Clinical Clearance of the Cervical Spine in the Presence of a Distracting Injury

14

Caleb Van Essen, Edward Hagen, and Brian Williams

Introduction

Early identification and clearance of cervical spine injuries are essential in blunt trauma patients. The potential for devastating consequences from missed injuries must be balanced with the increased morbidity of prolonged and unnecessary cervical spine stabilization [1–4]. Thus, many trauma centers have screening protocols, which often include clinical examination and radiography.

Multiple studies have shown that clinical exam alone is safe to clear the cervical spine without radiography in patients who are awake, alert, lack neurologic deficits, have a negative clinical exam, and particularly lack distracting injuries (DI) [5]. However, many historic and commonly used screening guidelines (NEXUS and Canadian C-spine rules) consider a negative physical examination unreliable in patients with distracting injuries (DI) and require further radiographic imaging to rule out cervical spine injury [5–7]. As a result, liberal use of radiography has been used for screening cervical spine primarily with computed tomography (CT) due to cost, efficiency, and high sensitivity and specificity [8, 9]. Recent literature advocates for more judicious radiographic criteria in patients with DI, citing resource utilization concerns and new data showing improved safety. Patients with DI, create a dilemma for trauma surgeons when clearing the cervical spine. We aim to review the current evidence for recommendations when clearing the cervical spine in blunt trauma patients who are alert, awake, have no neurologic deficits but do have distracting injuries (Table 14.1).

C. Van Essen (✉) · E. Hagen
Swedish Medical Center, Seattle, WA, USA
e-mail: bwilliams3@surgery.bsd.uchicago.edu

B. Williams
The University of Chicago, Chicago, IL, USA

© Springer Nature Switzerland AG 2022

K. Wilson, S. O. Rogers (eds.), *Difficult Decisions in Trauma Surgery*, Difficult Decisions in Surgery: An Evidence-Based Approach,
https://doi.org/10.1007/978-3-030-81667-4_14

Table 14.1 PICO clinical question

PICO category	PICO Description
*P*opulation	Blunt trauma patients who are alert, awake, have no neurologic deficits but do have distracting injuries
*I*ntervention	Screening radiographic imaging of cervical spine
*C*omparison	No screening radiographic imaging of cervical spine
*O*utcome	Rate of missed cervical spine injury

Literature Review Process

A literature search of English language publications from 2001 to 2019 was used to identify published data on the clearance of the cervical spine in alert and awake, blunt trauma patients with distracting injuries (DI). Databases searched included: PubMed, Cochrane Evidence-Based Medicine, and guidelines from Eastern Association for the Surgery of Trauma (EAST), Western Trauma Association (WTA), and Advanced Trauma Life Support (ATLS). Terms used in the literature search were "cervical spine," "clearance of cervical spine," "clearing cervical spine," and "distracting injury," "missed cervical spine injuries".

Articles were excluded if they evaluated obtunded/non-examinable patients, if they did not include evaluation of distracting injuries, isolated injury considered to be a distracting injury, i.e., only femur fracture patients. One multi-institutional prospective cohort study, three single institutional prospective cohort studies, and one retrospective study were included in our analysis. The data was classified using the GRADE system. The articles included are listed in Table 14.2.

Summary of Evidence

There are few studies, with no randomized controlled trials, evaluating clearance of the cervical spine in blunt trauma patients with DI. The missed rate of cervical spine injuries in DI patients ranged from 0.2% to 13%. The most robust evaluation of cervical spine injury in presence of DI is by Khan et al., a prospective multi-institutional study, which assessed approximately 3000 examinable blunt trauma patients showing no difference in the rate of clinically missed cervical injuries with or without DI (10.4% vs. 12.6%) [10]. The calculated negative predictive value of clinical exam with and without DI 99% and 98%. The clinical significance of these missed injuries was also questioned as only one patient with a clinically missed injury (0.4%) required operative intervention.

A challenge in many studies is the varying definitions of DI, being very specific (i.e., long bone fractures) or very broad (i.e., clinically apparent pain that might distract the patient from the pain of a cervical spine injury) [11, 12]. Konstantinidis et al. had the most inclusive definition of distracting injury, which included any complaint of non-cervical spine pain. They showed in their evaluation of 88 patients with cervical spine injuries and DI after blunt trauma that only 4.5% had negative

Table 14.2 Literature review evaluating cervical spine injury in alert and awake blunt trauma patients with distracting injuries

First author, year, journal, ref	Study type (level of evidence)	Number of patients	DI patients' rate of missed cervical spine injury (neg clinical exam with + c-spine injury)	Non-DI patients' rate of missed cervical spine injury (neg clinical exam with + c-spine injury)	Sensitivity and NPV of clinical exam with DI NPV	Clinically significant injury: % missed injury patients w/DI requiring treatment intervention (#), type of intervention	Evaluation of C spine	GCS score	Definition of distracting injury
Khan, 2019, J Trauma ACS [10]	Prospective cohort, multi-institutional (moderate)	2929	10.4%	12.6%	90%, 99%	43% (7), 1 patient ORIF, 5 patients cervical collar/ CTO brace	CT (>32 slice)	>14	Skull fracture, >2 facial bone fractures, mandible fracture, intracranial hemorrhage (including subdural hematoma, epidural hematoma, subarachnoid hemorrhage, intraventricular hemorrhage, intraparenchymal hematoma), >2 rib fractures, clavicle fracture, sternal fracture, pelvic fracture, thoracolumbar spine fracture, intraabdominal injury (including solid organ injury, hollow viscus injury, or diaphragmatic injury), femur fracture, tibia/fibula fracture, humerus fracture, radius/ulna fracture, and hip or shoulder dislocation.

(continued)

Table 14.2 (continued)

First author, year, journal, ref	Study type (level of evidence)	Number of patients	DI patients' rate of missed cervical spine injury (neg clinical exam with + c-spine injury)	Non-DI patients' rate of missed cervical spine injury (neg clinical exam with + c-spine injury)	Sensitivity and NPV of clinical exam with DI NPV	Clinically significant injury: % missed injury patients w/DI requiring treatment intervention (#), type of intervention	Evaluation of C spine	GCS score	Definition of distracting injury
Rose, 2012, J Trauma ACS [17]	Prospective cohort single institution (moderate)	761	0.2%	1.7%	99%, 99%	100% (1), cervical collar	CT	>14	Categories: head, torso, long bone injury
Heffernan, 2005, J Trauma [14]	Prospective cohort, single institution (moderate)	406	2.9% (5% upper torso injury vs 0% lower torso injury)	NA	NA	Not defined	Not defined	Not defined, excluded if unable to comply with questions	AIS >2, Lower torso injuries: abdomen, pelvis, lower extremities or lumbar spine. Upper torso injuries: head, neck, face, upper extremity, chest, diaphragm, or thoracic spine
Drew, 2015, Mil Med [15]	Retrospective, dept. of defense trauma registry (low)	149	13%	NA	NA	Not defined	CT, +/− MR	>14	Categories: head, torso, or long bone/extremity injuries. Open wounds >5 cm, fractures, and other painful injuries
Konstantinidis, 2011, J Trauma [13]	Prospective cohort, single institution (low)	101	4.5%	NA	NA	50% (2), cervical collar	Not defined	>13	Any immediately evident bony or soft tissue injury or a complaint of non–c-spine pain whether or not an actual injury was subsequently diagnosed

clinical examination. As all these "potential missed injuries" were isolated to the upper torso, they concluded that a more narrowed definition was required for DI, limiting it to upper torso injuries/pain [13]. Similarly, Heffernan et al. aimed to delineate DI that had the greatest effect on clinical examination showing upper torso injuries having an associated miss rate of 5% with no effect from lower torso injuries [14]. Drew et al. retrospective study from military trauma had a 13% miss rate in the setting of DI; however, they also showed that 85% of these patients had DI that were in close proximity to the neck in the upper torso as compared to the lower torso 15%. Of note, they only examined patients with midline tenderness, without assessing the movement of the neck [15]. Dahlquist et al. showed similar sensitivity and negative predictive value to the original NEXUS study when they redefined the definition of distracting injury to exclude femur fractures. Of patients that only met NEXUS imaging criteria for femur fracture, only 2 (0.6%) patients had cervical spine injuries, for a sensitivity of 96% [16].

Rose et al. completed a 2-year prospective study on blunt trauma patients with broad inclusion criteria for distracting injuries. Their group only found 1 patient (0.2%) with a missed injury, who was subsequently treated with a cervical collar. In addition, 53% of these patients had more than one DI. They also address how clinical exam alone can have a significant financial benefit ($156,000/year decrease in total patient charges) and reduction in radiation exposure while maintaining a low miss rate [17].

Guidelines

The EAST guidelines, updated to 2009, give a level 2 recommendation requiring CT imaging to evaluate cervical spine injury in awake, alert patients without neurologic deficit who have no neck pain or tenderness with a full range of motion of the neck who also have distracting injuries. Distracting injuries were not defined in their recommendations [18].

The WEST guidelines, as seen in their most recent prospective multi-institutional study on spine clearance in 2016, require CT imaging if patients fail to meet NEXUS or Canadian C-spine criteria [19].

The ATLS guidelines from the tenth edition are consistent with NEXUS and Canadian C-spine rules with NEXUS criteria requiring imaging for patients with distracting injuries and Canadian C-spine rules do not specifically include DI in their screening algorithm but use mechanism of injury [20].

Recommendations

- Blunt trauma patients who are alert, awake, without neurologic deficits but do have distracting injuries require additional imaging to clear the cervical spine (Grade 1B, evidence quality moderate, recommendation strong).

- Omitting additional imaging to clear the cervical spine may be considered in patients with isolated lower torso distracting injuries (Grade 2B, evidence quality moderate, recommendation weak).
- Future studies are needed to more clearly define distracting injuries (Grade 1B, evidence quality moderate, recommendation strong).

Personal Perspective

The current level of evidence is not sufficient to change current recommendations on clearing the cervical spine in patients with distracting injuries, as the rate of missed cervical spine injuries ranged up to 13%. Thus, the financial burden and radiation exposure of a highly sensitive and specific cervical spine imaging (CT or MR) needs to be balanced with the morbidity of missed cervical spine injury. However, more evidence in recent years suggests that the probability of a clinically significant spinal column injury in this patient population is low, and that cervical spine collars can probably be safely removed.

References

1. Ackland HM, Cooper JD, Malham GM, Kossmann T. Factors predicting cervical collar-related decubitus ulceration in major trauma patients. Spine. 2007;32:423–8.
2. Chendrasekhar A, Moorman DW, Timberlake GA. An evaluation of the effects of semirigid cervical collars in patients with severe closed head injury. Am Surg. 1998;64:604–6.
3. Powers J, Daniels D, McGuire C, Hilbish C. The incidence of skin breakdown associated with the use of cervical collars. J Trauma Nurs. 2006;13:198–200.
4. Mobbs RJ, Stoodley MA, Fuller J. Effect of cervical hard collar on intracranial injury after head injury. ANZ J Surg. 2002;72:389–91.
5. Anderson PA, Muchow RD, Munoz A, Tontz WL, Resnick DK. Clearance of the asymptomatic cervical spine: a meta-analysis. J Orthop Trauma. 2010;24(2):100–6. https://doi.org/10.1097/BOT.0b013e3181b16494.
6. Hoffman JR, Schriger DL, Mower W, Luo JS, Zucker M. Low-risk criteria for cervical-spine radiography in blunt trauma: a prospective study. Ann Emerg Med. 1992;21:1454–60.
7. Stiell IG, Wells GA, Vandemheen K, et al. The Canadian C-spine rule for radiography in alert and stable trauma patients. JAMA. 2001;286:1841–8.
8. Brown CV, Antevil JL, Sise MJ, Sack DI. Spiral computed tomography for the initial evaluation of spine trauma: a new standard of care. J Trauma. 2006;61(12):382–7.
9. Duane TM, Young AJ, Vanguri P, Wolfe LG, Katzen J, Han J, Mayglothling J, Whelan JF, Aboutanos MB, Ivatury RR, et al. Defining the cervical spine clearance algorithm: a single-institution prospective study of more than 9, 000 patients. J Trauma Acute Care Surg. 2016;81(3):541–7.
10. Khan AD, et al. Clearing the cervical spine in patients with distracting injuries: an AAST multi-institutional trial. J Trauma Acute Care Surg. 2019;86(1):28–35. https://doi.org/10.1097/TA.0000000000002063.
11. Hoffman JR, Wolfson AB, Todd K, Mower WR. Selective cervical spine radiography in blunt trauma: methodology of the National Emergency X-Radiography Utilization Study (NEXUS). Ann Emerg Med. 1998;32(4):461–9.

12. Hoffman JR, Mower WR, Wolfson AB, Todd KH. Zucker. Validity of a set of clinical criteria to rule out injury to the cervical spine in patients with blunt trauma. National Emergency X-Radiography Utilization Study Group. N Engl J Med. 2000;343(2):94–9.
13. Konstantinidis A, Plurad D, Barmparas G, et al. The presence of nonthoracic distracting injuries does not affect the initial clinical examination of the cervical spine in evaluable blunt trauma patients: a prospective observational study. J Trauma. 2011;71(3):528–32.
14. Heffernan DS, Schermer CR, Lu SW. What defines a distracting injury in cervical spine assessment? J Trauma: Inj Infect Crit Care. 2005;59(6):1396–9.
15. Drew J, Chou VB, Miller C, Borg B, Ingalls N, Shackelford S. Clearing the cervical spine in a war zone: what other injuries matter? Mil Med. 2015;180(7):792–7.
16. Dahlquist RT, Fischer PE, Desai H, et al. Femur fractures should not be considered distracting injuries for cervical spine assessment. Am J Emerg Med. 2015;33(12):1750–4.
17. Rose MK, Rosal LM, Gonzalez RP, et al. Clinical clearance of the cervical spine in patients with distracting injuries: it is time to dispel the myth. J Trauma Acute Care Surg. 2012;73(2):498–502.
18. Como JJ, Diaz JJ, Dunham CM, et al. Practice management guidelines for identification of cervical spine injuries following trauma: update from the eastern association for the surgery of trauma practice management guidelines committee. J Trauma. 2009;67(3):651–9.
19. Inaba K, Byerly S, Bush LD, et al. Cervical spinal clearance: a prospective Western trauma association multi-institutional trial. J Trauma Acute Care Surg. 2016;81(6):1122–30.
20. Committee on Trauma. ATLS advanced trauma life support, 10th ed. Student Course Manual. 2018 Am College Surg.