JOHNS HOPKINS ALL CHILDREN'S HOSPITAL

# Acute Traumatic Spinal Cord Injury Clinical Pathway

JOHNS HOPKINS
All Children's Hospital

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Updated: May 2025
Owners: Neurosurgery and Trauma



*This pathway is intended as a guide for physicians, physician assistants, nurse practitioners and other healthcare providers. It should be adapted to the care of specific patient based on the patient's individualized circumstances and the practitioner's professional judgment.*

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# Acute Traumatic Spinal Cord Injury Clinical Pathway

**Rationale:**

This clinical pathway was developed by a consensus group of Johns Hopkins All Children's Hospital (JHACH) physicians, advanced practice providers, pharmacists, and nurses to standardize the management of children presenting with concerns for traumatic acute spinal cord injuries (SCI). This guideline will assist to:

1. This pathway is not intended to be prescriptive or a highly detailed guide to management. It provides the general framework to help ensure SCI-related issues are considered at appropriate timepoints in the patient's care. SCI patients often have multisystem injuries, specifics of care will be individualized.
2. Define patients in which acute traumatic SCI is suspected
3. Define early intervention of SCI and prevent neurologic deterioration
4. Define acute critical care management goals of SCI
5. Identify prevention strategies for common systemic pathologies associated with SCI

**Background:**

SCI can cause significant long-term consequences to the patient and requires comprehensive assessment and management to determine the severity of the injury and treatment options.

*Definitions*:
Unstable spine injury: Any fracture pattern associated with a neurologic deficit and those prone to developing a neurologic deficit or late collapse (e.g., fracture subluxation and dislocation, severe burst fractures).

Neurogenic shock: Organ tissue hypoperfusion disrupting normal sympathetic control over vascular tone, often arising from SCI above T6.

Spinal shock: The sudden, temporary loss or impairment of spinal cord function below the level of injury after an acute SCI, including motor, sensory, reflex, and autonomic nervous systems.

Autonomic dysreflexia: Dysregulation of the autonomic nervous system leads to an uncoordinated sympathetic response that may result in a potentially life-threatening hypertensive episode when there is a noxious stimulus below the level of the SCI.

**Diagnosis:**

*Radiologic studies*: radiograph (X-ray), computed tomography (CT), magnetic resonance imaging (MRI)

For additional information refer to *Trauma - Cervical Spine Clearance* and *Trauma – Spine: Thoracolumbar Evaluation and Clearance* clinical pathways

**Clinical Management:**

*General:*

1. Standard resuscitation per Advanced Trauma Life Support (ATLS) protocol
2. The entire spine is immobilized during the primary survey
3. Radiographic clearance of the spine is not required before emergent surgical procedures
    a. The presence of SCI is assumed until excluded
4. Secondary and tertiary exams include examination of the spine for tenderness as well as testing all motor roots, sensations, and reflexes
5. Tertiary exams are performed only on alert and unimpaired patients without distracting injuries
6. If any spine fractures are found, the entire spine must be radiographed
7. Patients with radiographic injury will have Spine Service (Neurosurgery) consultation for focused pre-operative evaluation regarding relative instability and severity of injury before intubation when possible
8. Patients remain on spine precautions until the spine is cleared

*Guidelines*:

1. Follow airway, breathing, and circulation (ABC's)
2. Secondary survey:
    a. Log roll patient with full cervical (C)-spine immobilization to determine areas of tenderness in the thoracic and lumbosacral spine
        i. If tenderness is present, assume the spine to be unstable
    b. Examine for areas of increased kyphosis or spinous process step-off
    c. Perform a neurologic exam to determine any deficits suggestive of neurologic injury
    d. Examine rectal tone (involuntary and voluntary)
3. Consult the Spine Service (Neurosurgery) if a bony injury or neurologic deficit is found
    a. Exam should include a full American Spinal Injury Association (ASIA) *Standard Neurological Classification of SCI* exam (see Appendix), including rectal tone/contraction/deep anal pressure sensation to assess for sacral sparing
4. Maintain FULL spinal precautions
5. Admit to pediatric intensive care unit (PICU) as indicated
6. Initial resuscitation goals are to avoid secondary injury and include avoiding hypoxia, avoiding hypotension, maintaining normothermia, and maintaining spinal precautions
7. Neurogenic shock may complicate resuscitation and should be considered
8. Early decompression and stabilization of the spine should be performed within the first 48 hours of injury if the patient is cleared by PICU and Trauma teams
9. Avoid hypotension in all ages, consider elevating mean arterial pressure (MAP) to > 80 – 85 mmHg for ages 13 years and older for 5 days, utilizing vasopressor support if required
10. Maintain oxygen saturation ($SpO_2$) > 92%

11. Risk of impaired thermoregulation leading to hypothermia and persons with high-level SCI should avoid exposure to environmental temperature extremes due to impaired cord body temperature control
12. Patients with SCI are at higher risk of venous thromboembolism (VTE) and initiation of VTE prophylaxis should be considered including non-pharmacologic interventions such as sequential compression devices (SCDs) and chemical prophylaxis, see *Trauma – VTE Prevention & Anticoagulation Reversal for Trauma Patient Clinical Pathway*
13. Spinal shock may confound the neurologic exam below the level of injury
    a. Formal ASIA scoring should be done by the Neurosurgery 72 hours after injury
14. Adequate analgesia should be provided using multi-modal pain therapy including anti-inflammatories, muscle relaxants, opiates, and neuropathic pain management
15. Initiation of nutrition is important to recovery from traumatic injuries
    a. Vasopressor therapy is not an absolute contraindication to enteral nutrition
16. Patients with high cervical injury (at or above C5) are at high risk of respiratory compromise
    a. The medical team should consider early discussion regarding the need for a tracheostomy and/or long-term enteral feeding access with the care team and caregiver(s)
        i. A goal of early tracheostomy (within 14 days of injury) should be considered to help promote the progression of care, improve mobility, and discharge to rehab
17. Ileus is common in SCI patients and bowel regimens should be introduced early to prevent severe constipation
18. Autonomic dysreflexia if the injury is at T6 or above, may have clogged catheter or post-catheter removal retention
    a. The classic presentation is hypertension, bradycardia as well as headache, nausea/emesis, abdominal pain, and anxiety
    b. Treatment is to drain the bladder and/or bowel
19. Skin care champions can assist with frequent skin assessment/risk evaluation. A Wound Team consult can also be helpful for periodic assessment and recommendations to avoid skin breakdown and pressure injuries.
20. A Rehab Medicine consult should be placed as soon as the patient is stabilized and medically cleared for physical, occupational, and speech therapy
21. The Trauma registry staff will refer all spinal cord patients to the Brain and Spinal Cord Injury Program as required by the state of Florida
    a. Info on program: https://www.floridahealth.gov/provider-and-partner-resources/brain-and-spinal-cord-injury-program/index.html
    b. Referral form: https://www.floridahealth.gov/provider-and-partner-resources/brain-and-spinal-cord-injury-program/applicants/central-registry.html
22. Upon consultation with Rehab Medicine, coordination with Case Management and the patient's insurance will occur, to decipher the best location for rehabilitative needs
23. Consider Palliative Care consultation to assist in directing goals of care for the patient and family
24. SCI can significantly impact a patient's mental health, consult Psychology for mental health/coping

*Common complications*:

- Management of constipation
  - Goal: Bowel movement every evening (it may take 21 days or more to establish a reliable bowel program)
  - Patient should have bowel movement within 3 days otherwise consider neurogenic bowel and increase bowel regimen
  - Medications: (for further guidance refer to *JHACH Constipation Clinical Pathway*
    - Provide age-appropriate therapies
      - Softener: docusate, polyethylene glycol, lactulose
      - Motility: sennosides, bisacodyl
      - Evacuation: bisacodyl suppository, glycerin suppository, SMOG, sodium phosphate enemas (FLEET)
  - Consider multimodal therapy (i.e., softener, motility, and evacuation) for neurogenic bowel

- Management of neurogenic bladder
  - Neurogenic bladder evaluation following (IPCL022) *Bladder Management and Catheter-Associated Urinary Tract Infection (CAUTI) Prevention Policy*
    - If diagnosed, consult Urology
    - Consider discontinuing the bladder catheter
    - Clean intermittent catheterization (CIC) is the standard of care for upper motor neuron neurogenic bladder and may be indicated in patients with lower motor neuron neurogenic bladder and urinary retention
    - Begin CIC per Urology guidance
    - Adult-sized patient goal: < 350 – 400 mL with each catheterization
    - Pediatric patient goal: < maximum bladder capacity
      - Pediatric bladder capacity: (Age (years) + 2) x 30 = __ mL

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# Management of the Trauma Patient with Suspected or Confirmed Acute Spinal Cord Injury

**Emergency Center: Suspected or confirmed SCI?**

NO →

**OFF PATHWAY**

- See associated clinical pathways for suspected cervical thoracolumbar spine injury for imaging guidelines
  - *Trauma - Cervical Spine Clearance Clinical Pathway*
  - *Trauma – Spine: Thoracolumbar Evaluation and Clearance Clinical Pathway*

YES ↓

- Standard resuscitation per ATLS protocol
- Emergent Neurosurgery and Trauma Consult
- Stabilize spine (assume injury until proven otherwise): semi-rigid C-collar, transport on spine board, log roll spinal precautions
- Does the patient have neurological deficits?
- Does the patient have an abnormal spine exam (i.e., tenderness/pain, paraspinal edema, palpable interspinous gap)?

↓

**Considerations for Initial 24 hours after injury**

- Admission to PICU
- Bladder catheter placement if not already placed
- Avoid hypotension in all ages, consider elevating MAP to > 80 – 85 mmHg for ages 13 years and older **for 5 days**, utilizing vasopressor support if required
- Maintain $SpO_2$ > 92%
- Maintain normothermia
- Tertiary exam by Trauma Team

→

**Considerations for 24 – 48 hours after injury**

- PICU/Neurosurgery/Trauma discuss operative decompression/stabilization if indicated
  - Include discussion on initiating/advancing nutrition
- Trauma to consider VTE prophylaxis if > 12 years old, per *Trauma – VTE Prevention & Anticoagulation Reversal for Trauma Patient Clinical Pathway*

↓

**Considerations for 48 – 72 hours after injury**

- Spine Service (Neurosurgery) will characterize injury by ASIA exam at 72 hours (Appendix)
- PICU/Neurosurgery/Trauma discussion of early tracheostomy/long-term enteral feeding access; if high cervical cord injury, consider care conference if deemed appropriate
- Consult PT/OT/Speech and Rehab Medicine
- Determine early mobility leveling
- Neurogenic bladder evaluation following (IPCL022) *Bladder Management and Catheter-Associated Urinary Tract Infection (CAUTI) Prevention Policy*
  - If diagnosed, consult Urology
- Discuss bowel management:
  - Patient should have bowel movement within 3 days otherwise, consider neurogenic bowel and increase bowel regimen
- Consult Wound Team
- Consult Psychology for mental health/coping assessment
- Consider Palliative Care consult
- Multimodal pain management

→

**> 72 hours after injury**

- Consider the risk of complications related to immobility:
  - Pressure injuries, consider appropriateness of bed surface
  - Pneumonia
  - VTE

Abbreviations: ASIA, American Spinal Injury Association; MAP, mean arterial pressure; PT, physical therapy; OT, occupational therapy; SCI, spinal cord injury; VTE, venous thromboembolism

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Children's Hospital of Philadelphia
Spinal Cord Injury (SCI) Clinical Pathway — Emergency Department and ICU | Children's Hospital of Philadelphia (chop.edu)

**Outcomes:**

- Team compliance with utilization of the guideline
- Unexpected mortality or morbidity

Clinical Pathway Team
*Acute Spinal Injury Clinical Pathway*
Johns Hopkins All Children's Hospital

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**Disclaimer:**

*Clinical Pathways are intended to assist physicians, physician assistants, nurse practitioners, and other healthcare providers in clinical decision-making by describing a range of generally acceptable approaches for the diagnosis, management, or prevention of specific diseases or conditions. The ultimate judgment regarding the care of a particular patient must be made by the physician in light of the individual circumstances presented by the patient.*

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**Appendix:** American Spinal Injury Association (ASIA) *Standard Neurological Classification of SCI* exam



INTERNATIONAL STANDARDS FOR NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY (ISNCSCI)

Patient Name _____ Date/Time of Exam _____

Examiner Name _____ Signature _____

**RIGHT**

| MOTOR KEY MUSCLES | | SENSORY KEY SENSORY POINTS Light Touch (LTR) | Pin Prick (PPR) |
|---|---|---|---|
| | C2 | | |
| | C3 | | |
| Elbow flexors | C5 | | |
| Wrist extensors | C6 | | |
| Elbow extensors | C7 | | |
| Finger flexors | C8 | | |
| Finger abductors (little finger) | T1 | | |
| | T2 | | |
| | T3 | | |
| | T4 | | |
| | T5 | | |
| | T6 | | |
| | T7 | | |
| | T8 | | |
| | T9 | | |
| | T10 | | |
| | T11 | | |
| | T12 | | |
| | L1 | | |
| Hip flexors | L2 | | |
| Knee extensors | L3 | | |
| Ankle dorsiflexors | L4 | | |
| Long toe extensors | L5 | | |
| Ankle plantar flexors | S1 | | |
| | S2 | | |
| | S3 | | |
| | S4-5 | | |
| RIGHT TOTALS (MAXIMUM) | | (56) | (56) |

**UER** (Upper Extremity Right)

**LER** (Lower Extremity Right)

Comments (Non-key Muscle? Reason for NT? Pain? Non-SCI condition?):

(VAC) Voluntary Anal Contraction (Yes/No) ☐

**MOTOR SUBSCORES**

UER ☐ +UEL ☐ = UEMS TOTAL ☐ (50)
MAX (25) (25)

LER ☐ + LEL ☐ = LEMS TOTAL ☐ (50)
MAX (25) (25)

**SENSORY SUBSCORES**

LTR ☐ + LTL ☐ = LT TOTAL ☐ (112)
MAX (56) (56)

PPR ☐ + PPL ☐ = PP TOTAL ☐ (112)
MAX (56) (56)

| NEUROLOGICAL LEVELS Steps 1- 6 for classification as on reverse | R | L |
|---|---|---|
| 1. SENSORY | | |
| 2. MOTOR | | |

3. NEUROLOGICAL LEVEL OF INJURY (NLI) ☐

4. COMPLETE OR INCOMPLETE? ☐ (In injuries with absent motor OR sensory function in S4-5 only)
Incomplete = Any sensory or motor function in S4-5

5. ASIA IMPAIRMENT SCALE (AIS) ☐

| 6. ZONE OF PARTIAL PRESERVATION Most caudal levels with any innervation | R | L |
|---|---|---|
| SENSORY | | |
| MOTOR | | |

**LEFT**

| MOTOR KEY MUSCLES | | SENSORY KEY SENSORY POINTS Light Touch (LTL) | Pin Prick (PPL) |
|---|---|---|---|
| | C2 | | |
| | C3 | | |
| | C4 | | |
| C5 Elbow flexors | | | |
| C6 Wrist extensors | | | |
| C7 Elbow extensors | | | |
| C8 Finger flexors | | | |
| T1 Finger abductors (little finger) | | | |
| | T2 | | |
| | T3 | | |
| | T4 | | |
| | T5 | | |
| | T6 | | |
| | T7 | | |
| | T8 | | |
| | T9 | | |
| | T10 | | |
| | T11 | | |
| | T12 | | |
| | L1 | | |
| L2 Hip flexors | | | |
| L3 Knee extensors | | | |
| L4 Ankle dorsiflexors | | | |
| L5 Long toe extensors | | | |
| S1 Ankle plantar flexors | | | |
| | S2 | | |
| | S3 | | |
| | S4-5 | | |
| LEFT TOTALS (MAXIMUM) | | (56) | (56) |

**UEL** (Upper Extremity Left)

**LEL** (Lower Extremity Left)

**MOTOR** (SCORING ON REVERSE SIDE)

0 = Total paralysis
1 = Palpable or visible contraction
2 = Active movement, gravity eliminated
3 = Active movement, against gravity
4 = Active movement, against some resistance
5 = Active movement, against full resistance
NT = Not testable
0*, 1*, 2*, 3*, 4*, NT* = Non-SCI condition present

**SENSORY** (SCORING ON REVERSE SIDE)

0 = Absent
1 = Altered
2 = Normal
NT = Not testable
0*, 1*, NT* = Non-SCI condition present

(DAP) Deep Anal Pressure (Yes/No) ☐



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