SPINAL CORD INJURY

(*Last updated 12/02/2019; Reviewed by: Rudy Tedja, DO; Bo Hong, MD)*

PRESENTING COMPLAINT: Motor weakness, history of motor vehicle accidents, falls or trauma

FINDINGS

- **A** Check airway
- **B** ↓ RR, ↓ work of breathing, (seen in cervical cord injury above the C5 level)
- **C** ↓ BP, ↓ HR (injury above T4 often develop neurogenic shock); ↑ BP, ↑↓ HR (autonomic dysreflexia: flushing of skin, and/or diaphoresis above level of injury, anxiety)
- **D** Variable altered (V,P,U,D)*
- **E** Sensory and motor loss at the level below the injury, pain at trauma site, bladder distension; Glasgow Coma Scale (GCS), pupil size and reactivity, loss of rectal tone, hyperreflexia or areflexia
- **L_{PC}** ABG- ↓ PaO_2, ↑ PCO_2, (seen in high cervical cord injury)
- **U_{PC}** Abdominal ultrasound: bladder distension

***V** (verbal), **P (**pain), **U** (unconsciousness), **D** (delirious)

U_{PC} (point of care ultrasound) **L_{PC}** (point of care labs)

OTHER HISTORY

- **Signs & Symptoms**
    - Complete injury: sensory and motor loss below level of injury, acutely areflexic, flaccid tone, urinary retention, priapism, fasciculation
    - Incomplete injury: sensory > motor loss due to sensory tracts being more peripheral than motor tracts, same findings of complete injury to varying degrees depending on etiology of injury
    - Central cord syndrome: sensory loss affecting upper > lower extremities in cape distribution, sacral sparing as these fibers are most peripheral
    - Anterior cord syndrome: motor, pain and temperature sensation below lesion, bowel and bladder dysfunction. Proprioception and vibration are spared (posterior column). This is usually due to compromise of anterior spinal artery
    - Posterior cord syndrome: only vibration and proprioception affected
    - Brown Sequard syndrome: rare, caused by hemispinal insult from piercing injury or neoplasm. Contralateral loss of pain and temperature, ipsilateral loss of motor, proprioception and vibration
- **Symptoms by segment**

- High cervical (C1-C4): ventilator dependence, quadriplegia, autonomic dysreflexia, bowel and bladder incontinence
- Low cervical (C5-T1): distal arm weakness, trunk weakness, paraplegia, autonomic dysreflexia, bowel and bladder incontinence
- High thoracic: trunk weakness, paraplegia, bowel and bladder incontinence
- Low thoracic and lumbar: paraplegia, bowel and bladder incontinence
- Conus medullaris syndrome: sudden onset with back pain, mild-moderate symmetric weakness, perianal numbness, early bowel and bladder dysfunction
- Cauda equina syndrome: gradual onset with severe radicular pain, asymmetric but severe weakness in legs, late onset bladder dysfunction

- **Predisposing conditions**

  Motor vehicle accidents (48%), Falls (16%), violence (12%), Sports injuries (10%), Others (14%): Tumors, disc disease, inflammatory conditions (i.e. MS), spinal ischemia (eg. hypoperfusion during aortic surgeries); alcohol involved in 25% of cases

DIFFERENTIAL DIAGNOSIS

- Trauma patient; epidural abscess (weakness with fever in intravenous drug abuser or chronic alcoholics); epidural tumor (pain worse with lying down by stretching of cord); hematoma, disc protrusion (severe pain at onset of weakness); aortic dissection (acute chest pain preceding onset of weakness; metastasis or compressive vertebral fracture (history of cancer); spinal ischemia (symmetric weakness after aortic surgery)

OTHER INVESTIGATIONS

- **Imaging**
  - X-ray: anteroposterior, lateral, and odontoid views for a complete set. X-ray is useful to assess for bony destruction
  - CT: CT C-spine. Maintain C-spine immobilization during the imaging and transportation. Higher sensitivity compared to x-ray. Higher sensitivity than MRI for detecting fractures
  - MRI: gold standard. Up to 30% of patients with a spinal fracture can have multiple spinal fractures and so if a lesion is found, the complete spine should be imaged
    - Consider MRI for possibility of anterior-posterior spinal ligamentous injury if patient is alert with continued midline cervical spine tenderness
  - Myelography can be used if MRI and CT cannot be obtained (rarely done)
- **Who to image:** Any patients with signs and symptoms described above, obtunded patients without available history have a 7.5% incidence of cord injury; with high degree of suspicion for cord injury, 5.8% of patients with a negative CT demonstrate findings on MRI.

THERAPEUTIC INTERVENTIONS

- **Immobilize C-spine and maintain precautions**
- **Procedures**
    - Immobilize to prevent further injury with backboards and cervical collar
    - Trauma assessment including need for ventilator support, fiberoptic intubation preferred in order to avoid further neck manipulation
    - Cervical in-line stabilization must be carefully maintained throughout all intubation attempts
    - Supplemental oxygen if SpO2 < 92%
    - Continual reassessment of airway to ensure adequacy of ventilation and need for definitive airway. Decrement of vital capacity by 50% should lead to non-invasive ventilation techniques to be followed by intubation if required
    - Emergent surgery reserved for epidural abscess and patients with ongoing neurological deterioration ~2% of injury. Optimal timing of surgery for compressive lesions are not well established. Other life threatening interventions should be addressed prior to spine surgery
    - Prevent hypotension which can result in spinal hypoperfusion
    - Flaccid bladder: perform bladder scan and catheterization; will need urinary catheter placement
- **Surgical**
    - Decompression of the spinal cord to minimize additional injury from cord compression
    - Surgical stabilization of unstable ligamentous injury
    - Focus on stabilization until no spinal cord or bony injury is confirmed
- **Hemodynamics:** In acute spinal cord injury with neurogenic shock, maintain MAP 85-90mmHg for the first 7 days to improve spinal cord perfusion; fluid resuscitation to maintain euvolemia; second-line therapy: vasopressors or/and inotropes (norepinephrine or phenylephrine)
- **Medications**
    - Methylprednisolone for the treatment of spinal cord injury (not recommended)
    - High dose corticosteroids have mixed results in large trials, currently recommended for mass lesions only
    - Pain: fentanyl patch, oxycodone 10-20mg q 2hrs, hydromorphone 4mg q 4hrs
- **Consult:** Neurosurgery, neurology, orthopedics**, radiation oncology (in the setting of spinal cord compression from a cancer mass)**

ONGOING MANAGEMENT

- **Follow-Up**

- Clearing the cervical spine collar: Spinal cord can be cleared when CT does not reveal fractures, patient denies any neck tenderness on palpation, and is able to perform active range of motion in flexion, extension, lateral flexion and head rotation
- If patient is not conscious, an MRI is required to rule out ligamentous injury. Clearing the cervical collar is generally done by neurosurgery or orthopedic teams
- Consider MRI for possibility of anterior-posterior spinal ligamentous injury if patient is alert with continued midline cervical spine tenderness

- **Further Treatment:** Delayed pain: gabapentin; Bladder: teach self-catheterization; Bowel: daily bowel regimen - bisacodyl, docusate, senna, or glycerin suppository
- **Manage Complications**

  Prophylaxis: DVT prophylaxis is essential in spinal cord injury as patients have higher rates of venous thromboembolism, see the guidelines; resuming anticoagulation after spinal surgery: generally wait at least 7 days but could be sooner depending on the case

CAUTION

- **Complications**
  - Autonomic dysreflexia: episodic autonomic changes of hypertension, bradycardia, flushing, and sweating. This can be triggered by any local irritant including kinked urinary foley tubing or even wrinkled sheets under the patient
  - Spinal shock: immediate flaccidity, anesthesia, loss of bowel/bladder and areflexia which can last hours to weeks. As patient gets over initial injury, spastic paresis develops with bladder hyperactivity and hyperreflexia.

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