

Cervical Spine Clearance in Unconscious Blunt Trauma Patients (UBTPs)

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Background (1)

- Incidence of cervical spine injury in TBI is approx.
 5%
- Clearing = accurately confirming the absence of significant spinal injury following blunt trauma
- Clinical clearance is not possible in unconscious blunt trauma patients (UBTPs)

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- Best clearance method is controversial
- Most injuries can be detected by CT scan
- Very small number of false negative CT for unstable injuries

Background (2)

- Full spinal precautions (log-rolling, collar) maintained until spine is cleared
- Precautions are associated with morbidity
- Gold standard: Maximize chances of detecting an unstable injury whilst minimizing morbidity from application of spinal precautions in UBTPs who don't need it.



Background(3)

- Three approaches:
 - 1) CT alone: Normal CT scan is sufficient to clear
 - 2) CT + MRI: Normal CT, with maintenance of spinal precautions until an MRI rules out ligamentous injury
 - 3) CT + Clinical examination (CT + CE): Normal CT, with maintenance of spinal precautions until the patient is awake enough for clinical examination
- Each approach has inherent risks & benefits
- Regardless of the method employed, clearance of the cervical spine should be performed as soon as possible (ideally within 48-72 hours) in UBTPs



Risks/benefits of clearance strategy based solely on CT scanning (CT alone)

Benefit

 Allows rapid clearance and cessation of spinal precautions, reducing the risks of prolonged immobilisation

Risk

 Important soft tissue injury (e.g. ligamentous, discal) may be missed



Risks/benefits of clearance strategy based on CT scanning followed by MRI scanning (CT + MRI)

Benefits

 MRI scanning is more sensitive/specific for soft tissue injury

*25-40% of MRI scans are falsely positive for soft tissue injury

Risks

- Risks of prolonged immobilisation and application of the cervical collar
 - Cutaneous pressure ulceration, Elevated intracranial pressure, Difficult intubation, Failed enteral nutrition, Increased risk of VAP
- Risks associated with MRI scanning*
 - Risk of adverse events associated with prolonged scan time in isolated MRI environment, Risks associated with ferromagnetic foreign bodies



Risks/benefits of clearance strategy based on clinical examination (CT + CE)

Benefit

 Some clinicians believe this is the only way to reliably exclude occult ligamentous injury

Risks

- Risks of prolonged immobilisation and application of the cervical collar
 - Cutaneous pressure ulceration, Elevated intracranial pressure, Difficult intubation, Failed enteral nutrition, Increased risk of VAP



The Controversy

- Body of expert opinion that suggests CT alone approach is acceptable e.g. BOAST 2
- Rationale: Normal CT does not rule out injury with 100% sensitivity but *probably* pushes balance of risks in favour of discontinuing precautions
- Many UK institutions follow this approach
- However:
 - No RCTs
 - Studies that do exist are small, frequently retrospective & have methodological issues
 - No gold standard for interpretation of CT/MRI or determination of unstable injury requiring surgery or prolonged immobilization



The Evidence (1)

- Ligamentous injuries can be missed unless MRI is performed :
 - Menaker, J., et al., J Trauma, 2008. 64(4): p. 898-903
 - Stassen, N.A., et al., J Trauma, 2006. 60(1): p. 171-7.
 - Fisher, B.M., et al., Am J Surg, 2013. 206(6): p. 987-93
- Normal CT is sufficient to rule out unstable ligamentous injury:
 - Hennessy, D., et al., J Trauma, 2010. 68(3): p. 576-82.
 - Tomycz, N.D., et al., J Trauma, 2008. 64(5): p. 1258-63.
 - Harris, T.J., et al., Spine, 2008. 33(14): p. 1547-53.
 - Como, J.J., et al., J Trauma, 2007. 63(3): p. 544-9.



The Evidence (2)

- Meta-analyses/systematic reviews
 - Against CT-alone approach:
 - Schoenfeld, A.J., et al., J Trauma, 2010. 68(1): p. 109-13
 - Russin, J.J., et al, World Neurosurg, 2013. 80(3-4): p. 405-13.
 - In favour of CT-alone approach:
 - Panczykowski, D.M. et al, J Neurosurg, 2011. 115(3): p. 541-9.
 - Raza, M., et al., Injury, 2013. 44(11): p. 1589-95.
 - Patel, M.B., et al., *J Trauma Acute Care Surg.* 2015, 28 (2): p. 430-41

University Hospitals

NHS Trust

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 Badhiwala, J.H., et al., Annals of Internal Medicine, 2015. 162(6): p. 429-437.

The Evidence (3)

- "In obtunded adult blunt trauma patients, we conditionally recommend cervical collar removal after a negative high-quality C-spine CT scan result alone." (Patel, M.B., et al., *J Trauma Acute Care Surg.* 2015, 28 (2): p. 430-41)
- "Cervical spine clearance in obtunded adults after blunt traumatic injury with negative results from a well-interpreted, high-quality CT scan is probably a safe and efficient practice." (Badhiwala, J.H., et al., Annals of Internal Medicine, 2015. 162(6): p. 429-437)



The Evidence (4)

- Overall, the published evidence suggests that MRI scanning is not clearly beneficial in UBTPs with a normal high-resolution CT scan *in whom gross limb movement has been observed.*
- CT scanning appears to have a high sensitivity for unstable cervical spine injuries, but the quality of the data does not eliminate the controversy over which clearance strategy is best in this context



Patient vs Population (1)

- Incidence of unstable cervical spine injury undetected by a CT scan is less than 1%.
- For every 1000 UBTPs with a normal CT of their cervical spine, there are 10 or less patients at risk of spinal cord injury due to unstable cervical spine injury but there are 990 or more patients who will be exposed to the risks associated with unnecessary spinal precautions and MRI scanning if CT + MRI approach is used.
- Missed unstable cervical spine injury is a devastating complication for the *individual* patient.
- The fundamental question here is 'ls there an acceptable missed injury rate?'



Patient vs Population (2)

- Dunham et al Examined the balance of risks with computer modeling using an estimated risk of unstable cervical spine injury of 2.5%.
- This model shows that compared to a CT-alone clearance strategy, other strategies increase the risk secondary brain injury from the complications of prolonged immobilization or MRI scanning and that these strategies reduce the number of functional survivors in this context
- Dunham's estimated rate of unstable cervical spine injury (2.5%) is most likely an overestimate
 - Carter, K.J., et al., PLoS One, 2011. 6(4): p. e19177.
 - Dunham, C.M., et al., J Neurotrauma, 2011. 28(6): p. 1009-19.



Neurological deterioration due to unrecognized unstable spinal injury

- Levi et al (retrospective review of eight level 1 trauma centres) (Spine, 2006. 31(4): p. 451-8.)
- 24 missed spinal injuries in 44,520 trauma patients.
- 8 out of the 24 missed injuries occurred in UBTPs.
 - 33.3% of all the missed injuries were due to misread imaging studies
 - 8.3% were due to poor quality radiographs
 - 58.3% were due to insufficient imaging
- It could be argued that a CT-alone clearance strategy might benefit from a "quality control check" (i.e. a second consultant radiologist's opinion) before the spine is cleared.

SCIWORA

- Retrospective review of 11644 adult and 3458 children admitted to a trauma centre over 5 years (304 patients with SCI) (Como, J.J., et al., J Trauma Acute Care Surg, 2012. 73(5): p. 1261-6.)
- 279 had an *injury* of the cervical spine on imaging (i.e. radiological abnormality)
- Of the remaining 25 patients, 24 were adult and all of these had degenerative changes on the CT scan of the cervical spine.
- SCIWOTET (spinal cord injury without computed tomography evidence of *trauma*).
- It would appear prudent that in UBTPs with degenerative disease of the cervical spine on CT scan, MRI + CT would be the most appropriate method for clearing the cervical spine.



UHCW: Past, Present & Future

- Past: To Oct 2012 clearance based on BOAST 2
- Present: "2 out of 3 rule" A normal CT scan plus one of either a normal clinical examination or a normal MRI.
- Future: NICE Trauma Guidelines?



Considerations

- Full precautions initially
- Presence or absence of limb movements at first presentation should be documented.
- High res CT high-energy trauma, close attention should be paid to the occipitocervical junction
- MRI scan asap if there is evidence of neurological injury attributable to spinal cord injury (e.g. absence of limb movements) or if there is an abnormality on the initial CT scan.



Considerations

- If the patient is likely to be awake and suitable for clinical clearance within 72 hours then it is reasonable to maintain spinal precautions and clear the patient clinically.
- Otherwise, CT alone or CT + MRI clearance strategy is acceptable. However the clinicians must understand the consequences of the strategy chosen i.e. very small risk of unstable ligamentous injury with the CT-alone strategy or risks associated with longer spinal immobilization and transfer to remote MRI scanner.
- Patients are only suitable for clearance by the mersity Hospitals scanning alone if gross movement of all 4 limbs has been observed and the CT scan is normal, as

Considerations

- Patients are only suitable for clearance by CT scanning alone if gross movement of all 4 limbs has been observed and the CT scan is normal, as reported by a Consultant Radiologist, with no evidence of trauma or degenerative disease.
- A system whereby a second opinion of CT images from a second radiologist may be desirable for clearance based on CT-alone.

