Synovial cysts of the thoracic spine

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Object. Thoracic synovial cysts (TSCs) are rare and are usually the subject of case reports. The authors studied the clinical manifestations, radiological aspects, and surgical treatment in a series of patients at their institution who harbored TSCs. They also review the literature to discuss the potential factors involved in the pathogenesis of this lesion.

Methods. A database search of 16,000 patients who underwent decompressive spine surgery at the Mayo Clinic (Rochester, MN) between 1976 and 2003 disclosed nine patients (0.06%) in whom a diagnosis of TSC had been made. All patients were men. The mean age at presentation was 73 ± 5 years and mean duration of symptoms was 5 ± 3 months. The mean duration of follow up was 4 ± 3 years. The patients had no history of trauma or spine surgery. All patients had spastic paraparesis; two had urinary difficulties.

Detailed neurological examination revealed myelopathy and radiculopathy with a sensory level of T10-L4. Magnetic resonance imaging revealed bilateral cysts in four patients and unilateral lesions in five. Three of the cysts were at the T-10 interspace, seven at the T-11 interspace, and three at the T-12 interspace. Seven cysts were on the right and six were on the left. Computerized tomography myelography performed in five patients revealed a gas bubble in the TSC in two patients. All patients underwent laminectomy/partial facetectomy, excision of the cyst, and decompression of the thecal sac and nerve root without any complications. None of these patients underwent a fusion. Eight patients (89%) experienced moderate to excellent relief of their preoperative signs and symptoms and one patient (11%) remained stable. There was no evidence of cyst recurrence at the site of surgery or other spinal segments at follow-up examination in any patient.

Conclusions. When compared with their lumbar and cervical spine counterparts, TSCs are exceedingly rare. Their rarity may be explained by the decreased mobility of the thoracic spinal segments. The origin of TSCs is more likely degenerative rather than traumatic. Based on their experience and the follow-up duration, surgery provided durable relief from symptoms.

KEY WORDS • juxtafacet cyst • myelopathy • synovial cyst • thoracic spine • laminectomy

SYNOVIAL cysts of the spine are found within lumbar1,3,17,25,31,41,43,45 and less commonly cervical spine15,29,33,36,43 segments. They may cause myelopathy through spinal cord compression; they may cause radiculopathy through nerve root compression. These intraspinal extradural cysts arise from the facet capsules of degenerative facet joints and are known as synovial,10,11,21 juxtafacet,31,33 ganglion,8 or ligamentum flavum cysts.1 The term juxtafacet or ganglion cyst may be more appropriate because these cysts do not consistently have a true synovial lining. These extradural cysts may be found incidentally. Hemorrhage or gas entrapment in the cyst may cause axial pain and/or myeloradicular symptoms.

The paucity of TSCs has led to numerous case reports documenting their occurrence along the thoracic spine.5,14,17,18,20,22,23,25,35,37 The purpose of this study was to analyze the clinical features and possible factors involved in the pathogenesis of a series of surgically verified TSCs.

Abbreviations used in this paper: CSF = cerebrospinal fluid; CT = computed tomography; MR = magnetic resonance; SD = standard deviation; TSC = thoracic synovial cyst.

Clinical Material and Methods

Patient Population

Between 1976 and 2003, approximately 16,000 patients underwent decompressive spine surgery for various degenerative and nondegenerative spinal lesions at the Mayo Clinic, Rochester, Minnesota. Among these, nine consecutive patients (0.06%) harbored synovial cysts of the thoracic spine based on the histopathological examination of the resected cystic lesion. All patients were male with a mean age at diagnosis of 73 ± 5 (SD) years. The mean duration of their symptoms was 5 ± 3 (SD) months. We studied the clinical manifestations, neuroimaging aspects, surgical treatment, and outcome of these patients based on a retrospective review of their charts. This study was approved by the Mayo Clinic Institutional Review Board and all patients gave consent regarding their participation.

Neuroimaging Data

A single senior staff neuroradiologist (G.M.M.) reviewed all the imaging data available in these patients.
Thoracic synovial cysts

Preoperative MR imaging examinations were performed in eight patients (seven with contrast) and preoperative CT myelograms were obtained in five patients. Four patients underwent both studies. All imaging studies were retrospectively reviewed with knowledge of the surgical results. The MR studies were evaluated for the degree of spinal canal stenosis (mild, moderate, or severe), presence or absence of T₂-weighted signal change within the spinal cord at the level of the cyst, size of the cyst, T₁- and T₂-weighted signal characteristics of the cyst relative to the adjacent ligamentum flavum, cyst wall enhancement characteristics (none, solid, or peripheral), and presence or absence of facet degeneration. The CT myelograms were evaluated for the degree of spinal canal stenosis, the presence or absence of calcification/gas within the cyst, and facet degeneration.

Surgical Technique

Through a posterior approach, a laminectomy and tailored facetectomy were performed. Adequate bone removal allowed a wide exposure of the cyst margins, dural tube, and the compressed nerve root. The cyst was often adherent to the dural sac, requiring microsurgical techniques for its dissection. The cyst was decompressed initially and then separated from dura. The medial portion of the facet was removed. We did not routinely perform curettage or totally resect the facet joint synovium.

Postoperative Outcomes

Surgical outcomes were determined using postoperative clinical notes. Specifically, we assessed spine pain, radicular chest or abdominal wall pain, motor sensory deficits, ambulation, and the patients' overall subjective satisfaction. The mean duration of follow up was 4 ± 3 (SD) years.

Results

Clinical Features

There was no history of trauma or spine surgery in any patient. All patients had spastic paraparesis; two also had urinary difficulties. Preoperative detailed neurological examination by a staff neurologist revealed myelopathy and radiculopathy with a sensory level (T₁₀–L₄) in all patients. The clinical features of these patients are summarized in Table 1.

Neuroimaging Data

Thirteen synovial cysts were identified in nine patients. Four patients had bilateral cysts at the same level. Three of the cysts were at the T₁₀ interspace, seven at the T₁₁ interspace, and three at the T₁₂ interspace. Seven cysts were on the right and six were on the left.

Magnetic resonance studies were available for review in eight patients with 12 synovial cysts. All 12 cysts were identified. Moderately severe (four patients) to severe central canal stenosis (four patients) was present in all eight patients at the level of the cyst. Cord T₁ signal was present in five of the patients. The cysts ranged in size from 5 to 10 mm, with a mean size of 7 mm. On T₁-weighted sequences, four cysts were hypointense to ligamentum flavum signaling, which was similar to CSF (33%), six cysts were isointense and indistinguishable from the ligament (50%) and two cysts were hyperintense (17%). On T₂-weighted sequences, eight cysts showed high T₂-weighted signal similar to that of CSF (67%) and four were hypointense (dark) relative to the ligamentum flavum (33%). Of the eight cysts with high T₁ signal changes, two had a thin dark rim and six had a much thicker dark rim. Most (78%) showed peripheral enhancement after contrast administration (Fig. 1). All 12 synovial cysts were associated with degenerative changes in the adjacent facet joint.

Computerized tomography myelograms were available for review in five patients with seven synovial cysts. All seven cysts were identified as a postero-lateral extradural defect at the level of the facet joint. The degree of central canal stenosis ranged from mild (one patient) to moderate (one patient) to severe (three patients). Calcifications (57%) and gas (71%) within the cysts were common findings. All seven synovial cysts were associated with degenerative changes in the adjacent facet joint. No spondylolisthesis was noted on imaging in any patient (Fig. 2).

In the four patients who underwent both MR imaging and CT myelography a total of seven cysts were found at surgery. Two cysts were seen equally well on both studies and five cysts were better visualized on the CT myelography.

<table>
<thead>
<tr>
<th>Case No.</th>
<th>Age (yrs), Sex</th>
<th>Symptom/Sign (duration in mos)</th>
<th>Imaging Level/Side</th>
<th>Outcome/Duration (yrs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>74, M</td>
<td>paraparesis, ataxia, T₁₀ sensory level (6)</td>
<td>T₁₀/bilat</td>
<td>improved/3</td>
</tr>
<tr>
<td>2</td>
<td>65, M</td>
<td>paraparesis, ataxia, L₁ sensory level, sphincter dysfunction (3)</td>
<td>T₁₁/bilat</td>
<td>recovery/3</td>
</tr>
<tr>
<td>3</td>
<td>68, M</td>
<td>paraparesis, ataxia, T₁₂ sensory level, sphincter dysfunction (2)</td>
<td>T₁₁/bilat</td>
<td>improved/7</td>
</tr>
<tr>
<td>4</td>
<td>75, M</td>
<td>paraparesis, ataxia, T₁₂ sensory level (3)</td>
<td>T₁₁/bilat</td>
<td>recovery/2</td>
</tr>
<tr>
<td>5</td>
<td>81, M</td>
<td>paraparesis, L₁ sensory level (3)</td>
<td>T₁₁/bilat</td>
<td>improved/10</td>
</tr>
<tr>
<td>6</td>
<td>67, M</td>
<td>paraparesis, T₁₀ sensory level (12)</td>
<td>T₁₀/bilat</td>
<td>improved/3</td>
</tr>
<tr>
<td>7</td>
<td>76, M</td>
<td>paraparesis, L₄ sensory level (8)</td>
<td>T₁₁/bilat</td>
<td>improved/0.5</td>
</tr>
<tr>
<td>8</td>
<td>72, M</td>
<td>bilat LE pain, unsteady gait, paraparesis, L₁–₂ sensory level (2)</td>
<td>T₁₂/bilat</td>
<td>improved/3</td>
</tr>
<tr>
<td>9</td>
<td>75, M</td>
<td>bilat LE paresthesias, paraparesis, T₁₂ sensory level (7)</td>
<td>T₁₂/bilat</td>
<td>no improvement/1.5</td>
</tr>
</tbody>
</table>

* LE = lower-extremity.
Histopathological Examination

The cysts contained a capsule of partially calcified connective tissue. Synovial lining was evident in five specimens. Four others lacked a synovial lining and were noted to be ganglion cysts. Two cysts were noted to contain blood products. The contents of these cysts were clear, mucinous, gelatinous, or caseous.

Surgical Outcomes

There were no surgical complications. None of these patients underwent a concomitant or subsequent fusion procedure for spinal instability. Eight patients (89%) experienced moderate to excellent relief of their preoperative signs and symptoms, and one patient’s (11%) neurological status remained unchanged. There was no clinically symptomatic cyst recurrence at the site of surgery or other spinal segments in any patient.

Discussion

The present study has combined a series of patients with those reported in the literature to draw more meaningful conclusions regarding the characteristics of synovial cyst lesions. The proposed pathological substrates responsible for the development of spinal synovial cysts include facet arthrosis, spondylolisthesis, and trauma. The pathophysiology of these lesions may involve facet degeneration and areas of focal weakness in the joint capsule caused by repetitive motion due to instability followed by herniation of synovium and formation of the synovial cyst. Myxoid degeneration, increased production of hyaluronic acid, and nonspecific proliferation of mesenchymal cells are also proposed mechanisms of cyst development and enlargement. Sometimes the cyst will lose its connection with the facet joint. Features of both ganglion and synovial cysts have been reported in a single lesion, supporting the hypothesis that ganglion cysts may develop from synovial cysts disconnected from the facet joint. Hemorrhage into the cyst may cause acute neurological deterioration.

All the TSCs in our series were found at T10–12 interspaces. The T10–12 segments may be considered the transitional zone between the relatively immobile thoracic segments and highly mobile lumbar segments. Such differences in the degree of mobility between the neighboring spinal segments at the thoracolumbar junction may increase the biomechanical loading and torsional stress, hence accelerating the degenerative changes in the T10–12 facets. This phenomenon may not only explain the preponderance of the TSCs in the lower thoracic spine but also may explain the common occurrence of the synovial cysts at L4–5 facet joints or other spinal segments prone to spondylolisthesis. The same rationale has been used to explain the predilection of the herniated thoracic discs for the lower thoracic spine. The location of synovial cysts described in the literature is consistent with such a hypothesis because seven (64%) of 11 of these cysts were demonstrated at T9–12 interspaces (Table 2). Accurate recognition of a synovial cyst compared with a thoracic disc is important because the surgical approach for the resection of these two lesions is quite different.

This review of the cases reported to date reveals a mean patient age of 57 years at presentation. One young patient at age 24 years presented with a T-7 synovial cyst after a football accident. It is conceivable that trauma may be a predisposing factor for formation of synovial cysts in younger patients. Only two patients were reported to harbor bilateral cysts. Almost all cases were approached through a laminectomy and the results were satisfactory.

In our present series, no patient had a history of significant trauma. The mean age at presentation was 73 years. The attendance of synovial cysts in older patients may indicate a degenerative origin for these lesions. In addition, all patients revealed significantly increased concomitant facet
Thoracic synovial cysts

spondylitic changes at the level of their synovial cyst compared with other adjacent spinal levels on imaging.

Neuroimaging Data

Thoracic synovial cysts are an uncommon complication of degenerative spinal facet disease. Their MR appearance was variable because of their complex composition: they could contain hemorrhagic products, calcium, gas, or high-protein fluid.

The most common MR signal pattern observed in 33% of the cysts was an extradural lesion that was isointense to ligamentum flavum on T1- and high signal on T2-weighted studies. The classic dark T1-weighted, bright T2-weighted cyst was present in only three of the cysts (25%). The two cysts with high T1 signal proved to be hemorrhagic at surgery. One heavily calcified cyst at surgery was seen to have low signal on both the T1- and the T2-weighted sequences, making it difficult to diagnose prospectively. Peripheral enhancement of the cyst wall was common (78%), making contrast-enhanced studies very useful in identifying the synovial cyst, particularly those that were isointense to the ligamentum flavum on T1-weighted sequences and dark on T2. The peripheral enhancement of the cyst wall presumably results from vascularity or surrounding inflammation. Concomitant spinal stenosis (100%) and cord edema (63%) account for the myelopathic symptoms that bring these patients to clinical attention.

The most common CT myelography finding was an extradural defect at the level of a degenerated facet posteriorly contiguous with a degenerated facet joint containing calcium or gas.23,29,48 Gas in the cyst is presumably due to vacuum phenomenon within the degenerated facet joint.23 Distraction of the facet joint during flexion may produce a negative pressure within the capsule, causing transfer of the gas into the joint space.25

Computerized tomography myelography and MR imaging correctly identified all seven cysts in the five patients who underwent both examinations. Five of the cysts were better seen on the CT myelography only because they contained gas or calcification. There was no particular advantage to either examination, because all the synovial cysts in both studies could be identified. The MR imaging study would be preferable as it is noninvasive and does not require a lumbar puncture.

TABLE 2

Clinical demographics in patients included in the literature

<table>
<thead>
<tr>
<th>Authors &amp; Year</th>
<th>Age (yrs), Sex</th>
<th>Symptom/Sign</th>
<th>Level/Side</th>
<th>Procedure</th>
<th>Outcome/Duration (mos)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Holtzman, et al., 1987</td>
<td>72, M</td>
<td>paraparesis, sphincter dysfunction</td>
<td>T-12/bilat</td>
<td>laminectomy</td>
<td>excellent</td>
</tr>
<tr>
<td>Awwad, et al., 1991</td>
<td>69, F</td>
<td>rt LE paresis, T-10 sensory level</td>
<td>T-7/rt</td>
<td>laminectomy</td>
<td>excellent/2</td>
</tr>
<tr>
<td>Lopez, et al., 1992</td>
<td>45, M</td>
<td>lt flank pain, T-10 hypesthesia</td>
<td>T-9/lt</td>
<td>laminectomy, discectomy</td>
<td>excellent/36</td>
</tr>
<tr>
<td>Doherty, et al., 1993</td>
<td>80, M</td>
<td>paraparesis, T-10 sensory level</td>
<td>T-9/bilat</td>
<td>laminectomy</td>
<td>excellent</td>
</tr>
<tr>
<td>Freidberg, et al., 1994</td>
<td>60, M</td>
<td>bilat radicular leg pain, rt LE weakness</td>
<td>T-11/rt</td>
<td>laminectomy</td>
<td>excellent/60</td>
</tr>
<tr>
<td>64, F</td>
<td>paraparesis, T-12 sensory level</td>
<td>T-11/rt</td>
<td>laminectomy</td>
<td>excellent/48</td>
<td></td>
</tr>
<tr>
<td>Hodges, et al., 1994</td>
<td>51, F</td>
<td>thoracic pain</td>
<td>T-4/rt</td>
<td>laminectomy</td>
<td>excellent</td>
</tr>
<tr>
<td>Howington, et al., 1999</td>
<td>radicular pain</td>
<td>T-8</td>
<td>laminectomy</td>
<td>excellent</td>
<td></td>
</tr>
<tr>
<td>Lynn, et al., 2000</td>
<td>24, M</td>
<td>leg paresthesias, ataxia</td>
<td>T-7/rt</td>
<td>laminectomy</td>
<td>return to sports/wks</td>
</tr>
<tr>
<td>Graham, et al., 2001</td>
<td>54, F</td>
<td>paraparesis</td>
<td>T-11/rt</td>
<td>laminectomy/fusion</td>
<td>excellent/24</td>
</tr>
</tbody>
</table>

Fig. 2. Case 3. Upper: Computerized tomography myelography obtained in the prone anteroposterior view revealing high-grade obstruction to the flow of contrast at the T-11 interspace by an extradural lesion on the right. Lower: The postmyelogram CT revealing that the extradural lesion is adjacent to the right T-11 facet joint and contains gas.

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The differential diagnosis of an extradural mass on MR imaging includes neoplasm and a herniated disc fragment. The presence of a posterosateral T2-weighted hyperintense cyst, adjacent to a degenerated facet, with a rim that is hypointense on T2-weighted imaging but enhancing with administration of contrast may lead to a correct imaging diagnosis of a benign synovial cyst.

Treatment Modalities

Authors of some reports have documented spontaneous resolution of symptomatic synovial cysts. The use of corticosteroid injections and CT-guided aspiration of the cyst contents may be successful in temporary treatment of pain; however, only surgical treatment has been proven to be associated with a minimal rate of recurrence. Surgery therefore remains the most efficacious treatment for spinal synovial cysts.

Conclusions

Synovial cysts are very rare in the thoracic spine. Recognition of their characteristic MR imaging findings of an extradural mass arising from a degenerated facet joint with enhancing T2-weighted low signal intensity rim may result in an accurate diagnosis and selection of treatment strategies.

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References

Thoracic synovial cysts


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