Surgical Management of Multi-Level Cervical Spine Synovial Chondromatosis

Abstract
Cervical synovial chondromatosis is a benign condition which most commonly affects the knee joint. The involvement of the spinal column is rare, with only a few reports in the literature describing surgical treatment for compressive spinal lesions. Given the rarity of this condition, the best treatment methodology is yet to be established. We describe the case of a 38-year-old female who presented with progressively worsening myeloradicular symptoms localizing to the cervical spinal cord. Imaging revealed a multilevel osseous and epidural lesion involving the subaxial cervical spine. A computed tomography-guided biopsy was performed to obtain a diagnosis to aid further treatment planning. Subsequently, surgical decompression and stabilization were performed after which the patient made an excellent recovery. She continues to do well at 2 years follow-up. Cervical synovial chondromatosis is a rare condition which can present with pain, radiculopathy, and/or myelopathy. Surgical treatment should focus on complete resection, decompression, and stabilization with arthrodesis and fusion to prevent recurrence. We propose that the lack of motion provided by stabilization and fusion after gross total resection prevents disease recurrence.

Keywords: Cervical chondromatosis, myelopathy, radiculopathy, spinal cord compression

Introduction
Synovial chondromatosis is a benign pathology involving metaplastic proliferation of chondrocytes within the synovium. The knee joint is most commonly affected. Involvement of the cervical spine is rare. Thus far, 12 patient reports have been described in the literature involving single level facet disease with either an epidural mass or an exophytic neck mass.[1-11] In Gallia et al.’s report, one of the two cases had a two-level anterolateral component from a posteriorly arising facet lesion which was treated with gross total resection, decompression, and fusion.[3] Given the rarity of this problem in the cervical spine, the best approach to surgical management of this pathology has not yet been established. The question remains whether near gross total resection itself is enough or arthrodesis and fusion is required in these cases to prevent recurrence. It is also not certain whether there are any histological variations that can predict future recurrence.

Case Report
Presentation and symptoms
A 38-year-old female presented with a 5-month history of worsening intermittent neck pain radiating into her shoulder blades, associated with bilateral hand numbness and paresthesias hands. One week prior, she started developing numbness and cramping in her thighs and calves, difficulty walking, and imbalance. Neurologic examination revealed hyperreflexia bilaterally without motor or sensory deficits.

Imaging
Computed tomography (CT) of the cervical spine revealed an osseous mass centered at the left C4–5 facet joint extending along the lamina and involving C4 through C6 spinous processes. Significant kyphotic deformity was noted. CT angiogram of the neck demonstrated encasement and occlusion of the left vertebral artery at C4 and C5. Magnetic resonance imaging revealed a nonenhancing mass with epidural extension at C4–5 causing displacement of the spinal cord and spinal canal narrowing [Figure 1].
Surgical plan and intraoperative findings

The patient underwent a CT-guided biopsy of the mass at the C6 spinous process. Pathology was consistent with synovial chondromatosis. Given the patient’s continued radicular and myelopathic symptoms, the decision was made to proceed with decompression and stabilization of the cervical spine.

A standard posterior midline approach was conducted. The severity of cervical deformity, instability, and the large bony tumor mass was immediately obvious. The tumor involved the spinous processes of C4, C5, and C6 with extension into the left C4 and C5 facet joints [Figure 2a]. After removal of the osseous tumor components, C3–6 laminectomy and left C4–5 facetectomy was completed. Using microsurgical techniques, the intraspinal tumor was removed. A complete resection was achieved with adequate decompression of the spinal cord, nerves, and the left vertebral artery [Figure 2b]. To correct the kyphotic deformity and instability, a C2-T1 posterolateral arthrodesis and fusion as well as a C4–5 anterior cervical discectomy, interbody arthrodesis, and fusion was performed in the same session.

Postoperative care

The patient was admitted to the intensive care unit overnight for blood pressure control and then transferred to the floor on day one. The patient was discharged home on day four without any new neurological deficits. At 2 years follow-up, the patient reports minimal neck pain with no radiculopathy and significant improvement of myelopathic symptoms [Figure 3].

Pathology

Microscopic examination demonstrated a hypocellular chondroid lesion, with chondrocytes arranged predominantly in micronodules. The lesion demonstrated foci of enchondral ossification and attenuation of the host bone without definitive cortical permeation. There were rare microscopic foci present within the lesion that demonstrate ischemic-type necrosis. Given the unusual nature of this case, it sent for expert soft tissue and bone consultation, confirming the diagnosis of synovial chondromatosis. [Figure 4].

Discussion

First described in 1813, Synovial chondromatosis is an uncommon disorder which typically affects large joints, most commonly the knee.\(^{[11]}\) Cervical spine involvement is rare with only twelve cases reported thus far. Multilevel presentation is even more unusual, with only one of the twelve previously reported cases having a two-level anterolateral component [Table 1]. Usually, a single facet is involved, and it gives rise to an intraspinal epidural mass or exophytic neck mass, presenting with axial neck pain, radicular symptoms, or myelopathy. This was seen in our case where the mass was involving the left C4–5 facet joint extending anterolaterally to the C4–5 vertebral bodies. Even more uncommon was the presence of two different skip lesions on the spinous processes of C6 and C7.

Histologically, primary synovial chondromatosis reveals lobules of hypercellular hyaline cartilage admixed with atypical histological features: Multinucleation, nuclear crowding, nuclear enlargement, and hyperchromasia with mild myxoid changes. This is often accompanied by a variable degree of synovial proliferation. In our case, areas of necrosis were also seen which were deemed to be ischemic in nature rather than tumor necrosis, perhaps related to an accelerated growth. Differentiating primary synovial chondromatosis from low-grade chondrosarcoma can be a challenge due to these somewhat atypical findings, for which molecular markers or immunostains may be helpful in the future.

In series from orthopedic literature of extraspinal lesions, it has been noted that in secondary synovial chondromatosis, which is usually associated with osteoarthritis, rheumatoid disease, osteochondral plate fractures, the triggering factors were usually obvious, and the lesions were not aggressive. Conversely, primary synovial chondromatosis, was aggressive and associated with a high incidence of recurrence.\(^{[12]}\) Recurrence and degeneration of the tumor into synovial chondrosarcoma has been reported
### Table 1: Reports of cervical synovial chondromatosis in literature. Single case with multi-level involvement is highlighted.

| Study       | Pt. | Levels involved                              | Presenting Sx                              | Hx of Trauma | Conservative Treatment | Surgical Treatment                                      | F/U          | Recurrence                  |
|-------------|-----|----------------------------------------------|--------------------------------------------|--------------|------------------------|---------------------------------------------------------|--------------|------------------------------|
| Kyriakos6 (2000) | 39 yo F | C3-4 left facet and lamina                    | 9 mo. Neck and left arm pain               | None         | PT, Heat, U/S, NSAIDs I | Left C3 hemilaminectomy and partial facetectomy C3-4     | Post-operative neck pain for 6 mos | Unknown         |
| Greenlee4 (2002) | 48 yo M | C4-5 left anterior mass                       | 1 y left arm and suprascapular pain        | MVA 1 y prior | None                   | Resection of left C4-5 mass via anterior approach        | Unknown      | Unknown                     |
| Chiba1 (2003) | 52 yo F | C7-T1 right sided epidural mass, facet joint involvement C1-2 left sided epidural mass with C1-3 anterior extension, facet joint involvement C4-5 left anterior mass, C2-5 with cord compression C4-7, right facet epidural mass from C2-5 with cord compression | Right shoulder, arm, forearm pain with mild weakness 4 y neck pain. 4 y painful neck mass, pain in right shoulder and bicep | MVA          | Prednisone             | Right C7 hemilaminectomy, C7-T1 facetectomy, resection of epidural mass 2 staged: Left C1-2 hemilaminectomy, facetectomy, resection of epidural tumor, partial C2 VB resection, O-C5 fusion Tracheostomy. left-sided transmandibular circumglossal approach, tumor debulking, partial C1 arch resection and odontoideotomy Transcondylar far lateral approach, C2 laminectomy, right C1-2 facetectomy, en bloc tumor resection tumor, C1 to C4 posterior instrumentation and fusion | Improvement of pain. Mild dysesthesia 44 mos. Symptomatic improvement | Unknown         |
| Gallia3 (2004) | 46 yo M | C1-2 left sided epidural mass with C1-3 anterior extension, facet joint involvement | Neck pain, partial left-sided Brown-Séquadrd syndrome, myelopathy | MVA          | None                   | B/L C2-5 laminectomy, radical left C2-3, C3-4 facetectomy, partial C4-5 facetectomy, tumor resection, C-2 pedicle, C-3, C-4, and C-5 lateral mass screws. | None          | None                         |
| Moody8 (2010) | 44 yo M | C1-2, large right posterolateral exophytic mass | 6 y painful neck mass, pain in right shoulder and bicep | MVA          | None                   | Transcondylar far lateral approach, C2 laminectomy, right C1-2 facetectomy, en bloc tumor resection tumor, C1 to C4 posterior instrumentation and fusion | Unknown      | Unknown                     |
| Han5 (2012) | 21 yo M | C6-7, right facet epidural mass               | 17 mos right scapular pain, R hand numbness | MVA          | None                   | First op: Right C6 hemilaminectomy, partial C6-7 facetectomy, subtotal tumor resection Second op: Redo facetectomy and complete tumor resection | Improvement in pain. 3 yrs later: Recurrence of pain 4 mos: pain free | None            |
Figure 4: Pathology: Micrograph at ×10 demonstrates a hypocellular and chondroid lesion, comprised predominantly of chondrocytes arranged in small nodules. No atypia is seen.

Table 1: Contd...

| Study      | Pt.     | Levels involved | Presenting Sx                                      | Hx of Trauma | Treatment                                                                 | F/U   | Recurrence |
|------------|---------|-----------------|---------------------------------------------------|--------------|---------------------------------------------------------------------------|-------|------------|
| Shaw9 (2014) | 19 yo   | M               | Left sided weakness/ numbness from cord compression | MVA and Football | Left C3 laminoplasty and tumor resection | 7 mos PT | Unknown    |
| Mehra7 (2015) | 58 yo   | M               | 2 y right arm numbness | Left sided weakness/ numbness from cord compression | MVA and Football | Right C5–6 partial facetectomy, tumor resection, posterior fusion (levels unspecified) | 9 mos | None       |
| Wang10 (2015) | 8 y     | F               | C5–6, large right epidural mass involving neural foramen | Football     | Partial facetectomy, tumor resection, posterior fusion (levels unspecified) | Unknown | Unknown    |
| Wood11 (2016) | 42 yo   | F               | C3–4, large right exophytic mass involving TP and facet | Football     | Resection - details unspecified | 1 mos | Unknown    |

*Reports with surgical treatment involving arthrodesis and fusion. VB: vertebral body; O: occipital; PT: physical therapy; TP: transverse process

in extraspinal sites, with the rate being cited close to 6% and the median time to malignant transformation being two decades from initial diagnosis. Predicting recurrence in the cervical spine is a challenge given the rarity of cases. It can be presumed that since this tumor arises from metaplastic synovium, osteoarthritic changes...
leading to motion segment instability may contribute to the progression of the tumor, akin to a synovial cyst. We propose that the lack of motion provided by stabilization and fusion after gross total resection prevents tumor recurrence.

**Conclusion**

Cervical synovial chondromatosis is a rare condition. Surgical treatment should focus on complete resection, decompression, and stabilization with arthrodesis and fusion to prevent recurrence. Image-guided biopsy is also recommended before surgery to aid in establishing pathological diagnosis and goals of the surgery.

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**Declaration of patient consent**

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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**Conflicts of interest**

There are no conflicts of interest.

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