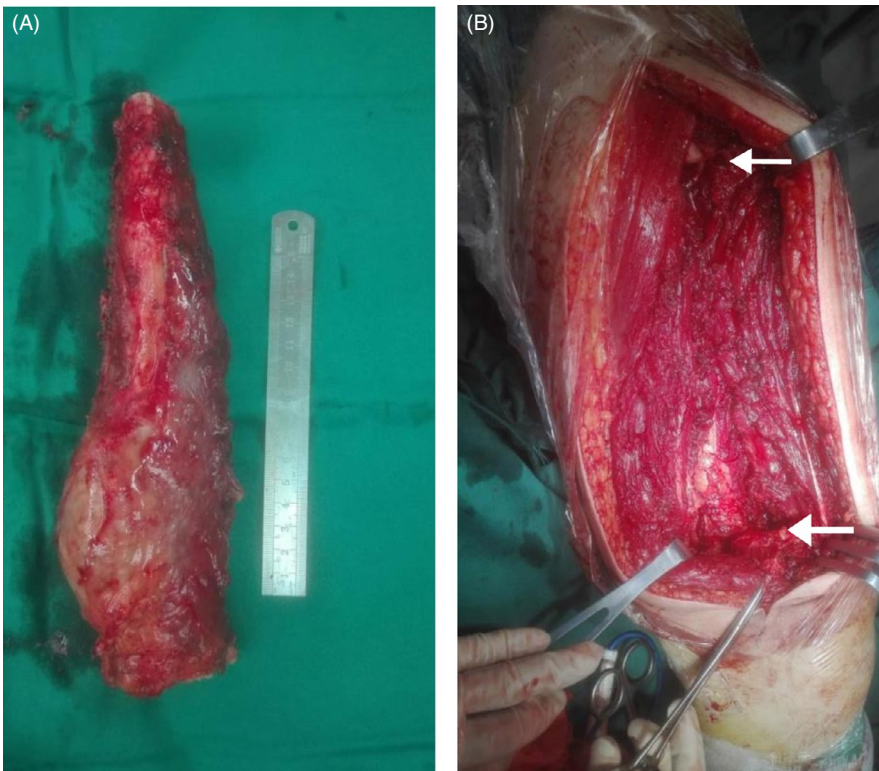


FIGURE 2 (A) The entire piece of removed tumor bone; (B) A rough outline after excision, the yellow arrows showed the top and bottom ends of the osteotomy

Magnetic Resonance Imaging (MRI) (Figure 1B-D). No abnormality was found in Computed Tomographic (CT) of lung. Finally, the patient was confirmed to osteosarcoma of the middle femur by local biopsy. Before surgery, patient was performed intra-arterial chemotherapy in left femoral via an implanted pump,⁷ 4 times with an interval of 3 weeks. After chemotherapy, the patient's

pain symptoms were obviously alleviated, and the reexamination of local ultrasound showed a significant decrease in tumor blood supply.

The patient underwent surgical treatment under general anesthesia in mid-July 2017. A small S-shaped incision was firstly made longitudinally on the anterior medial side of the left thigh. Then, a total length of 28 cm tumor bone was completely resected at

the region of above and below lesion 3 cm under the guidance of MRI following the principle of tumor-free operation (Figure 2A-B). Immediately, part of the tumor tissue was removed, the tumor bone was put in a double-layer sterile envelope. After removal of excess air, the envelope was put into a proper size of incubator, and poured into the liquid nitrogen to kill the tumor bone tissue for 20 minutes. Finally, after rewarming, the bone was fixed with an intramedullary needle (Figure 3A). Postoperative pathology confirmed there was no tumor cells in the medullary cavity of osteotomy. Postoperative chemotherapy was continued in accordance with the requirements of neoadjuvant chemotherapy after wound healing, and increased the interval step by step. Three months after surgery, the X-ray examination showed poor bone growth at both distal sides of osteotomy and disuse degeneration of knee joint (Figure 3B), and the patient felt slight discomfort and inability to carry out normal rehabilitation exercise, so limiting the function of the left knee joint, especially the

flexion. Therefore, the patient was performed an incision on the lateral side of the distal left thigh to secure the locking plate (Figure 3C), and followed up every 3 months by local X-ray and chest CT. The left lower limb was able to bear normal weight 4 months after the second operation, and the X-ray examination showed that the bone healed well (Figure 3D). Two years after operation, the patient had no sign of local recurrence and lung metastasis, with normal walking gait and 90° flexion of the left knee joint.

3 | DISCUSSION AND CONCLUSIONS

Neoadjuvant chemotherapy, especially preoperative chemotherapy, has been proved able to kill the small distant metastasis lesion, and effectively reduce the edema response of the surrounding tissue of the tumor mass, so as to shrink the tumor mass and form a false

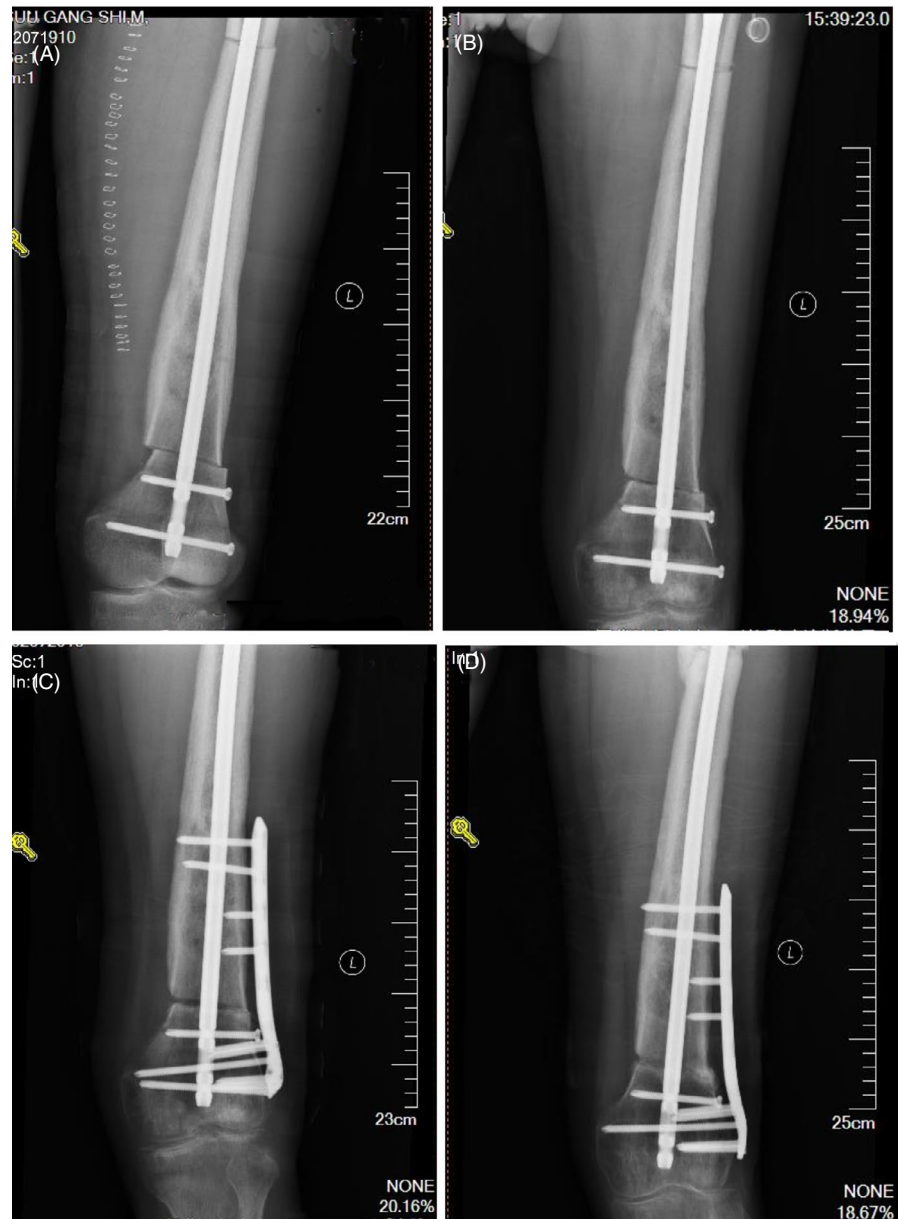


FIGURE 3 (A) The postoperative reexamination of X-ray examination; (B) X-ray reexamination of the patient nearly 3 months after the operation showed that the early functional exercise could not be done due to the distant micro-motion of the broken end, and the knee joint presented degenerative changes. (C) The locking plate was fixed again at the distal end; (D) Continuous callus formation was observed in both upper and lower osteotomies, and the knee joint improved with functional exercise

capsule to separate from the normal tissue, that is more conducive to surgical resection.⁸ Although, the effective implementation of neoadjuvant chemotherapy is the key part of limb salvage surgery, the surgical resection of primary tumor still also plays a vital role in the whole treatment process, especially the completeness of tumor resection has decisive effect for the prognosis of patients.⁹ Previous study has reported that there was no difference in survival rate limb between amputation and limb salvage surgery, while limb salvage surgery is still the mainstream surgery, due to it could avoid psychological impact caused by disability to patients.⁹

Limb salvage surgery includes artificial prosthesis and biological reconstruction. Among the artificial prosthesis reconstruction methods, tumorous type artificial total knee joint prosthetic replacement is unique, due to it can provide immediate stability, and make patients quickly recover and lower limb bear weight after surgery. However, it is accompanied complications, such as aseptic loosening, fracture around the prosthesis, prosthesis fracture, especially its own limited service life.¹⁰ Biological reconstruction, including autologous bone graft and bone tumor reconstruction, can provide better biomechanical conduction, similar support and activity function to normal bone after bone healing. Due to the mismatching and immune response, allogeneic bone is restricted to some extent in clinical application. Bone tumor reconstruction includes in situ reconstruction and in vitro reconstruction, the former includes intraoperative radiotherapy and microwave therapy, both have the risk of incompletely killing tumor and easily lead to infection due to long operative time in patients with larger lesion¹¹; the later includes boiling or high pressure steam inactivation, large dose radiation inactivation, alcohol inactivation, freezing inactivation, each has own disadvantages and advantages.⁴⁻⁶ While, in this case, the liquid ammonia freezing and inactivating was simple and accurate, which was considered to be a better way to treat tumor bone.¹²

This study noted the following points in specific clinical work: (a) Pay attention to preoperative chemotherapy, in which the artery perfusion injection chemotherapy could achieve better local control and provide guarantee for limb salvage.¹³ (b) Tumor-free operation is required in all limb salvage operations, the recurrence of tumor is not related to the method of bone reconstruction, but only to the nature of tumor and the surgical boundary. (c) Aseptic operation should be noted during the separation of bone tumor. (d) Strong internal fixation was needed. In this case firstly only used intramedullary needle, the patient could not early move due to the fretting of the distal part of bone tumor, resulting in a certain degree of damage to the knee joint function. Finally, the intramedullary needle plus steel plate achieved stability. (e) The anatomical location and size of the tumor also are important factors in determining the surgical approach. Artificial joint is still the best choice when most osteosarcoma is located in the metaphysis, especially in the metaphysis plate involvement and the operation inevitably destroys joint stability. (f) Early rehabilitation exercise plays a certain role in early weight-bearing for patients.

In general, the incidence of osteosarcoma in middle femur is low. There is no uniform standard for the selection of reconstruction

methods after bone tumor resection, different methods have their own advantages and disadvantages. Liquid nitrogen for cryotherapy may be a feasible local therapy for large lesion of osteosarcoma in middle femur.

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CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

CONSENT FOR PUBLICATION

Written informed consent was obtained from the patient for publication of this Case report and any accompanying images.

DATA AVAILBILTY STATEMENT

All relevant data and materials are included in the manuscript.

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