Cervical Spondylosis, Stenosis, and Rheumatoid Arthritis

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Cervical Spondylosis/Stenosis

Cervical spondylosis is common and progresses with increasing age. It is the result of degenerative changes in the cervical spine, including disc degeneration, facet arthropathy, osteophyte formation, ligamentous thickening and loss of cervical lordosis. Spinal stenosis, or narrowing of the spinal canal, may occur as a result of progression of spondylotic changes. Spinal cord or nerve root function may be affected, resulting in symptoms of myelopathy or radiculopathy.

Natural History and Epidemiology

Spinal cord compression resulting from spondylotic changes is usually a slow and progressive process. Many patients have evidence of significant compression on imaging studies but are asymptomatic. Most cases of myelopathy develop in a stepwise fashion described by episodes of exacerbation of symptoms and worsening function followed by long periods of static function. Fewer patients have steady progressive deterioration. With vascular insufficiency, acute onset may occur with devastating, irreversible ischemic changes occurring within the cord.

Approximately 25% of individuals younger than forty years of age, 50% of individuals over forty years of age, and 85% of individuals over sixty years of age have some degree of disc degeneration.

Pathophysiology

The pathoanatomy of cervical spondylosis results from the sequelae of the aging process in the spine, specifically, disk degeneration with hypertrophic osseous and ligamentous changes. Disk desiccation is accompanied by biochemical changes, with a relative increase in the ratio of keratan sulfate to chondroitin sulfate. The loss of elasticity and total disk substance results in a decrease in disk height with annular bulging. This altered biomechanical environment stimulates formation of chondro-osseous spurs at the annular insertion near the end-plates.

The uncovertebral joints hypertrophy, which may lead to foraminal stenosis. The posterior zygapophyseal joints can also become arthritic, causing foraminal narrowing. The ligamentum flavum thickens and sometimes buckles as a result of the loss of disk height. These degenerative changes can result in cervical stenosis with spinal cord compression. Concomitant straightening of cervical lordosis (or even kyphosis), disk herniations or protrusions often may accentuate the problem because the spinal cord will be stretched over the posterior aspect of the disks and vertebral bodies.

Cervical spondylosis will typically result in stiffening of the spinal motion segments. It is not uncommon for the motion segments one or two levels above the stiff segments to become hypermobile. The resulting instability may lead to dynamic cord compression.

Radiculopathy is due to biochemical and biomechanical changes that occur with age as a result of the degenerative cascade and lead to disc herniation or foraminal narrowing. The intervertebral disc gradually loses height, posterior portions of the disc bulge into the spinal canal and the neuroforamina, the ligamentum flavum and facet joint capsule infold, and osteophytes form. All of this leads to decreases in canal and foraminal size. Subluxation and hypermobility between vertebral bodies may occur. The pain that occurs as a result of nerve root compression is thought to be mediated by an inflammatory response as well as nerve root edema and fibrosis.

Clinical Presentations

Axial Neck Pain

Neck pain is an extremely common but nonspecific presenting symptom. It is often associated with stiffness and headaches. The pain or soreness is usually in the paramedian neck muscles posteriorly, with radiation toward the occiput or into the shoulder, arm and periscapular regions. The referred pain does not follow a dermatomal distribution. Deep palpation of some of these areas results in reproducible patterns of referred pain. Determining the source of neck pain can be a diagnostic challenge. New pain patterns may develop as a result of postural adaptations and compensatory overuse of normal tissues further confusing the clinical picture. Shoulder pathology sometimes presents with pain referred to the neck. A careful history should be obtained to rule out inflammatory arthritis or an infectious or neoplastic process.

Figure 1: Lateral cervical spine x-rays of a patient with degenerative cervical spondylosis showing disk space narrowing, end-plate sclerosis and osteophytes.
Cervical Radiculopathy

Cervical radiculopathy refers to symptoms in a specific dermatomal distribution in the upper extremity. Severe neck and arm pain is typical, partially alleviated by holding the arm over the head or tilting the head to the contralateral side. Patients may report sensory or motor loss corresponding to the involved nerve root. On physical exam, symptoms are aggravated by extension and lateral rotation of the head (Spurling Maneuver). Sensory deficits, motor deficits, and diminished reflex activity may be elucidated on exam. Care should be taken to differentiate cervical radiculopathy from compressive lesions of nerves of the upper extremity (i.e. carpal tunnel syndrome, cubital tunnel syndrome) and electrodiagnostic studies can often be useful. Additionally, patients with metabolic disorders, such as diabetes, who have neuropathy may be more susceptible to radiculopathy and compressive neuropathy.2,8

Cervical Myelopathy

The patient with cervical spondylotic myelopathy may present with subtle findings that have been present for years or with quadriparesis that developed over the course of a few hours. If the cord compression and myelopathy are either moderate or severe, patients complain of gait and balance abnormalities involving the lower extremities. They also have numbness or paresthesias in their upper extremities. Fine motor control is usually affected as well, and they will note changes in their handwriting or ability to manipulate buttons or zippers. Arm weakness is common. Leg weakness can occur, and patients may notice problems moving their body weight, such as is necessary when rising out of a chair or going up stairs. The proximal motor groups of the legs are more involved than the distal groups. Changes in bowel or bladder function can occur in extremely severe cases of myelopathy. On physical examination, the findings that establish the diagnosis are brisk reflexes, clonus, or pathological reflexes confirming an upper-motor-neuron lesion.1,9

Diagnosis

Plain radiographs are an important part of the diagnostic workup, and anteroposterior (AP), lateral, and flexion-extension views of the cervical spine should be obtained in essentially all patients with neck pain or neurologic symptoms. Typical radiographic manifestations of cervical spondylosis include disk-space narrowing, end-plate sclerosis, and osteophytic changes at the end-plates, uncovertebral joints, and facet joints. (Figure 1) The AP view allows identification of cervical ribs and scoliotic deformity. The lateral view demonstrates the degree of disk narrowing, the size of end-plate osteophytes, the size of the spinal canal, and overall sagittal alignment which may influence the choice of surgical procedure. Flexion-extension views are critical to diagnose instability, which may not be evident on a neutral lateral view. Oblique views can be used for visualizing foraminal narrowing, which is typically due to uncovertebral joint spurs.

Magnetic resonance imaging (MRI), while not indicated for every patient with neck pain, is the next step in the evaluation of the patient with a presumed diagnosis of spondylosis with myelopathy or radiculopathy. Persistent neck or arm pain of several months duration, neurologic findings, or a worsening symptomatic picture warrants MRI. If evidence of myelopathy is present on exam, MR imaging is indicated to assess for disk herniation, hypertrophy, buckling of the ligamentum flavum and the degree of cord compression. One of the strengths of MR imaging is the ability to visualize the spinal cord, its size, shape, quality (pathologic changes) and degree of compression.10,11

Although MR imaging provides optimal visualization of soft tissues, CT-myelography offers better definition of bone spurs or ossified posterior longitudinal ligament (OPLL). The exact degree of cord deformation in the transverse plane is more sharply visualized with CT-myelography as well. This modality is also useful when MRI is contraindicated.

Lastly, electrodiagnostic studies are sometimes used. For patients with cervical radiculopathy, electromyographic–nerve conduction studies may be useful in considering the differential diagnosis of carpal tunnel syndrome, ulnar cubital tunnel syndrome, or thoracic outlet syndrome. Electrodiagnostic modalities may also help elucidate the confusing clinical presentations of amyotrophic lateral sclerosis, multiple sclerosis, and severe peripheral neuropathy.1

Treatment

Axial Neck Pain

Nonoperative treatment is the standard for discogenic and axial neck pain. Nonsteroidal anti-inflammatory agents, narcotic analgesics, corticosteroids, muscle relaxants, and antidepressants are commonly used to relieve neck pain and radiculopathy. A short period of rest and the use of a soft collar with the neck in mild flexion may sometimes alleviate acute pain and spasm. Physical therapy, including isometric exercises, active range-of-motion exercises, aerobic conditioning, and resistive exercises, has been found to be helpful for patients with chronic neck pain.12 In one study, nonoperative management resulted in complete resolution

Figure 2: AP (a) and lateral (b) views of a patient who had an anterior cervical decompression and fusion at C5-C6
of symptoms in 43% of the patients and partial resolution in 25%, whereas 32% had continued moderate or severe pain.\textsuperscript{12} In rare cases, some patients who fail conservative management may improve with surgery for discogenic axial neck pain.

**Radiculopathy**

Cervical radiculopathy is first treated with conservative, nonoperative measures as described above. Additionally, some authors have reported that epidural injections may be of short-term benefit to patients with radiculopathy.\textsuperscript{13,14} Surgery is an option for patients with persistent cervical radiculopathy and disabling radicular pain following failure of nonoperative measures. These patients should have neuroimaging studies demonstrating a pathological condition that correlates with clinical findings and physical exam. Surgery is also an option for patients with a progressive motor deficit or a disabling motor deficit from the radiculopathy.\textsuperscript{15} Surgical treatment options include \textit{anterior cervical discectomy and fusion (ACDF)} (Figures 2a and 2b), total disc arthroplasty (Figures 3a and 3b), or posterior decompression with fusion.

**Myelopathy**

Treatment of myelopathy is generally surgical. Mild cases of myelopathy, usually consisting of mild upper extremity symptoms, may respond to nonoperative treatment but rarely resolves completely. In one prospective randomized study patients with mild-to-moderate nonprogressive or slowly progressive myelopathy were found to have similar outcomes after either nonoperative or operative treatment.\textsuperscript{16} Another study reports that trial of nonoperative treatment did not decrease the potential for ultimate recovery of patients with mild myelopathy.\textsuperscript{17} Patients with severe or progressive myelopathy are candidates for surgical intervention. A number of factors such as the degree of neurologic dysfunction, patient disability, findings on radiographs and magnetic resonance imaging, duration of symptoms, and presence of comorbidities are considered in the decision regarding when to proceed with surgery.

Surgical treatment options include anterior decompression utilizing either discectomy and fusion (for single level disease) or corpectomy with strut graft fusion (for multilevel disease). Posterior decompressive procedures also can be used to treat cervical myelopathy. These procedures include laminoplasty (a canal expanding procedure that maintains stability posteriorly) (Figure 4a and 4b) or laminectomy with instrumentation and fusion.

**RHEUMATOID ARTHRITIS OF THE CERVICAL SPINE**

Rheumatoid arthritis of the cervical spine is not as common as degenerative arthritis but up to 90% of patients with the diagnosis of rheumatoid arthritis have radiographic changes within the cervical spine.\textsuperscript{18} Many of these patients have mild symptoms of pain. Some may be even symptomatic while others may go on to develop severe pain and significant neurologic deficit.

Cervical spine involvement may be overlooked in spite of the fact that after the hands and feet, cervical spine is the most common site of disease involving rheumatoid arthritis.\textsuperscript{19} The involvement of the cervical spine may be difficult to detect due to systemic complaints or lack of clear neurologic deficit on physical exam. It is therefore imperative that the treating physician be well aware of the natural history as well as the clinical presentation in deciding what treatment options are available for patients with rheumatoid arthritis.
Pathophysiology

Rheumatoid arthritis is a systemic disease characterized by inflammation and eventual destruction of the synovial joints. The cervical spine has 22 synovial joints and the inflammatory process may mirror that which occurs in synovial joints throughout the body.18 The course of the disease in any patient is unpredictable. It may be very progressive. It may be characterized by intermittent flare-ups and remissions. In the cervical spine rheumatoid arthritis may lead to instability, subluxation and spinal cord compression. Three characteristic patterns of instability have been described. The most common area of involvement is the atlanto-axial or C1-C2 level. Synovitis results in eventual destruction of the transverse ligament as well as bone erosion of the odontoid process. Atlanto-axial subluxation occurs in up to 49% of patients.20 Sub-axial subluxation is the second most common type and it is due to destruction of the facet joints below the C2 level. (Figure 5) It results in the characteristic staircase deformity and occurs in approximately 30% of patients with rheumatoid arthritis.21 The third type of subluxation is atlanto-axial impaction with vertical subluxation of the axis. It occurs as C1, C2 and the occiput settle due to erosion of the joints. It can lead to brain stem compression as the odontoid enters the foramen magnum. This occurs in 12-30% of rheumatoid patients.21

Clinical Presentation

Neck pain is the most common presenting symptom in patients with rheumatoid arthritis. It can be present in up to 80% of the patients.18 Some patients with atlanto-axial subluxation can have a clunking sensation during neck extension with reduction of atlanto-axial subluxation. This has been labeled a positive sharp-purser test.22 Additionally, patients may complain of stiffness, crepitance and painful range of motion.

Depending upon the location of the pathological process patients may also present with paresthesia in the upper extremity as well as weakness involving both upper and lower extremities. Objective neurologic signs have been found to be present in seven to 34% of patients.18 If significant compression of the spinal cord occurs myelopathy will develop causing significant weakness in addition to gait disturbance. Subluxation may also cause occlusion of vertebral arteries and vascular insufficiency to the spinal cord and brain stem as well as the cerebellum. Patients may present with cranial nerve palsy, paraplegia and even sudden death.23

The classification system of Ranawat is commonly used to characterize the neurologic status of patients with rheumatoid arthritis.

Diagnostic Imaging

Even asymptomatic patients with known systemic rheumatoid arthritis should have periodic radiographs with flexion/extension views. Early detection of subluxation and close follow-up prevents the development of serious neurologic complications.

If there is concern about the upper cervical spine with regard to the possibility of bone erosion a CT scan can be very beneficial. If the clinical history and exam reveals neurologic deficit then an MRI of the cervical spine is the diagnostic study of choice.

Treatment

Non-surgical Treatment

While up to 90% of patients with rheumatoid arthritis will have some involvement of the cervical spine only about ten percent will become symptomatic enough to warrant surgical intervention. Patients with early cervical disease, intermittent pain and without radiographic instability or myelopathy can benefit from early aggressive medical treatment. This includes the use of non-steroidal anti-inflammatory medications, mild analgesics and disease modifying anti-rheumatic drugs (DMARD).26 In addition, the use of soft collars are appropriate and patients seem to benefit greatly from a comprehensive program of patient education, physical therapy with specific focus on isometric strengthening of neck muscles and postural training.

Classification System of Ranawat

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
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<tbody>
<tr>
<td>I</td>
<td>No neurologic deficit</td>
</tr>
<tr>
<td>II</td>
<td>Subjective weakness, hyperreflexia, dysethesis</td>
</tr>
<tr>
<td>III</td>
<td>Subjective weakness and long tract signs</td>
</tr>
<tr>
<td>a.) Ambulatory</td>
<td></td>
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<tr>
<td>b.) Quadriparetic non-ambulatory</td>
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Indications for radiographs of cervical spine in rheumatoid arthritis patients

1. Prolonged cervical symptoms greater than 6 months
2. Neurologic signs or symptoms
3. Scheduled operative procedure requiring endotracheal intubation
4. Rapid progressive destruction of carpal or tarsal bones
5. Rapid overall functional deterioration.
Surgical Treatment

As with any surgery it is imperative that a thorough pre-operative assessment be carried out in what is typically a very frail patient population. Serious consideration should be given to surgery in patients with progressive neurologic deficit as a result of spinal cord compression due to subluxation. In addition surgery for patients experiencing severe unrelenting pain unresponsive to medication are surgical candidates. Relative indications for surgery include patients who show radiographic risk factors of impending neurologic injury, particularly when the space available for the spinal cord is 14 mm or less due to subluxation.

Goals of surgical treatment in rheumatoid arthritis of the cervical spine are to decompress the spinal cord, achieve spinal stability through fusion across the unstable segment, and to prevent irreversible neurologic deficit and to avoid catastrophic functional decline.27,28

Surgical treatment of patients with rheumatoid arthritis of the cervical spine can be successful. Over the past decade outcomes have improved considerably as a result of earlier diagnosis of myelopathy and more aggressive medical management.29,30

Patients with rheumatoid arthritis have an overall higher complication rate than the general population. Complications include infection, instrument failure and lack of solid fusion in up to 25% of the patients. The peri-operative mortality rate is five to ten percent.30

Summary

The majority of patients with rheumatoid arthritis involving the cervical spine can be managed non-operatively. These patients should be monitored closely by the treating physician for the development of neurologic symptoms or subluxation on radiographs. Non-surgical treatment in the majority of patients has a definite role. Several studies now suggest early surgical intervention in patients with progressive instability and neurologic deficit is indicated to prevent significant morbidity and mortality in these patients.31

REFERENCES