Preliminary Results Using a Reduced Radiation Cervical Spine Clearance Algorithm In Pediatric Trauma Patients: A Simplified Approach
NO DISCLOSURES
Cervical spine injuries uncommon
- 1-2% incidence
- Devastating consequences
  - Death
  - Paralysis

Treatment of cervical spine injuries begins with cervical spine clearance
- Efficient and safe clearance of the uninjured patient
  - Limit radiation exposure
  - Identification of injured patients
Care of Pediatric Cervical Spine Injury is Clinically Challenging for the Trauma Team

- **Limited experience**
  - Orthopedic surgery
  - Neurosurgery
  - Trauma Surgery
  - Emergency Medicine
  - Radiology
  - First responders

- **Complex problem**
  - Poly-traumatized child
**NO Consensus**

- Trauma Surgery and Neurosurgery literature
- Awake child vs obtunded child
- Radiographs vs CT
- Standardized protocol

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### Developing a Spinal Clearance Protocol for Unconscious Pediatric Trauma Patients

Lynn Hutchings, MRCS, Oluwarantimi Atojum, MRCS(Ed), Chris Burgess, MRCS, and Keith Willett, FRCS

*J Trauma, 2009*

### Utility of a cervical spine clearance protocol after trauma in children between 0 and 3 years of age

Clinical article

Richard C. E. Anderson, M.D., Peter Kan, M.D., Monique Vanaman, M.D., Jeanne Rubi, N.P., Kristine W. Hansen, R.N., Eric R. Scalf, M.D., and Douglas L. Brockmeier, M.D.

*J Neurosurg Pediatrics 5:202-206, 2010*

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### Trauma Association of Canada Pediatric Subcommittee National Pediatric Cervical Spine Evaluation Pathway: Consensus Guidelines

Sara Chong, MD, FRCP, Angéla Mifunejima, MD, FRCP, Paul W. Walker, MD, Peter Burke, MD, PhD, Marsha Stelfox, MD, DMD, Ash Hoolak, MD, Vincent Grant, MD, FRCP, R. J. Hancock, MD, FRCP, FACS, David Gorney, MD, MSc, FRCP, Jeff Johnston, MD, Peter St-Vil, MD, Louis Cervier, MD, FRCP, Natalie Teschke, MD, MSc, FRCP, Allen Hayashi, MD, Vishal Mehra, BSc, MD, MSI, FRCP, FACS, Timothy Casey, MD, Steven Furness, RSC, (Pharm), MD, FRCP, Ron Siemens, MD, FRCPS, FAAP, Sheila Stelfox, MD, PhD, FRCP, and Darre Price, MD, FRCS(C)
Pediatric Cervical Spine Study Group

*Cervical Spine Clearance Survey*

- 25 Pediatric Trauma Centers
  - NO consensus
    - Primary team responsible for clearance
    - Imaging modalities used

ONLY 46% had cervical spine clearance protocol
Radiation Exposure

- Ionizing radiation
  - Increases life-long cancer risk
  - Breast/thyroid most sensitive

<table>
<thead>
<tr>
<th>Patient Age (y)</th>
<th>Head Effective dose (mSv)</th>
<th>Cervical spine Effective dose (mSv)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Radiographs*</td>
<td>CT</td>
</tr>
<tr>
<td>0-1 years</td>
<td>0.06</td>
<td>2.5</td>
</tr>
<tr>
<td>5 years</td>
<td>0.06</td>
<td>1.5</td>
</tr>
<tr>
<td>10 years</td>
<td>0.06</td>
<td>1.6</td>
</tr>
<tr>
<td>Adult</td>
<td>0.06</td>
<td>1.5</td>
</tr>
</tbody>
</table>

* assumes 1 PA + 1 AP + 1 lateral radiograph per examination
** assumes 1 AP + 1 lateral radiograph per examination
Institutional Objectives

**NEED for Improvement**

- Develop a clinical C-spine clearance algorithm which reflected current best practice

- Reduce radiation exposure without increasing missed injury rate

- Consistency among providers
  - Emergency medicine
  - Trauma
  - Orthopedics
  - Neurosurgery
  - Radiology
2011 C-Spine Clearance Algorithm

Algorithm for Evaluation of the Trauma Patient for Cervical Spine Injury

COOPERATIVE PATIENT

1. Is the patient fully alert and cooperative? (Yes/No)
   - Yes: Obtain history and physical examination
   - No: Continue to evaluate

2. Evaluate for signs of spinal injury (Yes/No)
   - Yes: Obtaining Neurosurgery/Orthopedic consultation
   - No: Continue to evaluate

Algorithm for Evaluation of the Trauma Patient for Cervical Spine Injury

UNCOOPERATIVE PATIENT

1. Are there altered sensorium or other pain in injury causing distraction? (Yes/No)
   - Yes: Is there clinical evidence of a spine injury? (Yes/No)
     - Yes: Obtain Neurosurgery/Orthopedic consultation
     - No: Obtain Lateral C-spine film
   - No: Proceed to next algorithm

2. Are there symptoms or signs of spinal injury? (Yes/No)
   - Yes: Obtain CT scan of entire cervical spine
   - No: Proceed to next algorithm

3. Are awake and alert within 24 hours? (Yes/No)
   - Yes: Obtain CT scan of entire cervical spine
   - No: Proceed to next algorithm

4. Is collar in place? (Yes/No)
   - Yes: Injury noted?
     - Yes: Proceed to next algorithm
     - No: Remove collar
   - No: Proceed to next algorithm

5. Proceed to next algorithm
ALGORITHM FOR EVALUATION OF THE TRAUMA PATIENT FOR CERVICAL SPINE INJURY

Reliable History and Physical

Normal Exam and Physical

Yes

Clear C-Spine

Normal

Persistent Neck Pain

Yes
Continue C-Collar

No
Persistant Neck Pain

Obtain C-Spine Xray

Abnormal Exam OR History or Age < 5

Re-evaluate in 24 hours

Consult Spine Service

Abnormal Exam

Positive finding on Xray

No findings on Xray

Yes

Normal

Continue C-Collar

No
Re-Evaluate

GCS ≤ 12

Leave in C-Collar obtain AP and Lateral C-Spine Xrays

Unreliable Exam

Reliable Exam
What Was Different?

- More frequent Emergency Department re-evaluation
- Next day re-evaluation
  - Trauma Surgery
- Increased involvement of the Spine Service
  - Neurosurgery
  - Orthopedics
Materials and Methods

- **Inclusion Criteria**
  - < 18 y of age
  - All patients with trauma mechanism suspicious for cervical spine injury
    - Emergency Medicine
    - Trauma Service
- **Exclusion Criteria**
  - All deaths
  - All patients with cervical spine CT from outside facility
- **3 study periods**
  - Study Group 1  2011
  - Study Group 2  2012-13
  - Study Group 3  2014

- **Data Points**
  - Age
  - MOI
  - ISS
  - GCS on arrival
  - Imaging studies
    - CT findings
  - Time to collar removal
    - Discharged in collar
  - Who cleared C-spine
    - Spine Service
  - Length of stay
  - C-spine injuries
    - Missed/delayed diagnosis
Study Population

- **3632 Trauma Contacts**
- **762 Required C-Spine Clearance**
- **259 Study Group 1**
  - 2011
- **360 Study Group 2**
  - 2012 & 2013
- **143 Study Group 3**
  - 2014
Study Group Demographics

- Male: 68.4% (521)
- Female: 31.1% (237)
- <= 5 years old: 28% (213)
- > 5 years old: 72% (549)

Mean age 8.8 years
## Study Population

<table>
<thead>
<tr>
<th>GCS</th>
<th>ISS</th>
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<tbody>
<tr>
<td>15</td>
<td>91% (694)</td>
</tr>
<tr>
<td>8-14</td>
<td>7.6% (58)</td>
</tr>
<tr>
<td>&lt;8</td>
<td>1.3% (10)</td>
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<table>
<thead>
<tr>
<th>ISS</th>
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<tbody>
<tr>
<td>Mild (1-8)</td>
<td>85% (646)</td>
</tr>
<tr>
<td>Moderate (9-16)</td>
<td>13% (99)</td>
</tr>
<tr>
<td>Severe (&gt;16)</td>
<td>2% (17)</td>
</tr>
</tbody>
</table>
# Sub-Group Analysis

<table>
<thead>
<tr>
<th>Number of CT’s</th>
<th>SG1</th>
<th>SG2</th>
<th>SG3</th>
</tr>
</thead>
<tbody>
<tr>
<td>p= &lt; 0.0001</td>
<td>90% (233)</td>
<td>42.2% (152)</td>
<td>28.7% (41)</td>
</tr>
<tr>
<td>LOS</td>
<td>2.51</td>
<td>2.45</td>
<td>2.27</td>
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<table>
<thead>
<tr>
<th>Clearance By</th>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Emergency Medicine</td>
<td>44% (96)</td>
<td>25% (76)</td>
<td>28% (34)</td>
</tr>
<tr>
<td>Surgery</td>
<td>44% (97)</td>
<td>46% (141)</td>
<td>48% (58)</td>
</tr>
<tr>
<td>Spine Service</td>
<td>12% (27)</td>
<td>29% (90)</td>
<td>24% (29)</td>
</tr>
</tbody>
</table>

Discharged in Collar = 113
## Time to Clearance

<table>
<thead>
<tr>
<th></th>
<th>SG1</th>
<th>SG2</th>
<th>SG3</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 13 hours</td>
<td>91% (197)</td>
<td>76% (232)</td>
<td>79% (97)</td>
</tr>
<tr>
<td>13-24 hours</td>
<td>8% (18)</td>
<td>22% (69)</td>
<td>19% (23)</td>
</tr>
<tr>
<td>&gt; 24 hours</td>
<td>1% (2)</td>
<td>2% (5)</td>
<td>2% (2)</td>
</tr>
</tbody>
</table>

Discharged in Collar = 113
Study Limitations

- PILOT study
- Small numbers
- Incomplete statistical analysis
- Retrospective study
- Historical control
Conclusions

The increased involvement of the Spine Service in C-spine clearance and NEXT day re-evaluation by the trauma team:

- An increase time to C-spine Clearance in the 13-24 hr time period
- No increase in LOS
- A significant reduction in the use of CT to obtain C-spine clearance with no increase in missed injury rate
Selected References