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Cervical spine injury: A review

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Abstract

The aim of this review is to re-examine the role of cervical spine imaging in the context of new guidelines and technical advances in imaging techniques. MRI and multislice CT technology have made rapid advances. The rapid primary clinical survey should be followed by lateral cervical spine, chest and pelvic radiographs. If a patient is unconscious then CT of the brain and at least down to C3 is very useful. The cranio-cervical scans should be a maximum of 2 mm thickness, and probably less, as undisplaced type II peg fractures, can be invisible even on 1 mm slices with reconstructions. If the lateral cervical radiograph and the CT scan are negative, then MRI is the investigation of choice to exclude instability. Patients with focal neurological deficit, sign of cord or disc injury, and patients whose surgery require pre-operative cord assessment should be imaged by MRI. It is also the investigation of choice for evaluating the complications and late sequela of trauma. If the patient is to have an MRI scan, do a sagittal STIR sequence of the entire vertebral column to exclude non-contiguous injuries, which, since the advent of MRI. Any areas of oedema or collapse then require detailed CT scanning. The aim of this review is to re-examine the role of cervical spine imaging in the context of new guidelines and technical advances in imaging techniques.

Keywords: Cervical spine, vertebral, neurological deficit

Introduction

Correlation with Severity score

The injury severity score (ISS)12 is for assessing the multiply injured, modified from the abbreviated injury scale which has been validated to correlate with mortality, severe disability and length of hospital stay. An ISS over 25 is associated with an increased risk of permanent impairment, and people do not usually survive with an ISS of more than 50. An ISS of 20 or more is fatal in 50% of those aged 65 or over, while 1% of all multiple injury patients die with an ISS of 14 or less.

Anatomical distribution of injury

According to NEXUS study the typical distribution of fractures (C2 23.9%, C6 20.25%, C7 19.08%, C5 14.98%) and dislocations or subluxations (C5/6 25.11%, C6/7 23.77%, C4/5 16.96%). However, half of the cranio-cervical injuries may not be suspected clinically. so identification requires a high index of suspicion and little reliance on an apparent lack of symptoms or signs. In unconscious patients there are chances of occipital condyl fracture. In order to make a reliable diagnosis of an occipital condyle fracture, it is necessary to perform high resolution, thin section (1 or 2 mm) CTscan (or multislice CT scan) of the base of the skull, with both orthogonal reconstructions. The diagnosis and classification of occipital condyle fractures guides treatment for instability and may explain persistent symptoms.

In the elderly, domestic falls are the commonest cause of cervical injury, where two-thirds of cervical fractures in this age group involve the occipital condyles or the upper three vertebrae. Such injuries are commonly associated with spondylosis or osteoporosis, which complicate the interpretation plain films and contribute to delayed diagnosis in 15—40%. In the over 60s devastating cord injury may occur without fractures or dislocations, spinal cord injury without obvious radiological abnormality, or SCIWORA is relatively common.

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The relevance of mechanism of injury

It is intuitive that the mechanism of injury influences the risk of cervical spine trauma, but there is insufficient documented evidence to rigidly stratify risk accordingly. While the mechanism may raise the level of suspicion, it rarely allows spinal injury to be excluded. This means that one cannot predict spinal injury on the basis of other injuries or vice versa. Each patient needs full evaluation of the whole spine. It must be remembered that cervical spine trauma is associated with upper rib fractures, pneumothoraces and damage to the great vessels and/or trachea, which need active exclusion in cases with a spinal injury. A mechanism involving high-energy transfer merely reinforces the need to investigate thoroughly. Several authors have determined mechanisms of injury and clinical parameters which allow patients to be divided into high or low risk, with imaging reserved for the former. If the circumstances of the injury are unclear, it is wise to err on the side of caution and investigate carefully, particularly in blunt trauma. High velocity bullets that miss but pass close to the spinal column may cause spinal injury as a result of the associated shock wave. On the other hand, gunshot wounds to the head rarely have any associated spinal injury and it is not necessary to take spinal precautions if there is no evidence of bullets passing close to the spinal column or of a separate blunt mechanism of injury. High-speed Motor Vehicles collision and falls from a height are associated with a high risk of spinal injury. Patients with clinically significant head injuries are at increased risk of cervical spine injury. The incidence of cervical spine injuries is inversely related to the GCS however there is no direct association between the severity of head injury and the incidence and nature of cervical spine occipital condyle injury.

Clinical Examination in Cervical spine Injury

It is generally advisable to immobilise the spine in significant blunt trauma cases.

A history and clinical examination can rule out significant injury. In an alert patient without neurological features, clinical examination should be done if the radiographs are normal, this time including active movements. If pain or tenderness is still a problem, flexion-extension radiographs should be considered, but may cause false negatives in neck muscle spasm. If the patient has an altered level of consciousness or has received sedative drugs, including opioids, the clinical examination may be unreliable. Distracting pain from a separate injury may cause the patient to disregard symptoms from unstable neck injury. Local pain, tenderness and neurological symptoms or signs must be assumed to indicate a potentially unstable injury. It is essential to image the spine before moving the neck

However, clinical examination remains an important part of the assessment and should not be omitted simply because radiographs are indicated.

The role of CT scanning

Patients with clinically significant head injuries are at increased risk of cervical spine injury. In a prospective study of blunt trauma patients requiring intubation and ventilation, spiral CT of the cervicodorsal junction detected fractures in 10%, which were occult on lateral and both oblique plain radiographs. Thirty four percent of ICU blunt trauma admissions, who could not be evaluated clinically, had cervical fractures on CT. In unconscious patients at the time of the initial brain CT, cranio-cervical junction CT should be

performed with sagittal and coronal reconstructions as a minimum, assuming that the AP and lateral whole cervical spine are adequate and normal. The technique must be precise with 1—3 mm axial slices. Multislice CT allows axial reconstructions at 1 mm or submillimetre widths, which allows one to diagnose small cortical breaks invisible even on 2 mm slices. It must be remembered that CT will miss up to 10% of fractures especially if in the plane of the axial CT slice, if both reconstructions are omitted typically at the peg. Axial fractures are missed, when slices are over 3 mm thick, usually at the dens, or between C6 and D1. Thin-section spiral CT is the optimal means imaging fractures, particularly where plain radiography is poor, at the cranio-cervical and cervico-dorsal junction.

MRI

MRI is unequivocally the modality of choice for evaluation of patients with neurological signs or symptoms. To assess soft tissue injury of the cord, disc and ligaments. MRI gives excellent soft tissue and cord detail, showing cord compression from haematoma and disc prolapses, often allowing the cause of focal neurology to be analysed. To assess soft tissue injury without MRI the extent of disc and ligamentous injury are underestimated. Cord injury is more likely with spondylosis and canal stenosis where acute central cord injury is particularly associated with a poor prognosis. Although cord injuries are associated with acute cervical fractures there may be no relationship between the extent of bone and soft tissue injury. In children the relatively large size of the head and inherent skeletal mobility, leaves the cord particularly vulnerable to damage seen on MRI with normal radiography, called significant cord injury without obvious radiological abnormality or SCIWORA. Hyperextension injuries may be unstable because of ligamentous or acute disc ruptures. Even if no specific intervention is indicated on the basis of the scans, the prognosis is often clarified, as acute cord haematoma at presentation is predictive of a complete lesion and has a poor outcome. MRI may be beneficial in hyperextension injuries, due to direct craniofacial trauma or whiplash, where the plain radiography abnormalities may be less useful. MRI may show vertebral artery trauma, associated with facet or foramina transversaria fractures. MRI allows accurate pre-operative cord assessment, surgical planning unstable cervical spine injuries and prevents iatrogenic worsening of the neurological defect. MRI can evaluate complications and late symptoms after trauma such as cord atrophy, myelomalacia, or post-traumatic syrinx formation.

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