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CASE REPORT

Surgical treatment of a lumbar aneurysmal bone cyst using percutaneous endoscopic lumbar discectomy

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Abstract
Purpose Aneurysmal bone cysts of the lumbar spine are usually treated by curettage followed by bone or bioactive ceramics grafting. Here, we present the first case of an aneurysmal bone cyst of the lumbar spine treated by percutaneous endoscopic lumbar discectomy (PELD).
Methods We describe the clinical characteristics of the patient including the radiological and pathological findings of the tumor and the surgical technique used.
Results A 15-year-old boy presented with low back pain, and he was diagnosed with an aneurysmal bone cyst of the L3 vertebra based on radiological findings, including plain radiograph, computed tomography, and magnetic resonance imaging. The technique and equipment of PELD were used to perform curettage of the tumor cavity and fill it with hydroxyapatite granules. The skin incision was only 8 mm. The patient was discharged 1 day postoperatively and could walk without assistance. The postoperative course was uneventful and the symptoms improved following surgery.
Conclusion Endoscopic surgery via PELD can be a treatment option for ABCs of the lumbar spine.

Keywords Aneurysmal bone cyst · Spinal tumor · Percutaneous endoscopic lumbar discectomy · Lumbar spine

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Introduction

An aneurysmal bone cyst (ABC) is a benign tumor-like lesion that mainly affects the diaphysis and metaphysis of long bones in the first three decades of life. Traditionally, intralesional curettage followed by bone or bioactive ceramics grafting is the mainstay of treatment. ABCs occurring in the spine are rather rare compared to those occurring in the extremities. We report here a case of an adolescent patient with an ABC affecting the lumbar spine who was treated using an endoscopic technique that was less invasive than traditional surgery.

Case report

A 15-year-old boy presented with low back pain that began 1 year earlier and worsened with prolonged sitting. On clinical examination, no neurological deficits were noted and the straight leg raise test was positive on the right side. Plain radiographs showed an expanding, destructive lesion involving the lamina and unilateral pedicle and body of the third lumbar vertebra. Magnetic resonance imaging (MRI) demonstrated an expansible osteolytic lesion that appeared dark on the T1-weighted image and bright on the T2-weighted image, and extended into the pedicle and posterior part of the vertebral body. No extraskeletal mass was recognized. Computed tomography (CT) showed an expansible lesion with a thinning cortex and bony intralesional septations. Calcification and new bone formation were not observed (Fig. 1). Based on these findings, we diagnosed the lesion as a benign bone tumor or tumor-like lesion, such as an ABC or solitary bone cyst.

Biopsy and curettage were performed under general anesthesia using the technique and equipment of percutaneous

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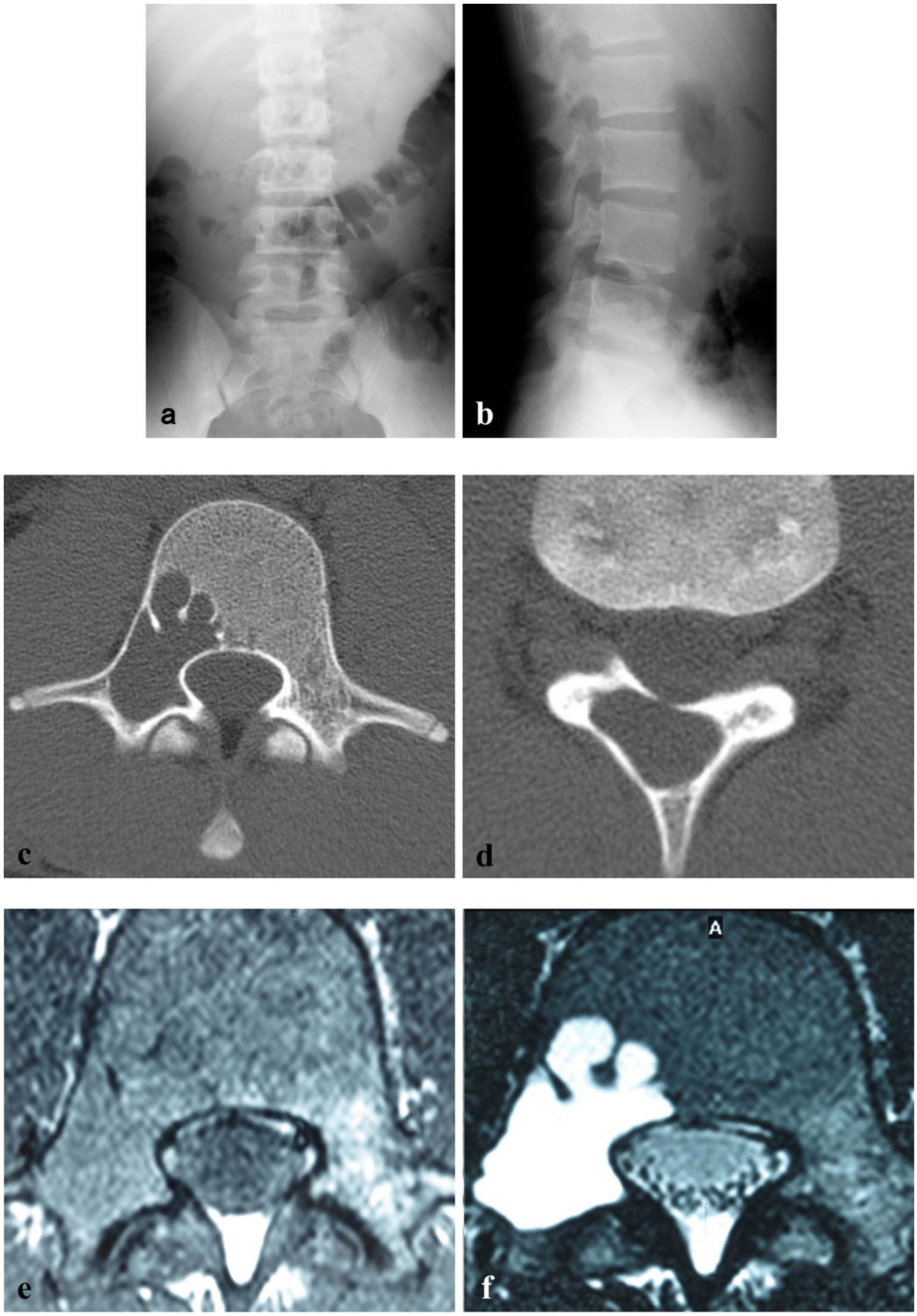

Fig. 1 Plain radiographs showing expanded vertebral arch in the third lumbar vertebra (**a**, **b**). Computed tomography images showing a cystic lesion extending from the vertebral arch to the body with a thin cortex and septum (**c**, **d**). Sagittal T1-weighted magnetic resonance images showing an isointense mass and T2-weighted image showing a hyperintense mass (**e**, **f**)

endoscopic lumbar discectomy (PELD). The surgical approach was created with the patient in the prone position under radiological guidance. An 8-mm skin incision was made at the right side on the level of the third lumbar vertebra. After the insertion of a cannula behind the vertebral arch, we created a hole at the most vulnerable site of the cystic lesion using an obturator and entered the lesion cavity (Fig. 2a). Fresh blood-like contents were aspirated from the cavity, measuring approximately 20 mL. The arthroscope was inserted through the same hole (Fig. 2b), and we then

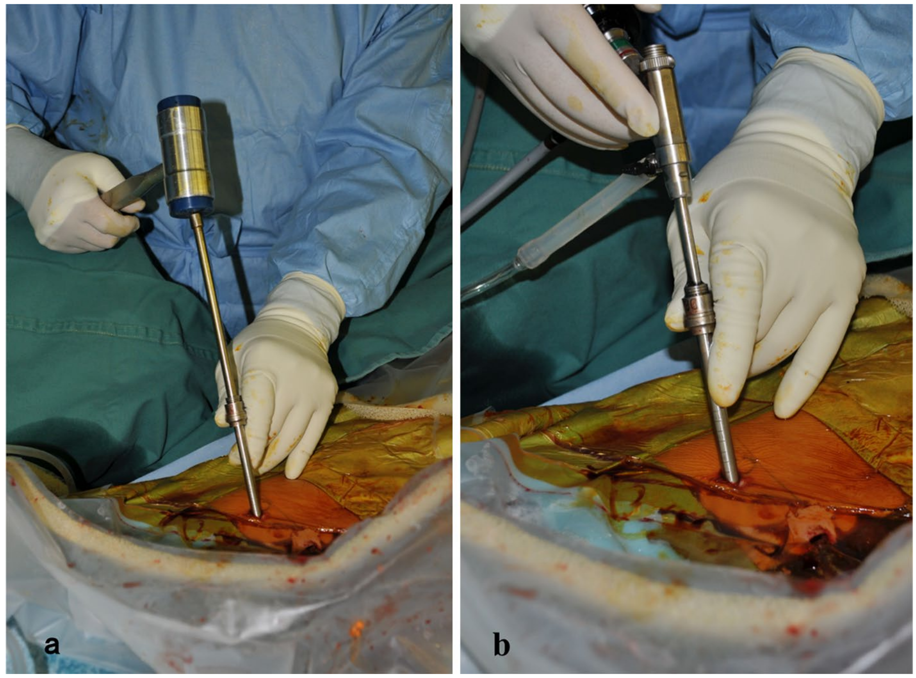

Fig. 2 Driving an obturator into the cavity (**a**). Insertion of the arthroscope through the cannula into the cavity (**b**)

observed the inner cavity. The resected surgical specimen was submitted for frozen section examination to confirm that it was not a malignant tumor. After curettage of the tissue on the lesion's inner walls (Fig. 3a), we considered that the one-way approach was difficult for performing adequate curettage, and we accordingly drilled another hole from another direction (Fig. 3b, c). After curettage of the whole wall surface, hydroxyapatite granules (20 g) were inserted into the cavity via a funnel-shaped tube through the cannula (Fig. 4a, b). Using an impactor, we packed the granule to the deepest part of the cavity. The outer diameter of the arthroscope used was 8 mm, with a working channel of 4.1 mm. We used a bipolar coagulator for hemostasis (Fig. 5). The operative time was 1 h 37 min, and blood loss during the operation was less than 10 mL.

Histopathological examination revealed that the blood component was dominated by neutrophil infiltration. Apparent tumor tissue containing multinucleated giant cells, characteristic of ABC, was not identified (Fig. 6).

The patient was discharged 1 day postoperatively and could walk unassisted. Although he experienced slight low back pain, which persisted with no change in severity at 5 months after surgery, the pain was relieved by 8 months after surgery. Pain assessment by Oswestry Disability Index improved from 14% preoperatively to 0% at 3 years after operation. There was no evidence of recurrence at the 3-year follow-up (Fig. 7).

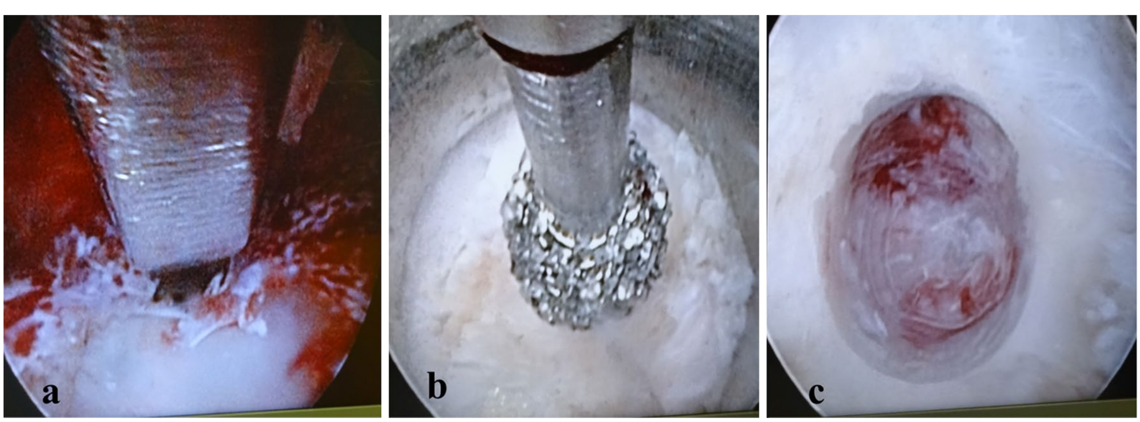

Fig. 3 Endoscopic view of curettage of the inner surface (**a**), drilling of the wall (**b**) and the drilled wall (**c**)

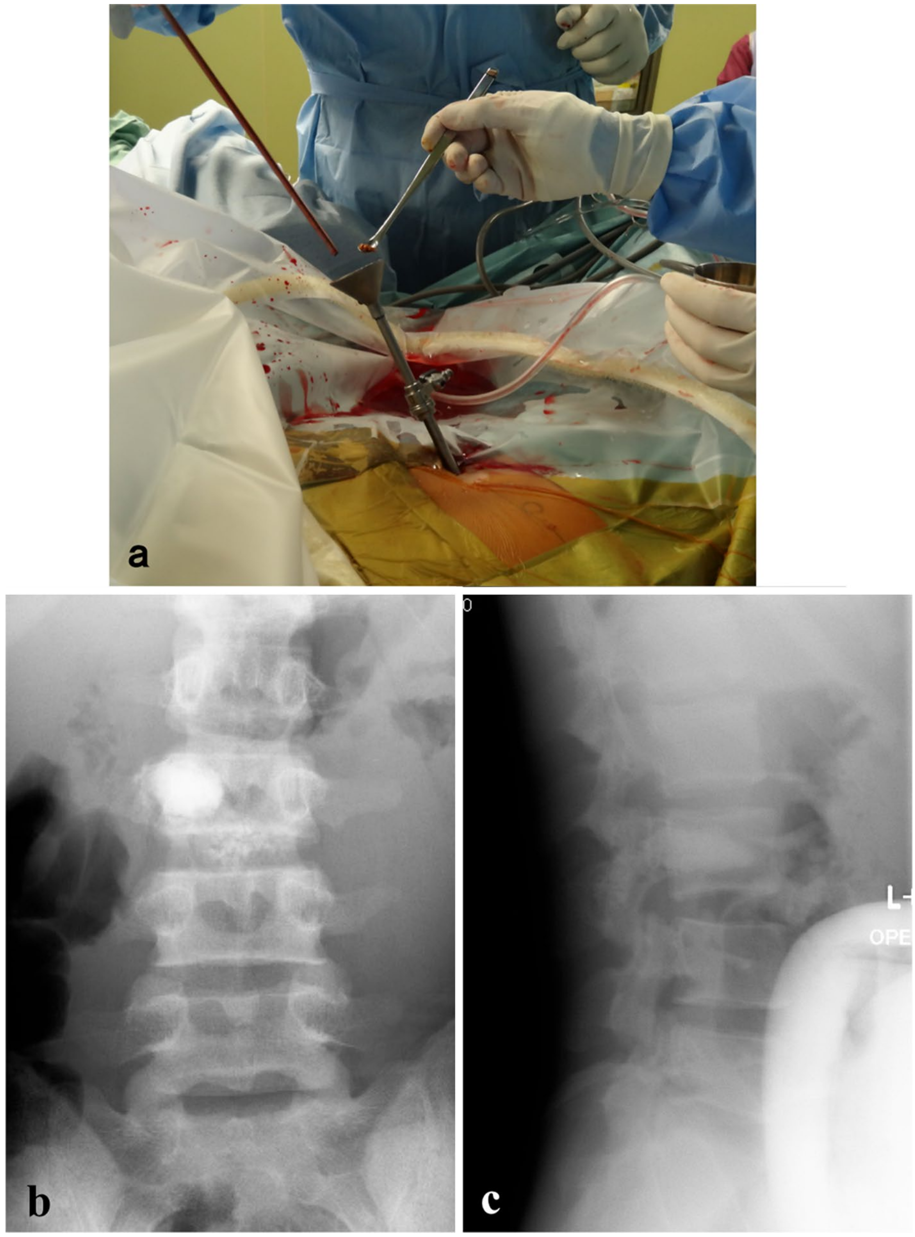

Fig. 4 Insertion of hydroxyapatite granules through the cannula (**a**). Plain radiographs after filling with hydroxyapatite (**b**, **c**)

Discussion

ABC is a non-neoplastic expansile bone lesion that most frequently affects the pelvic bone and metaphysis of long bones, such as the femur and tibia. It comprises approximately 2% of all bone tumors [1]. Approximately 20% of such cases involve the spine, and these lesions can occur in any part of the spinal column [2]. Radiologically, ABCs appear as radiolucent, expanding, “ballooned out” eccentric or central lesions that arise in the metaphysis or diaphysis of long bones. A ballooned-out cortex with an eggshell-thin rim along with intralesional septations is commonly noted. Grossly, the luminal surface shows a characteristic multilocular appearance covered with fibrous tissue, consisting of space filled with bloody fluid. Histological findings of fibrous connective tissue lining the wall of the cavity are characterized by the presence of proliferated spindle cells and osteoclast-like multinucleated cells, and occasionally small amount of osteoid [3]. The differential diagnoses of ABC include solitary bone cyst, giant cell tumor of the bone, osteoblastoma, hemangioma, and telangiectatic osteosarcoma. In the present case, neither the presence of spindle cells nor multinucleated giant cells, characteristic of ABC, could be confirmed on the histopathological examination. Although we diagnosed the lesion as ABC, based on the imaging findings, from the fresh bloody content aspirated from the lesion, and absence of fracture of the affected bone, we cannot

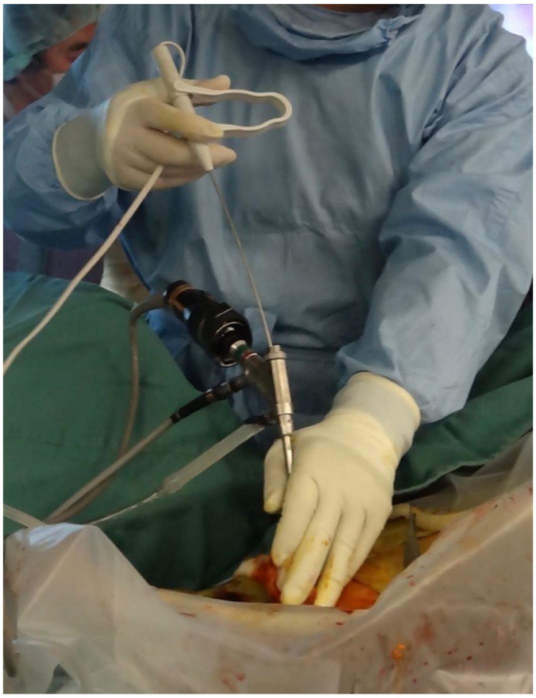

Fig. 5 Bipolar coagulator inserted through the same cannula for hemostasis

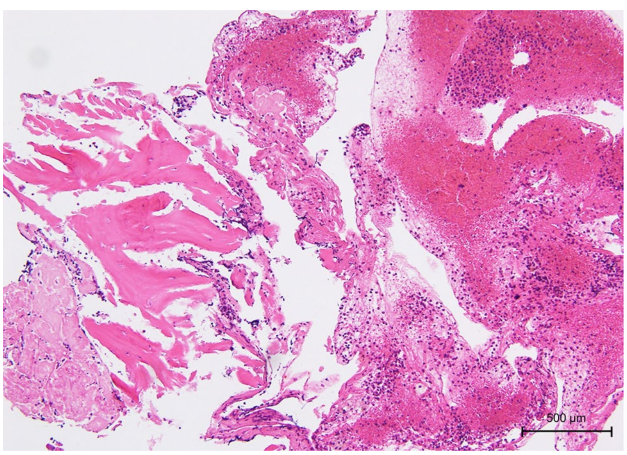

Fig. 6 Histopathological view showing blood component with neutrophil accumulation

definitively deny the possibility of the lesion being a solitary bone cyst. In this case, we performed curative surgery with intraoperative biopsy without preceding biopsy. Bhaker et al. reported that the diagnostic yield of intraoperative pathology in 39 cases of bone tumor, including 2 metastatic bone tumors, was 90.2% [4]. We surmise that the risk of intraoperative contamination of the surgical field would be minimal in a small-incision surgery like this case, even though it was possibly a malignant tumor.

Treatment options for ABCs include surgical therapy, such as curettage with or without filling the lesion cavity with bioactive ceramics or cement, complete excision, selective arterial embolization, radiation therapy, or a combination of these modalities. Radiation therapy involves the risk of radiation-induced sarcoma or post-radiation myelopathy [5]. Selective arterial embolization successfully treated an ABC of the spine in 17 out of 23 patients in a study by Terzi et al., clearly indicating this approach as a less-invasive, valid procedure [6], while embolization involves the danger of interruption of blood supply to the spinal cord in some parts of the spinal column, such as the thoracic spine [7]. Otherwise, Lange et al. reported the good treatment result of ABCs, clinically and radiologically, at cervical spine-treated denosumab [8]. Simple curettage and complete excision are the standard choices of surgical treatment. With respect to curettage, it is often difficult to visualize the lesion cavity because of continuous bleeding from the cavity surface, which prevents a clear operative field and hinders the performance of the operation [2]. Furthermore, local recurrence due to incomplete removal of the cavity lining is often a problem, and the recurrence rate after simple curettage has been reported to be 19% [3]. However, whereas total excision of tumor reduces the recurrence rate [9, 10], the structural instability arising from resection of the spinal column often requires spinal fusion [11, 12]. As a less-invasive operative procedure, Basu et al. reported that for ABCs arising from the thoracic or lumbar spine, favorable curettage could be performed using the hemostatic effect provided by the localized rise in temperature induced by polymethyl methacrylate, injected from the opposite side of the vertebral arch [13]. Further, Gaurnieri et al. reported that the percutaneous injection of osteoconductive cement can achieve good results in the treatment of lumbar ABCs [14]. Whereas endoscopic surgeries for the resection of bone tumors and tumor-like lesions in the extremities have been reported [15, 16], few reports have described endoscopic surgery for spinal tumors [17]. To our knowledge, this is the first report to describe the use of PELD for the treatment of an ABC of the spine.

PELD originated from percutaneous nucleotomy devised by Hijikta et al. in 1975. This technique offers a small skin incision and subsequent decompression under excellent visual control due to continuous irrigation of the surgical field, which eliminates the blood. As a result, the occurrence of approach-related morbidity, such as exiting nerve injury, has also decreased. While the disk can be usually dissected by three approach types, namely, the posterolateral, transforaminal, and intralaminar approaches, in the present case, we used the direct approach toward the affected vertebral arch.

As compared with the conventional procedure involving fenestration, curettage, and subsequent bone grafting, PELD offers the advantage of a clear visual field maintained by

Fig. 7 Computed tomography (**a**) and magnetic resonance imaging scan (**b**) at the 3-year follow-up demonstrating absence of local recurrence

continuous irrigation and hemostasis; thus, the operation can be performed without damaging the spinal structure followed by spinal fusion.

In comparison with microscopic surgery, which is often used for the surgical treatment of spinal lesions, PELD offers the advantages of a clear visual field, the possibility to aspirate tumor tissue using saline irrigation, and multidirectional visualization of the operative field, as opposed to microscopic surgery, which only provides a unidirectional operative field. In particular, PELD is favorable for detailed observation of intralesional septations in ABCs.

The disadvantages of PELD include the possibility of imperfect curettage, the relative difficulty of the technique, and its steep learning curve.

This case demonstrates that endoscopic surgery via PELD can be a treatment option for ABCs of the lumbar spine.

Compliance with ethical standards

Conflict of interest The authors declare that they have no conflicts of interest.

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Informed consent Informed consent was obtained from the patient and his family for the publication of this case.

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