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Deaconess REGIONAL TRAUMA CENTER

# Spinal Clearance and Spinal Injury Management

**Purpose:** To define trauma patients requiring spinal motion restriction and spine precautions as well as to provide guidelines for spine evaluation, clearance and therapeutic intervention strategies for trauma patients with spinal fractures and/or spinal cord injuries.

**Definitions:** See Attachment A

**Guidelines:**

A. Spinal Injury Consideration Criteria
   a. Blunt force trauma to head, neck, or back
   b. Neurologic deficits (weakness/paresthesia) in torso, legs, or arms not explained by peripheral nerve injuries
   c. Pain to palpation of the spine or paraspinous muscles

B. Assessment
   a. Primary Survey: Complete primary assessment per ATLS protocol
   b. Secondary Survey
      i. Logroll patient with full spinal motion restriction
      ii. Assess spine for areas of tenderness.
         1. If tender, assume the spine unstable.
      iii. Examine for areas of increased kyphosis or spinous process step-off.
      iv. Perform a complete neurological exam (motor and sensory).
         1. Assess for neurological deficits and identify the level of deficit.
      v. Examine rectal tone (involuntary and voluntary)
      vi. If pain or tenderness in the spine, or identified deficits in neurologic exam, obtain CT of the cervical/thoracic/lumbar spine to evaluate for fracture.
      vii. Maintain spinal motion restrictions until spine injury can be ruled out, spine is cleared, or definitive care is achieved.
         1. Any patient with known or suspected spine injury will have spine motion restriction maintained until injury can be ruled out, spine is cleared, or definitive care is achieved.
         2. The cervical collar is not to be removed from the patient's neck until c-spine is cleared and an order is received from the physician.
         3. The long spine board (LSB) should be removed as soon as possible even if spine has not been cleared per physician

order. These devices are not required to maintain spinal alignment and can quickly lead to skin breakdown.
    a. Goal is less than 20 minutes

C. Spine Clearance
    a. National Emergency X-Radiography Utilization Study Group (NEXUS) criteria should be utilized for cervical spine clearance. Criteria include
        i. The cervical spine may be cleared without radiographic assessment on an awake, asymptomatic, adult trauma patient without a high-risk MOI or neck tenderness and with a normal neurological exam and free range of cervical motion
        ii. Removal of a cervical collar is recommended for adult blunt trauma patients who are neurologically asymptomatic and have a negative CT scan
        iii. It is the clinician's discretion to clear the spine based on NEXUS criteria or with radiologic exams
    b. Any adult patient who does not meet NEXUS criteria to have their spine clinically cleared should undergo CT scanning with no greater than 3 mm cuts of the entire cervical spine with complete reformats or 5 mm cuts for the thoracolumbar spine.
    c. A negative CT scan is recommended as sufficient to remove a cervical collar in adult patients with blunt trauma who are obtunded or unable to be evaluated
    d. For presence of abnormalities on any of the radiographs or any neurological deficits attributable to a possible spinal cord injury, consult neurosurgery for advice on the next appropriate radiologic procedure
        i. The cervical collar should be kept in place and spinal precautions maintained until cleared or specific orders relating to positioning or activity are placed by neurosurgery or trauma surgery.
        ii. The patient should be logrolled and head of bed flat or reverse Trendelenburg for a patient with any spinal injuries until the neurosurgeon or trauma surgeon places orders relating to positioning or activity.
        iii. Field collars should be replaced by rigid collars immediately (i.e. DeRoyal, Miami J)
    e. Recommend ordering a MRI for patients with negative CT scans but have persistent neurological symptoms.
    f. Nursing Responsibility:
        i. Responsible to ensure that a physician order is on the chart "addressing spine clearance" upon admission to their unit for all activated trauma patients.
            1. If an order is not on the patient's chart, the primary nurse must maintain the patient in full spinal motion restriction and obtain an order addressing spine clearance from the physician.

2. Isolated trauma patients (i.e. non-activated patients) should be assessed based on NEXUS criteria or radiologic exams before removing a c-collar

ii. Nursing should notify the physician immediately of any changes in neurologic status (i.e. weakness, paresthesia, or respiratory compromise).

D. Management of Spinal Fractures
   a. If a neurologic deficit is present without bony injury, obtain an MRI scan of the area of the spine corresponding to the deficit.
   b. Consult neurosurgery for presence of injury to the vertebral body or neurologic deficit
      i. Recommend spinal stabilization surgery in patients without spinal cord injury within 36 hours from injury to reduce the risks of complications.
      ii. Maintain spinal precautions until cleared by the consulting Neurosurgeon
   c. Utilize compression fracture order set for compression if below criteria met:
      i. No compression deformity with loss of height > 25%
      ii. No radiographic evidence of posterior element involvement (pedicles, lamina, facets, articular process)
      iii. No significant acute kyphotic deformity
      iv. No history or clinical concern for malignancy
      v. No recent trauma worse than a ground level fall
      vi. No significant systemic infection
      vii. No acute neurological deficit
   d. If patient has a spinal fracture that is potentially an unstable fracture (see Definitions) and has not been seen by neurosurgery for plan of care, or if patient has a motor and/or sensory deficit, or a possible SCIWORA, patient should be admitted as a stepdown or higher level of care (i.e. ICU)

E. Management of Patients with Spinal Cord Injury
   a. If patient has tetraplegia or paraplegia at level T6 or above and is hemodynamically unstable
      i. Rule out hemorrhagic shock with chest x-ray, pelvic x-ray, FAST
      ii. Administer bolus crystalloid and/or blood
      iii. Place Foley and monitor urine output
      iv. Once hemorrhagic shock is rule out, start vasopressors and titrate to MAP > 85 x 7 days
      v. For tetraplegia or paraplegia, consider possibility of respiratory decline
         1. Consider elective intubation for increased work of breathing, hypoxia, or secretion management
         2. Closely monitor in ICU and promote pulmonary toilet
      vi. Methylpredisone within 8 hours following SCI cannot be definitively recommended

b. Bradycardia (Increased risk with injury above T6)
    i. Treatment
        1. Beta-2-Adrenergic agonist (Albuterol)
        2. Chronic Agents (Atropine, epinephrine, dopamine, norepinephrine)
        3. Phosphodiesterase inhibitors (aminophylline, theophylline)
c. Neurogenic Bowel Management
    i. Oral medications: stool softeners, laxatives, prokinetic agents, and rectal medications
    ii. Assisted defecation: manual disimpaction, positioning, mechanical rectal stimulation with digital stimulation, rectal stimulants (suppository, mini-enemas)
d. Neurogenic Bladder Management
    i. Indwelling catheter initially during resuscitation and stabilization
    ii. Intermittent catheterization performed 4 to 6 times every 24 hours
        1. Avoid bladder distention and bladder volumes > 400 ml to reduce risk for UTI
        2. Contraindications to intermittent catheterization include
            a. abnormal urethral anatomy
            b. cognitive impairment
            c. inability to adhere to catheterization schedule
            d. tendency to develop autonomic dysreflexia with bladder filling and persistently high fluid intake
    iii. Long term option: suprapubic catheterization is recommended when indwelling catheterization is indicated beyond the acute phase of traumatic spinal cord injury
e. Physical and Occupational therapy
f. Spasticity Management
    i. Anti-spasticity medications
        1. Baclofen: 5 – 20 mg/dose give 2 to 4 times daily
            a. Max 80mg/day
        2. Diazepam: 2 – 10 mg given 3 to 4 times daily
            a. Max dose not clearly established
        3. Dantrolene: initiate 25 mg once daily and increase weekly to 25 – 100 mg 3 to 4 times daily. Slowly titrate to effective dose.
            a. Max dose 400 mg/day
        4. Tizanidine: initiate 2 mg 3 times daily as needed and tolerated. Increase by 2 to 4 mg per dose every 1 to 4 days
            a. Max dose 36 mg/day
g. DVT prophylaxis
    i. Order mechanical DVT prophylaxis
    ii. Order chemical prophylaxis as soon as possible
        a. Goal for chemical prophylaxis initiation is 72 hours after arrival
f. Skin Assessment and Prevention of Breakdown Recommendations
    i. Assess skin per hospital policy.

ii. Ensure linen and padding is dry.
iii. Keep tubes, folds in the bedding, and other non-essential firm devices away from the patient
iv. Protect boney prominences and soft tissues from injury: Use pressure redistribution surfaces (i.e. specialty beds or mattresses, heel protectors, seat cushions, and padding between the elbows and between the knees when turned, elevate heels).
v. Consult neurosurgery for appropriateness of specialty beds when patient has an unstable vertebral column injury.
vi. Reposition patient every 2 hours to relieve pressure
vii. Mobilize the patient as soon as possible

g. Request full rehabilitation services consult as soon as appropriate

**Table 1. Major Motor Level**

| Level | Muscle Group | Action | DTR |
|---|---|---|---|
| C5 | Deltoid | Abduction of shoulder | Strike deltoid |
| C6 | Biceps, brachialis | Flexion of elbow | Biceps jerk |
| C7 | Triceps, wrist extensors | Extension of elbow, wrist | Triceps jerk |
| C8 | Intrinsic hand muscles | Make a fist | * |
| T1 | Intrinsic hand muscles | Abduct adduct fingers | * |
| L2 | Iliopsoas | Hip flexion | * |
| L3 | Quadriceps | Extension of knee | Knee jerk |
| L4 | Hamstrings | Flex knee | * |
| L5 | Tibialis anterior and extensor halluces longus | Dorsiflexion foot and big toe | Plantar reflex |
| S1 | Gastrocnemius | Plantar flexion of foot | Ankle jerk |
| S2-S4 | Anal sphincter; bulbocavernosus | Voluntary contractions of anal sphincter | * |

* Usually evaluated by neurology, neurosurgery, occupational therapy and/or physical therapy

**Table 2. Major Sensory Levels**

| Level | Sensory |
|---|---|
| C1 | None in 90% of population |
| C2 | Scalp |
| C3 | Neck |
| C4 | Shoulder |
| C5 | Deltoid (shoulder pads) |
| C6 | Thumb |
| C7 | Middle finger |
| C8 | Little finger |
| T1 | Medial forearm |
| T2 | Medial (proximal) arm |
| T4 | Nipple |
| T8 | Costal margin |
| T10 | Umbilicus |
| T12 | Inguinal ligament |
| L1, L2 | Anterior thigh |
| L3 | Medial aspect of knee |
| L5 | Lateral calf, dorsum of foot, big toe |
| S1 | Lateral foot, fifth toe |
| S3, S4 | Ischial tuberosity |
| S4, S5 | Buttocks, perianal region |

**Table 3. Segmental Reflexes**

| Reflex | Level |
|---|---|
| Biceps | C5 – C6 |
| Triceps | C6 – C7 |
| Upper Abdominal * | T7 – T10 |
| Lower Abdominal * | T7 – T10 |
| Cremaster * | L1 – L2 |
| Knee jerk | L3 – L4 |
| Posterior tibial jerk | L4 |
| Ankle jerk | S1 |
| Bulbocavernosus [1] | S2 – S4 |
| Anocutaneous [2] | S2 – S4 |

* Cutaneous reflexes: decreased in upper motor neuron lesion

1 Contraction of bulbocavernosus muscle after stroking dorsum of glans penis

2 Contraction of anal sphincter after stroking the perineal skin

**Definitions:**

A. Cervical spine (c-spine) motion restriction: The patient should be positioned supine in neutral alignment with no rotation or bending of the spinal column. The cervical spine should be further immobilized with use of a rigid cervical collar.
B. Thoracic/Lumbar motion restriction / Logroll: Neutral anatomic alignment of the entire vertebral column must be maintained while turning or moving the patient. One person is assigned to maintain control of the cervical spine; 2 people will be positioned unilaterally of the torso to turn the patient towards them while preventing segmental rotation, flexion, extension, and/or lateral bending of the chest or abdomen during transfer of the patient. A fourth person is responsible to remove the long spine board (LSB), check skin integrity and/or change linens and position padding. Neurologic function must be assessed after each position change.
C. Spine Clearance: A clinical decision suggesting the absence of acute bony, ligamentous, and neurologic abnormalities of the spine based on history, physical exam and/or negative radiologic studies.
D. Definitive care: Definitive care of a known spine injury is adequately stabilizing the spine and may include: surgical fixation, surgical decompression, and/or any number of cervical stabilization devices (i.e. Halo fixation, cervical collars)
E. Stable spine injury: Those injuries not associated with a neurologic deficit, not at risk for development of neurologic deficit, and not prone to late collapse. (i.e. spinous process or transverse process fractures)
F. Unstable spine injury: Any fracture pattern associated with a neurologic deficit, those that are prone to develop a neurologic deficit, or those prone to late collapse.
G. Traumatic tetraplegia: any injury associated with a spinal cord or nerve root deficit not involving the cranial nerves above and including C8, T1 roots
H. Traumatic paraplegia: any injury associated with a spinal cord or nerve root deficit including T2 and below
I. Complete: any spinal cord injury associated with a complete motor and sensory deficit below the level of injury
J. Incomplete: any sensory or motor sparing below the level of injury including perianal sensation
K. Adult Patient: patient greater than or equal to 15 years of age

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