The daunting task of "clearing" the cervical spine

Brian E. Grunau, MD*; Daniel Dibski, MSc, MD†; Jeremy Hall, MD†

ABSTRACT

The evaluation of the cervical spine in the emergency department is a common and often challenging task. We report the case of a 70-year-old female who presented intoxicated with evidence of a recent fall. A 64-slice computed tomographic (CT) scan with sagittal and coronal reconstructions revealed no acute injury. The patient was re-examined when alert and had persistent neck pain. Flexion-extension static views revealed severe subluxation of C5 on C6 with jumped facets, and subsequent magnetic resonance imaging confirmed significant ligamentous injury. The evidence available suggests that although CT with reconstruction is highly sensitive for clinically significant cervical injury, the possibility of severe injury remains.

RÉSUMÉ

L'évaluation de la colonne cervicale au service des urgences est une tâche courante et souvent difficile. Nous signalons le cas d'une femme de 70 ans qui s'est présentée aux urgences en état d'ébriété et portant des signes d'une chute récente. Un tomodensitogramme à 64 coupes par reconstruction frontale et sagittale n'a révélé aucune lésion aiguë. La patiente, une fois consciente, a été réexaminée et souffrait d'une douleur persistante au cou. Des clichés statiques en flexion-extension ont révélé une subluxation grave de C5 sur C6 et des facettes disloquées, et un examen subséquent d'imagerie par résonance magnétique (IRM) a confirmé une lésion ligamentaire importante. Les données disponibles permettent de présumer que bien que la sensibilité du tomodensitogramme par reconstruction soit élevée en cas de lésion cervicale importante sur le plan clinique, la possibilité de lésion grave demeure.

Keywords: cervical, computed tomography, imaging, spine, trauma

The evaluation of the cervical spine for significant injury after trauma is a common and often challenging obstacle in the emergency department (ED). Although rare, missed cervical injuries can have dramatic long-term neurologic consequences[1]; thus, screening imaging examinations must be highly sensitive. This case highlights several challenges pertaining to the selection of appropriate imaging studies, specifically in the unreliable patient and the patient with cervical tenderness, in the task of "clearing" the cervical spine.

CASE REPORT

A 70-year-old female was brought to the ED by ambulance late in the evening with the triage complaint identified as "Found down in the bathroom, EtOH, small abrasion to back of head. Poor historian." The husband of the patient stated that although she was not a frequent imbiber of alcohol, she had been drinking earlier in the evening and he had found her on the floor of the bathroom with blood on the floor and toilet seat. She had been unable to stand up and was confused. The emergency medical service was contacted and the patient was transported to the local ED.

The patient was intoxicated but was able to answer simple questions from the ED physician. She did not recall falling or hitting her head but was complaining of neck and posterior head pain. A cervical spine collar was applied. Past medical history included a lump in her breast for which a biopsy was pending. This had caused the patient significant stress and led to her drinking that night. She also had a history of chronic neck and back pain for which she took acetaminophen and codeine (Tylenol 3).

From the *Emergency Department, St. Paul's Hospital, and Department of Emergency Medicine, University of British Columbia, Vancouver, BC; and †Emergency Department, Chilliwack General Hospital, Chilliwack, BC.

Correspondence to: Dr. Brian E. Grunau, Emergency Department, St. Paul's Hospital, 1081 Burrard Street, Vancouver, BC V6Z 1Y6; briangrunau@gmail.com.

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On examination, the patient smelled of alcohol, was confused, and exhibited slurred speech; however, she opened her eyes spontaneously and obeyed motor commands. There were two small lacerations to the posterior scalp. The entire posterior neck was tender to palpation. Pain was not worse when palpating specific vertebrae. There were no neurologic or other physical examination abnormalities. Since this patient was > 65 years old, the patient's collar was not removed and neck rotation was not assessed until after computed tomography (CT) of the neck was completed.

The serum ethanol level was 60.9 mmol/L. The CT scan of the head revealed no acute intracranial pathology, and cervical plain films were positive only for degenerative disk disease. A CT scan (2007 GE 64-slice volume computed tomography) of the cervical spine with sagittal and coronal reconstructions was obtained that was negative for acute injury (Figure 1). There was multilevel degenerative disk disease with moderate neural foraminal narrowing and multilevel facet disease. Based on the results of imaging and a history of chronic neck pain, the patient's cervical collar was removed. She slept the remainder of the night.

Figure 1. Computed tomography of the cervical spine.

On reassessment in the morning, the patient was alert and oriented in spite of having a serum ethanol level of 28.1 mmol/L. She described mild paresthesias in both hands in no clear dermatomal pattern. There was persistent cervical neck pain located in the C4-C5 right paravertebral area. Neurologic examination revealed no objective deficits, and the patient was able to rotate her head 45° bilaterally without symptoms. The patient was assisted to a sitting position by nursing staff and tried to stand but was very unsteady on her feet and unable to bear weight. After being transported in a wheelchair to the toilet, she was unable to sit upright, grasp the hand rails, or move her feet to a supportive position. Voiding was unsuccessful. A hard collar was reapplied, and she was transferred back to a stretcher. Neurologic reassessment in an immobile supine position revealed only mild weakness with a normal objective sensory examination. The patient was able to move her legs and voided in a bedpan without difficulty.

A second radiologist was consulted, and the CT scan of the cervical spine confirmed that there was no evidence of acute injury. Flexion-extension static radiography was then performed. During the procedure, the patient complained of significant midline cervical pain with extremity weakness. The images revealed severe anterior subluxation greater than 50% of C5 on C6 with jumped facets, consistent with bilateral facet dislocation and subluxation (Figure 2 and Figure 3). The patient was immediately placed back in cervical spine precautions. A palpable reduction in this subluxation was felt during the reapplication of the collar, and the patient expressed acute relief of her symptoms.

The patient underwent cervical magnetic resonance imaging (MRI), which revealed instability at C5-C6 with tearing of the anterior and posterior longitudinal ligaments, the intervening disk, and the posterior ligaments, including facet joint capsules; traumatic disk herniation at C5-C6; possible occult fracture of C6; probable midcervical cord contusion; and extensive intraspinal extradural blood (Figure 4). The patient was transferred into the care of the neurosurgical team and underwent internal fixation of C5-C6. There were no permanent neurologic sequelae.

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Figure 2. Flexion-extension image of the cervical spine (1).

DISCUSSION

In alert patients, the cervical spine assessment has become more straightforward since the development of the NEXUS criteria[2] and Canadian C-Spine Rule,[3] although the evaluation of the patient with altered mental status, cervical tenderness, or distracting injuries and no obvious neurologic deficits continues to prove difficult. This case illustrates several clinical issues, including the most appropriate imaging study in the unreliable patient, the sensitivity of CT with reconstruction, the utility and safety of flexion-extension imaging after negative CT, and the necessity of further imaging in patients with negative CT and persistent cervical pain.

Figure 3. Flexion-extension image of the cervical spine (2).

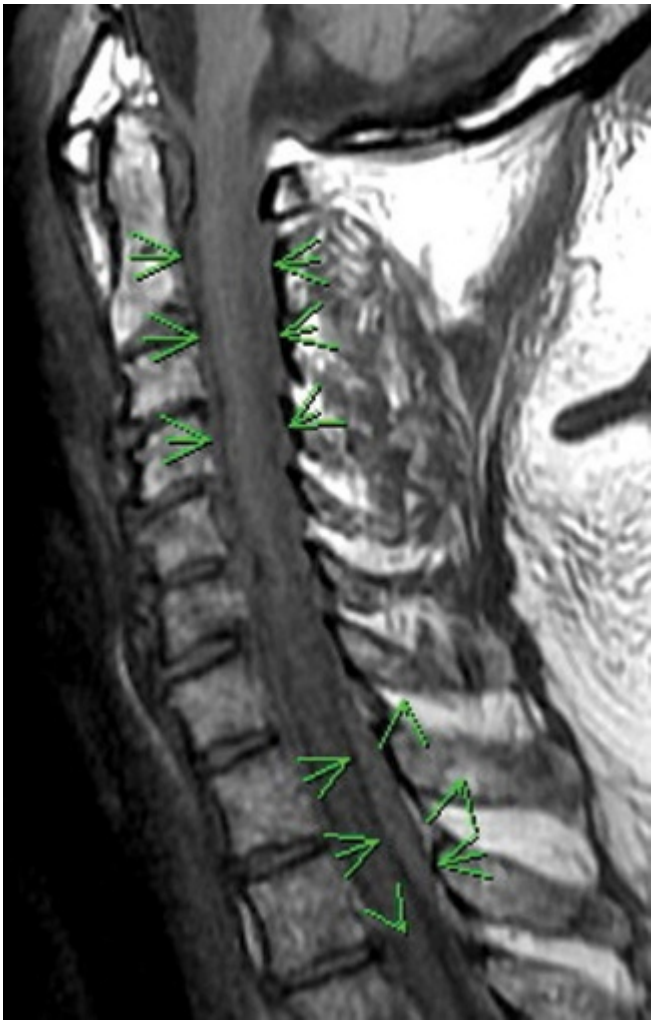

Figure 4. Magnetic resonance image of the cervical spine. Arrows point to abnormalities.

Plain radiographs are the traditional imaging modality in most EDs and have been found to be unreliable in those with altered mentation. A prospective study examining five-view cervical radiography involving 1,005 trauma patients with altered mental status or distracting injuries revealed that radiographs failed to identify 52% of fractures seen on CT, of which 17% were unstable.[4]

Thin-slice CT with reconstructions is the primary cervical spine imaging study for the trauma patient with impaired mental status.[5] Although it is generally accepted that those with neurologic deficits should undergo MRI,[6] the necessity of MRI to rule out ligamentous injury after a negative CT result in the patient without gross motor deficits remains unclear. Hogan and colleagues

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retrospectively identified 366 obtunded and/or "unreliable" patients with blunt trauma and no neurologic deficits who had normal CT results and underwent subsequent MRI.[7] Twelve patients had pathology identified, four with ligamentous injuries, although none were deemed "unstable" or required surgical intervention. Como and colleagues prospectively enrolled 115 "unreliable" trauma patients with no obvious neurologic deficits.[8] MRI was obtained in all patients as soon as was feasible, although it did not change management plans in any patient nor were any patients classified as unstable. Como and colleagues subsequently performed a prospective evaluation of a protocol using only CT to rule out cervical spine injuries in 197 trauma patients. All patients had clinical examinations when awake, with MRI performed for those with neck pain; however, no clinically significant injuries were missed.[9] The recent prospective studies of Stelfox and colleagues and Schuster and colleagues and the retrospective data of Tomycz and colleagues and Harris and colleagues examining the use of CT and MRI in unexaminable patients also support the conclusion that CT with reconstruction is 100% sensitive for clinically significant and unstable cervical injuries.[10–13]

Conversely, data exist that suggest that CT of the cervical spine may not confer a conclusive negative predictive value. Some authors argue that MRI is required to adequately rule out cervical injury, in spite of the cost and risks of a prolonged test. Menaker and colleagues identified 203 patients after negative CT with a Glasgow Coma Scale score $\leq$ 14 and no neurologic deficits.[14] They reported that of the 18 patients who had an abnormal MRI, 2 underwent operative intervention and 14 were treated with a cervical collar. Data from similar retrospective studies by Ghanta and colleagues, Stassen and colleagues, and Sarani and colleagues also report injuries of the cervical spine found by MRI after negative CT in trauma patients with altered mental status, although none required surgical intervention and management was limited to cervical collars.[15–17] A meta-analysis including 11 studies with data from 1,550 patients showed that MRI results altered management in 6% of patients, of whom 5% continued collar immobilization and 1% (12 patients) required surgical intervention.[18] This meta-analysis has been contested, however,[19] because a nonobtunded cohort was included in the analysis. When restricting the findings to obtunded patients with normal neurologic examinations, only 2 of 1,085 patients (0.2%) required operative cervical spine intervention. Findings from studies of this nature are limited because MRI-specific criteria for distinguishing significant injuries from inconsequential findings are lacking[20]; thus, variance in treatment strategies may be significant.

One strategy used to fully evaluate the soft tissues and ligaments of the cervical spine in the unexaminable patient with a normal CT scan has been to immobilize the cervical spine and assess with a clinical examination when the patient is alert or otherwise with MRI after a predetermined period of time (often 24–48 hours).[20] Although widely used, few data are available to guide this practice,[6] and adverse effects such as pressure sores, delirium, pneumonia, prolonged hospital and intensive care unit admissions, and increased intracranial pressure have been found to be more prevalent in this population.[10,21]

Flexion-extension films and dynamic fluoroscopy have also been used for the assessment of ligamentous stability after negative initial imaging in the alert patient with persistent neck pain or in the obtunded patient.[22] In the unexaminable patient, flexion-extension imaging has proved to be insensitive,[23] often inadequate,[24] cost ineffective,[25] potentially dangerous,[26] and unnecessary when CT has already been performed.[27–29] In the alert and stable patient, although images are often inadequate,[30] flexion-extension imaging may increase sensitivity if imaging is limited to plain films.[30–32] Using a proper technique, this strategy appears to be safe[31] and with adequate images has been reported to have a 100% negative predictive value.[30] However, Insko and colleagues reported that among the 30% of patients with inadequate studies, there was twice the prevalence of cervical injuries,[30] thereby limiting the utility of this modality.

Limited data are available to guide the management of alert neurologically intact patients with negative initial imaging and cervical tenderness.[5] Sarani and colleagues retrospectively identified 51 patients with normal CT results, no neurologic findings, and midline cervical tenderness of a cohort of 5,473 trauma patients, of whom 254 underwent CT and MRI.[17] Among those with normal CT results, one patient underwent surgery for a ligamentous injury and herniated disk and eight patients were treated with hard collars. Schuster and colleagues prospectively reported 93 patients with negative CT results and persistent neck pain, all of

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whom underwent MRI, which was negative for clinically significant injuries.[11] In this patient population, it is uncertain if adequate flexion-extension views would offer any benefit in identifying rare, clinically significant injuries missed by CT.

CONCLUSION

Clinically significant cervical spine injuries after thin-slice CT with reconstruction are rare. The case we have presented represents one of these injuries. The evidence available suggests that although CT with reconstruction is highly sensitive for clinically significant cervical injury, the possibility of severe injury remains. The available guidelines reflect this uncertainty in their post-CT management recommendations. The American College of Radiology recommends MRI if a patient's neurologic status cannot be evaluated within 48 hours.[20] The expert panel states that flexion-extension imaging has a role in alert patients with equivocal MRI results or after pain has resolved in patients treated with collars owing to cervical pain after normal CT and MRI. The Eastern Association for the Surgery of Trauma guidelines recommend that for the obtunded patient, CT alone, MRI as an adjunct, and continued immobilization are all possible options that must be individualized to the institution.[5] For alert patients with persistent neck pain after normal CT results, the guidelines recommend either continued immobilization, MRI, or adequate flexion-extension imaging. Finally, for patients with neurologic deficits, CT and MRI are recommended. Continued advances in CT technology and further data from prospective trials will likely clarify the optimal strategy for this task. Until that point, however, "clearing" the cervical spine will continue to be a challenge.

Competing interests: None declared.

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