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Spinal Injuries

Objectives:

- The ability to demonstrate knowledge of the following:
 - Basic anatomy of the spine
 - Initial assessment and treatment of spinal injuries at the field
 - Management of Cauda equina syndrome
 - Principle of spinal stability
 - Basic understanding of neurologic syndromes caused by spinal trauma

Done by: Abdulrhman AL-Zamil.

Edited By: Saleh AL-Khalifah.

Revised By: Adel Al Shihri.

References: Slides+Notes+Toronto+Appley's+433 Team.

Introduction

• Incidence & significance:

50000 cases per year

40-50% involving the cervical spine • 25% have neurologic deficit

Age: mostly between 15-24 years

Gender: mostly males (3:1)

Mechanism of injury :

MVA: 40-55%(most common)

Falls: 20-30%Sports: 6-12%Others: 12-21%

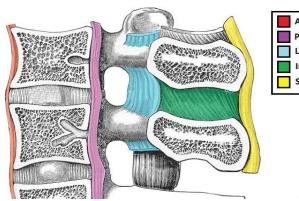
- Low energy trauma in a high risk patient (e.g. a patient with known spinal canal compromise such as ankylosing spondylitis, Osteoporosis or metastatic vertebral lesions)
- Penetrating trauma from gunshot or knives.

Anatomy of the spine

- Bones:
 - vertebrae for protection bear most of the weight put on your spine
- Joint:
 - o 3 joints:
 - Interiorly:
 intervertebral disc: helps absorb pressure and keeps the bones from rubbing against each other. (60---80 % injured)
 - Posterior: 2 facet joints (are a set of synovial, plane joints between the articular processes of two adjacent vertebrae. There are two facet joints in each spinal motion segment and each facet joint is innervated by the recurrent meningeal nerves. The biomechanical function of each pair of facet joints is to guide and limit movement of the spinal motion segment. In the lumbar spine, for example, the facet joints function to protect the motion segment from anterior shear forces, excessive rotation and flexion.)

• Ligaments:

- Supraspinaous.
- Intraspinaous.
- Ligamentum Flavum.
- Ant. Longitudinal Ligament.
- Post. Longitudinal Ligament.



Anterior longit. ligament Posterior longit. ligament Ligamentum flavum Interspinal ligament Supraspinous ligament

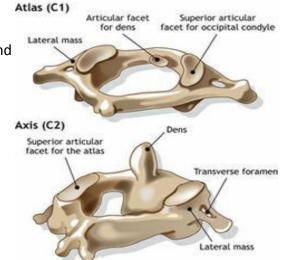
• Muscles:

All spinalis muscle

> Cervical anatomy:

♦ C1-C2

- 50% of rotation occurs between C1&C2). (50% of flexion and extension occurs between C1 and occiput).
- C1 (Atlas) >> No vertebral body.
- C2 (Axis) >> Has odontoid process (Dens)



♦ C3-C7:

• 5% range of motion at each level.

Transverse foramina are only present in the cervical vertebrae. These foramina allow the passage of the **vertebral artery** >>>> one of the structures that forms the circle of willis in the brain. So any fracture affect this area may affect the brain.

➤ Thoracic spine :

• Articulate with rib cage >>> less mobile >>> more prone to stiffness .

➤ Lumbar spine :

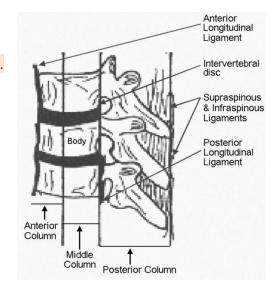
• The most common region for fracture



Three columns

> The Three columns

- Anterior Column > Anterior part of body
- Middle column > Posterior Part of body
- Posterior Column > Pedicle + Lamina + Spinal process.
- Stable injury :
 - One column only (e.g. Wedge fracture in Anterior Column)Not required treatment or conservative only.
 - Unstable injury :
 - 2 or more column.
 - Need intervention (surgery)



> Assessment of the spine injured patients :

- In cases of trauma, ABCDE's must be assessed first and treated appropriately
 Patients should be examined with spinal collar until spinal pathology is excluded.
- Careful log rolling keeping the head, neck and pelvis in line should be done to examine the spine properly.
- Immobilization (by cervical collar).
- History:
 - Mechanism of injury (high or low energy).
 compression, flexion, extension, distraction.
 - Head injury.
 - Seat belt.

- Physical examination:
 - Inspect for gaps, ecchymosis / palpate for tenderness.
 - Neurologic examination.

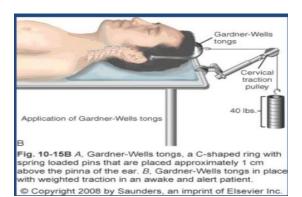
Spine board

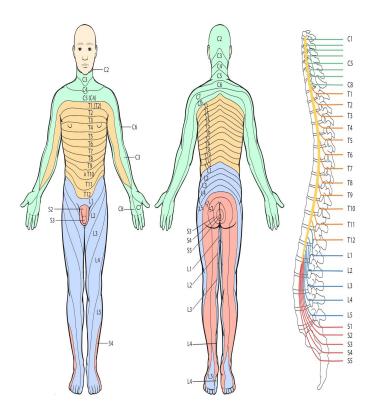


Cervical collar



Cervical traction





Dermatomes

ASIA classification

The extent of spinal cord injury (SCI) is defined by the American Spinal Injury Association (ASIA) Impairment Scale (the closer the patient to (E) the better prognosis

■ B = Incomplete: Sensory but not motor function is preserved below the neurological level and includes the særal segments S4-S5. ■ C = Incomplete: Motor function is preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3. ■ D = Incomplete: Motor function is preserved below the neurological level, and at least half of key muscles below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more. ■ E = Normal: motor and sensory function are normal	A = Complete: No motor or sensory function is preserved in the sacral segments S4-S5.		
preserved below the neurological level, and more than half of key muscles below the neurological level have a muscle grade less than 3. D = Incomplete: Motor function is preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3 or more. E = Normal: motor and sensory	motor function is preserved below the neurological level and		
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	preserved below the neurological level, and at least half of key muscles below the neurological level have a muscle grade of 3		
	Central Cord		
	☐ Brown-Sequard		
☐ Brown-Sequard	Anterior Cord Conus Medullaris		
Brown-Sequard Anterior Cord	Cauda Equina		

Spinal cord syndromes

- Complete spinal cord injury:
 - Flaccid paralysis below level of injury
 - May involve diaphragm if injury above C5
 - Sympathetic tone lost if fracture above T6 (The pressure will drop and the patient will present what looks like a shock)
- Incomplete SCI: (Good prognosis for recovery)

1- Central cord syndrome (when the center part of the cord get affected):

- Upper limb > lower limb deficit. (Because when spinal cord get crunched from front and back the edema will happen in the middle ,edema will make further damage to the fibers that closer to it which is the upper limb)
- Mechanism: hyper-extension
- Occur with or without fractures
- Recovery: 50% regaining function

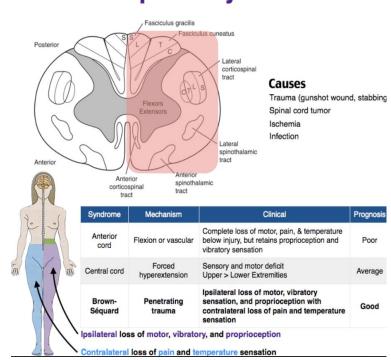
2- Anterior cord syndrome:

- Characterized by loss of corticospinal and spinothalamic tract with preserved posterior
- Mechanism: ischemia or infarction to spinal cord(Flexion or vascular).
- Common injury.
- Recovery: 10%.

3- Brown-Sequard syndrome: (Also called: cord hemi-section)

- Characterized by hemi-cord injury with ipsilateral paralysis, loss of Proprioception and fine touch, and contralateral loss of temperature and pain sensation.
- Prognosis is good, with over 90% regaining of bowel and bladder function and ambulatory capacity.

Brown-Séquard Syndrome



4- Conus Medullaris syndrome: (The most distal bulbous part of the spinal cord is called the conus medullaris). Injuries at the level of T12 to L2 vertebrae are most likely to result in conus medullaris syndrome. (Mostly L1)

- Mixture of UMN and LMN deficits.
- Loss of voluntary bowel and bladder control with preserved lumbar root function.

5- Cauda equina syndrome:

- Saddle anesthesia, urinary retention and stool incontinence (perform PR and sensation to that area)
- Usually due to large central disc herniation rather than fracture.

6- Nerve root deficit:

Lower motor neuron

7- Spinal shock:

- Transient loss of spinal reflexes(The first few days the patient will have no reflexes after that reflexes will come back) which reflexes will come back? the reflexes regenerating from the spinal cord below the level of the injury.
- Last 24-72 hours

Perform bulbocavernosus reflex (squeezing the glans penis in male or clitoris in female) > contraction of anus. (when the reflex is absent this mean that the patient is in spinal shock).

8- Neurogenic shock:

- Reduced tissue perfusion due to loss of sympathetic outflow and unopposed vagal tone
- Peripheral vasodilatation (hypotension & bradycardia)
- Rx.: fluid resuscitation

Imaging			
X-rays	СТ	MRI	
Cervical: 3 views AP, lateral and open mouth(An open mouth view x-ray is a special view to visualize upper cervical spine problems especially C1 and C2 vertebrae	best for bony anatomy	best to evaluate soft tissue	
Thoraco-lumbar: 2 views (AP & lateral)			
Flexion-Extension views			

Management of spinal injuries:

- O Depends on:
 - Level of injury
 - Degree and morphology of injury : (STABILITY)
 - Presence of neurologic deficit
 - Other factors

Some general rules :

- Stable injuries are usually treated conservatively
- Unstable injuries usually require surgery
- Neurologic compression requires decompression

Specific injuries

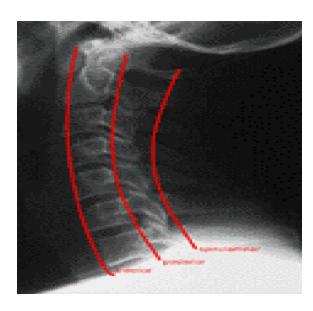
Cervical spine fractures:

- Descriptive: depends on mechanism of injury
 - Flexion/extension
 - Compression/distraction
 - Shear

♦ Presence of subluxation/dislocation

♦ SCI:

- high fracture results in quadriplegia
- Low fracture results in paraplegia



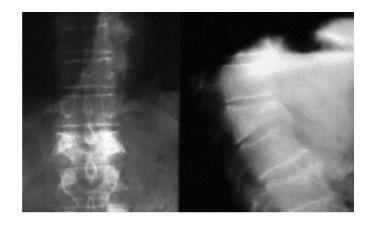


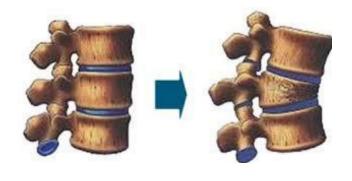
Thoraco-lumbar fractures:

- Spinal cord terminates at L1/2 disc in adult(L2/3 in a child)
- 50% of injuries occur at Thoracolumbar junction Why? because in this area the stiff (T12)met the mobile(L1)
- Common fractures:
 - Wedge fracture (flexion/compression)(the vertebra will look like a wedge)
 - Burst (compression)
 - Chance (flexion/distraction)

Wedge fracture

In this picture we only have 1 column injury which is the anterior part >>> Stable injury





Burst fracture

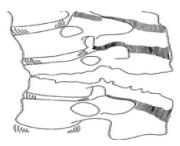
here we have 2 columns injury the anterior half (ANTERIOR COLUMN) and the posterior half of the vertebral body (Middle column).



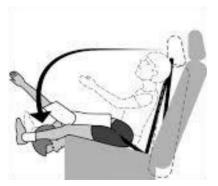


Chance fracture Three columns injury



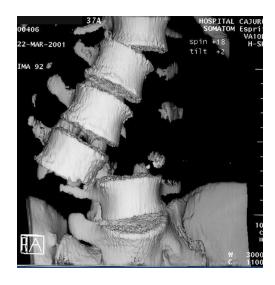






Fracture dislocation





Pathologic fractures (fracture in diseased bone):

- Usually due to infection or tumor
- Low-energy fractures
- Osteoporotic is common.
- X-rays: "winking owl" sign

Winking owl sign





Cauda Equina Syndrome:

- A surgical emergency
- Requires full neurologic examination including rectal examination for anal tone + sacral sensation
- Investigations: X-rays initially, but MRI is mandatory as X-rays are usually unremarkable(MRI usually done why? because usually caused by soft tissue trauma)
- Treatment: Emergency decompression-usually discectomy- within 24 hours.

• Causes of Cauda equina syndrome :

- Central disk herniation
- Burst fractures of lumbar spine.
- Tumors compressing the lower spinal nerve roots.
- Penetrating injuries such as stab wounds or bullets.