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Spinal injury



Introduction

- SCI >>> commonly results from a sudden, traumatic impact on the spine that fractures or dislocates vertebrae.
- Cervical spinal cord (50%)
- The single most common level affected being C5
- Thoracic level (35%)
- Lumbar region (11%).

Primary vs Secondary injury

- **The primary injury** >> initial mechanical forces delivered to the spinal cord
 - displaced bone fragments,
 - disc materials
 - ligaments bruise or tear into the spinal cord tissue.
- **The secondary injury** >> The results of the primary injury :
 1. Damage to ascending and descending pathways in the spinal cord.
 2. Disruption of blood vessels and cell membranes.
 3. Spinal shock.
 4. Ionic imbalance, and neurotransmitter accumulation

Spinal Stability:

- the ability of the spine under physiologic loads to limit displacement so as to prevent injury or irritation of the spinal cord and nerve roots and to prevent incapacitating deformity or pain due to structural changes.

Level of injury :

Click to add text

- the most caudal segment with motor function that is at least 3 out of 5 and if pain and temperature sensation is present.

Spinal Shock :

- Hypotension spinal shock : SBP < 80 mmHg
 - Interruption of the sympathetics :
 - I. Loss of the vasoconstrictors ...vasodilatation
 - II. Unopposed parasympatheticsbradycardia
 - I. Skeletal muscle paralysis.....venous pooling
 - True hypovolemia
- Neurological Spinal shock : Transient loss of all neurological fx
 - Muscle flaccid paralysis
 - Areflexia

American Spinal Injury Association (ASIA) impairment scale :

- Is a functional classification of SCI.
- Developed to assess the severity of SCI.
- Indicates the completeness of the SCI
- Categorization is important for treatment decisions and prognostication.

(ASIA) Impairment Scale:

Score: neurologic deficit	Examination results
A: complete	No conserved sublesion motor or sensory function, notably in segments S4–S5
B: incomplete	Only sensory function conserved below neurologic level, sometimes in sacral segments S4–S5
C: incomplete	Motor function conserved below neurologic level and most key muscles below show motor scores < 3
D: incomplete	Motor function conserved below neurologic level and most key muscles below show motor scores ≥ 3
E: absent	Normal motor and sensory function



STANDARD NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY

MOTOR

KEY MUSCLES

	R	L
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		

- Elbow flexors
- Wrist extensors
- Elbow extensors
- Finger flexors (distal phalanx of middle finger)
- Finger abductors (little finger)
- Hip flexors
- Knee extensors
- Ankle dorsiflexors
- Long toe extensors
- Ankle plantar flexors

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
 NT = not testable

Voluntary anal contraction (Yes/No)

TOTALS + = MOTOR SCORE
 (MAXIMUM) (50) (50) (100)

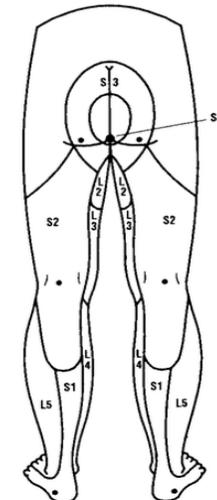
LIGHT TOUCH

	R	L
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		

PIN PRICK

	R	L
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		

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

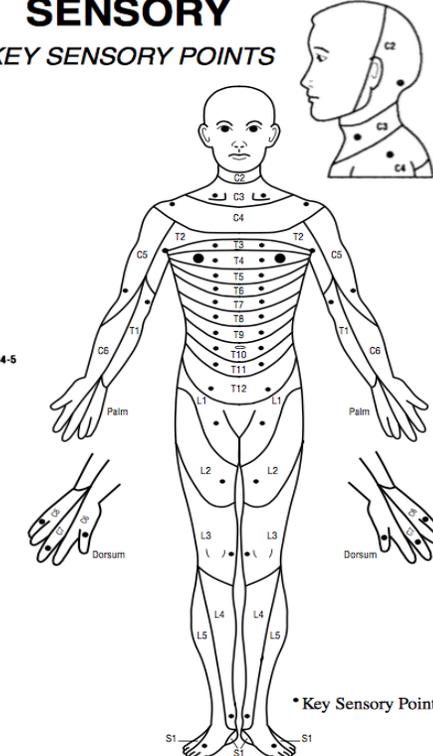


Any anal sensation (Yes/No)

TOTALS + = PIN PRICK SCORE (max: 112)
 (MAXIMUM) (56) (56) (56) (56)
 + = LIGHT TOUCH SCORE (max: 112)

SENSORY

KEY SENSORY POINTS



* Key Sensory Points

NEUROLOGICAL LEVEL The most caudal segment with normal function	R <input type="checkbox"/> L <input type="checkbox"/>	COMPLETE OR INCOMPLETE? <input type="checkbox"/> <i>Incomplete = Any sensory or motor function in S4-S5</i>	ZONE OF PARTIAL PRESERVATION <input type="checkbox"/> <i>Caudal extent of partially innervated segments</i>
	R <input type="checkbox"/> L <input type="checkbox"/>	ASIA IMPAIRMENT SCALE <input type="checkbox"/>	R <input type="checkbox"/> L <input type="checkbox"/>

Completeness of Injury:

- Complete SCI >> No preservation of any motor and/or sensory function more than 3 segments below the level of the of injury in the absence of spinal shock.
- About 3% of patients with complete injuries on initial exam will develop some recover within 24 hrs.
- If SCI remains complete > 72 hrs Recovery is essentially zero !

Function:
= Protection
= movement

Completeness of Injury:

- Incomplete SCI >> any residual motor or sensory function more than 3 segments below the level of the injury
- I. Central cord syndrome
 - II. Anterior cord syndrome
 - III. Posterior cord syndrome
 - IV. Brown-Séquard syndrome

Completeness of Injury:

Syndrome	Description
Central cord	Cervical lesion with upper-greater than lower-extremity paresis
Anterior cord	Anterior spinal artery disruption with loss of motor below lesion
Posterior cord	Rare, with loss of touch, vibration, and proprioception below lesion
Brown-Séquard	Interruption of lateral half of cord, with loss of ipsilateral motor and touch, and loss of contralateral pain and temperature

Management

- All of the following patients should be treated as having a SCI until proven otherwise :
 - I. All victims of significant trauma.
 - II. Trauma patients with LOC
 - III. Minor trauma victims with complaints referable to the spine (neck or back pain or tenderness) or spinal cord (numbness or tingling in an extremity, weakness, paralysis).
 - IV. associated findings suggestive of SCI include :
 - a) abdominal breathing
 - b) priapism (autonomic dysfunction)

'ABCs' and Resuscitation

- The most effective clinical treatment to limit tissue damage after primary injury is early surgical decompression (< 24 hours of the spinal cord injury) .

Stabilization and initial evaluation

- 1) Immobilization: maintain backboard/head-strap.
- 2) hypotension (spinal shock): maintain SBP \geq 90 mm Hg.
- 3) oxygenation
- 4) NG tube to suction: prevents vomiting and aspiration
- 5) (Foley) urinary catheter: for I's & O's urinary retention
- 6) DVT prophylaxis
- 7) Temp. Regulation & Electrolytes serum level
- 8) Detailed Neuro exam
- 9) Radiographic evaluation
- 10) Needed Medical Management

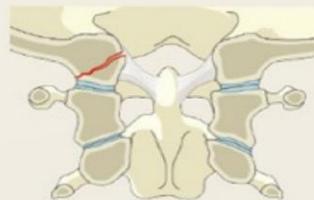




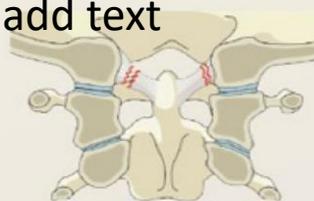
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I. Occipital Condyle and Craniocervical junction

Type A. Isolated bony injury (condyle)



Type B. Non-displaced ligamentous injury (craniocervical)

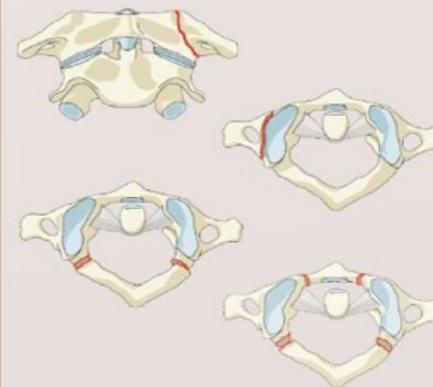


Type C. Any injury with displacement on spinal imaging

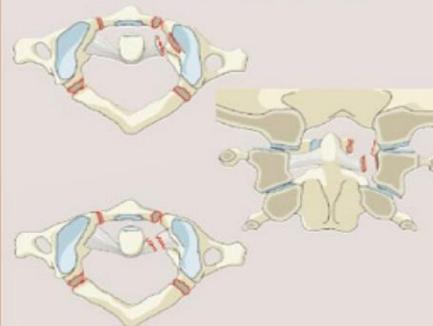


II. C1 Ring and C1-2 Joint

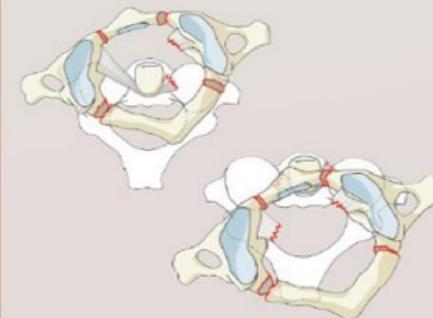
Type A. Isolated bony only (arch)



Type B. Ligamentous injury (transverse atlantal ligament)

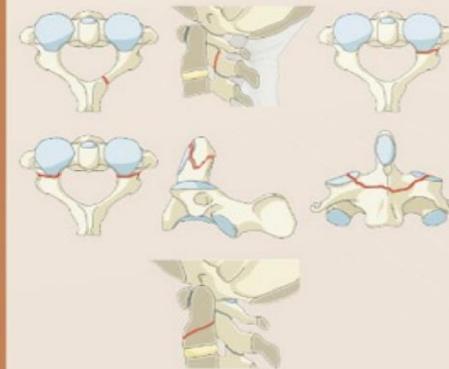


Type C. Atlantoaxial instability / Translation in any plane

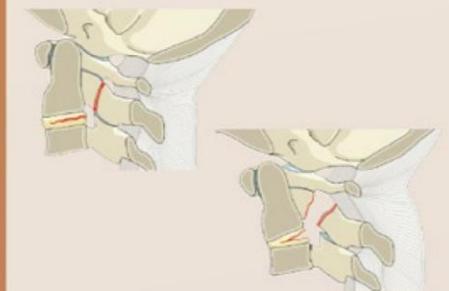


III. C2 and C2-3 Joint

Type A. Bony injury only without ligamentous, tension band, discal injury



Type B. Tension band / Ligamentous injury with or without bony injury



Type C. Any injury that leads to vertebral body translation in any directional plane



- Provide an airway and ventilatory support in patients with high tetraplegia early in the clinical course.

Patients with motor-complete injury at a level rostral to C5 will almost Invariably require ventilatory support.

- Prevent and treat hypotension.

Uncontrolled studies that used fluids and vasopressors to achieve a mean arterial pressure of 85 mmHg for a minimum of 7 days in patients with acute SCI have reported favorable outcomes.

- Monitor and treat symptomatic bradycardia

An ideal agent should have both alpha- and beta-adrenergic actions, Such as [dopamine](#), [norepinephrine](#), or [epinephrine](#), to counter the loss of sympathetic tone and provide chronotropic support to the heart.

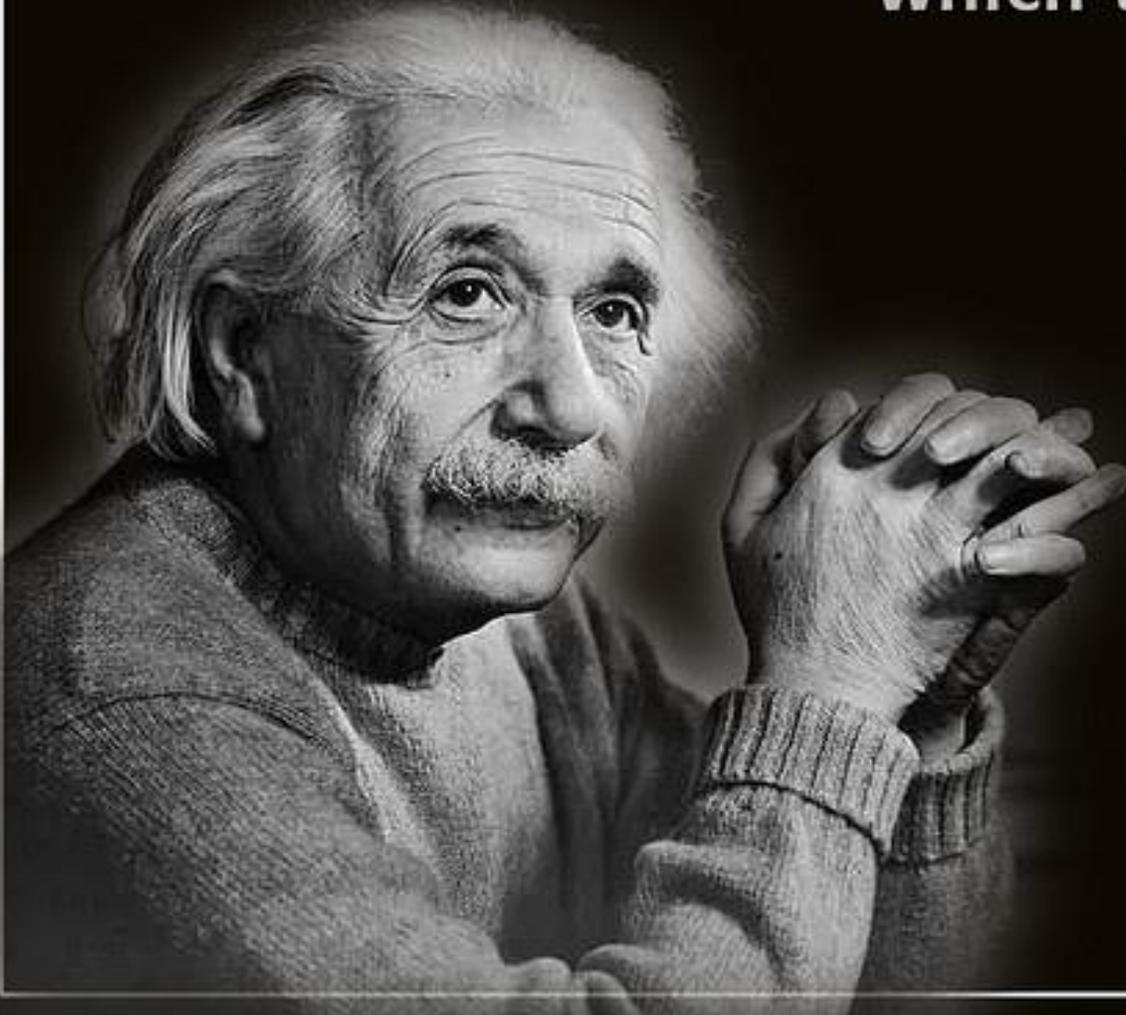
- Monitor and regulate temperature.

[Poikilothermia](#) results, which is a state in which the body assumes the temperature of the surrounding ambient environment.

People with SCI above T6 may experience hypothermia as well as reduced ability to dissipate body heat.

**„I never teach my pupils, I only
provide the conditions in
which they can learn“**

**Albert Einstein
1879-1955**



Radiological evaluation

- Radiographic evaluation should include spinal alignment, presence of any rotation or translation, assessment of the kyphosis, loss of vertebral height, and widened inter-pedicular or inter-spinous distance.
- (CT) scan provides excellent delineation of bony injuries.
- MRI scan provides information on spinal cord or root injury, presence and extent of cord edema and hemorrhage.









• Management :

Medical

- Analgesia & DVT & GI prophylaxis
- Methylprednisolone >>> It has been asserted that beneficial (sensory and motor) effects at 6 weeks, 6 Months and 1 year are seen when **(MP)** is administered but only if given within 8 hours of Injury.

Surgical

Spinal Infections

- Vertebral osteomyelitis
- Diskitis
- Epidural abscess
- Pott's disease (TB infection of the spine)
- Transverse Myelitis

Vertebral osteomyelitis (Spondylitis)

- 2 – 4 % of all cases of osteomyelitis
- More common in elderly . Male > Female
- Lumbar spine >>> most common location of pyogenic adult OM
- Most start by haematogenous spread . Arterial vs. Venous
- Posterior elements are rarely involved

Vertebral osteomyelitis (Spondylitis)

➤ Risk factors :

- I. I.V drug abuse
- II. diabetes mellitus
- III. corticosteroid use
- IV. chemotherapy for cancer
- V. Chronic Dx (RA, Hepatic, Renal)
- VI. Prior radiation therapy
- VII. Infective endocarditis

History and Physical Exam

- Localised Back +/- radicular pain
- pain independent on the activity..? sleep
- Paraspinal Muscle spasm
- Fever < 50 %

- O/E :
 - Neurological signs are uncommon initially
 - 17 % have neurological deficits
 - Sensory < motor ...since most cause anterior compression

Laboratory Studies

- WBC ...high in only 35 %
- ESRhigh in almost all /CRP...more sensitive , normalize earlier
- Blood Cx < 50 % positive
- Needle BX ...Yield 60–90%.....Open Bx more sensitive
- Most common causative organism >> Staph. Aureus

Imaging

- Plain X-ray: changes take 2–8 weeks to develop.
- MRI: T1WI → low signal T2WI → increased intensity of involved VBs and disc
- CT scan: for bony involvement & detailed bony anatomy in case instrumentation is needed
- Bone scan: three phase bone scan has good sensitivity and specificity.

Management

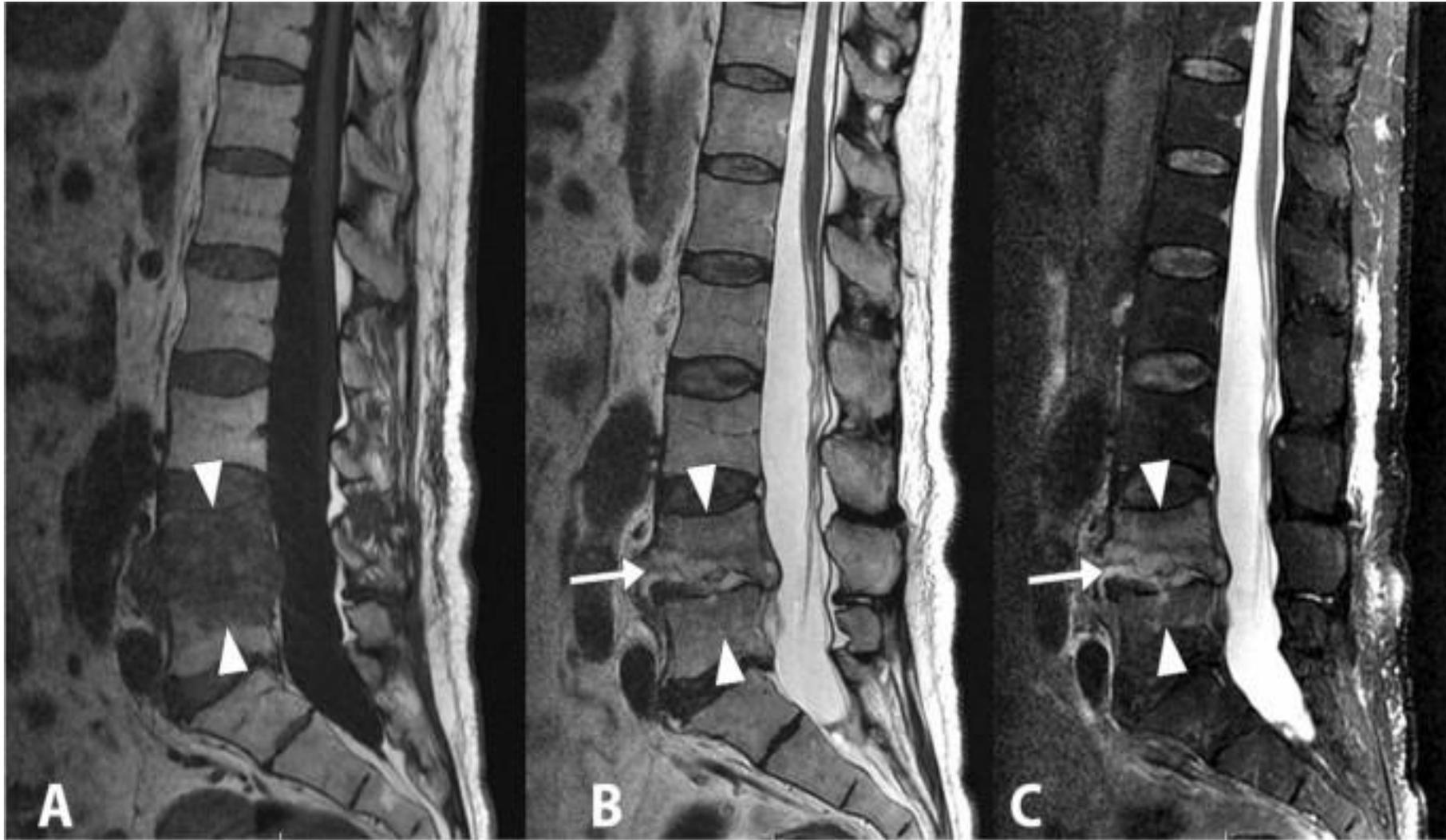
Medical

- I.V Abx for 4–6 weeks.

Ceftriaxone +
Metronidazole +
Vancomycine

- Analgesia
- Immobilization for 4 weeks with brace

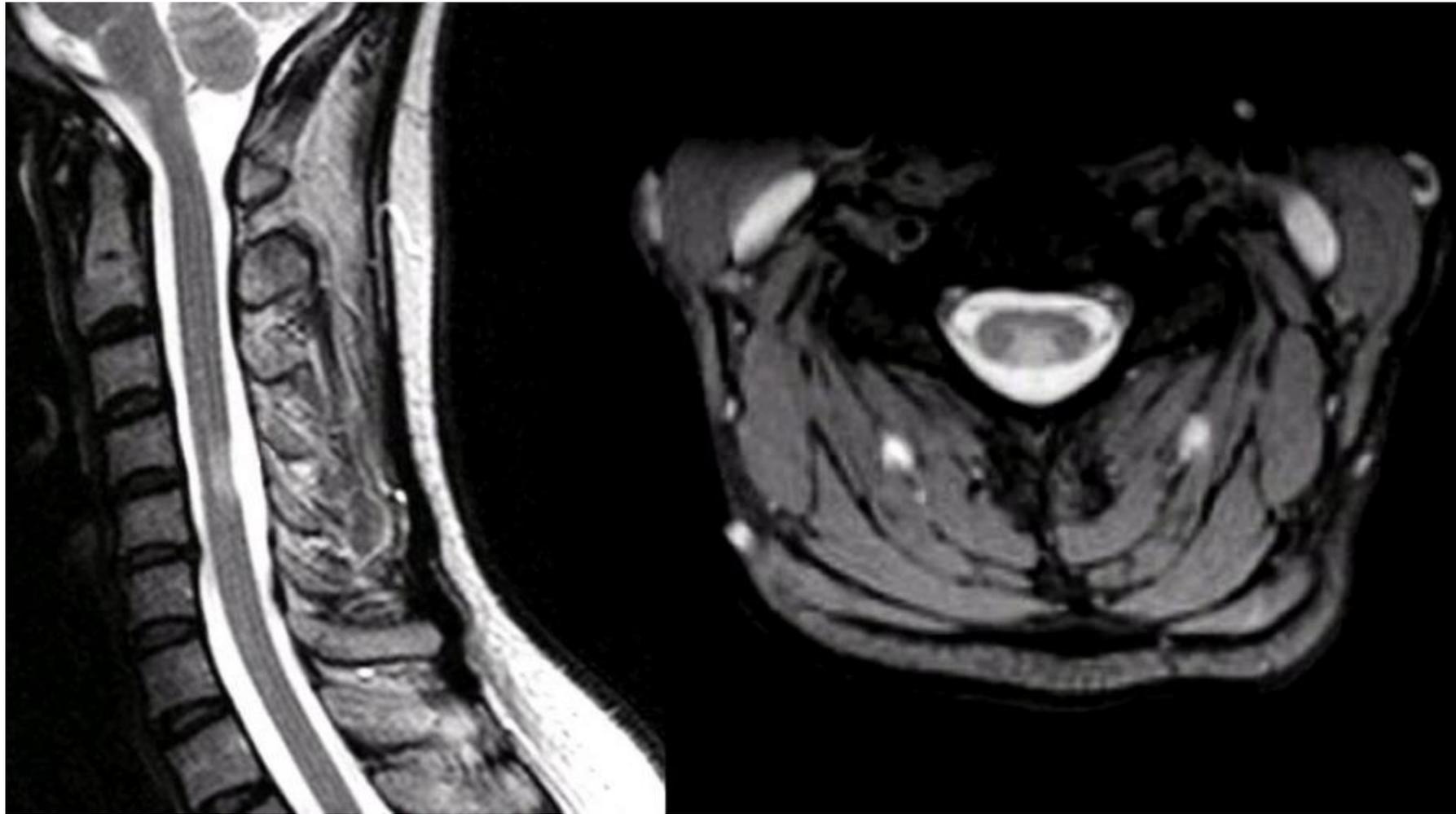
Surgical



Spondylodiscitis



Epidural abscess



Transverse Myelitis