Updated Guidelines For Management Of Acute Cervical Spine And Spinal Cord Injury In Pediatric Patients

This issue of *EM Practice Guidelines Update* reviews current guidelines from the American Association of Neurological Surgeons and the Congress of Neurological Surgeons (AANS/CNS) on the radiographic evaluation and management of pediatric cervical spine and spinal cord injuries. Pediatric trauma is a common complaint managed in the emergency department (ED), but serious pediatric cervical spine trauma and spinal cord injuries are very uncommon. The recommendations in this guideline most relevant to the emergency clinician outline the clinical criteria to determine which pediatric trauma patients do not need cervical spine imaging.

**Practice Guideline Impact**

- **Children aged ≥ 3 years do not require cervical spine imaging in the setting of trauma if they are alert and without midline cervical tenderness, neurological deficits, painful distracting injuries, unexplained hypotension, and intoxication.**
- **Children aged < 3 years do not require cervical spine imaging in the setting of trauma if the Glasgow Coma Scale (GCS) score is > 13, there is no midline cervical tenderness, neurological deficits, painful distracting injuries, intoxication, or unexplained hypotension, and the mechanism of injury does not include a motor vehicle collision (MVC), suspected nonaccidental trauma, or a fall from a height > 10 feet.**
- **Cervical spine radiographs or computed tomography (CT) is recommended for children who have experienced trauma and who do not meet the criteria for clinical clearance.**
- **Magnetic resonance imaging (MRI) of the region of suspected neurological injury is recommended in a patient with spinal cord injury without radiographic abnormality (SCIWORA).**
Introduction To The Guidelines: Pediatric Cervical Spine And Spinal Cord Injuries

This issue of EM Practice Guidelines Update reviews 2 guidelines on pediatric cervical spine and spinal cord injuries from the 2013 series of AANS/CNS guidelines on spine and spinal cord injury:


Assessment of cervical spine, spinal cord, and vertebral artery injuries in adults was covered in the previous issue of EM Practice Guidelines Update, available at: www.ebmedicine.net/AdultCervicalSpineGuidelines.

Even though cervical spine injury is uncommon in the pediatric population, if it is not diagnosed and managed appropriately after arrival in the ED, there is a high risk of morbidity and mortality.1-4 Because children have specific anatomic and developmental features, their cervical spine injury patterns differ from adults. In children aged < 8 years, the head is large relative to the body, creating a higher center of gravity and acting as a pivot for neck motion during blunt trauma, leading to a propensity for upper cervical spine injuries.1,5 Blunt trauma (such as occurring in MVCs, a fall from a height > 10 feet, or nonaccidental trauma) in children aged < 2 years are risk factors for atlanto-occipital dislocation (AOD), which can be neurologically devastating or fatal.1-2 Atlantoaxial rotary subluxation or fixation (AARF) is another condition that is much more common in children, and may present following minor trauma, in association with an upper respiratory infection, or without an identifiable inciting event. By the age of 8 years, the vertebral ossification centers fuse and the center of gravity moves inferiorly.1,3 These and other anatomic changes around that age lead to this subset of children frequently sustaining subaxial injuries as a consequence of MVCs, sports or diving trauma, or falls from a height > 10 feet.1,3

The most relevant recommendations for the emergency clinician in the guidelines address determining which patients with a possible cervical spine injury need imaging. Compared to studies on the adult population, there is less high-quality literature to guide decision making for imaging in the pediatric population. Nonetheless, in the 12 years since the last guideline was released, there have been multiple level II and III studies evaluating clinical decision-making rules for cervical spine imaging in children sustaining blunt trauma. These studies support the conclusion that clinical clearance rules are highly sensitive, but that different criteria for imaging should be used in children aged < 3 years versus children aged > 3 years.5 Interestingly, although the AANS/CNS guidelines favor CT imaging for adults, plain films are still considered an equally acceptable alternative for children, except for those with suspected AOD or AARF. ■

—Michelle Vazquez, MD
Assessment Of The Guideline Methodology

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 strength of the recommendations (see Table 1), now using the categories of Level I, II, or III. The author and editor of this issue of EM Practice Guidelines Update, Michelle Vazquez, MD, and Sigrid Hahn, MD, 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 authors and editor of this issue.

Table 1. Definition Of Level Of Evidence And Strength Of Recommendation Used In The American Association Of Neurological Surgeons And The Congress Of Neurological Surgeons Guidelines

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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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Abbreviation: AGREE, Appraisal of Guidelines for Research and Education.

Figure 1. AGREE Criteria For Pediatric Cervical Spine And Spinal Cord Injury

Abbreviation: RCT, randomized controlled trial.
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.

Determining Patients Who Can Be Cleared Without Imaging

- Cervical spine imaging is not recommended in children who are > 3 years of age and who have experienced trauma and who:
  - are alert,
  - have no neurological deficit,
  - have no midline cervical tenderness,
  - have no painful distracting injury,
  - do not have unexplained hypotension,
  - and are not intoxicated.
  (Level II)

- Cervical spine imaging is not recommended in children who are < 3 years of age who have experienced trauma and who:
  - have a GCS score > 13,
  - have no neurological deficit,
  - have no midline cervical tenderness,
  - have no painful distracting injury,
  - are not intoxicated,
  - do not have unexplained hypotension,
  - and do not have an MVC, a fall from a height > 10 feet, or non-accidental trauma (NAT) as a known or suspected mechanism of injury.
  (Level II)

Editorial Comment: Michelle Vazquez, MD

The guideline authors endorse using the National Emergency X-Radiography Utilization Study (NEXUS) criteria for the clinical clearance of children aged > 3 years in the setting of blunt trauma. They add unexplained hypotension as a criterion, as this can be caused by severe cervical spinal cord injury. They based their recommendation on 2 prospective studies that showed no missed injuries in over 800 patients fulfilling these low-risk criteria.

It is unlikely that an emergency clinician will encounter a child aged < 3 years with a cervical spine injury, as rates of injury are very low in this group. There were several studies looking specifically at imaging criteria in this age group, but several were limited by the low incidence of injuries in the very young. A review of > 10,000 patients found 4 independent risk factors for cervical spine injury: GCS score < 14, GCS eye opening = 1, MVC, and age 2 to 3 years. Another study found that in 905 infants with low-impact head trauma, only 2 cervical spine injuries were sustained, both due to nonaccidental trauma, which accounts for the addition of this criterion to the recommendation.

Evaluation Of Potential Atlanto-Occipital Dislocation

- CT imaging to determine the condyle-C1 interval (CCI) for pediatric patients with potential AOD is recommended. (Level I)

Editorial Comment: Michelle Vazquez, MD

This is the only level I recommendation in this guideline. As described previously, risk factors for AOD are high velocity MVC, fall from a height > 10 feet, and nonaccidental injury in children aged < 2 years.
Imaging For Atlantoaxial Rotatory Fixation

• Three-position CT with C1-C2 motion analysis to confirm and classify the diagnosis is recommended for children suspected of having atlantoaxial rotatory fixation (AARF). (Level II)

Editorial Comment: Michelle Vazquez, MD

AARF may be due to minor trauma or may even be spontaneous. It should be suspected clinically when the child’s head is rotated to one side and tilted to the other, and the child is unable turn the head past midline. Importantly, the longer AARF is present before diagnosis and treatment, the less likely it is that reduction will be successful. Plain films can identify the condition, but if it is suspected on clinical and/or radiographic grounds after an x-ray, CT is the study of choice.

Recommended Immobilization Position

• Thoracic elevation or an occipital recess is recommended in children < 8 years of age to prevent flexion of the head and neck when restrained supine on an otherwise flat backboard for better neutral alignment and immobilization of the cervical spine. (Level III)

Editorial Comment: Michelle Vazquez, MD

Because of their relatively large heads, children require different immobilization positions than adults to maintain cervical spine neutrality, and the authors of the guidelines note that no cervical collar provides acceptable immobilization for children. They comment that the type of immobilization utilized should take into account the child’s physical age and maturity, and that some types of “ideal” mobilization techniques (including taping of the torso) have the unintended consequence of reducing respiratory function.

Spinal Cord Injury Without Radiographic Abnormality

• Magnetic resonance imaging of the region of suspected neurological injury is recommended in a patient with spinal cord injury without radiographic abnormality (SCIWORA).
• Radiographic screening of the entire spinal column is recommended.
• Assessment of spinal stability in a SCIWORA patient is recommended with flexion-extension radiographs in the acute setting and at late follow-up, even in the presence of magnetic resonance imaging negative for extraneural injury. (Level III)

Editorial Comment: Michelle Vazquez, MD

SCIWORA is another phenomenon seen predominantly in the pediatric population. It is defined as objective signs of myelopathy without plain film or CT abnormalities. When MRIs are performed on these patients, findings range from normal to complete cord disruption. The prognosis may reflect the severity of the initial deficits and/or the severity of findings on MRI. Children who have transient or subjective findings should be treated with concern, as objective deficits may have a delayed onset and are often made known by these transient or subjective complaints. The emergency clinician should obtain an MRI and full radiographic screening of the entire spinal column in these patients.
References


CME Questions

To take the CME test, visit: www.ebmedicine.net/G0914 or scan the QR code below with a smartphone:

1. According to the guideline, which patient does not need cervical spine imaging?
   a. A 9-month-old girl with suspicion for nonaccidental trauma
   b. A 4-year-old boy who fell off his bike when riding in the park with no loss of consciousness, cervical spine tenderness, or neurological deficit
   c. A 15-year-old boy who collided with another player during a basketball game and sustained an open femur fracture
   d. A 16-year-old inebriated adolescent girl brought in by emergency medical services with signs of head trauma

2. According to the guideline, what is a potential method to prevent head and neck flexion in children aged < 4 years during prehospital immobilization?
   a. Place patients on a half-spine board with a rigid collar and tape across torso.
   b. Elevate the head by shoulder with arms placed immediately adjacent to neck.
   c. Place children in a soft collar with a half-spine board.
   d. Elevate the torso relative to the head with a thoracic pad or other device.

3. A 7-year-old boy is brought into the ED after a minor scuffle with his sibling, holding his head in a “cock robin” position, with the head rotated to the right and tilted to the left. What is the imaging test of choice for the suspected condition?
   a. 2-view plain films
   b. 3-view plain films
   c. CT scan
   d. MRI

4. Which of the following patients meet the definition of SCIWORA?
   a. A 10-year-old with a normal neurologic examination and an AARF on CT
   b. An 8-year-old with tingling in the bilateral upper extremities but no motor or sensory deficit
   c. A 9-year-old with weakness of the bilateral lower extremities and a normal spine CT
   d. A 7-year-old with evidence of ligamentous laxity on dynamic plain films with a normal neurologic examination
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Goals: Upon completion of this article, you should be able to: (1) demonstrate medical decision-making
based on the strongest clinical evidence, (2) cost-effectively diagnose and treat the most critical ED presenta-
tions, and (3) describe the most common medicolegal pitfalls for each topic covered.

Objectives: Upon completion of this article, you should be able to: (1) explain that suspected atlanto-occipital
dislocation and atlantoaxial rotational fixation (AARF) are best diagnosed in the pediatric population using
computed tomography rather than x-ray; (2) differentiate the recommendations for imaging of the cervical
spine in children aged < 3 years and children aged ≥ 3 years; (3) describe the ideal immobilization position
for children aged < 8 years with potential cervical spine trauma, and (4) assess the workup of spinal cord injury
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