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Evidence Based Medicine

ARE PLAIN RADIOGRAPHS SUFFICIENT TO EXCLUDE CERVICAL SPINE INJURIES IN LOW-RISK ADULTS?

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☐ **Abstract—Background: The routine use of clinical decision rules and three-view plain radiography to clear the cervical spine in blunt trauma patients has been recently called into question. Clinical Question: In low-risk adult blunt trauma patients, can plain radiographs adequately exclude cervical spine injury when clinical prediction rules cannot? Evidence Review: Four observational studies investigating the performance of plain radiographs in detecting cervical spine injury in low-risk adult blunt trauma patients were reviewed. Conclusion: The consistently poor performance of plain radiographs to rule out cervical spine injury in adult blunt trauma victims is concerning. Large, rigorously performed prospective trials focusing on low- or low/moderate-risk patients will be needed to truly define the utility of plain radiographs of the cervical spine in blunt trauma.** © **2014 Elsevier Inc.**

☐ **Keywords—cervical spine injury; medical imaging; radiographs; cost-effectiveness**

CASE REPORT

A 26-year-old previously healthy man is brought to the emergency department (ED) after he sideswiped the highway guardrail at 70 miles per hour. Although ambulatory at the scene, he arrives secured on a backboard with a cervical collar in place. On examination, he has mild diffuse tenderness throughout his neck, including the midline, as well as some mild diffuse tenderness of the thoracic and lumbar musculature that resolves shortly after he is taken off of the backboard. He is otherwise without complaints, and his primary concern is getting something to eat and leaving the ED as soon as possible. Because he has midline tenderness after a high-speed accident, you cannot clear his cervical spine (C-spine) with either the NEXUS or Canadian C-spine criteria (1,2). As you order a three-view plain film C-spine series, you think about how the trauma service cleared C-spines during your training and ask yourself: "Should I be ordering a computed tomography (CT) scan instead of plain films in this otherwise low-risk patient that cannot be clinically cleared?"

CLINICAL QUESTION

In low-risk adult blunt trauma patients, can plain radiographs adequately exclude C-spine injury when clinical prediction rules cannot?

CONTEXT

The baseline risk of C-spine injury is reported to be between 1% and 3% for all blunt trauma patients and up to 11.5% for high-risk patients evaluated at urban trauma centers (3–5). Delays in diagnosis or missed injuries have been reported to result in partial or full paralysis in up to 29% of injured patients (6). This underscores the dire consequence of missed C-spine injuries for not only the

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patient, but for the physicians involved and the health care system as a whole.

The routine use of clinical decision rules and three-view plain radiography to clear the C-spine has been recently called into question (7,8). The updated EAST guidelines recommend CT as the diagnostic modality of choice for the evaluation of blunt trauma patients with suspected cervical spine injury that cannot be cleared by clinical prediction rules (9). In fact, one investigation suggests that all blunt trauma victims requiring trauma team activation should be evaluated with a C-spine CT scan regardless of their clinical findings (8). Additionally, a recent decision analysis found that the use of CT was significantly more cost effective than plain radiography in the evaluation of moderate- to high-risk blunt trauma patients, not including litigation costs, which average an additional $2.9 million per case (4,6).

Routine use of CT, however, may not be without consequence. Aside from a significant financial charge to the patient, the degree of radiation carries a measurable risk of carcinogenesis (10,11). If plain radiographs, while exposing patients to much lower doses of radiation, were sufficiently sensitive to rule out C-spine injury, it would offer a safer alternative to indiscriminate use of CT. To answer our clinical question, we review the most recent pertinent literature on this topic.

EVIDENCE SEARCH

You want to look for studies that compare plain film radiography to a "gold standard" for the evaluation of C-spine injuries in low-risk adult patients suffering blunt trauma. Prior to searching, you decide to exclude trials that specifically assessed altered or obtunded patients (not considered low risk) and those that did not include a complete three-view plain radiographic series. Searching PubMed with the terms "cervical spine injury AND radiograph*" yields 5709 references. Limiting to "humans" and "clinical trials" reduces this total to 158 references. Review of titles and abstracts reveals only two useful studies. You re-run your search using the terms "cervical spine clearance AND radiograph*" without limits, capturing 113 papers. Review of these sources yields an additional two trials addressing your question. Reviewing the bibliographies of these four studies yields no additional trials.

EVIDENCE REVIEW

Use of Plain Radiography to Screen for Cervical Spine Injuries, 2001 (12)

Population. The NEXUS cohort comprised 34,069 blunt trauma patients from 21 United States centers aged 1 month to 101 years. Enrollment occurred at both academic and community hospitals of varying sizes with and without residency training programs.

Study design. Retrospective. Data for the NEXUS cohort was collected prospectively to determine which blunt trauma patients could safely forgo radiographic evaluation of their cervical spine. This trial reviewed this database to determine the frequency and types of cervical injuries missed by plain radiography.

Gold standard. Imaging beyond radiographs was ordered at the discretion of the treating physicians. Neurosurgical and risk-management logs of each participating institution were searched 3 months after study completion.

Exclusion criteria. Patients that did not suffer a traumatic injury or underwent cervical spine imaging for other reasons. There were no other exclusion criteria.

Primary outcome. Of the 34,069 patients enrolled, 818 (2.4%) had at least one cervical spine injury. Plain radiographs identified at least one injury in 498 of these patients (sensitivity 60.1%). After excluding patients with inadequate radiographs, the sensitivity for detecting at least one injury was 89.4% (95% confidence interval [CI] 86.9–91.4%). Injuries missed by plain radiographs were diagnosed by other modalities, including CT or magnetic resonance imaging (MRI). In 36 of the 83 patients (43%) with injuries missed by adequate radiographs, the radiographs were interpreted as abnormal but not diagnostic of injury. Including those patients as "true positives" increased the sensitivity of *adequate* radiographs to 92.1%. This left a total of 47/581 injured patients with normal adequate radiographs.

Prospective Evaluation of Multislice Computed Tomography Versus Plain Radiographic Cervical Spine Clearance in Trauma Patients, 2007 (13)

Population. There were 1511 consecutive trauma patients at the authors' Level I trauma center prospectively enrolled between October 2004 and February 2005. After 15 patients were excluded, 667 patients that failed the NEXUS criteria were ultimately included in this study.

Study design. Prospective observational. Patients who could not have their cervical spines cleared by the NEXUS criteria received three-view radiographs (with additional views added at the discretion of the attending radiologist) as well as multislice four-channel CT with coronal and sagittal reconstructions of the C-spine. Unblinded radiographic interpretations were performed by board-certified radiologists. Patient data were recorded throughout the hospital stay and at clinical follow-up. Sensitivity,