Cervical Spondylotic Myelopathy

BACKGROUND
Cervical Spondylotic Myelopathy (CSM) is the medical condition referring to myelopathy (spinal cord compression) due to narrowing (stenosis) of the spinal canal. Historically, there have been several reported cases of degeneration of the bones around the spinal cord leading to bony overgrowth (arthritis) and compression on the spinal cord dating back as early as the late 19th century.

The exact causes of CSM are still unclear. The narrowing of the spinal canal usually occurs due to an overgrowth of the bone surrounding the canal (much like arthritis). As the canal narrows, there is direct pressure on the spinal cord from the lack of space. In addition there may also be further damage (injury) on the spinal cord from the movement of the neck.

The average spinal canal measures about 17 to 18mm in the cervical spine (neck). Although there is some variation, the diameter in a patient with CSM is reduced to about 10-12mm. This narrowing of the spinal canal is due to overgrowth of bone around the spinal canal. The overgrowth is due to “wear and tear” degenerative changes that take place with aging and is termed spondylosis. This cascade of deterioration or degeneration starts with aging of an intervertebral disk (a pad of connective tissue that acts as a shock absorber between each vertebrae). As the disk degenerates due to overuse (wear and tear), the alignment (relationship between each bone of the spine) of the cervical spine is moved out of position. This mal-alignment leads to increased stress and strain on different areas of the spine (areas that are not meant to take on that stress). To compensate for the increase work load, these areas begin to remodel themselves, increasing their bulk (hyperostosis), thus leading to overgrowth of the bone as well as abnormal bony spurs. In addition to the bony overgrowth, the ligaments which hold the bones together also increase in size (hypertrophy). All of this leads to narrowing of the spinal canal. Myelopathy is believed to be irreversible, and without treatment may become progressively worse.

SIGNS and SYMPTOMS of DISEASE
The time course in which people develop signs and symptoms varies from person to person, as does the severity. Often, the patient will complain of neck pain, hand weakness, clumsiness, and inability to perform fine motor tasks such as buttoning clothes. There may be a loss of muscle mass in the hands. Legs may become stiff and reflexes become exaggerated. The gait (ability to walk) will become impaired as the myelopathy progresses. Balance problems ensue, combined with the gait, makes walking on uneven surfaces (sidewalks) difficult. Sensation becomes impaired, including the ability to sense where a joint or limb is in space, and loss of control of the bowel and bladder may occur as the disease worsens.
**DIAGNOSTIC TESTS**

1. **Plain X-Rays** - Good at detailing the bones in the spine and alignment (posture) of the spine. Bony overgrowth and spurs (arthritis) may be seen. In some cases, ability to see the lower cervical spine is difficult due to body habitus.

2. **CT Scan** - Further details the bone anatomy. It can be combined with a myelogram (contrast injected into the sac around the spinal cord) which provides more detailed anatomy of the nerve roots that come off the spinal cord.

3. **MRI** - Provides information on the soft tissue, particularly the spinal cord and ligaments. Can give information regarding spinal cord injury (myelopathy) which X-ray and CT can not visualize. It can also evaluate for other diseases, such as tumors, multiple sclerosis, syrinx, and Chiari malformations, which may present with similar symptoms. It is not good at detailing the bone and is expensive and time consuming. Patients are required to lie motionless in a tube for 30 - 60 minutes, which can be difficult in patients with pain or claustrophobia. Open MRIs are available; however provide less detail than conventional MRI.

4. **EMG** - Electromyography is used to detect peripheral nerve lesions, and can help distinguish radiculopathy (nerve root compression) from myelopathy (spinal cord injury).

**TREATMENT OPTIONS**

- **Non-operative**
  - Neck Brace (indefinitely)
  - Pain control with medication
  - Reserved for those who do not have progressive (worsening) disease, those without spondylotic changes, those who can not tolerate surgery (often due to other medical conditions), and those who refuse surgery.

- **Operative**
  - Decompression of the spinal canal
  - Restoration and reconstruction of the spine
  - Reserved for those who present early in the course of the disease, those with disease progression, and those with intractable pain.

**SURGICAL TECHNIQUE**

1. **Posterior approach** - Enables posterior decompression of the spinal cord by un-roofing the spinal canal (via removing the lamina). This provides for more space for the spinal cord, and can be combined with instrumentation (screws and plates) to fuse (lock in) the bones into position. Typically, reserved for those whose neck has maintained alignment and have disease at 3 or more levels from the front.

2. **Anterior approach** - Enables decompression by removing the disk between the vertebrae, removing the bony overgrowth in front of the spinal cord. Can be combined with instrumentation and alignment correction. Reserved for those with pathology primarily anterior to the spinal cord.

3. **Combined Anterior-Posterior approaches** - Reserved for those who have disease both in front of and behind the spinal cord. Allows for complete decompression of the spinal cord as well as offers the option of anterior instrumentation and fusion, posterior instrumentation and fusion, or both. This surgery requires rotating the patient from back to front or front to back.
**SURGICAL RISKS**
Surgical infection, hemATOMA, spinal cord injury (including paralysis), loss of movements, loss of sensation, loss of bowel and bladder function, loss of sexual function, spinal fluid leakage, spine instability, and nerve root injury are irrespective of the approach. Specific risks for the anterior approach also include damage to the recurrent laryngeal nerve (hoarseness of voice), injury to the carotid artery, injury to the esophagus and trachea. The bones not healing together (pseudoarthrosis). Risks specific to the posterior approach include injury to the vertebral artery. Any injury to the carotid or vertebral artery can lead to stroke.

**EXPECTED OUTCOME**
It must be recognized that spinal cord injury/myelopathy, if present, maybe irreversible. The primary goal of surgery is to prevent further worsening of the patient’s clinical condition. Patients rarely have significant improvement in their motor symptoms, and this understanding must be established prior to surgery. Second, is to prevent further disease by causing instability or mal-alignment. The third goal is reduce pain. While some patients benefit with some improvement in symptoms, it is difficult to distinguish those who have improvement and those who do not.

**AUTHOR**
Raymond D Turner IV, MD
Edited Harrop

**RELEVANT TERMS**
1. Atrophy - Wasting due to a loss of cells
2. CT Scan - eg. CAT Scan, A diagnostic imaging modality which delineates bone and soft tissues.
3. Spondylosis - Overgrowth of bone due to degenerative changes (eg Spondylotic)
4. Degeneration - Age related, overuse, wear and tear changes
5. Electromyography - A diagnostic modality using electrical stimulation of a muscle to determine function.
6. Hyperostosis - Increase in bone size and overgrowth (bone hypertrophy)
7. Hypertrophy - Increase in size of a structure
8. Instability - Abnormal movements due to lack of normal support structures
9. Ischemia - Lack of oxygen leading to cell death (stroke)
10. MRI - Magnetic Resonance Imaging, A diagnostic imaging modality which uses electromagnetic energy to produce an image.
11. Myelogram - Often combined with X-Ray or CT Scan, provides information regarding the spinal cord and nerve roots
12. Myelopathy - Injury leading to irreversible changes in the structure and function
13. Spasticity - Increased muscle tone and contractions causes stiff, awkward movements
14. Stenosis - Narrowing, lack of space
15. X-Ray - eg. Plain films, roentograms. A diagnostic imaging radiograph using radiation in conjunction with film paper. Delineates bone better than soft tissue
FIGURES
Figure 1
A plain X-ray of a patient cervical spine with very significant CSM. Note the bone spurs at multiple levels (small arrows), and the slippage of the vertebra (block arrow).
Figure 2
Below is an MR image of the same patient with CSM imaged in a sagittal (sideways) plane. The small arrow points to the region where the spinal cord is severely pinched.
Figure 3
Below are MRI images showing four slices a patient's spinal cord with CSM. The large arrow shows a normal level with a round spinal cord in a ring of white colored spinal fluid. The smaller arrow shows a triangular type shape which represents a severely compressed spinal cord.