Cervical clearance

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A cervical spine clearance after trauma is defined as accurately confirming the absence of a significant cervical spine injury. Although such injuries occur in only 2%—6% of blunt trauma victims, the assessment and clearance of the cervical spine is a priority in the management of these patients due to the potential for significant neurological injury. The National Emergency X-Radiography Utilization Study (NEXUS) criteria have been accepted as a standard for cervical spine clearance in the awake, cooperative patient with 99.9% sensitivity for detection of significant cervical injuries.12

Definitive assessment of the cervical spine in obtunded trauma patients is more difficult. Multidetector CT has become the imaging modality of choice for evaluation of cervical spine trauma, but the need for adjunctive studies following a negative CT scan in cognitively impaired patients, due to concern that an important soft tissue injury may be missed, has been a topic of debate. Usually important ligamentous or discal injuries are associated with neurological deficits, but there are exceptions. An acute rupture of the transverse atlantal ligament produces significant instability despite no neurological deficits and normal alignment while the patient is supine in a CT scanner. The obtunded patient may have a mild to moderate central cord syndrome that may be difficult to discern in the setting of a concomitant supratentorial injury. The management options for the obtunded trauma patient with a negative CT scan include collar removal without additional imaging, collar removal after negative dynamic fluoroscopy, collar removal after negative MR imaging, and rigid orthotic immobilization until the patient is competent and reliable enough to obtain a negative clinical examination of his or her cervical spine.

The efficacy of dynamic fluoroscopy is limited due to the need for repeat examinations, the difficulty in identifying specific ligamentous injuries, and inadequate visualization of the lower cervical spine.2,6,21 Even in awake and cooperative blunt trauma patients the probability of obtaining adequate flexion-extension radiographs is just over 30%.14 The limitations are so significant that the 2009 Eastern Association for the Surgery of Trauma (EAST) guidelines recommended that dynamic fluoroscopy should no longer be an option for cervical spine clearance in the obtunded patient.4

Immobilization in a rigid cervical collar in this patient population for more than 48–72 hrs has been associated with an increased incidence of pressure sores, intracranial hypertension (in the setting of a simultaneous head injury), airway management challenges, compromised central venous access, infection due to suboptimal venous catheter site care, and difficult oral hygiene.13,19,24 Although important, the morbidity associated with these potential orthosis-related complications is almost never as significant as a permanent cervical spinal cord injury. Nonetheless, it is unreasonable to immobilize the cervical spine indefinitely while waiting for cognitive function to improve.

The limitations of dynamic fluoroscopy and prolonged immobilization have led to a number of studies attempting to assess the utility of MR imaging of cognitively dysfunctional trauma patients with a negative cervical CT scan. Magnetic resonance imaging is expensive, requires patient transport, has a relatively long study time, and is so sensitive that it can detect subtle nonstabilizing injuries. Muchow et al.20 first used the technique of meta-analysis to determine the efficacy of MR imaging in the management of these patients, and in the following communication, Panczykowski et al.25 present their meta-analysis of the literature comparing CT technology with plain radiography, dynamic fluoroscopy, or MR imaging in obtunded blunt trauma patients. Panczykowski et al. report that 17 studies totaling 14,327 patients met their study inclusion criteria and overall sensitivity and specificity for CT were both > 99.9% (95% CI 0.99–1.00 and 0.99–1.00, respectively). Interestingly, the authors report that global severity of injury, CT slice thickness, and study quality did not significantly affect accuracy estimates.

Although CT is an excellent imaging modality, the data as presented in this study do not support the authors’ emphatic declaration that a cervical CT scan alone is sufficient to detect unstable cervical spine injuries and that a cervical collar may be removed from obtunded or intubated trauma patients without need of any MR imaging, provided a radiology report shows the CT scan is negative for acute injury.

It is important to carefully examine the data the authors chose to include in their meta-analysis. Five of the studies compared CT to plain radiography and concluded that CT was more sensitive in terms of detecting injury.3,8,10,11,16 The data provided by these studies do not address the adequacy of CT to detect all significant traumatic lesions but merely support its role as superior to the most basic imaging technique. Furthermore, Diaz et al.8 concluded that CT is not an effective modality for screening for ligamentous injury and MR imaging is a better modality for this purpose. None of these works address the need or lack thereof for additional testing following
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a normal CT scan in obtunded trauma patients. Schenarts et al. performed CT scans of just the upper cervical spine (occiput to C-3) and MR images were only obtained in patients with neck tenderness. Despite these major limitations, 3 patients were found to have significant injuries despite a normal CT. Schenarts et al. only concluded that CT was superior to plain radiography for the detection of upper cervical spinal injuries. Spiteri et al. used dynamic radiographs to evaluate patients following CT. Despite the previously mentioned problems with this technique, of 434 patients were found to have instability despite the original CT scan reading of normal. One patient had atlantooccipital dislocation and the other atlantoaxial ligamentous instability. It is difficult to understand why the authors failed to count these injuries in Table 3.

The most appropriate data come from those reports detailing the use of both CT and MR imaging. Almost all of these studies are compromised by either their retrospective design, failure to obtain an MR image in all patients, or lack of follow-up. Como et al. of 85 normal CT scans, 1 patient had extensive ligamentous injuries requiring treatment with “an extended course of cervical immobilization.” Only 29 patients in this study were obtunded and it is not clear whether the false negative CT scan was among that group. Steigelman et al. found that 5% of obtunded trauma patients had findings consistent with acute injuries on MR imaging that were not observed on CT. Two of these patients required prolonged immobilization with an orthosis. Kihiczak et al. only treated 19 obtunded patients and, similar to the work of Adams et al., this paper met the entrance criteria as listed by the authors but fell well short of the mark if one considers only obtunded patients. In the obtunded subgroup 10% of the patients with normal CT scans had abnormal MR images, and while these patients did not undergo surgery, it is not known whether they were treated with immobilization. Tomycz et al. reported that acute traumatic findings were detected by MR imaging in 21% of 180 obtunded patients with normal CT scans. Although none of these patients required acute surgery for instability, all with ligamentous injury per MR imaging were treated with a rigid cervical orthosis. Menaker et al. reported that 8.9% of obtunded trauma patients with a negative CT scan had an abnormal MR image. Two of these patients required surgery and 14 were treated with extended immobilization, leading these investigators to conclude that MR imaging was still a necessary part of the evaluation of this patient population.

In an article not included in this meta-analysis, Stassen et al. reviewed all obtunded adult trauma patients treated at their institution over a 1-year period (52 total) who were evaluated with both a CT scan (CTI Helical scanner, GE Medical Systems) and MR imaging and found that 30% of those with a negative CT scan (slice thickness 3 x 1.5 mm helical, 1:1 pitch from the skull base to the top of T-1 with sagittal reconstructions) had an MR image that demonstrated a ligamentous injury requiring treatment. The authors of the current meta-analysis reported in a prior publication that they detected acute ligamentous injuries in 8.9% of obtunded trauma patients with a normal CT scan and within the discussion in that paper they attributed the discrepancy between their findings and those of Stassen et al. to a difference in the timing of the MR images following trauma.

The determination of cervical instability has long been a topic of interest. While it is easy to agree on what constitutes absolute stability or instability, the gradations between these two extremes are more difficult to categorize. Denis proposed a strategy to determine instability for thoracolumbar fractures primarily using plain radiographs and reserving CT for only selected injuries. Three structural columns were defined and patients with injury to 2 or all of the columns were considered to have an unstable condition. While the 3-column concept has been applied to the cervical region it has not been validated for this area of the spine. White and Panjabi introduced a more sophisticated approach to cervical instability. They defined the anterior structures as the posterior longitudinal ligament and everything anterior to it. The components dorsal to this ligament were labeled posterior structures. These investigators concluded from a carefully performed series of experiments that if all of the ligamentous structures of one group were lost plus one additional supporting structure, then instability occurred. From this foundation these spine biomechanical pioneers proposed a means of determining clinical instability that was radically different because it included neurological status, the presence or absence of stenosis, and the activity level of the individual. The importance of ligamentous loss and neurological status continue to be emphasized in the more recently formulated Subaxial Cervical Injury Classification System (SLICS).

Panczykowski et al. chose to reassess the data with the publications comprising this meta-analysis and decide whether injuries missed by CT and detected by MR imaging were stable or not. The data provided in the original works are insufficient to make such judgments. Although the authors state that the criteria of White and Panjabi were used to make these determinations, none of the papers cited in their meta-analysis provide any information regarding the exact structures that were injured, clinical examination, canal stenosis, and others. It also appears that the authors consider the lack of need for surgery as synonymous with stability. This is not always true and immobilization is an important treatment modality. For example, most spine surgeons would consider a hangman’s fracture as an unstable injury, yet many of these patients can be managed successfully with a rigid cervical orthosis.

A final concern about the adequacy of the studies performed to date relates to patient follow-up, which is almost universally restricted to the acute hospitalization in the papers of this meta-analysis. Certainly the number of patients who present in a delayed fashion with a missed injury is small but it is not zero. Over the past 20 years the senior author of this editorial (V.C.T) has cared for 2 such patients and these individuals may not choose to return to the original treating institution.

Two important works have been published since the authors submitted their manuscript. Menaker et al. evaluated...