

## INDICATIONS FOR PREHOSPITAL SPINAL IMMOBILIZATION

Robert M. Domeier, MD, for the National Association of EMS Physicians Standards and Clinical Practice Committee

Indications for prehospital spinal immobilization have changed dramatically over the history of modern EMS systems. The first recommendations from the American Academy of Orthopedic Surgeons (AAOS) primarily included the use of symptoms and physical findings of potential spinal injury as indication for immobilization.<sup>1</sup> As it became clear that early emergency department (ED) evaluation of potential spinal injuries was not accurate or complete, the prehospital practice shifted to immobilization of essentially all patients with any potential for spinal injury.<sup>2</sup> This change in practice shifted emphasis from symptoms and physical findings to mechanism of injury. Mechanism of injury has persisted as the primary indication for spinal immobilization in nearly all U.S. EMS systems. Currently, spinal immobilization is often performed based only

on the mechanism of injury without consideration of the patient's symptoms and physical findings.

Cost-effective ED care of trauma patients has advanced significantly, and numerous studies examining indications for spine radiographs in trauma patients have been published.<sup>3-22</sup> The findings of these studies universally support the use of clinical criteria to determine the need for spinal radiographs. They also support the presumption that without symptoms and physical findings associated with spinal injury, no significant spinal injury exists. In addition, there have been no reported cases of spinal cord injury developing during appropriate normal patient handling of trauma patients who did not have a cord injury incurred at the time of the trauma. Although early emergency medical literature identified mishandling of patients as a common cause of iatrogenic injury, these instances have not been identified anywhere in the peer-reviewed literature and probably represent anecdote rather than science. Mechanistically, it seems unlikely that, after a significant trauma, the proportionately small additional energy imparted to the spine by the EMS providers would cause a patient with a spine fracture to develop a cord injury not caused by the initial trauma.

Retrospective literature has documented the association of the

criteria presented here with spinal fracture. Prospective prehospital studies have also been reported that support the use of clinical findings as indicators of the need for prehospital spinal immobilization.<sup>23-27</sup> Several EMS systems across the country have implemented prehospital protocols using clinical criteria as indication for spinal immobilization.<sup>28,29</sup>

Spinal immobilization on a rigid backboard is not an innocuous procedure. Besides the direct cost of the equipment, there are also significant effects on patient comfort and the cost of ED evaluation. Respiratory compromise due to the strapping techniques used and pressure complications from rigid immobilization have been reported.<sup>30,31</sup> Head and back pain is a nearly universal complication of prolonged rigid spinal immobilization and can alter ED presentation and evaluation, necessitating radiographs that might have been avoided by omitting spinal immobilization in asymptomatic patients.<sup>32,33</sup>

Based on the current ED and prehospital literature as cited here, spine immobilization is indicated in prehospital trauma patients who sustain an injury with a mechanism having the potential for causing spinal injury and who have at least one of these clinical criteria:

1. altered mental status
2. evidence of intoxication

---

.Dr. Domeier is at Saint Joseph Mercy Hospital, Ann Arbor, Michigan.

Approved by the NAEMSP Board of Directors February 22, 1999. Received March 3, 1999; accepted for publication March 3, 1999.

Presented at the NAEMSP mid-year meeting, Incline Village, Nevada, July 1997.

Address correspondence and reprint requests to: Robert M. Domeier, MD, Saint Joseph Mercy Hospital, P.O. Box 995, 5301 East Huron River Drive, Ann Arbor, MI 48106. e-mail: <rdomeier@aol.com>.

3. a distracting painful injury (e.g., long-bone extremity fracture)
4. neurologic deficit
5. spinal pain or tenderness

Patients without a mechanism of injury with the potential for causing spinal injury or those patients without one of the above clinical findings may safely have spinal immobilization omitted. These patients should be evaluated at an appropriate ED and should be transported in a position of comfort. EMS systems adopting procedures for clearance from prehospital spinal immobilization must develop mechanisms for education and quality improvement to ensure safe and appropriate use of clearance protocols.

These criteria represent clinical judgments by the EMS personnel, and supporting educational materials are critical to their accuracy. Assessment of altered mental status, for example, requires that there be no language or communication barriers (e.g., hearing impairment) between the EMS personnel and the patient. Extremes of age may also impact the provider's ability to accurately assess the patient's perception and communication of pain. Similarly, intoxication may be difficult to ascertain in the EMS environment. Maio et al. have reported that EMS providers may not accurately identify intoxication in victims of motor vehicle crashes.<sup>34</sup> There has been no prospectively validated definition for a painful distracting injury in the literature, although many authors utilize the above definition. Finally, the presence of spinal pain or tenderness may be variably interpreted. All of these issues must be clarified prior to implementation of a clinical clearance protocol.

The literature is limited in regard to the use of clearance protocols in pediatric patients. Spinal fractures and cord injuries in children are rare,<sup>35,36</sup> and most manifest as overt clinical findings.<sup>37</sup> Yet, the low incidence of pediatric spine fractures

makes prospective validation of pediatric criteria extremely difficult. EMS systems should consider this limitation when developing spinal immobilization clearance protocols. Additional research to validate clearance protocols in practice, in pediatric patients, and across various levels of EMS training for patients of all ages should be conducted.

## References

1. American Academy of Orthopedic Surgeons Committee on Injuries, Fractures and Dislocations of the Spine. In: *Emergency Care and Transportation of the Sick and Injured*. Chicago, IL: American Academy of Orthopedic Surgeons, 1971, pp 111-115.
2. Bohlman HH. Acute fractures and dislocations of the cervical spine. *J Bone Joint Surg*. 1979;61-A:1114-9.
3. Fischer RP. Cervical radiographic evaluation of alert patients following blunt trauma. *Ann Emerg Med*. 1984;13:905-7.
4. Bachulis BL, Long WB, Hynes GD, et al. Clinical indications for cervical spine radiographs in the traumatized patient. *Am J Surg*. 1987;153:473-7.
5. Cadoux CG, White JD, Hedberg MC. High-yield roentgenographic criteria for cervical spine injuries. *Ann Emerg Med*. 1987;16:738-42.
6. McNamara RM, Heine E, Esposito B. Cervical spine injury and radiography in alert, high-risk patients. *J Emerg Med*. 1990;8:177-82.
7. Mower WR, Hoffman JR, Schriger DL. The feasibility of selective radiography in patients with trauma-induced neck pain. *Ann Emerg Med*. 1990;19:1220-1.
8. Ringenberg BJ, Fisher AK, Urdaneta LF, et al. Rational ordering of cervical spine radiographs following trauma. *Ann Emerg Med*. 1988;17:792-6.
9. Saddison D, Vanek VW, Racanelli JL. Clinical indications for cervical spine radiographs in alert trauma patients. *Am Surg*. 1991;57:366-9.
10. Samuels LE, Kerstein MD. "Routine" radiographic evaluation of the thoracolumbar spine in blunt trauma patients: a reappraisal. *J Trauma*. 1993;34:85-9.
11. Meldon SW, Moettus LN. Thoracolumbar spine fractures: clinical presentation and the effect of altered sensorium and major injury. *J Trauma*. 1995;39:1110-4.
12. Cooper C, Dunham CM, Rodriguez A. Falls and major injuries are risk for thoracolumbar fractures: cognitive impairment and multiple injuries impede the detection of back pain and tenderness. *J Trauma*. 1995;38:692-9.
13. Terregino CA, Ross SE, Lipinski MF, et al. Selective indications for thoracic and lumbar radiography in blunt trauma. *Ann Emerg Med*. 1995;26:126-9.
14. Frankel HL, Rozycki GS, Harviel JD. Indications for obtaining surveillance thoracic and lumbar spine radiographs. *J Trauma*. 1994;37:673-6.
15. Velmahos GC, Theodorou D, Tatevossian R, et al. Radiographic cervical spine evaluation in the alert asymptomatic blunt trauma victim: much ado about nothing? *J Trauma*. 1996;40:768-73.
16. Hoffman JR, Schriger DL, Mower W, et al. Low-risk criteria for cervical-spine radiography in blunt trauma: a prospective study. *Ann Emerg Med*. 1992;21:1454-60.
17. Jergens ME, Morgan MT, McElroy CE. Selective use of radiography of the skull and cervical spine. *West J Med*. 1977;127:1-4.
18. Roberge RJ, Wears RC, Kelly M, et al. Selective application of cervical spine radiography in alert victims of blunt trauma: a prospective study. *J Trauma*. 1988;28:784-8.
19. Neifeld GL, Keene JG, Hevesy G. Cervical injury in head trauma. *J Emerg Med*. 1988;6:203-7.
20. Kreipke DL, Gillespie KR, McCarthy MC, et al. Reliability of indications for cervical spine films in trauma patients. *J Trauma*. 1989;29:1438-9.
21. Ross SE, O'Malley KF, DeLong WG, et al. Clinical predictors of unstable cervical spine injury in multiply injured patients. *Injury*. 1992;23:317-9.
22. Roberge RJ, Wears RC. Evaluation of neck discomfort, neck tenderness, and neurologic deficits as indicators for radiography in blunt trauma victims. *J Emerg Med*. 1992;10:539-44.
23. Pennardt AM, Zehner WJ. Paramedic documentation of indicators for cervical spine injury. *Prehosp Disaster Med*. 1994;9:40-3.
24. Domeier RM, Evans RW, Swor RA, et al. Prehospital clinical findings associated with spinal injury. *Prehosp Emerg Care*. 1997;1:11-5.
25. Domeier RM, Evans RW, Swor RA, et al. Prospective validation of prehospital spinal clearance criteria. *Acad Emerg Med*. 1997;6:643-6.
26. Domeier RM, Evans RW, Swor RA, et al. Mechanism of injury is not a factor in prehospital clinical evaluation of potential spine injury [abstract]. *Prehosp Disaster Med*. 1996;11(suppl):114, S41.
27. Domeier RM, Swor RA, Evans RW, et al. Multicenter prospective validation of prehospital clinical spinal clearance criteria [abstract]. *Acad Emerg Med* 1997; 5:435.
28. Goth P. *Spinal Injury: Clinical Criteria for Assessment and Management*. Augusta, ME: Medical Care Development,

- 1995.
29. Washtenaw/Livingston County Medical Control Authority: Spinal Injury Assessment and Immobilization; EMS Protocols, Ann Arbor, MI, 1997.
  30. Bauer D, Kowalski R. Effect of spinal immobilization devices on pulmonary function in the healthy, nonsmoking man. *Ann Emerg Med.* 1988;17:915-8.
  31. Schafermeyer RW, Ribbeck BM, Gaskins J, et al. Respiratory effects of spinal immobilization in children. *Ann Emerg Med.* 1991;20:1017-9.
  32. Chan D, Goldberg R, Tascone A, et al. The effect of spinal immobilization on healthy volunteers. *Ann Emerg Med.* 1994;23:48-51.
  33. Cordell WH, Hollingsworth JC, Olinger ML, et al. Pain and tissue-interface pressures during spine-board immobilization. *Ann Emerg Med.* 1995;26:31-6.
  34. Maio RF, Wu A, Blow FC, Zink B. EMS providers do not accurately note motor vehicle crash victims with positive serum alcohol concentrations. *Prehosp Disaster Med.* 1995;10:110-2.
  35. Handley MN, Zabramski JM, Browner CM, et al: Pediatric spinal trauma. *J Neurosurg.* 1988;68:18-24.
  36. Stauffer ES, Mazur JM. Cervical spine injuries in children. *Pediatr Ann.* 1982;11:502-11.
  37. Shah MN, El-Shammaa E, Dietrich A, Smith G. Characterization of pediatric cervical spinal injuries [abstract]. *Prehosp Emerg Care.* 1999;3:92.