Are computed tomography scans adequate in assessing cervical spine pain following blunt trauma?

Daniel M Sciubba, Gregory S McLoughlin, Ziya L Gokaslan, Ali Bydon, Edward Bessman, Hardin Pantle

Good quality three-view radiographs (anteroposterior, lateral, and open-mouth/odontoid) of the cervical spine exclude most unstable injuries, with sensitivity as high as 92% in adults and 94% in children. The diagnostic performance of helical computed tomography (CT) scanners may be even greater, with reported sensitivity as high as 99% and specificity 93%. Missed injuries are usually ligamentous, and may only be detected with magnetic resonance imaging (MRI) or dynamic plain radiographs. With improvements in the accessibility of advanced imaging (helical CT and MRI) and with improvements in the resolution of such imaging, dynamic screening is now used less commonly to screen for unstable injuries. This case involves a patient with an unstable cervical spine injury whose cervical subluxation was only detected following use of dynamic radiographs, despite a prior investigation with helical CT. In this way, the use of dynamic radiographs following blunt cervical trauma should be considered an effective tool for managing acute cervical spine injury in the awake, alert, and neurologically intact patient with neck pain.

A 49-year-old man struck his head while falling down stairs. He denied loss of consciousness and neurological deficit, but complained of significant neck pain. A cervical collar was in place. His Glasgow Coma Score was 15, and a focused neurological exam was within normal limits. A computed tomographic (CT) scan of the cervical spine was significant only for degenerative disc disease at the C5–7 levels (fig 1A). The collar was

removed to clinically clear the patient's cervical spine. He noted significant pain at the base of his neck with attempted flexion and was placed back in the collar. The patient was told to follow up in the neurosurgery spine clinic in 1–2 weeks for further evaluation of his neck pain. In the meantime, he had to wear a rigid cervical orthosis.

Before discharge, the patient communicated that his neck pain was so severe he was unsure if he could stand

up to leave the emergency department. Further questioning revealed severe pain (10/10) when upright, but minimal pain (2/10) when supine. Flexion–extension radiographs revealed a dislocation at C5–6 with bilateral jumped facets (fig 1B). Due to significant ligamentous instability, the patient agreed to a C3–6 posterior instrumented fusion. He awoke neurologically intact, and on the second postoperative day he was discharged home.

DISCUSSION

Accurate diagnosis of cervical spine injuries remains a significant problem when evaluating patients injured by blunt trauma, estimated to occur in approximately 4.2% of all patients.^{1,2} Missed diagnosis may occur in 5–23% of patients, and up to 30% of these patients may suffer permanent neurologic sequelae.³ Imaging recommendations have evolved from three-view plain film cervical spine series to additional use of flexion–extension (dynamic) plain radiographs, CT scans and magnetic resonance imaging (MRI) when deemed necessary. However, controversy in the literature stills exists regarding the ideal algorithm for treatment of such patients.

In the 1980s the American College of Radiology (ACR) recommended clinical examination in conjunction with flexion–extension radiographs for symptomatic patients as the standard for evaluation of ligamentous injury.⁴ These images are obtained with the assumption that an alert patient will complain of pain or neurologic symptoms before serious injury being caused by neck mobilisation. In 1998 and 2000, the Eastern Association of the Surgery of Trauma (EAST) recommended that in alert, awake patients with neck pain, in whom cervical plain films and CT scans were normal that, “the cervical collar is removed and flexion/extension lateral cervical spine x-rays are obtained...If voluntary, painless excursion...does not exceed 30 degrees, the cervical spine collar should be replaced.”^{5,6}

The Congress of Neurological Surgeons (CNS) and the American Association of Neurological Surgeons (AANS) likewise published their guidelines in 2002 regarding management of acute cervical spine injuries. In those guidelines, standard of care involves obtaining a three-view cervical spine series in symptomatic patients after traumatic injury. CT is recommended “to further define areas that are suspicious or not well visualized on the plain cervical x-rays”. It is also an “option” that “cervical spine immobilization in

Figure 1 (A) Sagittally reconstructed computed tomographic (CT) image of cervical spine, showing only mild degenerative changes, but no fractures or subluxations. (B) Lateral plain radiograph showing anterior subluxation of C5 on C6 (arrow).

awake patients with neck pain or tenderness and normal cervical spine *x* rays (including supplemental CT as necessary) be discontinued after either (a) normal and adequate dynamic flexion/extension radiographs, or (b) a normal [MRI] is obtained within 48 hours of injury".⁷

Despite such recommendations, emergency departments and trauma services are not consistently using dynamic radiographs or MRI in the evaluation of neurologically intact patient with neck pain and normal plain films or CT scans. At least two possible explanations exist for this observation. First, the incidence of occult ligamentous injury following three-view plain radiographs and CT is considered quite low. Chiu *et al* reviewed 2605 injured patients with a reduced conscious level and found only 14 (0.5%) patients with an unstable cervical ligamentous injury.² Thus, the need to perform routine DS to identify a low-incidence injury has been called into question, and the ACR no longer recommends standard use of dynamic screening (DS).⁸ A second reason may be related to the increased use of helical CT in emergency departments to image severely traumatised patients rapidly. During such scanning, the entire neuraxis can be rapidly and accurately interrogated, and thus dynamic radiographs may seem redundant.⁹⁻¹⁰ Spiteri *et al* showed comparable sensitivities and specificities for both diagnostic modalities and suggested that DS has no significant advantage over helical CT in detecting instability in obtunded patients.

Our case above does not represent a severely traumatised patient with an altered mental status, and thus clearance of his cervical spine should be

more straightforward. A lone CT scan was initially done on this patient that did not reveal injury. For this reason, the patient was to be discharged in a hard collar for outpatient workup of his neck pain. In keeping with the trauma guidelines (EAST) and the neurosurgical guidelines (AANS, CNS), evaluation of an awake, appropriate patient involved in blunt cervical trauma who complains of neck pain, and thus is at risk for unstable ligamentous injury, should include an MRI, flexion-extension films, or a neurosurgical or orthopaedic consultation (who may then order an MRI or dynamic studies). Although some authors propose using CT alone to assess for ligamentous injury,⁹⁻¹⁰ these studies have involved obtunded patients, and thus their conclusions should not be generalised to the awake patient complaining of neck pain. As a result, in the absence of dynamic films or MRI, this patient likely would have been sent home. Unfortunately, standard cervical collars may not effectively immobilise the neck in patients with overt spine instability,¹¹ and thus he may have suffered a delayed and severe neurological injury.

CONCLUSION

The utility of dynamic radiographs in assessing cervical spine injury following blunt trauma with or without concomitant MRI scans should not be undervalued or underutilised in the awake, appropriate patient. Careful clinical evaluation in concert with all indicated imaging modalities will provide the most appropriate management for such challenging patients.

Emerg Med J 2007;**24**:803-804.
doi: 10.1136/emj.2007.050997

Authors' affiliations

Daniel M Sciubba, Gregory S McLoughlin, Ziya I Gokaslan, Ali Bydon, Department of Neurosurgery, Johns Hopkins University, Baltimore, Maryland, USA
Edward Bessman, Hardin Pantile, Department of Emergency Medicine, Johns Hopkins University, Baltimore, Maryland, USA

Correspondence to: Daniel M Sciubba, MD, Department of Neurological Surgery, Johns Hopkins University, Meyer Building 8-161, 600 Wolfe Street, Baltimore, Maryland 21287, USA; dsciubb1@jhmi.edu

Accepted 5 July 2007

Competing interests: none declared

REFERENCES

- 1 **Marion D**, Domeier R, Dunham CM, *et al*. Determination of cervical spine stability in trauma patients (update of the 1997 EAST cervical spine clearance document 2000).
- 2 **Chiu WC**, Haan JM, Cushing BM, *et al*. Ligamentous injuries of the cervical spine in unreliable blunt trauma patients: incidence, evaluation, and outcome. *J Trauma* 2001;**50**:457-63; discussion 464.
- 3 **Davis JW**, Phreaner DL, Hoyt DB, *et al*. The etiology of missed cervical spine injuries. *J Trauma* 1993;**34**:342-6.
- 4 **Kathol MH**. Cervical spine trauma. What is new? *Radiol Clin North Am* 1997;**35**:507-32.
- 5 **Marion D**, Domeier R, Dunham CM, *et al*. Practice management guidelines for identifying cervical spine injuries following trauma. *East Assoc Surg Trauma (EAST)* 1998:1-14.
- 6 **Pasquale M**, Fabian TC. Practice management guidelines for trauma from the Eastern Association for the Surgery of Trauma. *J Trauma* 1998;**44**:941-56; discussion 956-7.
- 7 **Hadley MN**. Radiographic assessment of the cervical spine in symptomatic trauma patients. *Neurosurgery* 2002;**50**(3 Suppl):S36-43.
- 8 **Daffner RH**, Dalinka MK, Alazaki N. *Suspected cervical spine trauma. ACR Appropriateness Criteria*, American College of Radiology, 2003.
- 9 **Spiteri V**, Kotnis R, Singh P, *et al*. Cervical dynamic screening in spinal clearance: now redundant. *J Trauma* 2006;**61**:1171-7; discussion, 1177.
- 10 **Hogan GJ**, Mirvis SE, Shanmuganathan K, *et al*. Exclusion of unstable cervical spine injury in obtunded patients with blunt trauma: is MR imaging needed when multi-detector row CT findings are normal? *Radiology* 2005;**237**:106-13.
- 11 **Rosen PB**, McSwain NE, Arata M, *et al*. Comparison of two new immobilization collars. *Ann Emerg Med* 1992;**21**:1189-95.