Challenges and Progress in Identifying Cervical Spine Injuries in Children

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Over 8 million children are treated in the emergency department for traumatic injuries annually, many of whom undergo cervical spine evaluation. However, clinically significant cervical spine injury (CSI) is rare in children, occurring in only 1% to 2% of children undergoing cervical spine radiography after blunt trauma. Although most children with CSI have readily apparent signs or symptoms of injury, the risks of missing CSI can be grave, leaving clinicians with a quandary as to how to evaluate the unlikely possibility of CSI in the vast majority of injured children. Despite the infrequency of CSI among children without suggestive symptoms or signs, many clinicians have a low threshold for obtaining imaging studies to avoid the potentially serious and costly consequences of missing a CSI. However, the liberal use of imaging must be balanced against considerations of use, radiation exposure, and cost. Unfortunately, limited data exist to inform clinical decision-making regarding the need for diagnostic imaging for the evaluation of CSI in children. Most of the literature in this area has been retrospective in nature, and the most frequently cited prospective study is limited because of the low prevalence of CSI, especially in the youngest children.

In this issue of Pediatrics, investigators assess the performance characteristics of retrospectively identified CSI risk factors in a prospective cohort of children and compare them to a de novo risk model. In a sample of 4091 children <18 years presenting to the emergency department after blunt trauma, 74 had a CSI (1.8%); 14 factors were identified in association with the presence of CSI. In the models, sensitivities of 90% to 92% were demonstrated for the identification of CSI, with lower confidence intervals of 84% and 86%, respectively.

Before this analysis, the National Emergency X-Ray Utilization Study (NEXUS) was the largest prospective study of CSI that included children. Although the NEXUS enrolled predominantly adults, among the 3065 individuals <18 years of age CSI was rare, occurring in 30 children (1%). The NEXUS classified patients as low risk of CSI if none of the following criteria were present: midline cervical tenderness, altered level of alertness, evidence of intoxication, neurologic abnormality, and presence of distracting injury. The sensitivity of the NEXUS rule was 100%; however, the lower confidence bound was 87%, which may be too low to rely on in clinical practice. Additionally, only 29% of children were <9 years of age, and only 3% were <2 years. In these young children, intoxication is rarely a consideration, and the limited ability to communicate makes the assessment of many of the NEXUS criteria less reliable.

In the current study by Leonard et al, researchers sought to identify specific factors associated with CSI in children. Compared with the NEXUS, this pediatric-focused study included a much higher proportion of young children; nearly 40% were <8 years of age, and 1.4% had a CSI. It remains
unclear whether predictors included in the NEXUS would translate to this younger population of children. Thus, although the sensitivities of these reported models are lower than the NEXUS for the identification of CSI in children, the specificity was markedly higher (46%-50%). This is of particular importance given the potential implications of classifying a child not to be at low risk of CSI, including the long-term risk of exposure to ionizing radiation. If validated, these findings have the potential to spare imaging in over one-third of children.

The findings of this current study must be placed in the context of the limitations, many of which are inherent to the rare nature of CSI in children. Even with the largest sample of children undergoing evaluation for CSI, the authors acknowledge that this study is underpowered to provide narrow confidence intervals sufficient to support translation of a rule to routine clinical practice. Nor is the combination of identified risk factors adequately sensitive to develop a rule; most clinicians would be hesitant to employ a rule that does not approach 100% sensitivity, given the potential morbidity associated with missed CSI. However, the derivation of such a high-performing rule may be particularly difficult in the youngest children, in whom CSI is both rare and difficult to diagnose. Finally, the sheer number of risk factors identified in this study might be prohibitive in terms of implementation of a decision rule.

What is clear is that decision rules derived mainly in adult populations require scrutiny before implementation in pediatric populations. The complex and varying nature of CSI in children, the result of differences in the intrinsic biomechanics of the pediatric cervical spine, mechanism of injury, and variable presentations between younger and older children pose challenges for the development of a universal, simple, and highly sensitive clinical prediction rule. We are optimistic this study will provide the necessary conceptual foundation for the multicenter trial to determine the need for diagnostic imaging for the evaluation of CSI in children.

**ABBREVIATIONS**

CSI: cervical spine injury

NEXUS: National Emergency X-Ray Utilization Study

**REFERENCES**


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