Case Report

Mesenchymal Chondrosarcoma of the Lumbar Spine in a Child

Aristidis H. Zibis MD, PhD, M. Wade Shrader MD,
Lee S. Segal MD

Received: 27 July 2009 / Accepted: 24 February 2010 / Published online: 19 March 2010
© The Association of Bone and Joint Surgeons® 2010

Abstract

Background Chondrosarcomas of the spine constitute 4% to 10% of all primary spinal bone tumors and approximately 70% of the cases occur during the second or third decade of life. Mesenchymal chondrosarcoma is a rare aggressive variant of chondrosarcoma. The prognosis of mesenchymal chondrosarcoma is usually poor with a tendency for late local recurrence and metastasis.

Case Description We describe a case of primary mesenchymal chondrosarcoma affecting the L5 vertebra of a 9-year-old girl. The patient underwent a staged circumferential resection of the tumor after three rounds of neoadjuvant chemotherapy. The patient had additional chemotherapy and radiation therapy as an intralesional margin was achieved during the procedure. At 9 years followup, the patient was asymptomatic, neurologically intact, and remained in remission.

Each author certifies that he or she has no commercial associations (eg, consultancies, stock ownership, equity interest, patent/licensing arrangements, etc) that might pose a conflict of interest in connection with the submitted article.

Each author certifies that his or her institution approved the reporting of this case report, that all investigations were conducted in conformity with ethical principles of research, and that informed consent for participation in the study was obtained.

This work was performed at The Pennsylvania State University College of Medicine, Penn State Hershey Medical Center.

A. H. Zibis

Department of Orthopaedics and Rehabilitation, Pennsylvania State University College of Medicine, Penn State Hershey Medical Center, Hershey, PA, USA

M. Wade Shrader (✉), L. S. Segal

Division of Pediatric Orthopedic Surgery, Phoenix Children's Hospital, 1919 East Thomas Road, Phoenix, AZ 85016, USA
e-mail: mwshrader@phoenixchildrens.com

Literature Review We identified only four previously published cases of spinal mesenchymal chondrosarcoma in childhood, two of which had relatively early recurrence and poor survival, and two survived but with only short followup.

Purposes and Clinical Relevance As the clinical and radiographic findings of mesenchymal chondrosarcoma are nonspecific, the diagnosis of this rare tumor requires careful histopathologic review of the specimens. We suggest the differential diagnosis of every primary intraspinal tumor include tumors of mesenchymal origin. The prognosis is apparently not uniformly poor.

Introduction

Mesenchymal chondrosarcoma is a rare yet histologically distinct malignant neoplasm thought to derive from primitive cartilage-forming mesenchymal tissue. It is characterized by the presence of solid, highly cellular areas composed of round or slightly spindled primitive mesenchymal cells with foci of cartilaginous differentiation. Mesenchymal chondrosarcomas represent less than 10% of all chondrosarcomas and as a result are poorly understood [7]. Although the majority of these tumors are believed to originate in bone, 50% of the reported cases have an extraosseous origin, including the brain and the meninges [17]. It is exceedingly rare to find mesenchymal chondrosarcoma as a primary lesion of the bony elements of the spine. We identified only five published cases of spinal mesenchymal chondrosarcoma in childhood (Table 1) [2, 6, 8, 11, 15, 21].

We present the case of a 9-year-old patient with primary mesenchymal chondrosarcoma affecting the lumbar spine that had an unusual presentation, clinical findings,

Table 1. Literature review and outcomes for mesenchymal chondrosarcoma

Study	Age of patient/ gender	Site	Clinical presentation	Operative treatment	Chemotherapy	Radiation therapy	Outcome
Kruse et al. [9] 1997	9/F	C3 lamina and spinous process	Difficulty walking, falling, and right UE weakness	C2-C3 partial corpectomy, strut graft; Subtotal resection	Pulsed multidrug chemotherapy (specifics not provided)	Received (specifics not provided)	Tumor recurrence at 4 years; Died 5 + 1 years after initial diagnosis
Chan et al. [2] 1984	10/F	T3 pedicle and erosion of right T3-T4 foramen	3 month history of back and shoulder pain, gait disturbance and paresthesia 3 weeks before admission	Laminectomy T1-T4, tumor dissected off dural sac. Two weeks later, paravertebral tumor and extension into foramen resected through right thoracotomy approach; (surgical margins not provided)	Vincristine, cyclophosphamide, actinomycin D, adriamycin	5000 Rads in 25 fractions over 5 weeks to tumor bed	Alive, free of disease after 18 months
Tasdemiroglu et al. [21] 1996	12/F	L5	4-month history of back pain, LE weakness	L4-L5 laminectomy, gross tumor resection, nerve root decompression, L4-S1 pnf with segmental instrumentation	Cisplatinum, epirubicin, ifosfamide	5000 R boost (no other specifics provided)	Alive, 10-months followup, total neurologic improvement
Salvador et al. [19] 1971	17/F	Vertebra (level not specified)	Not provided	Excision, cordotomy	Not provided	Not provided	5 years followup, large recurrence
Current study	9/F	L5 vertebral body	Right ankle pain	Marginal resection; Anterior/posterior spine fusion L4-S1	Vincristine, cyclophosphamide, doxorubicin	5900 cGY in 32 fractions	Disease free at 9 years

treatment, and long-term course. A review of the current literature regarding management of mesenchymal chondrosarcoma of the spine is provided. The patient and her family were informed data concerning the case would be submitted for publication, and they gave their permission.

Case Report

A 9-year-old healthy girl presented with a 1-month history of a painful left ankle. The pain was worse at night. Clinical examination was normal, as were radiographs and a bone scan of the ankle. One month later, the patient complained of left foot numbness and subsequently was referred to our institution. The physical examination revealed limited lumbar flexion of 10°. The motor strength of the left extensor hallucis longus was 4/5, and the straight leg raise and contralateral straight leg raise tests were positive. The deep tendon reflexes were absent in the left lower extremity. Lumbar spine radiographs revealed an osteoblastic lesion with compression of the L5 vertebral body (Fig. 1A). MRI showed loss of normal marrow signal of the L5 vertebral body and a soft tissue mass in the spinal canal (Fig. 1B). A CT-guided biopsy was performed with a transpedicle approach through the right pedicle. CT examination of the chest, abdomen, and pelvis was normal.

The histopathologic examination revealed a dimorphic pattern with areas of primitive round or spindle-shaped mesenchymal cells alternating with zones of well-differentiated chondroid tissue, consistent with a diagnosis of mesenchymal chondrosarcoma (Fig. 2).

Subsequently, the patient underwent three cycles of neoadjuvant chemotherapy. The chemotherapy protocol used for our patient was Protocol #9354 from the Pediatric Oncology Group (Revised March, 1996) entitled “Evaluation of intensified vincristine, doxorubicin, cyclophosphamide, ifosfamide, and etoposide in the treatment of newly diagnosed Ewing’s sarcoma or primitive neuroectodermal tumor of bone or soft tissue.” The duration of the chemotherapy was 24 weeks (Appendix 1).

The child’s left ankle pain resolved at the completion of the chemotherapy. The patient then underwent a complete intralesional resection of the tumor in two stages. Initially, a posterior midline approach to the lumbosacral spine was used to remove the spinous process, lamina, and pedicles. The tumor was found around the left pedicle. Pedicle screws (4.75 mm) were placed at the L4 and S1 levels. Under the same general anesthetic, the patient was turned over to a supine position, and a paramedian retroperitoneal anterior approach was used to achieve an en bloc resection of the L5 body. Residual tumor was removed with an intralesional margin. An anterior column reconstruction

Fig. 1A–B (A) A preoperative lateral radiograph shows an osteoblastic lesion with compression of the L5 vertebral body. (B) An MR image of the lumbar spine shows loss of normal marrow signal of the L5 vertebral body and a soft tissue mass in the spinal canal.

was performed with an intervertebral titanium cage and bone graft. The pathologic examination of the specimen revealed 85% tumor necrosis.

A pantaloons cast with a left thigh extension was used for 3 months, and a Boston Overlap Brace (Boston Brace International, Inc, Avon, MA) was used for 9 months. The patient underwent additional chemotherapy (with similar

Fig. 2 Histopathologic findings reveal a dimorphic pattern with areas of primitive round or spindle-shaped mesenchymal cells alternating with zones of well-differentiated chondroid tissue, consistent with a diagnosis of mesenchymal chondrosarcoma (Stain, H & E).

protocols to those used preoperatively) and radiation therapy after the procedure for local disease control, as only an intralesional margin was achieved. The radiation therapy plan was made by using IGRT (Image Guided Radiation Therapy). The cumulative dose of radiation therapy was 5900 cGY in 32 fractions.

The patient was last seen for followup 9 years after the surgery and was doing well (Fig. 3; Table 1). She remained asymptomatic, had no pain, and had greater than 60° lumbar flexion. Her motor and sensory function was normal, and her bowel and bladder function remained intact.

Discussion

Mesenchymal chondrosarcoma is a rare and aggressive variant of chondrosarcoma [4, 11]. It is a primary malignant neoplasm of the bone and soft tissue, yet it is microscopically distinct from conventional and dedifferentiating chondrosarcoma [7]. Mesenchymal chondrosarcoma is reported to have an incidence of 0.24% among bone neoplasms [12]. The prevalence of mesenchymal chondrosarcoma in the spine is reported to range from 4% to 10% [1, 12, 20]. Approximately 70% of the cases occur during the second or third decade of life in patients with a mean age of

Fig. 3A–B (A) Anteroposterior and (B) lateral radiographs taken 9 years after surgery show a solid arthrodesis without evidence of instrumentation loosening.

25 years, with no gender prevalence [9]. The maxilla and mandible are the most frequent sites of involvement [9]. Other common locations are the vertebrae, ribs, pelvis, and humerus. The bones of the appendicular skeleton rarely are

involved [9]. Although the majority of these tumors are believed to originate in bone, there is a considerable percentage ranging from 22% to 50% that originates in the extraskeletal soft tissue. The brain and the meninges are involved most frequently [8, 17]. The tumor has a high propensity to metastasize to lungs, lymph nodes, and other bones [8, 17].

The primary initial symptoms are pain and swelling of the affected area. The majority of cases have swelling and/or the presence of a mass as the first finding, and later the mass may be associated with a varying amount of pain [11, 22]. Detection of mesenchymal chondrosarcoma usually is delayed owing to the nonspecific physical findings and patient complaints, especially when the spine or deep locations such as the retroperitoneum and pelvis are involved [12]. In our patient, the tumor was located at the L5 vertebral body and left ankle pain was the initial complaint of the child, and the pain gradually developed into a radiculopathy.

The radiographic appearance of mesenchymal chondrosarcoma is that of an osteolytic neoplasm. There is often a soft tissue lesion containing punctate calcifications. Plain radiographs usually show a radiolucent lesion with varying degrees of matrix calcification such as arc, ring, and stippled patterns [9, 11, 22]. There is no distinguishing radiographic or MRI features specifically to separate mesenchymal from the other chondrosarcomas. The differential diagnosis for this lesion based on the MRI findings is mesenchymal chondrosarcoma, myxochondrosarcoma, or a cartilage containing meningioma such as hemangiopericytoma.

The mesenchymal chondrosarcoma macroscopically seems to be grayish-white or pink with a soft to firm consistency [9]. Microscopically, as noted in this patient, the tumor has the characteristic bimorphic pattern composed of a solid mass of undifferentiated, small round or spindle cells and islands of chondroid tissue at various stages of differentiation [9]. There are two subtypes of mesenchymal chondrosarcoma based on the histopathologic appearance. The hemangiopericytomatoid variant is better differentiated, whereas the second variant consists of less differentiated small cell types with zones of anaplastic cells and cartilage cell and matrix in early developmental stages [7, 22]. Thus, the histologic differential diagnosis includes metastases, hemangiopericytoma, Ewing's sarcoma, soft tissue chondroma, and soft tissue sarcoma, in addition to mesenchymal chondrosarcoma [11, 13, 22]. The diagnosis of mesenchymal chondrosarcoma is made by histologic identification of chondroid differentiation in the precartilaginous mesenchymal blastoma [20].

There is no general agreement regarding the best approach to therapy [17]. Mesenchymal chondrosarcoma

has been considered resistant to chemotherapy and radiotherapy [5]. The treatment for chondrosarcomas is primarily surgical, obtaining wide surgical margins to achieve local eradication [11]. In an intraspinal mesenchymal chondrosarcoma, wide margins are impossible because of anatomic constraints. Thus, a marginal or intralesional excision only can be achieved. Laminectomy and root decompression will improve the neurologic condition but not the survival rate [11]. The role of neoadjuvant radiotherapy and/or chemotherapy remains controversial. However, Harwood et al. [5] reported mesenchymal chondrosarcoma responded to irradiation and recommended a combination of chemotherapy and radiotherapy should be used in unresectable tumors or those resected with inadequate safe margins. In addition, Huvoš et al. [8] suggested tumors with so-called Ewing-like microscopic features respond somewhat better to combination chemotherapy than those with spindle cell and hemangiopericytoma-like areas. The postoperative local radiotherapy may reduce local recurrence rates, and postoperative systemic chemotherapy may reduce the risk of metastasis [14].

The prognosis of mesenchymal chondrosarcoma is usually poor (Table 1), but recent studies with modern therapy have shown improved survival [3, 16]. The course of mesenchymal chondrosarcoma may be protracted, with a tendency to late local recurrence and metastasis [11]. Intraspinal tumors with dural attachment have a more favorable prognosis because acute cord compression by small tumors leads to early diagnosis and surgical intervention [5, 10, 17, 18, 22]. Huvoš et al. [8] found a median survival of 37.9 months in 35 patients. The 3-year survival rate in patients with mesenchymal chondrosarcoma in another study was 50% and the 10-year survival was 28% [8].

As the clinical and radiographic findings of mesenchymal chondrosarcoma are nonspecific, the diagnosis of this rare tumor requires careful histopathologic review of the specimens. We suggest the differential diagnosis of every primary intraspinal tumor include the tumors of mesenchymal origin. The mesenchymal chondrosarcoma appears to have a worse prognosis than the other types of chondrosarcomas, with high rates of recurrence and metastasis. Excision with wide surgical margins is preferred, but in certain locations such as the spine as in our patient, this may not be achievable. Adjunctive chemotherapy should be considered for systemic control of the disease and radiation therapy should be considered for local control.

Acknowledgments We thank Andrew Frieberg MD and Masayo Watanabe MD for help with this manuscript.

Appendix 1. Chemotherapy Roadmap

Protocol #9354 (From the Pediatric Oncology Group—revised March 12, 1996): Evaluation of intensified vincristine (VCR), doxorubicin (DOX), cyclophosphamide (CPM), ifosfamide (IFO), and etoposide (E) in the treatment of newly diagnosed Ewing's sarcoma or primitive neuroectodermal tumor of bone or soft tissue.

Regimen B: VCR 13.5 mg/m², DOX 375 mg/m², CPM 12 g/m², E 3 g/m², IFO 72 g/m²

Week 0

Day 1: VCR, DOX, and CPM
Day 2: DOX, CPM
Day 3: DOX
Day 4: G-CSF 140 mcg

Week 1

Day 1: VCR

Week 3

Day 1: VCR, DOX, CPM
Day 2: DOX, CPM
Day 3: DOX
Day 4: G-CSF

Week 4

Day 1: VCR

Week 6

Day 1: VCR, DOX, CPM
Day 2: DOX, CPM
Day 3: DOX
Day 4: G-CSF

Week 7

Day 1: VCR

Week 12

Day 1: VCR, DOX, CPM
Day 2: DOX
Day 4: G-CSF

Week 15

Day 1: IFO
Day 2 IFO
Day 3 IFO
Day 4 IFO
Day 5 IFO
Day 6 G-CSF

Week 16

Day 2: G-CSF

Week 17

G-CSF

Week 18

Day 1: VCR, DOX, CPM
Day 2: DOX
Day 4: G-CSF

Week 21

Day 1: IFO
Day 2: IFO
Day 3 : IFO
Day 4: IFO
Day 5: IFO
Day 6: G-CSF

Week 22

G-CSF

Week 23

G-CSF

References

1. Camins MB, Duncan AW, Smith J, Marcove RC. Chondrosarcoma of the spine. *Spine (Phila PA 1976)*. 1978;3:202–209.
2. Chan HS, Turner-Gomes SO, Chuang SH, Fitz CR, Daneman A, Martin DJ, Becker LE. A rare cause of spinal cord compression in childhood from intraspinal mesenchymal chondrosarcoma: a report of two cases and review of the literature. *Neuroradiology*. 1984;26:323–327.
3. Dantonello TM, Int-Veen C, Leuschner I, Schuck A, Furtwaengler R, Claviez A, Schneider DT, Klingebiel T, Bielack SS, Koscielniak E; CWS study group; COSS study group. Mesenchymal chondrosarcoma of soft tissues and bone in children, adolescents, and young adults: experiences of the CWS and COSS study groups. *Cancer*. 2008;112:2424–2431.
4. Di Lorenzo N, Palatinsky E, Artico M, Palma L. Dural mesenchymal chondrosarcoma of the lumbar spine: case report. *Surg Neurol*. 1989;31:470–472.
5. Harwood AR, Krajchich JJ, Fornasier VL. Mesenchymal chondrosarcoma: a report of 17 cases. *Clin Orthop Relat Res*. 1981;158:144–148.
6. Huckabee RE. Meningeal mesenchymal chondrosarcoma of the spine: a case report. *J Magn Reson Imaging*. 1991;1:93–95.
7. Huvo A. Mesenchymal chondrosarcoma. In: Mitchell J, ed. *Bone Tumors*. Philadelphia, PA: WB Saunders; 1991:382–393.
8. Huvo AG, Rosen G, Dabska M, Marcove RC. Mesenchymal chondrosarcoma: a clinicopathologic analysis of 35 patients with emphasis on treatment. *Cancer*. 1983;51:1230–1237.
9. Kruse R, Simon RG, Stanton R, Grisson LE, Conard K. Mesenchymal chondrosarcoma of the cervical spine in a child. *Am J Orthop (Belle Mead NJ)*. 1997;26:279–282.
10. Lee ST, Lui TN, Tsai MD. Primary intraspinal dura mesenchymal chondrosarcoma. *Surg Neurol*. 1989;31:54–57.
11. Lichtenstein L, Bernstein D. Unusual benign and malignant chondroid tumors of the bone: a survey of some mesenchymal cartilage tumors and malignant chondroblastic tumors, including a few multicentric ones, as well as many atypical benign chondroblastomas and chondromyxoid fibromas. *Cancer*. 1959;12:1142–1157.
12. Nguyen BD, Daffner RH, Dash N, Rothfus WE, Nathan G, Toca AR Jr. Case report 790: Mesenchymal chondrosarcoma of the sacrum. *Skeletal Radiol*. 1993;22:362–366.
13. Pritchard DJ, Lunke RJ, Taylor WF, Dahlin DC, Medley BE. Chondrosarcoma: a clinicopathologic and statistical analysis. *Cancer*. 1980;45:149–157.
14. Ranjan A, Chacko G, Joseph T, Chandi SM. Intraspinal mesenchymal chondrosarcoma: case report. *J Neurosurg*. 1994;80:928–930.
15. Reif J, Graf N. Intraspinal mesenchymal chondrosarcoma in a three-year-old boy. *Neurosurg Rev*. 1987;10:311–314.
16. Riedel RF, Larrier N, Dodd L, Kirsch D, Martinez S, Brigman BE. The clinical management of chondrosarcoma. *Curr Treat Options Oncol*. 2009;10:94–106.
17. Rushing EJ, Armonda RA, Ansari Q, Mena H. Mesenchymal chondrosarcoma: a clinicopathologic and flow cytometric study of 13 cases presenting in the central nervous system. *Cancer*. 1996;77:1884–1891.
18. Rushing EJ, Mena H, Smirniotopoulos JG. Mesenchymal chondrosarcoma of the cauda equina. *Clin Neuropathol*. 1995;14:150–153.
19. Salvador AH, Beabout JW, Dahlin DC. Mesenchymal chondrosarcoma: observations on 30 new cases. *Cancer*. 1971;28:605–615.
20. Shives TC, McLeod RA, Unni KK, Schray MF. Chondrosarcoma of the spine. *J Bone Joint Surg Am*. 1989;71:1158–1165.
21. Tasdemiroglu E, Bagatur E, Ayan I, Darendeliler E, Patchell RA. Primary spinal column sarcomas. *Acta Neurochir (Wien)*. 1996;138:1261–1266.
22. Theodorou DJ, Theodorou SJ, Xenakis T, Demou S, Agnantis N, Soucacos PN. Mesenchymal chondrosarcoma of soft tissues of the calf. *Am J Orthop (Belle Mead NJ)*. 2001;30:329–332.