Current Guidelines For Assessment Of Cervical Spine And Vertebral Artery Injuries In Adults Following Blunt Trauma

This issue of *EM Practice Guidelines Update* covers recommendations for the clinical and radiographic assessment of cervical spine and vertebral artery injuries in adults following blunt trauma. This updated guideline published by the American Association of Neurological Surgeons and the Congress of Neurological Surgeons (AANS/CNS) is relevant to emergency clinicians as it addresses a very common scenario seen in the emergency department (ED) - blunt cervical spine trauma - and strongly recommends computed tomography (CT) imaging (if available) over plain cervical spine radiographs for patients who cannot be clinically cleared. This is a revision of the AANS/CNS prior recommendations, and echoes the conclusions of other major guidelines on the topic.

Practice Guideline Impact

- In the awake, symptomatic patient or in the unevaluable patient, CT is recommended over plain radiographs of the cervical spine.
- CT angiography is recommended to assess for vertebral artery injury after blunt cervical trauma in patients meeting the modified Denver Screening criteria: lateralizing neurologic deficit (not explained by head CT), infarct on head CT scan, nonexpanding cervical hematoma, massive epistaxis, anisocoria/Horner syndrome, GCS score < 8 without significant CT findings, cervical spine fracture, basilar skull fracture, Le Fort II or III facial fractures, seatbelt sign above the clavicle, or cervical bruit/thrill.
Introduction To The Guidelines: Acute Cervical Spine Injury

This issue of *EM Practice Guidelines Update* reviews the AANS/CNS current guidelines for the evaluation and management of acute cervical spine and spinal cord injuries in adults following blunt trauma:


There is consensus among all major guidelines currently that CT scanning should be used instead of plain film radiography in patients with cervical spine trauma who need imaging (AANS, Eastern Association for the Surgery of Trauma [EAST], American College of Radiology). In 2009, the EAST guideline established this as a level 2 recommendation, based on numerous primary studies and a meta-analysis that showed a pooled sensitivity of plain films of 52% versus 98% for CT. The AANS/CNS has incorporated new evidence published since the EAST guideline and established the strength of the recommendation as a level 1. This could have a significant impact on emergency medicine practice, if clinicians have not already changed their practice in response to the guidelines.

Which imaging modality to use is not a new clinical question, and authors have long been predicting that CT scanning will become the standard of care. Nonetheless, in settings that see little serious trauma and have a patient population with low prevalence of clinically significant cervical spine injuries, CT scanning may seem like “overkill,” and emergency clinicians might have concerns about cost, radiation exposure, and/or delays in care related to CT scans. Emergency clinicians relying on plain films should make an informed decision about which test to order, with an awareness of these current recommendations and an understanding that obtaining technically optimal plain films is difficult, and inadequate images decrease sensitivity for fracture.

Given the cost and risks of CT imaging, it is worth reemphasizing the importance of using clinical clearance to avoid unnecessary imaging. In crafting their recommendations, the AANS/CNS guideline committee used elements of both the National Emergency X-Radiography Utilization Study (NEXUS) and the Canadian C-Spine Rule (CCR) rules in their recommendations, adding a functional range-of-motion examination to the other NEXUS criteria. This is based largely on a meta-analysis that looked at the CCR and NEXUS, as well as 9 institutional protocols for clinical clearance, and found that 24 of the 28 missed cervical spine fractures were in protocols that did not use a functional examination. The authors included absence of pain as one of their criteria for clinical clearance, although this was not a criterion of the NEXUS or CCR rules (or other institutional protocols included in the meta-analysis). It is not clear from the discussion why this decision was made, and imaging patients with pain and no other findings could significantly increase the use of radiographs in the ED without a clear benefit.

Finally, this issue reviews the recommendations for imaging to rule out vertebral artery injury, highlighting the clinical risk factors that should prompt concern for this diagnosis.

—Seth Gemme, MD; and Sigrid Hahn, MD, MPH
Expert Comment: Kaushal Shah, MD

Emergency clinicians should be utilizing not only the NEXUS and CCR clinical decision instruments for cervical spine clearance, but should also know the supporting literature. NEXUS enrolled 34,000 patients and the original CCR study enrolled almost 9000 patients. A subsequent study conducted by Stiell et al comparing the 2 instruments enrolled an additional 8000 patients. Combined, over 50,000 ED patients were evaluated with 1 of the instruments. The diagnostic tests that were predominantly utilized to evaluate the cervical spine were plain films. The verdict is that both instruments are extremely sensitive.

The 2 major neurosurgical societies, the AANS and CNS, developed clinical guideline recommendations for radiologic assessment of the cervical spine through a review of the latest literature. The committee was very deliberate and clear in the strength of evidence. However, the support for recommending imaging in any patient who presents with neck pain (whom they have deemed “symptomatic”) is lacking. It appears that they have not considered that all the minor motor vehicle collision patients and all the patients with muscle spasm or whiplash who present 6 to 24 hours after minor blunt trauma will now unnecessarily receive radiation to their necks (including the radiosensitive thyroid). The decision to image every patient with neck pain is not evidence-based. Emergency clinicians should not change their practice, but should continue to use the NEXUS or CCR criteria, including cervical spine tenderness and limited range of motion, to identify patients who need further radiographic evaluation.

The second notable recommendation of these guidelines is that all imaging should be with CT, rather than plain cervical spine films. The reason that neurosurgeons and trauma surgeons (refer to the EAST guidelines, available at http://www.east.org/resources/treatment-guidelines/cervical-spine-injuries-following-trauma) believe that cervical spine clearance should only be completed with CT imaging is likely because they have a huge spectrum bias. When emergency clinicians risk stratify patients with neck pain after blunt trauma, their low-risk group includes patients who walk in the next day after a "fender bender" and anxious patients whose neck pain resolves after the cervical collar is removed. These patients are never seen by surgeons. Due to the nature of their role in treating patients, surgeons do not have a low-risk group; they are only involved in the care of the trauma patient when the emergency clinician sends the patient for consultation, and this is only done for moderate- to high-risk patients. This is further evidenced by the fact that the incidence of significant cervical spine injury in the NEXUS and CCR studies was < 2%, as contrasted with the 5% to 10% in all the studies that compare CT imaging versus plain films that are performed on patients where the trauma team is involved. In fact, the cohort in most of these studies is trauma admissions, which, by definition, is the moderate- to high-risk group.

The evidence is clear (and well described in the present guideline) that CT imaging is of greater benefit than plain films for the detection of cervical spine injuries, and the risk of radiation is outweighed in moderate- to high-risk blunt trauma patients. Further, for patients who are obtunded and/or unevaluable, CT is the imaging of choice. Low-risk, awake, evaluable patients can continue to be evaluated by adequate plain films. Significant injuries are extremely unlikely to be missed. If an emergency clinician is concerned enough to consult a trauma surgeon or neurosurgeon, then CT imaging is likely warranted.

The management of symptomatic patients with negative imaging remains a nebulous area, as the evidence is weak. Appropriately, the recommendation from the neurosurgical societies is Level III, and they do allow for a breadth of options ranging from MRI to the discretion of treating physician. My recommendation for emergency clinicians is that very low-risk patients should be advised to take nonsteroidal anti-inflammatory medications. All others should be sent home in cervical immobilization with a cervical collar for close follow-up with a spine specialist (at which time, they will either find the patient to be asymptomatic and discontinue the immobilization, or further imaging can be obtained). Flexion/extension films are generally not reliable in the acute setting, as patients are required to reach full range of motion to get the films, but they are generally unable to accomplish this. MRI should be reserved for high-risk patients and admission to the trauma service.
Assessment Of The Guideline Methodology

The Joint Committee of the AANS/CNS authored these guidelines, and the complete methodology is presented in a stand-alone publication. They revised their previously used nomenclature for the strength of the recommendations (See Table 1), now using the categories of Level I, II, or III.

The author of this issue of EM Practice Guidelines Update, Seth Gemme, MD, and the Editor-in-Chief, Sigrid Hahn, MD, MPH, graded these guidelines using the Appraisal of Guidelines for Research and Education (AGREE) II instrument (available at http://www.agreetrust.org). This instrument is a checklist that allows users to grade a guideline on 23 items in 6 domains, reflecting the degree to which the guideline developers used unbiased, best-practice methodology in developing the guideline and writing the recommendations. The results of the AGREE instrument are presented in Figure 1, with a percentile calculated for each domain (maximum of 100%). The score for relevance to emergency medicine is not part of the AGREE instrument, but reflects the judgment of the author and editor of this issue.

—Seth Gemme, MD; and Sigrid Hahn, MD, MPH

Table 1. American Association Of Neurological Surgeons and Congress Of Neurological Surgeons Level Of Evidence And Strength Of Recommendation Definitions

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<th>Strength Of Recommendations</th>
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<td>Level I: Standard: reflection of a high degree of clinical certainty</td>
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<td>Level II: Guideline: reflection of a moderate degree of clinical certainty</td>
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<td>Level III: Option: reflection of unclear clinical certainty</td>
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<th>Classes Of Evidence</th>
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<tr>
<td>Class I: High-quality randomized controlled trials (RCTs), systematic review of high-quality RCTs</td>
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<tr>
<td>Class II: Lower-quality RCTs, prospective comparative study, systematic review of lower-quality RCTs, or high-quality RCTs with inconsistent results</td>
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<td>Class III: Case series, expert opinion</td>
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Figure 1. AGREE Criteria For Acute Cervical Spine Injury Guidelines

Abbreviation: AGREE, Appraisal of Guidelines for Research and Education.
Selected Guideline Recommendations, With Discussion

The recommendations excerpted here are presented as they appear in the original guidelines, including the strength of recommendation. This review does not include all recommendations provided in the original documents published by the AANS/CNS. Instead, it includes those recommendations most relevant to emergency medicine practice.

Radiographic Assessment Of The Awake, Asymptomatic Patient
- In the awake, asymptomatic patient who is without neck pain or tenderness, who has a normal neurological examination, is without an injury distracting from an accurate evaluation, and who is able to complete a functional range of motion examination, radiographic evaluation of the cervical spine is not recommended. (Level I)
- Discontinuance of cervical immobilization for these patients is recommended without cervical spinal imaging. (Level I)

Editorial Comment: Seth Gemme, MD; and Sigrid Hahn, MD, MPH
This recommendation describes the asymptomatic patients who should not undergo imaging, defining the AANS/CNS’ approach to clinical clearance. Most emergency clinicians use the NEXUS or CCR criteria for clearing cervical spines. In this level I recommendation, absence of subjective neck pain is included in the criteria for clinical clearance. This is not part of the NEXUS or CCR clinical decision rules, and using the recommendation in isolation without clinical judgment would likely lead to more imaging of whiplashed and other low-risk patients with pain. A more useful aspect of this recommendation is to test functional range of motion, which is part of the CCR, but not the NEXUS decision rule, as this step should optimize the sensitivity of the NEXUS rule.
Radiographic Assessment Of The Awake, Symptomatic Patient

- In the awake, symptomatic patient, high-quality CT imaging of the cervical spine is recommended. (Level I)
- If high-quality CT imaging is available, routine 3-view cervical spine radiographs are not recommended. (Level I)
- If high-quality CT imaging is not available, a 3-view cervical spine series (anteroposterior, lateral, and odontoid views) is recommended. This should be supplemented with CT (when it becomes available), if necessary, to further define areas that are suspicious or not well visualized on the plain cervical x-rays. (Level I)
- In the awake patient with neck pain or tenderness and normal high-quality CT imaging or normal 3-view cervical spine series (with supplemental CT if indicated), the following recommendations should be considered (Level III):
  1. Continue cervical immobilization until asymptomatic.
  2. Discontinue cervical immobilization following normal and adequate dynamic flexion/extension radiographs.
  3. Discontinue cervical immobilization following a normal magnetic resonance imaging (MRI) obtained within 48 hours of injury.
  4. Discontinue cervical immobilization at the discretion of the treating physician.

Editorial Comment: Seth Gemme, MD; and Sigrid Hahn, MD, MPH

The 2002 AANS/CNS guidelines for imaging of the cervical spine included a Level I recommendation for a 3-view cervical spine series with supplementation by CT for areas that were suspicious or not well visualized on the plain film. Since then, there have been multiple Class I studies and a meta-analysis to support CT as the primary test to detect cervical injuries. In fact, the combined studies since 2002 showed a sensitivity of plain films and CT to be 53% and 98%, respectively.\textsuperscript{1,3,10,11} In 2009, the EAST also recommended CT scanning as the test of choice. In addition to improved injury detection, a recent study found that evaluating cervical spine injuries initially with CT scanning instead of plain films was more cost-effective, required less testing, and shortened the overall time for evaluation of the blunt cervical trauma patient. This guideline does give an option to obtain plain films if there is no CT scanner available, with a follow-up CT scan “when available” for inadequate views. This might be applicable in a low-acuity center (such as an urgent care center) that sees low-risk trauma.

Many emergency clinicians may be comfortable using plain films in the very low-acuity “fender bender” patients; however, given both the Level I recommendation to utilize CT scan and the Level I recommendation not to obtain plain films, this may lead to a change in practice because of desire to adhere to guidelines and concern about liability.

Regarding symptomatic patients (with neck pain or tenderness) who have negative imaging and a normal neurologic examination, there is no Class I evidence regarding the next step, and the available Class II and III evidence is conflicting. Studies have looked at MRI’s ability to detect additional injury and have found minimal benefit. A study comparing MRI to flexion/extension plain films ultimately concluded that MRI should be used in patients with suspected ligamentous injury, but also stated that dynamic imaging is often not complete, and MRIs may have a high incidence of false-positive imaging.\textsuperscript{12} Importantly, the guideline allows flexibility on how to manage these patients, including the option to discontinue immobilization without further imaging.
Radiographic Assessment Of The Obtunded Or Unevaluable Patient

- In the obtunded or unevaluable patient, high-quality CT imaging is recommended as the initial imaging modality of choice. If CT imaging is available, routine 3-view cervical spine radiographs are not recommended. (Level I)
- If high-quality CT imaging is not available, a 3-view cervical spine series (anteroposterior, lateral, and odontoid views) is recommended. This should be supplemented with CT (when it becomes available), if necessary, to further define areas that are suspicious or not well visualized on the plain cervical x-rays. (Level I)
- In patients in whom there is a high clinical suspicion of injury, yet have a normal high-quality CT imaging study, it is recommended that the decisions for further patient management involve physicians trained in the diagnosis and management of spinal injuries. (Level II)
- In the obtunded or unevaluable patient with a normal high-quality CT or normal 3-view cervical spine series, the following recommendations should be considered (Level III):
  1. Continue cervical immobilization until asymptomatic.
  2. Discontinue cervical immobilization following a normal MRI study obtained within 48 hours of injury.
  3. Discontinue cervical immobilization at the discretion of the treating physician.
- In the obtunded or unevaluable patient with a normal high-quality CT, the routine use of dynamic imaging appears to be of marginal benefit and is not recommended. (Level III)

Editorial Comment: Seth Gemme, MD; and Sigrid Hahn, MD, MPH

In the previous 2002 AANS/CNS guidelines, there was only Class III evidence for the management of obtunded or unevaluable patients. Similar to awake, symptomatic patients, CT scanning has been shown in several Class I studies conducted since 2002 to have higher sensitivity compared to plain films.

Dynamic radiographs using flexion/extension views in the workup of the obtunded or unevaluable patient is not recommended. The conclusion of several studies is that dynamic radiographs in this patient population fail to add additional information over CT scan. Also, radiographs are often inadequate in visualizing the entire cervical spine.

The most controversial topic with regard to the obtunded or unevaluable patient is clearance of cervical spine. This guideline allows 3 options for the patient with a normal CT scan, but these Level III recommendations are based on Class II or III evidence. As the obtunded or unevaluable patient will not be discharged in that state from the ED, further workup can be determined through interdisciplinary cooperation between the emergency clinician and admitting trauma or neurosurgery services.
The discussion focused on the accuracy of various imaging techniques rather than on the performance of the modified Denver Screening Criteria. Since the 2002 AANS/CNS guidelines, there has been a substantial body of literature supporting the use of CTA in the diagnosis of VAI. The modified Denver Screening Criteria has been the most recently and frequently studied screening method. These criteria are: lateralizing neurological deficit (not explained by head CT), infarct on head CT scan, nonexpanding cervical hematoma, massive epistaxis, anisocoria/Horner syndrome, GCS score < 8 without significant CT findings, cervical spine fracture, basilar skull fracture, Le Fort II or III facial fractures, seatbelt sign above the clavicle, or cervical bruit/thrill. In a 2006 Class I study by Eastman et al, CTA was nearly 100% accurate in patients who met the modified Denver Screening Criteria. Several studies since then have found CTA to be accurate and adequate to diagnose VAI. Catheter angiography is the gold standard for diagnosis of VAI, but it is invasive and time-consuming and, therefore, more difficult to obtain in most EDs. Given the availability of CTA in most EDs and based on the recent evidence, it should be the test of choice to diagnose VAI.
References


CME Questions

1. According to the guideline, which of the following patient scenarios would require a CTA to evaluate for vertebral artery injury?
   a. A patient with an isolated facial fracture through the maxillary alveolar rim extending into the pterygoid plates
   b. A patient with signs of head trauma and a normal CT scan who is withdrawing to pain and opening eyes to pain, but is not saying any words
   c. A patient with a lower abdominal transverse ecchymotic lesion
   d. A patient with a normal cervical spine CT scan but continued complaints of pain in the lateral neck with movement

2. A 23-year-old awake woman presents to an urgent care center with neck pain after being rear-ended in a low-speed motor vehicle collision in which she was the restrained passenger. Three-view cervical spine plain radiographs do not show any injury, but she continues to complain of tenderness to palpation over C5. A cervical collar is left in place. According to the guideline, what would be the most appropriate management?
   a. Discontinue the cervical collar at the discretion of the treating physician.
   b. Obtain flexion-extension views.
   c. Refer the patient for a CT scan of her cervical spine.
   d. Refer the patient for spine consultation.

3. According to the guideline, the first step in the evaluation of a low-risk patient with neck pain and tenderness is:
   a. High-quality 3-view plain films
   b. CT scan
   c. MRI, if available
   d. High-quality 3-view plain films plus dynamic flexion-extension views

4. According to the guideline, in the unevaluable patient with a normal CT scan, the next step is to:
   a. Continue cervical immobilization until asymptomatic
   b. Discontinue cervical immobilization following a normal MRI study obtained within 48 hours of injury
   c. Discontinue cervical immobilization at the discretion of the treating physician.
   d. Any of the above
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</tr>
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