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Myelopathy

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ACR APPROPRIATENESS CRITERIA

Myelopathy

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Myelopathy describes any neurologic deficit related to the spinal cord. Myelopathy is usually due to compression of the spinal cord by osteophyte or extruded disk material in the cervical spine. Osteophytic spurring and disk herniation may also produce myelopathy localized to the thoracic spine, though less commonly. Other common sources of myelopathy are cord compression due to extradural mass caused by carcinoma metastatic to bone, and blunt or penetrating trauma. Many primary neoplastic, infectious, inflammatory, neurodegenerative, vascular, nutritional, and idiopathic disorders result in myelopathy, though these are very much less common than discogenic disease, metastases, and trauma. A variety of cysts and benign neoplasms may also compress the cord; these tend to arise intradurally. The most common of these are meningiomas, nerve sheath tumors, epidermoid cysts, and arachnoid cysts.[1-4]

Disorders of the spinal cord itself generally are uncommon and difficult to treat effectively. Therefore, radiologic evaluation of myelopathy is primarily focused on extrinsic compression of the spinal cord. MR imaging is the mainstay in evaluation of myelopathy.[1] Imaging of the spinal cord has improved to the point that reliable diagnosis of nonexpansile spinal cord lesions is routinely possible.

Diagnosis and treatment of myelopathy rest on demonstration of mechanical stability of the spine, particularly in the cervical region and when tumor or trauma history is present. Depiction of direct neural involvement by a pathologic process is then required for more refined diagnosis and specific treatment decisions. Anatomic diagnosis rests principally on the distinction among extradural, intradural, and intramedullary lesions.

Clinically, the diagnosis of myelopathy depends on the neurologic localization of the finding to the spinal cord, rather than the brain or peripheral nervous system and then to a particular segment of the spinal cord. The antecedent clinical syndrome and other details of the patient's course are helpful, but imaging plays a crucial role. Clinical categories are based on the presence or absence of significant trauma or pain, and the mode of onset (slowly progressive or insidious onset versus stepwise progression versus sudden onset). Patients with known tumor history and those in whom infectious disease is likely are considered separately.

In traumatic myelopathy, the first priority is mechanical stability. Plain radiographs are sometimes useful for this purpose, but CT is more useful when a high probability of bony injury or ligamentous injury is present. In many centers, routine multidetector CT with sagittal and coronal reconstructions has replaced plain radiographs, especially in the setting of multiple trauma.

MR imaging is widely used when paralysis is incomplete or under other circumstances where direct visualization of neural or ligamentous structures is clinically necessary. If surgery for herniated disk, hematoma, or other cause of incomplete paralysis is planned, MR imaging best depicts the relation of pathology to the cord, and can help predict which patients may benefit from surgery.[5-10]

When local or radicular pain accompanies myelopathy, the most likely diagnoses are spondylosis, tumor, and infection. Plain radiographs may depict osteophytic narrowing of the spinal canal or bone destruction. CT improves depiction of bony encroachment on the spinal canal and sometimes shows cord compression by herniated disk. Bone destruction and soft tissue masses may also be seen. MR imaging has replaced CT in noninvasive evaluation of patients with painful myelopathy because of superior soft tissue resolution and multiplanar capability. Invasive evaluation by means of myelography and CT myelography may be useful for surgical planning or other specific problem solving, though less frequently.[1,11-24]

Although most commonly due to spondylosis and disk herniation, a significant proportion of painful myelopathy is caused by tumor or infection. Demyelinating disease may also present with pain. Occasionally, syringomyelia presents with anesthetica dolorosa. MR imaging depicts the spinal cord directly, assesses its contour and internal signal intensity characteristics reliably and noninvasively. MR imaging is the study of choice in cervical myelopathy when spondylosis or disk herniation is the most likely cause. When MR imaging is not available, or to answer specific questions before surgical intervention, myelography and CT myelography may be useful.[25-29]

In slowly progressive myelopathy, the ability of MR imaging to depict the spinal cord is invaluable. Sometimes, specifically treatable disorders may be localized by myelography followed by CT. However, occasional catastrophic complications of myelography in cases of spinal block, difficulty in visualizing the upper extent of lesions, and relative "blind spots" at the cervical thoracic and craniocervical junctions limit utility. CT myelographic techniques may be useful to answer specific preoperative questions.

Enlargement of the spinal cord by intramedullary mass is depicted by myelography only when large masses are present, even when CT myelography supplements the plain examination. These techniques are much less useful than MR imaging because the distinction between solid and cystic masses is usu-

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Clinical condition: myelopathy	CT spine without contrast	CT spine with contrast	CT myelography	MRI spine without contrast	MRI spine without and with contrast	X-ray spine	X-ray myelography	CTA spine	MRA spine
Traumatic	9[a]	2	5[b]	8[cd]	2	7[ef]	3[g]	3[h]	3[h]
Painful*	7[i]	3[j]	5[k]	8	7[l]	3[f]	2[g]	2[c]	2
Sudden onset†	5[k]	3	6[k]	9	8	3[f]	6[g]	5[m]	4[m]
Stepwise progressive‡	5[k]	3	6[k]	9	8	3	6[gm]	5	4
Slowly progressive§	6[i]	3[j]	5[k]	8	7	3[f]	5[gn]	2	2
Infectious disease patient‖	6[k]	5	5[k]	8	9	3[f]	5[gk]	2	2
Oncology patient¶	6[k]	4	5[k]	9	8	3[o]	5[gk]	2[c]	2

Note:—Rating Scale: 1, least appropriate; 9, most appropriate.
[a] First test for acute management.
[b] MRI preferable.
[c] Problem solving or operative planning.
[d] Most useful when injury not explained by bony fracture.
[e] May be first test in multi-symptom trauma, especially when CT is delayed.
[f] To assess stability.
[g] Usually performed in conjunction with CT.
[h] For suspected vascular trauma.
[i] Most useful for spondylosis.
[j] Consider for infection, neoplasm or if MRI unavailable or contraindicated.
[k] Problem solving or if MRI unavailable or contraindicated.
[l] If infection or neoplastic disorder suspected.
[m] If AVM is suspected.
[n] If MRI is not possible or for preoperative planning and problem solving.
[o] Assess stability or for treatment planning.
* Bone scan, rating of 4 to search for associated extra spinal disease.
† Arteriography spine, rating of 4 if AVM suspected.
‡ Arteriography spine, rating of 6 if AVM suspected.
§ Bone scan, rating of 4 and arteriography spine, rating of 4.
‖ WBC scan rating of 4 may be combined with bone scan to diagnose osteomyelitis.
¶ Bone scan, rating of 6 to search for associated extra spinal disease.

ally not possible, even when delayed examination is performed. The distinction of syrinx from tumor, location of tumor nodule, extent of cyst, and distinction of nodule and cyst from edema are crucial in treatment planning for intramedullary disease and virtually necessitate MR imaging.[30,31]

When myelopathy progresses stepwise or is of sudden onset, vascular processes become significant diagnostic possibilities. Vascular malformations, spinal cord infarct, and epidural hematoma account for most vascular lesions of the cord. In practice, they are difficult to distinguish clinically from other nontraumatic causes of myelopathy because the classic history is frequently absent or difficult to elicit from a seriously ill patient.[32]

If AVM is considered clinically likely, gadolinium-enhanced MR imaging, MRA, and myelography to demonstrate abnormal vasculature may be useful to guide spinal arteriography. More recently, progress in CT angiography has led to its use in preangiographic evaluation of patients with suspected spinal vascular abnormalities.[33]

If myelopathy is painless and slowly progressive, the differential diagnosis is quite broad. Neoplastic disease of the spinal cord and extrinsic compression by epidural or intradural tumor may present in this manner. Demyelinating disease, degenerative diseases, and metabolic or deficiency diseases may also present in this fashion. Spondylosis may present painlessly as well, particularly in the elderly. In these cases, visualization of the spine as well as the spinal cord is useful and this is best accomplished noninvasively by MR imaging.[34-37]

In oncology and infectious disease patients, multiple sites of involvement are possible. In these patients it is often necessary to study the entire spine or even the entire skeleton despite a specifically localized myelopathic level. MR imaging is considered more sensitive at an individual site, but the convenience of radionuclide bone scanning makes it useful in this setting as well. AIDS patients may present with myelopathy due to primary cord disease caused by HIV infection.[38-45]

No high quality evidence supports the use of discography, thermography, epidural venography, sonography, or CSF flow studies in the evaluation of myelopathy. Radionuclide bone scan may play an adjunctive role, for example, to locate a safer biopsy site in patients with suspected metastatic cord compression.

An important limitation of MR imaging in the diagnosis of myelopathy is its high sensitivity. The ease with which the study depicts expansion and compression of the spinal cord in the myelopathic patient may lead to false-positive examinations and inappropriately aggressive therapy if findings are interpreted incorrectly. For example, transverse myelitis due to demyelinating disease may demonstrate cord enlargement and be mistaken for tumor. Spondylosis, which occurs with normal aging, may be mistaken for clinically significant osteophytic compression of the spinal cord in a patient who is myelopathic for other reasons. These problems are minimized by experienced observers and meticulous clinical correlation with radiologic findings. Similar problems are present in the interpretation of any anatomical study of the spinal cord and are not unique to MR imaging. Careful patient selection and clinical correlation are essential in interpretation of imaging findings.[1,46-48]

Review Information

This guideline was originally developed in 1996. The last review and update was completed in 2006.

Appendix

Expert Panel on Neurologic Imaging: David J. Seidenwurm, MD, Principal Author and Panel Chair, Radiologic Associates of Sacramento, Sacramento, Calif; Patricia C. Davis, MD; James A. Brunberg, MD; Robert Louis De La Paz, MD; Pr. Didier Dormont; David B. Hackney, MD; John E. Jordan, MD; John P. Karis, MD; Suresh Kumar Mukherji, MD; Patrick A. Turski, MD; Franz J. Wippold II, MD; Robert D. Zimmerman,

MD; Michael W. McDermott, MD, American Association of Neurlogical Surgeons; Michael A. Sloan, MD, MS, American Academy of Neurology.

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