Emergency Neurological Life Support Spinal Cord Compression Protocol Version 4.0

Authors
Ryan Martin, MD
Sarah Peacock, DNP, APRN. ACNP-BC
Megan Corry, EdD, EMTP
Kerri L. LaRovere, MD
Safdar A. Ansari, MD

Last updated: October 2019

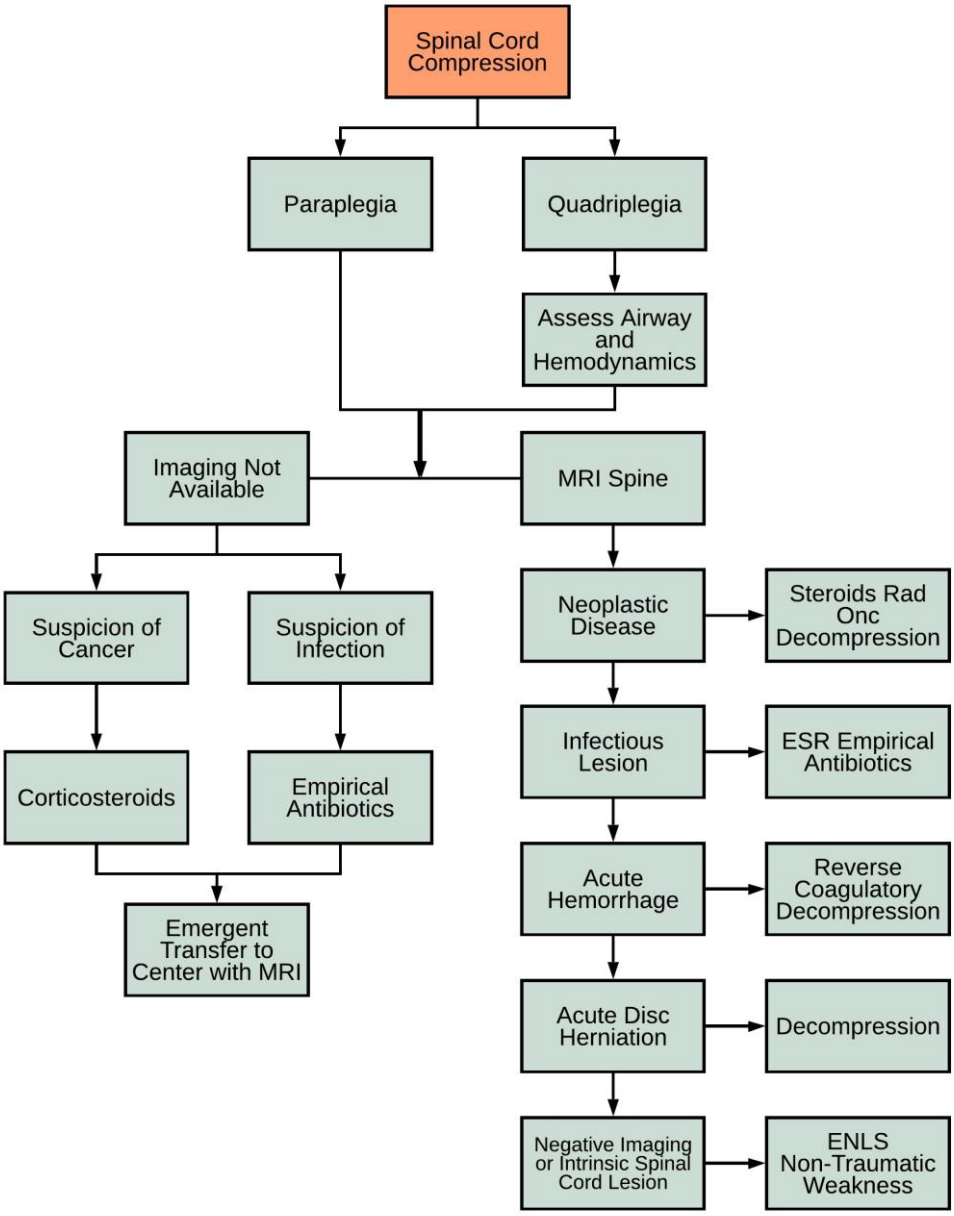
Neurocritical Care Society

ENLS

EMERGENCY NEUROLOGICAL LIFE SUPPORT

Spinal Cord Compression Algorithm

(click each box for details)



Checklist and Communication

Checklist

- ☐ Brief history of the patient
- ☐ Spinal motion restriction (motion restriction)
- ☐ Ensure proper ventilation, especially in the presence of quadriplegia
- ☐ Labs: CBC, Chemistries, INR/PT, PTT, platelet function assay (e.g. VerifyNow platelet reactivity profile)
- ☐ Obtain emergent spine imaging (MRI unless contraindicated)
- ☐ Alert spine surgeon
- ☐ Suspected neoplastic disease: administer corticosteroids (dexamethasone 10 mg IV load and 4 mg every 6 hours IV/PO), contact radiation oncology
- ☐ Suspected epidural infection: check ESR and start antibiotics
- ☐ Initiate interfacility transfer if anything cannot be performed at your facility

Communication

- ☐ Age, gender, premorbid conditions and risk factors
- ☐ Onset and duration of symptoms
- ☐ Paraplegia or quadriplegia
- ☐ Spinal level of clinical involvement
- ☐ Vital signs
- ☐ Airway status
- ☐ Bowel or bladder involvement
- ☐ Results of lab tests
- ☐ Results of imaging studies, if available
- ☐ Medical history (i.e. cancer, intravenous drug abuse, immunosuppression)
- ☐ Therapies initiated
- ☐ Discuss further interventions to start now

Sample Sign-off Narrative:
“I am transferring to you a patient who I suspect has a spinal cord compression secondary to an epidural abscess.
He is a 67-year-old male with a history of hypertension, diabetes, and intermittent intravenous drug use who presented one hour ago with mid-back pain over the last two weeks.
Over the last four days, his legs have been weak, and today he was unable to walk.
He appears paraplegic with a T-10 sensory level.
He has had low-grade fevers and chills since his back pain started.
On exam, he is afebrile, blood pressure is within normal limits and he has no evidence of respiratory insufficiency.
Strength in his arms is normal, but he is unable to lift his legs off the bed.
His bladder was distended and a Foley was placed.
CBC and coags are normal. ESR is pending. We do not have any spinal imaging available.

Given his history of IV drug use and recent fevers and chills, we suspect this is an epidural abscess leading to spinal cord compression.
Empirical antibiotics were started, including vancomycin, ceftriaxone and metronidazole.
We are initiating transfer to your facility for emergent MRI of the spine and surgical consultation.
Is there anything else we should do before transfer?”

Neurocritical Care Society
ENLS
EMERGENCY NEUROLOGICAL LIFE SUPPORT

Acute Disc Herniation

Decompression

If imaging reveals compression from disk herniation or from bone/vertebral body encroachment (spinal stenosis):

- Disk herniation that compresses the spinal cord or the cauda equina may represent a neurosurgical emergency.
- Disc herniation that does not compress the spinal cord or cauda equina is less urgent.

Acute Hemorrhage

Reverse coagulopathy and decompression

Spinal hematomas can present with rapidly developing paraparesis or quadriparesis with local or radicular pain. Spinal epidural hematomas are the more common compressive etiology, but intra-medullary hemorrhage (hematomyelia) can also occur and presents similarly. The most common causes of non-traumatic spinal cord hematoma include vascular malformations, coagulopathy, inflammatory myelitis, spinal tumors, and syringomyelia. Traumatic causes include penetrating injuries and high-impact, blunt-force trauma, or may be iatrogenic as a result of post-surgical bleeding. In rare cases, spinal hematoma can be a late complication after radiotherapy, presumably due to bleeding from telangiectasia caused by the radiotherapy.

MRI with and without gadolinium is the modality of choice for diagnosing spinal hematoma, as it will demonstrate both the hematoma and any associated underlying pathology, including spinal cord edema.

Treatment includes rapid reversal of coagulopathy and evaluation for surgical decompression.

Neurocritical Care Society
ENLS
EMERGENCY NEUROLOGICAL LIFE SUPPORT

Assess Airway and Hemodynamics

Cervical myelopathy may affect diaphragm

Those patients with quadriplegia should be monitored closely for respiratory distress and failure.

- Frequent bedside pulmonary function testing and the detection of dysphonia and tachypnea are vital to diagnose impending respiratory collapse.
- Consider intubation if:
    - Negative Inspiratory Force (NIF) < -30 cmH_2O
    - Forced Vital Capacity (FVC) < 1L
- The patient's own assessment of their respiratory status is frequently accurate but may be unreliable in the presence of analgesia or sedation.
- A low threshold should be maintained for placement of a definitive airway and mechanical ventilation, particularly if rapid progression of motor weakness is observed

If there is any suspicion of trauma, do not extend the spine for intubation, and refer to the **ENLS protocol for Traumatic Spine Injury**.

For patients with total body weakness and cranial nerve deficits, consider a generalized neuromuscular disorder, or a stroke. Secure the airway first, then pursue the **ENLS protocol for Acute Non-Traumatic Weakness**, or the **ENLS protocol for Acute Ischemic Stroke**.

Once ventilation has been assessed, move on to acute imaging, but for those patients who are not intubated, anticipate progression of weakness and ensure continuous monitoring of ventilation as the work-up continues.

Corticosteroids

Empirical treatment if cancer is suspected

Patients with malignant SCC and acute neurologic dysfunction should receive corticosteroids. Empirical treatment with corticosteroids is recommended in patients with known malignancy and acute SCC, even if unconfirmed by MRI spine imaging.

- Steroids are often given to rapidly reduce edema and decrease the chance of spinal cord venous infarction. The use of steroids in patients with compression from epidural metastatic disease is considered to be part of standard medical therapy.
- Given the safety profile and efficacy of the lower dose of dexamethasone, we recommend a dexamethasone 10 mg IV loading dose followed by 4 mg oral/IV every 6 hours as maintenance.

Emergent Transfer

To a facility that has spine imaging available

Due to the rapid progression of some acute SCC syndromes, transfer agreements between emergency departments and other acute care facilities should be pre-established to avoid prolonged attempts to find a facility when time is of the essence. Emergent transfer is warranted when the acute care facility treating the SCC patient is unable to provide definitive care.

If the circumstance arises in which there is no feasible way to transfer a patient, or if the transfer will be delayed significantly, spinal motion should be restricted to prevent worsening of spinal cord compression, and empirical treatment with corticosteroids or antibiotics for the most likely diagnosis should be implemented without delay. The medical complications of spinal cord injury will also need to be monitored and treated, including respiratory and hemodyna.mic instability, constipation, urinary retention, pain, deep vein thrombosis, and pressure ulcers

Empirical Antibiotics

Empirical treatment for presumed infectious cause

Patients with evidence of infection such as fever, leukocytosis, intravenous (IV) drug use, or a known infectious source should be started on empirical antibiotics after blood and urine cultures are drawn.

- Draw blood cultures and ESR
  - An ESR of less than 20 has excellent sensitivity for excluding a diagnosis of spinal epidural abscess
- Start empirical antibiotics with broad spectrum coverage
  - Abscesses are often multi-microbial
  - MRSA coverage – start vancomycin
  - Gram negative coverage – start third or fourth generation cephalosporin
  - Anaerobic coverage with metronidazole should be considered

Imaging Not Available

No MRI or CT

Without imaging, consider empirical medical treatment until imaging can be obtained.

- If the history, clinical picture suggests infection and epidural abscess is a possibility, start empirical antibiotics.
- If there is a history of cancer and neoplastic spinal cord compression is a possibility, start empirical corticosteroids.
- Expedited transfer to a facility with imaging capability is necessary.

Infectious Lesion

Empirical antibiotics and ESR

Suppurative infections of the spinal epidural space can cause neurological injury directly by compressing the spinal cord, or indirectly, by compromising blood flow. The classic triad of fever, back pain, and neurologic dysfunction is not seen in most patients, and other symptoms may include localized back pain, radiculopathy, weakness, sensory changes, and sphincter dysfunction.

- STAT consultation with a spine surgeon or facilitation of transfer if none is available.
- Draw blood cultures and ESR
    - An ESR of less than 20 has excellent sensitivity for excluding a diagnosis of spinal epidural abscess
- Start empirical antibiotics with broad spectrum coverage
    - Abscesses are often multi-microbial
    - MRSA coverage – start vancomycin
    - Gram negative coverage – start third or fourth generation cephalosporin
    - Anaerobic coverage with metronidazole should be considered
- Antibiotics alone (without decompression) may be considered in patients who are either neurologically intact or who have had complete weakness for more than 48-72 hours.
    - In these patients, close observation for neurological worsening is advised given the high failure rates of medical management (6-49%)
    - Risk factors for neurological worsening
        - Diabetes
        - CRP > 115
        - WBC > 12
        - age > 65
        - positive blood cultures
        - MRSA infection
- In patients with neurological deficits, early decompression, irrigation, and debridement is the mainstay of treatment [49].

MRI Spine

Spine imaging is available

Emergent MRI with gadolinium is preferred in most cases.

- CT with contrast and or CT myelogram is an alternative if MRI is contraindicated or not available.

Imaging is used to rule out any compressive etiology of the spinal cord like tumor, infection, or intervertebral disc herniation. It is important to communicate the neurological findings to your radiologist so that the proper location(s) of relevance are imaged.

- Quadriplegic patients should have at least the C-Spine imaged. Entire spine imaging (including the conus) may also be appropriate especially if the patient has known cancer.
- Paraplegic patients (if there are no symptoms in the arms) should have thoracic and lumbosacral spine imaged.
- A discussion with the radiologist is important to image the proper level, and to expedite the imaging so that treatments can be provided efficiently and quickly.
- It is also important to notify a spine surgeon that your patient may have a myelopathy that will need surgical decompression, and when their spine imaging will be completed.

Negative Imaging or Intrinsic Spinal Cord Lesion

ENLS Non-traumatic Weakness Protocol

Patients with acute symptoms of spinal cord dysfunction can have intrinsic or intra-medullary (non-compressive) abnormalities of the spinal cord on MRI. These include spinal infarct, inflammatory / demyelinating myelitis, infectious, and para-infectious disease.

Spinal cord ischemia may require further imaging with spinal angiography to identify arteriovenous malformation, arterial occlusion or other vascular abnormalities. Serum and CSF studies should be sent for evidence of autoimmune and infectious vasculitis. Serum studies should include serology for Lyme, syphilis, human immunodeficiency virus (HIV), and nutritional deficiencies including vitamin B12. CSF should be tested for viral studies including: herpes simplex virus 1,2 polymerase chain reaction (HSV PCR), cytomegalovirus (CMV) PCR, and Varicella Zoster Virus (VZV) IgM and IgG. Immunoglobulin indices should be evaluated including (but not limited to): IgG index, Albumin index, IgG synthesis rate and oligoclonal bands. Urine should be screened for copper deficiency (see the **ENLS Acute Non-Traumatic Weakness protocol**).

Negative spinal MRI in a patient with acute disturbance of motor and or sensory function (quadriplegia or paraplegia) should prompt evaluation for acute neuropathy, neuromuscular junction disorders and myopathy. Clinical presentation, CSF, and electrophysiologic studies may establish a diagnosis of Guillain-Barre syndrome (acute polyradiculoneuropathy), Myasthenia Gravis, Lambert-Eaton syndrome, or motor neuron disease (see **ENLS Acute Non-Traumatic Weakness protocol**).

Spinal cord injury without radiographic abnormality (SCIWORA) is a clinical diagnosis made in the setting of trauma and spinal cord dysfunction without an MRI abnormality. The cervical spinal cord is most likely affected due to increased mobility of the cervical spine. Children are high risk for this injury due to the relatively large head-to-body ratio in childhood. Treatment is non-surgical due to the absence of a surgical lesion. Supportive measures include spinal motion restriction with collars, braces, or orthosis for up to 3 months. The use of corticosteroids in this setting should be carefully evaluated with inherent risks and used judiciously.

Neoplastic Disease

Steroids, decompression, radiation oncology

Patients with malignant SCC and acute neurologic dysfunction should receive corticosteroids. Empirical treatment with corticosteroids is recommended when malignant SCC is suspected, even if unconfirmed by MRI spine imaging.

- Steroids are often given to rapidly reduce edema and decrease the chance of spinal cord venous infarction. The use of steroids in patients with compression from epidural metastatic disease is considered to be part of standard medical therapy.
- Given the safety profile and efficacy of the lower dose of dexamethasone, we recommend a dexamethasone 10 mg IV loading dose followed by 4 mg oral/IV every 6 hours as maintenance.

Once imaging and diagnosis is confirmed, a combination of surgical treatment, radiotherapy, and chemotherapy is recommended. Surgical removal of tumor and spinal decompression is the primary and emergent treatment for malignant SCC.

- Early surgery (within 24 hours) with circumferential removal of the tumor, decompression of the spinal cord, and stabilization of the spine has been shown to significantly improve clinical outcomes (ambulation and pain), quality of life, and reduces need for narcotics and corticosteroids. It is also associated with a trend towards improved survival rate.

Radiotherapy is often used in conjunction with surgery and is also recommended alone in patients with minimal neurologic dysfunction and high degree of tumor responsiveness to radiation. Hematologic tumors such as lymphoma, myeloma, and seminoma are highly radiosensitive, while breast, lung and prostate have intermediate radiosensitivity. There have been significant advancements in radiosurgical techniques, and all malignant SCC patients should be referred for evaluation.

Chemotherapy is not a mainstay for acute treatment of malignant SCC and is always delivered in conjunction with radiotherapy and surgery.

Paraplegia

Paralysis of the legs and lower body. This typically related to compression of the thoracic and/or lumbar spine.

Ventilatory issues are uncommon in patients with paraplegia/paraparesis, and transport and MRI imaging are safe.

Neurocritical Care Society
ENLS
EMERGENCY NEUROLOGICAL LIFE SUPPORT

Quadriplegia

Special airway issues

In the event of sudden or progressive quadriparesis or quadriplegia, the cause may be a cervical cord pathology. This may lead to hypoventilation because of both chest wall and diaphragmatic weakness, and respiratory assessment is vital before transport or MRI imaging.

Ventilatory issues are uncommon in patients with paraplegia/paraparesis, and transport and MRI imaging are safe.

Spinal Cord Compression

Suspected myelopathy

The presentation of spinal cord compression includes:

- Back/neck pain
- Bilateral weakness or paralysis of the limbs
- Urinary retention
- Obstipation
- Sensory level
    - Defined as a loss of sensation below the dermatomal level of compression.
- Spinal shock
    - Defined as flaccid paralysis, loss of reflexes, and sensation below the level of compression
- Compression of the cauda equina can cause a similar clinical presentation with concomitant perineal (saddle) anesthesia and radicular pain
- Spinal cord compression at or above T4 can lead to hemodynamic instability secondary to loss of sympathetic tone
    - This leads to neurogenic shock with systemic hypotension and relative bradycardia

SCC of the cervical segments can lead to quadriplegia, whereas compression below these levels causes paraplegia, which is far more common. Quadriplegia is the most disabling presentation of SCC, and when present in an alert and responsive patient, should suggest a cervical spinal cord lesion. The most widely used severity scale is the American Spinal Injury Association Impairment Scale (ASIA) which was devised for traumatic SCC.

Immediately after recognition or suspicion for SCC, spinal motion restriction should be instituted with a cervical collar and thoracolumbar motion restriction if warranted. Spinal motion restriction and precautions during patient care (and transport) prevent further cord compression and injury. While optimal blood pressure is not known, spinal cord blood flow is often impaired in the setting of a compressive lesion, and hypotension should be avoided.

Suspicion of Cancer

Possible metastasis

Consider spinal metastasis with spinal cord compression if there is a history of cancer, or new suspicion of cancer.

Neurocritical Care Society
ENLS
EMERGENCY NEUROLOGICAL LIFE SUPPORT

Suspicion of Infection

Consider epidural abscess

Suspicion for an infectious cause (epidural abscess) rises if the following are present:

- Fever
- Elevated WBC count
- Elevated ESR
- History of intravenous drug use
- Known infectious source- current or past endocarditis, sepsis, chronic infection like osteomyelitis
- Any of the above with focal spine tenderness elicited by percussion (reflex hammer striking your finger placed over the vertebral spinous process)