Acute Weakness: A Practical Step-by-Step Approach to Distinguishing Myelopathy from Neuropathy
Benjamin M. Greenberg, MD, MHS, and Douglas Kerr, MD, PhD

ABSTRACT

PURPOSE: The primary care clinician may on occasion need to evaluate the patient who presents with acute or insidious weakness, which may be as a result of a myelopathy or neuropathy. The purpose of this article is to review a step-by-step practical approach to the diagnosis and treatment of these conditions based on available data and expert opinion.

EPIDEMIOLOGY: Guillain-Barré syndrome is the most common type of acute neuropathy presenting with weakness or paralysis, and affects 10 to 20 individuals per million in the United States. Acute weakness secondary to spinal cord injury (myelopathy) is uncommon (32 cases per million population), but its impact on the individual, his family, and society are significant.

REVIEW SUMMARY: This review highlights the various conditions that may result in a presentation of an acute neuropathy or myelopathy, and provides criteria to distinguish between them. A practical algorithm is provided, allowing the clinician, guided by key historical questions and data from the physical examination, laboratory, and neuroimaging studies, to determine probable underlying etiologies and initiate proper treatment in a timely fashion.

TYPE OF AVAILABLE EVIDENCE: Systematic reviews, randomized, controlled trials, cohort studies, case reports, unstructured reviews, and textbooks.

GRADE OF AVAILABLE EVIDENCE: Good.

CONCLUSION: Although not every acute myelopathy has a clearly established treatment, the available evidence suggests that appropriate classification and treatment of patients with acute myelopathies eliminates unnecessary testing and can improve outcomes. Recent studies have identified key predictors of recovery in certain forms of myelopathy and ongoing studies are attempting to define diagnostic strategies that appropriately classify and prognosticate outcomes in patients with myelopathies.


Originating from either a peripheral or spinal source, the development of acute or insidious weakness can be as challenging to the clinician as it is frightening to the patient. Most cases of myelopathy arise as a result of trauma, although they may also be caused by intrinsic spinal cord pathologies. Whatever the cause, spinal cord injury or disease has a significant impact on the patient, his or her family, and on society. The incidence of myelopathy in the United States is approximately 32 new cases per million annually, whereas Guillain-Barré syndrome (GBS), the most common cause of weakness-inducing neuropathy, affects 10 to 20 individuals per million every year. The most common causes of spinal cord injury are motor vehicle accidents, accounting for nearly half of all events (44%) followed by acts of violence (24%), falls (22%), and athletic injuries (8%), with 2% occurring as a result of other miscellaneous causes. In recent years, acts of violence have superseded falls as the most common cause of injury. However, conditions ranging from infections to autoimmune conditions to vascular disorders, in addition to space-occupying lesions, all may cause myelopathy. Myelopathy and neuropathy may cause both significant morbidity and mortality, principally from respiratory complications fol-
Approximately 10% to 20% of patients who have sustained an acute spinal cord injury die prior to reaching the hospital, and another 3% die during the course of their acute hospitalization.\(^5\) The life expectancy for patients with tetraplegia and paraplegia is also shorter for those who survive the initial recovery process compared to those individuals who have never experienced myelopathy. Eighty-five percent of spinal cord injury patients who survive the first 24 hours of their injury are alive 10 years later, compared to 98% of individuals of similar age and gender who have never had an injury.\(^1\)

The primary care clinician may on occasion need to evaluate the patient who presents with acute or insidious weakness, which may be as a result of a myelopathy or neuropathy. The presence of significant trauma in a patient’s history is usually sufficient to cause physicians to consider spinal cord dysfunction when evaluating a patient with acute weakness. However, patients presenting with acute, nontraumatic weakness present diagnostic challenges to clinicians. The purpose of this article is to review a step-by-step practical approach to the diagnosis and treatment of these conditions based on expert opinion and supported by evidence where available.

**The Anatomy of the Spinal Cord: A Brief Review**

The spinal cord is housed within the vertebral column, and extends from the foramen magnum at the base of the skull to the conus medullaris, at the level of L-1 or L-2—the first or second lumbar vertebrae. The spinal cord is covered by 3 meninges: the dura mater, arachnoid mater, and pia mater. The outermost tough and fibrous dura mater covers each of the spinal nerves as they exit the spinal canal and continue into the dorsal root ganglia. Beneath the dura mater is the thin and delicate arachnoid mater, and then in direct contact with the spinal cord is the pia mater. Both the arachnoid and pia mater are continuous with the meninges surrounding the brain; the arachnoid mater terminates with the caudal end of the spinal cord, at the level of the second lumbar vertebra. Beyond this, the dorsal and ventral roots become the dorsal and ventral roots of the spinal nerves. The spinal cord is the central core of the spinal cord, principally composed of neural tissues and pia mater, and attach to the second or third lumbar vertebrae. The subarachnoid space is a space between the arachnoid mater and pia mater. It is normally filled with cerebrospinal fluid, which surrounds the brain and spinal cord; however, it can contain blood or purulent material during pathologic states.

The spinal cord is oval on transverse section, containing gray matter and white matter. Gray matter essentially is the central core of the spinal cord, principally composed of neurons, rather than myelinated axon tracts that serve as conduits between the brain and periphery. The gray matter neurons have processes or axons that connect the cord to the peripheral nervous system, innervating autonomic ganglia or skeletal muscles. The dorsal horns are relay centers for the sensory input (in a variety of nerves) that starts in the periphery. The white matter surrounds the gray matter, and contains both ascending nerve tracts (carrying sensory information to the brain) and descending nerve tracts (carrying motor information to skeletal muscle and viscera) from the brain. Together, the gray and white matter of the spinal cord acts as a conduit to and from the brain, and the periphery, such that the descending pathways mediate motor function, strength, and coordination. Ascending fibers originate in the periphery (in the skin or muscle), and carry impulses up through the spinal cord on their way to the brain where they mediate sensory function. A variety of nerve fibers will mediate various sensations, including proprioception, vibration, pain, and temperature (Figure 1; see online version).

**Classification of Acute Myelopathy**

Acute myelopathy is an acute dysfunction of neural cells and axons within the spinal cord, and the diagnosis of its underlying etiology may be determined according to its classification. For example, it is important to determine whether the myelopathy is extrinsic or intrinsic (ie, whether the problem originates within the cord itself, or whether it is, for example, from an external lesion exerting pressure on the spinal cord). Lesions outside of the dura are defined as extradural, whereas pathologies within the dura are intradural. Intradural pathologies might be parenchymal in origin in which case they are defined as intramedullary. Extramedullary lesions are located outside of the spinal cord parenchyma. If there is a lesion present, is it transverse, thus occupying the relatively small horizontal areas of the cord, or is it a longitudinally extensive lesion or abnormality? Other distinguishing characteristics include the nature of the pathology: is it inflammatory? What is the time course? Did the myelopathy occur instantaneously, suggesting either a compressive, traumatic, or potentially vascular cause? By contrast, progressive symptomatology is indicative of a variety of underlying etiologies ranging from genetic to inflammatory disorders. A relapsing and remitting pattern can be indicative of multiple sclerosis (MS). Whenever possible, it is important to determine the underlying mechanism at work, as this will help to determine treatment based on whether the cause of the myelopathy is ischemia, inflammation (with or without infections), compression (eg, neoplasm), or related to venous hypertension or vascular abnormalities.

**Distinguishing Myelopathy From Neuropathy**

Some neuropathic conditions may mimic myelopathy, most commonly GBS (Table 1).\(^6\) There are many features that can be used to differentiate neuropathic processes from myelopathic processes. One of the most

\(^1\) V ol. 6, No. 9 ■ October 2006

\(^2\) lowed by heart disease, other types of trauma, septicemia, and suicide.\(^3\)\(^5\)

\(^3\) Approximately 10% to 20% of patients who have sustained an acute spinal cord injury die prior to reaching the hospital, and another 3% die during the course of their acute hospitalization.\(^5\)

\(^5\) The life expectancy for patients with tetraplegia and paraplegia is also shorter for those who survive the initial recovery process compared to those individuals who have never experienced myelopathy. Eighty-five percent of spinal cord injury patients who survive the first 24 hours of their injury are alive 10 years later, compared to 98% of individuals of similar age and gender who have never had an injury.\(^1\)
common differentiating features is identifying upper motor neuron (UMN) findings from lower motor neuron (LMN) findings. The UMN is the connection from the cerebral cortex to the spinal cord, synapsing on the anterior horn cell. The LMN is the nerve originating from the anterior horn cell and transversing out into the periphery, ultimately synapsing on a muscle. Spinal cord pathologies that cause UMN dysfunction tend to lead to weakness, increased tone, and increased reflexes. LMN pathologies, such as GBS, lead to weakness in the setting of decreased tone and diminished reflexes.

Guillain-Barré syndrome is an acute, ascending paralytic disorder involving inflammation of the peripheral nerves. Patients with GBS develop a rapidly progressive loss of sensory and motor function that evolves over hours to days, very similarly to an acute myelopathy. However, there are several methods to distinguish the 2 conditions. GBS typically involves weakness and sensory loss of the lower extremities first and ascends, whereas a myelopathy will present with symptoms (paraparesis or quadriaparesis) at the particular level of the spinal cord where the lesion is located. Fundamentally, the distinction between GBS and transverse myelopathy is that the former involves a length-dependent loss of function and sensation, whereas the latter is transverse at a specific level of the spinal cord. On physical examination of the patient with GBS, it may be noted that the more distal areas of the body are more affected than the proximal regions (eg, the toes will be more affected than the thighs, and the hands will be more symptomatic than the shoulders). Conversely, in myelopathy, there is no length dependence. Rather, the sensory loss confirms a “spinal level” on the torso, as sensory nerves caudal to the inflammation are impaired as they pass through the level of injury. Patients with GBS often have absent reflexes, whereas patients with a myelopathy typically have brisk reflexes (although, in cases of acute spinal cord dysfunction, reflexes may be diminished). Autonomic function is affected in patients with both GBS and various myelopathies, but the dysfunction presents differently. For patients with transverse myelitis (TM), almost invariably there is autonomic dysfunction manifested by urinary urgency and/or retention. Among patients with GBS, by contrast, urinary dysfunction is less likely to occur in the early stages. However, cardiovascular complications, such as arrhythmias and alternations in blood pressure are more common in patients with GBS. Electrophysiology studies also can be helpful in distinguishing the 2 conditions, as patients with GBS exhibit slowed conduction, conduction block, and/or denervation on electromyography (EMG), whereas EMG/nerve conduction velocity in myelopathy patients will not be abnormal, except in rare circumstances (eg, in cases of Epstein-Barr virus myeloradiculitis and encephalomyeloradiculitis).5

Besides GBS, we are now faced with a second disease that can present with acute flaccid paralysis, namely West Nile Virus (WNV) infection. In less than 1% of patients infected with WNV, neuroinvasive disease develops. Of these patients, 10% to 15% develop infection of spinal motor neurons causing a clinical picture similar to poliomyelitis. Other patients can develop a GBS-like syndrome.4 Similar to classic GBS, flaccid paralysis caused by WNV can be differentiated from myelopathy based on a lack of a spinal level and an absence of any UMN findings.

A Practical Algorithm for Assessing Acute Myelopathy

When a patient presents with myelopathic signs and symptoms that are a result of dysfunction of ascending...
and descending axons and local neural circuits within the spinal cord, the clinical signs and symptoms do not necessarily reflect irreversible damage to these neural structures, and it is vital to attempt to identify and treat the myelopathy as soon as possible. A rapidly progressive myelopathy is a medical emergency, requiring immediate intervention. We present a practical algorithm for the clinician to utilize to facilitate the prompt diagnosis and treatment of a spinal cord pathology (Figure 2).9-12

**STEP 1: DEFINE THE PRESENCE OF A MYELOPATHY**

The first objective is to confirm the presence of a myelopathy via history and physical examination. The presence of a horizontal level below which sensory, motor, and/or autonomic function is impaired is the hallmark of spinal cord disease or injury. Thus, there are 4 major symptom groups to evaluate: motor, sensory, autonomic functioning, and as a subgroup of the sensory group, pain. Motor weakness can range from a mild weakness to complete paraplegia; at the region of the cervical spinal cord, all 4 limbs are involved; a central cord lesion in the cervical spine may affect upper extremities more so than the lower limbs. If there is an acute tumor or compression fracture in the thoracic spinal cord, arm movements are unaffected; however, the legs are impaired. Muscle tone varies from condition to condition, although the general rule with a myelopathy is that muscle tone is increased. There is muscle stiffness, hyper-reflexia, and an extensor plantar reflex (Babinski response).

Sensory impairment may be elicited via pinprick, temperature, proprioception, and vibration sense. Sensations of paresthesias are common; however, there can also be numbness, or an abnormal sensation of warmth or burning. Pain is frequently of a burning, radicular nature, with irritation of sensory nerves. If it occurs in the chest area, and is characterized as a tight, squeezing, or a band-like sensation, patients will frequently be evaluated for cardiac dysfunction. The presence of an impaired sensation corresponds either to the level of the damage to the spinal cord if the damage is bilateral, or impaired sensation may be slightly below the presence of the actual lesion if it is unilateral, as a result of the specific anatomy of the spinal tract.

Spinal cord lesions also typically produce autonomic disturbances consisting of disturbed sweating, bladder, bowel, and sexual dysfunction. Urinary urgency is defined as a decreased interval from bladder fullness to evacuation, and is somewhat subjective; patients may note nocturia in particular. Urinary retention, on the other hand, also is common but is more worrisome, indicative of an absolute autonomic dysfunction. Bowel urgency and retention can be helpful signs, although less sensitive than bladder symptomatology. Sexual dysfunction and other autonomic features are more common with intrinsic lesions within the spinal cord, rather than a spondylitic myelopathy.
**ACUTE WEAKNESS**

**STEP 2: RULE OUT OR TREAT A COMPRESSIVE ETIOLOGY**

The best diagnostic test to determine the presence of an acute, compressive myelopathy is gadolinium-enhanced magnetic resonance imaging (MRI) of the spinal cord. If the presence of a structural abnormality or spinal mass is detected, urgent action is required, as the most common causes are: tumor, hematoma, herniated intervertebral disc, or abscess. Epidural compression frequently will cause prodromal signs, such as neck or back pain, bladder disturbances, and sensory symptoms that precede the development of paralysis. By contrast, spinal subluxation, hemorrhage, and noncompressive etiologies (inflammatory, infectious, or vascular) are more likely to cause myelopathy without warning.

An acute compressive myelopathy evolving over hours or days generally involves an antecedent trigger, such as a motor vehicle accident, fall, or other hyperextension trauma. In such cases, patients may have had subclinical or silent arthritic disease that narrowed the spinal column, and in the setting of a hyperextension injury, resulted in direct transient compression of the spinal cord by encroaching disc/arthritic bone. In cases of acute compressive myelopathy, the spine must be immediately immobilized with a cervical collar. One should also consider high-dose methylprednisolone (30 mg/kg as a bolus, followed by 5.4 mg/kg per hour for 23 hours) if the patient is seen within the first 3 to 4 hours after injury. Initiation of steroids beyond the initial 8 hours is contraindicated, because it may worsen outcome.13,14 Patients will require urgent neurosurgical evaluation and intensive care for observation of potential autonomic instability, hemorrhage, or death.

More commonly, patients experience a subacute compressive myelopathy, which occurs over days or months and is generally marked by pain or other unilateral radicular signs and symptoms, suggestive, for example, of a herniated disc or spondylitic ridge. Patients with subacute compressive myelopathies may have decreased range of motion of the neck indicating a possible spondylosis or muscular spasm. Again, there may be an antecedent trigger, such as an exacerbation of symptoms with sudden movements, such as those caused by a sneeze or cough. Postural or cough headaches with brain stem symptoms frequently will cause prodromal signs, such as neck or back pain, bladder disturbances, and sensory symptoms that precede the development of paralysis. By contrast, spinal subluxation, hemorrhage, and noncompressive etiologies (inflammatory, infectious, or vascular) are more likely to cause myelopathy without warning.

As with an acute myelopathy, the spine should be immobilized with a cervical collar, and an MRI obtained to evaluate for spondylitic stenosis (an acquired arthritic compression of the spinal cord by the surrounding spinal column), herniated disc, congenital (eg, Chiari) malformation, or stenosis. Plain X rays taken while the patient is in flexion and extension are helpful to make the diagnosis of spondylosis or spondylolisthesis. A neurosurgical evaluation, again, is appropriate. It is important to note that cervical spondylitic myelopathy is the most common cause of a compressive myelopathy in the elderly.

Spinal cord compression also may be caused by neoplastic masses; in the adult, most are epidural in origin, and result from metastases from other cancers (most commonly from breast cancer, prostate cancer, and multiple myeloma). The site of metastasis generally is in the thoracic region, although prostate and ovarian cancers may spread to the sacral and lumbar vertebrae. The most common presenting symptom is pain, which may be sharp or dull, localized or radiating, and may be severe enough to awaken the patient during the night. Pain generally precedes other signs of cord compression. The primary diagnostic test is MRI, which may accurately distinguish between a neoplasm and other lesions, such as an abscess, hematoma, or benign tumor (intradural vs epidural masses, including meningiomas and neurofibromas, among others). Treatment may include corticosteroid therapy to reduce swelling, radiation, and/or surgical resection.

**STEP 3: DETERMINE THE PRESENCE OR ABSENCE OF SPINAL CORD INFLAMMATION**

The third objective in the evaluation of acute weakness is to determine whether there is an inflammatory cause by performing lumbar puncture and/or MRI. The best surrogate markers for inflammation in the spinal cord are cerebrospinal fluid (CSF) leukocytosis, CSF immunoglobulin production, or gadolinium enhancement on spinal MRI. If the CSF is evaluated early and is negative for oligoclonal bands and pleocytosis, it should be repeated in 2 to 7 days.

**STEP 4: CONSIDER CAUSES AND TREATMENT OF NONINFLAMMATORY MYELOPATHIES**

Table 2 indicates some potential etiologies of noninflammatory myelopathies, such as arterial or venous ischemic events. These cause an instantaneous onset of myelopathy of a particular pattern. When the posterior spinal artery is involved, there is an acute—or more commonly, progressive—syndrome of weakness and spasticity with little sensory change, superficially resembling amyotrophic lateral sclerosis. In anterior spinal artery syndrome, the dorsal column and the posterior aspect of the spinal cord are spared. There is normal sensation in the legs in terms of proprioception and vibration, but patients cannot feel temperature and movement is impaired because of involvement of the cortical spinal tract and the spinal thalamic tract, both of which are more anterior. Acute infarction in the territory of the anterior spinal artery produces sudden and dramatic (progressing in minutes or hours) paraplegia or quadriplegia, in addition to a loss of bladder and bowel control.

Patients may experience sharp or radiating back pain localized to the area of ischemia. Areflexia due to spinal shock is often present followed later by hyperreflexia and spasticity. The causes of spinal cord ischemia or infarction include atherosclerosis, dissecting aortic aneurysm,
hypotension, cardiogenic emboli, or vasculitis related to collagen vascular disease, but may also be idiopathic. Therapy must be matched to the underlying etiology.

Less common causes of noninflammatory myelopathies include dural arteriovenous (AV) fistulae, which can cause a stuttering myelopathy affecting the lower half of the spinal cord (legs, bladder, and bowel), typically in men older than 40 years of age. A dural AV fistula causes venous hypertension in the spinal cord, and can be diagnosed via a spinal angiogram. Consider blood and CSF dynamics as causative factors in acute myelopathy, especially if there is a structural abnormality in the spinal column that is present but insufficient to cause myelopathy by direct compression. Hemosiderin sequence MRIs may identify sites of previous intraparenchymal or subarachnoid bleeding, and spinal angiogram is the diagnostic study of choice for spinal AV malformation or for dural AV fistula.

**Step 5: Determine the Source of Inflammatory Myelopathies**

The fifth objective in the workup of acute weakness is to determine the presence and focality of inflammation within the nervous system. Gadolinium enhancements on MRI, CSF pleocytosis, and/or elevated CSF immunoglobulin G index are positive findings indicating inflammation. More specifically, it is important to assess whether the source of the inflammation is, for example, a direct infection of the spinal cord (Table 3) or is associated with a systemic disorder, such as Sjögren's syndrome, systemic lupus erythematosus, or sarcoidosis. Symptoms indicative of the presence of an infection include fever, meningismus, rash, and adenopathy. Spinal fluid viral and bacterial cultures and polymerase chain reaction studies should be obtained in patients with inflammatory spinal fluid. Mycoplasma serology and cold agglutinins also should be routinely checked in patients with acute TM. In patients with a...
vesicular rash or burning dysesthesias suggestive of herpes zoster (shingles), antiviral therapy should be initiated empirically. Individuals with noninfectious inflammatory syndromes may have overlapping symptoms with infections (such as rash and adenopathy), but also may have more classic indications of these usually autoimmune conditions, such as serositis, arthritis, conjunctivitis, and blood dyscrasias, among others (Table 4).10

Another diagnostic consideration is to determine whether there is 1 specific area of cord involvement or whether the condition is multifocal, such as is the case with MS, Sjögren’s syndrome, or sarcoidosis. Conditions such as MS, acute disseminated encephalomyelopathy, or neuromyelitis optica (Devic’s disease) involve the brain, optic tract, and spinal cord. By contrast, TM typically is a monofocal, monophasic disease, caused by inflammation across one level of the spinal cord (usually in the thoracic region). If clinical suspicion for neuromyelitis optica (NMO) exists, testing for the presence of the NMO-immunoglobulin G may be helpful in solidifying the diagnosis. However, a negative test would not rule out the condition.15

The inflammatory process involved in TM is demyelinating, necrotic, and may result in neuronal or axonal injury and death. Symptoms reflect this process, and may cause low back pain, in addition to weakness, pain, or other sensorimotor deficits of the lower extremities that may evolve over hours to weeks. More severe involvement may result in paralysis or bladder and bowel dysfunction. Specifically, TM encompasses 4 symptom groups: motor dysfunction (weakness and spasticity), sensory dysfunction (numbness, paresthesias, and dysesthesias), pain, and autonomic dysfunction (sexual, bowel, and bladder difficulties). The prognosis for this condition is variable, from complete recovery to permanent impairment. The condition affects all ages, races, and both sexes; there does not appear to be a genetic predisposition. There are approximately 1400 new cases of TM in the United States annually, with a prevalence of 34 000 cases at any given time and presentation, unique lymphocyte trafficking, and/or the unique host response of the spinal cord.12,17

The relatively rare patients who experience relapses after a diagnosis of TM has been made may actually have MS as their underlying condition. Imaging characteristics in the brain and spinal cord may distinguish MS from TM—patients with MS more often exhibit a lesion that occupies less than one-half the cord diameter and less than 2 rostral-caudal spinal segments, along with the presence of 2 or more brain lesions. In addition, MS frequently has a milder, usually asymmetric clinical presentation, with sensory symptoms rather than motor symptoms predominating. Oligoclonal bands are much more likely to also be present in the spinal fluid of patients with MS. Data from the history, physical examination, evoked potentials, or MRI may confirm a multiphasic, multifocal process when MS is the underlying etiology of the TM, and indicate the need to initiate immunomodulatory therapy. Patients with TM in association with systemic autoimmune disease also are more likely to have recurrent neurologic disease and, similar to patients with MS, should be considered for chronic immunomodulatory treatment.

A spinal cord injury or lesion (tumors, herniated discs, stenosis, or abscesses) also may be a cause of TM, and can be ruled out via MRI. “Generic” therapy for TM may include corticosteroid administration to reduce inflam-

---

**Table 3. Infections Associated with Spinal Myelopathy**

<table>
<thead>
<tr>
<th>Indicative Signs and Symptoms</th>
<th>Potential Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fever</td>
<td>CSF gram’s stain and bacterial culture</td>
</tr>
<tr>
<td>Meningismus</td>
<td>CSF PCR: HSV-1, HSV-2, HHV-6, VZV, CMV, EBV, enteroviruses, HIV</td>
</tr>
<tr>
<td>Rash</td>
<td>CSF viral culture</td>
</tr>
<tr>
<td>Concurrent systemic infection</td>
<td>CSF acid-fast bacilli smear and tuberculosis culture</td>
</tr>
<tr>
<td>Immunocompromised state</td>
<td>CSF HSV, VZV, and HTLV-1 antibodies</td>
</tr>
<tr>
<td>Recurrent genital infection</td>
<td>CSF anti-Boorrelia burgdorferi antibodies</td>
</tr>
<tr>
<td>Symptoms of zoster radiculopathy</td>
<td>CSF VDRL</td>
</tr>
<tr>
<td>Adenopathy</td>
<td>CSF India ink and fungal culture</td>
</tr>
<tr>
<td>Residence in area endemic for parasitic infections</td>
<td>Chest radiograph</td>
</tr>
<tr>
<td></td>
<td>Serology for antibodies to HSV, VZV, HTLV-1, B burgdorferi</td>
</tr>
<tr>
<td></td>
<td>Serology for hepatitis A, B, C, and Mycoplasma</td>
</tr>
<tr>
<td></td>
<td>Consider serology for parasites</td>
</tr>
<tr>
<td></td>
<td>Blood cultures</td>
</tr>
</tbody>
</table>

CMV = cytomegalovirus; CSF = cerebrospinal fluid; EBV = Epstein-Barr virus; HHV = human herpesvirus; HSV = herpes simplex virus; HTLV-1 = human T-cell lymphotropic virus type 1; PCR = polymerase chain reaction; VDRL = Venereal Disease Research Laboratory test; VZV = varicella zoster virus. Adapted with permission from Berger et al. Spinal Cord Disorders. AAN Continuum Life Long Learning in Neurology; 2005.11
Table 4. Diagnosis of Systemic Inflammatory Causes for Acute Weakness

<table>
<thead>
<tr>
<th>Indicative Signs and Symptoms</th>
<th>Potential Evaluation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serum ACE/chest CT with IV contrast/gallium scan</td>
<td>Autoantibodies: ANA, ds-DNA, SS-A (Ro), SS-B (La), Sm (Smith), RNP</td>
</tr>
<tr>
<td>Urinalysis with microscopic analysis for hematuria</td>
<td>Complement levels</td>
</tr>
<tr>
<td>Lip/salivary gland biopsy</td>
<td>Uricalysis with microscopic analysis for hematuria</td>
</tr>
<tr>
<td>Chest CT with IV contrast</td>
<td>Lip/salivary gland biopsy</td>
</tr>
<tr>
<td>Antiphospholipid antibodies, Russel viper</td>
<td>Chest radiograph</td>
</tr>
<tr>
<td>Venom time, partial thromboplastin time</td>
<td></td>
</tr>
</tbody>
</table>

ACE = angiotensin-converting enzyme; ANA = antinuclear antibodies; CT = computed tomography; IV = intravenous.

In the future, new tools that assist the clinician in distinguishing subtypes of disease and prognosticating outcomes may aid in the diagnosis and classification of acute myelopathies. By combining careful clinical observations with novel imaging strategies (such as diffusion tensor and magnetization transfer), and by defining specific immune derangements, such as the presence of autoantibodies, cytokine derangements, or unique immune effector mechanisms, we may be better able to categorize these patients into biologically relevant classifications. Furthermore, as our treatment options increase, we may be better able to utilize these therapies in a rational and effective way.

REFERENCES