Cervical Spine Trauma

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Objectives

• Assess patient with suspected cervical spine injury
• Describe mechanisms of cervical spine injury
• Describe common types of injury and their management
• Discuss management of patients with cervical spine injury
• Discuss some of the pitfalls while managing these patients
• Describe rehabilitation and other long-term issues
Recognition
Immobilisation
Investigation
Reduction
Stabilisation
Mobilisation
Rehabilitation
Assessment

- Understanding biomechanics of the injury
- Awareness of the types of injuries
- Detailed and directed clinical examination
- Choosing the appropriate investigations
- Systematic approach to interpreting the images
Mechanisms

- Hyperflexion
- Hyperextension
- Axial loading
- Rotational injuries
- Distraction
- Combination of any of the above
Neurological syndromes

It is important to recognize that a significant number of patients present also present with well-defined neurologic syndromes corresponding to specific incomplete neuroanatomic lesions.

- Complete and Incomplete
- ASIA classification
- Central cord syndrome
- Anterior spinal cord syndrome
- Brown-Séquard syndrome
## Neurological impairment

American Spinal Injury Association (ASIA) Impairment Scale is most widely used

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Complete</td>
<td>No motor function or sacral sensation</td>
</tr>
<tr>
<td>B</td>
<td>Sensory incomplete</td>
<td>Sensation preserved below the level of injury including S4-5</td>
</tr>
<tr>
<td>C</td>
<td>Motor incomplete</td>
<td>Majority of key muscles have a power grade of less than 3</td>
</tr>
<tr>
<td>D</td>
<td>Motor incomplete</td>
<td>Majority of key muscles having a power grade ≥ 3</td>
</tr>
<tr>
<td>E</td>
<td>Normal</td>
<td>Normal motor and sensory function</td>
</tr>
</tbody>
</table>
Radiological Assessment

- Several guidelines are in use
- Not necessary in conscious patients with no symptoms or other distracting injuries
- If GCS < 6 CT down to C2 when scanning head
- Lateral, AP and transoral X-rays can detect most (up to 95%) but not all injuries
- Use CT, MRI or dynamic images as necessary
Radiological Interpretation

Cervical radiographs are often the primary mode of investigation

Lateral view

• Is it adequate?
• Alignment and lines
• Bones
• Cartilage
• Soft tissue
Radiological Interpretation

Antero-posterior view

- Alignment
- Distance between spinous processes
- Uniformity
- Height of vertebrae
Radiological Interpretation

Open mouth odontoid view

- Spacing of dens
- Lateral masses
- Alignment of C1 and C2
- Uniformity

This view may not be always possible, CT scan is the investigation of choice in poly-trauma
Immobilisation

- Spinal board
- The unconscious patient
- Hard collar
- Sandbags
- Cranio-cervical traction
- Halo crown and vest

Extremely important to prevent secondary spinal cord injury. Appropriate method of spinal immobilization should be chosen according to the situation, be aware of the pitfalls – e.g. pressure sore, raised ICP with collar etc.
Reduction

- Cranio-cervical traction
- Closed reduction under GA
- Open reduction

Controlled reduction of subluxation, dislocation or displacement should be attempted soon after initial resuscitation, but beware of the perils of cranio-cervical traction in the presence of gross ligament instability. Weights of up to 15kg may be required. Regular clinical and radiological monitoring is a must.
## Stabilisation

<table>
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<tr>
<th>External stabilisation</th>
<th>Internal Fixation</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Hard collar</td>
<td>- Anterior</td>
</tr>
<tr>
<td>- SOMI brace</td>
<td>- Posterior</td>
</tr>
<tr>
<td>- Halo vest</td>
<td>- Combined</td>
</tr>
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</table>

Should be aimed at providing stability during repair of bone, soft tissue and neurological structures. A combination of techniques may be necessary.
Principles of surgical repair

• Single column injury – usually stable, generally heals with external immobilisation
• 2-column injury – often unstable, may need internal fixation
• 3-column injury – unstable, 3-column reconstruction or internal fixation supplement with halo
• Irreducible injuries – may need open reduction and fixation
• Discoligamentous injuries – watch out for delayed instability, often needs stabilisation
• Consider stabilisation for rehabilitation needs and pain even if complete cord lesion
Some common injuries and their management
Flexion-extension injury: Unifacet subluxation with fractured lamina
360° Fixation – Anterior plate, interbody fusion & lateral mass screws
Facet Subluxation

- Hyperflexion injury
- Unifacet or bifacet
- Look out for nerve root lesions
- Attempt reduction by cervical traction
- Often has discoligamentous damage
- Optimum treatment 360° fixation
Hyperextension/Flexion distraction: Type I Traumatic axial spondylolisthesis
Type IA  Traumatic axial spondylolisthesis—note the transverse foramen
Hangman’s fracture

- C2 Traumatic spondylolisthesis
- Hyperextension injury
- Type I – stable, Halo immobilisation
- Type II – Unstable, may require posterior fixation +/- halo
- Craniocervical traction may be hazardous
Hyperextension injury: Type II Odontoid peg fracture
Axial view - C1 lateral mass screws

C1 lateral mass and C2 pedicle

Type II odontoid peg fracture treated with C2 anterior odontoid screws
Intra-operative navigation can sometimes be useful in guiding difficult screw placements.
Odontoid peg fracture

- Hyperextension injury
- Type I – rare, stable, collar
- Type II – Unstable, halo, high non-union rate, anterior or posterior fixation
- Type III – Unstable, good fusion with halo
- Os odontoideum
- Fibrous non-union may be acceptable
Vertebral compression fracture

**Surgery:** Vertebrectomy, anterior cervical plate and screws
Compression fracture

- Axial loading injury
- Can be stable if no ligament injury
- Watch out for progressive kyphosis
- Stabilisation – vertebrectomy and anterior plating
Jefferson’s fracture

- Axial loading injury
- Burst ring of C1
- Can be stable if Transverse ligament intact
- Often no neurological deficits
- Can be treated in a Halo
- Look out for delayed AAI
Traumatic Central Cord Syndrome

- Disproportionately greater weakness of the upper than the lower extremities
- Variable sensory loss and bladder dysfunction
- Often initial neurological improvement followed by plateau in recovery and then late deterioration
- Timing of surgery controversial; Early surgery not proven to be beneficial
- Improvement in ASIA score inversely correlates with age at Injury
Common pitfalls

• Difficult to assess – the unconscious, inebriated
• In adequate x-rays – request CT scan if needed
• Normal looking x-rays – role of dynamic x-rays
• Multiple lesions
• Pre-existing conditions – Ank spond., Rh. arthritis etc
• Changing neurology – assess and reassess
• Remember SCIWORA
• Interpretation of paediatric x-rays
Straight lateral images may not always tell the whole story...
Posterior stabilisation alone can sometimes be adequate
A significant injury may not only distract the patient's focus...

Beware of a concomitant injury!

Note the Hangman’s fracture in addition to the facet subluxation
Continued assessment is necessary even after adequate initial reduction and stabilisation
4 Weeks post halo – progressive kyphosis

**Surgery:** Anterior stabilisation with autologous graft and plate
Paediatric spine:

- Increased incidence at C0/C1/C2
- Remember ossifications centres
- Psuedosubluxation at C2/3 and C3/4
- Anterior wedging of vertebral bodies
- Increased pre-vertebral space
- SCIWORA is common
Ankylosing spondylitis: Fracture through vertebral body treated in Halo

Good fusion and remodelling at 6 months

Surgery only rarely necessary
A dedicated multi-disciplinary team is vital during rehabilitation after SCI. Occupational therapy plays an important role in the rehabilitation. The therapeutic goal should be to maximize function. The three prime aspects are self-care, productivity and leisure. Community reintegration is another important aspect in maintaining quality of life.
Functional Electrical Stimulation (FES) uses electric impulses to control peripheral nerves aimed at achieving function.

- FES has been used to aid standing, grasp control, ambulation, bladder/bowel management and respiratory support.
- Lokomat®: Robot assisted gait orthosis that automates locomotion therapy.
Long term issues in SCI

- Rehabilitation
- Skin care
- Mobility
  - Walking aids, wheel chair, Lokomat®, Brain-computer interface
- Pain and spasticity
  - Medications, Baclofen pumps, Rhizotomy, tendon release
- Urological issues
  - Autonomic dysreflexia, recurrent UTI, urinary calculi
- Psychosocial issues
  - Adjusting to disability, depression, cultural adjustments
- Occupation
- Addressing sexual and reproductive needs
  - Erectile dysfunction, Electro-ejaculation, psychological burden, relationships
Functional Outcome measures

Functional Independence Measure (FIM)

Scale 1-7; examples below:
7: Complete independence (timely and safely)
4: Minimal assistance (Subject contribution 75%)
1: Total assistance (Subject 0%)

Modified Barthel Index

Scale 0-15
To establish the degree of independence from any help, physical or verbal

Walking Index for Spinal Cord Injured (WISCI)

Scale from 0-20; Score examples below:
13: ambulates with walker, no braces or assistance
16: Ambulates with two crutches, no braces or assistance
20: Ambulates with no devices or assistance

The Spinal Cord Independence Measure (SCIM)

Scale from 0-100; Score examples below:
useful for assessing changes in performance in patients with SCI
Research areas

• Hyperacute management of Spinal trauma
  Pharmaceutical agents, cooling etc

• Role of early decompressive surgery

• Spinal cord regeneration
  The role of stem cell and induced pluripotent cells

• Brain-Computer Interface

• Intervention for management of spasticity and pain
“If thou examinet a man having a dislocation in a vertebra of his neck, shouldst thou find him unconscious of his two arms and his two legs on account of it, while his phallus is erected on account of it, urine drops from his member without his knowing it; his flesh has received wind; his two eyes are bloodshot; it is a dislocation of a vertebra of his neck extending to his backbone…”

-The Edwin Smith Surgical Papyrus
1700 B.C.
Thank you