Journal of Orthopaedic Science xxx (2015) 1–4

Contents lists available at ScienceDirect

Journal of Orthopaedic Science

journal homepage: http://www.elsevier.com/locate/jos

Case report

Reconstruction using frozen tumour-bearing vertebra en bloc after total spondylectomy

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ARTICLE INFO

Article history:
Received 18 January 2015
Received in revised form
6 July 2015
Accepted 7 July 2015
Available online xxx

1. Introduction

An aneurysmal bone cyst (ABC) is a benign proliferative nonneoplastic lesion and accounts for 1.4% of all bone tumors. ABC can occur in any part of the bone, and approximately 20% of cases involve the spine. ABC of the spine typically presents in young patients in their second decade of life [1]. Subtotal excision of spinal lesions is associated with a high incidence of recurrence within 6–12 months. Therefore, complete surgical resection should be the goal of surgical intervention in ABC of the spine [2].

Total en bloc spondylectomy [3,4] is a surgical procedure designed to achieve complete resection of a malignant tumor with an adequate tumor margin and has been reported to decrease the local recurrence rate and prolong survival. In this procedure, a titanium mesh cage with an iliac autograft is generally used to provide mechanical stabilization for the spine after tumor resection.

In this report, we present a case of ABC at T11 in a patient who underwent total spondylectomy (piecemeal total excision of laminae and en bloc corpectomy) and reconstruction using frozen tumor-bearing vertebra en bloc in place of a titanium cage. Written informed consent for the surgery and the publication was obtained from this patient and family.

2. Case report

2.1. History and examination

A 16-year-old girl complained of the onset of low back pain 6 months before admission to our hospital and presented at our institution with a 3-month history of severe back pain. There was no history of trauma and admission, her neurological examination was normal. X-ray examination of the thoracic spine revealed osteolysis of the right T11 pedicle. Computed tomography (CT) demonstrated an expansile mass involving the T11 posterior vertebral body and the posterior elements on the right side. Magnetic resonance imaging (MRI) revealed that the mass was predominantly cystic in nature and demonstrated multiple loculi with fluid–fluid interfaces in the T11 vertebra and lamina (Fig. 1). A tissue sample was taken using a CT-guided needle biopsy technique with a histopathologic report of ABC.

2.2. Operative procedure

2.2.1. Tumor excision

We elected to perform a total spondylectomy (piecemeal total excision of laminae and en bloc corpectomy) using a single posterior approach. The patient underwent preoperative angiography and embolization 3 days prior to surgery to control intraoperative bleeding [4]. The bilateral segmental arteries at T10, T11, and T12 were embolized except for left T10 and right T12. A spinal branch (radiculomedullary artery) which supplied the anterior spinal artery was verified at left T10 segmental artery. The segmental artery of right T12 was too small to embolize.

Piecemeal total excision of the posterior element of T11 such as spinous process and lamina was performed after thorough dissection around the tumor with marginal margin. Soft tissue around biopsy tract was not excised since ABC is basically benign tumor. The nerve roots at the affected levels (bilateral T11 nerve roots and right T10 nerve root) were ligated and cut to allow for dissection around the vertebral body. Blunt dissection was performed bilaterally through the plane between the parietal pleura and the T11 vertebral body and the segmental arteries were carefully dissected off the vertebral body. Instrumented fixation was performed at two

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http://dx.doi.org/10.1016/j.jos.2015.07.001

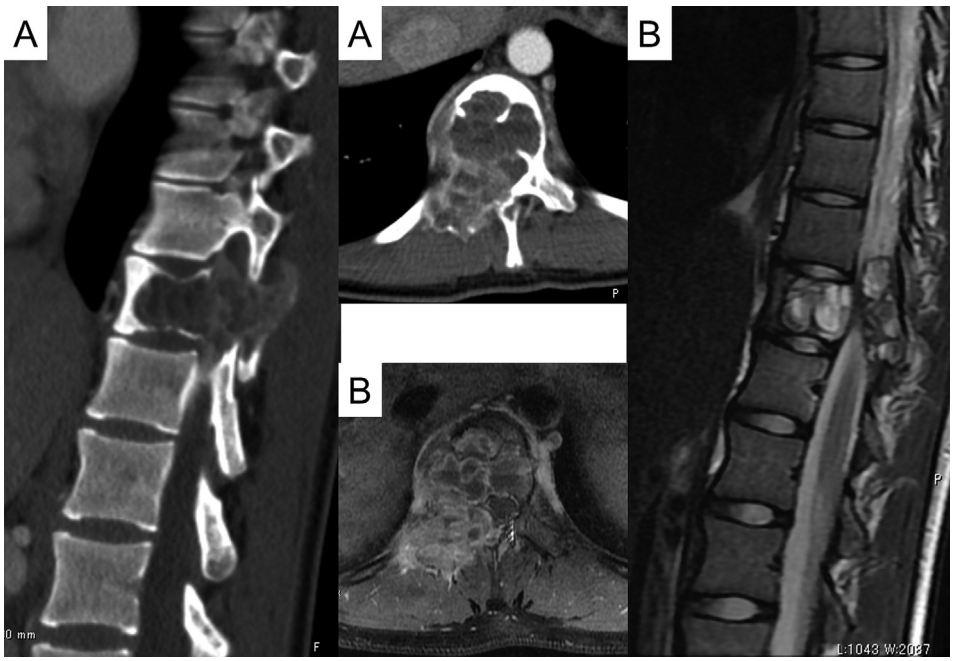

Fig. 1. Preoperative images of the T11 tumor, A: sagittal and axial views of contrast computed tomography, B: sagittal and axial views of T2-weighed magnetic resonance imaging.

levels above and two levels below the lesion and en bloc corpectomy of T11 was performed (Fig. 2A).

2.2.2. Freezing by liquid nitrogen

Curettage of the tumor from the excised tumor-bearing vertebra was performed. The ligaments and discs around the vertebra were also removed (Fig. 2B). The tumor-bearing vertebra was frozen in liquid nitrogen at −196 °C for 20 min and thawed at room temperature for 15 min (Fig. 2C). Anterior and lateral walls of this vertebra were intact. The tumor cavity of the thawed vertebra was filled with antibiotic-laden (imipenem 0.5 g) alpha-tricalcium phosphate (Fig. 2D). We used the antibiotics for a prophylactic purpose after the invasive and long surgery.

2.2.3. Reconstruction

The frozen en bloc T11 vertebra was then inserted back between the adjacent healthy vertebral bodies (T10 and T12). A small amount of autologous bone from the iliac crest was packed at the disc levels (T10/11 and T11/12) adjacent to the T11 vertebra. Slight spinal shortening was performed to attain compression for stabilization (Fig. 3). Total amount of bleeding was 710 ml. She received a transfusion of packed red blood cells (280 ml).

2.2.4. Postoperative course

The postoperative course was uneventful and the patient remained neurologically intact after surgery. Final diagnosis based on histological examination of the excised material was ABC. She had worn an orthosis for 6 months after the surgery. CT showed no tumor recurrence and bony union 12 months after surgery. The patient was pain free and no tumor recurrence was evident at 65 months after the surgery (Fig. 4A–C).

3. Discussion

Options for the treatment of ABC include intratumoral curettage, total resection, selective arterial embolization, radiation, and adjuvant therapy. Radiation should be avoided in the pediatric population because of the risk of radiation-induced sarcomatous change. Adjuvant therapies such as phenol and cryosurgery have been used in lesions not involving the spine; these therapies are not applicable in the spine because of the risk of dural tear, spinal cord injury, and major vessel injury. Intratumoral curettage alone has an approximately 19% recurrence rate, usually in the first 2 years [5]. In the spine, surgery for recurrence is very difficult and risky because of the adjacent major vessels, dura, and spinal cord. Primary complete total resection of tumor-bearing vertebra including the tumor shell and instrumentation is desirable to achieve long-term local control and structural stability. Therefore, total spondylectomy was performed in this case. However, total spondylectomy is one of the most sophisticated and demanding surgeries; it requires a high level of technical ability and experience.

A titanium mesh cylinder, which is filled with autologous bone graft from the iliac crest, is often used for anterior column reconstruction after corpectomy. Reconstruction using a frozen autograft vertebra en bloc is a novel surgical technique for the spine and to our knowledge, has never been previously reported. It is an effective operative procedure for a relatively large bone defect after spondylectomy, especially in pediatric patients, since it is difficult to obtain sufficient autograft quantities from the iliac crest in the pediatric age groups. Tsuchiya et al. reported successful clinical results in patients requiring limb surgery for malignant bone tumors, where they used autografts containing tumors treated with liquid nitrogen [6,7]. They suggested that a tumor-bearing autograft treated with liquid nitrogen was a simple, low-cost, ideal-fitting, and effective option for biological reconstruction. Moreover, frozen autograft has enough strength to bear mechanical stress [8]. In our case, to achieve ideal fitting of the tumor-bearing vertebra, we used a small amount of autologous bone graft from the iliac crest at the interface between the T11 vertebral body and the adjacent healthy vertebral bodies. Slight spinal shortening [9,10] enabled the optimal fitting and stabilized the tumor-bearing vertebra along with posterior instrumentation. For the tumor cavity of the T11 vertebra, alpha-tricalcium phosphate was used instead of bone cement (polymethylmethacrylate), since we expected bone remodeling in this young case.

Please cite this article in press as: Murakami H, et al., Reconstruction using frozen tumour-bearing vertebra en bloc after total spondylectomy, Journal of Orthopaedic Science (2015), http://dx.doi.org/10.1016/j.jos.2015.07.001