Cervical Spine Immobilization

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EPIDEMIOLOGY

Audience:

“WHY SHOULD I CARE?”
Incidence

Given the current population size of 314 million people in the U.S., the recent estimate showed that the annual incidence of spinal cord injury (SCI) is approximately 54 cases per million population in the U.S. or approximately 17,000 new SCI cases each year.

- New SCI cases do not include those who die at the scene of the accident.

Age at Injury

The average age at injury has increased from 29 years during the 1970s to 42 years currently.

Gender

Males account for approximately 80% of new SCI cases.
Since 2010:
- Incomplete Tetraplegia: 45%
- Incomplete Paraplegia: 21.3%
- Complete Paraplegia: 20%
- Complete Tetraplegia: 13.3%
- Normal: 0.4%
### Average Yearly Expenses (in 2015 dollars)

<table>
<thead>
<tr>
<th>Severity of Injury</th>
<th>First Year</th>
<th>Each Subsequent Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Tetraplegia (C1-C4) AIS ABC</td>
<td>$1,065,980</td>
<td>$185,111</td>
</tr>
<tr>
<td>Low Tetraplegia (C5-C8) AIS ABC</td>
<td>$770,264</td>
<td>$113,557</td>
</tr>
</tbody>
</table>

### Estimated Lifetime Costs by Age At Injury (discounted at 2%)

<table>
<thead>
<tr>
<th>Severity of Injury</th>
<th>25 years old</th>
<th>50 years old</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Tetraplegia (C1-C4) AIS ABC</td>
<td>$4,729,788</td>
<td>$2,599,411</td>
</tr>
<tr>
<td>Low Tetraplegia (C5-C8) AIS ABC</td>
<td>$3,455,879</td>
<td>$2,125,674</td>
</tr>
</tbody>
</table>

### Life expectancy (years) for post-injury by severity of injury and age at injury

For persons who survive the first 24 hours

<table>
<thead>
<tr>
<th>Age at Injury</th>
<th>No SCI</th>
<th>AIS D—Motor Functional at Any Level</th>
<th>Para</th>
<th>Low Tetra (C5–C8)</th>
<th>High Tetra (C1–C4)</th>
<th>Ventilator Dependent Any Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>20</td>
<td>59.5</td>
<td>52.6</td>
<td>45.1</td>
<td>40.0</td>
<td>35.7</td>
<td>19.3</td>
</tr>
<tr>
<td>40</td>
<td>40.6</td>
<td>34.2</td>
<td>27.7</td>
<td>23.5</td>
<td>20.1</td>
<td>8.9</td>
</tr>
<tr>
<td>60</td>
<td>23.1</td>
<td>17.9</td>
<td>13.1</td>
<td>10.3</td>
<td>8.1</td>
<td>2.2</td>
</tr>
</tbody>
</table>

For persons surviving at least 1 year post-injury

<table>
<thead>
<tr>
<th>Age at Injury</th>
<th>No SCI</th>
<th>AIS D—Motor Functional at Any Level</th>
<th>Para</th>
<th>Low Tetra (C5–C8)</th>
<th>High Tetra (C1–C4)</th>
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<td>21.0</td>
<td>12.6</td>
<td></td>
</tr>
<tr>
<td>60</td>
<td>18.2</td>
<td>13.4</td>
<td>10.6</td>
<td>8.7</td>
<td>4.0</td>
<td></td>
</tr>
</tbody>
</table>
BENEFITS/RATIONALE

• Patient may have an unstable C-spine injury

• Additional movement may worsen injury

• Hard collars may prevent these movements

• Hard collars are relatively harmless
IMMOBILIZATION

Victim's Prep and Ready for Transport.

Whoa! All I did was smash my finger.
CONSENSUS STATEMENTS
Spinal immobilisation for trauma patients (Review)

Kwan I, Bunn F, Roberts IG

Main results

We found no randomised controlled trials of spinal immobilisation strategies in trauma patients.
Cervical spine immobilization devices are effective but can result in patient morbidity. Spinal immobilization devices should be used to achieve the goals of spinal stability for safe extrication and transport. They should be removed as soon as a definitive evaluation is accomplished and/or definitive management is initiated. Spinal immobilization of trauma patients with penetrating injuries is not recommended.
Prehospital spinal immobilisation: an initial consensus statement

D Connor¹, I Greaves², K Porter³, M Bloch⁴, on behalf of the consensus group, Faculty of Pre-Hospital Care

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

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.
The use of spinal motion restriction procedures and adjuncts should not interfere with critical airway management and other time-critical interventions, such as hemorrhage control, or rapid transport.
Manual In-Line Stabilization for Acute Airway Management of Suspected Cervical Spine Injury: Historical Review and Current Questions

strong recommendations. It is prudent for clinicians to use manual in-line stabilization when it does not hinder intubation attempts. There are data to support allowing some flexion and extension of the upper cervical spine if needed to facilitate visualization of glottic structures during direct laryngoscopy.
EFFECT OF CERVICAL HARD COLLAR ON INTRACRANIAL PRESSURE AFTER HEAD INJURY

RALPH J. MOBBS,* MARCUS A. STOODLEY† AND JOHN FULLER‡

*Department of Neurosurgery, Institute of Neurological Sciences, The Prince of Wales Hospital, †School of Surgery, University of New South Wales, Sydney, New South Wales and ‡Department of Neurosurgery, The Canberra Hospital, Canberra, Australian Capital Territory, Australia

The Effect of Rigid Cervical Collars on Internal Jugular Vein Dimensions

Michael B. Stone, MD, RDMS, Catherine M. Tubridy, MD, and Robert Curran, DC
Conclusions: Penetrating ballistic trauma to the neck is associated with a high mortality rate. Our data suggests that it is very unlikely that penetrating ballistic trauma to the neck will result in an unstable cervical spine in survivors. In a hazardous environment (e.g. shooting incidents or terrorist bombings), the risk/benefit ratio of mandatory spinal immobilisation is unfavourable and may place medical teams at prolonged risk. In addition cervical collars may hide potential life-threatening conditions.
Unstable Cervical Spine Fracture After Penetrating Neck Injury:  
A Rare Entity in an Analysis of 1,069 Patients

Thomas Lustenberger, MD, Peep Talving, MD, PhD, FACS, Lydia Lam, MD, Leslie Kobayashi, MD, 
Kenji Inaba, MD, FACS, David Plurad, MD, FACS, Bernardino C. Branco, MD, 
and Demetrios Demetriades, MD, PhD, FACS

CONCLUSIONS

The incidence of unstable CSI after penetrating trauma to the neck is exceedingly low at 0.4%. No unstable CSI was observed after SWs to the neck. After GSW to the neck, unstable CSI was noted in <1% of patients, all of whom experienced severe neurologic findings or altered mental status. Surgical stabilization of the spinal fracture was performed in only two patients (0.2%) without significant neurologic recovery.
Increased risk of death with cervical spine immobilisation in penetrating cervical trauma


Department of Surgery, Tulane University, New Orleans, LA, United States

Vascular and airway injuries complicating penetrating cervical trauma require emergency intervention. Vascular injury complicates over 25% of penetrating cervical trauma with an associated mortality of up to 50%. Exsanguination was reported as the cause of 50% of penetrating cervical trauma deaths and is the leading cause of death in patients with penetrating cervical trauma. Airway injury occurs in approximately 10–18% of patients with penetrating cervical trauma. The rapid mortality associated with vascular and respiratory tract injuries has lead many authors to stress the importance immediately treating these life-threatening injuries before addressing concerns about cervical spine instability. Increased mortality with delayed
Figure 1. Sections from three-dimensional reconstructions of CT data showing axial plane and cranial-caudal motion during the tilt in cadaver 1 (A and B, respectively), and axial plane motion in cadavers 3 and 5 (C and D, respectively) while collar was applied. To create these images, CT examinations taken before and after the patient maneuver were spatially aligned so that C1 was in the same position in both scans. The gray areas in the images show the relationships within the occipitocervical spine before the patient maneuver, and yellow-orange regions show the relationships after the patient maneuver. The green arrow points to the C1 vertebra that is in the same position in both pre- and post-maneuver CT examinations.
Confirmation of suboptimal protocols in spinal immobilisation?

Mark Dixon,¹ Joseph O’Halloran,²,³ Ailish Hannigan,⁴ Scott Keenan,⁵ Niamh M Cummins⁶

Results  Controlled self-extrication without a collar resulted in a mean movement of 13.33° from the neutral in-line position of the cervical spine compared to a mean movement of 18.84° during one of the equipment-aided extrications. Two equipment-aided techniques had significantly higher movement (p<0.05) than other techniques. Both height (p=0.003) and mass (p=0.02) of the participants were significant independent predictors of movement.

Conclusions  These data support the findings of the proof of concept study, for haemodynamically stable patients controlled self-extrication causes less movement of the cervical spine than extrications performed using traditional prehospital rescue equipment.
Specific Pediatric Concerns

CSI in pediatric blunt trauma victims is rare and occurs in approximately 1–2% of patients,\textsuperscript{189–194} although more frequent with younger children have more high-level injuries, fewer fractures, more dislocations, and more SCIs because of their larger head/body ratio, greater ligament laxity, and more horizontal facet joints.\textsuperscript{186,191,193,194,196} Outcomes are often poorer in younger than
Conclusion

In conclusion, we hypothesise that alert, stable and co-operative trauma patients do not require mandatory immobilisation of the cervical spine, even if a clinical decision rule is positive and radiography is indicated. Instead, a "position of comfort" selected by the patient (and including a cervical collar and supine positioning only if found to be beneficial by that individual) may be more appropriate pending further clinical evaluation.
Any High Risk Factors?

ANY of the following:
- Age ≥ 65 years
- Dangerous Mechanism
- Paresthesias in extremities

Pt has high risk factor?
Well... then you should get....

None?
You may proceed...

Any Low Risk Factors?

ANY of the following:
- Simple rear-end MVC
- Sitting position in ED
- Ambulatory at ANY TIME
- Delayed (i.e. not immediate) onset of neck pain
- Absence of midline C-spine tenderness

Not even one?
Then... they aren't low risk!

Radiography

One of the above?
Excellent... proceed with ROM

Able to Rotate Neck actively?

i.e. Rotate neck 45 degrees left & right.

Can't move their neck?
Then... they aren't low risk!

Great!
Based on the CCR...

No Radiography
Figure 11. National Emergency X-Radiography Utilization Study (NEXUS) Criteria

Meets all low-risk criteria?
1. No posterior midline cervical-spine tenderness
2. No evidence of intoxication
3. A normal level of alertness
4. No focal neurologic deficit
5. No painful distracting injuries

- **Yes**: No Radiography
- **No**: Radiography
Questions?