Giant Cell Tumor Expanded Into the Thoracic Cavity With Spinal Involvement

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abstract

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This article describes a case of a giant cell tumor that expanded into the thoracic cavity and through the spinal canal into the vertebrae. A 36-year-old man presented with a 6-month history of back pain and dyspnea. Plain chest radiographs showed a huge mass accompanied by right pleural effusion. The mass involved the 12th thoracic spine, and the spinal cord was severely compressed. The tumor was resected with a 2-stage procedure. As a first stage to separate the tumor from the anterior vital structures under direct vision, thoracic surgeons performed a right thoracotomy with chest wall reconstruction from the 8th to 11th ribs. The right lung and inferior vena cava were gently retracted, and the tumor was carefully detached from these structures. We were not able to separate the tumor from the right diaphragm due to severe invasion; therefore, we performed partial resection of the right diaphragm with the tumor. After excision of the anterior part of the tumor, the thoracic wall was reconstructed with the right eighth rib and Marlex mesh. When the patient’s general condition improved 2 weeks later, spondylectomy by posterior approach was performed. We achieved excision of a giant cell tumor that had expanded into the thoracic cavity and through the spinal canal into the vertebrae. The patient had achieved full rehabilitation with no neurological or respiratory abnormalities at 7 years postoperatively.

Figure: Photographs of the resected specimens from the thoracic cavity (A) and the vertebral body (B).
Giant cell tumors are benign primary bone tumors that usually occur in the epiphysis of the long bones but rarely in the axial skeleton. They are found most commonly after skeletal maturity and show slight female predominance.\(^1\,^2\) Histologically, giant cell tumors consist of multinucleated osteoclastic giant cells in the stroma of spindle-shaped cells.\(^3\) Because giant cell tumors are typically aggressive locally, curettage can lead to a high rate of local recurrence.\(^4\) In the extremities, it has been reported that the combination of adjuvant therapy reduces the rate of local recurrence.\(^5\,^6\) When the spine is involved, these adjuvant therapies present the risk of postoperative complications because of the presence of major blood vessels and the spinal cord. Therefore, complete excision of giant cell tumors is generally considered to be the best treatment option. However, due to the difficulties of removing spinal tumors, complete resection is often feasible for giant cell tumors, especially when they have expanded into the thoracic cavity. This article describes a case of a giant cell tumor that expanded into the thoracic cavity and had spinal involvement.

**Case Report**

A 36-year-old man presented with a 6-month history of back pain and dyspnea. A week before our workup, the patient had worsening dyspnea and presented at his primary hospital. After examination, he was referred to our institution due to an abnormal shadow on his chest radiographs. He reported dyspnea at rest, and physical examination showed diminished right breath sounds. An arterial blood gas revealed a pH of 7.41, carbon dioxide partial pressure (pCO\(_2\)) of 46 mmHg, oxygen partial pressure (pO\(_2\)) of 66 mmHg, and an oxygen saturation of 93% on room air. No neurological deficits existed in his lower limbs. Plain chest radiographs showed an atelectatic region in the right thoracic cavity (Figure 1). In addition, disappearance of the right 12th rib and absence of the right pedicle shadow at T12 was observed.

Computed tomography (CT) scan revealed a large mass in the right hemithorax accompanied by pleural effusion. Due to the mass, the right lung was severely compressed, and the mediastinum was shifted to the left. The mass also involved the 12th thoracic vertebral body, right pedicle, and lamina (Figure 1). Coronal magnetic resonance imaging (MRI) revealed a 25×12-cm mass that enhanced heterogeneously by gadolinium (Figure 2). Invasion of the tumor mass into the spinal canal through the vertebrae was also observed (Figure 2). Further investigation revealed that no other tumor lesions existed. Biopsy confirmed a giant cell tumor.

To resect the tumor, we performed a 2-stage procedure. As a first stage to separate the tumor from the anterior vital structures under direct vision, a right thoracotomy with chest wall reconstruction from the 8th to 11th ribs was performed by a thoracic surgeon (M.O.). Adhesions existed between the tumor and the right lung, inferior vena cava, and right hemidiaphragm. The right lung and inferior vena cava were gently retracted, and the tumor was carefully detached from these structures. We were not able to separate the tumor from the right diaphragm because of severe invasion; therefore, we performed partial resection of the right diaphragm with the tumor. After excision of the anterior part of the tumor (Figure 3), the thoracic wall was reconstructed with the right eighth rib and Marlex mesh. Operative time was 460 minutes, with an intraoperative blood loss of 8700 mL. Postoperative intensive respiratory and circulatory care were given. After excision of the anterior part of the tumor, the arterial blood gas improved to a pO\(_2\) of 91 mmHg and oxygen saturation improved to 98% on room air.

When the patient’s general condition improved 2 weeks later, the second stage of the procedure, spondylectomy by posterior approach, was performed. After insertion of pedicle screws from T9 to L3, laminectomies at T11 and T12 were performed. The tumor compressed the dura matter, and thus was carefully detached from the tumor.
to preserve neurological function. Total spondylectomy was performed after cutting the inferior border of the T12-L1 disk and the superior border of the T10-T11 disk using the T-saw (Kashiwa, Kanazawa, Japan) (Figure 3). The vertebral body was then reconstructed using a titanium mesh cage filled with autogenous iliac crest bone. Pathologic examination showed a giant cell tumor with proliferation of multinucleate giant cells and mononuclear cells, with no significant cellular atypia.

One year postoperatively, the patient was found to have developed a subcutaneous recurrence of the tumor at the surgical wound site, likely due to seeding of the site during a prior surgery. This new growth was successfully excised. Four years postoperatively, he underwent revision surgery with anterior reconstruction using a titanium cage and fibula strut graft due to pseudarthrosis. Seven years postoperatively, follow-up imaging showed no signs of tumor recurrence and complete bony fusion at the reconstruction site; 1 of the pedicle screws at right T9 was seen to be placed laterally (Figure 4). The patient achieved full rehabilitation with no neurological or respiratory abnormalities.

**DISCUSSION**

Giant cell tumors are histologically benign tumors; however, they often take an aggressive course clinically. Local recurrence rates after intralesional curettage have been reported to be high, and some options exist for adjuvant treatment, including polymethylmethacrylate implantation, cryosurgery, and phenolization in the extremities. However, in the spine, physical adjuvant treatments carry the risk of damaging the spinal cord, nerve roots, and major blood vessels. Therefore, thorough excision during the initial surgery is the best course of action for giant cell tumors in the spine to prevent recurrence.

Few cases involving giant cell tumors occupying the thoracic cavity have been reported in the literature. The tumor in our patient was not detected until it had expanded into the thoracic cavity. Even if a large tumor is formed and lung involvement or compression occurs, it can be difficult to detect the tumor in the thoracic cavity due to its mild subjective symptoms. Furthermore, invasion of the tumor into the vertebral body, pedicle, and lamina made complete excision of the tumor difficult. Some reports recommended that surgical resection followed by radiotherapy may be effective because complete excision of giant cell tumors in vertebrae is difficult.

However, several authors recommend against radiotherapy because of the risk of sarcomatous change, which occurs in 27% of patients. Therefore, radiotherapy for giant cell tumors might be limited as a postoperative treatment to cases of palliative treatment of postoperative recurrences or unresectable large tumors.

As our first-stage procedure, we removed the tumor from the vital structures (including the lung and inferior vena cava) by anterior approach to improve respiratory and circulatory functions. A thoracic surgeon should be consulted to dissect the lung from the tumor capsule and perform chest wall reconstruction. After stabilizing the patient’s general condition, we performed total spondylectomy without damaging the spinal cord.

En bloc excision is feasible for aggressive tumors such as giant cell tumors. In a review of aggressive benign tumors, including giant cell tumors, Harrop et al recommended en bloc resection in the thoracic and lumbar spine. We excised the tumor in 2 stages. The patient had a subcutaneous recurrence in the surgical wound 1 year postoperatively, possibly because of intraoperative contamination. However, no recurrence occurred at the primary site, and no evidence of disease existed for 6 years. This good result was probably due to capsule excision of the tumor. In addition, giant cell tumors are not malignant; therefore, preserving neurological function could be considered a higher priority. Jimming et al discussed 22 cases of cervical giant cell tumors, in which local recurrence was detected in 5 of 7 cases that underwent subtotal resection. However, total excision was performed in 1 of 13 cases (even intralesional). Tomita et al considered it mandatory to perform total tumor excision, including the tumor capsule, in an en bloc or piecemeal fashion for benign tumors such as giant cell tu-

Figure 3: Photographs of the resected specimens from the thoracic cavity (A) and the vertebral body (B).

Figure 4: Chest radiograph 7 years postoperatively showing an atelectatic region in the right thoracic cavity almost recovered (A). Lateral radiograph of the thoracic spine (B). Reconstructed sagittal computed tomography scan showing complete bony fusion at the reconstruction site (C).
mors. Total excision of tumors, including the capsule, should be performed en bloc or intralesionally.

We achieved excision of a giant cell tumor that had expanded into the thoracic cavity and through the spinal canal into the vertebrae. The patient had achieved full rehabilitation with no neurological or respiratory abnormalities at 7 years postoperatively.

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