

# Rural Healthcare *Quality* Network

## *Hospital Peer Review*

June 2009

Hospital Peer Review is a monthly newsletter sponsored by the Rural Healthcare Quality Network to alert Critical Access Hospitals regarding findings from the Peer Review Program. Summarized are a few of the key findings and best practices that would be helpful for other critical access hospitals to be knowledgeable about. This newsletter is edited by Myron Bloom, Medical Director and he can be reached at [drmbloom@msn.com](mailto:drmbloom@msn.com).

### **Use of X-rays to Diagnose Cervical Spine Injuries Part 2: Who, What, Where, and Why is there CSI, and What Kind of Imaging?**

The NEXUS studies supported by the Agency for Healthcare Research and Quality (AHRQ) examined the prevalence and patterns of spinal injury among CSI patients x-rayed for blunt trauma to the spine to determine for whom x-rays are indicated for diagnosing spinal injury in these patients. NEXUS found that **cervical spine radiography may be omitted if patients did not have any of 5 criteria:**

- 1) **no midline posterior cervical spine tenderness,**
- 2) **no evidence of intoxication,**
- 3) **normal level of alertness,**
- 4) **no focal neurological deficit, and**
- 5) **no painful distracting injuries.**

Remarkable for its size (34,069), the sensitivity for detecting clinically important injuries has been reported to be 94-99% with a 13% specificity (true positive). Subsequent reviews of NEXUS data have shown about one third of 3-view studies will miss something primarily because of technical inadequacy, and therefore CT to be indicated when highly suspicious. Unfortunately, cervical spine films are often technically inadequate in the emergency setting. Thus, clinical judgment remains important for making decisions about when and which imaging studies to do for patients with possible cervical spine injuries.

**Duane, TM et al. "Clinical Examination and its Reliability in Identifying Cervical Spine Fractures." J Trauma June 2007: 62:1405-8**

In this study, investigators prospectively evaluated 534 blunt trauma patients over 16 years of age at a single level I trauma center to assess the reliability of the Eastern Association for the Surgery of Trauma (EAST) guidelines (radiographic evaluation is unnecessary in the awake, alert blunt trauma patient who is not intoxicated, has no distracting injuries, and demonstrates no tenderness over the c-spine or neurologic deficits). All patients underwent 16-slice CT, finding that 52 patients (or 9.7%) had cervical fractures (three times the rate of CSI in NEXUS). Forty were deemed to require CT because of positive examinations (sensitivity of 76.9% and a negative predictive value (NPV) of 95.7%. Sixteen of 24 patients with fractures and an initial Glasgow Coma Score of 15 were accurately identified for a sensitivity of 66.7% and an NPV of 96.5%. In the subset of patients, who by EAST guidelines would not require any radiographic evaluation, there were 17 fractures of which 10 were suspected at the time of clinical examination for sensitivity of 58.8% with an NPV of 96.4%. However, four of the seven unsuspected injuries required intervention. Their conclusion was that clinical examination is unreliable to exclude a cervical spine fracture.

**Mower, W R et al. "Use of Plain Radiography to Screen for Cervical Spine Injuries." *Annals of Emergency Medicine*; 38(1), pg. 1-7**

Patients with blunt trauma to the spine usually undergo a standard three-view series of x-rays (cross-table lateral, antero-posterior, and odontoid views), as well as any other imaging tests deemed necessary by their doctors to identify CSIs. A comparison of injuries detected by screening x-rays with final injury status for each of the 818 NEXUS patients with CSIs showed that standard three-view x-rays provided reliable screening for bony CSIs among most patients with blunt spinal trauma. However, on rare occasions, these x-rays failed to detect significant unstable injuries. Furthermore, in many patients with blunt trauma, plain x-rays were not technically adequate.

Plain x-rays revealed 932 injuries in 498 patients (1.46 percent of all blunt trauma patients) but missed 564 injuries in 320 patients (0.94 percent of all patients). The majority of missed injuries occurred in cases in which plain x-rays were interpreted as abnormal (but not diagnostic of injury) or inadequate. However, 23 patients had 35 injuries (including three potentially unstable injuries) that were not visualized on adequate plain film imaging.

**Lowery, D.W. et al, "Epidemiology of Cervical Spine Injury Victims." *Annals of Emergency Medicine*; 38(1), pg. 12-16**

The researchers examined the demographics and injury patterns among CSI patients undergoing ED cervical spine x-rays for blunt traumatic injury as part of the NEXUS study. Overall, CSI was more common among the elderly, males, and patients of white or "other" ethnicity. For example, people aged 65 or older were twice as likely to have CSI as younger people. In fact, CSI due to blunt trauma increased progressively with age. Elderly white men had the highest prevalence (5.5 percent) of any demographic group, followed by elderly white women (4.3 percent), who are prone to fractures from osteoporosis that often accompanies estrogen loss during menopause.

The rate of CSI also varied by ethnicity, with the highest injury prevalence among white and Middle Eastern patients, at about 3 percent each, and lowest among blacks (1.5 percent). Also, those with "other" ethnicity (individuals who could not be classified into one of the existing categories) were nearly twice as likely to have CSI (relative risk, RR of 1.79) as other groups. Males and whites were nearly twice as likely to have CSI (RR of 1.72 and 1.50, respectively). On the other hand, Hispanics were 36 percent less likely (RR of 0.64) and women were 42 percent less likely (RR of 0.58) to have CSI, as were blacks (RR of 0.55) and those less than 18 years of age (RR of 0.39). Most enrolled patients were males (59 percent), as were the majority of patients with CSI (71 percent).

Since CSI occurred in patients in all demographic categories, this information cannot be used to select patients with blunt trauma to the spine who should or should not undergo x-rays, the researchers concluded.

**Goldberg, W. et al. "Distribution and Patterns of Blunt Traumatic Cervical Spine Injury." *Annals of Emergency Medicine*; 38(1), pg. 17-21**

This study examined the patterns of spinal injury. The second cervical vertebra was the most common site of injury, and the sixth and seventh cervical vertebrae were involved in over one-third of all injuries. However, other spine levels were involved more often than had previously been thought.

Overall, CSI patients had a total of 1,496 distinct cervical spine injuries to 1,285 different cervical spine structures. The second cervical vertebra (C2) was involved in 24 percent of fractures, including 92 odontoid fractures. The relatively high rate of C2 injuries, particularly among the elderly, has been documented by others. Also, 39 percent of fractures occurred in the two lowest cervical vertebrae (C6 and C7). Injuries to the pedicles of the vertebral arch were relatively rare, occurring in only 6 percent of CSI patients. The vertebral body, injured in 235 patients, was the most frequent site of fracture. Nearly one-third (29 percent) of spinal injuries identified by x-ray were considered clinically insignificant.

**Thompson WL et al. "Association of Injury Mechanism with the Risk of Cervical Spine Fractures." CJEM January 2009: pg. 11-14**

In a secondary analysis of data of the 17,208 patients who presented to nine emergency departments with blunt trauma to the head or neck comprising the study that derived and validated the Canadian C-Spine Rule (CCR), 320 (2%) were diagnosed with clinically important C-spine injury (defined as a fracture or ligamentous instability generally requiring internal fixation or treatment with a halo, brace, or rigid collar). The following mechanisms of injury were significantly associated with risk for C-spine fracture:

- 1) diving incidents (odds ratio, 12.0),
- 2) axial loads (odds ratio, 7.3),
- 3) non-traffic collisions of motorized vehicles (odds ratio, 2.8; e.g., snowmobiles, all-terrain vehicles), and
- 4) falls (odds ratio 2.1). In further analysis of falls, risk for C-spine fracture increased with height of the fall (odds ratio, 2.8 for a fall from 1–3 m; odds ratio, 5.3 for a fall from >3 m) and age of the patient.

**Pollack, C.V., Hende, G.W., Martin, D.R., and others. "Use of Flexion-Extension Radiographs of the Cervical Spine in Blunt Trauma." Annals of Emergency Medicine July 2001: 38(1), pg. 8-11**

When standard three-view x-rays are negative for CSI in patients with blunt trauma but the doctor remains concerned about bony or ligamentous injuries, flexion-extension (F/E) x-rays of the cervical spine are often requested. F/E views are specifically recommended most often for patients with an acceleration-deceleration mechanism and patients with pain or tenderness and no obvious abnormalities on other studies. The reviewers tabulated how frequently F/E imaging provided diagnostically important information that was not evident on other x-rays. Of 818 patients ultimately found to have CSI, 86 (10.5 percent) underwent F/E testing. Two patients sustained stable bony injuries detected only on F/E views. Four other patients had a subluxation (partial or complete dislocation) detected only on F/E views, but all had other injuries apparent on routine cervical spine imaging.

F/E imaging adds little to the acute evaluation of patients with blunt trauma, according to this study. Flexion of more than 30% to be an adequate study is unlikely to be attained in acute injury. Other approaches—including MRI, CT, or delayed F/E—in the presence of specific clinical concerns would seem to provide a more reasonable approach to adjunctive imaging.

**Diaz JJ Jr et al. "Are Five-View Plain Films of the Cervical Spine Unreliable? A Prospective Evaluation in Blunt Trauma Patients with Altered Mental Status." J Trauma October 2003: 55:658-63**

In this prospective unblinded study of 1,006 consecutive blunt-trauma patients with altered mental status or distracting injuries, the authors compared the accuracy of CT and 5-view plain films of the cervical spine. In 116 patients, 172 cervical spine injuries were detected. Plain films identified only 82 (47.7%) injuries overall, including 1 of the 15 occipital condyle fractures (6.7%), 19 of 36 C1-3 fractures (52.8%), 62 of 121 C4-T1 fractures (51.2%), and 120 of 172 unstable cervical spine injuries (69.8%) requiring halo or surgical stabilization. CT identified 169 of the 172 (98.3%) cervical spine injuries with 3 missed stable spinal process fractures at C6-7. Both modalities yielded false-negative results in 2 patients with spinal cord injury without radiologic abnormality (SCIWORA). With the combined findings of CT and plain films used as the gold standard, the sensitivity of 5-view plain films compared with that of CT was 44.0% vs. 97.4%. The negative predictive value was 93.2% vs. 99.7%, while the specificity and the positive predictive value was 100% for both. Evidence supports the use of CT for patients at significant risk for cervical spine injury, particularly if they have altered mental status or distracting injuries.

**Hende et al. "Spinal Cord Injury without Radiographic Abnormality: Results of the National Emergency X-Radiography Utilization Study in Blunt Cervical Trauma." 2002**

The purpose of this study was to better define the incidence and characteristics of patients with spinal cord injury without radiographic abnormality (SCIWORA), using the database of the National Emergency X-Radiography Utilization Study (NEXUS). SCIWORA was defined as spinal cord injury demonstrated by magnetic resonance imaging (MRI), when a complete, technically adequate plain radiographic series revealed no injury. Of the 34,069 patients entered, there were 818 (2.4%) with cervical spine injury, including 27 (0.08%) patients with SCIWORA. Over 3,000 children were enrolled, including 30 with cervical spine injury, but none had SCIWORA. The most common MRI findings among SCIWORA patients were central disc herniation, spinal stenosis, and cord edema or contusion. Central cord syndrome was described in 10 cases. In the large NEXUS cohort, SCIWORA was an uncommon disorder, and occurred only in adults.

**Rana AR et al. "Traumatic Cervical Spine Injuries: Characteristics of Missed Injuries." Journal of Pediatric Surgery January 2009: 44:151**

While some experts advocate for CT as the preferred C-spine screening tool for adults because CT reduces the time to diagnosis and misses fewer injuries than plain films do, pediatric cervical spine injury is rare and concern about CT radiation exposure argues in favor of use of plain films. In this study, researchers reviewed a pediatric trauma center's experience with CT and plain radiography for C-spine imaging in patients under the age of 18. Clinical clearance of the C-spine was allowed per protocol in the absence of neck tenderness, neurological deficits, or abnormal Glasgow Coma Scale (GCS) scores. Otherwise, the patient underwent C-spine imaging with plain radiography, CT, or both. Of the 1,307 patients seen between 2004 and 2006, 318 or 24% (mean age of 10 and GCS score 13) underwent imaging for possible C-spine injury. CT was the sole imaging method in 63%, plain radiography was the sole method in 20%, and both methods were performed in 17%. The CT scans identified 27 patients with "true" C-spine injury and 7 false positives.

The plain x-rays performed in 23 of the children with true C-spine injury identified 18 but missed 5 injuries (none of which required operative intervention). The sensitivity and the specificity of CT scan for identifying C-spine injury were 100% and 97%, respectively and 78% and 95% for plain films.

**Yates D et al. British Medical Journal October 6, 2007: 335:719**

The UK National Institute of Clinical Excellence (NICE) recommends CT scanning of the cervical spine for adults and children over the age of ten in the setting of an initial GCS below 13; intubation; inadequate cervical x-rays; suspicion of injury despite normal x-rays; and when scanning is being performed for multiregion trauma. In younger children, cervical CT scanning is recommended in the setting of severe head injury (GCS 8 or lower); technically inadequate plain films or clinical suspicion of injury despite negative plain films.

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So, what take away conclusion can be formulated from the above? The decision to use plain radiography or CT should be individualized. Perhaps: 1) carefully clear those that you can on a clinical decision tool basis without imaging, and 2) the need for CT imaging rather than 3 view plain cervical spine x-rays is proportional to the clinical suspicion of CSI given the clinical examination, age, and osteoporotic risk of the patient as well as the mechanism of injury; while being mindful of the fact that younger patients have a higher risk of radiation induced oncogenic transformation. CT scans are particularly helpful for higher-risk patients, especially those with neurological deficit or altered mental status, and in patients with equivocal or inadequate plain radiographs.