Traumatic brain injury diagnosis

The goals of traumatic brain injury imaging include:

(1) detecting injuries that may require immediate surgical or procedural intervention

(2) detecting injuries that may benefit from early medical therapy or vigilant neurologic supervision

(3) determining the prognosis of patients to tailor rehabilitative therapy or help with family counseling and discharge planning [1].

Missed or delayed detection of progressive neuronal damage and secondary brain damage after intracranial injuries may have a negative impact on the outcome of patients with traumatic brain injury (TBI) [2].

Although CT, MRI, and TCD were determined to be the most useful modalities in the clinical setting, no single imaging modality proved sufficient for all patients due to the heterogeneity of TBI. All imaging modalities demonstrated the potential to emerge as part of future clinical care [3].

Despite the obvious advantages of MRI in terms of delineating the extent and severity of brain injury, the MRI suite is not immediately accessible, and CT remains the modality of choice in the acute phase.

Due to its sensitivity to venous blood SWI is commonly used in traumatic brain injury (TBI)

Spine films

1. cervical spine radiography: must be cleared radiographically from the cranio-cervical junction down through and including the C7-T1 junction. Spinal injury precautions (cervical collar…) are continued until the C-spine is cleared.

2. thoracic spine radiography and lumbosacral spine radiography should be obtained based on physical findings and on mechanism of injury.

Skull radiography

see Skull radiography for head trauma.

CT

see Head computed tomography for traumatic brain injury.

MRI

Usually not appropriate for acute head injuries. This is due to longer acquisition time, less access to patient during study, increased difficulty in supporting patient (requires special non-magnetic ventilators, cannot use most IV pumps...) and MRI is less sensitive than CT for detecting acute blood [4]. There were no surgical lesions demonstrated on MRI that were not evident on CT in one study [5]. There may be some additional benefit in combining CT with an MRI performed directly in the emergency department [6]. MRI may be helpful later after the patient is stabilized, e.g. to evaluate brainstem injuries, small white matter changes, [7] e.g. punctate hemorrhages in the corpus callosum seen in di use axonal injury

Spinal MRI is indicated in patients with spinal cord injuries. Rapid sequence MRI may be useful for follow-up in pediatrics to minimize radiation exposure.

CT imaging is limited by beam hardening effects, which can partially obscure the posterior fossa, temporal and frontal regions, and partial volume errors. The latter occur when a region of injured tissue has one or more dimensions that are smaller than the resolution of the acquired data [8]. This can mean that haemorrhage or other evidence of intracranial pathology may remain undetected. Such issues are of particular concern within the brain stem and spinal cord, where a small area of pathology can result in devastating injury, and in many patients who exhibit evidence of diffuse axonal injury (DAI) after trauma. DAI is a frequent finding after TBI, accounting for up to 50% of trauma patients [9]. The regions of the brain that are commonly injured include the grey–white matter interface, corpus callosum and deep white matter, periventricular and hippocampal areas, and brainstem [10]. Such regions are best visualized using MRI [11].

Gradient echo MRI

Gradient echo MRI is sensitive to changes in magnetic susceptibility which results in lesions of low intensity after haemorrhage within the brain due to local magnetic field inhomogeneities caused by the paramagnetic properties of haemosiderin. By employing a variety of different MR sequences, the extent of brain injury can be demonstrated with high resolution across the brain.

Micro-hemorrhages are a common result of traumatic brain injury (TBI), which can be quantified with susceptibility weighted imaging and mapping (SWIM), a quantitative susceptibility mapping approach.

Arteriogram in trauma

Cerebral arteriogram: useful with non missile penetrating trauma.

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