Clearing the Cervical Spine in the Emergency Department

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Conscious patient

Aim: to detect serious injury

Immobilised at scene
  Cervical collar

Clinical Assessment
  Neurological assessment
  Physical assessment
  NEXUS criteria & Canadian C-spine Rule

Radiology
Neurological Assessment

- Sensation
- Motor function
- Reflexes
- Rectal examination/perianal sensation

*If abnormality present, do not clinically assess. Imaging required*
Physical Assessment

Inspection & palpation from occiput to coccyx

- Pain with movement
- Tenderness
- Gap or step
- Oedema and bruising
- Spasm of associated muscles
NEXUS Group
Hoffman et al, NEJM, 2000
Hendey et al, J Trauma, 2002

National X Radiography Utilisation Study

Purpose of study

To whether a simple algorithm could determine need for plain cervical XR
Outcome of NEXUS Group

- 21 centers participated in the National X Radiography Utilisation Study
- 34,069 blunt trauma patients enrolled
- Radiographic studies included plain x-ray, CT, MRI
- Standard three XRs were obtained on all patients supplemented by other views and CT/MRI
Results of NEXUS Group

- Incidence of cervical spine injury > 2.4%
- 818 patients had one or more cervical spine injuries
- 570 (69.6%) of these had complete and adequate set of radiographs
Clinical Assessment: NEXUS criteria

- Midline cervical tenderness on palpation?
- Focal neurologic deficit?
- Evidence of intoxication?
- Painful distracting injury?
- Altered mental status?

If no to all, imaging not required
If yes to any, imaging required
Painful distracting injury

**NEXUS definition** *(Panacek et al, Ann Emerg Med, 2001)*

- Any condition thought by the clinician to be causing enough pain to distract from neck injury eg. long bone #, large laceration, degloving, crush injury, burns etc

**Non-specific definition**

**More recent view** *(Heffernan et al, J Trauma, 2005)*

- NEXUS definition may be narrowed to upper torso injuries
Canadian C-Spine Rule
Stiell et al, JAMA, 2001
Stiell et al, NEJM, 2004

High risk factors which mandate radiography?

Age $\geq$ 65 years?

Dangerous mechanism?

- Fall $>$ 1 metre
- Axial load eg diving
- High speed MCA, rollover, ejection
- Motorised recreational vehicles
- Bicycle collision
Spinal Clearance Protocol: Aims

- To detect injury to the spine
  - Gross injury
  - Occult injury
- To prevent extension of injury to para/quadriplegia
- To prevent complications of immobilisation
- Most protocols don’t exclude possibility of long term disability
Canadian C-Spine Rule

- Low risk factor allowing for safe assessment of range of motion?
  - Simple rear end MCA?
  - Sitting upright in ED or ambulatory?
  - Delayed onset of neck pain?
  - No midline tenderness?
- Then assess ability to rotate neck 45° to left & right
Alfred Hospital Protocol

Conscious patients

- NEXUS criteria
- Movement assessment component of Canadian C-spine Rule
Caution

Degenerative cervical spine change

- Detected on CT
- History of previous neck injury
Conscious patient

Alert, sober, neurologically intact patient under 65 years with low risk mechanism

- If no midline tenderness to palpation, remove collar
- If pt able to rotate head 45° to left & right, clear cervical spine – no radiology required
- Otherwise, imaging required
Radiology

- Plain XR
- CT
- MRI
Plain X-rays – skeletal fractures, cervical alignment

12-16% fractures missed on plain film$^{1,2}$

1. Widder et al, J Trauma, 2004
CT-skeletal fractures, subluxation/dislocation injuries, disc spaces, alignment

No view of ligaments and cord
MRI-ligamentous, disc and cord injuries

Poor view of fractures
Conscious patient

Failed NEXUS or C-Spine Criteria, then
→ CT
If CT NAD & symptoms resolved, clear spine
If CT NAD & significant ongoing symptoms incl midline tenderness or neurologic deficit
→ MRI
If MRI NAD, clear spine
Case Studies:

Conscious patient
No acute injury on CT
Continuing neck pain
MRI
Cervical Injury

Trauma patients are suspected of having spinal injury until proven otherwise.

Most spinal trauma results from 4 main mechanisms:

Hyperflexion
Hyperextension
Axial loading (vertical compression)
Lateral rotation
Pt 1: 54 year old male, truck vs tree, GCS 15, CT brain NAD, C spine degenerative changes only
Prevertebral haematoma C2-5, C5-6 disc protrusion with severe canal stenosis. Treatment: collar 4/52
Pt 2: 67 year old male, pt vs forklift, GCS 15, CT brain NAD, C spine non-acute loss of C6-7 disc height
C5-6 disc extrusion, with partial tear of PLL & high signal in PLL. Treatment: ACDF
If the pt undergoes MRI, how do we interpret the results?

Clinical significance of stable, single column injury?
Unconscious patient

Aim: to detect unstable injury & prevent progression of potential injury to permanent neurologic deficit

- Neurological assessment not possible
- Clinical assessment not possible – patient unable to complain of neck pain
Unconscious patient

- Priority: imaging required
- If CT NAD, clear spine
- If abnormality on CT, MRI may be required to assess non-vertebral structures
Case Study:
Unconscious pt
Occult disc/ligamentous injury
Motorcyclist vs stationary vehicle at 100kph
GCS 3 at scene
Fixed, dilated R) pupil
CT no # (regional centre)
Strong suspicion of hyperextension injury
→ MRI
C5/6 disc injury
ALL, supraspinous ligament rupture
Cord contusion, oedema
Unsuitable for internal fixation
Halo
Hyperflexion
Case Study:
Cord Injury
27 year old male

MBA vs car (car failed to give way from side street)

C4/5 fracture dislocation

Grossly unstable
ALL, PLL
C2-T1 cord
haemorrhage & compression
Value of MRI: Questions

- No consensus on approach
- Should unconscious trauma patients have routine cervical MRI? *(Ackland et al, Spine, 2007)*
- Should conscious neck pain patients have MRI following normal CT?
- Should abnormal neurology be the only indication for cervical MRI in conscious patients with normal CT? *(Labattaglia, Cameron et al, Emerg Med Aust 2007)*
MRI vs long term outcomes

Very few studies comparing acute cervical MRI with long term outcomes

- Kaale et al. (*J Neurotrauma, 2005*) compared functional outcome with late MRI (2-9 years post injury), inconclusive.
- Davis et al. (*Radiology, 1991*), 14 pts, late MRI, found multi-level disc injury.
- Borchgrevinck et al. (*Injury, 1997*), 40 pts, MRI within 48 hrs, no injuries.
- Further research required.
Alfred Hospital/Monash University Study
(Ackland, Cameron, Cooper et al)

- Commenced in December, 2006
- 250 patients
- Funded by TAC
- Emergency trauma patients with neck pain
- No cervical fracture on CT
- MRI within 72 hours of injury
- Follow-up at time points to 12 months post injury
Mechanism of injury??
Don’t ask!

Thank you
Hyperextension
Axial loading
Lateral rotation
Unstable cervical spine injury: Definition
3 spinal columns
(Denis, Clin Orthop Relat Res, 1983)

Anterior
ALL, anterior annulus fibrosis and anterior vertebral body

Middle
Posterior vertebral body, posterior annulus fibrosis & PLL

Posterior
All structures from ligamentum flavum to posterior bony and ligamentous complexes

2 or more columns affected = INSTABILITY