The Unstable Occult Cervical Spine Fracture: A Review

SHARON E. MACE, MD

The initial evaluation and management of cervical spine injuries is of critical importance because of the impact of early treatment and management on the patient's eventual outcome. The devastation and cost of missing even one unstable cervical spine fracture is tremendous. The existence of patients with an unsuspected cervical spine fracture who have few, if any, symptoms and/or signs of an injury to the cervical spine is a valid concern and a dilemma for the practicing physician. Thus the principle of the occult unstable cervical spine fracture, which has been established as the standard of care, has major significance and implications. Recently, however, the concept of the occult cervical spine fracture has been challenged. Does the entity of an occult cervical spine fracture exist? If so, how should this affect our indications for obtaining cervical spine radiographs? The author presents the case of an unstable occult cervical spine fracture and a review of the literature. (Am J Emerg Med 1992;10:136-142. Copyright © 1992 by W.B. Saunders Company)

In the past, indications for cervical spine radiographs have generally included the following: patients with a significant mechanism of injury, patients with an unreliable history and/or with an altered mental status, patients with complaints of neck pain or neurologic symptoms, and patients with a positive physical examination including pain on palpation of the neck and/or neurologic signs (weakness, abnormal reflexes, etc).1-6 (Table 1).

These guidelines were almost universally accepted and have become the dogma of physicians in the emergency department. Recently the criteria for obtaining cervical spine radiographs have been challenged.17-24 In today's cost-conscious society, these indications have been criticized as expensive, with a low yield, and resulting in unnecessary radiation to patients.25

Past reports of occult cervical spine fractures26-30 have been discounted as not fulfilling the criteria for being an unsuspected or occult cervical spine fracture with few, if any, symptoms and/or signs of a cervical spine fracture.

Yet recent reports continue to document patients with unstable occult cervical spine fractures.31-33

What is the status of the occult cervical spine fracture?

According to the literature is the unstable occult cervical spine fracture a reality or a myth, and what should the criteria be for obtaining cervical spine radiographs? How can we balance the importance of not missing a cervical spine fracture in any given individual against the desire to be cost-effective and limit unnecessary radiographs?

We present a case of an occult cervical spine fracture and a review of the literature regarding cervical spine injuries.

CASE PRESENTATION

A 51-year-old male was being evaluated for a fever and sore throat with possible epiglottitis. He was alert, oriented x 3, with a class I level of consciousness (Glasgow Coma Scale = 15), and he was not under the influence of alcohol or drugs at the time he was seen. Past medical history included seizures and alcohol abuse. His physical examination, including the neurologic examination (eg, mental status, cranial nerves, motor, sensory, gait, reflexes) was normal. A soft tissue film of the neck was taken to rule out epiglottitis. The report by the attending radiologist was "fullness in the subglottic tissue, odontoid fracture of the Type II variety at its base with anterior subluxation of the arch of C2 on C3 of approximately 1 cm." (Figure 1). Radiographs of the skull and cervical spine taken 1 year earlier were normal (Figure 2). He denied any history of recent trauma. He had no neck pain or tenderness on palpation of the neck. There were no symptoms or signs of neck, neurologic, or traumatic injury. He had cervical spine immobilization (Figure 3). His unstable fracture dislocation of C2 required neurosurgery with a bone graft and fusion of C1-C2.

DISCUSSION

The importance of the detection and initial management of cervical spine injuries in the emergency department is universally accepted and well recognized.34-41 However, it may be difficult to detect cervical spine injuries in certain patients.44-47 This includes, but is not limited to: patients with an altered mental status, patients with loss of consciousness, and patients with other significant injuries, such as an extremity fracture.11-19,44-47 The possibility of an occult cervical spine injury complicates the issue, making it difficult to recognize cervical spine injuries in emergency department patients since patients with an occult cervical spine fracture have few, if any, symptoms or signs of cervical spine injury. Yet have significant fractures of the cervical spine (Table 1).26-33,44,47

The first report of an occult cervical spine fracture was in 1972 by Thambyrajah.46 In this study of four cases of occult cervical spine fracture, all four patients were awake, alert, nonintoxicated, ambulatory, and had no neurologic deficits. Three of the four patients presented 1 to 2 days after the
trauma occurred. Two of the four patients had been drinking at the time of the trauma, but by the time they were seen the next day they were not intoxicated. The amount of force involved was variable in these four cases, including: a driver in a motor vehicle accident, a person hit in the jaw who then fell backward, a person who was hit in the back of the head, and a person who merely twisted her neck. One patient denied neck pain, stiffness, or tenderness, had full range of motion, no neurologic symptoms, and his cervical spine fracture was discovered incidentally on his skull roentgenograms. Three of the four patients had a history of trauma. The cervical spine injuries were significant and ranged from a fracture of the pedicle of C3 with subluxation of the C2-C3 apophyseal joint, to a fracture of the pedicle of C3 extending into the body, and a fracture of the lamina of C2. Treatment in the four patients ranged from cervical collars to crutchfield tongs and traction for weeks.26

The fourth patient might be considered to not have any trauma at all, ie, she was not in a motor vehicle accident, nor did she hit her head, face, or neck.26 She started to slip but caught herself and did not actually fall, but only twisted her neck. She had a subluxation of the atlantoaxial joint with a fracture of the atlas. It should also be noted that this patient was not elderly with severe degenerative disease of the spine, nor did she have any congenital anomalies which might predispose to injuries of the spine.48-49 Indeed, she was only 23 years old.

It should also be noted that routine roentgenograms did not show the fractures in three of the four cases.26 Only after repeated x-rays and coned views were the cervical spine fractures/subluxations detected.26 The inadequacy of plain roentgenograms in many cases, as noted in this study,26 has been confirmed by others.50-60

Following this initial report, additional cases have been noted over the years.27-33 Bresler and Rich presented the case of a fully conscious ambulatory patient who fell out of a car and offered no complaint of neck pain.27 Physical examination including the neurologic examination was normal except for a wrist deformity secondary to a fracture, and only mild tenderness on palpation of the neck. She had subluxation of C4 on C5, fractures of the pedicle and neural arch of C4, and a wrist fracture. She was immobilized, admitted

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**TABLE 1. Indications for Cervical Spine Radiographs**

<table>
<thead>
<tr>
<th>History or Mechanism of Injury</th>
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<tbody>
<tr>
<td>Multiple trauma patients</td>
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<td>Patients with significant head injuries</td>
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<tr>
<td>Patients with significant facial injuries</td>
<td></td>
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<tr>
<td>Patients with other significant injuries (such as an extremity fracture—wrist, femur, etc)</td>
<td></td>
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<tr>
<td>and a significant mechanism of injury</td>
<td></td>
</tr>
<tr>
<td>Unreliable History or Altered Mental Status</td>
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<tr>
<td>Intoxicated patients (due to history of alcohol and/or drug abuse)</td>
<td></td>
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<tr>
<td>Patients with an altered mental state</td>
<td></td>
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<tr>
<td>Patients with loss of consciousness</td>
<td></td>
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<tr>
<td>Significant History of Present Illness</td>
<td></td>
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<tr>
<td>Patients with complaints of neck pain</td>
<td></td>
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<tr>
<td>Patients with neurologic symptoms (weakness, paresthesias, etc)</td>
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<tr>
<td>Abnormal Physical Examination</td>
<td></td>
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<tr>
<td>Patients with pain on palpation of the neck</td>
<td></td>
</tr>
<tr>
<td>Patients with abnormal neurologic signs (weakness, abnormal reflexes, etc)</td>
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FIGURE 1. Cervical spine radiographs in our patient showing “fullness in subglottic tissue, marked degenerative changes in the cervical spine with large osteophytes, odontoid fracture of the Type II variety at its base with anterior subluxation of the arch of C2 on C3 of approximately 1 cm” (Report of attending radiologist).
to the hospital, and underwent an anterior cervical diskectomy, decompression, and fusion. The symptoms from her fractured wrist far overshadowed any symptoms from her cervical spine fracture and led to the recommendation that cervical spine films be obtained in trauma patients with other significant injuries, or an altered mental status due to alcohol and/or drugs, and those with loss of consciousness.28

Haines reported two cases of occult cervical spine fractures.28 Both patients were alert, not intoxicated, and seen a day after the incident. One came to the emergency department and one to a family physician’s office; both were ambulatory. One patient had “mild neck pain” after striking his head. The other patient was in a motorcycle accident and complained only of wrist pain and soreness all over. He denied any specific injury to his head or neck. Roentgenograms revealed a burst fracture of the body of C3 with subluxation of C5 on C6 in the first patient and subluxation of C4 on C5 in the second. Both were referred for neurosurgical evaluation. The second case illustrates the fact that denial of neck pain does not rule out significant cervical spine injury, and again, that other injuries (in this case a fractured wrist) may lead to ignoring or minimizing signs and symptoms of cervical spine injury.28

In the case report by Lieberman and Maull,29 an unrestrained, intoxicated victim of a motor vehicle accident, who did not lose consciousness, complained of shoulder and arm pain, but denied neck pain and had a normal neck examination without pain on palpation of the neck. The lateral cervical spine was read as negative by the “Senior Staff Radiologist”. He was admitted with the diagnosis of multiple trauma, subdural hematoma, renal hematoma, and fracture radius and ulna. The next day he complained of neck pain so a repeat lateral cervical spine roentgenogram was done, revealing a C2 fracture dislocation with narrowing of the canal from 23 mm to 12 mm. Computed tomographic scan confirmed an unstable odontoid fracture. He was treated with
Gardner Wells tongs, reduction of the displacement under traction, and a halo vest.29 Once again, the presence of other injuries masked a cervical spine injury.29

Again, both the history and physical examination (eg, denial of neck pain and no pain on palpation over the neck), when initially seen in the emergency department,29 were misleading.

Thus, the concern is that an alert nonintoxicated patient with a normal mental status may have a significant injury of the cervical spine while denying neck pain and with a normal neurologic and neck examination.26,31

In another alarming case report by Ogden and Dunn,30 an alert nonintoxicated female driver in a motor vehicle accident had a right flail chest and bilateral femur fractures. She denied neck pain, had no tenderness on palpation of the neck, and a normal neurologic examination in the emergency department. Eighteen hours later in the intensive care unit she complained of neck pain, so a roentgenogram was done which revealed a burst fracture of C2. The investigators noted that denial of neck pain and absence of neck pain on palpation on physical examination does not rule out significant cervical spine injury, and that patients will focus on the areas of greatest pain and often ignore the less painful but certainly not less significantly injured parts.30

Several clinical reviews26-30 of patients have confirmed the findings of these various case reports.26-30,33 In the study by Williams et al of 50 consecutive patients with cervical spine injuries seen in the emergency department,31 it was concluded that "the initial history and physical examination may be misleading in a large number of patients". They found that "in a significant number of instances (> 25%), objective careful radiographic interpretation is more important to the patient's welfare than is any other diagnostic modality—including history and physical examination."31

In a review of 67 patients with acute cervical spine fractures seen in the emergency department,32 the results of these earlier reports and studies26,27,31 were once more confirmed. The investigators concluded that "the absence of mental status changes, craniofacial injuries, range of motion abnormalities, and focal neurological findings is not uncommon in patients who have sustained cervical spine injuries."32 They noted that 18% (12/67 patients) had no complaint of neck pain. Their results suggested that "the painless cervical fractures alluded to in the literature may exist especially in inebriated or confused patients, those with multiple organ system injury or those with multiple lacerations/contusions."32

In a large retrospective study of 795 patients with blunt cervical spine trauma,61 a subset of 20 patients with documented neurologic deficits of the cervical spinal cord without fracture or dislocation were identified. In these 20 patients with documented neurologic deficits, eg, motor weakness in all patients (100% of 20/20) and absent reflexes (50% or 10/20), and documented blunt cervical spine trauma; only 70% had cervical spine tenderness.61 Thus, nearly one third of the patients (30%) with documented cervical spine injury,
<table>
<thead>
<tr>
<th>Author</th>
<th>Patient History</th>
<th>Chief Complaint</th>
<th>Ambulatory</th>
<th>Mental Status</th>
<th>LOC</th>
<th>Neurologic Symptoms</th>
<th>Pain on Palpation of Neck</th>
<th>Neurologic Examination</th>
<th>Other Injuries</th>
<th>Comments</th>
<th>Abnormality</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thambyrajah</td>
<td>elderly male, hit on back of head then fell on face</td>
<td>contusions of head</td>
<td>yes</td>
<td>alert, oriented, intact</td>
<td>no</td>
<td>no</td>
<td>no—initial, yes—on deep palpation only on repeat examination</td>
<td>NML</td>
<td>facial abrasions, contusions, shoulder, face, LS spine fracture</td>
<td>fracture not seen on C spine film, fusion on axial films</td>
<td>fracture pedicle of C2, subluxation C2/C3</td>
</tr>
<tr>
<td>female (34)</td>
<td>twisted her neck</td>
<td>contusions of neck</td>
<td>yes</td>
<td>alert, oriented, intact</td>
<td>no</td>
<td>yes—mild</td>
<td>no</td>
<td>NML</td>
<td>none</td>
<td>no</td>
<td>fracture of C2, subluxation of atlantoaxial joint</td>
</tr>
<tr>
<td>aged (67)</td>
<td>fell on back of head</td>
<td>neck/shoulder pain</td>
<td>yes</td>
<td>alert, oriented, intact</td>
<td>no</td>
<td>yes—mild</td>
<td>no</td>
<td>NML</td>
<td>none</td>
<td>no</td>
<td>fracture pedicle of C3</td>
</tr>
<tr>
<td>Bresler &amp; Rich</td>
<td>female (32)</td>
<td>wrist pain</td>
<td>yes</td>
<td>alert, oriented, intact</td>
<td>no</td>
<td>no</td>
<td>yes—mild</td>
<td>NML</td>
<td>wrist fracture, forehead laceration, multiple abrasions</td>
<td>seen 6 hrs later</td>
<td>fracture of C4 pedicle/nerve arch, subluxation of C4 on C5</td>
</tr>
<tr>
<td>Haines</td>
<td>male (19)</td>
<td>neck pain</td>
<td>yes</td>
<td>alert, oriented, intact</td>
<td>no</td>
<td>yes</td>
<td>yes—mild</td>
<td>decreased left hand grip</td>
<td>none</td>
<td>no</td>
<td>fracture of C6, subluxation of C4 on C5</td>
</tr>
<tr>
<td>diving accident</td>
<td>male (15)</td>
<td>neck pain</td>
<td>yes</td>
<td>alert, oriented, intact</td>
<td>no</td>
<td>no</td>
<td>yes—mild</td>
<td>NML</td>
<td>wrist fracture</td>
<td>none</td>
<td>fracture of C6, subluxation of C4 on C5</td>
</tr>
<tr>
<td>motor vehicle accident</td>
<td>neck pain</td>
<td>yes</td>
<td>alert, oriented, intact</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>NML</td>
<td>renal hematoma, small subdural hematoma, wrist fracture</td>
<td>seen 1 day later</td>
<td>fracture dislocation of C2 with narrowing of the canal</td>
<td></td>
</tr>
<tr>
<td>male (38)</td>
<td>punched in jaw &amp; fell backward</td>
<td>neck pain</td>
<td>yes</td>
<td>alert, oriented, intact</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>NML</td>
<td>NML</td>
<td>no</td>
<td>fracture dislocation of C2</td>
</tr>
<tr>
<td>Ogden &amp; Dunn</td>
<td>33 years old</td>
<td>headache left forearm pain, right shoulder pain, right chest &amp; leg pain</td>
<td>yes</td>
<td>alert, oriented, intact</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>NML</td>
<td>bilateral femur fracture</td>
<td>no</td>
<td>fracture of C2</td>
</tr>
<tr>
<td>Williams et al</td>
<td>50 patients with acute C spine injuries</td>
<td>C spine (fracture or dislocation)</td>
<td>no in 20% (13/50)</td>
<td>no in 62% (1/50)</td>
<td>no in 20% (13/50)</td>
<td>NML in 62% (1/50)</td>
<td>In greater than 25% Hx, PE were misleading (no neck pain, neurologic exam-NML)</td>
<td>C spine fracture and/or dislocation</td>
<td></td>
<td></td>
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<tr>
<td>Walter et al</td>
<td>67 patients with acute C spine injuries</td>
<td>C spine (fracture or dislocation) (at a community hospital)</td>
<td>6% unknown</td>
<td>21% yes</td>
<td>63% no</td>
<td>16% had no neck pain (19/67)</td>
<td>12% had no neck pain on palpation of neck (6/67)</td>
<td>NML in 88% (59/27)</td>
<td>2 patients had no neck pain on palpation of neck (6/67)</td>
<td>C spine fracture and/or dislocation</td>
<td></td>
</tr>
<tr>
<td>Mace</td>
<td>male (31)</td>
<td>fever epiglottis</td>
<td>yes</td>
<td>alert, oriented, intact</td>
<td>no</td>
<td>no</td>
<td>no</td>
<td>NML</td>
<td>unstable fracture. Subluxation of odontoid, had surgical fusion of C1/C2</td>
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Abbreviations: LOC, loss of consciousness; MVA, motor vehicle accident; C, cervical; EMS, emergency medical services; NML, normal; PF, physical examination; Hx, history;
eg, motor deficits, often with additional sensory deficits and absent reflexes, had no tenderness on palpation of the cervical spine.61

A prospective study of 233 patients demonstrated the inability of physicians to accurately predict the presence of cervical spine injury.62 Physicians were able to predict cervical spine injury with only a 50% accuracy. Furthermore, "twenty percent (5 of 24) of cervical spine injuries would have been missed if physicians had used physical examination and mechanism of injury as criteria."62

Our report is of particular concern because the patient denied any history of recent trauma, had no complaints of neck pain, did not have any tenderness or pain on palpation of the neck on physical examination, and had no symptoms or signs of neck trauma, neurologic injury, or traumatic injury. Furthermore, he had normal cervical spine films taken 1 year earlier, which indicates that the cause of the trauma and the resultant symptoms were so trivial as to be forgotten.33

In reviewing the literature (Table 2), the following has been noted in patients with known significant cervical spine injuries:

1. Patients may have no neurologic symptoms (such as numbness, weakness, paresthesias5,13,26-32). This is usually the case.31,32

2. Patients may have a normal neurologic examination, including normal motor, sensory, and reflexes.15,16,26-33 This is true in the vast majority of patients (80% to 90%)15,16,31,32 with known cervical spine fractures and/or dislocations.31,32 In one series 82% (or 41/50) patients, and in another series 88% (59/67), had a normal neurologic examination.31,32

3. Patients may be ambulatory.15,16,26-28,31-33

4. Patients often delay in seeking medical care and often are seen hours to days after the actual trauma occurred.20,28

5. The chief complaint or presenting symptom is often not neck pain.14-16,20-33

6. The mental status is often normal with no history of loss of consciousness.13,16,20-33

7. The injury may occur following minor or seemingly "trivial" trauma, such as twisting of the neck.15,16,26-33

8. Patients may have no complaint of neck pain.15,20-33

9. Patients may have no tenderness or pain on palpation over the cervical spine or neck.20,29-33

10. The injury may occur with or without significant head or facial injuries.11,14-32

11. The injury may occur with no history of trauma.32,33

It is a significant and disturbing fact that one fourth to one third of patients with cervical spine injuries (18% in the Walters et al study,32 24% in the Nichols et al study,15 35% in the Williams et al study,31 30% in the Blanda et al study61) may have no complaints of neck pain.15,31-32,50,62 Furthermore, the absence of neck pain can occur in patients who are alert, oriented × 3, and not intoxicated, and have a normal mental status.15,26-33,61

Of even greater concern for the clinician is the fact that some alert patients with cervical spine injury, with a normal mental status, when carefully examined may have no tenderness or pain on palpation on physical examination.26,28-33

Finally, in a small number of cases,32,33 there may be no history of trauma.

SUMMARY

Although in today's cost-conscious society, some have advocated various different indications for obtaining cervical spine roentgenograms,17-25 our review indicates that the unstable occult cervical spine fracture can and does exist, and that, as suggested by many physicians,11-16,26-33 it is important to maintain a high index of suspicion, especially in high-risk patients. We should heed the recommendations of those who advocate obtaining cervical spine roentgenograms in certain high-risk trauma patients, knowing that the entity of occult cervical spine fracture does exist.

REFERENCES

19. Cadoux CG, White JD: High-yield radiographic consider-