Abstract

Background: Spinal osteochondromas are typically benign tumors, but patients may present with myelopathy and neurologic deficits if there is tumor encroachment within the spinal canal.

Case Description: We report here a case of a large solitary osteochondroma originating from the posterior vertebral body of T9 causing spinal cord compression and myelopathy. A 17-year-old man presented with 3 months of bilateral feet numbness and gait difficulty. Imaging demonstrated a large left-sided 5.9 cm × 5.0 cm × 5.4 cm osseous mass arising from the T9 vertebra consistent with an osteochondroma. He underwent bilateral costotransversectomies, and a left two-level lateral extracavitary approach for three partial corpectomies to both safely decompress the spinal canal as well as obtain a gross total resection of the tumor. Use of the O-arm intraoperative stereotactic computed tomographic navigation system assisted in delineating the osseous portions of the tumor for surgical removal. He experienced complete neurologic recovery after operative intervention.

Conclusion: Careful surgical planning is needed to determine the best approach for spinal cord decompression and resection of this tumor, especially taking into account the bony elements from which it arises. We present this case, to highlight the feasibility of a single-stage posterior approach to the ventral thoracic spine for the resection of a large solitary thoracic osteochondroma causing cord compression.

Key Words: Costotransversectomy, lateral extracavitary, osteochondroma, thoracic vertebrae

INTRODUCTION

Osteochondroma, known otherwise as “osteocartilaginous exostosis,” is the most common benign tumor of the long bone, and results from abnormal endochondral ossification.[1,5] Although uncommon, tumors can arise from the axial skeleton, affecting the spine in 1–4% of cases.[3] In this paper, we present a case of a large thoracic osteochondroma causing myelopathy which required an extensive single-stage posterior approach to the ventral thoracic spine for gross total resection and decompression.

Use of the O-arm intraoperative stereotactic computed tomographic (CT) navigation system assisted with osseous tumor removal.

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How to cite this article: Pham MH, Cohen J, Tuchman A, Commins D, Acosta FL. Large solitary osteochondroma of the thoracic spine: Case report and review of the literature. Surg Neurol Int 2016;7:S323-7.

http://surgicalneurologyint.com/Large-solitary-osteochondroma-of-the-thoracic-spine—Case-report-and-review-of-the-literature/
CASE REPORT

Presentation
A 17-year-old male presented with numbness in both his feet for 3 months duration. His physical examination demonstrated full strength in the lower extremities, but hyperactive ankle knee jerk and ankle jerk reflexes of 3+ (with sustained ankle clonus), and bilateral Babinski responses. Sensory exam showed decreased sensation from the umbilicus down. He had difficulty with tandem gait testing.

Thoracic magnetic resonance imaging (MRI) showed a large 5.9 cm × 5.0 cm × 5.4 cm mass emanating from the T9–T10 level with severe cord compression [Figure 1], while the CT scan with bone windows confirmed this mass to be osseous in nature, arising from the posterior vertebral body (VB) of T9 vertebra [Figure 2]. Both studies were consistent with an osteochondroma. A soft tissue component presumed to be cartilage was noted at the left lateral aspect abutting the pleural margin of the left lung.

Operative resection and pathology
A wide laminectomy and bilateral facetectomy were performed at the T8–T10 levels followed by a right-sided costotransversectomy at T9. A left-sided T8 costotransversectomy and T9–T10 lateral extracavitary approach was now performed, and the lateral borders of the tumor were identified with the assistance of the stereotactic CT navigation system. A partial left-sided T8, T9, and T10 corpectomy was then performed to further decompress the thecal sac and remove the rest of the medial portion of the tumor. Gross total resection of the tumor was achieved and confirmed with the assistance of the stereotactic CT navigation system [Table 1].

Pathologically, the lesion was noted to have a cartilaginous cap centered by trabecular bone with endochondral ossification at the bone-cartilage interface [Figure 3]. These findings were consistent with a diagnosis of osteochondroma.

Postoperative care and clinical follow-up
A postoperative CT scan obtained while he was still an inpatient showed gross total resection of the tumor as well as appropriate positioning of the hardware [Figure 4]. His hospital stay was uneventful without complications, and he was discharged 6 days later with a full strength

Table 1: Surgical exposure and maneuvers required in this reported case for the purposes of spinal cord decompression and gross total resection of osteochondroma

| Procedure list                                      |
|-----------------------------------------------------|
| T8-T10 laminectomy and bilateral facetectomy        |
| Right T9 costotransversectomy and pediculectomy      |
| Left T8 costotransversectomy                         |
| Left T9-T10 lateral extracavitary approach and pediculectomy |
| Left T8-T10 partial corpectomies                     |
| T6-L2 posterior spinal fusion and instrumentation    |

Figure 1: Preoperative T2-weighted magnetic resonance imaging in both sagittal (a and b) and axial (c and d) dimensions demonstrating the osteochondroma causing spinal cord compression

Figure 2: Preoperative noncontrast computed tomographic scan in both axial (a) and sagittal (b) dimensions demonstrating the osteochondroma with significant encroachment within the spinal canal

Figure 3: Photomicrograph of the osteochondroma (hematoxylin and eosin stain). A cartilaginous cap (black arrowhead) is noted to be covering the trabecular bone (black arrow)
| Author                        | Age | Sex | Level | Origin         | Surgery                                                                 |
|-------------------------------|-----|-----|-------|----------------|--------------------------------------------------------------------------|
| Bradford et al., 1954         | 61  | Female | T9    | Posterior VB  | Laminectomy                                                              |
|                               | 29  | Male | T8    | Posterior VB  | Laminectomy                                                              |
| Twersky et al., 1975          | 12  | Male | T4    | CVJ           | Laminectomy                                                              |
| Natarajan et al., 1976        | 21  | Male | T4-T5 | CVJ           | Thoracotomy                                                              |
| Le Goff et al., 1978          | 54  | Female | T10   | Posterior arch | Laminectomy                                                              |
| Loftus et al., 1980           | 28  | Male | T4    | VB, pedicle   | Laminectomy                                                              |
| Palmer and Blum, 1980         | 31  | Female | T2    | Pedicle       | Laminectomy                                                              |
| Spallone et al., 1981         | 22  | Female | T1-T2 | Pedicle, TP   | Thoracotomy, laminectomy                                                 |
| Karian et al., 1978           | 54  | Female | T10   | Posterior arch | Laminectomy                                                              |
| Linkowski et al., 1985        | 33  | Male | T3    | Lamina, facet | Laminectomy                                                              |
| Kak et al., 1985              | 40  | Female | T7-T8 | Lamina        | Laminectomy                                                              |
| Czomy et al., 1985            | 22  | Male | T1-4  | VB            | Thoracotomy                                                              |
| Lanzieri et al., 1985         | 18  | Female | T11-T12 | CVJ   | NR                                                                      |
| Marchand et al., 1986         | 49  | Female | T8-9  | Lateral VB    | Laminectomy, facetectomy                                                |
| Kulali et al., 1991           | 9   | Female | T2    | Posterior arch, pedicle | Laminectomy                                                              |
| Prasad et al., 1992           | 45  | Male | T6    | VB            | Laminectomy                                                              |
|                             | 16  | Female | T10   | Pedicle       | Laminectomy                                                              |
| Braunschweig and Rose, 1994   | 51  | Female | T1    | Pedicle       | Laminectomy                                                              |
| Shuangshoti and Lerdum, 1997  | 21  | Male | T1    | Lateral VB    | Laminectomy                                                              |
| Sener, 1998                   | 65  | Male | T6    | Posterior arch, rib | Hemilaminectomy                                                          |
| Govender and Parbhoo, 1999    | 33  | Male | C7-T1 | Posterior elements | Laminectomy                                                              |
| Javadpour et al., 1999        | 51  | Female | T5    | Posterior arch | Laminectomy                                                              |
| Khosla et al., 1999           | 39  | Male | T1    | Posterior arch | Laminectomy                                                              |
|                             | 5   | Male | T8    | Lamina, pedicle | Laminectomy and fusion                                                  |
| Gorospe et al., 2002          | 18  | Male | T4    | Posterior VB  | Laminectomy, facetectomy                                                |
| Sharma et al., 2002           | 18  | Female | T12   | Pedicle       | Laminectomy                                                              |
|                             | 13  | Male | T4    | Pedicle       | Laminectomy                                                              |
| Blamoutier et al., 2002       | 38  | Male | T7    | *             | *                                                                        |
| Kulkarni et al., 2004         | 15  | Male | T10-T11 | Facet | Laminectomy, facetectomy                                                |
| Brastianos et al., 2005       | 26  | Female | T12   | Posterior VB  | Corpectomy                                                               |
| Faik et al., 2005             | 19  | Male | T4-5  | CVJ           | Laminectomy                                                              |
| Bess et al., 2005             | 19  | Male | T11   | Lamina        | Laminectomy and fusion                                                  |
| Song and Lee, 2007            | 11  | Male | T4    | Facet         | Laminectomy                                                              |
| Lotfinia et al., 2010         | 55  | Male | T9    | VB            | Combined anterior and posterior approach for resection and fusion        |
| Lee et al., 2011              | 47  | Male | T12   | CVJ           | Laminectomy                                                              |
| Mehrian et al., 2013          | 19  | Male | T8-T10 | Posterior arch | Laminectomy                                                              |
| Mardi et al., 2013            | 9   | Male | T1    | VB            | *                                                                        |
| Sciubba et al., 2015          | 46  | Female | T9-T10 | *    | *                                                                        |
|                             | 76  | Female | T11-T12 | *   | *                                                                        |
|                             | 60  | Male | T12   | *            | *                                                                        |
|                             | 13  | Female | T1    | *            | *                                                                        |
|                             | 36  | Female | T11-T12 | *   | *                                                                        |
|                             | 21  | Male | T7    | *            | *                                                                        |
|                             | 28  | Male | T1-T2  | *            | *                                                                        |
|                             | 22  | Female | T8-T11 | *   | *                                                                        |
| Zaijun et al., 2015           | 11  | Male | T1-T7  | Lamina        | Laminectomy and fusion                                                  |
|                             | 17  | Female | T6    | Pedicle      | Laminectomy and fusion                                                  |
|                             | 56  | Female | T5    | VB            | Laminectomy and fusion                                                  |
| Current study                | 17  | Male | T9-T10 | Posterior VB | Laminectomy, facetectomies, pediculectomies, partial corpectomies, and fusion |

*Not reported. CVJ: Costovertebral junction, TP: Transverse process, VB: Vertebral body
motor exam and no new deficits. On the last follow-up at 6 months, he was neurologically intact with a resolution of his sensory deficits, and a 6-month postoperative MRI showed no tumor recurrence [Figure 5].

**DISCUSSION**

A review of the English-language literature demonstrated 49 cases of solitary thoracic osteochondromas presenting with myelopathy, the majority of which underwent laminectomy for decompression and excision of tumor [Table 2]. A total of 8 patients required instrumentation and fusion for stabilization of the thoracic spine after resection of the osteochondroma [Table 3]. Brastianos et al. described performing a T12 corpectomy with a distractible cage and locking plate and screws from an anterolateral approach for a posterior VB osteochondroma with the subsequent complete recovery of the patient’s presenting symptoms.\(^2\) Lotfinia et al. described one patient in their series who initially underwent a posterior transpedicular approach for a T9 VB osteochondroma which was unsuccessful and had to be aborted.\(^4\) This

| Table 3: Reported cases in detail of solitary thoracic osteochondroma presenting with myelopathy requiring instrumentation and fusion |
|------------------------|-------------|-----------------|---------------------------------|------------------------|-----------------|-----------------|-----------------|
| Author | Age/sex | Level | Origin | Clinical presentation | Surgery | Follow-up | Clinical outcome | Radiographic outcome |
|---------|---------|-------|--------|-----------------------|---------|-----------|-----------------|----------------------|
| Khosla et al., 1991 | 5/male | T8 | Right pedicle and facet | Progressive difficulty walking, paraparesis, hyperreflexia, spastic gait | T8-T9 laminectomy and fusion | 20 months | Complete recovery | No recurrence |
| Bess et al., 2005 | 19/male | T11 | Lamina | Ataxia, weakness, sensory deficit | T11-T12 laminectomy and fusion, en bloc tumor resection | 7 years | Complete recovery | No recurrence |
| Brastianos et al., 2005 | 26/female | T12 | Posterior VB | Weakness and numbness, unsteady gait | T12 corpectomy | 5 months | Complete recovery | * |
| Lotfinia et al., 2010 | 55/male | T9 | VB | Paraparesis and sphincter dysfunction | Unsuccessful transpedicular approach, Reoperation for combined anterior transthoracic and posterior approach | 4 years** | Gradual recovery to independent ambulation | No recurrence |
| Zaijun et al., 2015 | 11/male | T1-T7 | Lamina | Pain and paraparesis | Laminectomy and fusion | 88 months | Good | * |
| | 17/female | T6 | Pedicle | Pain and hypesthesia | Laminectomy and fusion | 42 months | Good | * |
| | 56/female | T5 | VB | Back pain, hypesthesia, and paraparesis | Laminectomy and fusion | 2 months | Partial recovery | * |
| Current study | 17/male | T9-T10 | Posterior VB | Numbness and unsteady gait | Laminectomies, facetectomies, bilateral costotransversectomy and lateral extracavitary approach for pediculectomies and partial corpectomies, posterior instrumentation and fusion | 6 months | Complete recovery | No recurrence |

\(^a\)Not reported, \(^b\)Mean follow-up for entire reported patient series. VB: Vertebral body
patient then underwent a reoperation for combined anterior transthoracic resection of tumor and posterior placement of instrumentation and fusion. Both of these cases highlight the importance of careful surgical planning for the purposes of spinal cord decompression and complete resection of the osteochondroma.

Our patient presented with significant spinal cord compression causing myelopathy from a large osteochondroma originating from the T9 posterior VB. He required bilateral costotransversectomies and a left two-level lateral extracavitary approach for three partial corpectomies to both safely decompress the spinal canal as well as obtain a gross total resection of the tumor. Use of the O-arm intraoperative stereotactic CT navigation system assisted in delineating the osseous portions of the tumor for surgical removal. To our knowledge, this is the first report of a single-stage extensive posterior approach to the ventral thoracic spine for the purpose of osteochondroma resection. We present this case to highlight the feasibility and successful execution of this technique for resection of a solitary thoracic osteochondroma causing cord compression originating from the posterior VB.

Financial support and sponsorship
Nil.

Conflicts of interest
There are no conflicts of interest.

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