Management of Spinal Cord Injury

Dr. Nidal Abuhadrous MD, MRCS, ABHS(NS)
Consultant Neurosurgeon
Head of Neurosurgery – Nasser Medical Complex

Learning objectives

- Epidemiology, anatomy & pathophysiology
- Neurological assessment and classification systems
- Outline acute evaluation and imaging modalities
- Describe medical and surgical management principles
- Highlight rehabilitation strategies and long-term care considerations

Epidemiology & Risk Factors

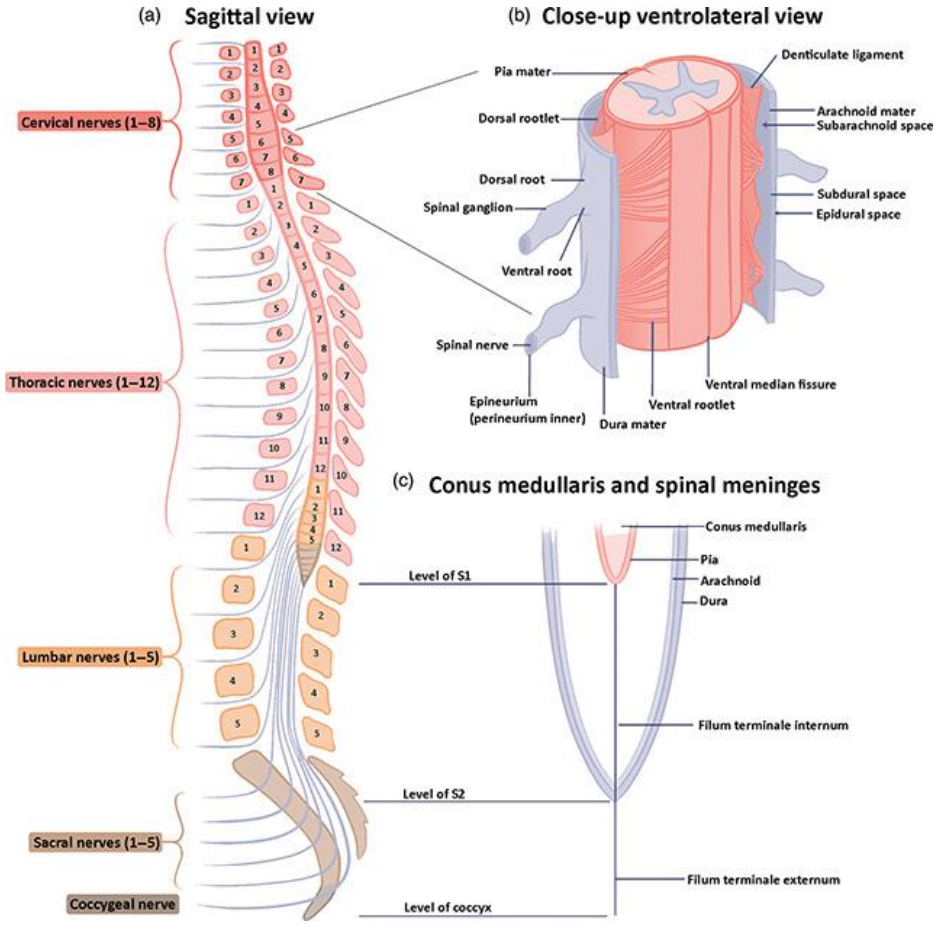
Spinal cord injuries (SCIs) affect approximately 54 per million people annually worldwide.

- Most common causes
  - Motor vehicle collisions
  - Falls
  - Sports and recreational activities
  - Violence
- High-risk populations
  - Young adult males (15–35 years)
  - Elderly with osteoporosis

Anatomy

Understanding spinal cord structure and injury mechanisms guides management.

- Gross anatomy
  - Cervical, thoracic, lumbar, sacral segments
  - White matter tracts (motor, sensory)
  - Gray matter (neuronal cell bodies)



Pathophysiology

- Primary injury
    - Mechanical compression, contusion, laceration

- Secondary injury cascade
    - Ischemia, inflammation, excitotoxicity
    - Apoptosis, free radical generation

Neurological assessment
Motor level

Lower limb	Upper Limb
L2- hip flexion	C5- elbow flexion
L3- knee extension	C6- wrist extension
L4- ankle dorsiflexion	C7- elbow extension
L5- big toe extension	C8- finger flexion
S1- ankle plantarflexion	T1-finger abduction

Neurological assessment
Motor score

No movement	0
Flicker	1
Without gravity	2
Against gravity	3
Subnormal	4
Normal Power	5

Neurological assessment

Sensory level

Area to test	Level
Deltoid	C5
Thumb	C6
Middle finger	C7
Little finger	C8
Nipple	T4
Xiphisternum	T8
Umbilicus	T10
Symphysis	T12
Medial leg	L4
Space between 1&2 toes	L5
Lateral foot	S1
Isch. Tuberosity	S3
Perianal	S5

Neurological assessment
Sensory score

Absent	0
Impaired	1
Normal	2
Not testable	NT

Neurological assessment
Complete or incomplete

- Complete (each of the next is present):
  - No voluntary anal contraction
  - All S4, S5 sensory scores are zero
  - No deep anal pressure

  ➢ Worse: Only 3% recover useful function

- Incomplete (Sacral sparing)
  - Better prognosis

Spinal shock vs. Neurogenic shock

Neurogenic shock

- BP low, bradycardia, due to loss of sympathetic tone
- Injury above T6.
- ICU, central line, IVF, pressors

Spinal shock

- Transient areflexia & hypotonia after severe SCI (hours – weeks)
- Bulbocavernosus & anal reflexes recover first

Classification systems

Accurate classification informs prognosis and treatment planning

- ASIA Impairment Scale (AIS) - Functional prognosis. Trials
- Syndromic classifications - Prognosis
- SLIC & TLIC - Guides surgical indication. Prognosis
- Level of injury - Respiratory risk. Rehab focus

ASIA Impairment Scale (AIS)

Class	Description
A	Complete: no motor/sensory function below injury level
B	Sensory incomplete: sensory but no motor function below level
C	Motor incomplete: motor function preserved, <50% key muscles ≥ grade 3
D	Motor incomplete: ≥50% key muscles ≥ grade 3
E	Normal motor and sensory function

Syndromic classifications

- Central cord syndrome (50% ambulate independently)
- Anterior cord syndrome (Worst prognosis)
- Brown–Sequard syndrome (Best prognosis. 90% ambulate)
- Posterior cord syndrome (Rare)
- Conus medullaris syndrome

Conus medullaris syndrome vs. CES

	Conus medullaris lesions	Cauda equina lesions
Spontaneous pain	Rare; when present, is usually bilateral & symmetric in perineum or thighs	May be most prominent symptom; severe; radicular type; in perineum, thighs & legs, back or bladder
Sensory deficit	Saddle; bilateral; usually symmetric; sensory dissociation	Saddle; no sensory dissociation; may be unilateral & asymmetric
Motor loss	Symmetric; not marked; fasciculations may be present	Asymmetric; more marked; atrophy may occur; fasciculations rare
Autonomic symptoms (including bladder dysfunction, impotency…)	Prominent early	Late
Reflexes	Only ankle jerk absent (preserved knee jerk)	Ankle jerk & knee jerk may be absent
Onset	Sudden and bilateral	Gradual and unilateral

SLIC

Characteristics	Points
Injury morphology • No abnormality • Compression # • Burst # • Distraction • Rotation/Translation	 0 1 2 3 4
Integrity of the disco-ligamentous complex • Intact • Indetermined • Disrupted	 0 1 2
Neurological status • Intact • Nerve root injury • Complete • Incomplete	 0 1 2 3
• Continuous cord compression + neuro deficit	+1

SLIC

Characteristics	Points
Injury morphology • No abnormality • Compression # • Burst # • Distraction • Rotation/Translation	 0 1 2 3 4
Integrity of the disco-ligame • Intact • Indetermined • Disrupted	 0 1 2
Neurological status • Intact • Nerve root injury • Complete • Incomplete	 0 1 2 3
• Continuous cord compression + neuro deficit	+1

Treatment

≤ 3 points: nonsurgical
4 points: indeterminate
≥ 5 points: surgical

TLICS

Characteristics	Points
Radiographic findings	
• Compression #	1
• Burst # or lateral angulation > 15	2
• Rotation/Translation	3
• Distraction	4
Integrity of the disco-ligamentous complex	
• Intact	0
• Indetermined	2
• Disrupted	3
Neurological status	
• Intact	0
• Nerve root injury	1
• Complete	2
• Incomplete	3
• CES	3

TLICS

Characteristics	Points
Radiographic findings	
• Compression #	1
• Burst # or lateral angulation > 15	2
• Rotation/Translation	3
• Distraction	4
Integrity of the disco-ligame	
• Intact	0
• Indetermined	2
• Disrupted	3
Neurological status	
• Intact	0
• Nerve root injury	1
• Complete	2
• Incomplete	3
• CES	3

Treatment

≤ 3 points: nonsurgical
4 points: indeterminate
≥ 5 points: surgical

Initial Evaluation

Rapid, systematic assessment in the trauma bay is critical

- Primary survey (ABCDE)
  - Airway protection with cervical immobilization
  - Breathing and circulation
  - Disability & exposure
- Secondary survey
  - Identify level of injury, score & complete or not
  - ASIA scale
- Adjuncts
  - IV access. NGT. Foley's. Thermoregulation
  - Lab: CBC. Electrolytes. Blood group, Rh. Pregnancy test in females
  - Xray, CT, MRI

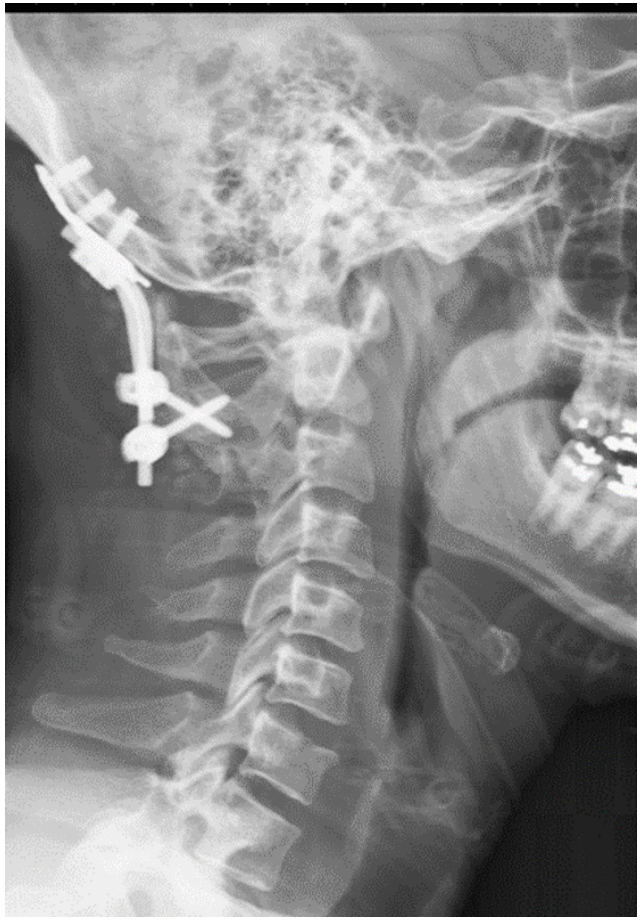
X-rays



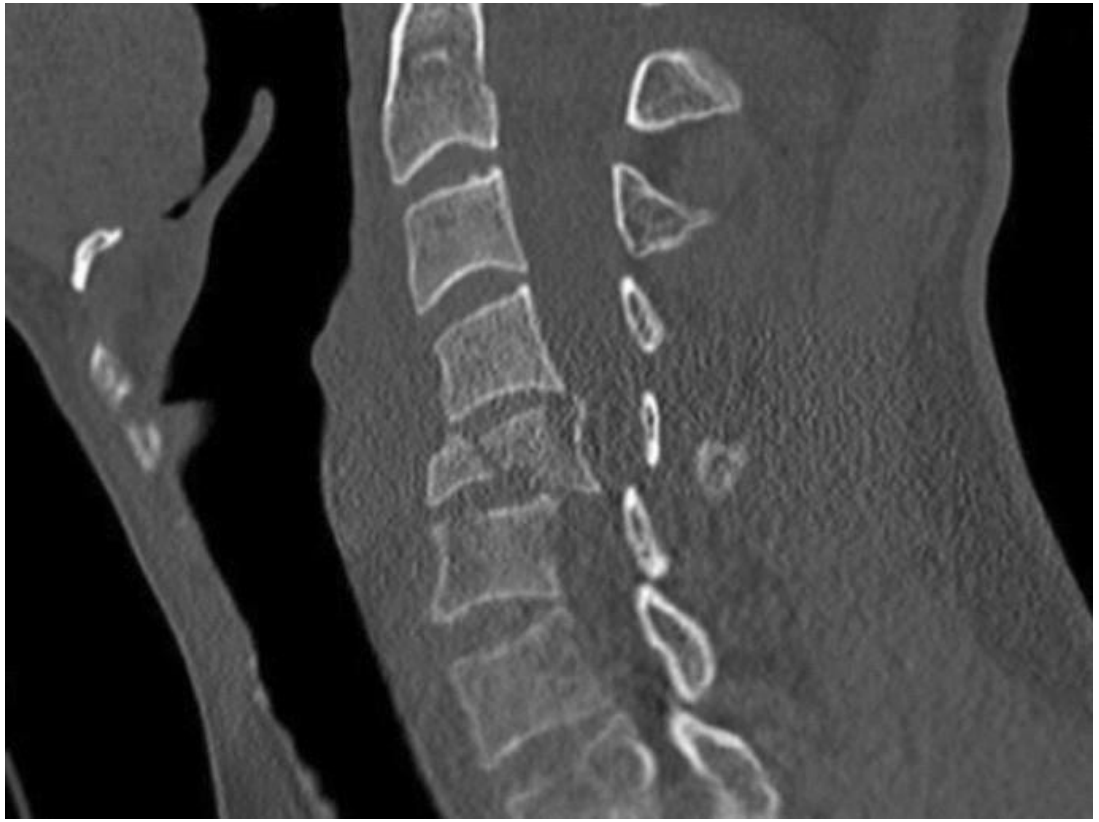




X-rays

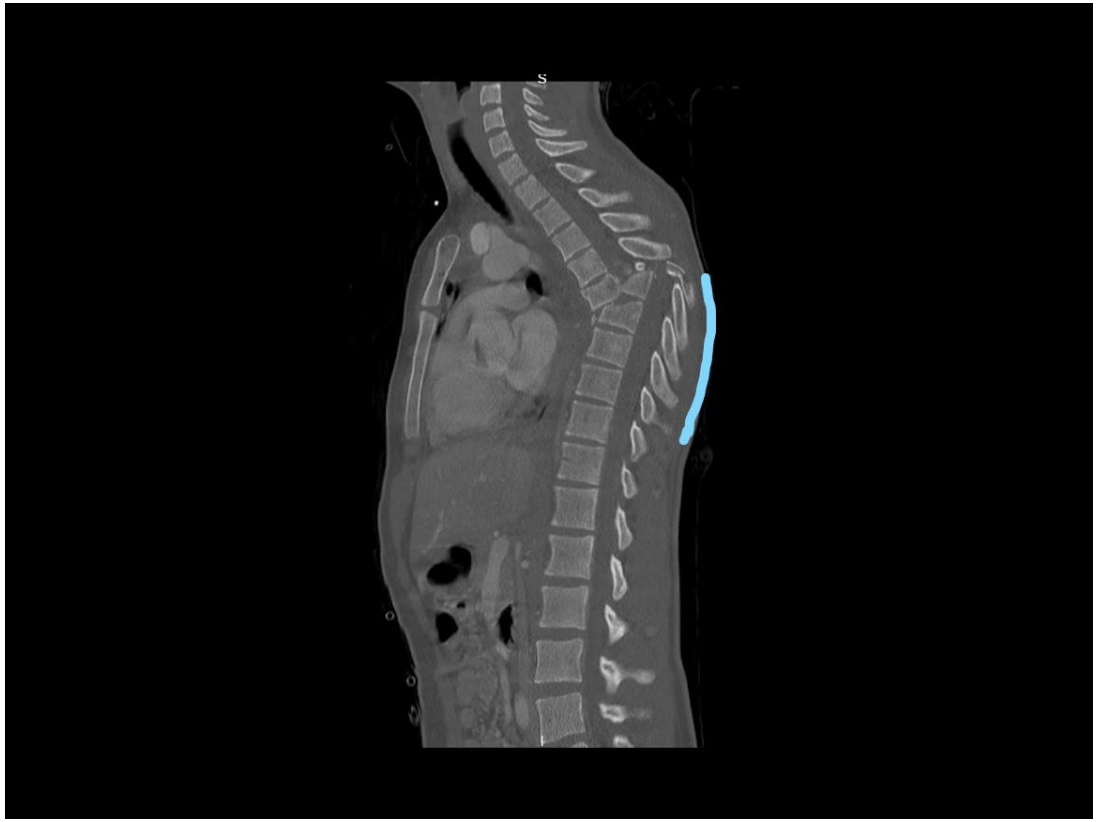


CT





CT





MRI





Acute Medical Management

Goals: limit secondary injury and optimize spinal cord perfusion

- Immobilization
  - Rigid cervical collar or halo device
  - Log rolling techniques
- Hemodynamic support
  - Maintain mean arterial pressure (MAP) 85–90 mmHg for first 7 days
- Pharmacologic therapies
  - Early methylprednisolone not routinely recommended (No class 1 evidence. Complications: infection, hyperglycemia)

Surgical Management

Indications, timing, and techniques

- Indications
  - Progressive neurologic deficits
  - Instability or deformity
  - Persistent cord compression
- Timing
  - Early (<24 hours) decompression linked to improved outcomes
- Approaches
  - Anterior cervical discectomy and fusion (ACDF)
  - Posterior laminectomy/fusion
  - Posterior instrumentation for thoracolumbar injuries
- Intraoperative monitoring
  - (Somatosensory & motor evoked potentials) for real time feedback

Postoperative & ICU Management

Holistic critical-care reduces complications and supports recovery

- Maintain BP esp. in cervical & high thoracic injury
- Neurological checks q1–2 hrs. for first 48 hrs.
- DVT prophylaxis: pneumatic compression + low–molecular-weight heparin
- Bowel/bladder program: intermittent catheterization, bowel regimen
- Aggressive pulmonary toilet: incentive spirometry, early weaning

Rehabilitation & Multidisciplinary Care

Early rehab correlates with better functional recovery

- Multidisciplinary team
    - Physiatrists, physical and occupational therapists
    - Nurses, social workers, psychologists
- Rehabilitation phases
    - Acute inpatient
    - Subacute therapy
    - Long-term community reintegration
- Key interventions
    - Strengthening, mobility training
    - Pressure-ulcer prevention
    - Bowel/bladder management

Complications & Long-Term Follow-Up

Proactive management reduces morbidity and enhances quality of life

- Early complications
  - Respiratory failure, deep vein thrombosis, autonomic dysreflexia, pressure ulcers
- Late sequelae
  - Spasticity, chronic pain, osteoporosis
- Surveillance
  - Regular neurologic exams
  - Imaging for hardware integrity
  - Bone density monitoring

Prognostic Indicators

Several factors correlate with neurological recovery

- ASIA grade at admission (A–E)
- Presence of intramedullary hemorrhage on MRI
- Time to decompression (< 24 hrs. vs > 72 hrs.)
- Patient age, comorbidities, initial hemodynamic stability

Incomplete injuries and early intervention yield highest functional gains

Future Directions

Innovations on the horizon promise paradigm shifts

- Stem-cell transplantation & biomaterial scaffolds
- Neuroprotective agents targeting secondary cascades
- Brain–spine interfaces to bypass lesion sites
- Personalized 3D-printed implants for complex reconstructions

Conclusion

- Timely assessment, hemodynamic support, and early surgical decompression are cornerstones of acute SCI care.
- Rigorous ICU care + prophylaxis of complications
- Multidisciplinary rehabilitation maximizes functional outcomes.
- Ongoing research into neuroprotective agents and regenerative therapies holds promise for future management.

Thanks



Any Questions?