

Emergency Management and Transfer Spine Cases

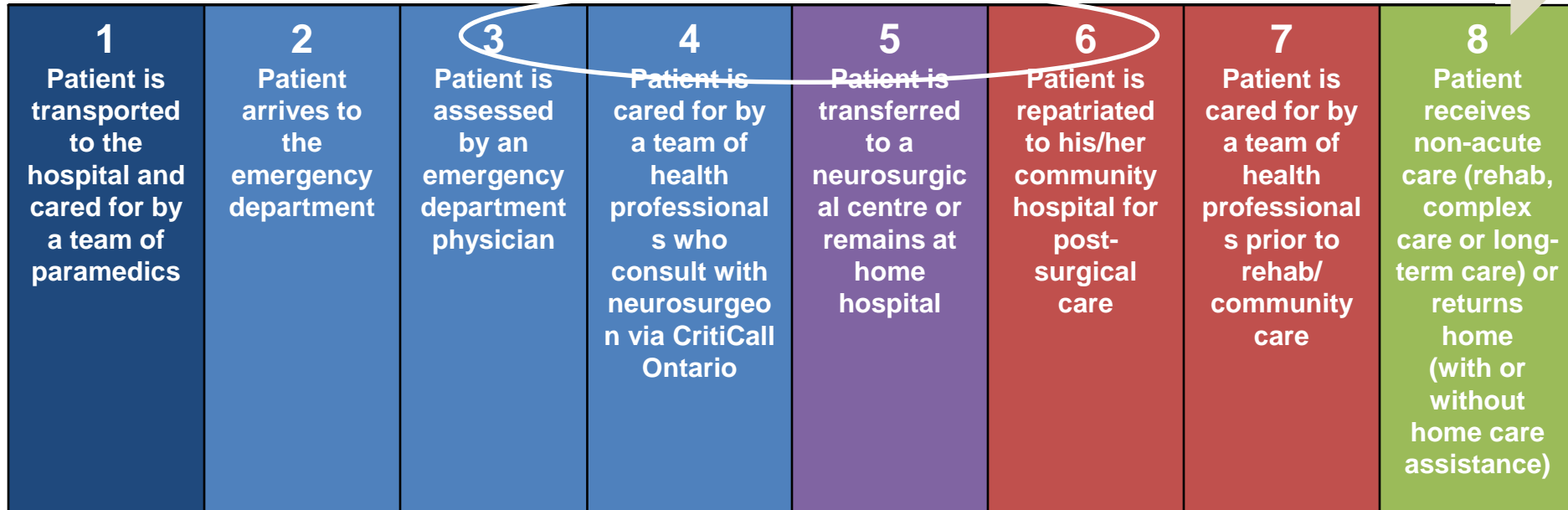


CCSO Critical Care Services Ontario

For questions please email [**info@ccso.ca**](mailto:info@ccso.ca)

Neurosurgical Patient Flow Model – Urgent/Emergent Cases

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



Neurosurgical Centres in Ontario

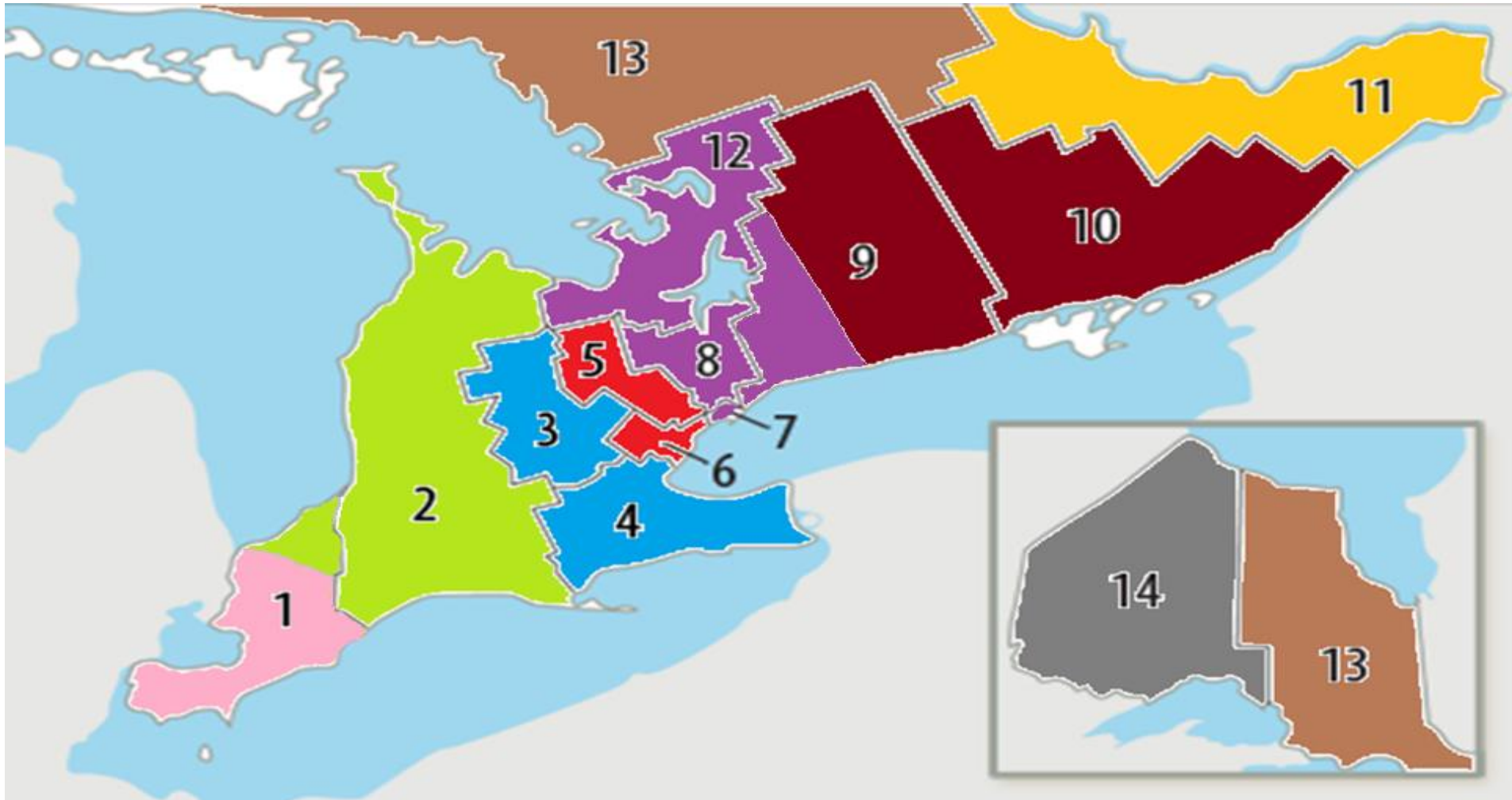
All neurosurgical centres have been designated as Level 2 or Level 3:

	Level 2 Neurosurgical Centre	Level 3 Neurosurgical Centre
Services	May not provide certain neurosurgical services (i.e. coil embolization)	Provides all neurosurgical services
Coverage	Generally do not provide 24/7/365	Provide 24/7/365 coverage

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

Level 2 Centre	Level 3 Partner
Health Sciences North	Toronto Collaborative (SMH, SHSC, UHN)
Kingston General Hospital	The Ottawa Hospital
Thunder Bay Regional Health Sciences Centre	Hamilton Health Sciences
Trillium Health Partners	Toronto Collaborative (SMH, SHSC, UHN)
Windsor Regional Hospital	London Health Sciences Centre





	Windsor Regional Hospital – Quellerie Site		Trillium Health Partners (Mississauga)		The Ottawa Hospital
	London Health Sciences Centre		Toronto Collaborative (SMH, SHSC, UHN)		Health Sciences North
	Hamilton Health Sciences Centre		Kingston General Hospital		Thunder Bay Regional Health Sciences Centre



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/webconcepteur/web/criticall/>



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



Proceed with next step before contacting CritiCall

1 Stabilization and management

For all pathology, in preparation for transfer:

- Attend to ABC's
- 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
- Lumbar disc herniation with significant canal compromise
- Spinal cord compression secondary to new mass

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

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

Early symptoms and signs

- Neurologic dysfunction
- Localized tenderness
- Severe unremitting spinal pain
- Nocturnal pain

Management

- Delineate primary lesion if applicable
- Avoid hypotension* (SBP < 100)
- 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 > 150 cc*
- Saddle anesthesia
- Decreased rectal tone
- Bilateral motor weakness

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.



Once all steps have been completed, urgently contact CritiCall at 1-800-668-4357

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

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

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

Patient A



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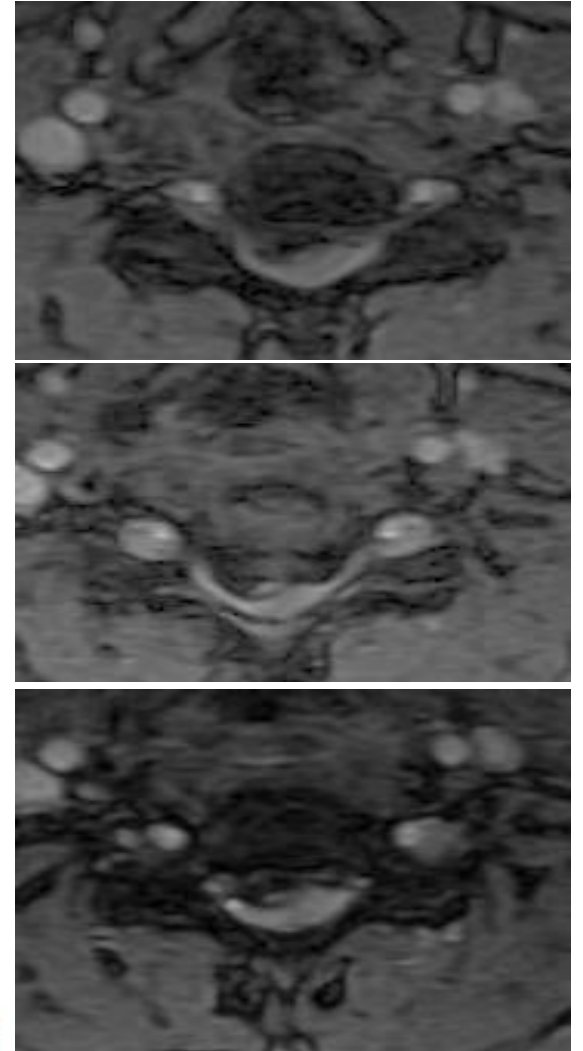
Patient B

- 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: 6months
 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

Patient B

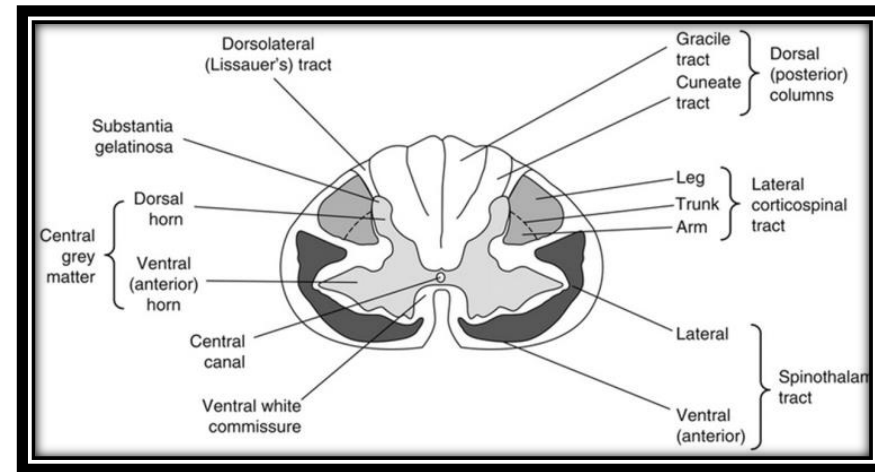


Radiculopathy

- 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



Key Points on History

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

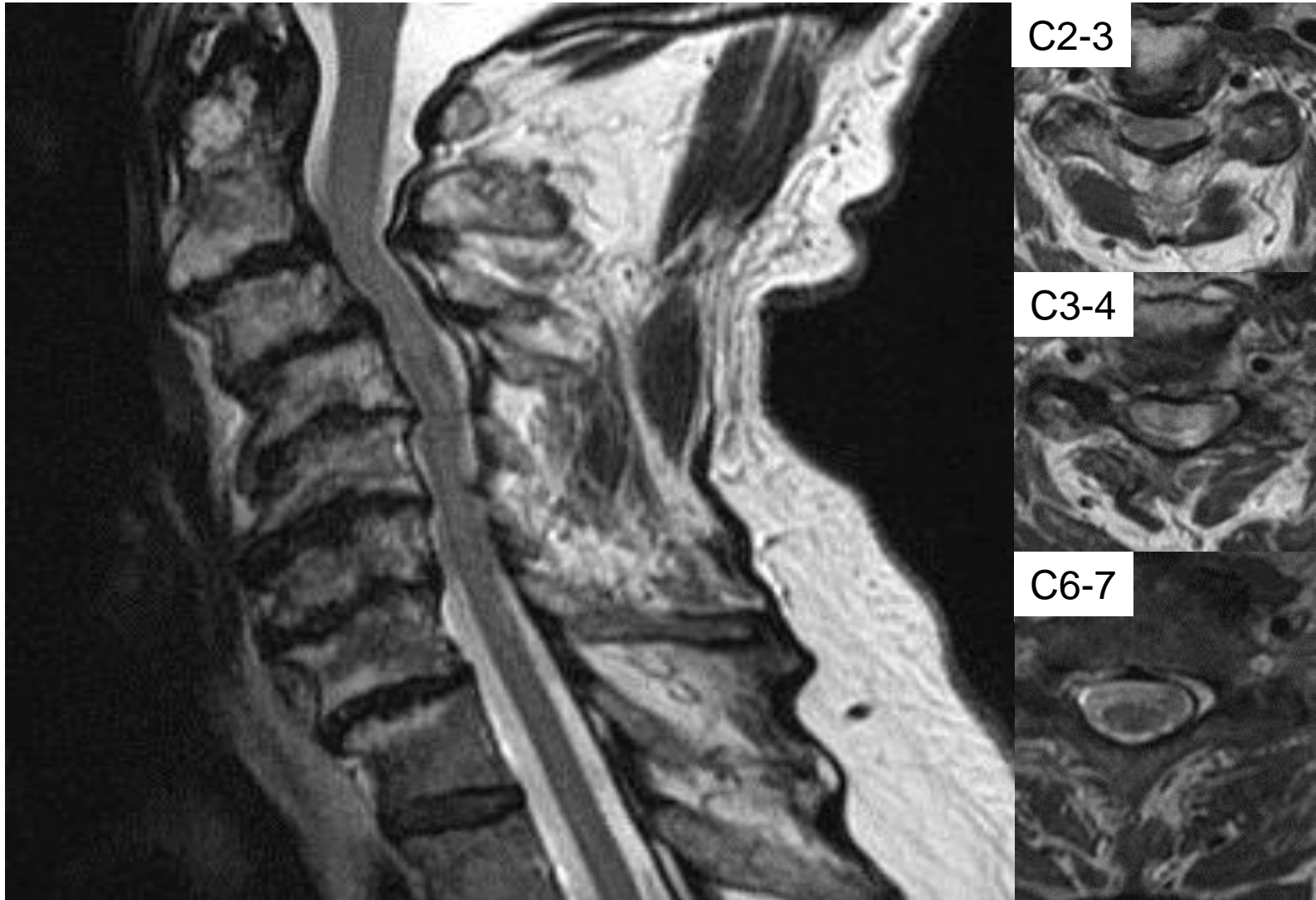
Trauma



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

Patient C



Patient Name _____ Date/Time of Exam _____

Examiner Name _____ Signature _____

RIGHT

MOTOR KEY MUSCLES

SENSORY KEY SENSORY POINTS

Light Touch (LTR) Pin Prick (PPR)

UER
(Upper Extremity Right)

Elbow flexors **C5**
Wrist extensors **C6**
Elbow extensors **C7**
Finger flexors **C8**
Finger abductors (little finger) **T1**

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

LER
(Lower Extremity Right)

Hip flexors **L2**
Knee extensors **L3**
Ankle dorsiflexors **L4**
Long toe extensors **L5**
Ankle plantar flexors **S1**

(VAC) Voluntary anal contraction
(Yes/No) ☐

RIGHT TOTALS
(MAXIMUM)

C2		
C3		
C4		
C5		
C6		
C7		
C8		
T1		
T2		
T3		
T4		
T5		
T6		
T7		
T8		
T9		
T10		
T11		
T12		
L1		
L2		
L3		
L4		
L5		
S1		
S2		
S3		
S4-5		

MOTOR SUBSCORES

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

NEUROLOGICAL LEVELS

Steps 1-5 for classification
as on reverse

1. SENSORY **R** ☐ **L** ☐
2. MOTOR ☐ ☐

3. NEUROLOGICAL
LEVEL OF INJURY (NLI) ☐

4. COMPLETE OR INCOMPLETE?
Incomplete = Any sensory or motor function in S4-5

5. ASIA IMPAIRMENT SCALE (AIS) ☐

(In complete injuries only)
**ZONE OF PARTIAL
PRESERVATION**
Most caudal level with any innervation

SENSORY **R** ☐ **L** ☐
MOTOR ☐ ☐

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REV 02/13

SENSORY KEY SENSORY POINTS

Light Touch (LTL) Pin Prick (PPL)

MOTOR KEY MUSCLES

LEFT

UEL
(Upper Extremity Left)

Elbow flexors **C5**
Wrist extensors **C6**
Elbow extensors **C7**
Finger flexors **C8**
Finger abductors (little finger) **T1**

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
5+ = normal corrected for pain/disease
NT = not testable

SENSORY (SCORING ON REVERSE SIDE)

0 = absent 2 = normal
1 = altered NT = not testable

LEL
(Lower Extremity Left)

Hip flexors **L2**
Knee extensors **L3**
Ankle dorsiflexors **L4**
Long toe extensors **L5**
Ankle plantar flexors **S1**

(DAP) Deep anal pressure
(Yes/No) ☐

LEFT TOTALS
(MAXIMUM)

C2		
C3		
C4		
C5		
C6		
C7		
C8		
T1		
T2		
T3		
T4		
T5		
T6		
T7		
T8		
T9		
T10		
T11		
T12		
L1		
L2		
L3		
L4		
L5		
S1		
S2		
S3		
S4-5		

SENSORY SUBSCORES

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

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 inhibiting factors (i.e. pain, disuse) 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 = Altered, either decreased/impaired sensation or hypersensitivity
- 2 = Normal
- NT = Not testable

Non Key Muscle Functions (optional)

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

Movement	Root level
Shoulder: Flexion, extension, abduction, adduction, internal and external rotation	C5
Elbow: Supination	
Elbow: Pronation	C6
Wrist: Flexion	
Finger: Flexion at proximal joint, extension.	C7
Thumb: Flexion, extension and abduction in plane of thumb	
Finger: Flexion at MCP joint	C8
Thumb: Opposition, adduction and abduction perpendicular to palm	
Finger: Abduction of the index finger	T1
Hip: Adduction	L2
Hip: External rotation	L3
Hip: Extension, abduction, internal rotation	L4
Knee: Flexion	
Ankle: Inversion and eversion	
Toe: MP and IP extension	
Hallux and Toe: DIP and PIP flexion and abduction	L5
Hallux: Adduction	S1

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 ≥ 3 .

E = Normal. If sensation and motor function as tested with the ISNCSCI 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 anal sphincter contraction or (2) sacral sensory sparing with sparing of motor function more than three levels below the motor level for that side of the body. The International Standards at this time allows even non-key muscle function more than 3 levels below the motor level to be used in determining motor incomplete status (AIS B versus C).

NOTE: When assessing the extent of motor sparing below the level for distinguishing between AIS B and C, the **motor level** on each side is used; whereas to differentiate between AIS C and D (based on proportion of key muscle functions with strength grade 3 or greater) the **neurological level of injury** is used.



Steps in Classification

The following order is recommended for determining the classification of individuals with SCI.

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 the 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 myotome 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.

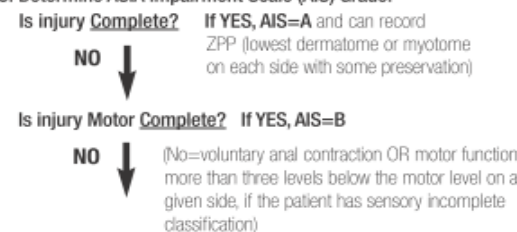
3. Determine the neurological level of injury (NLI)

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 anal contraction = **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:



Are **at least half** (half or more) of the key muscles below the **neurological** level of injury graded 3 or better?



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

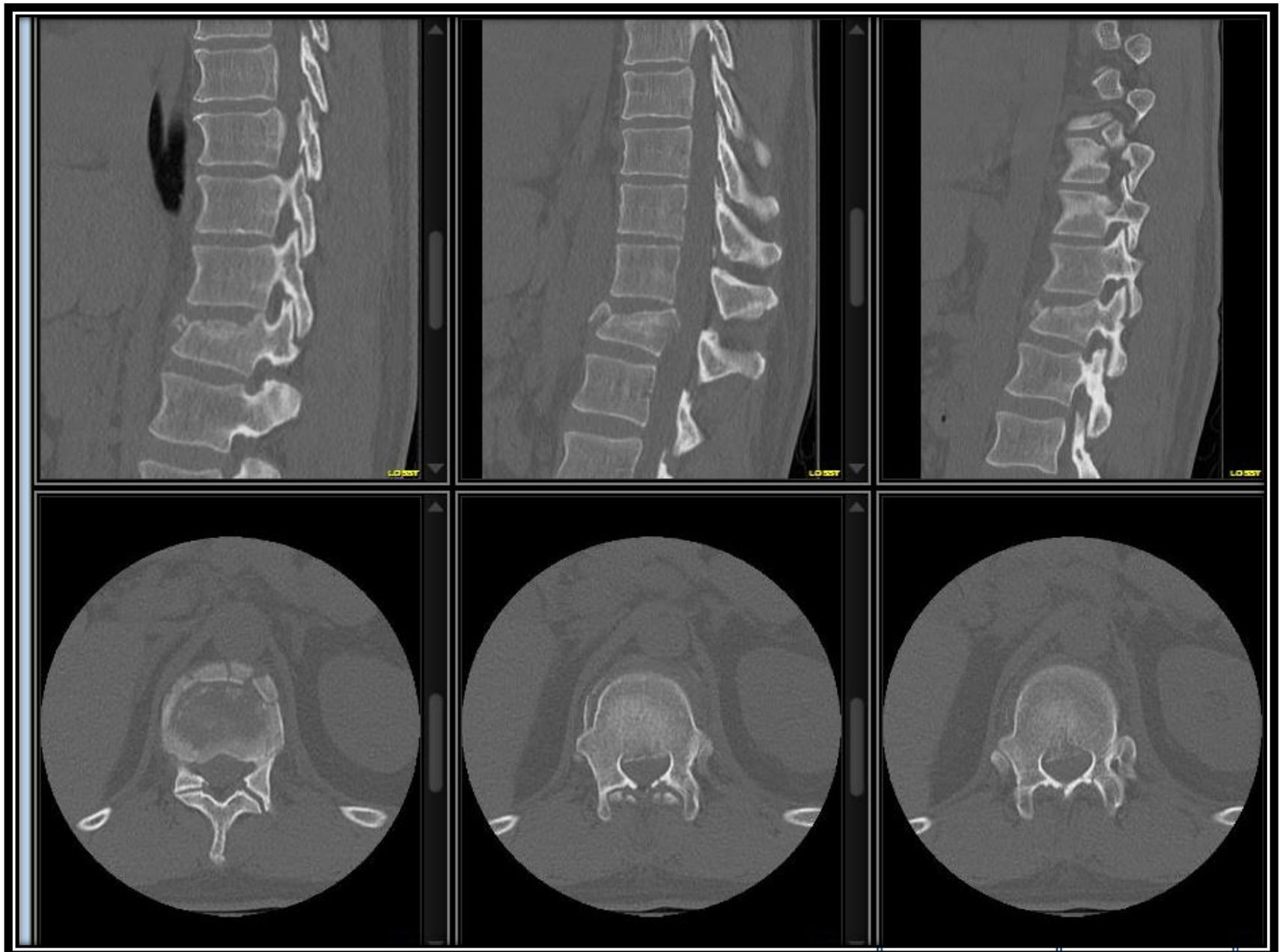
- 29M
- History
 - Fell from ladder
 - Low-thoracic back pain
 - No other sites of pain
- Physical
 - ATLS primary and secondary survey clear
 - Isolated tenderness to low thoracic spine
 - Neurologic exam normal/5 power in key ASIA muscle groups from L2 to S1

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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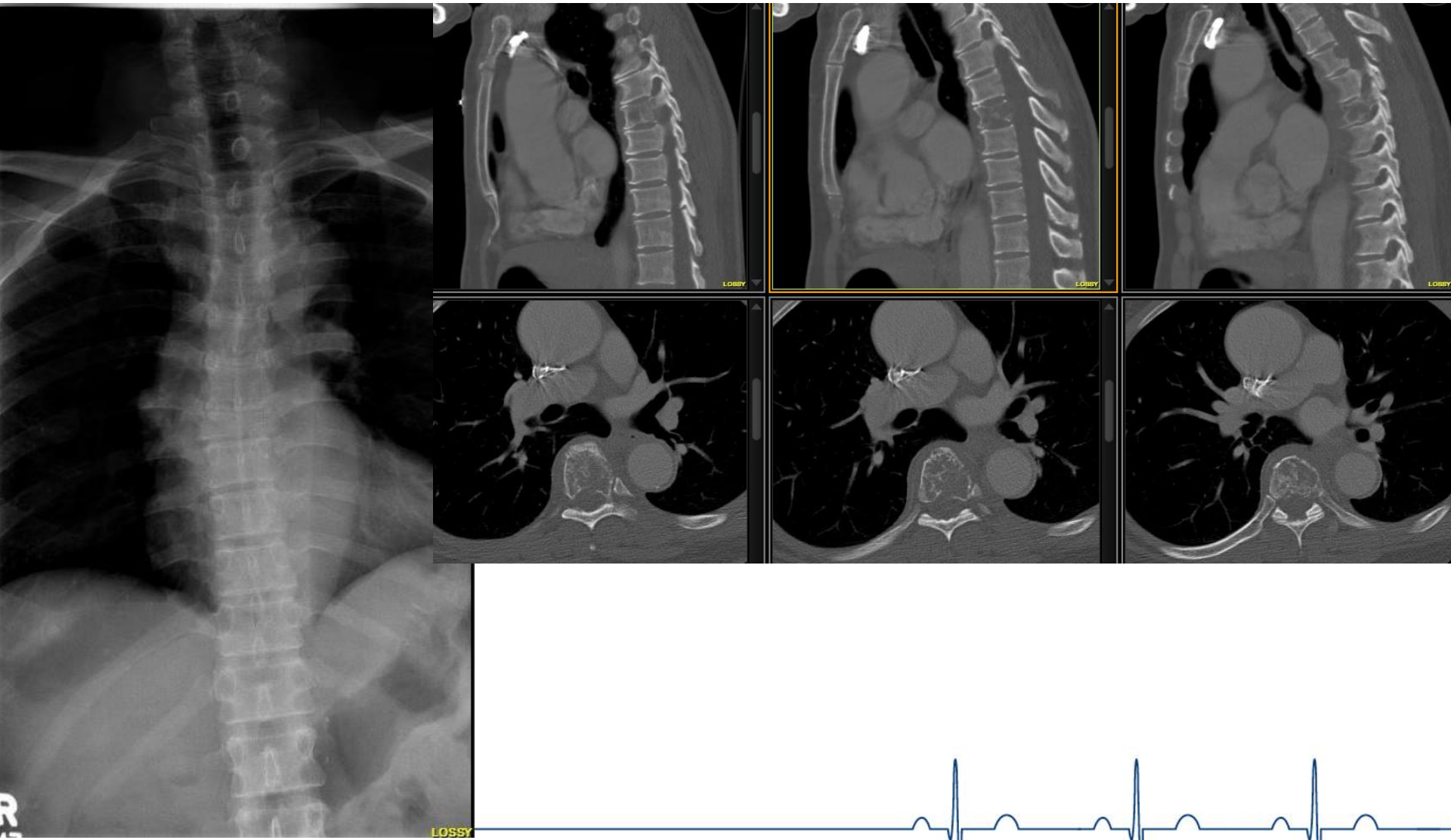
Malignancy



Patient E

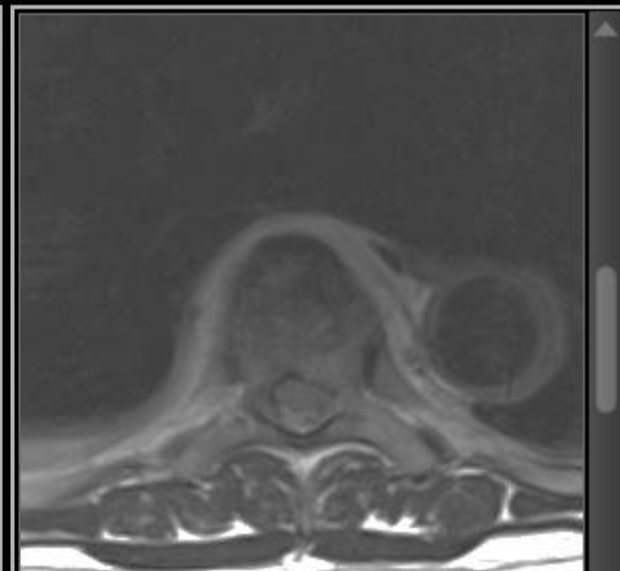
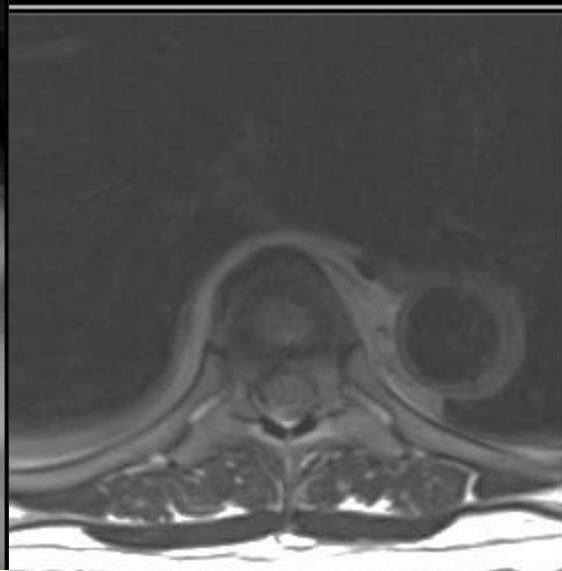
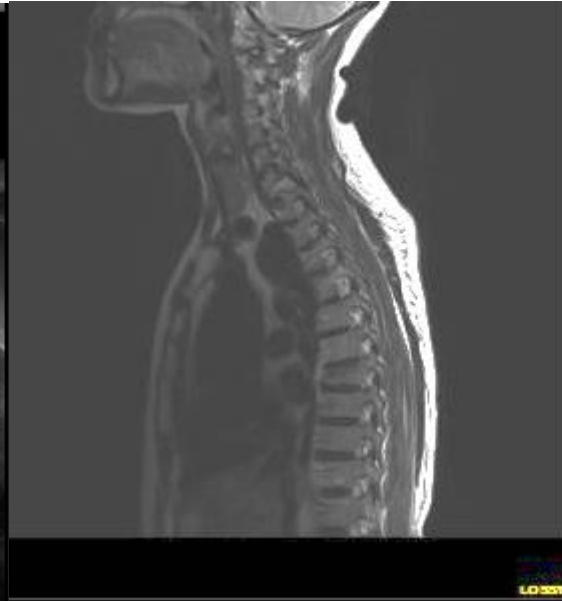
- 62F
- History
 - Mid-thoracic back pain for 1 month
 - Loss of ambulation over 1 week
 - Bedridden for 2 days
- Physical
 - 4/5 power in key ASIA muscle groups from L2 to S1
 - Diminished sensation to light touch and pinprick from T10 down
 - Rectal tone normal

Patient E



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Patient E



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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

Degenerative Lumbar Spine



Patient F

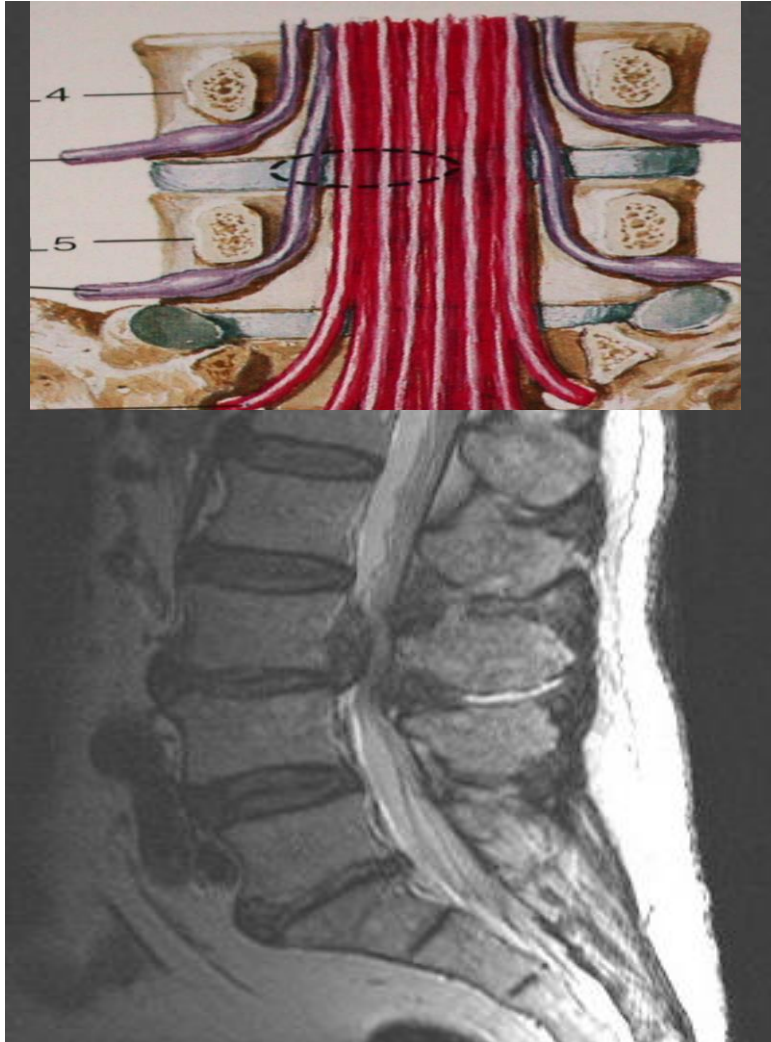
- Diagnosis
 - Acute Cauda Equina Syndrome
- Disposition
 - Determinants
 1. Severity: complete (retention)
 2. Time from onset: hours
 3. Tempo: stable
 4. Stability: stable
 - This patient should be seen by a spine surgeon within 8 hours

Patient F



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

Early symptoms and signs

- Neurologic dysfunction
- Localized tenderness
- Severe unremitting spinal pain
- Nocturnal pain

Management

- Delineate primary lesion if applicable
- Avoid hypotension* (SBP < 100)
- 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 $> 150\text{cc}^*$
- Saddle anesthesia
- Decreased rectal tone
- Bilateral motor weakness

Next steps

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THANK YOU!

Questions?

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