Emergency Management and Transfer
Spine Cases

Critical Care Services Ontario
For questions please email tanya.mohan@uhn.ca
Neurosurgical Patient Flow Model – Urgent/Emergent Cases

PNO system goals, and the principle of patient-centered care, apply across the continuum

<table>
<thead>
<tr>
<th>1</th>
<th>Patient is transported to the hospital and cared for by a team of paramedics</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Patient arrives to the emergency department</td>
</tr>
<tr>
<td>3</td>
<td>Patient is assessed by an emergency department physician</td>
</tr>
<tr>
<td>4</td>
<td>Patient is cared for by a team of health professionals who consult with neurosurgeon via CritiCall Ontario</td>
</tr>
<tr>
<td>5</td>
<td>Patient is transferred to a neurosurgical centre or remains at home hospital</td>
</tr>
<tr>
<td>6</td>
<td>Patient is repatriated to his/her community hospital for post-surgical care</td>
</tr>
<tr>
<td>7</td>
<td>Patient is cared for by a team of health professionals prior to rehab/ community care</td>
</tr>
<tr>
<td>8</td>
<td>Patient receives non-acute care (rehab, complex care or long-term care) or returns home (with or without home care assistance)</td>
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</tbody>
</table>
Neurosurgical Centres in Ontario

All neurosurgical centres have been designated as Level 2 or Level 3:

<table>
<thead>
<tr>
<th></th>
<th>Level 2 Neurosurgical Centre</th>
<th>Level 3 Neurosurgical Centre</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Services</strong></td>
<td>May not provide certain neurosurgical services (i.e. coil embolization)</td>
<td>Provides all neurosurgical services</td>
</tr>
<tr>
<td><strong>Coverage</strong></td>
<td>Generally do not provide 24/7/365</td>
<td>Provide 24/7/365 coverage</td>
</tr>
</tbody>
</table>

Provincial Neurosurgical and Spine Roster, facilitated by CritiCall Ontario, creates access to neurosurgical services (consult, transfer) for non-neurosurgical sites:

<table>
<thead>
<tr>
<th>Level 2 Centre</th>
<th>Level 3 Partner</th>
</tr>
</thead>
<tbody>
<tr>
<td>Health Sciences North</td>
<td>Toronto Collaborative (SMH, SHSC, UHN)</td>
</tr>
<tr>
<td>Kingston General Hospital</td>
<td>The Ottawa Hospital</td>
</tr>
<tr>
<td>Thunder Bay Regional Health Sciences Centre</td>
<td>Hamilton Health Sciences</td>
</tr>
<tr>
<td>Trillium Health Partners</td>
<td>Toronto Collaborative (SMH, SHSC, UHN)</td>
</tr>
<tr>
<td>Windsor Regional Hospital</td>
<td>London Health Sciences Centre</td>
</tr>
</tbody>
</table>
Acute Spine Consultation Guidelines

• Developed by Dr. James Rutka, Dr. Sunjay Sharma, Dr. Michael Fehlings and Dr. Avery Nathens, in collaboration with Provincial Neurosurgery Ontario and distributed electronically in December 2013.

• Purpose:
  a) Enables ED physicians to identify cases that require urgent or emergent transfer.
  b) Provides CritiCall’s number for emergency referral service.

• Guidelines can be downloaded by accessing CritiCall’s website: http://criticall.org/webconcepeur/web/criticall/
Acute Spine Consultation Guidelines

Developed by Dr. Sunjay Sharma, Dr. Michael Fehlings, and Dr. James Rutka for Provincial Neurosurgery Ontario

In all cases, ABC’s should be evaluated and treated prior to the application of these guidelines.

1 Stabilization and management

For all pathology, in preparation for transfer:
- Attend to ABCs
- Be mindful of FVC and ventilation in C-Spine injury
- MAP ≥85
- For neurogenic shock use Dopamine 5-10mcg/kg/min
- Avoid hypotension
- Aggressive pain control
- Perform neurovitals frequently (q1h)
- Judicious use of sedation (short acting drugs preferred)
- Reverse coagulopathy (INR < 1.5)

2 Imaging red flags

If no CT scanner but clinical/radiographic suspicion arises, arrange urgent transfer for proper imaging to closest facility. If significant neurological deficit and abnormalities on plain x-rays, consultation with neurosurgeon recommended prior to CT scan.

CT scan demonstrating at least 1 of the following
- Spinal column fracture
- Subluxation/dislocation of facet joints in cervical spine
- Collapse of vertebral body

Special considerations
- Patients with new deficit and history of malignant disease should be evaluated by gadolinium enhanced MRI emergently
- If history of trauma and new deficit, patient requires urgent MRI despite negative CT

3 Disease specific management

For all pathologies, images should be reviewed with an available radiologist prior to CritiCall referral.

Spinal Cord Injury (SCI)
CT scan is first line imaging modality.

Cervical
- Be vigilant in patients with new deficit and/or significant neck pain after trauma with normal CT scan. These patients require MRI to rule out spinal cord injury without radiographic abnormality.
- Immobilize in hard collar
- Thoracolumbar
- Assess bowel and bladder function
- Keep on bedrest with head of bed flat
- Severe unremitting spinal pain
- Nocturnal pain

Acute (<48hrs) spinal cord compression (metastatic)

Early symptoms and signs
- Neurologic dysfunction
- Localized tenderness

Management
- Delineate primary lesion if applicable
- Avoid hypotension
- Dexamethasone 16mg IV x 1
- Look for lesions, the whole spine must be imaged with MRI + gadolinium

Cauda equina syndrome

Keys to diagnosis
- Post void residual >150cc *
- Saddle anesthesia

Next steps
- Once clinical diagnosis established, must be corroborated by MRI to establish diagnosis prompting referral.
- Optimize laboratory values (i.e. coagulation) for operative intervention.

*Age-specific blood pressure values apply to pediatric patients.
*Adjust dosage for pediatric patients.
Life or Limb Policy

Guiding Principles:

• The Life or Limb Policy is in effect when a patient is life or limb threatened and therapeutic options exist, which are needed within 4 hours

• A patient’s life or limb threatening condition is a priority and the identification of beds is a secondary consideration

• No patient with a life or limb threatening condition will be refused care

• LHIN geographic boundaries will not limit a patient’s access to appropriate care in another LHIN

• Repatriation within a best effort window of 48 hours once a patient is deemed medically stable and suitable for transfer is key to ensuring ongoing access for patients with life or limb threatening conditions

• Consulting physician is to respond to pages from CritiCall Ontario regarding a provisional life or limb case within 10 minutes and will provide medical consultation to determine if the patient is life or limb threatened and recommend course of action (e.g. provide recommendations regarding management of life or limb patient to include stabilization, no transfer required, appropriate for urgent transfer)
Clinical Assessment
Determinants of Triage

1. Severity of neurologic deficit
   • Motor deficit more urgent than pure sensory deficit
   • Impact on ADLs

2. Time from onset

3. Tempo of progression

4. Spinal stability

For questions please email tanya.mohan@uhn.ca
Degenerative Cervical Spine
Patient A

- 36F

- History
  - 1 year history of severe neck pain
  - Presents to ED today because of unprovoked acute worsening of neck pain and new shooting pains and numbness in left arm
  - No difficulty with coordination, gait or sphincter function

- Physical
  - Stable gait
  - 5/5 power in all key ASIA muscle groups
  - Numbness in C6 distribution

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Patient A

- **Diagnosis**
  - Left C6 radiculopathy secondary to a herniated disc at C5-6

- **Disposition**
  - Determinants
    1. Severity: isolated sensory
    2. Time from onset: hours
    3. Tempo: stable, non-progressive
    4. Spinal Stability: stable
  - This patient can be referred to a spine surgeon on an elective basis
  - The natural history of cervical radiculopathy is favourable

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Patient B

- 72M

- History
  - Unable to use zipper or close buttons, numb fingertips, unsteady gait, urinary urgency
  - Symptoms began 6 months ago, slight progression over last month (began wearing diaper since can’t reach bathroom on time)
  - Presents to ED today because frustrated that FMD brushed off complaints as “old age”

- Physical
  - Unsteady tandem toe-to-heel gait
  - 4/5 power in upper and lower extremities
  - Hyper-reflexic, positive Hoffman reflex, up-going Babinski
Patient B

- Diagnosis
  - Severe myelopathy

- Disposition
  - Determinants
    1. Severity: motor, sensory, proprioception, & sphincter impacting on ADLs
    2. Time from onset: 6 months
    3. Tempo: progressing over weeks
    4. Spinal Stability: stable
  - This patient should be seen by a spine surgeon within 1 to 2 weeks
  - At the surgeon’s discretion, this patient can be seen through CritiCall or as an outpatient

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Patient B

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Radiculopathy

• Dysfunction of nerve roots

• Manifests with
  • Neuropathic Pain
  • Sensory disturbance
    • Light touch and pinprick
  • Lower Motor Neuron (UMN) signs
    • Hypo-reflexia, decreased tone, diminished reflexes
Myelopathy

- Dysfunction of spinal cord tracts

- Manifests with:
  - Sensory Disturbance
    - Light touch **and/or** pinprick
  - Proprioceptive deficit
    - Incoordination, ataxia
  - Upper Motor Neuron (UMN) signs
    - Hyper-reflexia, spasticity, pathologic reflexes, clonus
  - Sphincter dysfunction
    - Neurogenic Bladder: urgency +/- incomplete emptying
    - Neurogenic Bowel: constipation with overflow incontinence

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Key Points on History

• Time from onset
• Tempo of progression (hours, days, weeks, months)
• Severity of deficit
• Reason for presentation to emergency department

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Trauma
Patient C

- 62F

- History
  - 5 year history of severe neck pain
  - Slipped on ice today
  - Now unable to walk or move arms

- Physical
  - 2/5 power in key ASIA muscle groups from C5 to S1
  - Diminished sensation to light touch and pinprick in upper extremities, normal in lower extremities
  - Rectal tone normal, normal peri-anal sensation

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This form may be copied freely but should not be altered without permission from the American Spinal Injury Association.

http://www.asia-spinalinjury.org/elearning/ASIA_ISCOS_high.pdf
**Muscle Function Grading**

- **0** = total paralysis
- **1** = palpable or visible contraction
- **2** = active movement, full range of motion (ROM) with gravity eliminated
- **3** = active movement, full ROM against gravity
- **4** = active movement, full ROM against gravity and moderate resistance in a muscle specific position
- **5** = (normal) active movement, full ROM against gravity and full resistance in a functional muscle position expected from an otherwise unimpaired person
- **5** = (normal) active movement, full ROM against gravity and sufficient resistance to be considered normal if identified limiting factors (i.e. pain, disease) were not present
- **NT** = not testable (i.e. due to immobilization, severe pain such that the patient cannot be graded, amputation of limb, or contracture of > 50% of the normal range of motion)

**Sensory Grading**

- **0** = Absent
- **1** = Alter, other decreased/impaired sensation or hypopression
- **2** = Normal
- **NT** = Not testable

**Non Key Muscle Functions (optional)**

May be used to assign a motor level to differentiate AIS B vs. C

<table>
<thead>
<tr>
<th>Movement</th>
<th>Root level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shoulder</td>
<td>C5</td>
</tr>
<tr>
<td>Elbow: Pronation</td>
<td>C6</td>
</tr>
<tr>
<td>Wrist: Flexion</td>
<td>C6</td>
</tr>
<tr>
<td>Finger: Flexion at proximal joint, extension.</td>
<td>C7</td>
</tr>
<tr>
<td>Thumb: Flexion, extension and abduction in plane of thumb</td>
<td>C8</td>
</tr>
<tr>
<td>Finger: Flexion at MCP joint</td>
<td>C8</td>
</tr>
<tr>
<td>Thumb: Opposition, adduction and abduction perpendicular to palm</td>
<td>T1</td>
</tr>
<tr>
<td>Hip: Adduction</td>
<td>L2</td>
</tr>
<tr>
<td>Hip: External rotation</td>
<td>L3</td>
</tr>
<tr>
<td>Hip: Extension, abduction, internal rotation</td>
<td>L4</td>
</tr>
<tr>
<td>Knee: Flexion</td>
<td></td>
</tr>
<tr>
<td>Ankle: Inversion and eversion</td>
<td></td>
</tr>
<tr>
<td>Toe: MP and IP extension</td>
<td></td>
</tr>
<tr>
<td>Hallux and Toe: DIP and PIP flexion and abduction</td>
<td>L5</td>
</tr>
<tr>
<td>Hallux: Adduction</td>
<td>S1</td>
</tr>
</tbody>
</table>

**ASIA Impairment Scale (AIS)**

- **A** = Complete. No sensory or motor function is preserved in the sacral segments S4-5.
- **B** = Sensory Incomplete. Sensory but not motor function is preserved below the neurological level and includes the sacral segments S4-5 (light touch or pin prick at S4-5 or deep anal pressure) and no motor function is preserved more than three levels below the motor level on either side of the body.
- **C** = Motor Incomplete. Motor function is preserved below the neurological level**, and more than half of key muscle functions below the neurological level of injury (NLI) have a muscle grade less than 3 (Grades 0-2).
- **D** = Motor Incomplete. Motor function is preserved below the neurological level**, and at least half (half or more) of key muscle functions below the NLI have a muscle grade less than 3.
- **E** = Normal. If sensation and motor function as tested with the SNS are graded as normal in all segments, and the patient had prior deficits, then the AIS grade is E. Someone without an initial SCI does not receive an AIS grade.

**For an individual to receive a grade of C or D, i.e. motor incomplete status, they must have either 1) voluntary ankle clonus or 2) sacral sensory sparing and sparing of motor function more than three levels below the motor level for that side of the body. The International Standards at this time also allow non key muscle function more than three levels below the motor level to be used in determining motor incomplete status (AIS B versus C).**

**Steps in Classification**

1. **Determine sensory levels for right and left sides.**
   - The sensory level is the most caudal, intact dermatome for both pin prick and light touch sensation.

2. **Determine motor levels for right and left sides.**
   - Defined by the lowest key muscle function that has a grade of at least 3 (on supine testing), providing key muscle functions represented by segments above that level are judged to be intact (graded as a 5). Note: In regions where there is no etiology to test, the motor level is presumed to be the same as the sensory level. If testable motor function above that level is also normal.

3. **Determine the neurological level of injury (NLI)**
   - This refers to the most caudal segment of the cord with intact sensation and antigravity (3 or more) muscle function strength, provided that there is normal (intact) sensory and motor function rostrally, respectively.
   - The NLI is the most cephalad of the sensory and motor levels determined in steps 1 and 2.

4. **Determine whether the injury is Complete or Incomplete.**
   - (i.e. absence or presence of sacral sparing)
   - If voluntary ankle clonus = No and all S4-5 sensory scores = 0 and deep anal pressure = NO, then injury is Complete. Otherwise, injury is Incomplete.

5. **Determine ASIA Impairment Scale (AIS) Grade:**

   - Is injury Complete? NO YES
   - If YES, AIS = A and can record ZPP (lowest dermatome or myotome on each side with some preservation)

   - Is injury Motor Complete? NO YES
   - If YES, AIS = B
   - (No voluntary ankle clonus OR motor function more than three levels below the motor level on a given side, if the patient has sensory incomplete classification)

   - Are at least half (half or more) of the key muscles below the neurological level of injury graded 3 or better? NO YES

   - AIS = C
   - AIS = D

   - If sensation and motor function is normal in all segments, AIS = E

   - Note: AIS E is used in follow-up testing when an individual with a documented SCI has recovered normal function. If at initial testing no deficits are found, the individual is neurologically intact; the ASIA Impairment Scale does not apply.
Patient D

- 29M

- History
  - Fell from ladder
  - Low-thoracic back pain
  - No other sites of pain

- Physical
  - ATLS primary and secondary survey clear
  - Isolated tenderness to low thoracic spine
  - Neurologic exam normal/5 power in key ASIA muscle groups from L2 to S1
Patient D

• Diagnosis
  • Burst Fracture
  • Disposition
  • Determinants
    1. Severity: ASIA E, normal
    2. Time from onset: N/A
    3. Tempo: N/A
    4. Stability: stable
  • This patient should be seen by a spine surgeon within 1-2 weeks

• Spine surgeon should make treatment recommendations over phone

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Malignancy
Patient E

- 62F

- History
  - Mid-thoracic back pain for 1 month
  - Loss of ambulation over 1 week
  - Bedridden for 2 days

- Physical
  - 4/5 power in key ASIA muscle groups from L2 to S1
  - Diminished sensation to light touch and pinprick from T10 down
  - Rectal tone normal
Patient E

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Patient E

• Diagnosis
  • Incomplete Spinal Cord Injury (ASIA D)
  • Neoplastic Spinal Instability
  • Neoplastic Spinal Cord Compression

• Disposition
  • Determinants
    1. Severity: ASIA C, non-ambulatory
    2. Time from onset: 1 week
    3. Tempo: progressing over days
    4. Spinal stability: unstable
  • This patient should be seen by a spine surgeon within 24 hours

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Degenerative Lumbar Spine
Patient F

• Diagnosis
  • Acute Cauda Equina Syndrome

• Disposition
  • Determinants
    1. Severity: complete (retention)
    2. Time from onset: hours
    3. Tempo: stable
    4. Stability: stable
  • This patient should be seen by a spine surgeon within 8 hours

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Patient F

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Cauda Equina Syndrome

- Simultaneous radiculopathy of bilateral S2-4 nerve roots

- Manifests as:
  - Sensory Disturbance: pinprick and light touch
  - Atonic bladder (retention)
  - Atonic external anal sphincter
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- Aggressive pain control
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- Judicious use of sedation (short acting drugs preferred)
- Reverse coagulopathy (INR <1.5)

2 Imaging red flags
If no CT scanner but clinical/radiographic suspicion arises, arrange urgent transfer for proper imaging to closest facility. If significant neurological deficit and abnormalities on plain x-rays, consultation with neurosurgeon recommended prior to CT scan.

CT scan demonstrating at least 1 of the following
- Spinal column fracture
- Subluxation/dislocation of facet joints in cervical spine
- Collapse of vertebral body

Special considerations
- Patients with new deficit and history of malignant disease should be evaluated by gadolinium enhanced MRI emergently
- If history of trauma and new deficit, patient requires urgent MRI despite negative CT

3 Disease specific management
For all pathologies, images should be reviewed with an available radiologist prior to CritiCall referral.

Cauda equina syndrome
Keys to diagnosis
- Decreased rectal tone
- Bilateral motor weakness

Spinal Cord Injury (SCI)
CT scan is first line imaging modality.

Cervical
- Be vigilant in patients with new deficit and/or significant neck pain after trauma with normal CT scan. These patients require MRI to rule out spinal cord injury without radiographic abnormality.

Thoracolumbar
- Assess bowel and bladder function
- Keep on bedrest with head of bed flat

Acute (<48hrs) spinal cord compression (metastatic)
Early symptoms and signs
- Neurologic dysfunction
- Localized tenderness
- Management
- Delineate primary lesion if applicable
- Avoid hypotension* (SBP < 100)

- Investigate for associated spinal and systemic injuries (e.g. bowel injury, occult spinal injury)

Dexamethasone 16mg IV x 1*
- Look for lesions, the whole spine must be imaged with MRI + gadolinium

*Age-specific blood pressure values apply to paediatric patients.
*Adjust dosage for paediatric patients.
THANK YOU!

Questions?

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