



Recommendations

Level I

There is no clinically significant effect using high-dose steroid infusion in patients with spinal cord injury (SCI), and the complication risk is increased. Patients with concomitant traumatic brain injury (TBI) may have increased mortality rates using steroid infusion (Edwards et al. 2005).

In trauma patients that are awake, sober, without neck or distracting pain, neurologically intact, and able to complete a functional range of motion (ROM) examination, spinal stabilization and radiographic assessment of the cervical spine are not recommended (Theodore et al. 2013).

Level II

The American Spinal Injury Association (ASIA) score is recommended as the preferred neurological examination tool in the assessment of acute SCI patients (Hadley et al. 2013).

Level III

One can attempt to prevent secondary neurologic injury following spinal trauma by applying a

spine board, a collar, and/or manual in-line stabilization of the cervical spine (Kornhall et al. 2017). Patients with SCI seem to benefit from early decompression and stabilization (<24 h) as well as maintaining a middle arterial pressure (MAP) above 85 mmHg for 5–7 days (Saadeh et al. 2017).

15.1 Overview

Attend to life-threatening injuries first, minimizing the movement of the patient until spinal trauma has been excluded. Obtain as much information as possible from the patient history and physical examination in order to establish a baseline in the patient's neurological status. Physical examination of the spine includes palpation of the vertebral column (log-rolling the patient), neurologic evaluation (motor and sensory deficits including reflexes), and rectal exploration. An alert, awake, sober, pain-free, and neurologically intact patient with normal ROM does not need stabilization or radiological investigations of the spine (Theodore et al. 2013). All other patients should have a radiological examination. CT imaging of the cervical spine is the method of choice. X-ray (AP, lateral, and odontoid view) should only be used as an initial evaluation if CT is not available. Based on CT findings and/or neurological status of the patient, MRI of the cervical spine may be necessary to complete the

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radiological investigation. MRI is superior in order to reveal injuries to ligamentous structures, the spinal cord, and intervertebral discs as well as displaying hematomas within the spinal canal. All patients with neurologic symptoms such as paresis, sensory disturbances, or radiating pain should have MRI of the cervical spine, even if the primary CT investigation is considered normal.

In the obtunded trauma patient not eligible for clinical examination and with a normal CT of the cervical spine, the available evidence is not sufficient to support a uniform strategy. However, there is increasing support in favor of cervical collar removal after a negative high-quality cervical spine CT scan alone (Ryken et al. 2013, Patel et al. 2015).

15.2 Background

The distribution of spinal injury shows the thoracolumbar region (Th12/L1) to be the most commonly affected followed by the cervical region (Leucht et al. 2009). Approximately 20% of patients admitted to a trauma center with a cervical fracture also have a SCI. The prevalence of a concomitant cervical spinal injury of any kind in patients with TBI is ca. 6.5% (Pandrich et al. 2018).

15.2.1 Classification of Cervical Spine Injuries

Based on the radiological and clinical investigations, the aim is to classify the injuries of the cervical spine as stable or unstable. We recommend using either the Subaxial Cervical Spine Injury Classification System (SLICS) or the latest AO classification for this purpose.

15.2.2 Treatment of Cervical Spine Injuries

Based on stability assessment and degree of compression of neurological structures, we sort cervical spine injuries into three treatment groups: (1)

open surgery, (2) external immobilization, and (3) no stabilizing treatment needed. Surgical treatment consists of internal fixation, with or without additional reduction and/or decompression. This can be done by either an anterior or posterior approach. In cases with severe instability, such as subluxation injuries, a combined anterior and posterior procedure is required. Patients with SCI seem to benefit from early surgical intervention with decompression of the spinal cord as this may improve the final neurological outcome, as well as decreasing systemic complications. Some studies indicate that this should be done within 24 h after the trauma and that very early decompression (<8 h), if possible, may even further add benefits to the neurological result (Fehlings et al. 2012; Lee et al. 2018). In addition to decompression and stabilization of the injury, these patients should maintain middle arterial pressure (MAP) above 85 mmHg for 5–7 days (Saadeh et al. 2017). External stabilization is usually performed using a rigid collar for 6–12 weeks, less frequently a cranio-thoracic orthosis. A minor group of injuries (isolated spinous or transverse process fractures) do not need any stabilizing treatment.

15.3 Specific Pediatric Concerns

In pediatric trauma patients >3 years of age that are alert, not intoxicated, not having midline neck or distracting pain, neurologically intact, and not having unexplained hypotension, radiographic assessment of the cervical spine is not recommended.

For pediatric patients <3 years of age, the same criteria for cervical spine clearance apply, but additionally a high-energy trauma mechanism (motorized vehicle accidents, falls from more than 3 m, and non-accidental trauma) should be ruled out to clear the cervical spine without radiographic assessment (Rozzelle et al. 2013).

The incidence of cervical spine fractures in pediatric patients is less than in adults, and the type of injuries shows a higher share of pure ligamentous disruption like atlanto-occipital injuries, C1-C2 subluxations, and SCIWORA. There is no

literature supporting elevated MAP in pediatric patients with SCI, but adult guidelines are usually adapted.

Tips, Tricks, and Pitfalls

- Immobilization on the spine board should be of as short duration as possible (less than 2 h) in order to prevent decubitus ulcers.
- CT scanning is the radiological examination of choice, but you should be aware that disc and ligament lesions are difficult and in some cases impossible to see on CT imaging.
- Spinal shock is a reversible condition and defined by the flaccidity and loss of reflexes seen after spinal cord injury, whereas neurogenic shock refers to impairment of the sympathetic pathways in the cervical or upper thoracic spinal cord. Both conditions, however, indicate spinal cord injury.
- Neurogenic shock includes loss of vasomotor tone and sympathetic innervations to the heart, causing vasodilatation, hypotension, and bradycardia.
- The ASIA (American Spinal Injury Association) score can be used to classify the spinal cord injury.
- Injuries located at C6 or higher can result in partial or total loss of respiratory function.

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