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Synovial cysts of the cervicothoracic junction causing myelopathy: report of 3 cases and review of the literature

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Synovial cysts are uncommon pathological entities in patients with cervical degenerative spinal disease, and there are only a few reports in the literature. Treatment typically involves decompression; however, biomechanical data indicate that laminectomies in the cervical spine also result in cervical instability, specifically within the cervicothoracic junction, supporting the use of fusion as well. The authors describe the use of fusion with decompression in the treatment of 3 patients with cervicothoracic synovial cysts that presented in an acute fashion with associated myelopathy and neurological decline, and they review the diagnostic elements, histopathology, and treatment of these cysts. All 3 of the patients did well with decompression via a posterior approach with a single-level instrumented fusion from C-7 to T-1. Each patient regained complete neurological function and had no residual neurological deficits. These results are promising, although the sample size of 3 cases is too small to make any conclusive evaluations. Future studies incorporating Class I and Class II data are imperative to make firm conclusions regarding general management of this rare entity.
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Key Words • **synovial cyst** • **ganglion cyst** • **cervicothoracic** • **facet arthropathy** • **myelopathy** • **cervical spine**

Synovial cysts are an uncommon pathological condition in the cervical spine. The great majority of synovial cysts are found in the lumbar spine,[23,32] making presentation in other spinal regions very rare. Most reports of lower cervical spinal cysts in the literature describe single cases that have not resulted in significant neurological deficits.[5,7,9,11–13,17,21,23,31,34,36,37,41,43,45,50–52,56,58,60] The treatment of choice is posterior surgical decompression. Fusion augmentation is still controversial, but recent studies have supported its use in the lumbar spine, in particular, to avoid recurrence and back pain.[4,59] Here, we present 3 cases of cervicothoracic synovial cysts causing myelopathy and discuss the diagnostic elements, histopathological findings, and treatment.

Case Reports

Case 1

History and Examination. A 65-year-old man presented to the clinic with a 3-week history of numbness in the left leg. The numbness had progressed and involved gait disturbances. At presentation, he had numbness extending from the abdomen to both legs related to myelopathy. A CT scan provided poor visualization of the lower cervical spine because of the patient's body habitus, indicating only moderate facet arthropathy at C6–7 and C7–T1, with no evidence of spinal canal or neural foraminal compromise. Magnetic resonance imaging showed an extradural cystic lesion adjacent to the left C7–T1 facet joint, with centrally high T2 signal and intermediate-to-low T1 signal, and severe compression of the spinal cord. There was peripheral enhancement after administration of gadolinium contrast medium, but the central cystic component demonstrated no enhancement (Fig. 1).

Surgical Intervention and Postoperative Course. The patient underwent C7–T1 laminectomy with microsurgical resection of the cyst using neuromonitoring and C7–T1 instrumented fusion with local bone graft. During resection, the cyst was noted to be adhering to the dura mater. The pathology report indicated that the lesion was consistent with a synovial cyst. In the 3-year follow-up period, the patient has recovered complete neurological function.

Case 2

History and Examination. A 43-year-old man presented with a 1-month history of increasing numbness extend-

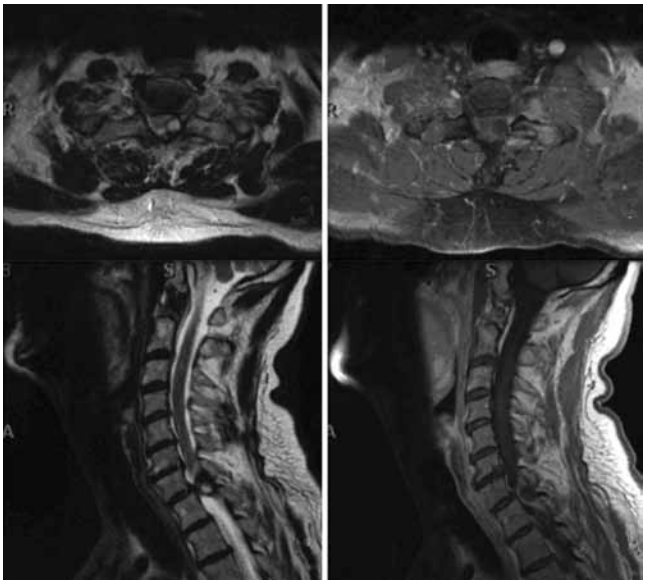

Fig. 1. Case 1. **Left:** T2-weighted MR images showing a cystic formation at C7–T1. **Right:** T1-weighted MR images obtained after administration of a contrast agent showing enhancement of the cystic capsule.

ing to the upper chest and gait disturbances. On physical examination, he presented with a motor deficit of 4/5 in his lower extremities, a normal sensory level at T-3 but altered sensitivity below that level, hyperreflexia, and bilateral Babinski sign. A CT scan demonstrated a 15 × 11–mm extradural cystic–appearing lesion at C-7 in the left posterior aspect of the spinal canal that slightly deformed the cord. Sclerosis and scalloping of the adjacent bone with thinning of the left lamina of T-1 and multilevel facet hypertrophy from C-4 to T-1 were observed. The MRI study, however, showed an extradural cystic lesion in the right posterolateral aspect of C7–T1, with centrally high T2 signal and intermediate-to-low T1 signal, and severe compression of the spinal cord (Fig. 2).

Surgical Treatment and Postoperative Course. The patient was treated surgically with a C7–T1 laminectomy with microsurgical resection of the cyst using neuromonitoring and a C7–T1 instrumented fusion with local bone graft. Histopathologically, the tissue was soft and reddish pink. Microscopically, fragments of fibroadipose and fibrocartilaginous tissues with an inflammatory reaction were observed. No neoplasm was identified. At his 12-month follow-up examination, the patient was completely recovered and had no neck pain.

Case 3

History and Examination. A 58-year-old man presented to the emergency room with numbness from the nipples down. He had been referred from another hospital, where he had been treated with steroids. The patient had had a ground-level fall 6 weeks earlier and had acute onset of numbness in his lower extremities 1 month before presentation. The numbness progressed to a complete loss of sensation and proprioception in his lower extremities up to a T-4 sensory level. On examination, neither motor

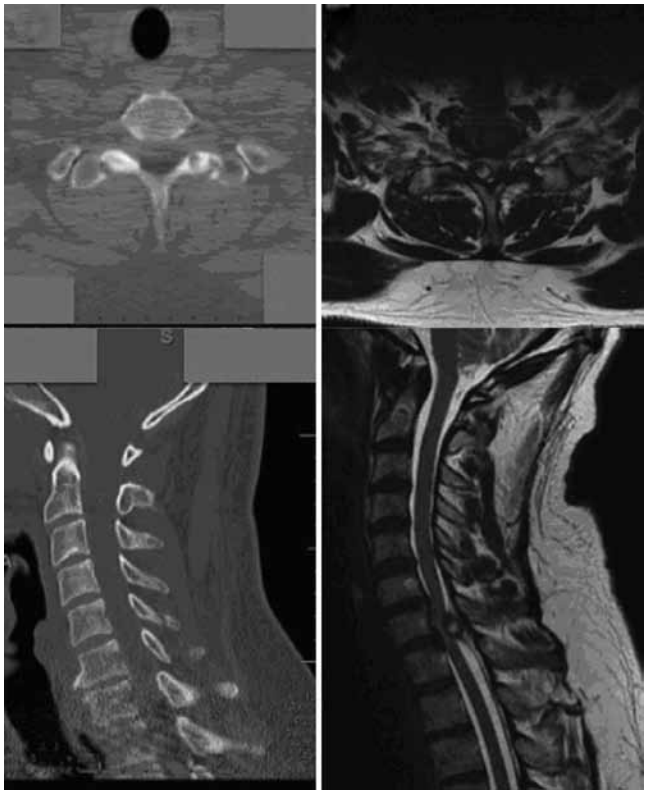

Fig. 2. Case 2. **Left:** CT scans showing a posterior extradural mass at C7–T1. **Right:** T2-weighted MR images without contrast enhancement clearly showing a posterior cystic formation at C7–T1.

deficit nor bladder or bowel dysfunction was found, and his deep tendon reflexes were normal.

Severe generalized cervical degenerative changes were noted on the CT scan, with a 1-cm focus of air lucency projecting into the right posterolateral aspect of the spinal canal at the C7–T1 level, likely representing air within a synovial cyst projecting anteromedially from the right C7–T1 facet joint. The cyst appeared to have a calcified shell, resulting in at least moderate spinal canal stenosis and severe narrowing of the subarticular region. An anterolisthesis in C7–T1 of 2.9 mm was observed. Magnetic resonance imaging showed a severe narrowing of the right subarticular region secondary to a right posterolateral 0.9 × 1.6 × 1.9–cm extradural mass. This mass was characterized by heterogeneous, predominantly low T2 signal, with low T1 signal centrally and T1 signal isointense to the cord peripherally (associated with air signal centrally), and minimal rim enhancement. It had a discrete T2-hypointense rim. A moderate facet arthropathy, greater on the right side, was noted, and an area of high T2 and short-tau inversion recovery (STIR) signal within the cord adjacent to the cyst was identified (Fig. 3).

Surgical Intervention and Postoperative Course. The patient underwent a C7–T1 laminectomy with microsurgical resection of the cyst using neuromonitoring and a C7–T1 instrumented fusion with local bone graft (Fig. 3). Adhesions from the cyst to the dura where found. No complications occurred during the procedure. The pathology report described a red-tan, irregular, bony, soft-tissue

Fig. 3. Case 3. **Left:** CT scans demonstrating a cystic formation containing gas. **Right:** T2-weighted MR images showing the right cystic formation.

fragment measuring 2.0 × 1.5 × 1.1 cm. Microscopically, there were fragments of benign, synovial membrane–lined fibrocartilaginous tissue and bone. The patient had complete neurological recovery immediately postoperatively and minimal neck pain at the 1-month follow-up visit.

Literature Review

A Medline and PubMed search was performed using key words "synovial cyst," "ganglion cyst," "spinal cyst," and "juxtafacet cyst," related to the cervicothoracic junction. The identified articles were reviewed in detail, and other appropriate references were obtained.

Results

We identified 15 papers describing 27 patients with epidural cystic formations in the cervical and thoracic area. Combining these cases with the 3 new cases reported in the present paper yielded 30 cases for analysis.

Epidemiology

Frequency. Among 183 patients who underwent decompressive cervical or thoracic spine surgery performed by the senior author, we found that 1.6% had cysts in the cervicothoracic region.

Age and Sex. Of the 30 identified cases, 22 (76%) involved men, 7 (24%) involved women, and in one case, the patient's sex was not specified, yielding a 3.1:1 male-to-female ratio. The average age was 64.2 ± 10.8 years (range 41–80 years), with most patients presenting in their 7th decade (Fig. 4).

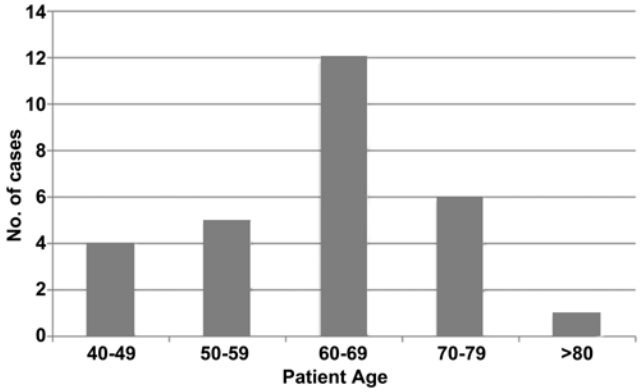

Fig. 4. Graph showing the age distribution (in years) of patients presenting with cervicothoracic synovial cyst.

Clinical Presentation

Myelopathy alone was the most common clinical syndrome, occurring in 15 cases (50%), followed by radiculopathy alone in 14 cases (47%), and mixed symptomatology in 1 case (1%).

Treatment

Posterior decompression and resection was the most common surgical procedure; it was performed in 25 cases (83%). Fusion augmentation was performed in only 4 cases (13%) including the 3 in our series. In 1 case (3%), only conservative treatment was provided because the patient wanted to delay surgery; at the 6-month follow-up, the patient's symptoms had mostly resolved and there was no evidence of the cyst on MR images.[11]

Outcome

In 26 cases (86%) data were available for outcome evaluation. Follow-up data were available for 12 (80%) of the 15 patients who presented with myelopathy; similarly, 13 (92%) of 14 patients who presented with radiculopathy were monitored after surgery. Although the general clinical outcome was favorable in all reports, the best outcome was for patients treated for radiculopathy (Fig. 5).

Only 14 (47%) of the 30 patients were monitored postoperatively, with a mean follow-up of 17.5 ± 16.1 months

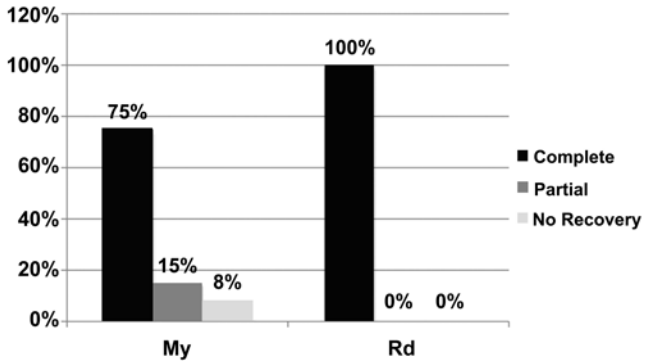

Fig. 5. Graph showing the clinical outcome of myelopathy (My) and radiculopathy (Rd) for patients with synovial cysts in the cervicothoracic junction.

(range 2–60 months). There were no reports of cyst recurrence or postoperative need for fusion after laminectomy.

Discussion

The frequency of synovial cysts in the cervicothoracic junction is unknown. This may be due to the rarity of the entity; we found only 15 papers reporting on synovial cysts in this region (Table 1).[5,7,9,11–13,17,23,36,37,43,50–52,58] However, we report a synovial cyst prevalence of 1.6% among patients who underwent subaxial cervical or upper thoracic surgery performed by the senior author. The first report of a synovial cyst in the cervical spine was in 1974 by Kao et al.[33] The cause of synovial cysts is not yet clearly identified, but they have been related to degenerative spinal facet disease,[42] rheumatoid arthritis,[15] postoperative segmental spinal instability,[30] trauma, spondylolisthesis, and abnormal joint movement.[10,13,41] In our cases, only one cyst related to trauma, and plain radiographs and CT demonstrated degenerative changes in all 3 patients. These degenerative changes can also be age-related, but the mean age of our patients (55.3 years) is younger than that of the typical patient with synovial cysts described in the literature, who is described as being in his or her mid-60s.[10,16] Several theories have been suggested to explain the pathophysiology of these cysts, in particular for ganglion cysts,[52] including the chronic joint capsule weakness theory,[21,46,52] the myxoid degeneration theory,[10,21] the trauma theory,[5,31,39] the inflammatory process theory,[2] and the stress theory.[15,55]

Histologically, cysts related to the facet joints can be classified as "synovial cysts" or as "ganglion cysts," which are also known as "pseudocysts." Synovial cysts (true cysts) rigorously present a capsule with a synovial lining, typically contain a clear and serous fluid, and have a direct connection to the facet joint.[33] In contrast, ganglion

TABLE 1: Summary of symptoms, treatment, and outcome in reported cases of synovial cysts of the cervicothoracic junction*

Authors & Year	Age (yrs), Sex	Symptoms	Treatment	FU (mos)	Recovery
Cartwright et al., 1985	41, M	My	PLR	12	complete
Epstein & Hollingsworth, 1993	47, M	Rd	PLR	NS	NS
Freidberg et al., 1994	NS	My	PLR	60	complete
Kotilainen & Marttila, 1997	64, M	My	PLR	2	complete
Krauss et al., 1998	66, M	Rd	PLR	NS	complete
	69, M	Rd	PLR	NS	complete
	79, F	Rd	PLR	NS	complete
	68, M	Rd	PLR	NS	complete
	58, F	Rd	PLR	NS	complete
	59, M	My	PLR	NS	none
	76, M	Rd	PLR	NS	complete
	65, M	Rd	PLR	NS	complete
	64, F	Rd	PLR + fusion	NS	complete
Cudlip et al., 1999	61, M	My	PLR	6	partial
	61, M	My	PLR	12	complete
Stoodley et al., 2000	65, M	Rd	PLR	5	complete
Shima et al., 2002	66, M	My	PLR	9	partial
	68, M	Rd	PLR	NS	complete
	72, F	My	PLR	NS	complete
Cho et al., 2004	80, M	My	PLR	NS	complete
Miwa et al., 2004	74, F	Rd	PLR	36	complete
Song et al., 2006	74, M	My	PLR	NS	NS
Colen & Rengachary, 2006	58, F	Rd	conservative	6	complete
Christophis et al., 2007	74, F	My	PLR	12	NS
	58, M	My	PLR	12	NS
Vastagh et al., 2008	44, M	My + Rd	PLR	18	complete
Costa et al., 2010	84, M	Rd	PLR	NS	complete
present report	65, M	My	PLR + fusion	36	complete
	43, M	My	PLR + fusion	12	complete
	58, M	My	PLR + fusion	NS	complete

* FU = follow-up; My = myelopathy; NS = not specified; PLR = posterior laminotomy and resection; Rd = radiculopathy.

cysts lack a synovial lining and have a fibrous connective tissue wall instead; the content is characterized by myxoid gelatinous, highly viscous fluid, and even if the cyst is related to the facet joint, there is no direct connection.[50] Ganglion cysts may be also found in the ligamentum flavum.[53,56,60] The term "juxtafacet cysts" has been proposed to encompass both synovial and ganglion cysts.[33] Moreover, there is a possibility that ganglions may be a chronic form of synovial cysts.[18,21,26,29,52] In a 9-case series of cysts in the thoracic spine, synovial cysts made up 34.5% of cases.[10] We present 3 cases of true synovial cysts.

The clinical presentation of patients with synovial cysts can include radiculopathy, myelopathy, neck pain, or a mixture of these syndromes. In the 3 cases that we report, the patients all presented with pure myelopathy. Although the natural history is unpredictable, the 3 patients presented with a progressive myelopathy pattern from 3 to 6 weeks after the onset of symptoms. Radiographs can be used to find nonspecific degenerative changes in the facet joints or adjacent structures and even bone erosion. Dynamic radiographs are useful as a support for the diagnosis of instability associated with a synovial cyst. In patients with instability, an instrumented fusion should be considered as part of the surgical treatment. Neurodiagnostic studies are very helpful to differentiate these cysts from other extradural or intradural compressive syndromes. Myelography is sensitive for demonstrating an extradural lesion, but it is nonspecific.[23] When the cyst is calcified or contains gas, CT scans show a posterolateral round epidural lesion.[23,24,38,45] Otherwise, CT scans are nonspecific. Magnetic resonance imaging is the diagnostic study of choice because of the soft-tissue origin of the cysts. The MRI characteristics of these lesions depend on the content of the cysts.[8,10,24] Signal intensity may be isointense to cerebrospinal fluid in cases in which the cyst contains relatively clear synovial fluid,[24,34] but it may change depending on the protein content,[24] and the presence and age of hemorrhagic products and air,[19] and calcification of the rim.[34] Enhancement of the cystic wall with gadopentetate dimeglumine reflects the relatively increased vascularity of the capsule.[24]

Because synovial cysts may be associated with hemorrhage, inflammation, and bone erosion, misdiagnosis as another pathological condition associated with inflammation or hemorrhage, such as tumor, infection, or other arthropathies, is possible. The differential diagnosis of these cysts must include epidural and some intradural compressive syndromes of the spine.

Misinterpretation of a synovial cyst as an extruded disc herniation on the basis of CT findings has been reported.[46] Neoplasms such as extradural metastases, extradural meningioma, schwannoma (neurinoma), hematopoietic disease (such as lymphoma), chordoma, epidermoid and dermoid cysts,[25] cystic teratomas,[54] and cystic neurofibroma can also be confused for synovial cysts.[20,22]

Spinal meningeal cysts,[40,44] including both extradural arachnoid cysts[28] and Tarlov perineural cysts, should also be considered in the differential diagnosis.[28,34] Several other cysts of the spine can be confused with cervical and thoracic epidural cystic formations. Hydatid cysts[25,28,40] are parasitic cysts caused by *Echinococcus granulosus*, which is endemic to the Middle East, South America, New Zealand, and Mediterranean countries. Ependymal[27,40,47] and enterogenous[40,49,57] cysts also may be confused with synovial cysts.

Surgical intervention is the gold standard for treating a synovial cyst in the cervical spine. We found only a single reported case of a synovial cyst in the cervical spine that was successfully treated conservatively. In that case, the cyst resolved during the 6-month period following diagnosis.[11] Posterior decompression surgery is the treatment of choice for cervical synovial cysts. The role of fusion is still controversial. It has been shown that patients with synovial cysts in the lumbar spine who undergo laminectomy and fusion have lower incidences of cyst recurrence and back pain than those who undergo laminectomy alone.[4,59] When patients with lumbar synovial cysts are treated with decompression alone, there is a greater possibility of the development or progression of listhesis than when they are treated with decompression and fusion.[16] Presentation in the cervicothoracic junction, such as in the cases we describe, has special biomechanical characteristics, because the rigid thoracic spine meets the flexible cervical spine at this junction, and there is a higher risk of instability than in other areas of the cervical or thoracic spine.[3,6,48] Laminectomies performed to treat other pathological conditions have been demonstrated to cause instability in this region, and so fusion is suggested.[1,14,35] Therefore, to avoid instability, cyst recurrence, and postoperative neck pain, we suggest augmenting resection of the cyst with a short-segment pedicle-instrumented C7–T1 fusion.

Disclosure

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author contributions to the study and manuscript preparation include the following. Conception and design: Schmidt. Acquisition of data: Sauri-Barraza, Niazi. Analysis and interpretation of data: Bisson, Sauri-Barraza, Niazi. Drafting the article: Bisson, Sauri-Barraza, Niazi. Critically revising the article: Schmidt, Bisson. Reviewed submitted version of manuscript: Schmidt, Bisson, Sauri-Barraza. Approved the final version of the manuscript on behalf of all authors: Schmidt.

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