

Pre-hospital spinal immobilisation: an initial consensus statement

D Connor,¹ I Greaves,² K Porter,³ M Bloch,⁴ On behalf of the consensus group, Faculty of Pre-Hospital Care

INTRODUCTION

Spinal injuries are thankfully relatively uncommon but have the potential to cause very significant morbidity and mortality. It is reported that between 0.5% and 3% of patients presenting with blunt trauma suffer spinal cord injury (SCI).^{1 2} The incidence varies globally and time has yielded increased numbers of injuries annually. American figures estimate an incidence in the region of 40 cases per million per year.³ In the UK, the majority of traumatic SCI are attributable to land transport (50%), followed by falls (43%), then sport (7%).⁴ Of those fractures causing SCI, half involve fractures of the cervical spine, with 37% due to thoracic spine injury and 11% due to lumbar spine injury. Of the C-spine, 50% occur at the C6/7 junction and a third at C2.⁵ Data show a crossover rate in the region of 10%–15% of patients with a confirmed cervical fracture also having a thoracolumbar fracture.⁶ It is well recognised that immobilisation is not without harm but the 'number needed to treat' in order to include one actual injury is high.

SCI occurs when unstable spinal fractures (only diagnosed by imaging in hospital) cause direct mechanical damage as a result of traction and compression, following which ischaemia and cord swelling ensues. Unstable fractures are those where there is disruption of two or three vertebral columns. The anterior column is formed by the anterior longitudinal ligament and the anterior half of the vertebral body, disc and annulus, the middle column by the posterior half of the vertebral body, disc and annulus and the posterior longitudinal ligament and the posterior column by the facet joints, ligamentum flavum, the posterior elements and the interconnecting ligaments.

Immobilisation is based on the logical premise that preventing movement should decrease the incidence of SCI or further deterioration of existing damage. This is undertaken by, in effect, adding external supports to the body, preventing secondary injury during extrication, resuscitation, transport and evaluation.

Immobilisation is a routinely performed procedure in the prehospital environment. Its potentially serious adverse sequelae and the litigious nature of modern medicine have seen the development of an extraordinarily conservative approach to immobilisation where it is applied in many cases in which neither the mechanism of injury nor the clinical findings would support its use.

Methods vary and research has drawn together consensus opinion on immobilisation techniques. Common practice involves the use of a rigid cervical collar, head blocks with straps or tapes and a long board with straps. A number of organisations use the orthopaedic scoop stretcher or Kendrick Extrication Device. The scoop stretcher is of value in reducing the amount of handling to which victims of trauma are subjected and the Faculty of Pre-Hospital Care is shortly to issue consensus guidance regarding *minimal handling protocols* in trauma. The vacuum mattress is indicated in prolonged transportation to minimise the risks explained below. A pelvic sling should therefore be placed in the correct position in the vacuum mattress and the patient transferred in the scoop onto the mattress and the pelvic binder fastened appropriately. Once on a vacuum mattress, the scoop can be removed in such prolonged transfers.

SEARCH STRATEGY

Prior to the Faculty meeting in March 2012, a review of the published literature was undertaken using PubMed to search the Medline database. Secondary searches were made using UK PubMed Central and Google Scholar. The search terms included prehospital, out-of-hospital, spinal immobilisation, cervical collar and c-spine clearance. A tertiary search

analysed the references of retrieved articles to identify further sources.

THE DEBATE

Immobilisation is a key concept in most trauma guidelines. The ATLS course recommends that all trauma patients considered to be at potential risk of spinal injury have immediate neck immobilisation.⁷ This guidance is founded upon expert opinion rather than definitive evidence and current protocols have a strong historical rather than scientific precedent. In the practice's favour, Reid in 1987 reported that secondary neurological injury occurred in 1.4% of patients with spinal injury diagnosed in the ED whereas the secondary neurological injury rate was 10.5% in those in whom a diagnosis of spinal injury was missed.⁸

However, a full review undertaken by Kwan and colleagues concluded that there is no high-level evidence quantifying the effect of immobilisation versus no immobilisation on adverse effects.⁹ They commented that the low prevalence of SCI would mean 50–100 patients would need to be immobilised for every patient at risk of SCI. Opinions are increasingly being expressed that the practice is overused and needs review since the procedure itself is not benign. It is uncomfortable; takes time and delays initiation of specialist treatment in time-critical patients; raises intracranial pressure; increases aspiration risk and the risk of decubitus ulceration; and also potentially reduces airway opening and respiratory efficacy.⁹ Indeed, the latter two risks refute an axiom of prehospital care where airway maintenance takes precedence over other considerations. Kwan concludes her review by stating that, "...the possibility that immobilisation may increase mortality and morbidity cannot be excluded."

Hauswald's biomechanics have been published several times.^{10 11} His group surmises that injury is done at the time of impact by forces of greater magnitude than those encountered in subsequent movement, which is generally not sufficient to cause further damage. They comment that the alert patient will develop a position of comfort with muscle spasm protecting a damaged spine.

A 2009 review also concluded that the alert, cooperative patient does not require immobilisation even if a clinical decision rule is positive, unless their conscious level deteriorates.¹² They state that muscle spasm is a superior method to an artificial procedure. The College of Emergency Medicine guidance emphasises the need for large-scale studies¹³ while acknowledging

¹Department of Emergency Medicine, Southampton General Hospital, Southampton, UK; ²Department of Emergency Medicine, James Cook Hospital, Middlesbrough, Middlesbrough, UK; ³Department of Clinical Traumatology, Queen Elizabeth Hospital Birmingham, Birmingham, UK; ⁴Department of Anaesthetist, Aberdeen Royal Infirmary, Aberdeen, UK

Correspondence to Professor K Porter, Trauma, Queen Elizabeth Hospital Birmingham, Birmingham B15 2WB, UK; keith.porter@uhb.nhs.uk

Consensus statement

the ethical conundrum that, “*the current practice...is so widely adopted and the consequences of causing or exacerbating a spinal injury so catastrophic that such trials may not be supported.*”

SELECTIVE IMMOBILISATION

Practice is shifting from blanket immobilisation to a selective approach. The question posed is whether guidelines can safely identify those with a spinal fracture or SCI. Whether selective immobilisation differs from prehospital clearance is undecided. At times the terms appear synonymous. However, an algorithm-based decision rule must only have the sensitivity to identify all occult fractures. Clearance requires a high degree of specificity that is not required when ruling-in immobilisation.

Emergency department (ED) management of spinal patients has changed over the past 10 years with the incorporation of level one evidence into x-ray procedures. There are two validated decision rules with near 100% sensitivity for significant SCI. The NEXUS rules¹⁴ identified five low-risk criteria which, if met, could exclude injury:

- ▶ No midline tenderness
- ▶ No focal neurological deficit
- ▶ Normal alertness
- ▶ No intoxication
- ▶ No painful distracting injury

The Canadian C-Spine Rule (CCSR) uses low-risk and high-risk factors¹⁵:

- ▶ First, is any high-risk factor present (age greater than 65, paraesthesia, significant mechanism?)
- ▶ Second, is there any low-risk factor that allows safe assessment of range of motion? (Simple rear-end collision, sitting position in the ED, ambulatory at any time, delayed onset of pain, absence of spinal tenderness).
- ▶ Last, can the patient actively rotate their neck through 45°?

NICE guidance favoured the CCSR but chose to combine the two rules adding midline tenderness to increase sensitivity.¹⁶ However, while this may appear logical, it invalidates the evidence base developed for each system and a paper comparing the two came out firmly in favour of CCSR.¹⁷

Validation of the CCSR in the prehospital setting has been undertaken and its reliability proven. Qualitative studies have shown that paramedics are comfortable using it.¹⁸

Other rules exist. American EMS physicians' algorithm indications include patients with a mechanism suggestive of clinical risk and at least one of the following: an altered

mental status, evidence of intoxication, distracting painful injury, neurological deficit or spinal tenderness.¹⁹

Mechanism of injury is commonly used as being a predictor of injury and is component of the CCSR, despite being excluded from the NEXUS guidance. The American College of Neurological Surgeons emphasises it as the main factor mandating immobilisation over examination in the prehospital setting.²⁰ Refuting this, other series show no link between mechanism and outcome.²¹

JRCALC guidance suggests that all patients should be initially immobilised if the mechanism of injury is suggestive of SCI.²² The guidance gives a list of criteria which, if absent, allow removal of immobilisation. The recent 2011 update stresses that suspicion of thoracic and lumbar injury despite a ‘cleared’ C-spine warrants full immobilisation. The current lack of a clear consensus potentiates the risk of litigation, as no matter which guideline is used, expert witnesses will be found who will argue against it.

CONSENSUS OUTCOMES

The consensus meeting held by the Faculty of Pre-hospital Care aimed to clarify the practice of immobilisation. Preliminary discussions highlighted salient points that required discussion. The conclusions of the consensus group are given below.

1. *The long spinal board is an extrication device solely. Manual in-line stabilisation is a suitable alternative to a cervical collar.*

With respect to methods of immobilisation, a firm distinction was made between extrication and transport/evacuation. The Faculty recommends the use of a long board solely as an extrication device and not for the transport of patients to hospital. For this purpose, a scoop stretch or vacuum mattress should be used. Not only does this abate pressure effects but limits the exposure of patients to unnecessary and detrimental log rolling. It was also felt that manual in-line stabilisation is an appropriate substitute for a cervical collar and may well be better in certain patients such as those with a compromised airway, possible raised intracranial pressure, combative patients and children. However, if a cervical collar is used, this should be correctly sized and fitted. Incorrect use may give a false sense of security and the patient should still be fully immobilised. Once fully immobilised, the collar may be loosened to reduce discomfort, reduce intracranial

pressure and potentially facilitate airway management.

2. *An immobilisation algorithm may be adopted although the content of this remains undefined.*

Selective immobilisation algorithms are viable in the UK prehospital setting. Using algorithms such as these in the prehospital environment would allow clinicians to immobilise only those who meet predefined criteria. The precise details of these prehospital criteria are yet to be decided but may well resemble the NEXUS rules. With any algorithm, a sensitivity level must be accepted that strikes a balance between prevention of SCI and use of the finite resources available. Furthermore, the practice of ‘clearing the C-spine’ should be aimed at including all serious injuries and treating accordingly.

The suggestion that some of the criteria in the above-mentioned guidelines might be ‘weighted’ was discussed although no firm conclusions were drawn. In particular, it was felt that the subjective elements (eg, mechanism of injury) could be viewed as a source of over-triage whereas objective elements such as age might be given more priority.

3. *There may be potential to vary the immobilisation algorithm based on the conscious level of the patient.*

It was felt that emphasis should remain on prioritising ABC in polytrauma patients. It was agreed that differentiation between the conscious and unconscious patient and the appropriate treatment for each should be considered in future guidelines. It may be that in the cooperative patient, immobilisation can be deferred until after the primary survey by advising the casualty to refrain from movement. This is obviously not possible in the unconscious patient, but in their case, the need for a primary survey evaluation is paramount and independent movement is less likely. These suggestions are provisional.

4. *Penetrating trauma with no neurological signs does not require immobilisation.*

In line with other evidence, the meeting agreed that penetrating trauma to the spine does not require immobilisation in the absence of overt neurological signs.

5. *‘Standing take down’ practice should be avoided.*

It was also agreed that the practice of a ‘standing take down’ where a person who is wandering around with an element of neck pain gets placed against an upright spinal board and placed horizontal and then immobilised is seldom, if ever, warranted.

6. *In the conscious patient with no overt alcohol or drugs on board and with no*

major distracting injuries, the patient, unless physically trapped should be invited to self-extricate and lie on the trolley cot. Likewise, for the non-trapped patient who has self-extricated, they can be walked to the vehicle and then laid supine, examined and then if necessary immobilised.

This may seem like a quantum leap but was felt by many involved within the consensus process to be a justified balance of risks versus benefits as previously described and supported by Hauswald's work.^{10 11} With regards to this recommendation, one should err on the side of safety and if there is any question as to whether the patient fulfils the requirements described, then immobilisation should occur unless this will compromise the patient in any other way.

7. Further research into effective, practical and safe immobilisation practice, and dissemination of this, is required.

The consensus group emphasised the differences between the prehospital environment and secondary care and the unique challenges prehospital practice presents. As a result, in-hospital guidelines cannot be assumed to be directly transferable. Research in this area is needed and research-supported practices will, the group believes, lead to advances in care, which should be widely disseminated via reproducible education and training. Subsequent audit of the new practice will allow refinements and changes to be instigated.

CONCLUSIONS

The consensus group was absolutely clear that a change is needed from a policy of immobilising necks as much for the protection of the clinician as for that of the patient, to a system of selective immobilisation designed to reduce the risks to the trauma victim.

It is important to remember, however, that voluntary aid organisations will be looking for guidance in this challenging

area. For these practitioners, guidance for the 'non-professional' managing trauma should err towards the side of over triage. They could with benefit, however, be made aware that cervical collars are not the panacea that they are often made out to be and that manual in-line stabilisation (MILS) is often a more beneficial and acceptable modality compared with triple immobilisation. They should also be encouraged to consider moving away from spinal boards towards non-metallic scoops and the concept of minimal handling.

Contributors The literature search and programme presentation was produced by DC and MB. The consensus paper was written by all contributors. The delivery of the consensus process was coordinated by Professor KP.

Funding Faculty of Pre-Hospital Care.

Competing interests None.

Provenance and peer review Commissioned; internally peer reviewed.

► Additional material is published online only. To view please visit the journal online (<http://dx.doi.org/10.1136/emmermed-2013-203207>)

To cite Connor D, Greaves I, Porter K, et al. *Emerg Med J* 2013;**30**:1067–1069.

Received 17 September 2013
Accepted 23 September 2013

Emerg Med J 2013;**30**:1067–1069.
doi:10.1136/emmermed-2013-203207

REFERENCES

- Cameron P, Bagge B, McNeil J, et al. The trauma registry as a statewide quality improvement tool. *J Trauma* 2005;**59**:1469–76.
- Burney R, Maio R, Maynard F, et al. Incidence, characteristics, and outcomes of spinal cord injury at trauma centers in North America. *Arch Surg* 1993;**128**:596–9.
- The National Spinal Cord Injury Statistic Center. *Spinal Cord Injury: facts and figures at a glance*. Birmingham, Alabama: University of Alabama at Birmingham National Spinal Injury Center, 1998.
- Aung T, El Masry W. Audit of a British Centre for spinal injury. *Spinal Cord* 1997;**35**:147–50.
- Spinal Cord Association. Preserving and developing the National Spinal Cord Injury Service: Phase 2—seeking the evidence. Research Report, May 2009.
- Winslow J, Hensberry R, Bozeman W, et al. Risk of thoracolumbar fractures in victims of motor vehicle

- collisions with cervical spine fractures. *J Trauma* 2006;**61**:686–7.
- American College of Surgeons. *Advanced Trauma Life Support for Doctors*. 8th edn. Chicago: American College of Surgeons, 2009.
- Reid D, Henderson R, Saboe L, et al. Etiology and clinical course of missed spine fractures. *J Trauma* 1987;**27**:980–6.
- Kwan I, Bunn F, Roberts IG. Spinal Immobilisation for trauma patients (Review). Prepared and maintained by The Cochrane Collaboration. Published in The Cochrane Library 2009, Issue 1.
- Hauswald M, Braude D. Spinal immobilization in trauma patients: is it really necessary? *Curr Opin Crit Care* 2002;**8**:566–70.
- Hauswald M, Ong G, Tandberg D, et al. Out-of-hospital spinal immobilization: its effect on neurologic injury. *Acad Emerg Med* 1998;**5**:214–21.
- Blackham J, Bengler J. 'Clearing' the cervical spine in conscious trauma patients. *J Trauma* 2009;**11**:93–109.
- The College of Emergency Medicine Clinical Effectiveness Committee. *Guideline on the management of alert, adult patients with a potential cervical spine injury in the Emergency Department*. London: College of Emergency Medicine, 2010.
- Hoffman J, Mower W, Wolfson A, et al. Validity of a set of clinical criteria to rule out injury to the cervical spine in patients with blunt trauma. National Emergency X-Radiography Utilization Study Group. *N Engl J Med* 2000;**343**:94–9.
- Stiell I, Wells G, Vandemheen K, et al. The Canadian C-spine rule for radiography in alert and stable trauma patients. *JAMA* 2001;**286**:1841–8.
- National Institute for Health and Clinical Excellence. *NICE clinical guidance 56: Triage, assessment, investigation and early management of head injury in infants, children and adults*. NICE, 2007.
- Stiell I, Clement C, McKnight D, et al. The Canadian C-spine rule versus the NEXUS low-risk criteria in patients with trauma. *N Engl J Med* 2003;**349**:2510–18.
- Vaillancourt C, Stiell I, Beaudoin T, et al. The out-of-hospital validation of the Canadian C-Spine Rule by paramedics. *Ann Emerg Med* 2009;**54**:663–71.
- Domeier R. National Association of EMS Physicians Position Paper: Indications for pre-hospital spinal immobilization. *Prehosp Emerg Care* 1999;**3**:251–3.
- McCormick P. Cervical spine immobilization before admission to hospital. Section on Disorders of the spine and peripheral nerves in: American Association of Neurological Surgeons. *Neurosurgery* 2002;**50** (suppl):S7–S17.
- Domeier R, Evans R, Swor R, et al. The reliability of pre-hospital clinical evaluation for potential spinal injury is not affected by mechanism of injury. *Prehosp Emerg Care* 1999;**3**:251–3.
- Joint Royal Colleges Ambulance Liaison Committee. *Neck and back trauma*. JRCALC, 2006.



Pre-hospital spinal immobilisation: an initial consensus statement

D Connor, I Greaves, K Porter, M Bloch and On behalf of the consensus group, Faculty of Pre-Hospital Care

Emerg Med J 2013 30: 1067-1069
doi: 10.1136/emered-2013-203207

Updated information and services can be found at:
<http://emj.bmj.com/content/30/12/1067>

These include:

References

This article cites 15 articles, 0 of which you can access for free at:
<http://emj.bmj.com/content/30/12/1067#BIBL>

Email alerting service

Receive free email alerts when new articles cite this article. Sign up in the box at the top right corner of the online article.

Notes

To request permissions go to:
<http://group.bmj.com/group/rights-licensing/permissions>

To order reprints go to:
<http://journals.bmj.com/cgi/reprintform>

To subscribe to BMJ go to:
<http://group.bmj.com/subscribe/>