

OBJECTIVE:

To provide a guideline for the diagnosis and management of patients with traumatic non-penetrating spinal cord injury (SCI).

Definitions:

Spinal shock: spinal cord dysfunction based on physiologic rather than structural disruption. Resolution typically occurs within 24 hours of injury. Resolution is diagnosed when the reflex arcs distal to the level of injury have returned.

Neurogenic shock: refers to flaccid paralysis, areflexia, and loss of sensation with hypotension associated loss of peripheral vascular resistance in spinal cord injury (T1-L2 sympathetic outflow disruption). It almost always resolves within 24-48 hours of injury.

The bulbo-cavernous reflex: refers to the contraction of the anal sphincter in response to squeezing of the glans of the penis in men, the clitoris in women, or tugging of the urethral catheter in both. The absence of this reflex indicates the presence of spinal shock. The return of this reflex is indicative of the end of spinal shock. If the reflex is present at the time of the injury (absence of spinal shock), then the patient has a complete SCI, and the deficit will not improve.

Complete spinal cord injury: no sensation or voluntary movement caudal to the level of injury in the presence of an intact bulbo-cavernous reflex. The level of injury is named by the last spinal level of partial neurologic function. One can expect up to one or two levels of root recovery, although the prognosis for recovery is extremely poor.

Incomplete spinal cord injury: some neurologic function persists caudal to the level of injury after the return of the bulbo-cavernous reflex (as a general rule, the greater the function and the faster the recovery, the better the prognosis).

Sacral sparing: represented by the presence of perianal sensation, voluntary rectal contraction, and great toe flexor activity. It indicates partial continuity of the white matter tracts, namely, corticospinal and spinothalamic, with implied continuity between the cerebral cortex and the lower sacral motor neurons.

Brown-Sequard syndrome: a hemicord injury with ipsilateral motor paralysis, loss of proprioception and light touch sensation, and contralateral hypesthesia to pain and temperature. The prognosis is good, with 90% of patients regaining bladder function and ambulation.

Central cord syndrome: it is typically an extension injury in middle-aged person with osteoarthritic spine. It presents with upper extremity flaccid paralysis (more involved) and spastic paralysis lower extremities (less involved) in the presence of sacral sparing. The prognosis is fair, with 50% to 60% of patients regaining sensory and motor function of the LEs.

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Tetraplegia: Complete SCI associated with a spinal cord or nerve root deficit not involving the cranial nerves above and including C8, T1 roots.

Paraplegia: Complete SCI associated with a spinal cord or nerve root deficit below and including T2. SCI involves a primary mechanical injury by way of compression, penetration, laceration, shear, and/or distraction followed by a host of secondary injury mechanisms, including (1) vascular compromise leading to reduced blood flow, loss of autoregulation, loss of microcirculation, vasospasm, thrombosis, and hemorrhage, (2) electrolyte shifts, permeability changes, loss of cellular membrane integrity, edema, and loss of energy metabolism, and (3) biochemical changes including neurotransmitter accumulation, arachidonic acid release, free radical and prostaglandin production, and lipid peroxidation. Systemic hypotension in the setting of acute spinal cord injury, with coincident loss of spinal cord autoregulatory function, compounds local spinal cord ischemia by further reducing spinal cord blood flow and perfusion^{1,2}.

Guidelines:

1. Follow the [ABCs](#).
2. Perform a complete neurologic exam looking for neurologic deficit and the level of the deficit.
3. Maintain spine precautions.
4. If tetraplegia or paraplegia is present, document the presence or absence of the bulbo-cavernous reflex.
5. Rule out hemorrhagic shock and treat the hypotension (SBP < 90 mmHg or MBP < 65 mmHg), if present, first with volume resuscitation and blood products as needed and subsequently, if needed, with norepinephrine titrated to maintain an MBP at 80-90 mmHg^{3,4}.
6. Obtain CT scan of the C and TLS spine.
7. Consult the Spine Service
8. Admit to ICU
9. Be aware of pulmonary dysfunction in quadriplegics⁵ (lesion ≤ C5), which may require intubation and mechanical ventilation.
10. If in doubt, intubate and provide ventilator support for the following patients:
 - Patients with VC < 10 mL/kg
 - Patients unable to clear secretion and/or able to cough effectively
 - Patients who develop hypercapnia on high-flow O₂
11. Consider early tracheostomy ≤ 7 days⁶.
12. Obtain PM&R consult early for referral to SCI Rehabilitation Centers

References:

1. Tator CH. Vascular effects and blood flow in acute spinal cord injuries. J Neurosurg Sci.

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1984; 28(3-4):115-119.

2. Tator CH, Fehlings MG. Review of the secondary injury theory of acute spinal cord trauma with emphasis on vascular mechanisms. J Neurosurg. 1991; 75(1): 15-26.
3. Management of acute spinal cord injuries in an intensive care unit or other monitored setting. In: Guidelines for the management of acute cervical spine and spinal cord injuries. Neurosurgery. 2002; 50(3 Suppl):S51-S57.
4. Blood pressure management following acute spinal cord injury. In: Guidelines for the management of acute cervical spine and spinal cord injuries. Neurosurgery. 2002; 50(3 Suppl):S58-S62.
5. Como JJ et al.: Characterizing the need for mechanical ventilation following cervical spinal cord injury with neurologic deficit. J Trauma 2005; 59(4): 912-916.
6. Khan, Muhammad, et al. "Early Tracheostomy in Patients with Cervical Spine Injury Reduces Morbidity and Improves Resource Utilization." The American Journal of Surgery, vol. 220, no. 3, Sept. 2020, pp. 773-77. DOI.org (Crossref), <https://doi.org/10.1016/j.amjsurg.2020.01.054>.

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